

INSTYTUT GEODEZJI I KARTOGRAFII



# ROCZNIK ASTRONOMICZNY

NA ROK

# 2015



INSTYTUT GEODEZJI I KARTOGRAFII

# ROCZNIK ASTRONOMICZNY

NA ROK 2015

LXX



WARSZAWA 2014

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JOHANNIS HEVELII, URANOGRAPHIA, TOTUM COELUM STELLATUM, 1690

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Wydanie w wersji elektronicznej przygotowane w CGiG IGiK

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# SKRÓTY STOSOWANE W ROCZNIKU

|       |   |                                                                                                                                                         |
|-------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| BG    | — | Borowa Góra                                                                                                                                             |
| BIH   | — | Bureau International de l'Heure (Międzynarodowe Biuro Czasu)                                                                                            |
| BIPM  | — | Bureau International des Poids et Mesures (Międzynarodowe Biuro Wag i Miar)                                                                             |
| BCRS  | — | Barycentric Celestial Reference System (Barycentryczny Niebieski System Odniesienia)                                                                    |
| CEO   | — | Celestial Ephemeris Origin (Niebieski Efemerydalny Punkt Początkowy)                                                                                    |
| CEP   | — | Celestial Ephemeris Pole (Efemerydalny Biegun Niebieski)                                                                                                |
| CIO   | — | Celestial Intermediate Origin (Niebieski Pośredni Punkt Początkowy)                                                                                     |
| CIO*  | — | Conventional International Origin (międzynarodowy umowny średni biegun północny Ziemi)                                                                  |
| CIP   | — | Celestial Intermediate Pole (Pośredni Biegun Niebieski)                                                                                                 |
| CRP   | — | Conventional Reference Pole (Konwencjonalny Biegun Odniesienia)                                                                                         |
| CSE   | — | czas środkowoeuropejski (str. 179)                                                                                                                      |
| CTRS  | — | Conventional Terrestrial Reference System (Konwencjonalny Ziemi System Odniesienia)                                                                     |
| DORIS | — | Doppler Orbit Determination and Radio Positioning Integrated on Satellite (francuski globalny system nawigacyjny dla obiektów naziemnych i kosmicznych) |
| DUT1  | — | różnica czasów <i>UT1</i> i <i>UTC</i>                                                                                                                  |
| EOP   | — | Earth Orientation Parameters (parametry ruchu obrotowego Ziemi)                                                                                         |
| ERA   | — | Earth Rotation Angle (Kąt Obrótu Ziemi) (str. 169)                                                                                                      |
| ET    | — | Czas Efemeryd (str. 180)                                                                                                                                |
| FK4   | — | czwarty fundamentalny katalog gwiazd                                                                                                                    |
| FK5   | — | piąty fundamentalny katalog gwiazd                                                                                                                      |
| FK6   | — | szósty fundamentalny katalog gwiazd                                                                                                                     |
| GCRS  | — | Geocentric Celestial Reference System (Geocentryczny Niebieski System Odniesienia)                                                                      |
| GMT   | — | czas słoneczny średni Greenwich (str. 176)                                                                                                              |
| GMST  | — | średni czas gwiazdowy Greenwich (str. 177)                                                                                                              |
| GPS   | — | Global Positioning System (Globalny System Nawigacyjny)                                                                                                 |
| GPST  | — | GPS Time (czas GPS)                                                                                                                                     |
| GRS   | — | Geodetic Reference System (Geodezyjny System Odniesienia)                                                                                               |
| GSD   | — | patrz <i>JSD</i>                                                                                                                                        |
| GST   | — | prawdziwy czas gwiazdowy Greenwich (str. 177)                                                                                                           |
| GTRS  | — | Geocentric Terrestrial Reference System (Geocentryczny Ziemi System Odniesienia)                                                                        |
| IAU   | — | International Astronomical Union (Międzynarodowa Unia Astronomiczna)                                                                                    |
| ICRS  | — | International Celestial Reference System (Międzynarodowy Niebieski System Odniesienia)                                                                  |
| IERS  | — | International Earth Rotation and Reference Systems Service (Międzynarodowa Służba Ruchu Obrotowego Ziemi i Systemów Odniesienia)                        |
| ILS   | — | International Latitude Service (Międzynarodowa Służba Szerokości)                                                                                       |
| IPMS  | — | International Polar Motion Service (Międzynarodowa Służba Ruchu Bieguna)                                                                                |
| IRM   | — | IERS Reference Meridian (południk zerowy IERS)                                                                                                          |
| IRP   | — | IERS Reference Pole (biegun odniesienia IERS)                                                                                                           |
| IRS   | — | Intermediate Reference System (Pośredni System Odniesienia)                                                                                             |
| ITRS  | — | International Terrestrial Reference System (Międzynarodowy Ziemi System Odniesienia)                                                                    |
| IUGG  | — | International Union of Geodesy and Geophysics (Międzynarodowa Unia Geodezji i Geofizyki)                                                                |
| JD    | — | data juliańska odniesiona do czasu ziemskiego ( <i>TT</i> ) (str. 182)                                                                                  |
| JED   | — | data juliańska odniesiona do skali Czasu Efemeryd (str. 182)                                                                                            |
| JPL   | — | Jet Propulsion Laboratory                                                                                                                               |
| JSD   | — | juliańska data gwiazdowa (str. 182)                                                                                                                     |
| LLR   | — | Lunar Laser Ranging (laserowe pomiary odległości do Księżyca)                                                                                           |
| MJD   | — | zmodyfikowana data juliańska (str. 182)                                                                                                                 |
| NRO   | — | Non-Rotating Origin (Nieobracający się Punkt Początkowy)                                                                                                |
| RA    | — | Rocznik Astronomiczny IGIK                                                                                                                              |
| SAO   | — | Smithsonian Astrophysical Observatory                                                                                                                   |
| SDT   | — | Dynamiczny Czas Gwiazdowy (str. 178)                                                                                                                    |
| SI    | — | Système International d'Unités (międzynarodowy system jednostek)                                                                                        |
| SLR   | — | Satellite Laser Ranging (laserowe pomiary odległości do sztucznych satelitów Ziemi)                                                                     |
| TAI   | — | Międzynarodowy Czas Atomowy (str. 173)                                                                                                                  |
| TCB   | — | czas współrzędnych barycentrycznych (str. 175)                                                                                                          |
| TCG   | — | czas współrzędnych geocentrycznych (str. 174)                                                                                                           |
| TDB   | — | Barycentryczny Czas Dynamiczny (str. 175)                                                                                                               |
| TDI   | — | Ziemi Czas Dynamiczny (str. 181)                                                                                                                        |
| TEO   | — | Terrestrial Ephemeris Origin (Ziemi Efemerydalny Punkt Początkowy)                                                                                      |
| TIO   | — | Terrestrial Intermediate Origin (Ziemi Pośredni Punkt Początkowy)                                                                                       |
| TT    | — | Czas Ziemi (str. 174)                                                                                                                                   |
| USNO  | — | US Naval Observatory                                                                                                                                    |
| UT    | — | czas uniwersalny (str. str. 176, 180)                                                                                                                   |
| UT0   | — | czas uniwersalny prawdziwy (str. 180)                                                                                                                   |
| UT1   | — | czas uniwersalny średni (str. str. 176, 180)                                                                                                            |
| UT2   | — | czas uniwersalny quasi-jednostajny (str. 180)                                                                                                           |
| UTC   | — | Czas Uniwersalny Koordynowany (str. 178)                                                                                                                |
| VLBI  | — | Very Long Baseline Interferometry (interferometria długich baz)                                                                                         |
| WGS   | — | World Geodetic System (Światowy System Geodezyjny)                                                                                                      |
| ZT    | — | czas strefowy (str. 179)                                                                                                                                |

## PRZEDMOWA

Niniejszy, LXX tom Rocznika Astronomicznego jest kontynuacją serii roczników astronomicznych opracowywanych i wydawanych nakładem Instytutu Geodezji i Kartografii w Warszawie od 1946 roku. Został on opracowany w ramach realizacji zadań statutowych Centrum Geodezji i Geodynamiki IGIK. Zespół autorski LXX tomu Rocznika Astronomicznego stanowią: Jan Kryński i Marcin Sękowski.

Podobnie jak w latach 2002–2014 Rocznik Astronomiczny na rok 2015 obok wersji drukowanej został opracowany także w formie elektronicznej, w formacie *pdf*. Począwszy od bieżącego wydania obie wersje są jednak różne. Wersja elektroniczna pozostała w swojej strukturze niezmieniona natomiast wersja drukowana Rocznika została istotnie skrócona w stosunku do wydań z poprzednich lat; ze względów edytorskich zmieniono w niej również układ tablic. Obie wersje Rocznika uzupełnia ponadto nowa forma prezentacji danych, jaką jest **Rocznik Astronomiczny „on-line”**.

Wprowadzone zmiany mają swe źródło, przede wszystkim, w dążeniu do zapewnienia największej możliwej spójności pomiędzy dokładnościami danych zawartych w Roczniku a ich możliwym do osiągnięcia poziomem, wynikającym z dokładności danych źródłowych oraz stosowanych współcześnie modeli obliczeniowych. Dotyczy to przede wszystkim pozycji pozornych gwiazd w Niebieskim Systemie Pośrednim (*IRS*) obliczanych przy wykorzystaniu tablic miejsc pozornych gwiazd w tym systemie. Dokładność wartości interpolowanych wewnątrz przedziału danych podawanych w tablicach przy przyjętym dla większości gwiazd 7-dniowym kroku tablicowania pozostawała na poziomie znacząco niższym od wartości możliwych do osiągnięcia na drodze bezpośrednich obliczeń na zadany moment. Naturalnym rozwiązaniem tego problemu była więc rezygnacja z dotychczasowego sposobu tabelarycznej prezentacji części danych w wersji drukowanej Rocznika i przeniesienie ich do Internetu — Rocznika Astronomicznego „on-line”.

W wersji drukowanej Rocznika usunięto tablice miejsc pozornych gwiazd w systemie *IRS*, tablice miejsc pozornych gwiazd okołobiegunowych w systemie *IRS*, tablice pozycji gwiazd w systemie *ICRS* oraz tablice barycentrycznych i heliocentrycznych pozycji Ziemi. Zastąpił je **kalkulator pozycji pozornej gwiazd** zapewniający możliwość bezpośredniego obliczenia pozycji pozornej wybranej gwiazdy na dowolny zadany moment.

Zarówno wersja elektroniczna Rocznika (*pdf*), jak i Rocznik Astronomiczny „on-line” (kalkulator pozycji pozornej) są dostępne na stronach internetowych Centrum Geodezji i Geodynamiki IGIK (<http://www.igik.edu.pl>).

W kolejnych wydaniach Roczników, począwszy od wydania na 2004 rok, uwzględniono zmiany definicji niebieskich systemów odniesienia, transformacji między tymi systemami oraz systemów czasu, dostosowujące je do precyzji współczesnych technik obserwacyjnych (poniżej mikrosekundy łuku). Zmiany te, przyjęte przez Międzynarodową Unię Astronomiczną (IAU) w 2000 r. oraz przez Międzynarodową Unię Geodezji i Geofizyki (IUGG) w 2003 r. obowiązują od 1 stycznia 2003 roku. Stosując się do zaleceń IAU i IUGG wprowadzono również dalsze zmiany wynikające z rezolucji kolejnych Zgromadzeń Generalnych IAU (Praga, 2006; Rio de Janeiro, 2009) i IUGG (Perugia, 2007).

Zawarte w tablicach Rocznika na 2015 rok pozycje Słońca i Księżyca oraz pozycje gwiazd są wyrażone, zgodnie z zaleceniami IAU, zarówno w nowym Niebieskim Pośrednim Systemie Odniesienia o początku *CIO*, jak i w ujęciu „klasycznym” związanym z punktem równonocy wiosennej.

W pracach nad Rocznikiem Astronomicznym na 2015 rok korzystano z materiałów z kolejnych Zgromadzeń Generalnych IAU i IUGG, zbiorów opracowań: IERS Technical Note 29 (zawierającą publikacje z Workshopu IERS „Implementation of the New IAU Resolutions”), który się odbył w kwietniu 2002 roku w Paryżu, „IERS Conventions 1996”, „IERS Conventions 2003”, opracowań Grup Roboczych Oddziału Astronomii Fundamentalnej IAU i szeregu publikacji, zaczerpniętych głównie z *Astronomy & Astrophysics*, a także z materiałów Workshopu Sekcji Dynamiki Ziemi Komitetu Geodezji PAN w Warszawie w maju 2004 roku.

Zawartość większości tablic w Roczniku stanowi wynik obliczeń wykonanych w Centrum Geodezji i Geodynamiki IGIK przy użyciu programów własnych, w których zostały wykorzystane procedury udostępnione przez IERS i SOFA — wszystkich opracowanych przez Marcina Sękowskiego. Do sporządzenia efemeryd Słońca, Księżyca i planet Układu Słonecznego posłużyły dane efemerydalne DE405/LE405.

Dane liczbowe dotyczące zaćmień Słońca i Księżyca zostały zaczerpnięte ze stron „NASA Eclipse Web Site”. Współrzędne bieguna północnego Ziemi *CIP* oraz różnice *UT1 – UTC* zaczerpnięto z wydawnictw Centralnego Biura Międzynarodowej Służby Ruchu Obrotowego Ziemi (IERS) w Paryżu. Program do interpolacji izogon deklinacji magnetycznej oraz mapę tych deklinacji na rok 2015 sporządziła Elżbieta Welker. Informacje o radiowych sygnałach czasu oparte są na corocznie uaktualnianych danych dostarczanych przez Bureau International des Poids et Mesures w Sèvres. W bieżącym wydaniu Rocznika zaktualizowano listę stacji nadawczych, ograniczając ją jednocześnie do stacji nadających sygnały w trybie całodobowym. Programy używane do tablicowania danych i formatowania Rocznika oraz skład całości Rocznika w systemie  $\text{\TeX}$ , zarówno drukowanej wersji książkowej, jak

i elektronicznej *pdf* zostały wykonane przez Marcina Sękowskiego. Obliczenia kontrolne przykładów numerycznych zamieszczonych w części szczegółowej Rocznika wykonali Helena Bieniewska, Anna Jędrzejewska, Maciej Moskwiński, Marcin Sękowski i Łukasz Żak.

Definicje i wielkości stałych astronomicznych użyte w Roczniku odnoszą się do systemu IAU2009. Zostały one zaczerpnięte ze strony (<http://maia.usno.navy.mil/NSFA/CBE.html>). Dołączono również uzupełniającą listę stałych i wielkości pomocniczych — niektóre odniesione do poprzednio obowiązujących systemów. Mogą one być stosowane w obliczeniach nie wymagających najwyższych dokładności.

Algorytmy i programy opracowane do obliczania podanych w niniejszym Roczniku pozycji ciał niebieskich, wyrażonych w nowych systemach odniesienia, były poddane skrupulatnej kontroli wewnętrznej i weryfikacji. Ich poprawność została także potwierdzona zgodnością publikowanych danych z danymi zawartymi w innych wydawnictwach rocznikowych, w których w ostatnim okresie zostały wdrożone zalecenia IAU (Apparent Places of Fundamental Stars, Astronomisches Rechen-Institut, Heidelberg; Astronomičeskij Jeżegodnik, Institut Prikladnoj Astronomii RAN, St. Petersburg; The Astronomical Almanac, Waszyngton/Londyn).

Jan Kryński  
Redaktor naukowy Rocznika Astronomicznego

# ROK 2015

## DNI ŚWIĄTECZNE

|                   |              |    |          |                         |           |    |           |
|-------------------|--------------|----|----------|-------------------------|-----------|----|-----------|
| Nowy Rok          | czwartek     | 1  | stycznia | Boże Ciało              | czwartek  | 4  | czerwca   |
| Trzech Króli      | wtorek       | 6  | stycznia | Wniebowzięcie NMP       | sobota    | 15 | sierpnia  |
| Wielkanoc         | niedziela    | 5  | kwietnia | Wszystkich Świętych     | niedziela | 1  | listopada |
| Pon. Wielk.       | poniedziałek | 6  | kwietnia | Nar. Św. Niepodległości | środa     | 11 | listopada |
| Święto Pracy      | piątek       | 1  | maja     | Boże Narodzenie         | piątek    | 25 | grudnia   |
| Św. Narod. 3 Maja | niedziela    | 3  | maja     | Świętego Szczepana      | sobota    | 26 | grudnia   |
| Zielone Świątki   | niedziela    | 24 | maja     |                         |           |    |           |

## PORY ROKU

|                                                                 |    |          |                                                |    |
|-----------------------------------------------------------------|----|----------|------------------------------------------------|----|
| Słońce wstępuje w znak Barana, początek wiosny astronomicznej   | 20 | marca    | 22 <sup>h</sup> 45 <sup>m</sup> 2 <sup>s</sup> | UT |
| Słońce wstępuje w znak Raka, początek lata astronomicznego      | 21 | czerwca  | 16 37.9                                        | „  |
| Słońce wstępuje w znak Wagi, początek jesieni astronomicznej    | 23 | września | 8 20.6                                         | „  |
| Słońce wstępuje w znak Koziorożca, początek zimy astronomicznej | 22 | grudnia  | 4 48.0                                         | „  |
| Ziemia w perihelium                                             | 4  | stycznia | 6 <sup>h</sup> 6 <sup>m</sup>                  | „  |
| Ziemia w aphelium                                               | 6  | lipca    | 19.7                                           | „  |

## STAŁE PRECESYJNE(2015.5)

## IAU1976

## IAU2006

|                                         |               |                                                 |                                                 |
|-----------------------------------------|---------------|-------------------------------------------------|-------------------------------------------------|
| Roczna precesja w długości              | $p$           | 50 <sup>h</sup> 29 <sup>m</sup> 44 <sup>s</sup> | 50 <sup>h</sup> 29 <sup>m</sup> 14 <sup>s</sup> |
| Roczna precesja równika                 | $p_1$         | 50.3885                                         | 50.3815                                         |
| Roczna precesja ekliptyki               | $p_2$         | 0.1026                                          | 0.0982                                          |
| Roczna precesja w rektascensji          | $m$           | 46.1287 = 3 <sup>s</sup> .07525                 | 46.1259 = 3 <sup>s</sup> .07506                 |
| Roczna precesja w deklinacji            | $n$           | 20.0418 = 1.33612                               | 20.0406 = 1.33604                               |
| Średnie nachylenie ekliptyki do równika | $\varepsilon$ | 23°26'14 <sup>h</sup> .19                       | 23°26'14 <sup>h</sup> .15                       |

## Współrzędne geograficzne Obserwatoriów w Polsce

| Miejscowość | Nazwa                              | Punkt                   | $\varphi$              | $\lambda$                                       |
|-------------|------------------------------------|-------------------------|------------------------|-------------------------------------------------|
| Belsk       | Centralne Obs. Geofizyczne IGF PAN |                         | +51°50'12 <sup>h</sup> | +1 <sup>h</sup> 23 <sup>m</sup> 10 <sup>s</sup> |
| Białków     | Filia Obserw. Inst. Astr. UW.      | słup pawil. wyższego    | +51 28 32              | +1 06 38.38                                     |
| Borowa Góra | Obserw. Geod.-Geofiz. IGK          | instr. przejściowy      | +52 28 34              | +1 24 08.914                                    |
| Borowiec    | Astrogeodyn. Obserw. CBK PAN       | dawny instr. przejśc. I | +52 16 38              | +1 08 18.437                                    |
| Chorzów     | Obserwatorium Astronomiczne        | refraktor               | +50 17 31.8            | +1 15 58.52                                     |
| Fort Skala  | Filia Obserw. Astr. UJ             | radioteleskop           | +50 03 15              | +1 19 18.5                                      |
| Grybów      | Filia Obserw. Astr.-Geod. PW       | słup centralny          | +49 37 48.5            | +1 23 48.28                                     |
| Hel         | Obserw. Geofizyczne IGF PAN        |                         | +54 36 24              | +1 15 17.2                                      |
| Józefosław  | Obserw. Astr.-Geod. PW             | instr. przejściowy      | +52 05 54              | +1 24 08.600                                    |
| Kraków      | Obserwatorium Astronomiczne UJ     | koło południkowe        | +50 03 51.9            | +1 19 50.28                                     |
| Książ       | Dolnośl. Obs. Geofizyczne IGF PAN  | stan. wahadeł pływ.     | +50 50 41              | +1 05 11                                        |
| Lankówko    | Obserwatorium Satelitarne UWM      | słup stacji perm. GPS   | +53 53 32.631          | +1 22 40.785                                    |
| Ostrowik    | Filia Obserw. Astr. UW             | refraktor               | +52 05 23              | +1 25 40.8                                      |
| Piwnice     | Obserwatorium Astronomiczne UMK    | słup centralny          | +53 05 48              | +1 14 13.1                                      |
| Poznań      | Obserwatorium Astronomiczne UAM    | dawny instr. przejśc.   | +52 23 53.0            | +1 07 30.99                                     |
| Suhora      | Obserw. Astr. UP w Krakowie        |                         | +49 34 09              | +1 20 16.2                                      |
| Świder      | Obserw. Geofizyczne IGF PAN        |                         | +52 06.9               | +1 25 01                                        |
| Warszawa    | Obserwatorium Astronomiczne PW     | słup centralny          | +52 13 21.0            | +1 24 02.36                                     |
| Warszawa    | Obserwatorium Astronomiczne UW     | dawne koło połudn.      | +52 13 04.6            | +1 24 07.25                                     |
| Warszawa    | Stacja Pływowa CBK PAN             | słup grawimetryczny     | +52 12 52              | +1 20 17                                        |
| Wrocław     | Obserw. Inst. Astr. UW.            | instr. przejściowy      | +51 06 42.1            | +1 08 21.22                                     |



# CZAS GWIAZDOWY GREENWICH I KĄT OBROTU ZIEMI 2015

| Data    |    | 0 <sup>h</sup> UT1                                   |                               |                       |                                                      | Data     |    | 0 <sup>h</sup> UT1                                   |                               |                       |                                                      |
|---------|----|------------------------------------------------------|-------------------------------|-----------------------|------------------------------------------------------|----------|----|------------------------------------------------------|-------------------------------|-----------------------|------------------------------------------------------|
|         |    | GMST                                                 | Eq                            | GST                   | $\theta$                                             |          |    | GMST                                                 | Eq                            | GST                   | $\theta$                                             |
| Styczeń | 0  | 6 <sup>h</sup> 37 <sup>m</sup> 22 <sup>s</sup> .5764 | 0 <sup>s</sup> .0001<br>+2957 | 22 <sup>s</sup> .8722 | 6 <sup>h</sup> 36 <sup>m</sup> 36 <sup>s</sup> .4623 | Luty     | 15 | 9 <sup>h</sup> 38 <sup>m</sup> 44 <sup>s</sup> .1234 | 0 <sup>s</sup> .0001<br>+3147 | 44 <sup>s</sup> .4381 | 9 <sup>h</sup> 37 <sup>m</sup> 57 <sup>s</sup> .6220 |
|         | 1  | 6 41 19.1318                                         | +2979                         | 19.4297               | 6 40 33.0093                                         |          | 16 | 9 42 40.6787                                         | +3190                         | 40.9977               | 9 41 54.1689                                         |
|         | 2  | 6 45 15.6872                                         | +3023                         | 15.9895               | 6 44 29.5562                                         |          | 17 | 9 46 37.2341                                         | +3220                         | 37.5561               | 9 45 50.7159                                         |
|         | 3  | 6 49 12.2425                                         | +3082                         | 12.5507               | 6 48 26.1032                                         |          | 18 | 9 50 33.7895                                         | +3223                         | 34.1118               | 9 49 47.2628                                         |
|         | 4  | 6 53 08.7979                                         | +3147                         | 09.1126               | 6 52 22.6501                                         |          | 19 | 9 54 30.3448                                         | +3193                         | 30.6641               | 9 53 43.8098                                         |
|         | 5  | 6 57 05.3533                                         | +3208                         | 05.6741               | 6 56 19.1971                                         |          | 20 | 9 58 26.9002                                         | +3133                         | 27.2135               | 9 57 40.3567                                         |
|         | 6  | 7 01 01.9086                                         | +3257                         | 02.2344               | 7 00 15.7440                                         |          | 21 | 10 02 23.4556                                        | +3056                         | 23.7611               | 10 01 36.9037                                        |
|         | 7  | 7 04 58.4640                                         | +3289                         | 58.7929               | 7 04 12.2910                                         |          | 22 | 10 06 20.0109                                        | +2980                         | 20.3089               | 10 05 33.4506                                        |
|         | 8  | 7 08 55.0194                                         | +3300                         | 55.3494               | 7 08 08.8379                                         |          | 23 | 10 10 16.5663                                        | +2920                         | 16.8583               | 10 09 29.9976                                        |
|         | 9  | 7 12 51.5747                                         | +3291                         | 51.9039               | 7 12 05.3849                                         |          | 24 | 10 14 13.1217                                        | +2885                         | 13.4101               | 10 13 26.5445                                        |
|         | 10 | 7 16 48.1301                                         | +3267                         | 48.4568               | 7 16 01.9318                                         |          | 25 | 10 18 09.6770                                        | +2873                         | 09.9643               | 10 17 23.0915                                        |
|         | 11 | 7 20 44.6855                                         | +3231                         | 45.0086               | 7 19 58.4788                                         |          | 26 | 10 22 06.2324                                        | +2879                         | 06.5203               | 10 21 19.6384                                        |
|         | 12 | 7 24 41.2409                                         | +3192                         | 41.5601               | 7 23 55.0257                                         |          | 27 | 10 26 02.7878                                        | +2894                         | 03.0772               | 10 25 16.1854                                        |
|         | 13 | 7 28 37.7962                                         | +3158                         | 38.1120               | 7 27 51.5727                                         |          | 28 | 10 29 59.3432                                        | +2909                         | 59.6341               | 10 29 12.7323                                        |
| Luty    | 14 | 7 32 34.3516                                         | +3135                         | 34.6651               | 7 31 48.1196                                         | Marzec   | 1  | 10 33 55.8985                                        | +2916                         | 56.1901               | 10 33 09.2793                                        |
|         | 15 | 7 36 30.9070                                         | +3131                         | 31.2200               | 7 35 44.6666                                         |          | 2  | 10 37 52.4539                                        | +2907                         | 52.7446               | 10 37 05.8262                                        |
|         | 16 | 7 40 27.4623                                         | +3150                         | 27.7774               | 7 39 41.2135                                         |          | 3  | 10 41 49.0093                                        | +2880                         | 49.2973               | 10 41 02.3732                                        |
|         | 17 | 7 44 24.0177                                         | +3195                         | 24.3372               | 7 43 37.7605                                         |          | 4  | 10 45 45.5646                                        | +2833                         | 45.8480               | 10 44 58.9201                                        |
|         | 18 | 7 48 20.5731                                         | +3260                         | 20.8990               | 7 47 34.3074                                         |          | 5  | 10 49 42.1200                                        | +2769                         | 42.3969               | 10 48 55.4671                                        |
|         | 19 | 7 52 17.1284                                         | +3334                         | 17.4619               | 7 51 30.8544                                         |          | 6  | 10 53 38.6754                                        | +2691                         | 38.9445               | 10 52 52.0140                                        |
|         | 20 | 7 56 13.6838                                         | +3404                         | 14.0241               | 7 55 27.4013                                         |          | 7  | 10 57 35.2307                                        | +2605                         | 35.4913               | 10 56 48.5610                                        |
|         | 21 | 8 00 10.2392                                         | +3451                         | 10.5843               | 7 59 23.9483                                         |          | 8  | 11 01 31.7861                                        | +2520                         | 32.0381               | 11 00 45.1079                                        |
|         | 22 | 8 04 06.7945                                         | +3466                         | 07.1411               | 8 03 20.4952                                         |          | 9  | 11 05 28.3415                                        | +2442                         | 28.5857               | 11 04 41.6549                                        |
|         | 23 | 8 08 03.3499                                         | +3447                         | 03.6946               | 8 07 17.0422                                         |          | 10 | 11 09 24.8968                                        | +2378                         | 25.1347               | 11 08 38.2018                                        |
|         | 24 | 8 11 59.9053                                         | +3404                         | 60.2457               | 8 11 13.5891                                         |          | 11 | 11 13 21.4522                                        | +2334                         | 21.6856               | 11 12 34.7488                                        |
|         | 25 | 8 15 56.4606                                         | +3353                         | 56.7959               | 8 15 10.1361                                         |          | 12 | 11 17 18.0076                                        | +2311                         | 18.2386               | 11 16 31.2957                                        |
|         | 26 | 8 19 53.0160                                         | +3309                         | 53.3469               | 8 19 06.6830                                         |          | 13 | 11 21 14.5629                                        | +2308                         | 14.7938               | 11 20 27.8427                                        |
|         | 27 | 8 23 49.5714                                         | +3283                         | 49.8997               | 8 23 03.2300                                         |          | 14 | 11 25 11.1183                                        | +2321                         | 11.3504               | 11 24 24.3896                                        |
|         | 28 | 8 27 46.1267                                         | +3280                         | 46.4547               | 8 26 59.7769                                         |          | 15 | 11 29 07.6737                                        | +2341                         | 07.9078               | 11 28 20.9366                                        |
|         | 29 | 8 31 42.6821                                         | +3298                         | 43.0119               | 8 30 56.3239                                         |          | 16 | 11 33 04.2290                                        | +2355                         | 04.4646               | 11 32 17.4835                                        |
|         | 30 | 8 35 39.2375                                         | +3331                         | 39.5706               | 8 34 52.8708                                         |          | 17 | 11 37 00.7844                                        | +2352                         | 01.0196               | 11 36 14.0305                                        |
|         | 31 | 8 39 35.7928                                         | +3372                         | 36.1301               | 8 38 49.4178                                         |          | 18 | 11 40 57.3398                                        | +2320                         | 57.5717               | 11 40 10.5774                                        |
|         | 1  | 8 43 32.3482                                         | +3411                         | 32.6893               | 8 42 45.9647                                         |          | 19 | 11 44 53.8951                                        | +2258                         | 54.1209               | 11 44 07.1244                                        |
|         | 2  | 8 47 28.9036                                         | +3440                         | 29.2476               | 8 46 42.5117                                         |          | 20 | 11 48 50.4505                                        | +2173                         | 50.6678               | 11 48 03.6713                                        |
|         | 3  | 8 51 25.4590                                         | +3452                         | 25.8042               | 8 50 39.0586                                         |          | 21 | 11 52 47.0059                                        | +2082                         | 47.2141               | 11 52 00.2183                                        |
|         | 4  | 8 55 22.0143                                         | +3445                         | 22.3588               | 8 54 35.6055                                         |          | 22 | 11 56 43.5613                                        | +2002                         | 43.7614               | 11 55 56.7652                                        |
|         | 5  | 8 59 18.5697                                         | +3417                         | 18.9114               | 8 58 32.1525                                         |          | 23 | 12 00 40.1166                                        | +1946                         | 40.3112               | 11 59 53.3122                                        |
|         | 6  | 9 03 15.1251                                         | +3372                         | 15.4622               | 9 02 28.6994                                         |          | 24 | 12 04 36.6720                                        | +1917                         | 36.8637               | 12 03 49.8591                                        |
|         | 7  | 9 07 11.6804                                         | +3314                         | 12.0118               | 9 06 25.2464                                         |          | 25 | 12 08 33.2274                                        | +1912                         | 33.4186               | 12 07 46.4061                                        |
|         | 8  | 9 11 08.2358                                         | +3250                         | 08.5608               | 9 10 21.7933                                         |          | 26 | 12 12 29.7827                                        | +1921                         | 29.9748               | 12 11 42.9530                                        |
|         | 9  | 9 15 04.7912                                         | +3187                         | 05.1099               | 9 14 18.3403                                         |          | 27 | 12 16 26.3381                                        | +1933                         | 26.5314               | 12 15 39.5000                                        |
|         | 10 | 9 19 01.3465                                         | +3133                         | 01.6599               | 9 18 14.8872                                         |          | 28 | 12 20 22.8935                                        | +1938                         | 23.0873               | 12 19 36.0469                                        |
|         | 11 | 9 22 57.9019                                         | +3095                         | 58.2114               | 9 22 11.4342                                         |          | 29 | 12 24 19.4488                                        | +1930                         | 19.6418               | 12 23 32.5939                                        |
|         | 12 | 9 26 54.4573                                         | +3077                         | 54.7650               | 9 26 07.9811                                         |          | 30 | 12 28 16.0042                                        | +1903                         | 16.1945               | 12 27 29.1408                                        |
|         | 13 | 9 30 51.0126                                         | +3082                         | 51.3208               | 9 30 04.5281                                         |          | 31 | 12 32 12.5596                                        | +1858                         | 12.7454               | 12 31 25.6878                                        |
|         | 14 | 9 34 47.5680                                         | +3107                         | 47.8787               | 9 34 01.0750                                         | Kwiecień | 1  | 12 36 09.1149                                        | +1795                         | 09.2944               | 12 35 22.2347                                        |
|         | 15 | 9 38 44.1234                                         | +3147                         | 44.4381               | 9 37 57.6220                                         |          | 2  | 12 40 05.6703                                        | +1718                         | 05.8421               | 12 39 18.7817                                        |

# CZAS GWIAZDOWY GREENWICH I KĄT OBROTU ZIEMI 2015

| Data     |    | 0 <sup>h</sup> UT1                                    |                 |                       |                                                       | Data     |    | 0 <sup>h</sup> UT1                                    |                 |                       |                                                       |
|----------|----|-------------------------------------------------------|-----------------|-----------------------|-------------------------------------------------------|----------|----|-------------------------------------------------------|-----------------|-----------------------|-------------------------------------------------------|
|          |    | GMST                                                  | Eq              | GST                   | $\theta$                                              |          |    | GMST                                                  | Eq              | GST                   | $\theta$                                              |
| Kwiecień | 1  | 12 <sup>h</sup> 36 <sup>m</sup> 09 <sup>s</sup> .1149 | 0°0001<br>+1795 | 09 <sup>s</sup> .2944 | 12 <sup>h</sup> 35 <sup>m</sup> 22 <sup>s</sup> .2347 | Maj      | 17 | 15 <sup>h</sup> 37 <sup>m</sup> 30 <sup>s</sup> .6619 | 0°0001<br>+ 665 | 30 <sup>s</sup> .7284 | 15 <sup>h</sup> 36 <sup>m</sup> 43 <sup>s</sup> .3944 |
|          | 2  | 12 40 05.6703                                         | +1718           | 05.8421               | 12 39 18.7817                                         |          | 18 | 15 41 27.2172                                         | + 678           | 27.2850               | 15 40 39.9413                                         |
|          | 3  | 12 44 02.2257                                         | +1633           | 02.3889               | 12 43 15.3286                                         |          | 19 | 15 45 23.7726                                         | + 716           | 23.8442               | 15 44 36.4883                                         |
|          | 4  | 12 47 58.7810                                         | +1546           | 58.9357               | 12 47 11.8755                                         |          | 20 | 15 49 20.3280                                         | + 769           | 20.4049               | 15 48 33.0352                                         |
|          | 5  | 12 51 55.3364                                         | +1466           | 55.4830               | 12 51 08.4225                                         |          | 21 | 15 53 16.8833                                         | + 825           | 16.9658               | 15 52 29.5822                                         |
|          | 6  | 12 55 51.8918                                         | +1400           | 52.0318               | 12 55 04.9694                                         |          | 22 | 15 57 13.4387                                         | + 872           | 13.5259               | 15 56 26.1291                                         |
|          | 7  | 12 59 48.4471                                         | +1353           | 48.5825               | 12 59 01.5164                                         |          | 23 | 16 01 09.9941                                         | + 902           | 10.0843               | 16 00 22.6761                                         |
|          | 8  | 13 03 45.0025                                         | +1328           | 45.1353               | 13 02 58.0633                                         |          | 24 | 16 05 06.5494                                         | + 913           | 06.6407               | 16 04 19.2230                                         |
|          | 9  | 13 07 41.5579                                         | +1324           | 41.6903               | 13 06 54.6103                                         |          | 25 | 16 09 03.1048                                         | + 902           | 03.1951               | 16 08 15.7700                                         |
|          | 10 | 13 11 38.1132                                         | +1338           | 38.2470               | 13 10 51.1572                                         |          | 26 | 16 12 59.6602                                         | + 875           | 59.7477               | 16 12 12.3169                                         |
|          | 11 | 13 15 34.6686                                         | +1359           | 34.8045               | 13 14 47.7042                                         |          | 27 | 16 16 56.2156                                         | + 836           | 56.2991               | 16 16 08.8639                                         |
|          | 12 | 13 19 31.2240                                         | +1379           | 31.3619               | 13 18 44.2511                                         |          | 28 | 16 20 52.7709                                         | + 790           | 52.8500               | 16 20 05.4108                                         |
|          | 13 | 13 23 27.7794                                         | +1385           | 27.9179               | 13 22 40.7981                                         |          | 29 | 16 24 49.3263                                         | + 747           | 49.4010               | 16 24 01.9578                                         |
|          | 14 | 13 27 24.3347                                         | +1369           | 24.4716               | 13 26 37.3450                                         |          | 30 | 16 28 45.8817                                         | + 714           | 45.9530               | 16 27 58.5047                                         |
|          | 15 | 13 31 20.8901                                         | +1325           | 21.0226               | 13 30 33.8920                                         |          | 31 | 16 32 42.4370                                         | + 697           | 42.5067               | 16 31 55.0517                                         |
|          | 16 | 13 35 17.4455                                         | +1257           | 17.5712               | 13 34 30.4389                                         | Czerwiec | 1  | 16 36 38.9924                                         | + 702           | 39.0626               | 16 35 51.5986                                         |
|          | 17 | 13 39 14.0008                                         | +1177           | 14.1186               | 13 38 26.9859                                         |          | 2  | 16 40 35.5478                                         | + 731           | 35.6208               | 16 39 48.1455                                         |
|          | 18 | 13 43 10.5562                                         | +1102           | 10.6664               | 13 42 23.5328                                         |          | 3  | 16 44 32.1031                                         | + 781           | 32.1812               | 16 43 44.6925                                         |
|          | 19 | 13 47 07.1116                                         | +1046           | 07.2161               | 13 46 20.0798                                         |          | 4  | 16 48 28.6585                                         | + 845           | 28.7430               | 16 47 41.2394                                         |
|          | 20 | 13 51 03.6669                                         | +1019           | 03.7688               | 13 50 16.6267                                         |          | 5  | 16 52 25.2139                                         | + 912           | 25.3051               | 16 51 37.7864                                         |
|          | 21 | 13 55 00.2223                                         | +1020           | 00.3243               | 13 54 13.1737                                         |          | 6  | 16 56 21.7692                                         | + 970           | 21.8662               | 16 55 34.3333                                         |
|          | 22 | 13 58 56.7777                                         | +1042           | 56.8818               | 13 58 09.7206                                         |          | 7  | 17 00 18.3246                                         | +1006           | 18.4252               | 16 59 30.8803                                         |
|          | 23 | 14 02 53.3330                                         | +1072           | 53.4403               | 14 02 06.2676                                         |          | 8  | 17 04 14.8800                                         | +1016           | 14.9816               | 17 03 27.4272                                         |
|          | 24 | 14 06 49.8884                                         | +1100           | 49.9984               | 14 06 02.8145                                         |          | 9  | 17 08 11.4353                                         | +1000           | 11.5354               | 17 07 23.9742                                         |
|          | 25 | 14 10 46.4438                                         | +1115           | 46.5553               | 14 09 59.3615                                         |          | 10 | 17 12 07.9907                                         | + 966           | 08.0873               | 17 11 20.5211                                         |
|          | 26 | 14 14 42.9991                                         | +1114           | 43.1105               | 14 13 55.9084                                         |          | 11 | 17 16 04.5461                                         | + 926           | 04.6387               | 17 15 17.0681                                         |
|          | 27 | 14 18 39.5545                                         | +1092           | 39.6637               | 14 17 52.4554                                         |          | 12 | 17 20 01.1014                                         | + 895           | 01.1910               | 17 19 13.6150                                         |
|          | 28 | 14 22 36.1099                                         | +1052           | 36.2151               | 14 21 49.0023                                         |          | 13 | 17 23 57.6568                                         | + 884           | 57.7452               | 17 23 10.1620                                         |
|          | 29 | 14 26 32.6652                                         | + 997           | 32.7650               | 14 25 45.5493                                         |          | 14 | 17 27 54.2122                                         | + 900           | 54.3022               | 17 27 06.7089                                         |
|          | 30 | 14 30 29.2206                                         | + 933           | 29.3139               | 14 29 42.0962                                         |          | 15 | 17 31 50.7676                                         | + 943           | 50.8618               | 17 31 03.2559                                         |
| Maj      | 1  | 14 34 25.7760                                         | + 865           | 25.8625               | 14 33 38.6432                                         |          | 16 | 17 35 47.3229                                         | +1004           | 47.4233               | 17 34 59.8028                                         |
|          | 2  | 14 38 22.3313                                         | + 802           | 22.4116               | 14 37 35.1901                                         |          | 17 | 17 39 43.8783                                         | +1072           | 43.9855               | 17 38 56.3498                                         |
|          | 3  | 14 42 18.8867                                         | + 752           | 18.9619               | 14 41 31.7371                                         |          | 18 | 17 43 40.4337                                         | +1137           | 40.5473               | 17 42 52.8967                                         |
|          | 4  | 14 46 15.4421                                         | + 720           | 15.5141               | 14 45 28.2840                                         |          | 19 | 17 47 36.9890                                         | +1187           | 37.1077               | 17 46 49.4437                                         |
|          | 5  | 14 50 11.9975                                         | + 711           | 12.0685               | 14 49 24.8310                                         |          | 20 | 17 51 33.5444                                         | +1217           | 33.6661               | 17 50 45.9906                                         |
|          | 6  | 14 54 08.5528                                         | + 725           | 08.6253               | 14 53 21.3779                                         |          | 21 | 17 55 30.0998                                         | +1225           | 30.2223               | 17 54 42.5376                                         |
|          | 7  | 14 58 05.1082                                         | + 757           | 05.1839               | 14 57 17.9249                                         |          | 22 | 17 59 26.6551                                         | +1214           | 26.7765               | 17 58 39.0845                                         |
|          | 8  | 15 02 01.6636                                         | + 801           | 01.7436               | 15 01 14.4718                                         |          | 23 | 18 03 23.2105                                         | +1187           | 23.3292               | 18 02 35.6315                                         |
|          | 9  | 15 05 58.2189                                         | + 844           | 58.3033               | 15 05 11.0188                                         |          | 24 | 18 07 19.7659                                         | +1152           | 19.8810               | 18 06 32.1784                                         |
|          | 10 | 15 09 54.7743                                         | + 876           | 54.8619               | 15 09 07.5657                                         |          | 25 | 18 11 16.3212                                         | +1115           | 16.4327               | 18 10 28.7254                                         |
|          | 11 | 15 13 51.3297                                         | + 887           | 51.4184               | 15 13 04.1127                                         |          | 26 | 18 15 12.8766                                         | +1084           | 12.9850               | 18 14 25.2723                                         |
|          | 12 | 15 17 47.8850                                         | + 872           | 47.9722               | 15 17 00.6596                                         |          | 27 | 18 19 09.4320                                         | +1067           | 09.5386               | 18 18 21.8193                                         |
|          | 13 | 15 21 44.4404                                         | + 833           | 44.5237               | 15 20 57.2066                                         |          | 28 | 18 23 05.9873                                         | +1068           | 06.0942               | 18 22 18.3662                                         |
|          | 14 | 15 25 40.9958                                         | + 779           | 41.0737               | 15 24 53.7535                                         |          | 29 | 18 27 02.5427                                         | +1093           | 02.6520               | 18 26 14.9132                                         |
|          | 15 | 15 29 37.5511                                         | + 724           | 37.6235               | 15 28 50.3005                                         |          | 30 | 18 30 59.0981                                         | +1140           | 59.2121               | 18 30 11.4601                                         |
|          | 16 | 15 33 34.1065                                         | + 682           | 34.1747               | 15 32 46.8474                                         | Lipiec   | 1  | 18 34 55.6534                                         | +1205           | 55.7739               | 18 34 08.0071                                         |
|          | 17 | 15 37 30.6619                                         | + 665           | 30.7284               | 15 36 43.3944                                         |          | 2  | 18 38 52.2088                                         | +1278           | 52.3366               | 18 38 04.5540                                         |

# CZAS GWIAZDOWY GREENWICH I KĄT OBROTU ZIEMI 2015

| Data     |    | $0^h UT1$                                             |       |                       |                                                       | Data        |    | $0^h UT1$                                             |       |                       |                                                       |
|----------|----|-------------------------------------------------------|-------|-----------------------|-------------------------------------------------------|-------------|----|-------------------------------------------------------|-------|-----------------------|-------------------------------------------------------|
|          |    | GMST                                                  | $Eq$  | GST                   | $\theta$                                              |             |    | GMST                                                  | $Eq$  | GST                   | $\theta$                                              |
| Lipiec   | 1  | 18 <sup>h</sup> 34 <sup>m</sup> 55 <sup>s</sup> .6534 | +1205 | 55 <sup>s</sup> .7739 | 18 <sup>h</sup> 34 <sup>m</sup> 08 <sup>s</sup> .0071 | Sierpień    | 16 | 21 <sup>h</sup> 36 <sup>m</sup> 17 <sup>s</sup> .2004 | +1338 | 17 <sup>s</sup> .3342 | 21 <sup>h</sup> 35 <sup>m</sup> 29 <sup>s</sup> .1667 |
|          | 2  | 18 38 52.2088                                         | +1278 | 52.3366               | 18 38 04.5540                                         |             | 17 | 21 40 13.7557                                         | +1274 | 13.8831               | 21 39 25.7137                                         |
|          | 3  | 18 42 48.7642                                         | +1345 | 48.8987               | 18 42 01.1010                                         |             | 18 | 21 44 10.3111                                         | +1203 | 10.4314               | 21 43 22.2606                                         |
|          | 4  | 18 46 45.3195                                         | +1394 | 45.4589               | 18 45 57.6479                                         |             | 19 | 21 48 06.8665                                         | +1132 | 06.9797               | 21 47 18.8076                                         |
|          | 5  | 18 50 41.8749                                         | +1414 | 42.0163               | 18 49 54.1949                                         |             | 20 | 21 52 03.4219                                         | +1069 | 03.5287               | 21 51 15.3545                                         |
|          | 6  | 18 54 38.4303                                         | +1405 | 38.5708               | 18 53 50.7418                                         |             | 21 | 21 55 59.9772                                         | +1019 | 60.0791               | 21 55 11.9015                                         |
|          | 7  | 18 58 34.9857                                         | +1374 | 35.1230               | 18 57 47.2888                                         |             | 22 | 21 59 56.5326                                         | + 988 | 56.6314               | 21 59 08.4484                                         |
|          | 8  | 19 02 31.5410                                         | +1332 | 31.6742               | 19 01 43.8357                                         |             | 23 | 22 03 53.0880                                         | + 977 | 53.1856               | 22 03 04.9954                                         |
|          | 9  | 19 06 28.0964                                         | +1295 | 28.2259               | 19 05 40.3827                                         |             | 24 | 22 07 49.6433                                         | + 985 | 49.7419               | 22 07 01.5423                                         |
|          | 10 | 19 10 24.6518                                         | +1274 | 24.7792               | 19 09 36.9296                                         |             | 25 | 22 11 46.1987                                         | +1009 | 46.2996               | 22 10 58.0893                                         |
|          | 11 | 19 14 21.2071                                         | +1278 | 21.3350               | 19 13 33.4766                                         |             | 26 | 22 15 42.7541                                         | +1039 | 42.8580               | 22 14 54.6362                                         |
|          | 12 | 19 18 17.7625                                         | +1307 | 17.8932               | 19 17 30.0235                                         |             | 27 | 22 19 39.3094                                         | +1063 | 39.4158               | 22 18 51.1832                                         |
|          | 13 | 19 22 14.3179                                         | +1355 | 14.4534               | 19 21 26.5705                                         |             | 28 | 22 23 35.8648                                         | +1069 | 35.9717               | 22 22 47.7301                                         |
|          | 14 | 19 26 10.8732                                         | +1414 | 11.0146               | 19 25 23.1174                                         |             | 29 | 22 27 32.4202                                         | +1046 | 32.5247               | 22 26 44.2771                                         |
|          | 15 | 19 30 07.4286                                         | +1471 | 07.5757               | 19 29 19.6644                                         |             | 30 | 22 31 28.9755                                         | + 992 | 29.0747               | 22 30 40.8240                                         |
|          | 16 | 19 34 03.9840                                         | +1518 | 04.1358               | 19 33 16.2113                                         | Wrzesień    | 31 | 22 35 25.5309                                         | + 915 | 25.6224               | 22 34 37.3710                                         |
|          | 17 | 19 38 00.5393                                         | +1546 | 00.6940               | 19 37 12.7583                                         |             | 1  | 22 39 22.0863                                         | + 832 | 22.1694               | 22 38 33.9179                                         |
|          | 18 | 19 41 57.0947                                         | +1553 | 57.2500               | 19 41 09.3052                                         |             | 2  | 22 43 18.6416                                         | + 759 | 18.7175               | 22 42 30.4649                                         |
|          | 19 | 19 45 53.6501                                         | +1538 | 53.8039               | 19 45 05.8522                                         |             | 3  | 22 47 15.1970                                         | + 708 | 15.2679               | 22 46 27.0118                                         |
|          | 20 | 19 49 50.2054                                         | +1506 | 50.3560               | 19 49 02.3991                                         |             | 4  | 22 51 11.7524                                         | + 685 | 11.8209               | 22 50 23.5588                                         |
|          | 21 | 19 53 46.7608                                         | +1461 | 46.9069               | 19 52 58.9461                                         |             | 5  | 22 55 08.3077                                         | + 685 | 08.3762               | 22 54 20.1057                                         |
|          | 22 | 19 57 43.3162                                         | +1412 | 43.4574               | 19 56 55.4930                                         |             | 6  | 22 59 04.8631                                         | + 698 | 04.9329               | 22 58 16.6527                                         |
|          | 23 | 20 01 39.8715                                         | +1366 | 40.0081               | 20 00 52.0400                                         |             | 7  | 23 03 01.4185                                         | + 715 | 01.4900               | 23 02 13.1996                                         |
|          | 24 | 20 05 36.4269                                         | +1329 | 36.5599               | 20 04 48.5869                                         |             | 8  | 23 06 57.9738                                         | + 725 | 58.0463               | 23 06 09.7466                                         |
|          | 25 | 20 09 32.9823                                         | +1309 | 33.1132               | 20 08 45.1339                                         |             | 9  | 23 10 54.5292                                         | + 720 | 54.6012               | 23 10 06.2935                                         |
|          | 26 | 20 13 29.5376                                         | +1309 | 29.6686               | 20 12 41.6808                                         |             | 10 | 23 14 51.0846                                         | + 696 | 51.1542               | 23 14 02.8405                                         |
|          | 27 | 20 17 26.0930                                         | +1331 | 26.2262               | 20 16 38.2278                                         |             | 11 | 23 18 47.6400                                         | + 651 | 47.7050               | 23 17 59.3874                                         |
|          | 28 | 20 21 22.6484                                         | +1373 | 22.7857               | 20 20 34.7747                                         |             | 12 | 23 22 44.1953                                         | + 587 | 44.2540               | 23 21 55.9344                                         |
|          | 29 | 20 25 19.2038                                         | +1427 | 19.3465               | 20 24 31.3216                                         |             | 13 | 23 26 40.7507                                         | + 508 | 40.8015               | 23 25 52.4813                                         |
|          | 30 | 20 29 15.7591                                         | +1482 | 15.9074               | 20 28 27.8686                                         |             | 14 | 23 30 37.3061                                         | + 422 | 37.3482               | 23 29 49.0283                                         |
| Sierpień | 31 | 20 33 12.3145                                         | +1525 | 12.4669               | 20 32 24.4155                                         |             | 15 | 23 34 33.8614                                         | + 334 | 33.8948               | 23 33 45.5752                                         |
|          | 1  | 20 37 08.8699                                         | +1541 | 09.0240               | 20 36 20.9625                                         |             | 16 | 23 38 30.4168                                         | + 252 | 30.4420               | 23 37 42.1222                                         |
|          | 2  | 20 41 05.4252                                         | +1526 | 05.5778               | 20 40 17.5094                                         |             | 17 | 23 42 26.9722                                         | + 183 | 26.9905               | 23 41 38.6691                                         |
|          | 3  | 20 45 01.9806                                         | +1483 | 02.1289               | 20 44 14.0564                                         |             | 18 | 23 46 23.5275                                         | + 131 | 23.5406               | 23 45 35.2161                                         |
|          | 4  | 20 48 58.5360                                         | +1424 | 58.6784               | 20 48 10.6033                                         |             | 19 | 23 50 20.0829                                         | + 99  | 20.0928               | 23 49 31.7630                                         |
|          | 5  | 20 52 55.0913                                         | +1365 | 55.2278               | 20 52 07.1503                                         |             | 20 | 23 54 16.6383                                         | + 87  | 16.6469               | 23 53 28.3100                                         |
|          | 6  | 20 56 51.6467                                         | +1319 | 51.7786               | 20 56 03.6972                                         |             | 21 | 23 58 13.1936                                         | + 90  | 13.2026               | 23 57 24.8569                                         |
|          | 7  | 21 00 48.2021                                         | +1297 | 48.3318               | 21 00 00.2442                                         |             | 22 | 0 02 09.7490                                          | + 102 | 09.7592               | 0 01 21.4039                                          |
|          | 8  | 21 04 44.7574                                         | +1300 | 44.8874               | 21 03 56.7911                                         |             | 23 | 0 06 06.3044                                          | + 114 | 06.3158               | 0 05 17.9508                                          |
|          | 9  | 21 08 41.3128                                         | +1323 | 41.4451               | 21 07 53.3381                                         |             | 24 | 0 10 02.8597                                          | + 114 | 02.8711               | 0 09 14.4978                                          |
|          | 10 | 21 12 37.8682                                         | +1357 | 38.0039               | 21 11 49.8850                                         |             | 25 | 0 13 59.4151                                          | + 92  | 59.4243               | 0 13 11.0447                                          |
|          | 11 | 21 16 34.4235                                         | +1393 | 34.5628               | 21 15 46.4320                                         |             | 26 | 0 17 55.9705                                          | + 41  | 55.9746               | 0 17 07.5916                                          |
|          | 12 | 21 20 30.9789                                         | +1419 | 31.1208               | 21 19 42.9789                                         |             | 27 | 0 21 52.5258                                          | − 35  | 52.5224               | 0 21 04.1386                                          |
|          | 13 | 21 24 27.5343                                         | +1430 | 27.6773               | 21 23 39.5259                                         |             | 28 | 0 25 49.0812                                          | − 125 | 49.0687               | 0 25 00.6855                                          |
|          | 14 | 21 28 24.0896                                         | +1420 | 24.2316               | 21 27 36.0728                                         |             | 29 | 0 29 45.6366                                          | − 211 | 45.6154               | 0 28 57.2325                                          |
|          | 15 | 21 32 20.6450                                         | +1389 | 20.7839               | 21 31 32.6198                                         | Październik | 30 | 0 33 42.1919                                          | − 278 | 42.1642               | 0 32 53.7794                                          |
|          | 16 | 21 36 17.2004                                         | +1338 | 17.3342               | 21 35 29.1667                                         |             | 1  | 0 37 38.7473                                          | − 314 | 38.7159               | 0 36 50.3264                                          |

# CZAS GWIAZDOWY GREENWICH I KĄT OBROTU ZIEMI 2015

| Data        |    | 0 <sup>h</sup> UT1                                   |                              |                       |                                                      | Data     |    | 0 <sup>h</sup> UT1                                   |                                |                                                      |              |
|-------------|----|------------------------------------------------------|------------------------------|-----------------------|------------------------------------------------------|----------|----|------------------------------------------------------|--------------------------------|------------------------------------------------------|--------------|
|             |    | GMST                                                 | Eq                           | GST                   | $\theta$                                             |          |    | GMST                                                 | Eq                             | GST                                                  | $\theta$     |
| Październik | 1  | 0 <sup>h</sup> 37 <sup>m</sup> 38. <sup>s</sup> 7473 | 0 <sup>s</sup> 0001<br>– 314 | 38. <sup>s</sup> 7159 | 0 <sup>h</sup> 36 <sup>m</sup> 50. <sup>s</sup> 3264 | Listopad | 16 | 3 <sup>h</sup> 39 <sup>m</sup> 00. <sup>s</sup> 2943 | –1211<br>00. <sup>s</sup> 1731 | 3 <sup>h</sup> 38 <sup>m</sup> 11. <sup>s</sup> 4861 |              |
|             | 2  | 0 41 35.3027                                         | – 323                        | 35.2704               | 0 40 46.8733                                         |          | 17 | 3 42 56.8496                                         | –1171                          | 56.7325                                              | 3 42 08.0330 |
|             | 3  | 0 45 31.8581                                         | – 312                        | 31.8269               | 0 44 43.4203                                         |          | 18 | 3 46 53.4050                                         | –1146                          | 53.2904                                              | 3 46 04.5800 |
|             | 4  | 0 49 28.4134                                         | – 294                        | 28.3841               | 0 48 39.9672                                         |          | 19 | 3 50 49.9604                                         | –1142                          | 49.8461                                              | 3 50 01.1269 |
|             | 5  | 0 53 24.9688                                         | – 280                        | 24.9408               | 0 52 36.5142                                         |          | 20 | 3 54 46.5157                                         | –1163                          | 46.3994                                              | 3 53 57.6739 |
|             | 6  | 0 57 21.5242                                         | – 280                        | 21.4962               | 0 56 33.0611                                         |          | 21 | 3 58 43.0711                                         | –1203                          | 42.9508                                              | 3 57 54.2208 |
|             | 7  | 1 01 18.0795                                         | – 298                        | 18.0497               | 1 00 29.6081                                         |          | 22 | 4 02 39.6265                                         | –1252                          | 39.5013                                              | 4 01 50.7677 |
|             | 8  | 1 05 14.6349                                         | – 337                        | 14.6012               | 1 04 26.1550                                         |          | 23 | 4 06 36.1818                                         | –1294                          | 36.0525                                              | 4 05 47.3147 |
|             | 9  | 1 09 11.1903                                         | – 395                        | 11.1507               | 1 08 22.7020                                         |          | 24 | 4 10 32.7372                                         | –1315                          | 32.6057                                              | 4 09 43.8616 |
|             | 10 | 1 13 07.7456                                         | – 468                        | 07.6988               | 1 12 19.2489                                         |          | 25 | 4 14 29.2926                                         | –1305                          | 29.1621                                              | 4 13 40.4086 |
|             | 11 | 1 17 04.3010                                         | – 551                        | 04.2459               | 1 16 15.7959                                         |          | 26 | 4 18 25.8479                                         | –1263                          | 25.7216                                              | 4 17 36.9555 |
|             | 12 | 1 21 00.8564                                         | – 635                        | 00.7929               | 1 20 12.3428                                         |          | 27 | 4 22 22.4033                                         | –1200                          | 22.2833                                              | 4 21 33.5025 |
|             | 13 | 1 24 57.4117                                         | – 714                        | 57.3403               | 1 24 08.8898                                         |          | 28 | 4 26 18.9587                                         | –1128                          | 18.8459                                              | 4 25 30.0494 |
|             | 14 | 1 28 53.9671                                         | – 781                        | 53.8890               | 1 28 05.4367                                         |          | 29 | 4 30 15.5140                                         | –1062                          | 15.4079                                              | 4 29 26.5964 |
|             | 15 | 1 32 50.5225                                         | – 831                        | 50.4394               | 1 32 01.9837                                         |          | 30 | 4 34 12.0694                                         | –1013                          | 11.9681                                              | 4 33 23.1433 |
|             | 16 | 1 36 47.0778                                         | – 860                        | 46.9918               | 1 35 58.5306                                         | Grudzień | 1  | 4 38 08.6248                                         | – 987                          | 08.5261                                              | 4 37 19.6903 |
|             | 17 | 1 40 43.6332                                         | – 870                        | 43.5462               | 1 39 55.0776                                         |          | 2  | 4 42 05.1801                                         | – 983                          | 05.0818                                              | 4 41 16.2372 |
|             | 18 | 1 44 40.1886                                         | – 862                        | 40.1024               | 1 43 51.6245                                         |          | 3  | 4 46 01.7355                                         | – 999                          | 01.6356                                              | 4 45 12.7842 |
|             | 19 | 1 48 36.7439                                         | – 844                        | 36.6595               | 1 47 48.1715                                         |          | 4  | 4 49 58.2909                                         | –1029                          | 58.1880                                              | 4 49 09.3311 |
|             | 20 | 1 52 33.2993                                         | – 824                        | 33.2169               | 1 51 44.7184                                         |          | 5  | 4 53 54.8462                                         | –1066                          | 54.7397                                              | 4 53 05.8781 |
|             | 21 | 1 56 29.8547                                         | – 811                        | 29.7736               | 1 55 41.2654                                         |          | 6  | 4 57 51.4016                                         | –1101                          | 51.2915                                              | 4 57 02.4250 |
|             | 22 | 2 00 26.4100                                         | – 816                        | 26.3284               | 1 59 37.8123                                         |          | 7  | 5 01 47.9570                                         | –1128                          | 47.8441                                              | 5 00 58.9720 |
|             | 23 | 2 04 22.9654                                         | – 845                        | 22.8809               | 2 03 34.3593                                         |          | 8  | 5 05 44.5124                                         | –1141                          | 44.3983                                              | 5 04 55.5189 |
|             | 24 | 2 08 19.5208                                         | – 898                        | 19.4310               | 2 07 30.9062                                         |          | 9  | 5 09 41.0677                                         | –1134                          | 40.9543                                              | 5 08 52.0659 |
|             | 25 | 2 12 16.0762                                         | – 970                        | 15.9792               | 2 11 27.4532                                         |          | 10 | 5 13 37.6231                                         | –1106                          | 37.5125                                              | 5 12 48.6128 |
|             | 26 | 2 16 12.6315                                         | –1045                        | 12.5271               | 2 15 24.0001                                         |          | 11 | 5 17 34.1785                                         | –1058                          | 34.0727                                              | 5 16 45.1598 |
|             | 27 | 2 20 09.1869                                         | –1106                        | 09.0763               | 2 19 20.5471                                         |          | 12 | 5 21 30.7338                                         | – 995                          | 30.6343                                              | 5 20 41.7067 |
|             | 28 | 2 24 05.7423                                         | –1140                        | 05.6283               | 2 23 17.0940                                         |          | 13 | 5 25 27.2892                                         | – 925                          | 27.1967                                              | 5 24 38.2537 |
|             | 29 | 2 28 02.2976                                         | –1141                        | 02.1835               | 2 27 13.6410                                         |          | 14 | 5 29 23.8446                                         | – 860                          | 23.7585                                              | 5 28 34.8006 |
|             | 30 | 2 31 58.8530                                         | –1115                        | 58.7415               | 2 31 10.1879                                         |          | 15 | 5 33 20.3999                                         | – 810                          | 20.3189                                              | 5 32 31.3476 |
| Listopad    | 31 | 2 35 55.4084                                         | –1074                        | 55.3009               | 2 35 06.7349                                         |          | 16 | 5 37 16.9553                                         | – 782                          | 16.8771                                              | 5 36 27.8945 |
|             | 1  | 2 39 51.9637                                         | –1033                        | 51.8604               | 2 39 03.2818                                         |          | 17 | 5 41 13.5107                                         | – 780                          | 13.4327                                              | 5 40 24.4415 |
|             | 2  | 2 43 48.5191                                         | –1004                        | 48.4187               | 2 42 59.8288                                         |          | 18 | 5 45 10.0660                                         | – 799                          | 09.9861                                              | 5 44 20.9884 |
|             | 3  | 2 47 45.0745                                         | – 992                        | 44.9752               | 2 46 56.3757                                         |          | 19 | 5 49 06.6214                                         | – 831                          | 06.5383                                              | 5 48 17.5354 |
|             | 4  | 2 51 41.6298                                         | –1003                        | 41.5296               | 2 50 52.9227                                         |          | 20 | 5 53 03.1768                                         | – 861                          | 03.0907                                              | 5 52 14.0823 |
|             | 5  | 2 55 38.1852                                         | –1033                        | 38.0819               | 2 54 49.4696                                         |          | 21 | 5 56 59.7321                                         | – 876                          | 59.6445                                              | 5 56 10.6293 |
|             | 6  | 2 59 34.7406                                         | –1080                        | 34.6325               | 2 58 46.0166                                         |          | 22 | 6 00 56.2875                                         | – 866                          | 56.2009                                              | 6 00 07.1762 |
|             | 7  | 3 03 31.2959                                         | –1138                        | 31.1822               | 3 02 42.5635                                         |          | 23 | 6 04 52.8429                                         | – 826                          | 52.7603                                              | 6 04 03.7232 |
|             | 8  | 3 07 27.8513                                         | –1199                        | 27.7314               | 3 06 39.1105                                         |          | 24 | 6 08 49.3982                                         | – 761                          | 49.3221                                              | 6 08 00.2701 |
|             | 9  | 3 11 24.4067                                         | –1257                        | 24.2810               | 3 10 35.6574                                         |          | 25 | 6 12 45.9536                                         | – 682                          | 45.8855                                              | 6 11 56.8171 |
|             | 10 | 3 15 20.9620                                         | –1303                        | 20.8317               | 3 14 32.2044                                         |          | 26 | 6 16 42.5090                                         | – 602                          | 42.4488                                              | 6 15 53.3640 |
|             | 11 | 3 19 17.5174                                         | –1333                        | 17.3841               | 3 18 28.7513                                         |          | 27 | 6 20 39.0643                                         | – 534                          | 39.0109                                              | 6 19 49.9110 |
|             | 12 | 3 23 14.0728                                         | –1343                        | 13.9385               | 3 22 25.2983                                         |          | 28 | 6 24 35.6197                                         | – 489                          | 35.5709                                              | 6 23 46.4579 |
|             | 13 | 3 27 10.6281                                         | –1331                        | 10.4950               | 3 26 21.8452                                         |          | 29 | 6 28 32.1751                                         | – 467                          | 32.1283                                              | 6 27 43.0049 |
|             | 14 | 3 31 07.1835                                         | –1301                        | 07.0534               | 3 30 18.3922                                         |          | 30 | 6 32 28.7305                                         | – 469                          | 28.6835                                              | 6 31 39.5518 |
|             | 15 | 3 35 03.7389                                         | –1258                        | 03.6131               | 3 34 14.9391                                         |          | 31 | 6 36 25.2858                                         | – 489                          | 25.2369                                              | 6 35 36.0988 |
|             | 16 | 3 39 00.2943                                         | –1211                        | 00.1731               | 3 38 11.4861                                         |          | 32 | 6 40 21.8412                                         | – 519                          | 21.7893                                              | 6 39 32.6457 |

**SŁOŃCE 2015, STYCZEŃ – LUTY**

| Data    | JD   | $0^h TT$             |                                        |                      |                  |          |        |            |                                        | CSE                   |                                |                                 |
|---------|------|----------------------|----------------------------------------|----------------------|------------------|----------|--------|------------|----------------------------------------|-----------------------|--------------------------------|---------------------------------|
|         |      | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$                | $\delta_{app}$       | $V_{\delta}/1^h$ | $R$      | $\pi$  | $E + 12^h$ | $V_E/1^h$                              | w Warszawie<br>wsch.  | zach.                          |                                 |
|         | 2457 |                      |                                        |                      |                  | 16'      |        |            |                                        |                       |                                |                                 |
| Styczeń | 0    | 022.5                | 18 <sup>h</sup> 39 <sup>m</sup> 19.016 | 65 <sup>s</sup> .426 | −23°06′53″.97    | +10″.574 | 15″.90 | 8″.94      | 11 <sup>h</sup> 57 <sup>m</sup> 17.446 | −1 <sup>s</sup> .1963 | 7 <sup>h</sup> 45 <sup>m</sup> | 15 <sup>h</sup> 33 <sup>m</sup> |
|         | 1    | 023.5                | 18 43 44.129                           | 90.549               | −23 02 26.31     | +11.726  | 15.93  | 8.94       | 11 56 48.881                           | −1.1838               | 7 45                           | 15 34                           |
|         | 2    | 024.5                | 18 48 08.926                           | 55.359               | −22 57 31.07     | +12.873  | 15.95  | 8.94       | 11 56 20.630                           | −1.1700               | 7 45                           | 15 35                           |
|         | 3    | 025.5                | 18 52 33.380                           | 79.828               | −22 52 08.38     | +14.014  | 15.96  | 8.94       | 11 55 52.723                           | −1.1552               | 7 45                           | 15 36                           |
|         | 4    | 026.5                | 18 56 57.465                           | 103.927              | −22 46 18.40     | +15.148  | 15.96  | 8.94       | 11 55 25.185                           | −1.1392               | 7 45                           | 15 37                           |
|         | 5    | 027.5                | 19 01 21.154                           | 67.631               | −22 40 01.31     | +16.275  | 15.96  | 8.94       | 11 54 58.043                           | −1.1222               | 7 44                           | 15 38                           |
|         | 6    | 028.5                | 19 05 44.423                           | 90.913               | −22 33 17.28     | +17.394  | 15.95  | 8.94       | 11 54 31.321                           | −1.1042               | 7 44                           | 15 40                           |
|         | 7    | 029.5                | 19 10 07.247                           | 53.749               | −22 26 06.50     | +18.505  | 15.94  | 8.94       | 11 54 05.044                           | −1.0852               | 7 44                           | 15 41                           |
|         | 8    | 030.5                | 19 14 29.603                           | 76.114               | −22 18 29.16     | +19.607  | 15.92  | 8.94       | 11 53 39.235                           | −1.0652               | 7 43                           | 15 42                           |
|         | 9    | 031.5                | 19 18 51.466                           | 97.985               | −22 10 25.49     | +20.700  | 15.89  | 8.94       | 11 53 13.919                           | −1.0442               | 7 43                           | 15 44                           |
|         | 10   | 032.5                | 19 23 12.814                           | 59.339               | −22 01 55.70     | +21.782  | 15.86  | 8.94       | 11 52 49.117                           | −1.0223               | 7 42                           | 15 45                           |
|         | 11   | 033.5                | 19 27 33.626                           | 80.156               | −21 53 00.04     | +22.855  | 15.82  | 8.94       | 11 52 24.853                           | −0.9995               | 7 41                           | 15 46                           |
|         | 12   | 034.5                | 19 31 53.878                           | 100.412              | −21 43 38.75     | +23.917  | 15.78  | 8.94       | 11 52 01.147                           | −0.9758               | 7 41                           | 15 48                           |
|         | 13   | 035.5                | 19 36 13.551                           | 60.090               | −21 33 52.10     | +24.967  | 15.73  | 8.94       | 11 51 38.021                           | −0.9512               | 7 40                           | 15 49                           |
|         | 14   | 036.5                | 19 40 32.624                           | 79.169               | −21 23 40.37     | +26.006  | 15.67  | 8.94       | 11 51 15.496                           | −0.9258               | 7 39                           | 15 51                           |
|         | 15   | 037.5                | 19 44 51.076                           | 97.629               | −21 13 03.84     | +27.033  | 15.61  | 8.94       | 11 50 53.590                           | −0.8995               | 7 38                           | 15 53                           |
|         | 16   | 038.5                | 19 49 08.889                           | 55.453               | −21 02 02.82     | +28.046  | 15.55  | 8.94       | 11 50 32.324                           | −0.8724               | 7 37                           | 15 54                           |
|         | 17   | 039.5                | 19 53 26.043                           | 72.620               | −20 50 37.62     | +29.047  | 15.48  | 8.94       | 11 50 11.718                           | −0.8445               | 7 37                           | 15 56                           |
|         | 18   | 040.5                | 19 57 42.518                           | 89.110               | −20 38 48.58     | +30.034  | 15.41  | 8.94       | 11 49 51.789                           | −0.8158               | 7 36                           | 15 57                           |
|         | 19   | 041.5                | 20 01 58.295                           | 104.902              | −20 26 36.04     | +31.006  | 15.34  | 8.94       | 11 49 32.559                           | −0.7864               | 7 35                           | 15 59                           |
|         | 20   | 042.5                | 20 06 13.356                           | 59.979               | −20 14 00.34     | +31.964  | 15.26  | 8.94       | 11 49 14.046                           | −0.7561               | 7 33                           | 16 01                           |
|         | 21   | 043.5                | 20 10 27.680                           | 74.316               | −20 01 01.84     | +32.907  | 15.17  | 8.94       | 11 48 56.269                           | −0.7250               | 7 32                           | 16 02                           |
|         | 22   | 044.5                | 20 14 41.249                           | 87.895               | −19 47 40.91     | +33.835  | 15.09  | 8.94       | 11 48 39.246                           | −0.6932               | 7 31                           | 16 04                           |
|         | 23   | 045.5                | 20 18 54.046                           | 100.698              | −19 33 57.91     | +34.747  | 15.00  | 8.93       | 11 48 22.997                           | −0.6607               | 7 30                           | 16 06                           |
|         | 24   | 046.5                | 20 23 06.055                           | 52.712               | −19 19 53.20     | +35.644  | 14.91  | 8.93       | 11 48 07.534                           | −0.6276               | 7 29                           | 16 08                           |
|         | 25   | 047.5                | 20 27 17.264                           | 63.924               | −19 05 27.14     | +36.525  | 14.81  | 8.93       | 11 47 52.872                           | −0.5941               | 7 27                           | 16 10                           |
|         | 26   | 048.5                | 20 31 27.662                           | 74.326               | −18 50 40.12     | +37.390  | 14.71  | 8.93       | 11 47 39.021                           | −0.5601               | 7 26                           | 16 11                           |
|         | 27   | 049.5                | 20 35 37.241                           | 83.911               | −18 35 32.51     | +38.239  | 14.61  | 8.93       | 11 47 25.989                           | −0.5258               | 7 25                           | 16 13                           |
|         | 28   | 050.5                | 20 39 45.995                           | 92.673               | −18 20 04.70     | +39.072  | 14.50  | 8.93       | 11 47 13.782                           | −0.4914               | 7 23                           | 16 15                           |
|         | 29   | 051.5                | 20 43 53.921                           | 100.609              | −18 04 17.08     | +39.889  | 14.39  | 8.93       | 11 47 02.403                           | −0.4568               | 7 22                           | 16 17                           |
| Luty    | 30   | 052.5                | 20 48 01.016                           | 47.716               | −17 48 10.04     | +40.690  | 14.27  | 8.93       | 11 46 51.854                           | −0.4222               | 7 20                           | 16 19                           |
|         | 31   | 053.5                | 20 52 07.282                           | 53.994               | −17 31 43.98     | +41.475  | 14.14  | 8.93       | 11 46 42.136                           | −0.3876               | 7 19                           | 16 20                           |
|         | 1    | 054.5                | 20 56 12.718                           | 59.443               | −17 14 59.29     | +42.244  | 14.01  | 8.93       | 11 46 33.247                           | −0.3531               | 7 17                           | 16 22                           |
|         | 2    | 055.5                | 21 00 17.327                           | 64.063               | −16 57 56.36     | +42.996  | 13.88  | 8.92       | 11 46 25.184                           | −0.3187               | 7 16                           | 16 24                           |
|         | 3    | 056.5                | 21 04 21.114                           | 67.860               | −16 40 35.58     | +43.732  | 13.74  | 8.92       | 11 46 17.945                           | −0.2845               | 7 14                           | 16 26                           |
|         | 4    | 057.5                | 21 08 24.083                           | 70.836               | −16 22 57.35     | +44.451  | 13.59  | 8.92       | 11 46 11.523                           | −0.2506               | 7 12                           | 16 28                           |
|         | 5    | 058.5                | 21 12 26.240                           | 72.999               | −16 05 02.06     | +45.154  | 13.44  | 8.92       | 11 46 05.913                           | −0.2169               | 7 11                           | 16 30                           |
|         | 6    | 059.5                | 21 16 27.591                           | 74.354               | −15 46 50.11     | +45.840  | 13.28  | 8.92       | 11 46 01.109                           | −0.1835               | 7 09                           | 16 32                           |
|         | 7    | 060.5                | 21 20 28.144                           | 74.909               | −15 28 21.90     | +46.509  | 13.12  | 8.92       | 11 45 57.102                           | −0.1504               | 7 07                           | 16 34                           |
|         | 8    | 061.5                | 21 24 27.907                           | 74.674               | −15 09 37.82     | +47.162  | 12.96  | 8.92       | 11 45 53.886                           | −0.1177               | 7 05                           | 16 35                           |
|         | 9    | 062.5                | 21 28 26.889                           | 73.659               | −14 50 38.28     | +47.797  | 12.78  | 8.91       | 11 45 51.451                           | −0.0853               | 7 04                           | 16 37                           |
|         | 10   | 063.5                | 21 32 25.099                           | 71.872               | −14 31 23.68     | +48.415  | 12.61  | 8.91       | 11 45 49.788                           | −0.0533               | 7 02                           | 16 39                           |
|         | 11   | 064.5                | 21 36 22.547                           | 69.324               | −14 11 54.43     | +49.017  | 12.43  | 8.91       | 11 45 48.887                           | −0.0218               | 7 00                           | 16 41                           |
|         | 12   | 065.5                | 21 40 19.242                           | 66.026               | −13 52 10.95     | +49.601  | 12.24  | 8.91       | 11 45 48.739                           | +0.0094               | 6 58                           | 16 43                           |
|         | 13   | 066.5                | 21 44 15.195                           | 61.988               | −13 32 13.64     | +50.167  | 12.05  | 8.91       | 11 45 49.333                           | +0.0401               | 6 56                           | 16 45                           |
|         | 14   | 067.5                | 21 48 10.416                           | 57.220               | −13 12 02.93     | +50.717  | 11.86  | 8.91       | 11 45 50.659                           | +0.0704               | 6 54                           | 16 47                           |
|         | 15   | 068.5                | 21 52 04.915                           | 51.731               | −12 51 39.25     | +51.249  | 11.66  | 8.90       | 11 45 52.707                           | +0.1003               | 6 52                           | 16 49                           |

**SŁOŃCE 2015, LUTY – MARZEC**

| Data     | JD       | $0^h TT$                                             |                         |                |                  |        |       |                                                      |                       | CSE                            |                                 |
|----------|----------|------------------------------------------------------|-------------------------|----------------|------------------|--------|-------|------------------------------------------------------|-----------------------|--------------------------------|---------------------------------|
|          |          | $\alpha_{app}^{CIO}$                                 | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$ | $R$    | $\pi$ | $E + 12^h$                                           | $V_E/1^h$             | w Warszawie<br>wsch.           | zach.                           |
| Luty     | 2457     |                                                      |                         |                |                  | 16'    |       |                                                      |                       |                                |                                 |
|          | 15 068.5 | 21 <sup>h</sup> 52 <sup>m</sup> 04. <sup>s</sup> 915 | 51. <sup>s</sup> 731    | −12°51'39".25  | +51."249         | 11."66 | 8."90 | 11 <sup>h</sup> 45 <sup>m</sup> 52. <sup>s</sup> 707 | +0. <sup>s</sup> 1003 | 6 <sup>h</sup> 52 <sup>m</sup> | 16 <sup>h</sup> 49 <sup>m</sup> |
|          | 16 069.5 | 21 55 58.701                                         | 105.530                 | −12 31 03.02   | +51.763          | 11.47  | 8.90  | 11 45 55.468                                         | +0.1298               | 6 50                           | 16 51                           |
|          | 17 070.5 | 21 59 51.785                                         | 98.625                  | −12 10 14.69   | +52.259          | 11.27  | 8.90  | 11 45 58.931                                         | +0.1589               | 6 48                           | 16 52                           |
|          | 18 071.5 | 22 03 44.173                                         | 91.022                  | −11 49 14.69   | +52.737          | 11.06  | 8.90  | 11 46 03.090                                         | +0.1877               | 6 46                           | 16 54                           |
|          | 19 072.5 | 22 07 35.875                                         | 82.729                  | −11 28 03.45   | +53.196          | 10.86  | 8.90  | 11 46 07.935                                         | +0.2161               | 6 44                           | 16 56                           |
|          | 20 073.5 | 22 11 26.898                                         | 73.755                  | −11 06 41.41   | +53.638          | 10.65  | 8.89  | 11 46 13.458                                         | +0.2442               | 6 42                           | 16 58                           |
|          | 21 074.5 | 22 15 17.251                                         | 64.108                  | −10 45 08.99   | +54.061          | 10.44  | 8.89  | 11 46 19.652                                         | +0.2719               | 6 40                           | 17 00                           |
|          | 22 075.5 | 22 19 06.944                                         | 53.802                  | −10 23 26.61   | +54.467          | 10.23  | 8.89  | 11 46 26.507                                         | +0.2992               | 6 38                           | 17 02                           |
|          | 23 076.5 | 22 22 55.987                                         | 102.848                 | −10 01 34.69   | +54.855          | 10.02  | 8.89  | 11 46 34.010                                         | +0.3260               | 6 36                           | 17 04                           |
|          | 24 077.5 | 22 26 44.394                                         | 91.260                  | − 9 39 33.66   | +55.226          | 9.81   | 8.89  | 11 46 42.151                                         | +0.3522               | 6 34                           | 17 05                           |
|          | 25 078.5 | 22 30 32.179                                         | 79.052                  | − 9 17 23.91   | +55.579          | 9.59   | 8.89  | 11 46 50.912                                         | +0.3778               | 6 32                           | 17 07                           |
|          | 26 079.5 | 22 34 19.359                                         | 66.241                  | − 8 55 05.87   | +55.916          | 9.37   | 8.88  | 11 47 00.280                                         | +0.4027               | 6 30                           | 17 09                           |
|          | 27 080.5 | 22 38 05.950                                         | 52.842                  | − 8 32 39.94   | +56.237          | 9.15   | 8.88  | 11 47 10.236                                         | +0.4269               | 6 27                           | 17 11                           |
|          | 28 081.5 | 22 41 51.971                                         | 98.873                  | − 8 10 06.52   | +56.541          | 8.92   | 8.88  | 11 47 20.762                                         | +0.4502               | 6 25                           | 17 13                           |
| Marzec   | 1 082.5  | 22 45 37.441                                         | 84.352                  | − 7 47 26.01   | +56.829          | 8.70   | 8.88  | 11 47 31.838                                         | +0.4728               | 6 23                           | 17 15                           |
|          | 2 083.5  | 22 49 22.380                                         | 69.298                  | − 7 24 38.80   | +57.100          | 8.46   | 8.87  | 11 47 43.446                                         | +0.4944               | 6 21                           | 17 16                           |
|          | 3 084.5  | 22 53 06.810                                         | 53.734                  | − 7 01 45.27   | +57.356          | 8.23   | 8.87  | 11 47 55.564                                         | +0.5153               | 6 19                           | 17 18                           |
|          | 4 085.5  | 22 56 50.750                                         | 97.678                  | − 6 38 45.80   | +57.596          | 7.99   | 8.87  | 11 48 08.170                                         | +0.5352               | 6 16                           | 17 20                           |
|          | 5 086.5  | 23 00 34.223                                         | 81.153                  | − 6 15 40.77   | +57.820          | 7.75   | 8.87  | 11 48 21.244                                         | +0.5542               | 6 14                           | 17 22                           |
|          | 6 087.5  | 23 04 17.250                                         | 64.180                  | − 5 52 30.56   | +58.029          | 7.50   | 8.87  | 11 48 34.764                                         | +0.5723               | 6 12                           | 17 24                           |
|          | 7 088.5  | 23 07 59.854                                         | 106.784                 | − 5 29 15.53   | +58.222          | 7.25   | 8.86  | 11 48 48.707                                         | +0.5894               | 6 10                           | 17 25                           |
|          | 8 089.5  | 23 11 42.058                                         | 88.988                  | − 5 05 56.05   | +58.399          | 7.00   | 8.86  | 11 49 03.050                                         | +0.6057               | 6 07                           | 17 27                           |
|          | 9 090.5  | 23 15 23.883                                         | 70.814                  | − 4 42 32.49   | +58.561          | 6.74   | 8.86  | 11 49 17.771                                         | +0.6209               | 6 05                           | 17 29                           |
|          | 10 091.5 | 23 19 05.354                                         | 52.287                  | − 4 19 05.22   | +58.707          | 6.49   | 8.86  | 11 49 32.848                                         | +0.6353               | 6 03                           | 17 31                           |
|          | 11 092.5 | 23 22 46.491                                         | 93.428                  | − 3 55 34.61   | +58.839          | 6.22   | 8.85  | 11 49 48.258                                         | +0.6487               | 6 01                           | 17 33                           |
|          | 12 093.5 | 23 26 27.318                                         | 74.261                  | − 3 32 01.02   | +58.954          | 5.96   | 8.85  | 11 50 03.978                                         | +0.6612               | 5 58                           | 17 34                           |
|          | 13 094.5 | 23 30 07.856                                         | 54.807                  | − 3 08 24.83   | +59.055          | 5.69   | 8.85  | 11 50 19.987                                         | +0.6727               | 5 56                           | 17 36                           |
|          | 14 095.5 | 23 33 48.128                                         | 95.089                  | − 2 44 46.41   | +59.139          | 5.43   | 8.85  | 11 50 36.262                                         | +0.6834               | 5 54                           | 17 38                           |
|          | 15 096.5 | 23 37 28.154                                         | 75.125                  | − 2 21 06.13   | +59.209          | 5.16   | 8.84  | 11 50 52.783                                         | +0.6932               | 5 51                           | 17 40                           |
|          | 16 097.5 | 23 41 07.954                                         | 54.935                  | − 1 57 24.39   | +59.262          | 4.89   | 8.84  | 11 51 09.529                                         | +0.7022               | 5 49                           | 17 41                           |
|          | 17 098.5 | 23 44 47.549                                         | 94.538                  | − 1 33 41.56   | +59.300          | 4.62   | 8.84  | 11 51 26.482                                         | +0.7104               | 5 47                           | 17 43                           |
|          | 18 099.5 | 23 48 26.955                                         | 73.949                  | − 1 09 58.04   | +59.322          | 4.35   | 8.84  | 11 51 43.622                                         | +0.7179               | 5 44                           | 17 45                           |
|          | 19 100.5 | 23 52 06.190                                         | 53.187                  | − 0 46 14.20   | +59.327          | 4.07   | 8.83  | 11 52 00.934                                         | +0.7247               | 5 42                           | 17 47                           |
|          | 20 101.5 | 23 55 45.270                                         | 92.267                  | − 0 22 30.44   | +59.317          | 3.80   | 8.83  | 11 52 18.401                                         | +0.7308               | 5 40                           | 17 48                           |
|          | 21 102.5 | 23 59 24.210                                         | 71.206                  | + 0 01 12.86   | +59.290          | 3.53   | 8.83  | 11 52 36.008                                         | +0.7363               | 5 37                           | 17 50                           |
|          | 22 103.5 | 0 03 03.025                                          | 50.021                  | + 0 24 55.34   | +59.247          | 3.26   | 8.83  | 11 52 53.740                                         | +0.7412               | 5 35                           | 17 52                           |
|          | 23 104.5 | 0 06 41.730                                          | 88.729                  | + 0 48 36.61   | +59.188          | 2.99   | 8.82  | 11 53 11.582                                         | +0.7455               | 5 33                           | 17 54                           |
|          | 24 105.5 | 0 10 20.342                                          | 67.347                  | + 1 12 16.28   | +59.113          | 2.73   | 8.82  | 11 53 29.517                                         | +0.7490               | 5 30                           | 17 55                           |
|          | 25 106.5 | 0 13 58.878                                          | 105.891                 | + 1 35 54.00   | +59.023          | 2.46   | 8.82  | 11 53 47.528                                         | +0.7518               | 5 28                           | 17 57                           |
|          | 26 107.5 | 0 17 37.356                                          | 84.378                  | + 1 59 29.39   | +58.918          | 2.19   | 8.82  | 11 54 05.597                                         | +0.7538               | 5 26                           | 17 59                           |
|          | 27 108.5 | 0 21 15.795                                          | 62.826                  | + 2 23 02.08   | +58.798          | 1.92   | 8.81  | 11 54 23.705                                         | +0.7550               | 5 23                           | 18 01                           |
|          | 28 109.5 | 0 24 54.216                                          | 101.256                 | + 2 46 31.71   | +58.664          | 1.65   | 8.81  | 11 54 41.831                                         | +0.7554               | 5 21                           | 18 02                           |
|          | 29 110.5 | 0 28 32.639                                          | 79.687                  | + 3 09 57.93   | +58.515          | 1.38   | 8.81  | 11 54 59.955                                         | +0.7548               | 5 19                           | 18 04                           |
|          | 30 111.5 | 0 32 11.084                                          | 58.138                  | + 3 33 20.39   | +58.351          | 1.11   | 8.81  | 11 55 18.057                                         | +0.7535               | 5 16                           | 18 06                           |
|          | 31 112.5 | 0 35 49.574                                          | 96.632                  | + 3 56 38.75   | +58.174          | 0.84   | 8.80  | 11 55 36.114                                         | +0.7512               | 5 14                           | 18 07                           |
| Kwiecień | 1 113.5  | 0 39 28.129                                          | 75.189                  | + 4 19 52.66   | +57.982          | 0.57   | 8.80  | 11 55 54.106                                         | +0.7480               | 5 12                           | 18 09                           |
|          | 2 114.5  | 0 43 06.772                                          | 53.832                  | + 4 43 01.78   | +57.776          | 0.30   | 8.80  | 11 56 12.010                                         | +0.7439               | 5 09                           | 18 11                           |

**SŁOŃCE 2015, KWIECIEŃ – MAJ**

| Data     | JD   | $0^h TT$             |                         |                |                           |             |           |            |                      | CSE                  |            |             |
|----------|------|----------------------|-------------------------|----------------|---------------------------|-------------|-----------|------------|----------------------|----------------------|------------|-------------|
|          |      | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$          | $R$         | $\pi$     | $E + 12^h$ | $V_E/1^h$            | w Warszawie<br>wsch. | zach.      |             |
| Kwiecień | 2457 |                      |                         |                |                           | 15'         |           |            |                      |                      |            |             |
|          | 1    | 113.5                | $0^h 39^m 28^s.129$     | $75^s.189$     | $+ 4^{\circ} 19' 52''.66$ | $+57''.982$ | $60''.57$ | $8''.80$   | $11^h 55^m 54^s.106$ | $+0^s.7480$          | $5^h 12^m$ | $18^h 09^m$ |
|          | 2    | 114.5                | 0 43 06.772             | 53.832         | $+ 4 43 01.78$            | $+57.776$   | 60.30     | 8.80       | 11 56 12.010         | $+0.7439$            | 5 09       | 18 11       |
|          | 3    | 115.5                | 0 46 45.524             | 92.584         | $+ 5 06 05.79$            | $+57.556$   | 60.02     | 8.80       | 11 56 29.805         | $+0.7389$            | 5 07       | 18 13       |
|          | 4    | 116.5                | 0 50 24.406             | 71.466         | $+ 5 29 04.36$            | $+57.322$   | 59.75     | 8.79       | 11 56 47.469         | $+0.7330$            | 5 05       | 18 14       |
|          | 5    | 117.5                | 0 54 03.442             | 50.503         | $+ 5 51 57.14$            | $+57.075$   | 59.47     | 8.79       | 11 57 04.980         | $+0.7261$            | 5 03       | 18 16       |
|          | 6    | 118.5                | 0 57 42.653             | 89.715         | $+ 6 14 43.83$            | $+56.813$   | 59.19     | 8.79       | 11 57 22.317         | $+0.7184$            | 5 00       | 18 18       |
|          | 7    | 119.5                | 1 01 22.060             | 69.126         | $+ 6 37 24.08$            | $+56.538$   | 58.92     | 8.79       | 11 57 39.456         | $+0.7098$            | 4 58       | 18 20       |
|          | 8    | 120.5                | 1 05 01.685             | 48.757         | $+ 6 59 57.59$            | $+56.249$   | 58.64     | 8.78       | 11 57 56.379         | $+0.7003$            | 4 56       | 18 21       |
|          | 9    | 121.5                | 1 08 41.549             | 88.629         | $+ 7 22 24.00$            | $+55.947$   | 58.36     | 8.78       | 11 58 13.062         | $+0.6899$            | 4 53       | 18 23       |
|          | 10   | 122.5                | 1 12 21.671             | 68.761         | $+ 7 44 43.01$            | $+55.630$   | 58.08     | 8.78       | 11 58 29.486         | $+0.6787$            | 4 51       | 18 25       |
|          | 11   | 123.5                | 1 16 02.073             | 49.173         | $+ 8 06 54.26$            | $+55.300$   | 57.80     | 8.78       | 11 58 45.631         | $+0.6666$            | 4 49       | 18 26       |
|          | 12   | 124.5                | 1 19 42.773             | 89.884         | $+ 8 28 57.42$            | $+54.956$   | 57.52     | 8.77       | 11 59 01.478         | $+0.6538$            | 4 47       | 18 28       |
|          | 13   | 125.5                | 1 23 23.788             | 70.908         | $+ 8 50 52.16$            | $+54.598$   | 57.25     | 8.77       | 11 59 17.010         | $+0.6403$            | 4 44       | 18 30       |
|          | 14   | 126.5                | 1 27 05.136             | 52.263         | $+ 9 12 38.11$            | $+54.225$   | 56.97     | 8.77       | 11 59 32.209         | $+0.6262$            | 4 42       | 18 32       |
|          | 15   | 127.5                | 1 30 46.831             | 93.962         | $+ 9 34 14.94$            | $+53.839$   | 56.69     | 8.77       | 11 59 47.061         | $+0.6114$            | 4 40       | 18 33       |
|          | 16   | 128.5                | 1 34 28.887             | 76.019         | $+ 9 55 42.30$            | $+53.438$   | 56.42     | 8.76       | 12 00 01.552         | $+0.5961$            | 4 38       | 18 35       |
|          | 17   | 129.5                | 1 38 11.316             | 58.449         | $+10 16 59.84$            | $+53.022$   | 56.15     | 8.76       | 12 00 15.670         | $+0.5803$            | 4 36       | 18 37       |
|          | 18   | 130.5                | 1 41 54.128             | 101.262        | $+10 38 07.21$            | $+52.591$   | 55.88     | 8.76       | 12 00 29.404         | $+0.5642$            | 4 33       | 18 39       |
|          | 19   | 131.5                | 1 45 37.334             | 84.470         | $+10 59 04.07$            | $+52.145$   | 55.62     | 8.76       | 12 00 42.746         | $+0.5476$            | 4 31       | 18 40       |
|          | 20   | 132.5                | 1 49 20.941             | 68.083         | $+11 19 50.08$            | $+51.685$   | 55.36     | 8.75       | 12 00 55.685         | $+0.5307$            | 4 29       | 18 42       |
|          | 21   | 133.5                | 1 53 04.959             | 52.110         | $+11 40 24.88$            | $+51.210$   | 55.10     | 8.75       | 12 01 08.215         | $+0.5134$            | 4 27       | 18 44       |
|          | 22   | 134.5                | 1 56 49.396             | 96.557         | $+12 00 48.12$            | $+50.721$   | 54.84     | 8.75       | 12 01 20.325         | $+0.4958$            | 4 25       | 18 45       |
|          | 23   | 135.5                | 2 00 34.261             | 81.434         | $+12 20 59.46$            | $+50.218$   | 54.59     | 8.75       | 12 01 32.007         | $+0.4777$            | 4 23       | 18 47       |
|          | 24   | 136.5                | 2 04 19.564             | 66.748         | $+12 40 58.56$            | $+49.700$   | 54.34     | 8.75       | 12 01 43.251         | $+0.4593$            | 4 21       | 18 49       |
|          | 25   | 137.5                | 2 08 05.315             | 52.509         | $+13 00 45.07$            | $+49.169$   | 54.09     | 8.74       | 12 01 54.046         | $+0.4403$            | 4 19       | 18 51       |
|          | 26   | 138.5                | 2 11 51.526             | 98.728         | $+13 20 18.67$            | $+48.624$   | 53.84     | 8.74       | 12 02 04.383         | $+0.4210$            | 4 16       | 18 52       |
|          | 27   | 139.5                | 2 15 38.206             | 85.414         | $+13 39 39.01$            | $+48.066$   | 53.59     | 8.74       | 12 02 14.250         | $+0.4012$            | 4 14       | 18 54       |
|          | 28   | 140.5                | 2 19 25.366             | 72.579         | $+13 58 45.78$            | $+47.494$   | 53.35     | 8.74       | 12 02 23.636         | $+0.3810$            | 4 12       | 18 56       |
|          | 29   | 141.5                | 2 23 13.018             | 60.234         | $+14 17 38.67$            | $+46.909$   | 53.11     | 8.73       | 12 02 32.532         | $+0.3603$            | 4 10       | 18 57       |
|          | 30   | 142.5                | 2 27 01.171             | 48.389         | $+14 36 17.34$            | $+46.311$   | 52.87     | 8.73       | 12 02 40.926         | $+0.3392$            | 4 08       | 18 59       |
| Maj      | 1    | 143.5                | 2 30 49.836             | 97.055         | $+14 54 41.50$            | $+45.700$   | 52.63     | 8.73       | 12 02 48.808         | $+0.3176$            | 4 07       | 19 01       |
|          | 2    | 144.5                | 2 34 39.023             | 86.244         | $+15 12 50.83$            | $+45.076$   | 52.39     | 8.73       | 12 02 56.168         | $+0.2957$            | 4 05       | 19 02       |
|          | 3    | 145.5                | 2 38 28.742             | 75.967         | $+15 30 45.04$            | $+44.440$   | 52.15     | 8.73       | 12 03 02.995         | $+0.2733$            | 4 03       | 19 04       |
|          | 4    | 146.5                | 2 42 19.003             | 66.233         | $+15 48 23.82$            | $+43.790$   | 51.92     | 8.72       | 12 03 09.282         | $+0.2506$            | 4 01       | 19 06       |
|          | 5    | 147.5                | 2 46 09.814             | 57.052         | $+16 05 46.88$            | $+43.129$   | 51.68     | 8.72       | 12 03 15.017         | $+0.2274$            | 3 59       | 19 08       |
|          | 6    | 148.5                | 2 50 01.186             | 48.433         | $+16 22 53.92$            | $+42.455$   | 51.45     | 8.72       | 12 03 20.192         | $+0.2039$            | 3 57       | 19 09       |
|          | 7    | 149.5                | 2 53 53.126             | 100.385        | $+16 39 44.64$            | $+41.768$   | 51.22     | 8.72       | 12 03 24.799         | $+0.1801$            | 3 55       | 19 11       |
|          | 8    | 150.5                | 2 57 45.642             | 92.914         | $+16 56 18.76$            | $+41.070$   | 50.99     | 8.71       | 12 03 28.830         | $+0.1559$            | 3 54       | 19 12       |
|          | 9    | 151.5                | 3 01 38.739             | 86.024         | $+17 12 35.98$            | $+40.359$   | 50.76     | 8.71       | 12 03 32.279         | $+0.1316$            | 3 52       | 19 14       |
|          | 10   | 152.5                | 3 05 32.424             | 79.720         | $+17 28 35.99$            | $+39.636$   | 50.53     | 8.71       | 12 03 35.141         | $+0.1070$            | 3 50       | 19 16       |
|          | 11   | 153.5                | 3 09 26.700             | 74.006         | $+17 44 18.51$            | $+38.901$   | 50.31     | 8.71       | 12 03 37.412         | $+0.0823$            | 3 48       | 19 17       |
|          | 12   | 154.5                | 3 13 21.570             | 68.883         | $+17 59 43.23$            | $+38.154$   | 50.09     | 8.71       | 12 03 39.090         | $+0.0575$            | 3 47       | 19 19       |
|          | 13   | 155.5                | 3 17 17.033             | 64.350         | $+18 14 49.85$            | $+37.394$   | 49.87     | 8.70       | 12 03 40.174         | $+0.0328$            | 3 45       | 19 21       |
|          | 14   | 156.5                | 3 21 13.088             | 60.408         | $+18 29 38.09$            | $+36.623$   | 49.65     | 8.70       | 12 03 40.665         | $+0.0082$            | 3 43       | 19 22       |
|          | 15   | 157.5                | 3 25 09.733             | 57.056         | $+18 44 07.66$            | $+35.840$   | 49.44     | 8.70       | 12 03 40.568         | $-0.0162$            | 3 42       | 19 24       |
|          | 16   | 158.5                | 3 29 06.960             | 54.287         | $+18 58 18.28$            | $+35.045$   | 49.23     | 8.70       | 12 03 39.887         | $-0.0404$            | 3 40       | 19 25       |
|          | 17   | 159.5                | 3 33 04.764             | 52.098         | $+19 12 09.66$            | $+34.237$   | 49.03     | 8.70       | 12 03 38.630         | $-0.0642$            | 3 39       | 19 27       |

**SŁOŃCE 2015, MAJ – CZERWIEC**

| Data     | JD   | $0^h TT$             |                         |                |                           |             |           |            |                     | CSE                  |            |             |
|----------|------|----------------------|-------------------------|----------------|---------------------------|-------------|-----------|------------|---------------------|----------------------|------------|-------------|
|          |      | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$          | $R$         | $\pi$     | $E + 12^h$ | $V_E/1^h$           | w Warszawie<br>wsch. | zach.      |             |
| Maj      | 2457 |                      |                         |                |                           | 15'         |           |            |                     |                      |            |             |
|          | 17   | 159.5                | $3^h 33^m 04.s764$      | $52.s098$      | $+19^{\circ} 12' 09''.66$ | $+34''.237$ | $49''.03$ | $8''.70$   | $12^h 03^m 38.s630$ | $-0.s0642$           | $3^h 39^m$ | $19^h 27^m$ |
|          | 18   | 160.5                | 3 37 03.135             | 50.479         | $+19 25 41.54$            | +33.418     | 48.83     | 8.69       | 12 03 36.807        | -0.0876              | 3 37       | 19 28       |
|          | 19   | 161.5                | 3 41 02.062             | 49.418         | $+19 38 53.64$            | +32.588     | 48.64     | 8.69       | 12 03 34.426        | -0.1106              | 3 36       | 19 30       |
|          | 20   | 162.5                | 3 45 01.536             | 48.906         | $+19 51 45.69$            | +31.746     | 48.45     | 8.69       | 12 03 31.499        | -0.1331              | 3 35       | 19 31       |
|          | 21   | 163.5                | 3 49 01.545             | 48.929         | $+20 04 17.42$            | +30.893     | 48.27     | 8.69       | 12 03 28.037        | -0.1552              | 3 33       | 19 33       |
|          | 22   | 164.5                | 3 53 02.079             | 49.476         | $+20 16 28.55$            | +30.030     | 48.09     | 8.69       | 12 03 24.050        | -0.1768              | 3 32       | 19 34       |
|          | 23   | 165.5                | 3 57 03.127             | 50.535         | $+20 28 18.84$            | +29.156     | 47.91     | 8.69       | 12 03 19.549        | -0.1980              | 3 31       | 19 36       |
|          | 24   | 166.5                | 4 01 04.677             | 52.095         | $+20 39 48.03$            | +28.271     | 47.74     | 8.68       | 12 03 14.546        | -0.2188              | 3 29       | 19 37       |
|          | 25   | 167.5                | 4 05 06.720             | 54.145         | $+20 50 55.87$            | +27.378     | 47.57     | 8.68       | 12 03 09.050        | -0.2391              | 3 28       | 19 38       |
|          | 26   | 168.5                | 4 09 09.244             | 56.675         | $+21 01 42.14$            | +26.474     | 47.41     | 8.68       | 12 03 03.073        | -0.2589              | 3 27       | 19 40       |
|          | 27   | 169.5                | 4 13 12.238             | 59.673         | $+21 12 06.60$            | +25.562     | 47.25     | 8.68       | 12 02 56.626        | -0.2782              | 3 26       | 19 41       |
|          | 28   | 170.5                | 4 17 15.690             | 63.129         | $+21 22 09.04$            | +24.640     | 47.09     | 8.68       | 12 02 49.720        | -0.2971              | 3 25       | 19 42       |
|          | 29   | 171.5                | 4 21 19.590             | 67.033         | $+21 31 49.26$            | +23.710     | 46.94     | 8.68       | 12 02 42.368        | -0.3155              | 3 24       | 19 43       |
|          | 30   | 172.5                | 4 25 23.925             | 71.373         | $+21 41 07.04$            | +22.772     | 46.78     | 8.68       | 12 02 34.580        | -0.3333              | 3 23       | 19 45       |
|          | 31   | 173.5                | 4 29 28.684             | 76.139         | $+21 50 02.21$            | +21.826     | 46.64     | 8.67       | 12 02 26.368        | -0.3507              | 3 22       | 19 46       |
| Czerwiec | 1    | 174.5                | 4 33 33.853             | 81.317         | $+21 58 34.58$            | +20.872     | 46.49     | 8.67       | 12 02 17.746        | -0.3676              | 3 21       | 19 47       |
|          | 2    | 175.5                | 4 37 39.421             | 86.896         | $+22 06 43.98$            | +19.911     | 46.35     | 8.67       | 12 02 08.724        | -0.3839              | 3 20       | 19 48       |
|          | 3    | 176.5                | 4 41 45.375             | 92.864         | $+22 14 30.23$            | +18.943     | 46.21     | 8.67       | 12 01 59.317        | -0.3997              | 3 20       | 19 49       |
|          | 4    | 177.5                | 4 45 51.703             | 99.207         | $+22 21 53.19$            | +17.968     | 46.07     | 8.67       | 12 01 49.536        | -0.4150              | 3 19       | 19 50       |
|          | 5    | 178.5                | 4 49 58.391             | 105.910        | $+22 28 52.70$            | +16.987     | 45.93     | 8.67       | 12 01 39.395        | -0.4297              | 3 18       | 19 51       |
|          | 6    | 179.5                | 4 54 05.425             | 52.958         | $+22 35 28.60$            | +16.000     | 45.80     | 8.67       | 12 01 28.908        | -0.4439              | 3 18       | 19 52       |
|          | 7    | 180.5                | 4 58 12.790             | 60.335         | $+22 41 40.76$            | +15.008     | 45.67     | 8.67       | 12 01 18.090        | -0.4574              | 3 17       | 19 53       |
|          | 8    | 181.5                | 5 02 20.471             | 68.025         | $+22 47 29.04$            | +14.010     | 45.55     | 8.66       | 12 01 06.957        | -0.4702              | 3 16       | 19 54       |
|          | 9    | 182.5                | 5 06 28.449             | 76.010         | $+22 52 53.30$            | +13.008     | 45.42     | 8.66       | 12 00 55.525        | -0.4822              | 3 16       | 19 55       |
|          | 10   | 183.5                | 5 10 36.707             | 84.273         | $+22 57 53.42$            | +12.000     | 45.30     | 8.66       | 12 00 43.814        | -0.4935              | 3 16       | 19 56       |
|          | 11   | 184.5                | 5 14 45.223             | 92.794         | $+23 02 29.30$            | +10.989     | 45.19     | 8.66       | 12 00 31.845        | -0.5038              | 3 15       | 19 56       |
|          | 12   | 185.5                | 5 18 53.976             | 101.552        | $+23 06 40.83$            | + 9.973     | 45.08     | 8.66       | 12 00 19.639        | -0.5131              | 3 15       | 19 57       |
|          | 13   | 186.5                | 5 23 02.941             | 50.524         | $+23 10 27.94$            | + 8.954     | 44.97     | 8.66       | 12 00 07.221        | -0.5214              | 3 15       | 19 58       |
|          | 14   | 187.5                | 5 27 12.094             | 59.687         | $+23 13 50.55$            | + 7.932     | 44.87     | 8.66       | 11 59 54.615        | -0.5287              | 3 14       | 19 58       |
|          | 15   | 188.5                | 5 31 21.406             | 69.012         | $+23 16 48.60$            | + 6.907     | 44.78     | 8.66       | 11 59 41.849        | -0.5348              | 3 14       | 19 59       |
|          | 16   | 189.5                | 5 35 30.852             | 78.472         | $+23 19 22.03$            | + 5.880     | 44.69     | 8.66       | 11 59 28.951        | -0.5397              | 3 14       | 19 59       |
|          | 17   | 190.5                | 5 39 40.402             | 88.038         | $+23 21 30.79$            | + 4.850     | 44.61     | 8.66       | 11 59 15.947        | -0.5435              | 3 14       | 20 00       |
|          | 18   | 191.5                | 5 43 50.029             | 97.680         | $+23 23 14.84$            | + 3.819     | 44.53     | 8.66       | 11 59 02.867        | -0.5461              | 3 14       | 20 00       |
|          | 19   | 192.5                | 5 47 59.705             | 107.369        | $+23 24 34.14$            | + 2.787     | 44.46     | 8.65       | 11 58 49.738        | -0.5476              | 3 14       | 20 00       |
|          | 20   | 193.5                | 5 52 09.403             | 57.078         | $+23 25 28.66$            | + 1.754     | 44.39     | 8.65       | 11 58 36.588        | -0.5479              | 3 14       | 20 01       |
|          | 21   | 194.5                | 5 56 19.095             | 66.780         | $+23 25 58.39$            | + 0.721     | 44.33     | 8.65       | 11 58 23.443        | -0.5472              | 3 14       | 20 01       |
|          | 22   | 195.5                | 6 00 28.755             | 76.447         | $+23 26 03.32$            | - 0.312     | 44.27     | 8.65       | 11 58 10.329        | -0.5453              | 3 15       | 20 01       |
|          | 23   | 196.5                | 6 04 38.359             | 86.057         | $+23 25 43.45$            | - 1.345     | 44.22     | 8.65       | 11 57 57.272        | -0.5425              | 3 15       | 20 01       |
|          | 24   | 197.5                | 6 08 47.882             | 95.585         | $+23 24 58.80$            | - 2.376     | 44.17     | 8.65       | 11 57 44.297        | -0.5386              | 3 15       | 20 01       |
|          | 25   | 198.5                | 6 12 57.298             | 105.005        | $+23 23 49.40$            | - 3.407     | 44.13     | 8.65       | 11 57 31.427        | -0.5337              | 3 16       | 20 01       |
|          | 26   | 199.5                | 6 17 06.586             | 54.299         | $+23 22 15.27$            | - 4.435     | 44.09     | 8.65       | 11 57 18.686        | -0.5278              | 3 16       | 20 01       |
|          | 27   | 200.5                | 6 21 15.722             | 63.441         | $+23 20 16.48$            | - 5.462     | 44.05     | 8.65       | 11 57 06.097        | -0.5210              | 3 16       | 20 01       |
|          | 28   | 201.5                | 6 25 24.685             | 72.413         | $+23 17 53.07$            | - 6.486     | 44.02     | 8.65       | 11 56 53.681        | -0.5133              | 3 17       | 20 01       |
|          | 29   | 202.5                | 6 29 33.453             | 81.192         | $+23 15 05.13$            | - 7.507     | 44.00     | 8.65       | 11 56 41.460        | -0.5048              | 3 18       | 20 01       |
|          | 30   | 203.5                | 6 33 42.007             | 89.759         | $+23 11 52.71$            | - 8.524     | 43.97     | 8.65       | 11 56 29.454        | -0.4954              | 3 18       | 20 01       |
| Lipiec   | 1    | 204.5                | 6 37 50.327             | 98.094         | $+23 08 15.92$            | - 9.539     | 43.95     | 8.65       | 11 56 17.681        | -0.4853              | 3 19       | 20 00       |
|          | 2    | 205.5                | 6 41 58.395             | 106.178        | $+23 04 14.85$            | -10.549     | 43.93     | 8.65       | 11 56 06.159        | -0.4745              | 3 19       | 20 00       |



**SŁOŃCE 2015, LIPIEC – SIERPIEŃ**

| Data     | JD   | $0^h TT$             |                         |                |                           |            |           |            |                      | CSE                  |            |             |
|----------|------|----------------------|-------------------------|----------------|---------------------------|------------|-----------|------------|----------------------|----------------------|------------|-------------|
|          |      | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$          | $R$        | $\pi$     | $E + 12^h$ | $V_E/1^h$            | w Warszawie<br>wsch. | zach.      |             |
| Lipiec   | 2457 |                      |                         |                |                           | 15'        |           |            |                      |                      |            |             |
|          | 1    | 204.5                | $6^h 37^m 50^s.327$     | $98^s.094$     | $+23^{\circ} 08' 15''.92$ | $-9''.539$ | $43''.95$ | $8''.65$   | $11^h 56^m 17^s.681$ | $-0^s.4853$          | $3^h 19^m$ | $20^h 00^m$ |
|          | 2    | 205.5                | 6 41 58.395             | 106.178        | +23 04 14.85              | -10.549    | 43.93     | 8.65       | 11 56 06.159         | -0.4745              | 3 19       | 20 00       |
|          | 3    | 206.5                | 6 46 06.196             | 53.994         | +22 59 49.60              | -11.555    | 43.92     | 8.65       | 11 55 54.905         | -0.4630              | 3 20       | 20 00       |
|          | 4    | 207.5                | 6 50 13.712             | 61.523         | +22 55 00.28              | -12.557    | 43.91     | 8.65       | 11 55 43.936         | -0.4508              | 3 21       | 19 59       |
|          | 5    | 208.5                | 6 54 20.928             | 68.749         | +22 49 46.99              | -13.553    | 43.90     | 8.65       | 11 55 33.267         | -0.4380              | 3 22       | 19 59       |
|          | 6    | 209.5                | 6 58 27.828             | 75.657         | +22 44 09.84              | -14.544    | 43.90     | 8.65       | 11 55 22.914         | -0.4245              | 3 23       | 19 58       |
|          | 7    | 210.5                | 7 02 34.397             | 82.231         | +22 38 08.98              | -15.529    | 43.89     | 8.65       | 11 55 12.892         | -0.4104              | 3 24       | 19 57       |
|          | 8    | 211.5                | 7 06 40.618             | 88.456         | +22 31 44.52              | -16.508    | 43.90     | 8.65       | 11 55 03.217         | -0.3956              | 3 25       | 19 57       |
|          | 9    | 212.5                | 7 10 46.476             | 94.319         | +22 24 56.64              | -17.480    | 43.90     | 8.65       | 11 54 53.907         | -0.3801              | 3 26       | 19 56       |
|          | 10   | 213.5                | 7 14 51.952             | 99.802         | +22 17 45.48              | -18.446    | 43.92     | 8.65       | 11 54 44.978         | -0.3638              | 3 27       | 19 55       |
|          | 11   | 214.5                | 7 18 57.028             | 104.886        | +22 10 11.23              | -19.403    | 43.93     | 8.65       | 11 54 36.449         | -0.3467              | 3 28       | 19 55       |
|          | 12   | 215.5                | 7 23 01.685             | 49.555         | +22 02 14.08              | -20.354    | 43.95     | 8.65       | 11 54 28.338         | -0.3289              | 3 29       | 19 54       |
|          | 13   | 216.5                | 7 27 05.906             | 53.789         | +21 53 54.23              | -21.296    | 43.98     | 8.65       | 11 54 20.664         | -0.3103              | 3 30       | 19 53       |
|          | 14   | 217.5                | 7 31 09.671             | 57.568         | +21 45 11.88              | -22.229    | 44.01     | 8.65       | 11 54 13.446         | -0.2909              | 3 31       | 19 52       |
|          | 15   | 218.5                | 7 35 12.962             | 60.873         | +21 36 07.24              | -23.154    | 44.05     | 8.65       | 11 54 06.703         | -0.2707              | 3 32       | 19 51       |
|          | 16   | 219.5                | 7 39 15.760             | 63.684         | +21 26 40.53              | -24.070    | 44.09     | 8.65       | 11 54 00.452         | -0.2499              | 3 33       | 19 50       |
|          | 17   | 220.5                | 7 43 18.048             | 65.984         | +21 16 51.96              | -24.976    | 44.14     | 8.65       | 11 53 54.710         | -0.2283              | 3 35       | 19 49       |
|          | 18   | 221.5                | 7 47 19.811             | 67.756         | +21 06 41.76              | -25.873    | 44.19     | 8.65       | 11 53 49.494         | -0.2061              | 3 36       | 19 47       |
|          | 19   | 222.5                | 7 51 21.033             | 68.985         | +20 56 10.16              | -26.760    | 44.25     | 8.65       | 11 53 44.819         | -0.1833              | 3 37       | 19 46       |
|          | 20   | 223.5                | 7 55 21.702             | 69.659         | +20 45 17.38              | -27.638    | 44.32     | 8.65       | 11 53 40.698         | -0.1600              | 3 39       | 19 45       |
|          | 21   | 224.5                | 7 59 21.803             | 69.764         | +20 34 03.66              | -28.505    | 44.39     | 8.65       | 11 53 37.143         | -0.1361              | 3 40       | 19 44       |
|          | 22   | 225.5                | 8 03 21.328             | 69.292         | +20 22 29.24              | -29.362    | 44.47     | 8.65       | 11 53 34.165         | -0.1119              | 3 41       | 19 43       |
|          | 23   | 226.5                | 8 07 20.265             | 68.233         | +20 10 34.38              | -30.208    | 44.55     | 8.66       | 11 53 31.775         | -0.0872              | 3 43       | 19 41       |
|          | 24   | 227.5                | 8 11 18.606             | 66.579         | +19 58 19.32              | -31.043    | 44.63     | 8.66       | 11 53 29.981         | -0.0622              | 3 44       | 19 40       |
|          | 25   | 228.5                | 8 15 16.345             | 64.324         | +19 45 44.33              | -31.868    | 44.72     | 8.66       | 11 53 28.789         | -0.0370              | 3 46       | 19 38       |
|          | 26   | 229.5                | 8 19 13.476             | 61.464         | +19 32 49.66              | -32.682    | 44.81     | 8.66       | 11 53 28.205         | -0.0115              | 3 47       | 19 37       |
|          | 27   | 230.5                | 8 23 09.994             | 57.992         | +19 19 35.59              | -33.485    | 44.91     | 8.66       | 11 53 28.234         | +0.0141              | 3 49       | 19 35       |
|          | 28   | 231.5                | 8 27 05.896             | 53.907         | +19 06 02.38              | -34.277    | 45.01     | 8.66       | 11 53 28.878         | +0.0398              | 3 50       | 19 34       |
|          | 29   | 232.5                | 8 31 01.182             | 49.207         | +18 52 10.30              | -35.057    | 45.11     | 8.66       | 11 53 30.139         | +0.0655              | 3 52       | 19 32       |
|          | 30   | 233.5                | 8 34 55.852             | 103.891        | +18 37 59.64              | -35.827    | 45.22     | 8.66       | 11 53 32.016         | +0.0911              | 3 53       | 19 31       |
| Sierpień | 31   | 234.5                | 8 38 49.908             | 97.959         | +18 23 30.65              | -36.585    | 45.33     | 8.66       | 11 53 34.507         | +0.1166              | 3 55       | 19 29       |
|          | 1    | 235.5                | 8 42 43.354             | 91.415         | +18 08 43.62              | -37.333    | 45.44     | 8.66       | 11 53 37.609         | +0.1419              | 3 56       | 19 27       |
|          | 2    | 236.5                | 8 46 36.194             | 84.262         | +17 53 38.79              | -38.069    | 45.55     | 8.66       | 11 53 41.316         | +0.1670              | 3 58       | 19 26       |
|          | 3    | 237.5                | 8 50 28.434             | 76.507         | +17 38 16.45              | -38.793    | 45.67     | 8.67       | 11 53 45.622         | +0.1919              | 3 59       | 19 24       |
|          | 4    | 238.5                | 8 54 20.081             | 68.156         | +17 22 36.85              | -39.506    | 45.79     | 8.67       | 11 53 50.522         | +0.2165              | 4 01       | 19 22       |
|          | 5    | 239.5                | 8 58 11.140             | 59.217         | +17 06 40.27              | -40.207    | 45.91     | 8.67       | 11 53 56.010         | +0.2408              | 4 02       | 19 20       |
|          | 6    | 240.5                | 9 02 01.618             | 49.699         | +16 50 26.99              | -40.895    | 46.04     | 8.67       | 11 54 02.079         | +0.2650              | 4 04       | 19 19       |
|          | 7    | 241.5                | 9 05 51.518             | 99.606         | +16 33 57.33              | -41.571    | 46.17     | 8.67       | 11 54 08.726         | +0.2889              | 4 06       | 19 17       |
|          | 8    | 242.5                | 9 09 40.846             | 88.942         | +16 17 11.57              | -42.235    | 46.30     | 8.67       | 11 54 15.945         | +0.3127              | 4 07       | 19 15       |
|          | 9    | 243.5                | 9 13 29.605             | 77.712         | +16 00 10.04              | -42.886    | 46.44     | 8.67       | 11 54 23.733         | +0.3363              | 4 09       | 19 13       |
|          | 10   | 244.5                | 9 17 17.799             | 65.918         | +15 42 53.05              | -43.523    | 46.58     | 8.67       | 11 54 32.086         | +0.3598              | 4 10       | 19 11       |
|          | 11   | 245.5                | 9 21 05.432             | 53.563         | +15 25 20.92              | -44.148    | 46.73     | 8.68       | 11 54 41.000         | +0.3831              | 4 12       | 19 09       |
|          | 12   | 246.5                | 9 24 52.507             | 100.649        | +15 07 33.98              | -44.759    | 46.88     | 8.68       | 11 54 50.472         | +0.4063              | 4 14       | 19 07       |
|          | 13   | 247.5                | 9 28 39.028             | 87.179         | +14 49 32.55              | -45.357    | 47.04     | 8.68       | 11 55 00.498         | +0.4293              | 4 15       | 19 05       |
|          | 14   | 248.5                | 9 32 25.000             | 73.159         | +14 31 16.94              | -45.941    | 47.20     | 8.68       | 11 55 11.073         | +0.4521              | 4 17       | 19 03       |
|          | 15   | 249.5                | 9 36 10.427             | 58.591         | +14 12 47.48              | -46.512    | 47.37     | 8.68       | 11 55 22.192         | +0.4746              | 4 19       | 19 01       |
|          | 16   | 250.5                | 9 39 55.316             | 103.483        | +13 54 04.49              | -47.069    | 47.54     | 8.68       | 11 55 33.850         | +0.4969              | 4 20       | 18 59       |

**SŁOŃCE 2015, SIERPIEŃ – WRZESIEŃ**

| Data        | JD   | $0^h TT$             |                         |                |                         |             |           |            |                    | <i>CSE</i><br>w Warszawie |                   |
|-------------|------|----------------------|-------------------------|----------------|-------------------------|-------------|-----------|------------|--------------------|---------------------------|-------------------|
|             |      | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$        | $R$         | $\pi$     | $E + 12^h$ | $V_E/1^h$          | wsch.                     | zach.             |
|             | 2457 |                      |                         |                |                         | 15'         |           |            |                    |                           |                   |
| Sierpień    | 16   | 250.5                | $9^h39^m55^s.316$       | $103.^s483$    | $+13^{\circ}54'04''.49$ | $-47''.069$ | $47''.54$ | $8''.68$   | $11^h55^m33^s.850$ | $+0.^s4969$               | $4^h20^m18^h59^m$ |
|             | 17   | 251.5                | 9 43 39.673             | 87.842         | +13 35 08.29            | -47.613     | 47.71     | 8.68       | 11 55 46.040       | +0.5189                   | 4 22 18 57        |
|             | 18   | 252.5                | 9 47 23.506             | 71.677         | +13 15 59.20            | -48.143     | 47.89     | 8.69       | 11 55 58.755       | +0.5406                   | 4 24 18 55        |
|             | 19   | 253.5                | 9 51 06.822             | 54.994         | +12 56 37.54            | -48.660     | 48.08     | 8.69       | 11 56 11.986       | +0.5619                   | 4 25 18 53        |
|             | 20   | 254.5                | 9 54 49.630             | 97.804         | +12 37 03.63            | -49.163     | 48.26     | 8.69       | 11 56 25.725       | +0.5829                   | 4 27 18 51        |
|             | 21   | 255.5                | 9 58 31.941             | 80.119         | +12 17 17.80            | -49.652     | 48.46     | 8.69       | 11 56 39.961       | +0.6034                   | 4 28 18 49        |
|             | 22   | 256.5                | 10 02 13.765            | 61.948         | +11 57 20.36            | -50.129     | 48.65     | 8.69       | 11 56 54.683       | +0.6234                   | 4 30 18 47        |
|             | 23   | 257.5                | 10 05 55.114            | 103.304        | +11 37 11.64            | -50.591     | 48.85     | 8.70       | 11 57 09.881       | +0.6430                   | 4 32 18 44        |
|             | 24   | 258.5                | 10 09 36.001            | 84.201         | +11 16 51.97            | -51.041     | 49.06     | 8.70       | 11 57 25.542       | +0.6620                   | 4 33 18 42        |
|             | 25   | 259.5                | 10 13 16.439            | 64.649         | +10 56 21.66            | -51.477     | 49.26     | 8.70       | 11 57 41.650       | +0.6804                   | 4 35 18 40        |
|             | 26   | 260.5                | 10 16 56.443            | 104.665        | +10 35 41.04            | -51.901     | 49.47     | 8.70       | 11 57 58.193       | +0.6981                   | 4 37 18 38        |
|             | 27   | 261.5                | 10 20 36.030            | 84.263         | +10 14 50.42            | -52.311     | 49.68     | 8.70       | 11 58 15.153       | +0.7152                   | 4 38 18 36        |
|             | 28   | 262.5                | 10 24 15.217            | 63.459         | + 9 53 50.12            | -52.709     | 49.89     | 8.70       | 11 58 32.513       | +0.7314                   | 4 40 18 33        |
|             | 29   | 263.5                | 10 27 54.023            | 102.271        | + 9 32 40.45            | -53.094     | 50.11     | 8.71       | 11 58 50.254       | +0.7469                   | 4 42 18 31        |
|             | 30   | 264.5                | 10 31 32.468            | 80.719         | + 9 11 21.69            | -53.467     | 50.32     | 8.71       | 11 59 08.356       | +0.7615                   | 4 43 18 29        |
| Wrzesień    | 31   | 265.5                | 10 35 10.574            | 58.825         | + 8 49 54.14            | -53.827     | 50.54     | 8.71       | 11 59 26.797       | +0.7752                   | 4 45 18 27        |
|             | 1    | 266.5                | 10 38 48.362            | 96.614         | + 8 28 18.09            | -54.175     | 50.76     | 8.71       | 11 59 45.556       | +0.7879                   | 4 47 18 24        |
|             | 2    | 267.5                | 10 42 25.854            | 74.107         | + 8 06 33.83            | -54.510     | 50.97     | 8.71       | 12 00 04.610       | +0.7998                   | 4 48 18 22        |
|             | 3    | 268.5                | 10 46 03.071            | 51.327         | + 7 44 41.66            | -54.833     | 51.20     | 8.72       | 12 00 23.940       | +0.8109                   | 4 50 18 20        |
|             | 4    | 269.5                | 10 49 40.033            | 88.295         | + 7 22 41.90            | -55.142     | 51.42     | 8.72       | 12 00 43.526       | +0.8211                   | 4 51 18 18        |
|             | 5    | 270.5                | 10 53 16.759            | 65.030         | + 7 00 34.87            | -55.438     | 51.64     | 8.72       | 12 01 03.347       | +0.8306                   | 4 53 18 15        |
|             | 6    | 271.5                | 10 56 53.266            | 101.546        | + 6 38 20.89            | -55.720     | 51.87     | 8.72       | 12 01 23.387       | +0.8393                   | 4 55 18 13        |
|             | 7    | 272.5                | 11 00 29.572            | 77.862         | + 6 16 00.30            | -55.988     | 52.10     | 8.72       | 12 01 43.628       | +0.8473                   | 4 56 18 11        |
|             | 8    | 273.5                | 11 04 05.694            | 53.994         | + 5 53 33.45            | -56.243     | 52.33     | 8.73       | 12 02 04.052       | +0.8546                   | 4 58 18 08        |
|             | 9    | 274.5                | 11 07 41.649            | 89.957         | + 5 31 00.66            | -56.484     | 52.57     | 8.73       | 12 02 24.645       | +0.8613                   | 5 00 18 06        |
|             | 10   | 275.5                | 11 11 17.451            | 65.765         | + 5 08 22.28            | -56.710     | 52.81     | 8.73       | 12 02 45.389       | +0.8673                   | 5 01 18 04        |
|             | 11   | 276.5                | 11 14 53.119            | 101.437        | + 4 45 38.64            | -56.923     | 53.05     | 8.73       | 12 03 06.268       | +0.8726                   | 5 03 18 01        |
|             | 12   | 277.5                | 11 18 28.667            | 76.987         | + 4 22 50.09            | -57.121     | 53.30     | 8.74       | 12 03 27.267       | +0.8772                   | 5 05 17 59        |
|             | 13   | 278.5                | 11 22 04.113            | 52.433         | + 3 59 56.96            | -57.305     | 53.54     | 8.74       | 12 03 48.369       | +0.8812                   | 5 06 17 57        |
|             | 14   | 279.5                | 11 25 39.471            | 87.791         | + 3 36 59.59            | -57.474     | 53.79     | 8.74       | 12 04 09.557       | +0.8844                   | 5 08 17 54        |
|             | 15   | 280.5                | 11 29 14.759            | 63.079         | + 3 13 58.32            | -57.629     | 54.05     | 8.74       | 12 04 30.816       | +0.8870                   | 5 10 17 52        |
|             | 16   | 281.5                | 11 32 49.993            | 98.313         | + 2 50 53.49            | -57.770     | 54.31     | 8.75       | 12 04 52.129       | +0.8889                   | 5 11 17 50        |
|             | 17   | 282.5                | 11 36 25.191            | 73.512         | + 2 27 45.44            | -57.897     | 54.57     | 8.75       | 12 05 13.478       | +0.8901                   | 5 13 17 47        |
|             | 18   | 283.5                | 11 40 00.369            | 48.694         | + 2 04 34.52            | -58.009     | 54.83     | 8.75       | 12 05 34.847       | +0.8905                   | 5 15 17 45        |
|             | 19   | 284.5                | 11 43 35.546            | 83.876         | + 1 41 21.06            | -58.107     | 55.09     | 8.75       | 12 05 56.217       | +0.8902                   | 5 16 17 43        |
|             | 20   | 285.5                | 11 47 10.739            | 59.076         | + 1 18 05.41            | -58.190     | 55.36     | 8.75       | 12 06 17.571       | +0.8891                   | 5 18 17 40        |
|             | 21   | 286.5                | 11 50 45.967            | 94.313         | + 0 54 47.93            | -58.260     | 55.63     | 8.76       | 12 06 38.889       | +0.8873                   | 5 19 17 38        |
|             | 22   | 287.5                | 11 54 21.250            | 69.605         | + 0 31 28.94            | -58.315     | 55.90     | 8.76       | 12 07 00.154       | +0.8846                   | 5 21 17 35        |
|             | 23   | 288.5                | 11 57 56.606            | 104.971        | + 0 08 08.80            | -58.356     | 56.17     | 8.76       | 12 07 21.345       | +0.8811                   | 5 23 17 33        |
|             | 24   | 289.5                | 12 01 32.057            | 80.430         | - 0 15 12.14            | -58.383     | 56.44     | 8.76       | 12 07 42.441       | +0.8767                   | 5 24 17 31        |
|             | 25   | 290.5                | 12 05 07.624            | 56.004         | - 0 38 33.55            | -58.396     | 56.72     | 8.77       | 12 08 03.420       | +0.8714                   | 5 26 17 28        |
|             | 26   | 291.5                | 12 08 43.331            | 91.714         | - 1 01 55.10            | -58.395     | 56.99     | 8.77       | 12 08 24.260       | +0.8651                   | 5 28 17 26        |
|             | 27   | 292.5                | 12 12 19.202            | 67.586         | - 1 25 16.45            | -58.381     | 57.26     | 8.77       | 12 08 44.937       | +0.8578                   | 5 29 17 24        |
|             | 28   | 293.5                | 12 15 55.261            | 103.644        | - 1 48 37.29            | -58.354     | 57.54     | 8.77       | 12 09 05.425       | +0.8494                   | 5 31 17 21        |
|             | 29   | 294.5                | 12 19 31.535            | 79.918         | - 2 11 57.31            | -58.313     | 57.81     | 8.78       | 12 09 25.697       | +0.8399                   | 5 33 17 19        |
|             | 30   | 295.5                | 12 23 08.050            | 56.435         | - 2 35 16.20            | -58.258     | 58.08     | 8.78       | 12 09 45.729       | +0.8293                   | 5 34 17 17        |
| Październik | 1    | 296.5                | 12 26 44.831            | 93.220         | - 2 58 33.64            | -58.190     | 58.35     | 8.78       | 12 10 05.496       | +0.8177                   | 5 36 17 14        |

# SŁOŃCE 2015, PAŹDZIERNIK – LISTOPAD

| Data        | JD   | $0^h TT$             |                                                      |                      |                  |          |        |            |                                                      | <i>CSE</i>            |                                |                                 |
|-------------|------|----------------------|------------------------------------------------------|----------------------|------------------|----------|--------|------------|------------------------------------------------------|-----------------------|--------------------------------|---------------------------------|
|             |      | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$                              | $\delta_{app}$       | $V_{\delta}/1^h$ | $R$      | $\pi$  | $E + 12^h$ | $V_E/1^h$                                            | w Warszawie<br>wsch.  | zach.                          |                                 |
|             | 2457 |                      |                                                      |                      |                  | 15'      |        |            |                                                      |                       |                                |                                 |
| Październik | 1    | 296.5                | 12 <sup>h</sup> 26 <sup>m</sup> 44 <sup>s</sup> .831 | 93 <sup>s</sup> .220 | − 2°58′33″.64    | −58″.190 | 58″.35 | 8″.78      | 12 <sup>h</sup> 10 <sup>m</sup> 05 <sup>s</sup> .496 | +0 <sup>s</sup> .8177 | 5 <sup>h</sup> 36 <sup>m</sup> | 17 <sup>h</sup> 14 <sup>m</sup> |
|             | 2    | 297.5                | 12 30 21.902                                         | 70.299               | − 3 21 49.29     | −58.108  | 58.62  | 8.78       | 12 10 24.971                                         | +0.8051               | 5 38                           | 17 12                           |
|             | 3    | 298.5                | 12 33 59.287                                         | 107.694              | − 3 45 02.80     | −58.011  | 58.89  | 8.79       | 12 10 44.133                                         | +0.7916               | 5 40                           | 17 10                           |
|             | 4    | 299.5                | 12 37 37.007                                         | 85.424               | − 4 08 13.84     | −57.900  | 59.15  | 8.79       | 12 11 02.960                                         | +0.7772               | 5 41                           | 17 07                           |
|             | 5    | 300.5                | 12 41 15.083                                         | 63.510               | − 4 31 22.03     | −57.774  | 59.42  | 8.79       | 12 11 21.431                                         | +0.7619               | 5 43                           | 17 05                           |
|             | 6    | 301.5                | 12 44 53.535                                         | 101.970              | − 4 54 27.01     | −57.633  | 59.69  | 8.79       | 12 11 39.526                                         | +0.7459               | 5 45                           | 17 03                           |
|             | 7    | 302.5                | 12 48 32.382                                         | 80.824               | − 5 17 28.40     | −57.477  | 59.96  | 8.80       | 12 11 57.226                                         | +0.7290               | 5 46                           | 17 01                           |
|             | 8    | 303.5                | 12 52 11.641                                         | 60.087               | − 5 40 25.85     | −57.305  | 60.23  | 8.80       | 12 12 14.514                                         | +0.7114               | 5 48                           | 16 58                           |
|             | 9    | 304.5                | 12 55 51.332                                         | 99.781               | − 6 03 18.97     | −57.117  | 60.51  | 8.80       | 12 12 31.370                                         | +0.6931               | 5 50                           | 16 56                           |
|             | 10   | 305.5                | 12 59 31.470                                         | 79.920               | − 6 26 07.39     | −56.914  | 60.78  | 8.80       | 12 12 47.778                                         | +0.6741               | 5 51                           | 16 54                           |
|             | 11   | 306.5                | 13 03 12.074                                         | 60.524               | − 6 48 50.74     | −56.695  | 61.05  | 8.81       | 12 13 03.722                                         | +0.6544               | 5 53                           | 16 51                           |
|             | 12   | 307.5                | 13 06 53.158                                         | 101.608              | − 7 11 28.62     | −56.460  | 61.32  | 8.81       | 12 13 19.185                                         | +0.6340               | 5 55                           | 16 49                           |
|             | 13   | 308.5                | 13 10 34.739                                         | 83.190               | − 7 34 00.67     | −56.208  | 61.60  | 8.81       | 12 13 34.150                                         | +0.6130               | 5 57                           | 16 47                           |
|             | 14   | 309.5                | 13 14 16.833                                         | 65.285               | − 7 56 26.49     | −55.941  | 61.88  | 8.81       | 12 13 48.604                                         | +0.5913               | 5 58                           | 16 45                           |
|             | 15   | 310.5                | 13 17 59.454                                         | 107.910              | − 8 18 45.70     | −55.657  | 62.15  | 8.82       | 12 14 02.529                                         | +0.5691               | 6 00                           | 16 43                           |
|             | 16   | 311.5                | 13 21 42.618                                         | 91.079               | − 8 40 57.92     | −55.357  | 62.43  | 8.82       | 12 14 15.912                                         | +0.5462               | 6 02                           | 16 40                           |
|             | 17   | 312.5                | 13 25 26.339                                         | 74.808               | − 9 03 02.74     | −55.040  | 62.71  | 8.82       | 12 14 28.739                                         | +0.5226               | 6 04                           | 16 38                           |
|             | 18   | 313.5                | 13 29 10.631                                         | 59.109               | − 9 24 59.78     | −54.707  | 62.98  | 8.82       | 12 14 40.993                                         | +0.4985               | 6 05                           | 16 36                           |
|             | 19   | 314.5                | 13 32 55.510                                         | 103.998              | − 9 46 48.63     | −54.357  | 63.26  | 8.83       | 12 14 52.662                                         | +0.4738               | 6 07                           | 16 34                           |
|             | 20   | 315.5                | 13 36 40.989                                         | 89.488               | −10 08 28.89     | −53.991  | 63.54  | 8.83       | 12 15 03.730                                         | +0.4485               | 6 09                           | 16 32                           |
|             | 21   | 316.5                | 13 40 27.083                                         | 75.591               | −10 30 00.17     | −53.608  | 63.82  | 8.83       | 12 15 14.182                                         | +0.4225               | 6 11                           | 16 30                           |
|             | 22   | 317.5                | 13 44 13.807                                         | 62.323               | −10 51 22.06     | −53.209  | 64.09  | 8.83       | 12 15 24.005                                         | +0.3959               | 6 13                           | 16 28                           |
|             | 23   | 318.5                | 13 48 01.177                                         | 49.699               | −11 12 34.16     | −52.793  | 64.37  | 8.84       | 12 15 33.182                                         | +0.3687               | 6 14                           | 16 26                           |
|             | 24   | 319.5                | 13 51 49.209                                         | 97.734               | −11 33 36.09     | −52.362  | 64.64  | 8.84       | 12 15 41.697                                         | +0.3408               | 6 16                           | 16 23                           |
|             | 25   | 320.5                | 13 55 37.921                                         | 86.447               | −11 54 27.44     | −51.914  | 64.91  | 8.84       | 12 15 49.533                                         | +0.3121               | 6 18                           | 16 21                           |
|             | 26   | 321.5                | 13 59 27.329                                         | 75.856               | −12 15 07.84     | −51.450  | 65.18  | 8.84       | 12 15 56.671                                         | +0.2827               | 6 20                           | 16 19                           |
|             | 27   | 322.5                | 14 03 17.452                                         | 65.981               | −12 35 36.92     | −50.971  | 65.44  | 8.85       | 12 16 03.095                                         | +0.2525               | 6 22                           | 16 17                           |
|             | 28   | 323.5                | 14 07 08.310                                         | 56.844               | −12 55 54.31     | −50.476  | 65.70  | 8.85       | 12 16 08.784                                         | +0.2216               | 6 23                           | 16 15                           |
|             | 29   | 324.5                | 14 10 59.919                                         | 108.462              | −13 15 59.63     | −49.965  | 65.96  | 8.85       | 12 16 13.722                                         | +0.1899               | 6 25                           | 16 13                           |
|             | 30   | 325.5                | 14 14 52.297                                         | 100.851              | −13 35 52.52     | −49.437  | 66.22  | 8.85       | 12 16 17.891                                         | +0.1575               | 6 27                           | 16 12                           |
| Listopad    | 31   | 326.5                | 14 18 45.459                                         | 94.025               | −13 55 32.58     | −48.894  | 66.47  | 8.86       | 12 16 21.276                                         | +0.1246               | 6 29                           | 16 10                           |
|             | 1    | 327.5                | 14 22 39.419                                         | 87.998               | −14 14 59.41     | −48.334  | 66.72  | 8.86       | 12 16 23.863                                         | +0.0910               | 6 31                           | 16 08                           |
|             | 2    | 328.5                | 14 26 34.188                                         | 82.778               | −14 34 12.62     | −47.758  | 66.96  | 8.86       | 12 16 25.641                                         | +0.0571               | 6 32                           | 16 06                           |
|             | 3    | 329.5                | 14 30 29.778                                         | 78.377               | −14 53 11.78     | −47.165  | 67.21  | 8.86       | 12 16 26.598                                         | +0.0227               | 6 34                           | 16 04                           |
|             | 4    | 330.5                | 14 34 26.196                                         | 74.803               | −15 11 56.50     | −46.555  | 67.45  | 8.87       | 12 16 26.727                                         | −0.0120               | 6 36                           | 16 02                           |
|             | 5    | 331.5                | 14 38 23.451                                         | 72.063               | −15 30 26.36     | −45.928  | 67.69  | 8.87       | 12 16 26.019                                         | −0.0470               | 6 38                           | 16 01                           |
|             | 6    | 332.5                | 14 42 21.548                                         | 70.164               | −15 48 40.96     | −45.284  | 67.93  | 8.87       | 12 16 24.468                                         | −0.0822               | 6 40                           | 15 59                           |
|             | 7    | 333.5                | 14 46 20.493                                         | 69.112               | −16 06 39.88     | −44.623  | 68.17  | 8.87       | 12 16 22.071                                         | −0.1176               | 6 41                           | 15 57                           |
|             | 8    | 334.5                | 14 50 20.288                                         | 68.909               | −16 24 22.72     | −43.944  | 68.40  | 8.87       | 12 16 18.822                                         | −0.1531               | 6 43                           | 15 55                           |
|             | 9    | 335.5                | 14 54 20.936                                         | 69.560               | −16 41 49.06     | −43.249  | 68.63  | 8.88       | 12 16 14.721                                         | −0.1886               | 6 45                           | 15 54                           |
|             | 10   | 336.5                | 14 58 22.438                                         | 71.065               | −16 58 58.51     | −42.536  | 68.86  | 8.88       | 12 16 09.766                                         | −0.2242               | 6 47                           | 15 52                           |
|             | 11   | 337.5                | 15 02 24.794                                         | 73.427               | −17 15 50.65     | −41.807  | 69.09  | 8.88       | 12 16 03.958                                         | −0.2597               | 6 49                           | 15 51                           |
|             | 12   | 338.5                | 15 06 28.001                                         | 76.641               | −17 32 25.08     | −41.060  | 69.32  | 8.88       | 12 15 57.297                                         | −0.2952               | 6 50                           | 15 49                           |
|             | 13   | 339.5                | 15 10 32.057                                         | 80.707               | −17 48 41.39     | −40.296  | 69.55  | 8.88       | 12 15 49.788                                         | −0.3304               | 6 52                           | 15 47                           |
|             | 14   | 340.5                | 15 14 36.958                                         | 85.619               | −18 04 39.18     | −39.515  | 69.78  | 8.89       | 12 15 41.434                                         | −0.3655               | 6 54                           | 15 46                           |
|             | 15   | 341.5                | 15 18 42.699                                         | 91.373               | −18 20 18.05     | −38.718  | 70.00  | 8.89       | 12 15 32.240                                         | −0.4004               | 6 56                           | 15 45                           |
|             | 16   | 342.5                | 15 22 49.274                                         | 97.961               | −18 35 37.59     | −37.904  | 70.22  | 8.89       | 12 15 22.212                                         | −0.4350               | 6 58                           | 15 43                           |

# SŁOŃCE 2015, LISTOPAD – GRUDZIEŃ

| Data        | JD    | $0^h TT$                                             |                         |                |                  |        |       |                                                      |                       | CSE                            |                                 |
|-------------|-------|------------------------------------------------------|-------------------------|----------------|------------------|--------|-------|------------------------------------------------------|-----------------------|--------------------------------|---------------------------------|
|             |       | $\alpha_{app}^{CIO}$                                 | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$ | $R$    | $\pi$ | $E + 12^h$                                           | $V_E/1^h$             | w Warszawie<br>wsch.           | zach.                           |
|             | 2457  |                                                      |                         |                |                  | 16'    |       |                                                      |                       |                                |                                 |
| Listopad 16 | 342.5 | 15 <sup>h</sup> 22 <sup>m</sup> 49 <sup>s</sup> .274 | 97 <sup>s</sup> .961    | −18°35'37".59  | −37".904         | 10".22 | 8".89 | 12 <sup>h</sup> 15 <sup>m</sup> 22 <sup>s</sup> .212 | −0 <sup>s</sup> .4350 | 6 <sup>h</sup> 58 <sup>m</sup> | 15 <sup>h</sup> 43 <sup>m</sup> |
| 17          | 343.5 | 15 26 56.675                                         | 105.375                 | −18 50 37.41   | −37.074          | 10.44  | 8.89  | 12 15 11.358                                         | −0.4693               | 6 59                           | 15 42                           |
| 18          | 344.5 | 15 31 04.896                                         | 53.606                  | −19 05 17.10   | −36.227          | 10.66  | 8.89  | 12 14 59.684                                         | −0.5033               | 7 01                           | 15 40                           |
| 19          | 345.5 | 15 35 13.929                                         | 62.648                  | −19 19 36.27   | −35.364          | 10.87  | 8.90  | 12 14 47.198                                         | −0.5370               | 7 03                           | 15 39                           |
| 20          | 346.5 | 15 39 23.765                                         | 72.491                  | −19 33 34.55   | −34.486          | 11.08  | 8.90  | 12 14 33.909                                         | −0.5703               | 7 05                           | 15 38                           |
| 21          | 347.5 | 15 43 34.397                                         | 83.127                  | −19 47 11.54   | −33.593          | 11.29  | 8.90  | 12 14 19.823                                         | −0.6033               | 7 06                           | 15 37                           |
| 22          | 348.5 | 15 47 45.818                                         | 94.552                  | −20 00 26.89   | −32.684          | 11.49  | 8.90  | 12 14 04.950                                         | −0.6360               | 7 08                           | 15 36                           |
| 23          | 349.5 | 15 51 58.019                                         | 106.757                 | −20 13 20.24   | −31.761          | 11.69  | 8.90  | 12 13 49.296                                         | −0.6684               | 7 10                           | 15 35                           |
| 24          | 350.5 | 15 56 10.993                                         | 59.737                  | −20 25 51.25   | −30.823          | 11.89  | 8.91  | 12 13 32.869                                         | −0.7004               | 7 11                           | 15 33                           |
| 25          | 351.5 | 16 00 24.733                                         | 73.487                  | −20 37 59.60   | −29.872          | 12.08  | 8.91  | 12 13 15.676                                         | −0.7321               | 7 13                           | 15 32                           |
| 26          | 352.5 | 16 04 39.229                                         | 87.995                  | −20 49 44.96   | −28.907          | 12.26  | 8.91  | 12 12 57.726                                         | −0.7635               | 7 14                           | 15 31                           |
| 27          | 353.5 | 16 08 54.474                                         | 103.255                 | −21 01 07.02   | −27.928          | 12.44  | 8.91  | 12 12 39.028                                         | −0.7944               | 7 16                           | 15 31                           |
| 28          | 354.5 | 16 13 10.457                                         | 59.253                  | −21 12 05.45   | −26.937          | 12.61  | 8.91  | 12 12 19.593                                         | −0.8249               | 7 17                           | 15 30                           |
| 29          | 355.5 | 16 17 27.164                                         | 75.975                  | −21 22 39.96   | −25.933          | 12.78  | 8.91  | 12 11 59.432                                         | −0.8548               | 7 19                           | 15 29                           |
| 30          | 356.5 | 16 21 44.582                                         | 93.407                  | −21 32 50.22   | −24.916          | 12.94  | 8.92  | 12 11 38.562                                         | −0.8841               | 7 20                           | 15 28                           |
| Grudzień 1  | 357.5 | 16 26 02.694                                         | 51.530                  | −21 42 35.94   | −23.888          | 13.10  | 8.92  | 12 11 16.997                                         | −0.9127               | 7 22                           | 15 27                           |
| 2           | 358.5 | 16 30 21.482                                         | 70.327                  | −21 51 56.82   | −22.847          | 13.25  | 8.92  | 12 10 54.756                                         | −0.9405               | 7 23                           | 15 27                           |
| 3           | 359.5 | 16 34 40.925                                         | 89.776                  | −22 00 52.58   | −21.795          | 13.40  | 8.92  | 12 10 31.859                                         | −0.9673               | 7 25                           | 15 26                           |
| 4           | 360.5 | 16 39 01.002                                         | 49.859                  | −22 09 22.94   | −20.732          | 13.55  | 8.92  | 12 10 08.329                                         | −0.9933               | 7 26                           | 15 26                           |
| 5           | 361.5 | 16 43 21.690                                         | 70.552                  | −22 17 27.64   | −19.658          | 13.69  | 8.92  | 12 09 44.189                                         | −1.0182               | 7 27                           | 15 25                           |
| 6           | 362.5 | 16 47 42.962                                         | 91.828                  | −22 25 06.43   | −18.573          | 13.83  | 8.92  | 12 09 19.463                                         | −1.0420               | 7 29                           | 15 25                           |
| 7           | 363.5 | 16 52 04.793                                         | 53.665                  | −22 32 19.06   | −17.479          | 13.96  | 8.93  | 12 08 54.179                                         | −1.0647               | 7 30                           | 15 24                           |
| 8           | 364.5 | 16 56 27.155                                         | 76.034                  | −22 39 05.31   | −16.375          | 14.09  | 8.93  | 12 08 28.364                                         | −1.0862               | 7 31                           | 15 24                           |
| 9           | 365.5 | 17 00 50.018                                         | 98.906                  | −22 45 24.96   | −15.263          | 14.22  | 8.93  | 12 08 02.048                                         | −1.1064               | 7 32                           | 15 24                           |
| 10          | 366.5 | 17 05 13.351                                         | 62.251                  | −22 51 17.82   | −14.142          | 14.34  | 8.93  | 12 07 35.261                                         | −1.1254               | 7 33                           | 15 23                           |
| 11          | 367.5 | 17 09 37.123                                         | 86.036                  | −22 56 43.67   | −13.013          | 14.46  | 8.93  | 12 07 08.037                                         | −1.1429               | 7 35                           | 15 23                           |
| 12          | 368.5 | 17 14 01.298                                         | 50.226                  | −23 01 42.36   | −11.877          | 14.58  | 8.93  | 12 06 40.408                                         | −1.1590               | 7 36                           | 15 23                           |
| 13          | 369.5 | 17 18 25.844                                         | 74.787                  | −23 06 13.71   | −10.733          | 14.69  | 8.93  | 12 06 12.410                                         | −1.1737               | 7 37                           | 15 23                           |
| 14          | 370.5 | 17 22 50.724                                         | 99.682                  | −23 10 17.56   | − 9.584          | 14.80  | 8.93  | 12 05 44.077                                         | −1.1869               | 7 38                           | 15 23                           |
| 15          | 371.5 | 17 27 15.902                                         | 64.873                  | −23 13 53.77   | − 8.429          | 14.90  | 8.93  | 12 05 15.446                                         | −1.1986               | 7 38                           | 15 23                           |
| 16          | 372.5 | 17 31 41.342                                         | 90.325                  | −23 17 02.21   | − 7.269          | 15.01  | 8.93  | 12 04 46.552                                         | −1.2088               | 7 39                           | 15 23                           |
| 17          | 373.5 | 17 36 07.008                                         | 55.999                  | −23 19 42.75   | − 6.105          | 15.11  | 8.94  | 12 04 17.433                                         | −1.2175               | 7 40                           | 15 24                           |
| 18          | 374.5 | 17 40 32.865                                         | 81.863                  | −23 21 55.30   | − 4.937          | 15.20  | 8.94  | 12 03 48.123                                         | −1.2247               | 7 41                           | 15 24                           |
| 19          | 375.5 | 17 44 58.877                                         | 107.880                 | −23 23 39.75   | − 3.766          | 15.29  | 8.94  | 12 03 18.658                                         | −1.2304               | 7 41                           | 15 24                           |
| 20          | 376.5 | 17 49 25.011                                         | 74.019                  | −23 24 56.05   | − 2.592          | 15.37  | 8.94  | 12 02 49.071                                         | −1.2348               | 7 42                           | 15 25                           |
| 21          | 377.5 | 17 53 51.234                                         | 100.249                 | −23 25 44.13   | − 1.417          | 15.45  | 8.94  | 12 02 19.396                                         | −1.2378               | 7 43                           | 15 25                           |
| 22          | 378.5 | 17 58 17.513                                         | 66.538                  | −23 26 03.98   | − 0.240          | 15.53  | 8.94  | 12 01 49.663                                         | −1.2395               | 7 43                           | 15 26                           |
| 23          | 379.5 | 18 02 43.819                                         | 92.856                  | −23 25 55.58   | + 0.937          | 15.60  | 8.94  | 12 01 19.904                                         | −1.2400               | 7 44                           | 15 26                           |
| 24          | 380.5 | 18 07 10.121                                         | 59.173                  | −23 25 18.93   | + 2.115          | 15.66  | 8.94  | 12 00 50.149                                         | −1.2392               | 7 44                           | 15 27                           |
| 25          | 381.5 | 18 11 36.390                                         | 85.458                  | −23 24 14.04   | + 3.291          | 15.71  | 8.94  | 12 00 20.427                                         | −1.2372               | 7 44                           | 15 27                           |
| 26          | 382.5 | 18 16 02.596                                         | 51.681                  | −23 22 40.94   | + 4.467          | 15.76  | 8.94  | 11 59 50.768                                         | −1.2340               | 7 45                           | 15 28                           |
| 27          | 383.5 | 18 20 28.710                                         | 77.810                  | −23 20 39.67   | + 5.640          | 15.80  | 8.94  | 11 59 21.201                                         | −1.2295               | 7 45                           | 15 29                           |
| 28          | 384.5 | 18 24 54.703                                         | 103.816                 | −23 18 10.28   | + 6.811          | 15.84  | 8.94  | 11 58 51.755                                         | −1.2239               | 7 45                           | 15 30                           |
| 29          | 385.5 | 18 29 20.544                                         | 69.667                  | −23 15 12.83   | + 7.979          | 15.87  | 8.94  | 11 58 22.461                                         | −1.2170               | 7 45                           | 15 31                           |
| 30          | 386.5 | 18 33 46.204                                         | 95.336                  | −23 11 47.38   | + 9.143          | 15.89  | 8.94  | 11 57 53.347                                         | −1.2088               | 7 45                           | 15 31                           |
| 31          | 387.5 | 18 38 11.653                                         | 60.791                  | −23 07 54.05   | +10.303          | 15.91  | 8.94  | 11 57 24.446                                         | −1.1993               | 7 45                           | 15 32                           |
| 32          | 388.5 | 18 42 36.859                                         | 86.003                  | −23 03 32.93   | +11.458          | 15.93  | 8.94  | 11 56 55.787                                         | −1.1886               | 7 45                           | 15 33                           |

KSIĘŻYC 2015, STYCZEŃ – LUTY

| Data    |    | $0^h TT$             |                         |                           |                  |               |                | wiek    | CSE         |             |            |
|---------|----|----------------------|-------------------------|---------------------------|------------------|---------------|----------------|---------|-------------|-------------|------------|
|         |    | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$            | $V_{\delta}/1^h$ | $R$           | $\pi$          |         | w Warszawie |             |            |
|         |    |                      |                         |                           |                  |               |                |         | wsch.       | górow.      | zach.      |
| Styczeń | 0  | $2^h 21^m 34.835^s$  | $81.245^s$              | $+12^{\circ} 10' 35.41''$ | $+494.42''$      | $15' 43.03''$ | $57' 40.892''$ | $8.9^d$ | $12^h 32^m$ | $20^h 00^m$ | $2^h 29^m$ |
|         | 1  | 3 15 05.505          | 51.925                  | +15 06 09.58              | +379.93          | 15 34.63      | 57 10.061      | 9.9     | 13 08       | 20 52       | 3 38       |
|         | 2  | 4 09 00.663          | 47.096                  | +17 12 11.47              | +247.90          | 15 26.45      | 56 40.059      | 10.9    | 13 49       | 21 44       | 4 43       |
|         | 3  | 5 03 02.587          | 49.035                  | +18 23 11.59              | +106.24          | 15 18.55      | 56 11.046      | 11.9    | 14 37       | 22 35       | 5 42       |
|         | 4  | 5 56 41.261          | 87.723                  | +18 37 07.67              | − 35.86          | 15 10.97      | 55 43.231      | 12.9    | 15 30       | 23 26       | 6 33       |
|         | 5  | 6 49 22.787          | 69.264                  | +17 55 39.61              | −169.36          | 15 03.84      | 55 17.050      | 13.9    | 16 27       | —           | 7 18       |
|         | 6  | 7 40 38.914          | 85.404                  | +16 23 45.71              | −287.03          | 14 57.35      | 54 53.244      | 14.9    | 17 28       | 0 15        | 7 55       |
|         | 7  | 8 30 14.060          | 60.562                  | +14 08 45.00              | −384.45          | 14 51.80      | 54 32.860      | 15.9    | 18 30       | 1 02        | 8 26       |
|         | 8  | 9 18 07.978          | 54.489                  | +11 19 06.99              | −460.08          | 14 47.52      | 54 17.177      | 16.9    | 19 33       | 1 47        | 8 54       |
|         | 9  | 10 04 34.623         | 81.142                  | + 8 03 31.53              | −514.43          | 14 44.91      | 54 07.588      | 17.9    | 20 36       | 2 31        | 9 18       |
|         | 10 | 10 49 59.144         | 105.669                 | + 4 30 12.74              | −548.96          | 14 44.33      | 54 05.463      | 18.9    | 21 39       | 3 14        | 9 41       |
|         | 11 | 11 34 54.643         | 101.173                 | + 0 46 49.08              | −565.01          | 14 46.12      | 54 12.012      | 19.9    | 22 42       | 3 56        | 10 02      |
|         | 12 | 12 19 59.516         | 106.050                 | − 2 59 24.36              | −563.08          | 14 50.51      | 54 28.150      | 20.9    | 23 46       | 4 38        | 10 25      |
|         | 13 | 13 05 55.280         | 101.819                 | − 6 41 07.84              | −542.23          | 14 57.65      | 54 54.345      | 21.9    | —           | 5 22        | 10 48      |
|         | 14 | 13 53 24.235         | 70.780                  | −10 10 19.86              | −499.90          | 15 07.49      | 55 30.452      | 22.9    | 0 52        | 6 07        | 11 15      |
|         | 15 | 14 43 05.937         | 52.490                  | −13 17 39.94              | −432.16          | 15 19.77      | 56 15.517      | 23.9    | 1 58        | 6 55        | 11 46      |
|         | 16 | 15 35 31.434         | 77.998                  | −15 52 05.68              | −334.72          | 15 33.95      | 57 07.573      | 24.9    | 3 04        | 7 46        | 12 23      |
|         | 17 | 16 30 54.953         | 101.529                 | −17 41 07.38              | −205.05          | 15 49.18      | 58 03.490      | 25.9    | 4 10        | 8 40        | 13 09      |
|         | 18 | 17 29 04.938         | 51.529                  | −18 32 07.13              | − 45.54          | 16 04.30      | 58 58.980      | 26.9    | 5 11        | 9 38        | 14 04      |
|         | 19 | 18 29 19.606         | 66.213                  | −18 14 53.44              | +133.68          | 16 17.91      | 59 48.903      | 27.9    | 6 07        | 10 37       | 15 10      |
|         | 20 | 19 30 33.244         | 79.867                  | −16 44 54.95              | +314.72          | 16 28.55      | 60 27.981      | 28.9    | 6 54        | 11 36       | 16 25      |
|         | 21 | 20 31 34.106         | 80.742                  | −14 05 44.67              | +476.13          | 16 35.05      | 60 51.823      | 0.3     | 7 35        | 12 35       | 17 44      |
|         | 22 | 21 31 25.461         | 72.107                  | −10 29 07.79              | +599.43          | 16 36.72      | 60 57.973      | 1.3     | 8 10        | 13 33       | 19 06      |
|         | 23 | 22 29 38.359         | 85.012                  | − 6 12 43.99              | +674.04          | 16 33.60      | 60 46.519      | 2.3     | 8 41        | 14 28       | 20 27      |
|         | 24 | 23 26 11.742         | 58.399                  | − 1 36 39.42              | +698.15          | 16 26.37      | 60 19.958      | 3.3     | 9 10        | 15 22       | 21 47      |
|         | 25 | 0 21 24.007          | 70.667                  | + 2 59 38.29              | +676.23          | 16 16.13      | 59 42.389      | 4.3     | 9 38        | 16 14       | 23 04      |
|         | 26 | 1 15 42.229          | 88.893                  | + 7 19 11.65              | +615.81          | 16 04.16      | 58 58.437      | 5.3     | 10 06       | 17 06       | —          |
|         | 27 | 2 09 32.773          | 79.442                  | +11 08 13.84              | +524.96          | 15 51.59      | 58 12.329      | 6.3     | 10 37       | 17 58       | 0 18       |
|         | 28 | 3 03 14.380          | 61.058                  | +14 16 07.43              | +411.31          | 15 39.34      | 57 27.343      | 7.3     | 11 11       | 18 49       | 1 29       |
|         | 29 | 3 56 53.928          | 100.616                 | +16 35 12.26              | +282.08          | 15 27.98      | 56 45.656      | 8.3     | 11 50       | 19 41       | 2 36       |
|         | 30 | 4 50 25.172          | 71.872                  | +18 00 40.07              | +144.44          | 15 17.84      | 56 08.444      | 9.3     | 12 35       | 20 32       | 3 36       |
|         | 31 | 5 43 30.897          | 77.610                  | +18 30 37.28              | + 5.76           | 15 09.04      | 55 36.134      | 10.3    | 13 25       | 21 22       | 4 29       |
| Luty    | 1  | 6 35 48.178          | 94.903                  | +18 06 06.06              | −126.78          | 15 01.56      | 55 08.685      | 11.3    | 14 20       | 22 11       | 5 15       |
|         | 2  | 7 26 55.170          | 101.906                 | +16 50 51.83              | −246.89          | 14 55.34      | 54 45.859      | 12.3    | 15 19       | 22 58       | 5 55       |
|         | 3  | 8 16 37.144          | 83.890                  | +14 50 52.82              | −349.89          | 14 50.32      | 54 27.435      | 13.3    | 16 20       | 23 44       | 6 28       |
|         | 4  | 9 04 50.005          | 96.758                  | +12 13 37.00              | −432.98          | 14 46.49      | 54 13.373      | 14.3    | 17 23       | —           | 6 57       |
|         | 5  | 9 51 40.946          | 87.704                  | + 9 07 17.41              | −495.14          | 14 43.91      | 54 03.896      | 15.3    | 18 26       | 0 28        | 7 23       |
|         | 6  | 10 37 27.098         | 73.861                  | + 5 40 16.34              | −536.54          | 14 42.71      | 53 59.513      | 16.3    | 19 28       | 1 11        | 7 46       |
|         | 7  | 11 22 33.355         | 80.120                  | + 2 00 43.70              | −557.91          | 14 43.11      | 54 00.977      | 17.3    | 20 31       | 1 54        | 8 08       |
|         | 8  | 12 07 30.201         | 76.969                  | − 1 43 28.98              | −559.96          | 14 45.35      | 54 09.191      | 18.3    | 21 35       | 2 36        | 8 30       |
|         | 9  | 12 52 51.845         | 98.615                  | − 5 24 40.74              | −542.78          | 14 49.68      | 54 25.081      | 19.3    | 22 38       | 3 19        | 8 53       |
|         | 10 | 13 39 14.419         | 61.192                  | − 8 55 02.69              | −505.58          | 14 56.31      | 54 49.431      | 20.3    | 23 43       | 4 02        | 9 18       |
|         | 11 | 14 27 13.720         | 60.497                  | −12 06 13.67              | −446.48          | 15 05.37      | 55 22.694      | 21.3    | —           | 4 48        | 9 47       |
|         | 12 | 15 17 21.755         | 68.538                  | −14 48 57.60              | −362.87          | 15 16.84      | 56 04.762      | 22.3    | 0 47        | 5 36        | 10 20      |
|         | 13 | 16 10 01.557         | 48.349                  | −16 52 55.30              | −252.32          | 15 30.44      | 56 54.700      | 23.3    | 1 51        | 6 27        | 11 00      |
|         | 14 | 17 05 20.566         | 67.370                  | −18 07 08.95              | −114.41          | 15 45.64      | 57 50.475      | 24.3    | 2 53        | 7 21        | 11 49      |
|         | 15 | 18 03 04.661         | 51.477                  | −18 21 17.67              | + 46.95          | 16 01.51      | 58 48.742      | 25.3    | 3 50        | 8 18        | 12 48      |

# KSIĘŻYC 2015, LUTY – MARZEC

| Data     |    | $0^h TT$                                             |                         |                |                  |           |            | wiek               | CSE                            |                                |                                 |
|----------|----|------------------------------------------------------|-------------------------|----------------|------------------|-----------|------------|--------------------|--------------------------------|--------------------------------|---------------------------------|
|          |    | $\alpha_{app}^{CIO}$                                 | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$ | $R$       | $\pi$      |                    | w Warszawie                    |                                |                                 |
|          |    |                                                      |                         |                |                  |           |            |                    | wsch.                          | górow.                         | zach.                           |
| Luty     | 15 | 18 <sup>h</sup> 03 <sup>m</sup> 04. <sup>s</sup> 661 | 51. <sup>s</sup> 477    | −18°21′17″.67  | + 46″.95         | 16′01″.51 | 58′48″.742 | 25. <sup>d</sup> 3 | 3 <sup>h</sup> 50 <sup>m</sup> | 8 <sup>h</sup> 18 <sup>m</sup> | 12 <sup>h</sup> 48 <sup>m</sup> |
|          | 16 | 19 02 36.813                                         | 83.641                  | −17 27 48.13   | +221.51          | 16 16.80  | 59 44.832  | 26.3               | 4 41                           | 9 16                           | 13 56                           |
|          | 17 | 20 03 03.934                                         | 50.774                  | −15 24 30.28   | +392.84          | 16 29.95  | 60 33.106  | 27.3               | 5 25                           | 10 15                          | 15 12                           |
|          | 18 | 21 03 30.982                                         | 77.831                  | −12 16 34.67   | +541.40          | 16 39.40  | 61 07.814  | 28.3               | 6 04                           | 11 14                          | 16 34                           |
|          | 19 | 22 03 15.706                                         | 62.561                  | − 8 16 47.58   | +649.63          | 16 43.91  | 61 24.352  | 29.3               | 6 37                           | 12 11                          | 17 57                           |
|          | 20 | 23 01 56.658                                         | 103.515                 | − 3 43 46.11   | +706.44          | 16 42.86  | 61 20.504  | 0.8                | 7 08                           | 13 08                          | 19 20                           |
|          | 21 | 23 59 32.097                                         | 78.954                  | + 1 01 06.15   | +709.09          | 16 36.49  | 60 57.100  | 1.8                | 7 38                           | 14 03                          | 20 41                           |
|          | 22 | 0 56 12.795                                          | 59.653                  | + 5 36 53.08   | +662.25          | 16 25.76  | 60 17.724  | 2.8                | 8 07                           | 14 57                          | 22 00                           |
|          | 23 | 1 52 13.167                                          | 60.028                  | + 9 45 32.44   | +575.25          | 16 12.11  | 59 27.643  | 3.8                | 8 38                           | 15 51                          | 23 15                           |
|          | 24 | 2 47 43.837                                          | 90.703                  | +13 13 13.08   | +459.25          | 15 57.09  | 58 32.492  | 4.8                | 9 12                           | 16 44                          | —                               |
|          | 25 | 3 42 47.111                                          | 93.983                  | +15 50 33.58   | +325.34          | 15 42.03  | 57 37.233  | 5.8                | 9 51                           | 17 36                          | 0 25                            |
|          | 26 | 4 37 15.874                                          | 62.756                  | +17 32 25.89   | +183.45          | 15 27.97  | 56 45.612  | 6.8                | 10 34                          | 18 28                          | 1 28                            |
|          | 27 | 5 30 55.778                                          | 102.670                 | +18 17 23.62   | + 42.07          | 15 15.55  | 56 00.048  | 7.8                | 11 22                          | 19 19                          | 2 25                            |
|          | 28 | 6 23 29.763                                          | 76.665                  | +18 07 04.47   | − 91.96          | 15 05.13  | 55 21.796  | 8.8                | 12 16                          | 20 08                          | 3 13                            |
| Marzec   | 1  | 7 14 43.252                                          | 90.163                  | +17 05 30.11   | −213.48          | 14 56.80  | 54 51.229  | 9.8                | 13 13                          | 20 56                          | 3 55                            |
|          | 2  | 8 04 28.271                                          | 75.190                  | +15 18 26.01   | −318.97          | 14 50.51  | 54 28.125  | 10.8               | 14 13                          | 21 42                          | 4 30                            |
|          | 3  | 8 52 45.518                                          | 92.442                  | +12 52 45.03   | −406.29          | 14 46.09  | 54 11.929  | 11.8               | 15 15                          | 22 26                          | 5 00                            |
|          | 4  | 9 39 44.394                                          | 91.322                  | + 9 55 58.44   | −474.32          | 14 43.38  | 54 01.980  | 12.8               | 16 17                          | 23 10                          | 5 27                            |
|          | 5  | 10 25 41.739                                         | 88.669                  | + 6 35 56.05   | −522.56          | 14 42.21  | 53 57.679  | 13.8               | 17 20                          | 23 52                          | 5 51                            |
|          | 6  | 11 11 00.063                                         | 46.993                  | + 3 00 35.08   | −550.85          | 14 42.47  | 53 58.619  | 14.8               | 18 23                          | —                              | 6 14                            |
|          | 7  | 11 56 05.809                                         | 52.739                  | − 0 42 03.98   | −559.04          | 14 44.11  | 54 04.658  | 15.8               | 19 26                          | 0 35                           | 6 36                            |
|          | 8  | 12 41 27.819                                         | 74.749                  | − 4 23 56.03   | −546.86          | 14 47.19  | 54 15.935  | 16.8               | 20 30                          | 1 17                           | 6 59                            |
|          | 9  | 13 27 35.844                                         | 82.775                  | − 7 56 46.19   | −513.76          | 14 51.79  | 54 32.828  | 17.8               | 21 33                          | 2 01                           | 7 23                            |
|          | 10 | 14 14 58.789                                         | 105.722                 | −11 12 02.48   | −458.87          | 14 58.06  | 54 55.855  | 18.8               | 22 37                          | 2 46                           | 7 50                            |
|          | 11 | 15 04 02.299                                         | 49.236                  | −14 00 49.57   | −381.16          | 15 06.14  | 55 25.512  | 19.8               | 23 40                          | 3 32                           | 8 21                            |
|          | 12 | 15 55 05.462                                         | 52.404                  | −16 13 49.58   | −279.89          | 15 16.10  | 56 02.067  | 20.8               | —                              | 4 21                           | 8 58                            |
|          | 13 | 16 48 16.853                                         | 63.804                  | −17 41 38.57   | −155.47          | 15 27.88  | 56 45.303  | 21.8               | 0 41                           | 5 13                           | 9 42                            |
|          | 14 | 17 43 31.043                                         | 78.003                  | −18 15 28.07   | − 10.66          | 15 41.21  | 57 34.231  | 22.8               | 1 38                           | 6 06                           | 10 35                           |
|          | 15 | 18 40 27.537                                         | 74.508                  | −17 48 16.48   | +148.23          | 15 55.54  | 58 26.808  | 23.8               | 2 30                           | 7 02                           | 11 36                           |
|          | 16 | 19 38 34.070                                         | 81.051                  | −16 16 22.75   | +310.79          | 16 09.96  | 59 19.747  | 24.8               | 3 16                           | 7 58                           | 12 46                           |
|          | 17 | 20 37 14.330                                         | 61.319                  | −13 40 59.81   | +463.15          | 16 23.26  | 60 08.544  | 25.8               | 3 56                           | 8 55                           | 14 03                           |
|          | 18 | 21 35 57.308                                         | 104.303                 | −10 09 16.69   | +589.92          | 16 33.98  | 60 47.910  | 26.8               | 4 31                           | 9 52                           | 15 23                           |
|          | 19 | 22 34 24.048                                         | 71.045                  | − 5 54 22.78   | +676.95          | 16 40.73  | 61 12.666  | 27.8               | 5 03                           | 10 48                          | 16 46                           |
|          | 20 | 23 32 28.988                                         | 75.985                  | − 1 14 22.70   | +714.24          | 16 42.44  | 61 18.965  | 28.8               | 5 34                           | 11 45                          | 18 09                           |
|          | 21 | 0 30 16.027                                          | 63.023                  | + 3 29 50.75   | +698.03          | 16 38.75  | 61 05.417  | 0.5                | 6 04                           | 12 40                          | 19 31                           |
|          | 22 | 1 27 51.563                                          | 98.559                  | + 7 57 19.02   | +631.57          | 16 30.07  | 60 33.564  | 1.5                | 6 35                           | 13 36                          | 20 50                           |
|          | 23 | 2 25 17.329                                          | 64.328                  | +11 49 36.82   | +524.09          | 16 17.51  | 59 47.457  | 2.5                | 7 09                           | 14 31                          | 22 05                           |
|          | 24 | 3 22 25.547                                          | 72.552                  | +14 52 50.35   | +388.54          | 16 02.56  | 58 52.567  | 3.5                | 7 46                           | 15 26                          | 23 14                           |
|          | 25 | 4 18 58.147                                          | 105.159                 | +16 58 34.45   | +238.91          | 15 46.74  | 57 54.533  | 4.5                | 8 29                           | 16 20                          | —                               |
|          | 26 | 5 14 30.434                                          | 77.456                  | +18 03 47.60   | + 87.86          | 15 31.41  | 56 58.235  | 5.5                | 9 17                           | 17 13                          | 0 16                            |
|          | 27 | 6 08 37.676                                          | 84.708                  | +18 09 59.50   | − 54.85          | 15 17.53  | 56 07.322  | 6.5                | 10 10                          | 18 04                          | 1 09                            |
|          | 28 | 7 01 01.745                                          | 48.786                  | +17 21 53.36   | −182.86          | 15 05.77  | 55 24.150  | 7.5                | 11 06                          | 18 52                          | 1 53                            |
|          | 29 | 7 51 35.313                                          | 82.361                  | +15 46 06.26   | −292.93          | 14 56.45  | 54 49.938  | 8.5                | 12 06                          | 19 39                          | 2 31                            |
|          | 30 | 8 40 22.752                                          | 69.806                  | +13 30 05.75   | −383.92          | 14 49.66  | 54 25.018  | 9.5                | 13 07                          | 20 24                          | 3 03                            |
|          | 31 | 9 27 38.545                                          | 85.602                  | +10 41 30.59   | −455.86          | 14 45.32  | 54 09.086  | 10.5               | 14 09                          | 21 08                          | 3 31                            |
| Kwiecień | 1  | 10 13 44.601                                         | 91.660                  | + 7 27 54.64   | −509.02          | 14 43.23  | 54 01.423  | 11.5               | 15 11                          | 21 50                          | 3 56                            |
|          | 2  | 10 59 07.586                                         | 54.647                  | + 3 56 47.39   | −543.43          | 14 43.14  | 54 01.088  | 12.5               | 16 14                          | 22 33                          | 4 19                            |

**KSIEŻYC 2015, KWIECIEŃ – MAJ**

| Data     | $0^h TT$             |                         |                |                           |             |               | wiek           | CSE         |             |             |            |
|----------|----------------------|-------------------------|----------------|---------------------------|-------------|---------------|----------------|-------------|-------------|-------------|------------|
|          | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$          | $R$         | $\pi$         |                | w Warszawie |             |             |            |
|          |                      |                         |                |                           |             |               |                | wsch.       | górow.      | zach.       |            |
| Kwiecień | 1                    | $10^h 13^m 44^s.601$    | $91^s.660$     | $+ 7^{\circ} 27' 54''.64$ | $-509''.02$ | $14' 43''.23$ | $54' 01''.423$ | $11.5^d$    | $15^h 11^m$ | $21^h 50^m$ | $3^h 56^m$ |
|          | 2                    | $10 59 07.586$          | $54.647$       | $+ 3 56 47.39$            | $-543.43$   | $14 43.14$    | $54 01.088$    | 12.5        | 16 14       | 22 33       | 4 19       |
|          | 3                    | $11 44 16.723$          | $63.783$       | $+ 0 15 43.80$            | $-558.59$   | $14 44.77$    | $54 07.072$    | 13.5        | 17 17       | 23 15       | 4 41       |
|          | 4                    | $12 29 42.042$          | $89.102$       | $- 3 27 23.20$            | $-553.51$   | $14 47.87$    | $54 18.437$    | 14.5        | 18 21       | 23 59       | 5 04       |
|          | 5                    | $13 15 52.787$          | $99.848$       | $- 7 04 12.11$            | $-526.85$   | $14 52.22$    | $54 34.424$    | 15.5        | 19 25       | —           | 5 28       |
|          | 6                    | $14 03 15.581$          | $62.643$       | $-10 25 47.93$            | $-477.21$   | $14 57.70$    | $54 54.521$    | 16.5        | 20 30       | 0 44        | 5 54       |
|          | 7                    | $14 52 12.047$          | $59.113$       | $-13 22 46.04$            | $-403.60$   | $15 04.23$    | $55 18.483$    | 17.5        | 21 34       | 1 30        | 6 24       |
|          | 8                    | $15 42 55.872$          | $102.944$      | $-15 45 28.35$            | $-306.00$   | $15 11.80$    | $55 46.273$    | 18.5        | 22 35       | 2 19        | 6 59       |
|          | 9                    | $16 35 29.819$          | $76.899$       | $-17 24 34.80$            | $-186.06$   | $15 20.43$    | $56 17.950$    | 19.5        | 23 33       | 3 09        | 7 40       |
|          | 10                   | $17 29 43.928$          | $91.017$       | $-18 11 51.05$            | $- 47.69$   | $15 30.11$    | $56 53.468$    | 20.5        | —           | 4 01        | 8 29       |
|          | 11                   | $18 25 16.465$          | $63.565$       | $-18 01 08.03$            | $+102.58$   | $15 40.72$    | $57 32.438$    | 21.5        | 0 26        | 4 55        | 9 26       |
|          | 12                   | $19 21 38.553$          | $85.663$       | $-16 49 22.43$            | $+255.89$   | $15 52.01$    | $58 13.861$    | 22.5        | 1 12        | 5 50        | 10 32      |
|          | 13                   | $20 18 21.592$          | $68.712$       | $-14 37 24.68$            | $+401.77$   | $16 03.46$    | $58 55.888$    | 23.5        | 1 53        | 6 44        | 11 43      |
|          | 14                   | $21 15 04.764$          | $51.890$       | $-11 30 25.16$            | $+529.19$   | $16 14.31$    | $59 35.708$    | 24.5        | 2 28        | 7 39        | 12 59      |
|          | 15                   | $22 11 39.611$          | $86.742$       | $- 7 37 57.45$            | $+627.40$   | $16 23.56$    | $60 09.658$    | 25.5        | 3 01        | 8 34        | 14 18      |
|          | 16                   | $23 08 10.171$          | $57.304$       | $- 3 13 40.70$            | $+686.84$   | $16 30.10$    | $60 33.668$    | 26.5        | 3 30        | 9 28        | 15 39      |
|          | 17                   | $0 04 48.960$           | $96.093$       | $+ 1 25 22.05$            | $+700.31$   | $16 32.93$    | $60 44.035$    | 27.5        | 4 00        | 10 23       | 17 00      |
|          | 18                   | $1 01 50.157$           | $97.291$       | $+ 5 59 58.23$            | $+664.49$   | $16 31.38$    | $60 38.367$    | 28.5        | 4 30        | 11 18       | 18 21      |
|          | 19                   | $1 59 21.680$           | $68.816$       | $+10 10 38.03$            | $+581.46$   | $16 25.38$    | $60 16.336$    | 0.3         | 5 02        | 12 14       | 19 39      |
|          | 20                   | $2 57 18.223$           | $65.365$       | $+13 39 53.49$            | $+459.28$   | $16 15.45$    | $59 39.894$    | 1.3         | 5 38        | 13 10       | 20 53      |
|          | 21                   | $3 55 17.953$           | $65.104$       | $+16 14 33.90$            | $+311.01$   | $16 02.63$    | $58 52.848$    | 2.3         | 6 19        | 14 06       | 22 00      |
|          | 22                   | $4 52 45.218$           | $92.379$       | $+17 47 16.80$            | $+152.07$   | $15 48.23$    | $57 59.993$    | 3.3         | 7 06        | 15 01       | 22 58      |
|          | 23                   | $5 48 59.249$           | $106.421$      | $+18 16 44.32$            | $- 3.12$    | $15 33.57$    | $57 06.173$    | 4.3         | 7 58        | 15 54       | 23 48      |
|          | 24                   | $6 43 25.315$           | $72.499$       | $+17 46 43.22$            | $-143.93$   | $15 19.79$    | $56 15.587$    | 5.3         | 8 55        | 16 45       | —          |
|          | 25                   | $7 35 43.260$           | $90.454$       | $+16 24 18.71$            | $-264.48$   | $15 07.75$    | $55 31.430$    | 6.3         | 9 55        | 17 34       | 0 29       |
|          | 26                   | $8 25 50.505$           | $97.707$       | $+14 18 05.36$            | $-362.97$   | $14 58.05$    | $54 55.825$    | 7.3         | 10 56       | 18 20       | 1 04       |
|          | 27                   | $9 14 00.126$           | $47.335$       | $+11 36 47.36$            | $-440.10$   | $14 51.00$    | $54 29.920$    | 8.3         | 11 59       | 19 04       | 1 34       |
|          | 28                   | $10 00 36.548$          | $83.761$       | $+ 8 28 38.51$            | $-497.47$   | $14 46.67$    | $54 14.058$    | 9.3         | 13 01       | 19 47       | 2 00       |
|          | 29                   | $10 46 11.128$          | $58.344$       | $+ 5 01 16.01$            | $-536.39$   | $14 45.01$    | $54 07.946$    | 10.3        | 14 04       | 20 30       | 2 23       |
|          | 30                   | $11 31 18.673$          | $65.891$       | $+ 1 21 55.59$            | $-557.27$   | $14 45.79$    | $54 10.806$    | 11.3        | 15 07       | 21 12       | 2 46       |
| Maj      | 1                    | $12 16 34.933$          | $82.152$       | $- 2 22 03.23$            | $-559.38$   | $14 48.70$    | $54 21.506$    | 12.3        | 16 10       | 21 56       | 3 08       |
|          | 2                    | $13 02 34.576$          | $81.797$       | $- 6 02 50.86$            | $-540.98$   | $14 53.38$    | $54 38.684$    | 13.3        | 17 15       | 22 40       | 3 31       |
|          | 3                    | $13 49 49.008$          | $96.233$       | $- 9 31 47.53$            | $-499.73$   | $14 59.43$    | $55 00.874$    | 14.3        | 18 20       | 23 26       | 3 57       |
|          | 4                    | $14 38 43.495$          | $90.725$       | $-12 39 16.62$            | $-433.37$   | $15 06.45$    | $55 26.634$    | 15.3        | 19 25       | —           | 4 25       |
|          | 5                    | $15 29 33.443$          | $80.681$       | $-15 14 58.99$            | $-340.80$   | $15 14.09$    | $55 54.681$    | 16.3        | 20 28       | 0 15        | 4 59       |
|          | 6                    | $16 22 20.474$          | $67.721$       | $-17 08 33.99$            | $-223.21$   | $15 22.07$    | $56 23.983$    | 17.3        | 21 29       | 1 05        | 5 38       |
|          | 7                    | $17 16 49.991$          | $97.250$       | $-18 10 47.17$            | $- 85.02$   | $15 30.20$    | $56 53.810$    | 18.3        | 22 24       | 1 58        | 6 25       |
|          | 8                    | $18 12 32.543$          | $79.815$       | $-18 14 52.53$            | $+ 65.88$   | $15 38.34$    | $57 23.689$    | 19.3        | 23 12       | 2 51        | 7 20       |
|          | 9                    | $19 08 50.266$          | $97.550$       | $-17 17 45.61$            | $+219.16$   | $15 46.40$    | $57 53.280$    | 20.3        | 23 54       | 3 46        | 8 23       |
|          | 10                   | $20 05 06.957$          | $54.253$       | $-15 20 42.27$            | $+363.79$   | $15 54.28$    | $58 22.173$    | 21.3        | —           | 4 40        | 9 32       |
|          | 11                   | $21 00 57.772$          | $105.078$      | $-12 29 13.52$            | $+489.76$   | $16 01.77$    | $58 49.667$    | 22.3        | 0 31        | 5 34        | 10 45      |
|          | 12                   | $21 56 14.656$          | $61.968$       | $- 8 52 29.03$            | $+588.90$   | $16 08.55$    | $59 14.573$    | 23.3        | 1 03        | 6 27        | 12 01      |
|          | 13                   | $22 51 06.196$          | $53.513$       | $- 4 42 32.51$            | $+654.81$   | $16 14.16$    | $59 35.146$    | 24.3        | 1 32        | 7 20        | 13 19      |
|          | 14                   | $23 45 53.087$          | $100.407$      | $- 0 13 44.79$            | $+682.43$   | $16 17.99$    | $59 49.198$    | 25.3        | 2 00        | 8 12        | 14 37      |
|          | 15                   | $0 41 01.058$           | $48.381$       | $+ 4 17 47.63$            | $+668.07$   | $16 19.41$    | $59 54.439$    | 26.3        | 2 29        | 9 06        | 15 56      |
|          | 16                   | $1 36 52.612$           | $99.939$       | $+ 8 34 54.55$            | $+610.32$   | $16 17.93$    | $59 48.993$    | 27.3        | 2 59        | 10 00       | 17 14      |
|          | 17                   | $2 33 38.561$           | $85.895$       | $+12 20 32.89$            | $+511.46$   | $16 13.29$    | $59 31.958$    | 28.3        | 3 32        | 10 55       | 18 29      |

# KSIĘŻYC 2015, MAJ – CZERWIEC

| Data     |    | $0^h TT$             |                         |                       |             |              |               | wiek     | $CSE$       |            |            |
|----------|----|----------------------|-------------------------|-----------------------|-------------|--------------|---------------|----------|-------------|------------|------------|
|          |    | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$        | $V_8/1^h$   | $R$          | $\pi$         |          | w Warszawie |            |            |
|          |    |                      |                         |                       |             |              |               |          | wsch.       | górow.     | zach.      |
| Maj      | 17 | $2^h33^m38^s.561$    | $85^s.895$              | $+12^\circ20'32''.89$ | $+511''.46$ | $16'13''.29$ | $59'31''.958$ | $28.3^d$ | $3^h32^m$   | $10^h55^m$ | $18^h29^m$ |
|          | 18 | 3 31 11.085          | 58.428                  | $+15\ 19\ 32.62$      | $+378.76$   | 16 05.62     | 59 03.808     | 29.3     | 4 10        | 11 51      | 19 40      |
|          | 19 | 4 29 01.305          | 48.661                  | $+17\ 20\ 39.54$      | $+224.43$   | 15 55.44     | 58 26.448     | 1.0      | 4 54        | 12 47      | 20 44      |
|          | 20 | 5 26 24.230          | 71.599                  | $+18\ 18\ 13.08$      | $+63.55$    | 15 43.58     | 57 42.926     | 2.0      | 5 44        | 13 42      | 21 39      |
|          | 21 | 6 22 30.635          | 78.019                  | $+18\ 12\ 34.08$      | $-89.46$    | 15 31.04     | 56 56.891     | 3.0      | 6 40        | 14 35      | 22 25      |
|          | 22 | 7 16 40.874          | 88.270                  | $+17\ 09\ 07.22$      | $-224.12$   | 15 18.82     | 56 12.025     | 4.0      | 7 39        | 15 25      | 23 03      |
|          | 23 | 8 08 34.232          | 81.640                  | $+15\ 16\ 26.69$      | $-335.14$   | 15 07.80     | 55 31.594     | 5.0      | 8 42        | 16 13      | 23 35      |
|          | 24 | 8 58 11.001          | 58.419                  | $+12\ 44\ 16.80$      | $-421.70$   | 14 58.70     | 54 58.184     | 6.0      | 9 45        | 16 59      | —          |
|          | 25 | 9 45 48.979          | 96.404                  | $+9\ 42\ 06.80$       | $-485.55$   | 14 52.00     | 54 33.617     | 7.0      | 10 48       | 17 43      | 0 03       |
|          | 26 | 10 31 57.916         | 105.347                 | $+6\ 18\ 32.04$       | $-529.16$   | 14 48.01     | 54 18.961     | 8.0      | 11 51       | 18 26      | 0 27       |
|          | 27 | 11 17 14.461         | 61.897                  | $+2\ 41\ 13.18$       | $-554.45$   | 14 46.82     | 54 14.596     | 9.0      | 12 54       | 19 08      | 0 50       |
|          | 28 | 12 02 18.462         | 65.901                  | $-1\ 02\ 40.80$       | $-562.07$   | 14 48.37     | 54 20.285     | 10.0     | 13 57       | 19 51      | 1 12       |
|          | 29 | 12 47 50.351         | 97.795                  | $-4\ 45\ 58.52$       | $-551.16$   | 14 52.44     | 54 35.236     | 11.0     | 15 01       | 20 35      | 1 35       |
|          | 30 | 13 34 28.814         | 76.263                  | $-8\ 20\ 50.73$       | $-519.48$   | 14 58.69     | 54 58.149     | 12.0     | 16 06       | 21 20      | 1 59       |
|          | 31 | 14 22 47.853         | 95.308                  | $-11\ 38\ 22.57$      | $-463.92$   | 15 06.63     | 55 27.285     | 13.0     | 17 12       | 22 08      | 2 26       |
| Czerwiec | 1  | 15 13 12.578         | 60.042                  | $-14\ 28\ 24.34$      | $-381.58$   | 15 15.69     | 56 00.562     | 14.0     | 18 17       | 22 58      | 2 57       |
|          | 2  | 16 05 53.795         | 101.271                 | $-16\ 39\ 54.04$      | $-271.31$   | 15 25.27     | 56 35.707     | 15.0     | 19 20       | 23 50      | 3 35       |
|          | 3  | 17 00 42.865         | 90.353                  | $-18\ 02\ 02.00$      | $-135.56$   | 15 34.74     | 57 10.468     | 16.0     | 20 18       | —          | 4 19       |
|          | 4  | 17 57 09.960         | 57.464                  | $-18\ 25\ 54.50$      | $+18.35$    | 15 43.56     | 57 42.852     | 17.0     | 21 10       | 0 45       | 5 12       |
|          | 5  | 18 54 29.017         | 76.536                  | $-17\ 46\ 29.22$      | $+178.69$   | 15 51.32     | 58 11.336     | 18.0     | 21 55       | 1 40       | 6 14       |
|          | 6  | 19 51 49.586         | 97.119                  | $-16\ 03\ 56.34$      | $+331.69$   | 15 57.77     | 58 34.986     | 19.0     | 22 34       | 2 36       | 7 22       |
|          | 7  | 20 48 31.007         | 78.551                  | $-13\ 23\ 49.01$      | $+464.70$   | 16 02.79     | 58 53.435     | 20.0     | 23 08       | 3 30       | 8 35       |
|          | 8  | 21 44 12.371         | 59.925                  | $-9\ 56\ 04.86$       | $+568.55$   | 16 06.41     | 59 06.722     | 21.0     | 23 38       | 4 24       | 9 50       |
|          | 9  | 22 38 54.832         | 102.394                 | $-5\ 53\ 35.56$       | $+637.84$   | 16 08.68     | 59 15.041     | 22.0     | —           | 5 16       | 11 07      |
|          | 10 | 23 32 57.411         | 104.977                 | $-1\ 30\ 45.96$       | $+669.98$   | 16 09.62     | 59 18.493     | 23.0     | 0 05        | 6 08       | 12 23      |
|          | 11 | 0 26 49.480          | 97.051                  | $+2\ 57\ 17.65$       | $+663.92$   | 16 09.19     | 59 16.932     | 24.0     | 0 33        | 7 00       | 13 40      |
|          | 12 | 1 21 02.298          | 49.874                  | $+7\ 15\ 15.94$       | $+619.61$   | 16 07.29     | 59 09.949     | 25.0     | 1 01        | 7 52       | 14 57      |
|          | 13 | 2 16 00.535          | 48.118                  | $+11\ 08\ 02.41$      | $+538.31$   | 16 03.77     | 58 57.020     | 26.0     | 1 32        | 8 46       | 16 11      |
|          | 14 | 3 11 54.379          | 101.972                 | $+14\ 21\ 28.37$      | $+423.81$   | 15 58.53     | 58 37.775     | 27.0     | 2 06        | 9 40       | 17 23      |
|          | 15 | 4 08 33.789          | 81.395                  | $+16\ 43\ 37.89$      | $+283.52$   | 15 51.58     | 58 12.284     | 28.0     | 2 46        | 10 35      | 18 29      |
|          | 16 | 5 05 27.748          | 75.369                  | $+18\ 06\ 20.75$      | $+128.72$   | 15 43.13     | 57 41.282     | 29.0     | 3 33        | 11 30      | 19 28      |
|          | 17 | 6 01 50.764          | 98.400                  | $+18\ 26\ 28.30$      | $-27.15$    | 15 33.58     | 57 06.228     | 0.4      | 4 26        | 12 23      | 20 18      |
|          | 18 | 6 56 55.378          | 103.029                 | $+17\ 46\ 11.20$      | $-171.46$   | 15 23.49     | 56 29.196     | 1.4      | 5 24        | 13 15      | 21 00      |
|          | 19 | 7 50 05.315          | 52.979                  | $+16\ 12\ 03.97$      | $-295.21$   | 15 13.53     | 55 52.632     | 2.4      | 6 26        | 14 05      | 21 36      |
|          | 20 | 8 41 03.550          | 51.226                  | $+13\ 53\ 20.65$      | $-394.13$   | 15 04.39     | 55 19.068     | 3.4      | 7 29        | 14 52      | 22 05      |
|          | 21 | 9 29 53.387          | 101.072                 | $+11\ 00\ 06.88$      | $-467.96$   | 14 56.70     | 54 50.863     | 4.4      | 8 33        | 15 38      | 22 31      |
|          | 22 | 10 16 54.693         | 102.385                 | $+7\ 42\ 03.25$       | $-518.73$   | 14 51.02     | 54 30.010     | 5.4      | 9 36        | 16 21      | 22 55      |
|          | 23 | 11 02 38.614         | 86.311                  | $+4\ 07\ 50.97$       | $-549.10$   | 14 47.76     | 54 18.029     | 6.4      | 10 40       | 17 04      | 23 17      |
|          | 24 | 11 47 42.953         | 90.656                  | $+0\ 25\ 12.97$       | $-561.11$   | 14 47.18     | 54 15.906     | 7.4      | 11 43       | 17 46      | 23 39      |
|          | 25 | 12 32 48.825         | 96.533                  | $-3\ 18\ 41.98$       | $-555.50$   | 14 49.40     | 54 24.061     | 8.4      | 12 46       | 18 29      | —          |
|          | 26 | 13 18 38.169         | 85.881                  | $-6\ 56\ 43.48$       | $-531.38$   | 14 54.37     | 54 42.318     | 9.4      | 13 50       | 19 13      | 0 02       |
|          | 27 | 14 05 51.241         | 98.960                  | $-10\ 21\ 01.30$      | $-486.36$   | 15 01.88     | 55 09.866     | 10.4     | 14 55       | 19 59      | 0 28       |
|          | 28 | 14 55 03.112         | 50.840                  | $-13\ 22\ 34.58$      | $-417.08$   | 15 11.51     | 55 45.213     | 11.4     | 16 00       | 20 48      | 0 56       |
|          | 29 | 15 46 38.450         | 86.189                  | $-15\ 51\ 01.69$      | $-320.44$   | 15 22.67     | 56 26.172     | 12.4     | 17 04       | 21 39      | 1 30       |
|          | 30 | 16 40 44.874         | 92.626                  | $-17\ 35\ 08.22$      | $-195.52$   | 15 34.59     | 57 09.918     | 13.4     | 18 06       | 22 34      | 2 11       |
| Lipiec   | 1  | 17 37 07.044         | 54.811                  | $-18\ 24\ 07.75$      | $-45.93$    | 15 46.37     | 57 53.169     | 14.4     | 19 02       | 23 30      | 3 01       |
|          | 2  | 18 35 05.705         | 53.487                  | $-18\ 09\ 50.87$      | $+118.75$   | 15 57.09     | 58 32.519     | 15.4     | 19 51       | —          | 3 59       |



# KSIĘŻYC 2015, LIPIEC – SIERPIEŃ

| Data     |    | $0^h TT$                                             |                         |                            |                       |                        |                         | wiek               | CSE                             |                                 |                                |
|----------|----|------------------------------------------------------|-------------------------|----------------------------|-----------------------|------------------------|-------------------------|--------------------|---------------------------------|---------------------------------|--------------------------------|
|          |    | $\alpha_{app}^{CIO}$                                 | $\alpha_{app}^{\gamma}$ | $\delta_{app}$             | $V_{\delta}/1^h$      | $R$                    | $\pi$                   |                    | w Warszawie                     |                                 |                                |
|          |    |                                                      |                         |                            |                       |                        |                         |                    | wsch.                           | górow.                          | zach.                          |
| Lipiec   | 1  | 17 <sup>h</sup> 37 <sup>m</sup> 07. <sup>s</sup> 044 | 54. <sup>s</sup> 811    | −18°24′07. <sup>″</sup> 75 | − 45. <sup>″</sup> 93 | 15′46. <sup>″</sup> 37 | 57′53. <sup>″</sup> 169 | 14. <sup>d</sup> 4 | 19 <sup>h</sup> 02 <sup>m</sup> | 23 <sup>h</sup> 30 <sup>m</sup> | 3 <sup>h</sup> 01 <sup>m</sup> |
|          | 2  | 18 35 05.705                                         | 53.487                  | −18 09 50.87               | +118.75               | 15 57.09               | 58 32.519               | 15.4               | 19 51                           | —                               | 3 59                           |
|          | 3  | 19 33 45.369                                         | 93.167                  | −16 49 04.20               | +283.82               | 16 05.92               | 59 04.904               | 16.4               | 20 34                           | 0 26                            | 5 06                           |
|          | 4  | 20 32 09.587                                         | 57.398                  | −14 24 56.26               | +432.89               | 16 12.23               | 59 28.084               | 17.4               | 21 10                           | 1 23                            | 6 19                           |
|          | 5  | 21 29 36.837                                         | 84.658                  | −11 06 45.70               | +552.14               | 16 15.75               | 59 40.983               | 18.4               | 21 42                           | 2 19                            | 7 36                           |
|          | 6  | 22 25 49.413                                         | 97.242                  | − 7 08 22.06               | +633.03               | 16 16.51               | 59 43.765               | 19.4               | 22 11                           | 3 13                            | 8 54                           |
|          | 7  | 23 20 53.023                                         | 100.857                 | − 2 45 53.36               | +672.41               | 16 14.83               | 59 37.599               | 20.4               | 22 39                           | 4 06                            | 10 12                          |
|          | 8  | 0 15 10.033                                          | 57.872                  | + 1 44 05.87               | +670.89               | 16 11.18               | 59 24.226               | 21.4               | 23 07                           | 4 58                            | 11 29                          |
|          | 9  | 1 09 10.470                                          | 58.313                  | + 6 05 43.24               | +631.12               | 16 06.07               | 59 05.481               | 22.4               | 23 36                           | 5 50                            | 12 45                          |
|          | 10 | 2 03 23.170                                          | 71.019                  | +10 04 21.51               | +556.62               | 15 59.93               | 58 42.937               | 23.4               | —                               | 6 42                            | 14 00                          |
|          | 11 | 2 58 07.909                                          | 55.768                  | +13 26 58.52               | +451.85               | 15 53.06               | 58 17.726               | 24.4               | 0 08                            | 7 35                            | 15 11                          |
|          | 12 | 3 53 29.173                                          | 77.042                  | +16 02 35.76               | +322.82               | 15 45.66               | 57 50.559               | 25.4               | 0 45                            | 8 28                            | 16 18                          |
|          | 13 | 4 49 13.026                                          | 60.909                  | +17 43 04.91               | +177.75               | 15 37.85               | 57 21.877               | 26.4               | 1 28                            | 9 22                            | 17 19                          |
|          | 14 | 5 44 49.071                                          | 96.968                  | +18 24 02.12               | + 27.00               | 15 29.72               | 56 52.065               | 27.4               | 2 17                            | 10 15                           | 18 12                          |
|          | 15 | 6 39 38.081                                          | 85.993                  | +18 05 23.95               | −118.40               | 15 21.44               | 56 21.655               | 28.4               | 3 13                            | 11 07                           | 18 57                          |
|          | 16 | 7 33 02.933                                          | 50.857                  | +16 51 19.69               | −248.79               | 15 13.21               | 55 51.460               | 29.4               | 4 12                            | 11 58                           | 19 35                          |
|          | 17 | 8 24 38.301                                          | 86.237                  | +14 49 15.33               | −357.63               | 15 05.35               | 55 22.620               | 0.8                | 5 15                            | 12 46                           | 20 07                          |
|          | 18 | 9 14 15.604                                          | 63.549                  | +12 08 29.48               | −442.05               | 14 58.25               | 54 56.552               | 1.8                | 6 19                            | 13 32                           | 20 35                          |
|          | 19 | 10 02 02.791                                         | 50.742                  | + 8 58 52.05               | −502.13               | 14 52.34               | 54 34.836               | 2.8                | 7 23                            | 14 17                           | 20 59                          |
|          | 20 | 10 48 21.021                                         | 68.978                  | + 5 29 47.44               | −539.69               | 14 48.04               | 54 19.079               | 3.8                | 8 26                            | 15 00                           | 21 22                          |
|          | 21 | 11 33 40.565                                         | 88.526                  | + 1 49 49.10               | −556.97               | 14 45.78               | 54 10.774               | 4.8                | 9 29                            | 15 42                           | 21 44                          |
|          | 22 | 12 18 37.311                                         | 85.275                  | − 1 53 18.96               | −555.70               | 14 45.89               | 54 11.174               | 5.8                | 10 32                           | 16 24                           | 22 07                          |
|          | 23 | 13 03 50.143                                         | 98.111                  | − 5 32 21.70               | −536.51               | 14 48.62               | 54 21.182               | 6.8                | 11 35                           | 17 07                           | 22 31                          |
|          | 24 | 13 49 58.774                                         | 106.747                 | − 9 00 02.16               | −498.60               | 14 54.08               | 54 41.241               | 7.8                | 12 39                           | 17 52                           | 22 57                          |
|          | 25 | 14 37 41.228                                         | 89.207                  | −12 08 27.82               | −439.83               | 15 02.25               | 55 11.211               | 8.8                | 13 43                           | 18 38                           | 23 28                          |
|          | 26 | 15 27 30.152                                         | 78.140                  | −14 48 43.76               | −357.28               | 15 12.88               | 55 50.233               | 9.8                | 14 46                           | 19 28                           | —                              |
|          | 27 | 16 19 47.407                                         | 95.406                  | −16 50 46.42               | −248.43               | 15 25.51               | 56 36.588               | 10.8               | 15 49                           | 20 20                           | 0 05                           |
|          | 28 | 17 14 37.496                                         | 85.507                  | −18 03 55.69               | −113.14               | 15 39.40               | 57 27.584               | 11.8               | 16 47                           | 21 15                           | 0 49                           |
|          | 29 | 18 11 42.281                                         | 90.306                  | −18 18 20.27               | + 44.04               | 15 53.57               | 58 19.577               | 12.8               | 17 40                           | 22 11                           | 1 43                           |
|          | 30 | 19 10 21.154                                         | 69.193                  | −17 27 11.27               | +212.37               | 16 06.81               | 59 08.195               | 13.8               | 18 27                           | 23 09                           | 2 46                           |
| Sierpień | 31 | 20 09 39.686                                         | 87.737                  | −15 29 04.53               | +375.91               | 16 17.89               | 59 48.860               | 14.8               | 19 07                           | —                               | 3 57                           |
|          | 1  | 21 08 44.731                                         | 92.792                  | −12 29 27.29               | +517.09               | 16 25.71               | 60 17.559               | 15.8               | 19 42                           | 0 06                            | 5 14                           |
|          | 2  | 22 06 58.808                                         | 106.876                 | − 8 40 21.88               | +621.27               | 16 29.56               | 60 31.668               | 16.8               | 20 13                           | 1 03                            | 6 34                           |
|          | 3  | 23 04 06.976                                         | 55.049                  | − 4 18 32.83               | +679.87               | 16 29.24               | 60 30.516               | 17.8               | 20 43                           | 1 58                            | 7 54                           |
|          | 4  | 0 00 14.893                                          | 62.968                  | + 0 17 09.78               | +690.88               | 16 25.13               | 60 15.432               | 18.8               | 21 11                           | 2 52                            | 9 14                           |
|          | 5  | 0 55 41.339                                          | 89.416                  | + 4 48 12.44               | +657.35               | 16 18.00               | 59 49.256               | 19.8               | 21 41                           | 3 45                            | 10 33                          |
|          | 6  | 1 50 49.153                                          | 97.235                  | + 8 57 54.04               | +585.27               | 16 08.82               | 59 15.541               | 20.8               | 22 12                           | 4 39                            | 11 49                          |
|          | 7  | 2 45 56.993                                          | 105.080                 | +12 32 15.64               | +481.97               | 15 58.53               | 58 37.782               | 21.8               | 22 48                           | 5 32                            | 13 02                          |
|          | 8  | 3 41 13.045                                          | 61.141                  | +15 20 22.75               | +355.44               | 15 47.93               | 57 58.869               | 22.8               | 23 28                           | 6 25                            | 14 10                          |
|          | 9  | 4 36 31.662                                          | 79.769                  | +17 14 39.54               | +214.26               | 15 37.57               | 57 20.865               | 23.8               | —                               | 7 18                            | 15 13                          |
|          | 10 | 5 31 33.904                                          | 82.023                  | +18 11 02.81               | + 67.53               | 15 27.81               | 56 45.027               | 24.8               | 0 15                            | 8 11                            | 16 08                          |
|          | 11 | 6 25 52.299                                          | 100.429                 | +18 09 09.90               | − 75.61               | 15 18.80               | 56 11.986               | 25.8               | 1 07                            | 9 03                            | 16 55                          |
|          | 12 | 7 18 58.455                                          | 106.597                 | +17 12 08.20               | −206.98               | 15 10.63               | 55 41.991               | 26.8               | 2 04                            | 9 53                            | 17 35                          |
|          | 13 | 8 10 30.683                                          | 78.834                  | +15 25 59.66               | −320.34               | 15 03.32               | 55 15.155               | 27.8               | 3 05                            | 10 42                           | 18 09                          |
|          | 14 | 9 00 18.933                                          | 67.092                  | +12 58 46.31               | −411.96               | 14 56.92               | 54 51.648               | 28.8               | 4 08                            | 11 28                           | 18 38                          |
|          | 15 | 9 48 26.110                                          | 74.274                  | + 9 59 31.09               | −480.43               | 14 51.52               | 54 31.835               | 0.1                | 5 12                            | 12 13                           | 19 04                          |
|          | 16 | 10 35 06.559                                         | 54.726                  | + 6 37 28.19               | −526.09               | 14 47.29               | 54 16.323               | 1.1                | 6 15                            | 12 56                           | 19 27                          |

# KSIĘŻYC 2015, SIERPIEŃ – WRZESIEŃ

| Data        |             | 0 <sup>h</sup> TT                                    |                               |                  |                                |           |            | wiek              | CSE                            |                                 |                                 |
|-------------|-------------|------------------------------------------------------|-------------------------------|------------------|--------------------------------|-----------|------------|-------------------|--------------------------------|---------------------------------|---------------------------------|
|             |             | α <sub>app</sub> <sup>CIO</sup>                      | α <sub>app</sub> <sup>γ</sup> | δ <sub>app</sub> | V <sub>δ</sub> /1 <sup>h</sup> | R         | π          |                   | w Warszawie                    |                                 |                                 |
|             |             |                                                      |                               |                  |                                |           |            |                   | wsch.                          | górow.                          | zach.                           |
| Sierpień    | 16          | 10 <sup>h</sup> 35 <sup>m</sup> 06. <sup>s</sup> 559 | 54.726                        | + 6°37'28".19    | −526".09                       | 14'47".29 | 54'16".323 | 1. <sup>d</sup> 1 | 6 <sup>h</sup> 15 <sup>m</sup> | 12 <sup>h</sup> 56 <sup>m</sup> | 19 <sup>h</sup> 27 <sup>m</sup> |
|             | 17          | 11 20 43.302                                         | 91.471                        | + 3 01 30.87     | −550.22                        | 14 44.47  | 54 05.956  | 2.1               | 7 18                           | 13 39                           | 19 50                           |
|             | 18          | 12 05 45.245                                         | 93.416                        | − 0 40 02.17     | −554.30                        | 14 43.32  | 54 01.743  | 3.1               | 8 21                           | 14 21                           | 20 12                           |
|             | 19          | 12 50 44.876                                         | 93.048                        | − 4 19 24.36     | −539.45                        | 14 44.14  | 54 04.756  | 4.1               | 9 23                           | 15 04                           | 20 35                           |
|             | 20          | 13 36 16.400                                         | 64.575                        | − 7 49 07.08     | −505.99                        | 14 47.20  | 54 16.004  | 5.1               | 10 26                          | 15 47                           | 21 00                           |
|             | 21          | 14 22 53.897                                         | 102.075                       | −11 01 38.50     | −453.32                        | 14 52.73  | 54 36.282  | 6.1               | 11 29                          | 16 32                           | 21 29                           |
|             | 22          | 15 11 08.911                                         | 57.094                        | −13 49 01.30     | −379.98                        | 15 00.83  | 55 06.015  | 7.1               | 12 31                          | 17 19                           | 22 02                           |
|             | 23          | 16 01 26.990                                         | 75.181                        | −16 02 37.69     | −284.18                        | 15 11.47  | 55 45.054  | 8.1               | 13 33                          | 18 09                           | 22 42                           |
|             | 24          | 16 54 03.078                                         | 51.278                        | −17 33 13.38     | −164.89                        | 15 24.38  | 56 32.461  | 9.1               | 14 32                          | 19 01                           | 23 29                           |
|             | 25          | 17 48 56.673                                         | 104.884                       | −18 11 34.53     | − 23.49                        | 15 39.05  | 57 26.277  | 10.1              | 15 26                          | 19 56                           | —                               |
|             | 26          | 18 45 49.003                                         | 97.225                        | −17 49 46.88     | +134.49                        | 15 54.59  | 58 23.342  | 11.1              | 16 16                          | 20 52                           | 0 26                            |
|             | 27          | 19 44 05.069                                         | 53.302                        | −16 23 10.65     | +298.35                        | 16 09.84  | 59 19.292  | 12.1              | 16 59                          | 21 49                           | 1 32                            |
|             | 28          | 20 43 01.768                                         | 50.009                        | −13 52 20.00     | +452.92                        | 16 23.34  | 60 08.864  | 13.1              | 17 37                          | 22 46                           | 2 46                            |
|             | 29          | 21 41 59.492                                         | 107.740                       | −10 24 19.55     | +581.43                        | 16 33.63  | 60 46.632  | 14.1              | 18 10                          | 23 43                           | 4 05                            |
|             | 30          | 22 40 31.825                                         | 80.076                        | − 6 12 38.73     | +669.22                        | 16 39.48  | 61 08.100  | 15.1              | 18 41                          | —                               | 5 27                            |
|             | Wrzesień    | 31                                                   | 23 38 29.053                  | 77.305           | − 1 35 38.03                   | +707.12   | 16 40.22   | 61 10.811         | 16.1                           | 19 11                           | 0 39                            |
| 1           |             | 0 35 55.096                                          | 103.347                       | + 3 06 03.84     | +692.86                        | 16 35.91  | 60 55.002  | 17.1              | 19 42                          | 1 35                            | 8 11                            |
| 2           |             | 1 33 00.422                                          | 48.674                        | + 7 32 14.31     | +630.65                        | 16 27.32  | 60 23.460  | 18.1              | 20 14                          | 2 30                            | 9 31                            |
| 3           |             | 2 29 54.121                                          | 102.377                       | +11 25 21.21     | +529.29                        | 16 15.66  | 59 40.664  | 19.1              | 20 49                          | 3 25                            | 10 48                           |
| 4           |             | 3 26 37.574                                          | 85.837                        | +14 31 56.79     | +400.01                        | 16 02.30  | 58 51.630  | 20.1              | 21 28                          | 4 20                            | 12 00                           |
| 5           |             | 4 23 01.383                                          | 49.654                        | +16 43 13.40     | +254.67                        | 15 48.49  | 58 00.937  | 21.1              | 22 13                          | 5 14                            | 13 06                           |
| 6           |             | 5 18 46.390                                          | 94.671                        | +17 55 02.42     | +104.48                        | 15 35.20  | 57 12.151  | 22.1              | 23 04                          | 6 07                            | 14 03                           |
| 7           |             | 6 13 28.415                                          | 76.705                        | +18 07 27.40     | − 40.89                        | 15 23.08  | 56 27.660  | 23.1              | 24 00                          | 7 00                            | 14 53                           |
| 8           |             | 7 06 44.824                                          | 93.124                        | +17 23 58.86     | −173.94                        | 15 12.48  | 55 48.786  | 24.1              | —                              | 7 50                            | 15 35                           |
| 9           |             | 7 58 20.359                                          | 68.667                        | +15 50 38.45     | −289.56                        | 15 03.56  | 55 16.033  | 25.1              | 0 59                           | 8 39                            | 16 11                           |
| 10          |             | 8 48 10.331                                          | 58.645                        | +13 35 02.82     | −384.88                        | 14 56.29  | 54 49.362  | 26.1              | 2 01                           | 9 26                            | 16 41                           |
| 11          |             | 9 36 20.891                                          | 69.209                        | +10 45 36.25     | −458.72                        | 14 50.60  | 54 28.462  | 27.1              | 3 03                           | 10 11                           | 17 08                           |
| 12          |             | 10 23 07.298                                         | 55.617                        | + 7 30 57.26     | −510.96                        | 14 46.38  | 54 12.969  | 28.1              | 4 06                           | 10 55                           | 17 32                           |
| 13          |             | 11 08 51.424                                         | 99.745                        | + 3 59 38.97     | −542.09                        | 14 43.56  | 54 02.631  | 29.1              | 5 09                           | 11 37                           | 17 55                           |
| 14          |             | 11 53 59.381                                         | 107.701                       | + 0 20 00.56     | −552.75                        | 14 42.14  | 53 57.417  | 0.6               | 6 12                           | 12 20                           | 18 17                           |
| 15          |             | 12 38 59.580                                         | 107.900                       | − 3 19 53.47     | −543.47                        | 14 42.18  | 53 57.561  | 1.6               | 7 15                           | 13 02                           | 18 40                           |
| 16          |             | 13 24 21.182                                         | 69.502                        | − 6 52 09.14     | −514.57                        | 14 43.81  | 54 03.550  | 2.6               | 8 17                           | 13 45                           | 19 05                           |
| 17          |             | 14 10 32.624                                         | 80.946                        | −10 08 55.63     | −466.00                        | 14 47.22  | 54 16.048  | 3.6               | 9 20                           | 14 29                           | 19 32                           |
| 18          |             | 14 57 59.896                                         | 108.221                       | −13 02 17.29     | −397.43                        | 14 52.59  | 54 35.782  | 4.6               | 10 22                          | 15 15                           | 20 03                           |
| 19          |             | 15 47 04.277                                         | 52.607                        | −15 24 08.82     | −308.44                        | 15 00.11  | 55 03.383  | 5.6               | 11 23                          | 16 03                           | 20 39                           |
| 20          |             | 16 37 59.550                                         | 107.887                       | −17 06 19.09     | −199.07                        | 15 09.87  | 55 39.177  | 6.6               | 12 21                          | 16 53                           | 21 22                           |
| 21          |             | 17 30 49.189                                         | 97.535                        | −18 00 50.95     | − 70.61                        | 15 21.79  | 56 22.950  | 7.6               | 13 16                          | 17 45                           | 22 14                           |
| 22          |             | 18 25 24.688                                         | 73.044                        | −18 00 43.11     | + 73.41                        | 15 35.61  | 57 13.667  | 8.6               | 14 06                          | 18 38                           | 23 14                           |
| 23          |             | 19 21 26.500                                         | 74.865                        | −17 00 54.79     | +226.37                        | 15 50.74  | 58 09.200  | 9.6               | 14 50                          | 19 33                           | —                               |
| 24          |             | 20 18 28.396                                         | 76.769                        | −14 59 45.09     | +378.26                        | 16 06.25  | 59 06.125  | 10.6              | 15 30                          | 20 29                           | 0 21                            |
| 25          |             | 21 16 04.346                                         | 52.725                        | −12 00 09.29     | +516.24                        | 16 20.86  | 59 59.744  | 11.6              | 16 05                          | 21 25                           | 1 36                            |
| 26          |             | 22 13 55.243                                         | 103.626                       | − 8 10 29.97     | +626.20                        | 16 33.05  | 60 44.491  | 12.6              | 16 37                          | 22 21                           | 2 55                            |
| 27          |             | 23 11 52.531                                         | 100.915                       | − 3 44 41.71     | +695.02                        | 16 41.32  | 61 14.831  | 13.6              | 17 07                          | 23 17                           | 4 17                            |
| 28          |             | 0 09 57.217                                          | 105.600                       | + 0 58 44.88     | +713.27                        | 16 44.50  | 61 26.525  | 14.6              | 17 38                          | —                               | 5 40                            |
| 29          |             | 1 08 14.781                                          | 63.164                        | + 5 38 41.61     | +677.56                        | 16 42.13  | 61 17.806  | 15.6              | 18 10                          | 0 14                            | 7 03                            |
| 30          | 2 06 47.899 | 96.284                                               | + 9 54 05.05                  | +591.73          | 16 34.53                       | 60 49.936 | 16.6       | 18 44             | 1 10                           | 8 24                            |                                 |
| Październik | 1           | 3 05 29.644                                          | 78.033                        | +13 26 45.34     | +466.14                        | 16 22.79  | 60 06.816  | 17.6              | 19 24                          | 2 07                            | 9 41                            |

# KSIĘŻYC 2015, PAŹDZIERNIK – LISTOPAD

| Data        |              | 0 <sup>h</sup> TT                                   |                               |                  |                                |           |            | wiek  | CSE                             |                                |                                |
|-------------|--------------|-----------------------------------------------------|-------------------------------|------------------|--------------------------------|-----------|------------|-------|---------------------------------|--------------------------------|--------------------------------|
|             |              | α <sup>CIO</sup> <sub>app</sub>                     | α <sup>γ</sup> <sub>app</sub> | δ <sub>app</sub> | V <sub>δ</sub> /1 <sup>h</sup> | R         | π          |       | w Warszawie                     |                                |                                |
|             |              |                                                     |                               |                  |                                |           |            |       | wsch.                           | górow.                         | zach.                          |
| Październik | 1            | 3 <sup>h</sup> 05 <sup>m</sup> 29 <sup>s</sup> .644 | 78 <sup>s</sup> .033          | +13°26′45″.34    | +466″.14                       | 16′22″.79 | 60′06″.816 | 17.6  | 19 <sup>h</sup> 24 <sup>m</sup> | 2 <sup>h</sup> 07 <sup>m</sup> | 9 <sup>h</sup> 41 <sup>m</sup> |
|             | 2            | 4 04 00.027                                         | 48.424                        | +16 03 38.21     | +315.40                        | 16 08.36  | 59 13.874  | 18.6  | 20 08                           | 3 04                           | 10 52                          |
|             | 3            | 5 01 47.958                                         | 96.364                        | +17 37 49.49     | +155.21                        | 15 52.81  | 58 16.782  | 19.6  | 20 58                           | 4 00                           | 11 55                          |
|             | 4            | 5 58 18.355                                         | 66.772                        | +18 08 23.71     | − 0.67                         | 15 37.46  | 57 20.467  | 20.6  | 21 53                           | 4 54                           | 12 49                          |
|             | 5            | 6 53 01.327                                         | 49.754                        | +17 39 12.31     | −142.30                        | 15 23.34  | 56 28.616  | 21.6  | 22 52                           | 5 46                           | 13 35                          |
|             | 6            | 7 45 39.274                                         | 87.709                        | +16 17 13.20     | −264.04                        | 15 11.07  | 55 43.595  | 22.6  | 23 54                           | 6 36                           | 14 12                          |
|             | 7            | 8 36 09.520                                         | 57.961                        | +14 10 55.20     | −363.75                        | 15 01.00  | 55 06.622  | 23.6  | —                               | 7 24                           | 14 44                          |
|             | 8            | 9 24 42.857                                         | 91.303                        | +11 29 09.55     | −441.46                        | 14 53.21  | 54 38.033  | 24.6  | 0 56                            | 8 09                           | 15 12                          |
|             | 9            | 10 11 39.986                                        | 88.434                        | + 8 20 33.76     | −498.10                        | 14 47.63  | 54 17.555  | 25.6  | 1 59                            | 8 53                           | 15 37                          |
|             | 10           | 10 57 27.701                                        | 76.150                        | + 4 53 21.59     | −534.62                        | 14 44.09  | 54 04.562  | 26.6  | 3 01                            | 9 36                           | 16 00                          |
|             | 11           | 11 42 35.792                                        | 84.242                        | + 1 15 28.58     | −551.55                        | 14 42.37  | 53 58.276  | 27.6  | 4 04                            | 10 18                          | 16 22                          |
|             | 12           | 12 27 34.796                                        | 83.246                        | − 2 25 16.06     | −548.88                        | 14 42.28  | 53 57.943  | 28.6  | 5 07                            | 11 01                          | 16 45                          |
|             | 13           | 13 12 54.312                                        | 102.763                       | − 6 00 57.78     | −526.21                        | 14 43.65  | 54 02.967  | 0.1   | 6 10                            | 11 43                          | 17 09                          |
|             | 14           | 13 59 01.481                                        | 49.933                        | − 9 23 29.10     | −482.92                        | 14 46.38  | 54 12.992  | 1.1   | 7 12                            | 12 27                          | 17 35                          |
|             | 15           | 14 46 19.273                                        | 67.729                        | −12 24 28.72     | −418.52                        | 14 50.46  | 54 27.943  | 2.1   | 8 15                            | 13 13                          | 18 05                          |
|             | 16           | 15 35 04.453                                        | 52.914                        | −14 55 29.05     | −333.05                        | 14 55.92  | 54 47.995  | 3.1   | 9 16                            | 14 00                          | 18 39                          |
|             | 17           | 16 25 25.432                                        | 73.901                        | −16 48 14.11     | −227.52                        | 15 02.87  | 55 13.488  | 4.1   | 10 16                           | 14 49                          | 19 20                          |
|             | 18           | 17 17 20.688                                        | 69.166                        | −17 55 08.44     | −104.37                        | 15 11.39  | 55 44.770  | 5.1   | 11 11                           | 15 39                          | 20 08                          |
|             | 19           | 18 10 38.781                                        | 87.269                        | −18 09 55.94     | + 32.19                        | 15 21.53  | 56 21.985  | 6.1   | 12 02                           | 16 31                          | 21 03                          |
|             | 20           | 19 05 00.860                                        | 49.359                        | −17 28 24.02     | +176.09                        | 15 33.20  | 57 04.813  | 7.1   | 12 47                           | 17 24                          | 22 06                          |
|             | 21           | 20 00 05.613                                        | 54.121                        | −15 49 06.05     | +319.62                        | 15 46.10  | 57 52.185  | 8.1   | 13 27                           | 18 18                          | 23 15                          |
|             | 22           | 20 55 35.341                                        | 83.857                        | −13 13 56.62     | +453.80                        | 15 59.68  | 58 42.012  | 9.1   | 14 02                           | 19 11                          | —                              |
|             | 23           | 21 51 20.990                                        | 69.511                        | − 9 48 37.57     | +568.72                        | 16 13.04  | 59 31.028  | 10.1  | 14 34                           | 20 05                          | 0 30                           |
|             | 24           | 22 47 24.307                                        | 72.832                        | − 5 42 55.21     | +654.00                        | 16 24.98  | 60 14.880  | 11.1  | 15 04                           | 21 00                          | 1 48                           |
|             | 25           | 23 43 56.353                                        | 104.879                       | − 1 10 44.09     | +699.53                        | 16 34.17  | 60 48.591  | 12.1  | 15 33                           | 21 55                          | 3 08                           |
|             | 26           | 0 41 12.575                                         | 61.102                        | + 3 30 17.05     | +697.07                        | 16 39.31  | 61 07.470  | 13.1  | 16 04                           | 22 51                          | 4 30                           |
|             | 27           | 1 39 25.238                                         | 73.767                        | + 7 59 57.67     | +642.64                        | 16 39.53  | 61 08.261  | 14.1  | 16 37                           | 23 49                          | 5 52                           |
|             | 28           | 2 38 34.721                                         | 83.255                        | +11 57 47.32     | +538.90                        | 16 34.59  | 60 50.129  | 15.1  | 17 14                           | —                              | 7 13                           |
|             | 29           | 3 38 22.503                                         | 71.046                        | +15 05 51.14     | +396.14                        | 16 25.01  | 60 14.987  | 16.1  | 17 57                           | 0 47                           | 8 30                           |
|             | 30           | 4 38 09.883                                         | 58.437                        | +17 11 40.34     | +230.74                        | 16 11.94  | 59 27.010  | 17.1  | 18 46                           | 1 45                           | 9 39                           |
| Listopad    | 31           | 5 37 05.208                                         | 53.774                        | +18 09 53.97     | + 61.17                        | 15 56.84  | 58 31.574  | 18.1  | 19 41                           | 2 42                           | 10 39                          |
|             | 1            | 6 34 17.663                                         | 66.242                        | +18 02 11.32     | − 96.73                        | 15 41.18  | 57 34.110  | 19.1  | 20 40                           | 3 37                           | 11 30                          |
|             | 2            | 7 29 10.921                                         | 59.511                        | +16 55 26.63     | −232.85                        | 15 26.24  | 56 39.268  | 20.1  | 21 42                           | 4 29                           | 12 12                          |
|             | 3            | 8 21 30.307                                         | 78.906                        | +14 59 22.56     | −343.10                        | 15 12.95  | 55 50.513  | 21.1  | 22 46                           | 5 19                           | 12 46                          |
|             | 4            | 9 11 22.186                                         | 70.793                        | +12 24 23.20     | −427.74                        | 15 01.94  | 55 10.075  | 22.1  | 23 49                           | 6 06                           | 13 16                          |
|             | 5            | 9 59 08.657                                         | 57.269                        | + 9 20 17.84     | −489.05                        | 14 53.50  | 54 39.099  | 23.1  | —                               | 6 51                           | 13 42                          |
|             | 6            | 10 45 21.301                                        | 69.917                        | + 5 55 54.88     | −529.58                        | 14 47.71  | 54 17.865  | 24.1  | 0 52                            | 7 34                           | 14 05                          |
|             | 7            | 11 30 36.139                                        | 84.758                        | + 2 19 09.51     | −551.12                        | 14 44.48  | 54 06.016  | 25.1  | 1 55                            | 8 16                           | 14 28                          |
|             | 8            | 12 15 30.192                                        | 78.813                        | − 1 22 32.10     | −554.27                        | 14 43.59  | 54 02.749  | 26.1  | 2 57                            | 8 58                           | 14 50                          |
|             | 9            | 13 00 39.162                                        | 87.785                        | − 5 01 44.73     | −538.54                        | 14 44.75  | 54 06.988  | 27.1  | 4 00                            | 9 41                           | 15 13                          |
|             | 10           | 13 46 35.522                                        | 84.150                        | − 8 30 40.73     | −502.63                        | 14 47.62  | 54 17.536  | 28.1  | 5 03                            | 10 25                          | 15 38                          |
|             | 11           | 14 33 46.380                                        | 95.013                        | −11 40 57.31     | −445.02                        | 14 51.89  | 54 33.215  | 29.1  | 6 07                            | 11 10                          | 16 07                          |
|             | 12           | 15 22 30.825                                        | 79.465                        | −14 23 39.86     | −364.72                        | 14 57.28  | 54 52.993  | 0.5   | 7 09                            | 11 57                          | 16 40                          |
|             | 13           | 16 12 57.006                                        | 105.655                       | −16 29 45.47     | −262.18                        | 15 03.57  | 55 16.080  | 1.5   | 8 10                            | 12 46                          | 17 18                          |
|             | 14           | 17 04 59.927                                        | 108.589                       | −17 50 47.13     | −140.05                        | 15 10.63  | 55 41.975  | 2.5   | 9 08                            | 13 37                          | 18 04                          |
|             | 15           | 17 58 21.544                                        | 70.218                        | −18 19 52.72     | − 3.59                         | 15 18.39  | 56 10.447  | 3.5   | 10 01                           | 14 28                          | 18 57                          |
| 16          | 18 52 34.464 | 83.151                                              | −17 52 44.47                  | +139.71          | 15 26.83                       | 56 41.427 | 4.5        | 10 47 | 15 21                           | 19 57                          |                                |

# KSIEŻYC 2015, LISTOPAD – GRUDZIEŃ

| Data     | $0^h TT$             |                         |                |                           |             |               | wiek           | CSE         |             |             |             |
|----------|----------------------|-------------------------|----------------|---------------------------|-------------|---------------|----------------|-------------|-------------|-------------|-------------|
|          | $\alpha_{app}^{CIO}$ | $\alpha_{app}^{\gamma}$ | $\delta_{app}$ | $V_{\delta}/1^h$          | $R$         | $\pi$         |                | w Warszawie |             |             |             |
|          |                      |                         |                |                           |             |               |                | wsch.       | górow.      | zach.       |             |
| Listopad | 16                   | $18^h 52^m 34^s.464$    | $83^s.151$     | $-17^{\circ} 52' 44''.47$ | $+139''.71$ | $15' 26''.83$ | $56' 41''.427$ | $4.5^d$     | $10^h 47^m$ | $15^h 21^m$ | $19^h 57^m$ |
|          | 17                   | 19 47 09.083            | 57.783         | -16 28 21.16              | +281.18     | 15 35.93      | 57 14.829      | 5.5         | 11 28       | 16 13       | 21 04       |
|          | 18                   | 20 41 41.910            | 90.620         | -14 09 11.68              | +412.17     | 15 45.59      | 57 50.301      | 6.5         | 12 04       | 17 05       | 22 15       |
|          | 19                   | 21 36 01.991            | 50.710         | -11 01 03.59              | +524.84     | 15 55.58      | 58 26.966      | 7.5         | 12 36       | 17 58       | 23 29       |
|          | 20                   | 22 30 13.390            | 62.115         | - 7 12 41.71              | +612.21     | 16 05.45      | 59 03.195      | 8.5         | 13 05       | 18 50       | —           |
|          | 21                   | 23 24 33.535            | 82.265         | - 2 55 32.57              | +667.70     | 16 14.53      | 59 36.508      | 9.5         | 13 33       | 19 42       | 0 46        |
|          | 22                   | 0 19 28.383             | 77.116         | + 1 36 22.12              | +684.98     | 16 21.94      | 60 03.695      | 10.5        | 14 02       | 20 36       | 2 04        |
|          | 23                   | 1 15 25.253             | 73.990         | + 6 06 35.78              | +658.51     | 16 26.72      | 60 21.239      | 11.5        | 14 32       | 21 31       | 3 24        |
|          | 24                   | 2 12 43.845             | 92.589         | +10 16 56.29              | +585.42     | 16 28.02      | 60 26.021      | 12.5        | 15 06       | 22 28       | 4 44        |
|          | 25                   | 3 11 26.462             | 75.215         | +13 48 59.21              | +467.99     | 16 25.33      | 60 16.142      | 13.5        | 15 45       | 23 26       | 6 02        |
|          | 26                   | 4 11 10.427             | 59.193         | +16 26 38.43              | +315.63     | 16 18.63      | 59 51.554      | 14.5        | 16 30       | —           | 7 16        |
|          | 27                   | 5 11 07.709             | 56.490         | +17 58 57.57              | +144.39     | 16 08.46      | 59 14.223      | 15.5        | 17 23       | 0 24        | 8 22        |
|          | 28                   | 6 10 15.227             | 64.024         | +18 22 09.89              | - 26.83     | 15 55.79      | 58 27.747      | 16.5        | 18 22       | 1 22        | 9 19        |
|          | 29                   | 7 07 32.845             | 81.657         | +17 39 42.63              | -181.64     | 15 41.85      | 57 36.587      | 17.5        | 19 25       | 2 17        | 10 07       |
|          | 30                   | 8 02 19.865             | 68.690         | +16 00 24.31              | -310.03     | 15 27.87      | 56 45.258      | 18.5        | 20 29       | 3 09        | 10 46       |
| Grudzień | 1                    | 8 54 22.302             | 71.138         | +13 35 39.33              | -408.82     | 15 14.91      | 55 57.707      | 19.5        | 21 34       | 3 59        | 11 18       |
|          | 2                    | 9 43 50.528             | 99.372         | +10 37 05.41              | -479.62     | 15 03.82      | 55 16.985      | 20.5        | 22 39       | 4 45        | 11 46       |
|          | 3                    | 10 31 12.011            | 60.862         | + 7 15 12.62              | -526.04     | 14 55.15      | 54 45.158      | 21.5        | 23 42       | 5 30        | 12 10       |
|          | 4                    | 11 17 03.868            | 52.725         | + 3 39 01.39              | -551.67     | 14 49.21      | 54 23.381      | 22.5        | —           | 6 13        | 12 33       |
|          | 5                    | 12 02 07.334            | 56.196         | - 0 03 41.09              | -558.92     | 14 46.12      | 54 12.019      | 23.5        | 0 45        | 6 55        | 12 55       |
|          | 6                    | 12 47 04.205            | 53.072         | - 3 45 46.48              | -548.58     | 14 45.78      | 54 10.782      | 24.5        | 1 48        | 7 37        | 13 17       |
|          | 7                    | 13 32 34.404            | 83.276         | - 7 20 07.03              | -519.95     | 14 47.98      | 54 18.838      | 25.5        | 2 51        | 8 21        | 13 41       |
|          | 8                    | 14 19 13.659            | 62.538         | -10 39 02.98              | -471.16     | 14 52.36      | 54 34.913      | 26.5        | 3 55        | 9 05        | 14 08       |
|          | 9                    | 15 07 30.520            | 79.408         | -13 34 03.72              | -400.00     | 14 58.48      | 54 57.397      | 27.5        | 4 58        | 9 51        | 14 39       |
|          | 10                   | 15 57 42.436            | 91.336         | -15 55 51.92              | -305.02     | 15 05.86      | 55 24.472      | 28.5        | 6 00        | 10 40       | 15 16       |
|          | 11                   | 16 49 51.568            | 100.480        | -17 34 58.93              | -186.95     | 15 13.98      | 55 54.263      | 29.5        | 7 01        | 11 31       | 15 59       |
|          | 12                   | 17 43 42.225            | 91.153         | -18 22 53.37              | - 49.99     | 15 22.36      | 56 25.020      | 0.6         | 7 57        | 12 23       | 16 50       |
|          | 13                   | 18 38 42.544            | 91.487         | -18 13 30.38              | + 97.89     | 15 30.60      | 56 55.295      | 1.6         | 8 47        | 13 16       | 17 49       |
|          | 14                   | 19 34 11.802            | 60.760         | -17 04 32.60              | +246.01     | 15 38.44      | 57 24.062      | 2.6         | 9 30        | 14 10       | 18 55       |
|          | 15                   | 20 29 31.639            | 80.610         | -14 58 10.03              | +383.17     | 15 45.71      | 57 50.736      | 3.6         | 10 08       | 15 03       | 20 05       |
|          | 16                   | 21 24 16.612            | 65.594         | -12 00 45.00              | +499.84     | 15 52.34      | 58 15.082      | 4.6         | 10 41       | 15 55       | 21 18       |
|          | 17                   | 22 18 19.935            | 68.926         | - 8 21 57.39              | +589.14     | 15 58.32      | 58 37.005      | 5.6         | 11 11       | 16 47       | 22 33       |
|          | 18                   | 23 11 53.282            | 102.279        | - 4 13 41.58              | +646.59     | 16 03.57      | 58 56.299      | 6.6         | 11 38       | 17 38       | 23 49       |
|          | 19                   | 0 05 22.226             | 71.229         | + 0 10 39.16              | +669.09     | 16 07.96      | 59 12.409      | 7.6         | 12 06       | 18 29       | —           |
|          | 20                   | 0 59 19.379             | 68.388         | + 4 36 35.18              | +654.14     | 16 11.20      | 59 24.311      | 8.6         | 12 34       | 19 22       | 1 06        |
|          | 21                   | 1 54 16.288             | 65.303         | + 8 48 42.79              | +599.84     | 16 12.90      | 59 30.550      | 9.6         | 13 05       | 20 16       | 2 23        |
|          | 22                   | 2 50 34.391             | 83.416         | +12 31 11.10              | +506.10     | 16 12.62      | 59 29.496      | 10.6        | 13 40       | 21 12       | 3 40        |
|          | 23                   | 3 48 15.905             | 64.942         | +15 28 47.72              | +376.57     | 16 09.96      | 59 19.751      | 11.6        | 14 20       | 22 08       | 4 54        |
|          | 24                   | 4 46 57.517             | 106.569        | +17 28 51.81              | +220.40     | 16 04.75      | 59 00.615      | 12.6        | 15 08       | 23 06       | 6 03        |
|          | 25                   | 5 45 51.472             | 100.540        | +18 23 28.61              | + 52.03     | 15 57.08      | 58 32.450      | 13.6        | 16 04       | —           | 7 05        |
|          | 26                   | 6 43 56.693             | 105.778        | +18 11 06.04              | -111.80     | 15 47.36      | 57 56.790      | 14.6        | 17 05       | 0 02        | 7 57        |
|          | 27                   | 7 40 16.312             | 65.412         | +16 56 36.03              | -256.59     | 15 36.29      | 57 16.169      | 15.6        | 18 09       | 0 56        | 8 41        |
|          | 28                   | 8 34 12.864             | 61.977         | +14 49 34.63              | -373.49     | 15 24.73      | 56 33.726      | 16.6        | 19 16       | 1 48        | 9 17        |
|          | 29                   | 9 25 34.532             | 83.655         | +12 01 53.35              | -459.92     | 15 13.56      | 55 52.746      | 17.6        | 20 22       | 2 37        | 9 47        |
|          | 30                   | 10 14 32.588            | 81.719         | + 8 45 28.20              | -517.69     | 15 03.62      | 55 16.258      | 18.6        | 21 27       | 3 23        | 10 14       |
|          | 31                   | 11 01 34.581            | 83.719         | + 5 11 02.75              | -550.63     | 14 55.59      | 54 46.776      | 19.6        | 22 31       | 4 07        | 10 37       |
|          | 32                   | 11 47 17.470            | 66.614         | + 1 27 45.82              | -562.55     | 14 49.97      | 54 26.165      | 20.6        | 23 34       | 4 50        | 11 00       |

# Momenty wejść Słońca w znaki Zodiaku w 2015 roku

| Data     | TT                               | Znak Zodiaku | $\lambda_{\odot}$ |
|----------|----------------------------------|--------------|-------------------|
| Styczeń  | 20 <sup>d</sup> 9 <sup>h</sup> 7 | Wodnik ♒     | 300°              |
| Luty     | 18 23.8                          | Ryby ♓       | 330               |
| Marzec   | 20 22.8                          | Baran ♈      | 0                 |
| Kwiecień | 20 9.7                           | Byk ♉        | 30                |
| Maj      | 21 8.7                           | Bliźnięta ♊  | 60                |
| Czerwiec | 21 16.6                          | Rak ♋        | 90                |

| Data     | TT                               | Znak Zodiaku | $\lambda_{\odot}$ |
|----------|----------------------------------|--------------|-------------------|
| Lipiec   | 23 <sup>d</sup> 3 <sup>h</sup> 5 | Lew ♌        | 120°              |
| Sierpień | 23 10.6                          | Panna ♍      | 150               |
| Wrzesień | 23 8.3                           | Waga ♎       | 180               |
| Paźdz.   | 23 17.8                          | Skorpion ♏   | 210               |
| Listopad | 22 15.4                          | Strzelec ♏   | 240               |
| Grudzień | 22 4.8                           | Koziorożec ♐ | 270               |

Symboliczne oznaczenia Słońca, Księżyca i planet

☉ Słońce, ☾ Księżyc, ☿ Merkury, ♀ Wenus, ♁ Ziemia, ♀ Mars, ♃ Jowisz, ♄ Saturn, ♅ Uran, ♆ Neptun

## Planety 2015, 0<sup>h</sup> TT

| Data |    | MERKURY                                           |                |       |     | WENUS                                             |                |       |      | MARS                                              |                |       |     |
|------|----|---------------------------------------------------|----------------|-------|-----|---------------------------------------------------|----------------|-------|------|---------------------------------------------------|----------------|-------|-----|
|      |    | $\alpha_{app}^{CIO}$                              | $\delta_{app}$ | $\pi$ | $R$ | $\alpha_{app}^{CIO}$                              | $\delta_{app}$ | $\pi$ | $R$  | $\alpha_{app}^{CIO}$                              | $\delta_{app}$ | $\pi$ | $R$ |
| I    | 1  | 19 <sup>h</sup> 42 <sup>m</sup> 54.1 <sup>s</sup> | −23°27′56″     | 6.9   | 2.6 | 19 <sup>h</sup> 55 <sup>m</sup> 21.3 <sup>s</sup> | −22°08′24″     | 5.4   | 5.2  | 21 <sup>h</sup> 34 <sup>m</sup> 28.9 <sup>s</sup> | −15°33′16″     | 4.5   | 2.4 |
|      | 11 | 20 44 56.5                                        | −19 19 01      | 8.2   | 3.1 | 20 47 38.1                                        | −19 24 41      | 5.5   | 5.3  | 22 04 46.4                                        | −12 50 06      | 4.4   | 2.3 |
|      | 21 | 21 15 52.6                                        | −14 42 37      | 10.8  | 4.1 | 21 37 47.0                                        | −15 45 30      | 5.7   | 5.4  | 22 34 23.6                                        | − 9 55 01      | 4.3   | 2.3 |
|      | 31 | 20 44 20.9                                        | −14 24 19      | 13.4  | 5.1 | 22 25 48.8                                        | −11 23 27      | 5.8   | 5.5  | 23 03 25.3                                        | − 6 51 32      | 4.2   | 2.2 |
| II   | 10 | 20 11 27.0                                        | −17 06 09      | 12.1  | 4.6 | 23 12 03.8                                        | − 6 31 39      | 6.0   | 5.7  | 23 31 57.4                                        | − 3 43 05      | 4.1   | 2.2 |
|      | 20 | 20 27 03.6                                        | −18 16 19      | 9.9   | 3.8 | 23 57 06.9                                        | − 1 22 55      | 6.2   | 5.8  | 0 00 08.4                                         | − 0 32 51      | 4.0   | 2.1 |
| III  | 2  | 21 09 40.8                                        | −17 10 18      | 8.4   | 3.2 | 0 41 37.4                                         | + 3 50 12      | 6.4   | 6.0  | 0 28 06.2                                         | + 2 36 02      | 3.9   | 2.1 |
|      | 12 | 22 03 43.7                                        | −13 50 57      | 7.5   | 2.9 | 1 26 14.3                                         | + 8 55 25      | 6.6   | 6.3  | 0 55 58.1                                         | + 5 40 34      | 3.9   | 2.1 |
|      | 22 | 23 03 37.7                                        | − 8 25 27      | 6.9   | 2.6 | 2 11 35.3                                         | +13 40 44      | 6.9   | 6.6  | 1 23 52.6                                         | + 8 38 06      | 3.8   | 2.0 |
| IV   | 1  | 0 08 39.5                                         | − 1 03 49      | 6.6   | 2.5 | 2 58 07.2                                         | +17 54 08      | 7.3   | 6.9  | 1 51 55.9                                         | +11 26 00      | 3.7   | 2.0 |
|      | 11 | 1 20 31.8                                         | + 7 47 54      | 6.6   | 2.5 | 3 46 00.4                                         | +21 23 55      | 7.7   | 7.3  | 2 20 12.8                                         | +14 01 51      | 3.7   | 2.0 |
|      | 21 | 2 38 00.1                                         | +16 35 19      | 7.3   | 2.8 | 4 35 06.5                                         | +23 59 45      | 8.2   | 7.8  | 2 48 48.0                                         | +16 23 30      | 3.6   | 1.9 |
| V    | 1  | 3 47 46.4                                         | +22 28 33      | 8.9   | 3.4 | 5 24 49.2                                         | +25 33 49      | 8.8   | 8.3  | 3 17 42.7                                         | +18 28 56      | 3.6   | 1.9 |
|      | 11 | 4 33 08.9                                         | +24 22 36      | 11.5  | 4.4 | 6 14 07.0                                         | +26 02 10      | 9.5   | 9.0  | 3 46 56.3                                         | +20 16 24      | 3.5   | 1.9 |
|      | 21 | 4 45 09.5                                         | +23 00 02      | 14.5  | 5.5 | 7 01 48.4                                         | +25 25 53      | 10.4  | 9.9  | 4 16 27.0                                         | +21 44 30      | 3.5   | 1.9 |
|      | 31 | 4 28 59.8                                         | +19 37 36      | 16.0  | 6.1 | 7 46 37.8                                         | +23 51 10      | 11.5  | 10.9 | 4 46 09.2                                         | +22 52 08      | 3.5   | 1.8 |
| VI   | 10 | 4 13 15.8                                         | +17 05 39      | 14.6  | 5.6 | 8 27 24.5                                         | +21 28 22      | 12.9  | 12.2 | 5 15 56.2                                         | +23 38 37      | 3.4   | 1.8 |
|      | 20 | 4 22 43.1                                         | +17 34 36      | 11.8  | 4.5 | 9 03 07.4                                         | +18 30 36      | 14.6  | 13.8 | 5 45 40.9                                         | +24 03 41      | 3.4   | 1.8 |
|      | 30 | 5 01 33.5                                         | +20 17 12      | 9.3   | 3.6 | 9 32 32.5                                         | +15 13 35      | 16.8  | 15.9 | 6 15 13.7                                         | +24 07 31      | 3.4   | 1.8 |
| VII  | 10 | 6 08 47.4                                         | +22 59 25      | 7.6   | 2.9 | 9 53 53.9                                         | +11 55 36      | 19.6  | 18.6 | 6 44 26.1                                         | +23 50 44      | 3.4   | 1.8 |
|      | 20 | 7 37 19.8                                         | +22 47 36      | 6.7   | 2.6 | 10 04 45.7                                        | + 8 58 57      | 23.0  | 21.8 | 7 13 11.2                                         | +23 14 18      | 3.4   | 1.8 |
|      | 30 | 9 04 52.4                                         | +18 29 51      | 6.6   | 2.5 | 10 02 09.1                                        | + 6 53 05      | 26.7  | 25.4 | 7 41 21.6                                         | +22 19 32      | 3.4   | 1.8 |
| VIII | 9  | 10 17 21.6                                        | +11 53 01      | 6.9   | 2.6 | 9 45 21.5                                         | + 6 09 18      | 29.7  | 28.2 | 8 08 53.3                                         | +21 07 57      | 3.4   | 1.8 |
|      | 19 | 11 15 48.7                                        | + 4 43 36      | 7.5   | 2.9 | 9 21 11.9                                         | + 6 55 06      | 30.4  | 28.8 | 8 35 44.2                                         | +19 41 17      | 3.5   | 1.8 |
|      | 29 | 12 02 56.6                                        | − 1 57 49      | 8.5   | 3.2 | 9 02 42.4                                         | + 8 31 35      | 28.2  | 26.7 | 9 01 52.4                                         | +18 01 21      | 3.5   | 1.9 |
| IX   | 8  | 12 37 41.6                                        | − 7 19 55      | 9.9   | 3.8 | 8 58 52.0                                         | +10 01 22      | 24.6  | 23.4 | 9 27 19.3                                         | +16 09 59      | 3.5   | 1.9 |
|      | 18 | 12 51 41.9                                        | − 9 53 49      | 11.9  | 4.5 | 9 09 57.7                                         | +10 49 11      | 21.1  | 20.0 | 9 52 07.4                                         | +14 09 01      | 3.6   | 1.9 |
|      | 28 | 12 31 05.1                                        | − 6 51 51      | 13.5  | 5.2 | 9 32 16.8                                         | +10 42 18      | 18.2  | 17.2 | 10 16 18.7                                        | +12 00 18      | 3.7   | 1.9 |
| X    | 8  | 12 03 18.8                                        | − 0 28 50      | 11.6  | 4.4 | 10 02 11.5                                        | + 9 38 25      | 15.8  | 15.0 | 10 39 57.8                                        | + 9 45 33      | 3.7   | 2.0 |
|      | 18 | 12 25 54.3                                        | − 0 48 56      | 8.6   | 3.3 | 10 36 54.7                                        | + 7 41 11      | 13.9  | 13.2 | 11 03 08.6                                        | + 7 26 30      | 3.8   | 2.0 |
|      | 28 | 13 20 32.8                                        | − 6 34 32      | 7.0   | 2.7 | 11 14 36.4                                        | + 4 57 54      | 12.5  | 11.8 | 11 25 54.5                                        | + 5 04 52      | 3.9   | 2.1 |
| XI   | 7  | 14 22 04.4                                        | −13 12 35      | 6.3   | 2.4 | 11 54 17.7                                        | + 1 37 50      | 11.3  | 10.7 | 11 48 20.2                                        | + 2 42 10      | 4.1   | 2.2 |
|      | 17 | 15 25 16.4                                        | −18 55 45      | 6.1   | 2.3 | 12 35 28.9                                        | − 2 07 45      | 10.3  | 9.7  | 12 10 29.0                                        | + 0 20 00      | 4.2   | 2.2 |
|      | 27 | 16 30 29.3                                        | −23 06 17      | 6.1   | 2.3 | 13 18 02.9                                        | − 6 06 31      | 9.5   | 9.0  | 12 32 23.1                                        | − 2 00 04      | 4.4   | 2.3 |
| XII  | 7  | 17 37 57.9                                        | −25 20 24      | 6.4   | 2.4 | 14 02 10.8                                        | −10 05 45      | 8.8   | 8.3  | 12 54 05.5                                        | − 4 16 39      | 4.6   | 2.4 |
|      | 17 | 18 45 40.4                                        | −25 16 58      | 7.0   | 2.7 | 14 48 06.1                                        | −13 51 55      | 8.2   | 7.8  | 13 15 36.3                                        | − 6 28 17      | 4.8   | 2.6 |
|      | 27 | 19 45 30.6                                        | −22 51 10      | 8.4   | 3.2 | 15 36 00.0                                        | −17 11 22      | 7.8   | 7.4  | 13 36 54.6                                        | − 8 33 36      | 5.1   | 2.7 |

**Planety 2015, 0<sup>h</sup> TT**

| Data |    | JOWISZ                                            |                |       |       | SATURN                                             |                |       |      |
|------|----|---------------------------------------------------|----------------|-------|-------|----------------------------------------------------|----------------|-------|------|
|      |    | $\alpha_{app}^{CIO}$                              | $\delta_{app}$ | $\pi$ | $R$   | $\alpha_{app}^{CIO}$                               | $\delta_{app}$ | $\pi$ | $R$  |
| I    | 1  | 9 <sup>h</sup> 36 <sup>m</sup> 53 <sup>s</sup> .3 | +15°03'36"     | 1".9  | 20".3 | 15 <sup>h</sup> 55 <sup>m</sup> 47 <sup>s</sup> .7 | −18°26'20"     | 0".8  | 6".9 |
|      | 21 | 9 29 13.3                                         | +15 45 15      | 2.0   | 21.0  | 16 03 22.6                                         | −18 46 10      | 0.8   | 7.1  |
| II   | 10 | 9 19 03.0                                         | +16 35 52      | 2.0   | 21.2  | 16 09 00.4                                         | −18 58 45      | 0.9   | 7.3  |
| III  | 2  | 9 09 15.4                                         | +17 20 56      | 2.0   | 20.8  | 16 12 10.4                                         | −19 03 50      | 0.9   | 7.5  |
|      | 22 | 9 02 34.4                                         | +17 49 18      | 1.9   | 19.9  | 16 12 34.9                                         | −19 01 36      | 0.9   | 7.8  |
| IV   | 11 | 9 00 35.5                                         | +17 56 12      | 1.8   | 18.8  | 16 10 15.8                                         | −18 52 50      | 1.0   | 8.0  |
| V    | 1  | 9 03 35.3                                         | +17 41 40      | 1.7   | 17.7  | 16 05 42.2                                         | −18 38 58      | 1.0   | 8.2  |
|      | 21 | 9 10 59.8                                         | +17 07 41      | 1.6   | 16.7  | 15 59 48.9                                         | −18 22 24      | 1.0   | 8.2  |
| VI   | 10 | 9 21 54.6                                         | +16 16 44      | 1.5   | 15.8  | 15 53 47.4                                         | −18 06 24      | 1.0   | 8.2  |
|      | 30 | 9 35 23.0                                         | +15 11 18      | 1.4   | 15.2  | 15 48 48.8                                         | −17 54 27      | 1.0   | 8.0  |
| VII  | 20 | 9 50 34.4                                         | +13 54 00      | 1.4   | 14.7  | 15 45 48.8                                         | −17 49 26      | 0.9   | 7.8  |
| VIII | 9  | 10 06 45.5                                        | +12 27 42      | 1.4   | 14.5  | 15 45 18.8                                         | −17 52 49      | 0.9   | 7.6  |
|      | 29 | 10 23 18.7                                        | +10 55 38      | 1.4   | 14.4  | 15 47 26.7                                         | −18 04 34      | 0.9   | 7.3  |
| IX   | 18 | 10 39 39.0                                        | + 9 21 30      | 1.4   | 14.5  | 15 52 02.5                                         | −18 23 22      | 0.8   | 7.1  |
| X    | 8  | 10 55 11.5                                        | + 7 49 41      | 1.4   | 14.8  | 15 58 44.9                                         | −18 47 08      | 0.8   | 6.9  |
|      | 28 | 11 09 18.1                                        | + 6 25 10      | 1.5   | 15.3  | 16 07 05.4                                         | −19 13 25      | 0.8   | 6.8  |
| XI   | 17 | 11 21 15.6                                        | + 5 13 37      | 1.5   | 16.0  | 16 16 30.7                                         | −19 39 49      | 0.8   | 6.7  |
| XII  | 7  | 11 30 14.5                                        | + 4 21 10      | 1.6   | 16.9  | 16 26 24.6                                         | −20 04 14      | 0.8   | 6.7  |
|      | 27 | 11 35 23.9                                        | + 3 53 44      | 1.7   | 18.0  | 16 36 08.7                                         | −20 25 05      | 0.8   | 6.8  |
| Data |    | URAN                                              |                |       |       | NEPTUN                                             |                |       |      |
|      |    | $\alpha_{app}^{CIO}$                              | $\delta_{app}$ | $\pi$ | $R$   | $\alpha_{app}^{CIO}$                               | $\delta_{app}$ | $\pi$ | $R$  |
| I    | 1  | 0 <sup>h</sup> 46 <sup>m</sup> 40 <sup>s</sup> .2 | + 4°22'22"     | 0".4  | 1".8  | 22 <sup>h</sup> 29 <sup>m</sup> 07 <sup>s</sup> .1 | −10°13'03"     | 0".3  | 1".1 |
|      | 21 | 0 47 54.7                                         | + 4 31 04      | 0.4   | 1.7   | 22 31 16.7                                         | −10 00 14      | 0.3   | 1.1  |
| II   | 10 | 0 50 18.3                                         | + 4 46 53      | 0.4   | 1.7   | 22 33 54.3                                         | − 9 44 46      | 0.3   | 1.1  |
| III  | 2  | 0 53 37.1                                         | + 5 08 16      | 0.4   | 1.7   | 22 36 44.6                                         | − 9 28 06      | 0.3   | 1.1  |
|      | 22 | 0 57 32.9                                         | + 5 33 11      | 0.4   | 1.7   | 22 39 32.2                                         | − 9 11 48      | 0.3   | 1.1  |
| IV   | 11 | 1 01 45.6                                         | + 5 59 30      | 0.4   | 1.7   | 22 42 01.9                                         | − 8 57 20      | 0.3   | 1.1  |
| V    | 1  | 1 05 54.6                                         | + 6 25 04      | 0.4   | 1.7   | 22 44 01.0                                         | − 8 46 01      | 0.3   | 1.1  |
|      | 21 | 1 09 40.2                                         | + 6 47 51      | 0.4   | 1.7   | 22 45 19.1                                         | − 8 38 52      | 0.3   | 1.1  |
| VI   | 10 | 1 12 44.4                                         | + 7 06 09      | 0.4   | 1.7   | 22 45 50.3                                         | − 8 36 29      | 0.3   | 1.1  |
|      | 30 | 1 14 52.0                                         | + 7 18 31      | 0.4   | 1.7   | 22 45 32.9                                         | − 8 38 58      | 0.3   | 1.1  |
| VII  | 20 | 1 15 52.1                                         | + 7 24 00      | 0.4   | 1.8   | 22 44 30.9                                         | − 8 45 53      | 0.3   | 1.1  |
| VIII | 9  | 1 15 40.0                                         | + 7 22 13      | 0.5   | 1.8   | 22 42 53.5                                         | − 8 56 11      | 0.3   | 1.2  |
|      | 29 | 1 14 18.7                                         | + 7 13 34      | 0.5   | 1.8   | 22 40 55.0                                         | − 9 08 23      | 0.3   | 1.2  |
| IX   | 18 | 1 12 00.8                                         | + 6 59 20      | 0.5   | 1.8   | 22 38 53.0                                         | − 9 20 39      | 0.3   | 1.2  |
| X    | 8  | 1 09 08.0                                         | + 6 41 43      | 0.5   | 1.8   | 22 37 06.3                                         | − 9 31 10      | 0.3   | 1.1  |
|      | 28 | 1 06 08.6                                         | + 6 23 38      | 0.5   | 1.8   | 22 35 51.7                                         | − 9 38 17      | 0.3   | 1.1  |
| XI   | 17 | 1 03 33.1                                         | + 6 08 10      | 0.5   | 1.8   | 22 35 21.6                                         | − 9 40 54      | 0.3   | 1.1  |
| XII  | 7  | 1 01 48.2                                         | + 5 58 03      | 0.5   | 1.8   | 22 35 42.4                                         | − 9 38 26      | 0.3   | 1.1  |
|      | 27 | 1 01 12.1                                         | + 5 55 09      | 0.4   | 1.8   | 22 36 53.8                                         | − 9 31 01      | 0.3   | 1.1  |

**Fazy Księżyca 2015 w TT**

| Miesiąc  | Pełnia                                          | III kwadra                                      | Nów (lunacja)                                          | I kwadra                                        | Pełnia                                   |
|----------|-------------------------------------------------|-------------------------------------------------|--------------------------------------------------------|-------------------------------------------------|------------------------------------------|
| Styczeń  | 05 <sup>d</sup> 04 <sup>h</sup> 55 <sup>m</sup> | 13 <sup>d</sup> 09 <sup>h</sup> 47 <sup>m</sup> | 20 <sup>d</sup> 13 <sup>h</sup> 15 <sup>m</sup> (1139) | 27 <sup>d</sup> 04 <sup>h</sup> 49 <sup>m</sup> | <sup>d</sup> — <sup>h</sup> <sup>m</sup> |
| Luty     | 03 23 10                                        | 12 03 51                                        | 18 23 48 (1140)                                        | 25 17 15                                        | —                                        |
| Marzec   | 05 18 06                                        | 13 17 49                                        | 20 09 37 (1141)                                        | 27 07 44                                        | —                                        |
| Kwiecień | 04 12 06                                        | 12 03 46                                        | 18 18 58 (1142)                                        | 25 23 56                                        | —                                        |
| Maj      | 04 03 43                                        | 11 10 37                                        | 18 04 14 (1143)                                        | 25 17 20                                        | —                                        |
| Czerwiec | 02 16 20                                        | 09 15 42                                        | 16 14 07 (1144)                                        | 24 11 03                                        | —                                        |
| Lipiec   | 02 02 21                                        | 08 20 25                                        | 16 01 26 (1145)                                        | 24 04 05                                        | 31 10 44                                 |
| Sierpień | —                                               | 07 02 04                                        | 14 14 54 (1146)                                        | 22 19 32                                        | 29 18 36                                 |
| Wrzesień | —                                               | 05 09 55                                        | 13 06 42 (1147)                                        | 21 09 01                                        | 28 02 51                                 |
| Paźdz.   | —                                               | 04 21 08                                        | 13 00 06 (1148)                                        | 20 20 33                                        | 27 12 06                                 |
| Listopad | —                                               | 03 12 25                                        | 11 17 48 (1149)                                        | 19 06 28                                        | 25 22 45                                 |
| Grudzień | —                                               | 03 07 41                                        | 11 10 31 (1150)                                        | 18 15 15                                        | 25 11 13                                 |

**Perigeum Księżyca 2015**

**w TT**

**Apogeum Księżyca 2015**

|          |                                 |          |                                |          |                                |          |                                 |
|----------|---------------------------------|----------|--------------------------------|----------|--------------------------------|----------|---------------------------------|
| Styczeń  | 21 <sup>d</sup> 20 <sup>h</sup> | Sierpień | 2 <sup>d</sup> 10 <sup>h</sup> | Styczeń  | 9 <sup>d</sup> 18 <sup>h</sup> | Lipiec   | 21 <sup>d</sup> 11 <sup>h</sup> |
| Luty     | 19 07                           | Sierpień | 30 15                          | Luty     | 6 06                           | Sierpień | 18 03                           |
| Marzec   | 19 20                           | Wrzesień | 28 02                          | Marzec   | 5 08                           | Wrzesień | 14 11                           |
| Kwiecień | 17 04                           | Paźdz.   | 26 13                          | Kwiecień | 1 13                           | Paźdz.   | 11 13                           |
| Maj      | 15 00                           | Listopad | 23 20                          | Kwiecień | 29 04                          | Listopad | 7 22                            |
| Czerwiec | 10 05                           | Grudzień | 21 09                          | Maj      | 26 22                          | Grudzień | 5 15                            |
| Lipiec   | 5 19                            |          |                                | Czerwiec | 23 17                          |          |                                 |

Tablice do obliczania czasu wschodu i zachodu (w CSE) Słońca poza Warszawą

| Data | $\varphi$ | wschód             |                    |                   |                   |                   |                    | zachód             |                    |                    |                   |                   |                   |                    |                    |
|------|-----------|--------------------|--------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|--------------------|--------------------|
|      |           | 49°                | 50°                | 51°               | 52°               | 53°               | 54°                | 55°                | 49°                | 50°                | 51°               | 52°               | 53°               | 54°                | 55°                |
| I    | 1         | -15.2 <sup>m</sup> | -10.7 <sup>m</sup> | -6.1 <sup>m</sup> | -1.1 <sup>m</sup> | +4.1 <sup>m</sup> | + 9.6 <sup>m</sup> | +15.6 <sup>m</sup> | +15.2 <sup>m</sup> | +10.7 <sup>m</sup> | +6.1 <sup>m</sup> | +1.1 <sup>m</sup> | -4.1 <sup>m</sup> | - 9.6 <sup>m</sup> | -15.5 <sup>m</sup> |
|      | 11        | -14.0              | - 9.9              | -5.6              | -1.0              | +3.8              | + 8.9              | +14.3              | +14.0              | + 9.9              | +5.6              | +1.0              | -3.8              | - 8.8              | -14.3              |
|      | 21        | -12.3              | - 8.7              | -4.9              | -0.9              | +3.3              | + 7.8              | +12.5              | +12.3              | + 8.7              | +4.9              | +0.9              | -3.3              | - 7.7              | -12.4              |
|      | 31        | -10.3              | - 7.3              | -4.1              | -0.8              | +2.8              | + 6.5              | +10.4              | +10.3              | + 7.2              | +4.1              | +0.8              | -2.7              | - 6.4              | -10.3              |
| II   | 10        | - 8.2              | - 5.8              | -3.2              | -0.6              | +2.2              | + 5.1              | + 8.2              | + 8.1              | + 5.7              | +3.2              | +0.6              | -2.1              | - 5.0              | - 8.1              |
|      | 20        | - 6.0              | - 4.2              | -2.4              | -0.4              | +1.6              | + 3.7              | + 5.9              | + 5.9              | + 4.1              | +2.3              | +0.4              | -1.5              | - 3.6              | - 5.8              |
| III  | 2         | - 3.7              | - 2.6              | -1.5              | -0.3              | +1.0              | + 2.3              | + 3.7              | + 3.6              | + 2.6              | +1.4              | +0.3              | -1.0              | - 2.2              | - 3.6              |
|      | 12        | - 1.5              | - 1.1              | -0.6              | -0.1              | +0.4              | + 0.9              | + 1.5              | + 1.4              | + 1.0              | +0.6              | +0.1              | -0.4              | - 0.9              | - 1.4              |
|      | 22        | + 0.7              | + 0.5              | +0.3              | +0.1              | -0.2              | - 0.4              | - 0.7              | - 0.8              | - 0.6              | -0.3              | -0.1              | +0.2              | + 0.5              | + 0.8              |
| IV   | 1         | + 2.9              | + 2.0              | +1.2              | +0.2              | -0.8              | - 1.8              | - 2.9              | - 3.0              | - 2.1              | -1.2              | -0.2              | +0.8              | + 1.9              | + 3.0              |
|      | 11        | + 5.1              | + 3.6              | +2.0              | +0.4              | -1.4              | - 3.2              | - 5.1              | - 5.3              | - 3.7              | -2.1              | -0.4              | +1.4              | + 3.3              | + 5.2              |
| V    | 21        | + 7.4              | + 5.2              | +2.9              | +0.5              | -2.0              | - 4.6              | - 7.3              | - 7.5              | - 5.3              | -3.0              | -0.6              | +2.0              | + 4.7              | + 7.5              |
|      | 1         | + 9.6              | + 6.8              | +3.8              | +0.7              | -2.6              | - 6.0              | - 9.6              | - 9.7              | - 6.9              | -3.9              | -0.7              | +2.6              | + 6.1              | + 9.8              |
|      | 11        | +11.8              | + 8.3              | +4.7              | +0.9              | -3.1              | - 7.4              | -11.9              | -11.9              | - 8.4              | -4.7              | -0.9              | +3.2              | + 7.5              | +12.1              |
|      | 21        | +13.8              | + 9.8              | +5.5              | +1.0              | -3.7              | - 8.8              | -14.1              | -13.9              | - 9.9              | -5.6              | -1.0              | +3.7              | + 8.8              | +14.3              |
|      | 31        | +15.5              | +11.0              | +6.2              | +1.2              | -4.2              | - 9.9              | -16.0              | -15.6              | -11.1              | -6.3              | -1.2              | +4.2              | +10.0              | +16.1              |
| VI   | 10        | +16.7              | +11.8              | +6.7              | +1.3              | -4.5              | -10.7              | -17.4              | -16.8              | -11.9              | -6.7              | -1.3              | +4.6              | +10.8              | +17.5              |
|      | 20        | +17.2              | +12.2              | +6.9              | +1.3              | -4.7              | -11.1              | -18.0              | -17.2              | -12.2              | -6.9              | -1.3              | +4.7              | +11.1              | +18.0              |
|      | 30        | +16.9              | +12.0              | +6.8              | +1.3              | -4.6              | -10.9              | -17.7              | -16.9              | -12.0              | -6.8              | -1.3              | +4.6              | +10.9              | +17.6              |
| VII  | 10        | +15.9              | +11.3              | +6.4              | +1.2              | -4.3              | -10.2              | -16.5              | -15.8              | -11.2              | -6.4              | -1.2              | +4.3              | +10.1              | +16.4              |
|      | 20        | +14.4              | +10.2              | +5.7              | +1.1              | -3.9              | - 9.1              | -14.7              | -14.2              | -10.1              | -5.7              | -1.1              | +3.8              | + 9.1              | +14.6              |
| VIII | 30        | +12.4              | + 8.8              | +5.0              | +0.9              | -3.3              | - 7.8              | -12.6              | -12.3              | - 8.7              | -4.9              | -0.9              | +3.3              | + 7.8              | +12.5              |
|      | 9         | +10.3              | + 7.3              | +4.1              | +0.8              | -2.7              | - 6.4              | -10.4              | -10.2              | - 7.2              | -4.0              | -0.8              | +2.7              | + 6.4              | +10.2              |
|      | 19        | + 8.1              | + 5.7              | +3.2              | +0.6              | -2.1              | - 5.0              | - 8.1              | - 8.0              | - 5.6              | -3.2              | -0.6              | +2.1              | + 5.0              | + 8.0              |
|      | 29        | + 5.9              | + 4.1              | +2.3              | +0.4              | -1.6              | - 3.6              | - 5.8              | - 5.7              | - 4.1              | -2.3              | -0.4              | +1.5              | + 3.6              | + 5.7              |
|      | 8         | + 3.7              | + 2.6              | +1.5              | +0.3              | -1.0              | - 2.3              | - 3.6              | - 3.6              | - 2.5              | -1.4              | -0.3              | +0.9              | + 2.2              | + 3.5              |
| IX   | 18        | + 1.5              | + 1.0              | +0.6              | +0.1              | -0.4              | - 0.9              | - 1.5              | - 1.4              | - 1.0              | -0.5              | -0.1              | +0.4              | + 0.8              | + 1.4              |
|      | 28        | - 0.7              | - 0.5              | -0.3              | -0.1              | +0.2              | + 0.4              | + 0.7              | + 0.8              | + 0.6              | +0.3              | +0.1              | -0.2              | - 0.5              | - 0.8              |
|      | 8         | - 2.9              | - 2.0              | -1.1              | -0.2              | +0.8              | + 1.8              | + 2.8              | + 3.0              | + 2.1              | +1.2              | +0.2              | -0.8              | - 1.8              | - 2.9              |
| X    | 18        | - 5.1              | - 3.6              | -2.0              | -0.4              | +1.3              | + 3.1              | + 5.0              | + 5.2              | + 3.7              | +2.1              | +0.4              | -1.4              | - 3.2              | - 5.1              |
|      | 28        | - 7.3              | - 5.1              | -2.9              | -0.5              | +1.9              | + 4.5              | + 7.2              | + 7.4              | + 5.2              | +2.9              | +0.5              | -2.0              | - 4.6              | - 7.3              |
| XI   | 7         | - 9.5              | - 6.7              | -3.8              | -0.7              | +2.5              | + 5.9              | + 9.5              | + 9.6              | + 6.7              | +3.8              | +0.7              | -2.5              | - 6.0              | - 9.6              |
|      | 17        | -11.5              | - 8.2              | -4.6              | -0.9              | +3.1              | + 7.2              | +11.6              | +11.6              | + 8.2              | +4.6              | +0.9              | -3.1              | - 7.3              | -11.7              |
|      | 27        | -13.4              | - 9.5              | -5.3              | -1.0              | +3.6              | + 8.4              | +13.6              | +13.4              | + 9.5              | +5.4              | +1.0              | -3.6              | - 8.5              | -13.7              |
|      | 7         | -14.8              | -10.5              | -5.9              | -1.1              | +4.0              | + 9.4              | +15.1              | +14.8              | +10.5              | +5.9              | +1.1              | -4.0              | - 9.4              | -15.2              |
| XII  | 17        | -15.5              | -11.0              | -6.2              | -1.2              | +4.2              | + 9.9              | +16.0              | +15.5              | +11.0              | +6.2              | +1.2              | -4.2              | - 9.9              | -16.0              |
|      | 27        | -15.5              | -11.0              | -6.2              | -1.2              | +4.2              | + 9.9              | +15.9              | +15.5              | +11.0              | +6.2              | +1.2              | -4.2              | - 9.9              | -15.9              |
|      | 37        | -14.7              | -10.4              | -5.9              | -1.1              | +4.0              | + 9.3              | +15.1              | +14.7              | +10.4              | +5.9              | +1.1              | -3.9              | - 9.3              | -15.0              |
|      |           |                    |                    |                   |                   |                   |                    |                    |                    |                    |                   |                   |                   |                    |                    |

Uwaga: oprócz poprawki z tej tablicy, należy odjąć różnicę długości geograficznej  $\lambda_i - \lambda_{W-wa}$ .

Tablice do obliczania czasu wschodu i zachodu (w CSE) Księżyca poza Warszawą

| $\tau$                         | Szerokość geograficzna $\varphi$ |                    |                    |                   |                   |                    |                    |
|--------------------------------|----------------------------------|--------------------|--------------------|-------------------|-------------------|--------------------|--------------------|
|                                | +49°                             | +50°               | +51°               | +52°              | +53°              | +54°               | +55°               |
| 3 <sup>h</sup> 00 <sup>m</sup> | -24.8 <sup>m</sup>               | -17.7 <sup>m</sup> | -10.1 <sup>m</sup> | -1.9 <sup>m</sup> | +7.0 <sup>m</sup> | +16.8 <sup>m</sup> | +27.6 <sup>m</sup> |
| 10                             | -23.0                            | -16.4              | - 9.3              | -1.8              | +6.4              | +15.3              | +25.1              |
| 20                             | -21.3                            | -15.1              | - 8.6              | -1.6              | +5.9              | +14.0              | +22.9              |
| 30                             | -19.6                            | -14.0              | - 7.9              | -1.5              | +5.4              | +12.8              | +20.8              |
| 40                             | -18.1                            | -12.8              | - 7.3              | -1.4              | +4.9              | +11.7              | +19.0              |
| 3 50                           | -16.6                            | -11.8              | - 6.7              | -1.3              | +4.5              | +10.7              | +17.3              |
| 4 00                           | -15.2                            | -10.8              | - 6.1              | -1.1              | +4.1              | + 9.7              | +15.7              |
| 10                             | -13.9                            | - 9.8              | - 5.5              | -1.0              | +3.7              | + 8.8              | +14.2              |
| 20                             | -12.6                            | - 8.9              | - 5.0              | -0.9              | +3.4              | + 7.9              | +12.8              |
| 30                             | -11.3                            | - 8.0              | - 4.5              | -0.8              | +3.0              | + 7.1              | +11.4              |
| 40                             | -10.1                            | - 7.1              | - 4.0              | -0.8              | +2.7              | + 6.3              | +10.2              |
| 4 50                           | - 8.9                            | - 6.3              | - 3.6              | -0.7              | +2.4              | + 5.6              | + 8.9              |
| 5 00                           | - 7.8                            | - 5.5              | - 3.1              | -0.6              | +2.1              | + 4.8              | + 7.8              |
| 10                             | - 6.7                            | - 4.7              | - 2.6              | -0.5              | +1.8              | + 4.1              | + 6.6              |
| 20                             | - 5.6                            | - 3.9              | - 2.2              | -0.4              | +1.5              | + 3.4              | + 5.5              |
| 30                             | - 4.5                            | - 3.2              | - 1.8              | -0.3              | +1.2              | + 2.8              | + 4.4              |
| 40                             | - 3.4                            | - 2.4              | - 1.4              | -0.3              | +0.9              | + 2.1              | + 3.4              |
| 5 50                           | - 2.4                            | - 1.7              | - 0.9              | -0.2              | +0.6              | + 1.5              | + 2.3              |
| 6 00                           | - 1.3                            | - 0.9              | - 0.5              | -0.1              | +0.3              | + 0.8              | + 1.3              |
| 10                             | - 0.3                            | - 0.2              | - 0.1              | 0.0               | +0.1              | + 0.2              | + 0.3              |
| 20                             | + 0.8                            | + 0.6              | + 0.3              | +0.1              | -0.2              | - 0.5              | - 0.8              |
| 30                             | + 1.8                            | + 1.3              | + 0.7              | +0.1              | -0.5              | - 1.1              | - 1.8              |
| 40                             | + 2.9                            | + 2.0              | + 1.1              | +0.2              | -0.8              | - 1.8              | - 2.9              |
| 6 50                           | + 4.0                            | + 2.8              | + 1.6              | +0.3              | -1.0              | - 2.4              | - 3.9              |
| 7 00                           | + 5.0                            | + 3.5              | + 2.0              | +0.4              | -1.3              | - 3.1              | - 5.0              |
| 10                             | + 6.1                            | + 4.3              | + 2.4              | +0.5              | -1.6              | - 3.8              | - 6.1              |
| 20                             | + 7.2                            | + 5.1              | + 2.9              | +0.5              | -1.9              | - 4.5              | - 7.2              |
| 30                             | + 8.4                            | + 5.9              | + 3.3              | +0.6              | -2.2              | - 5.2              | - 8.4              |
| 40                             | + 9.5                            | + 6.7              | + 3.8              | +0.7              | -2.5              | - 5.9              | - 9.6              |
| 7 50                           | +10.7                            | + 7.6              | + 4.3              | +0.8              | -2.9              | - 6.7              | -10.8              |
| 8 00                           | +12.0                            | + 8.4              | + 4.8              | +0.9              | -3.2              | - 7.5              | -12.1              |
| 10                             | +13.2                            | + 9.4              | + 5.3              | +1.0              | -3.5              | - 8.4              | -13.5              |
| 20                             | +14.5                            | +10.3              | + 5.8              | +1.1              | -3.9              | - 9.2              | -14.9              |
| 30                             | +15.9                            | +11.3              | + 6.4              | +1.2              | -4.3              | -10.2              | -16.4              |
| 40                             | +17.4                            | +12.3              | + 7.0              | +1.3              | -4.7              | -11.2              | -18.1              |
| 8 50                           | +18.9                            | +13.4              | + 7.6              | +1.4              | -5.2              | -12.2              | -19.9              |
| 9 00                           | +20.4                            | +14.5              | + 8.3              | +1.6              | -5.6              | -13.4              | -21.8              |
| 10                             | +22.1                            | +15.8              | + 9.0              | +1.7              | -6.2              | -14.7              | -24.0              |
| 20                             | +23.9                            | +17.1              | + 9.7              | +1.8              | -6.7              | -16.0              | -26.3              |
| 9 30                           | +25.8                            | +18.4              | +10.5              | +2.0              | -7.3              | -17.6              | -29.0              |

$\tau$  odstęp czasu między górowaniem a wschodem lub zachodem a górowaniem Księżyca.

Znaki tablic odnoszą się do wschodu. Dla zachodu należy zmienić znaki na przeciwne.

Uwaga: oprócz poprawki z tej tablicy, należy odjąć różnicę długości geograficznej  $\lambda_i - \lambda_{W-wa}$ .

Poprawki do obliczeń momentów początku i końca zmiernych cywilnego w Warszawie

| <i>Miesiąc</i><br>Dzień | I               | II              | III             | IV              | V               | VI              | VII             | VIII            | IX              | X               | XI              | XII             | <i>Miesiąc</i><br>Dzień |
|-------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------------|
| 1                       | 51 <sup>m</sup> | 46 <sup>m</sup> | 43 <sup>m</sup> | 43 <sup>m</sup> | 49 <sup>m</sup> | 61 <sup>m</sup> | 63 <sup>m</sup> | 53 <sup>m</sup> | 45 <sup>m</sup> | 42 <sup>m</sup> | 45 <sup>m</sup> | 50 <sup>m</sup> | 1                       |
| 11                      | 49              | 45              | 42              | 45              | 53              | 63              | 60              | 50              | 44              | 43              | 46              | 51              | 11                      |
| 21                      | 48              | 43              | 43              | 47              | 57              | 65              | 57              | 47              | 43              | 43              | 48              | 51              | 21                      |

początek brzasku = wschód Słońca - poprawka

koniec zmiernych = zachód Słońca + poprawka



**Wschód i zachód Słońca w 2015 roku w niektórych miastach Polski**  
w CSE

| Data |    | Białystok                      |                                 | Bydgoszcz                      |                                 | Gdańsk                         |                                 | Katowice                       |                                 | Kielce                         |                                 | Koszalin                       |                                 | Kraków                         |                                 | Lublin                         |                                 |
|------|----|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|
|      |    | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           |
| I    | 4  | 7 <sup>h</sup> 41 <sup>m</sup> | 15 <sup>h</sup> 24 <sup>m</sup> | 8 <sup>h</sup> 01 <sup>m</sup> | 15 <sup>h</sup> 44 <sup>m</sup> | 8 <sup>h</sup> 06 <sup>m</sup> | 15 <sup>h</sup> 35 <sup>m</sup> | 7 <sup>h</sup> 43 <sup>m</sup> | 15 <sup>h</sup> 54 <sup>m</sup> | 7 <sup>h</sup> 40 <sup>m</sup> | 15 <sup>h</sup> 45 <sup>m</sup> | 8 <sup>h</sup> 15 <sup>m</sup> | 15 <sup>h</sup> 46 <sup>m</sup> | 7 <sup>h</sup> 39 <sup>m</sup> | 15 <sup>h</sup> 52 <sup>m</sup> | 7 <sup>h</sup> 34 <sup>m</sup> | 15 <sup>h</sup> 36 <sup>m</sup> |
|      | 11 | 7 37                           | 15 33                           | 7 58                           | 15 54                           | 8 02                           | 15 45                           | 7 41                           | 16 03                           | 7 37                           | 15 54                           | 8 11                           | 15 56                           | 7 36                           | 16 00                           | 7 31                           | 15 45                           |
|      | 18 | 7 31                           | 15 45                           | 7 52                           | 16 05                           | 7 55                           | 15 57                           | 7 35                           | 16 13                           | 7 31                           | 16 05                           | 8 04                           | 16 08                           | 7 31                           | 16 11                           | 7 25                           | 15 55                           |
|      | 25 | 7 23                           | 15 57                           | 7 43                           | 16 18                           | 7 46                           | 16 10                           | 7 28                           | 16 25                           | 7 24                           | 16 16                           | 7 55                           | 16 21                           | 7 24                           | 16 22                           | 7 18                           | 16 07                           |
| II   | 1  | 7 12                           | 16 11                           | 7 32                           | 16 31                           | 7 34                           | 16 24                           | 7 19                           | 16 37                           | 7 14                           | 16 28                           | 7 44                           | 16 35                           | 7 15                           | 16 34                           | 7 08                           | 16 19                           |
|      | 8  | 7 00                           | 16 24                           | 7 20                           | 16 45                           | 7 21                           | 16 38                           | 7 08                           | 16 49                           | 7 03                           | 16 41                           | 7 31                           | 16 49                           | 7 04                           | 16 46                           | 6 57                           | 16 32                           |
|      | 15 | 6 46                           | 16 38                           | 7 07                           | 16 58                           | 7 07                           | 16 53                           | 6 56                           | 17 01                           | 6 51                           | 16 53                           | 7 16                           | 17 03                           | 6 52                           | 16 58                           | 6 44                           | 16 45                           |
|      | 22 | 6 31                           | 16 51                           | 6 52                           | 17 12                           | 6 52                           | 17 07                           | 6 43                           | 17 13                           | 6 37                           | 17 06                           | 7 01                           | 17 17                           | 6 39                           | 17 10                           | 6 30                           | 16 57                           |
| III  | 1  | 6 16                           | 17 05                           | 6 36                           | 17 25                           | 6 35                           | 17 21                           | 6 28                           | 17 25                           | 6 23                           | 17 18                           | 6 45                           | 17 31                           | 6 25                           | 17 22                           | 6 16                           | 17 10                           |
|      | 8  | 6 00                           | 17 18                           | 6 20                           | 17 39                           | 6 19                           | 17 35                           | 6 14                           | 17 37                           | 6 08                           | 17 30                           | 6 28                           | 17 45                           | 6 10                           | 17 33                           | 6 00                           | 17 22                           |
|      | 15 | 5 43                           | 17 31                           | 6 04                           | 17 51                           | 6 01                           | 17 48                           | 5 59                           | 17 48                           | 5 52                           | 17 41                           | 6 11                           | 17 58                           | 5 55                           | 17 44                           | 5 45                           | 17 34                           |
|      | 22 | 5 26                           | 17 44                           | 5 47                           | 18 04                           | 5 44                           | 18 02                           | 5 43                           | 17 59                           | 5 37                           | 17 53                           | 5 54                           | 18 12                           | 5 40                           | 17 56                           | 5 29                           | 17 45                           |
| IV   | 29 | 5 10                           | 17 56                           | 5 30                           | 18 17                           | 5 26                           | 18 15                           | 5 28                           | 18 11                           | 5 21                           | 18 05                           | 5 36                           | 18 25                           | 5 24                           | 18 07                           | 5 13                           | 17 57                           |
|      | 5  | 4 53                           | 18 09                           | 5 13                           | 18 29                           | 5 09                           | 18 28                           | 5 13                           | 18 22                           | 5 06                           | 18 16                           | 5 19                           | 18 38                           | 5 09                           | 18 18                           | 4 58                           | 18 09                           |
|      | 12 | 4 36                           | 18 21                           | 4 57                           | 18 42                           | 4 52                           | 18 42                           | 4 58                           | 18 33                           | 4 50                           | 18 27                           | 5 02                           | 18 51                           | 4 55                           | 18 29                           | 4 42                           | 18 20                           |
|      | 19 | 4 21                           | 18 34                           | 4 41                           | 18 54                           | 4 35                           | 18 55                           | 4 43                           | 18 44                           | 4 36                           | 18 39                           | 4 46                           | 19 04                           | 4 40                           | 18 40                           | 4 27                           | 18 32                           |
| V    | 26 | 4 05                           | 18 46                           | 4 26                           | 19 07                           | 4 20                           | 19 08                           | 4 30                           | 18 55                           | 4 22                           | 18 50                           | 4 30                           | 19 18                           | 4 27                           | 18 51                           | 4 13                           | 18 43                           |
|      | 3  | 3 51                           | 18 59                           | 4 12                           | 19 19                           | 4 05                           | 19 21                           | 4 17                           | 19 06                           | 4 09                           | 19 01                           | 4 15                           | 19 31                           | 4 14                           | 19 01                           | 4 00                           | 18 55                           |
|      | 10 | 3 38                           | 19 11                           | 3 58                           | 19 31                           | 3 51                           | 19 34                           | 4 05                           | 19 16                           | 3 57                           | 19 12                           | 4 01                           | 19 43                           | 4 02                           | 19 12                           | 3 48                           | 19 06                           |
|      | 17 | 3 26                           | 19 22                           | 3 47                           | 19 43                           | 3 38                           | 19 46                           | 3 55                           | 19 27                           | 3 46                           | 19 23                           | 3 49                           | 19 55                           | 3 52                           | 19 22                           | 3 37                           | 19 16                           |
| VI   | 24 | 3 16                           | 19 33                           | 3 37                           | 19 54                           | 3 28                           | 19 58                           | 3 46                           | 19 36                           | 3 37                           | 19 32                           | 3 39                           | 20 06                           | 3 44                           | 19 31                           | 3 28                           | 19 26                           |
|      | 31 | 3 09                           | 19 42                           | 3 29                           | 20 03                           | 3 20                           | 20 07                           | 3 40                           | 19 44                           | 3 30                           | 19 40                           | 3 30                           | 20 16                           | 3 37                           | 19 39                           | 3 21                           | 19 35                           |
|      | 7  | 3 03                           | 19 50                           | 3 24                           | 20 10                           | 3 14                           | 20 15                           | 3 35                           | 19 51                           | 3 26                           | 19 47                           | 3 25                           | 20 24                           | 3 33                           | 19 46                           | 3 16                           | 19 42                           |
|      | 14 | 3 00                           | 19 55                           | 3 21                           | 20 16                           | 3 11                           | 20 21                           | 3 33                           | 19 55                           | 3 23                           | 19 52                           | 3 22                           | 20 30                           | 3 30                           | 19 51                           | 3 14                           | 19 46                           |
| VII  | 21 | 3 00                           | 19 58                           | 3 21                           | 20 18                           | 3 10                           | 20 24                           | 3 33                           | 19 58                           | 3 24                           | 19 55                           | 3 21                           | 20 33                           | 3 31                           | 19 53                           | 3 14                           | 19 49                           |
|      | 28 | 3 03                           | 19 58                           | 3 24                           | 20 19                           | 3 13                           | 20 24                           | 3 36                           | 19 58                           | 3 26                           | 19 55                           | 3 24                           | 20 33                           | 3 33                           | 19 54                           | 3 16                           | 19 49                           |
|      | 5  | 3 08                           | 19 55                           | 3 29                           | 20 16                           | 3 18                           | 20 21                           | 3 40                           | 19 56                           | 3 31                           | 19 53                           | 3 29                           | 20 30                           | 3 38                           | 19 52                           | 3 21                           | 19 47                           |
|      | 12 | 3 15                           | 19 50                           | 3 36                           | 20 11                           | 3 26                           | 20 15                           | 3 47                           | 19 52                           | 3 37                           | 19 48                           | 3 37                           | 20 24                           | 3 44                           | 19 47                           | 3 28                           | 19 42                           |
| VIII | 19 | 3 24                           | 19 42                           | 3 45                           | 20 03                           | 3 36                           | 20 07                           | 3 54                           | 19 45                           | 3 45                           | 19 41                           | 3 46                           | 20 16                           | 3 52                           | 19 41                           | 3 36                           | 19 36                           |
|      | 26 | 3 34                           | 19 33                           | 3 55                           | 19 53                           | 3 46                           | 19 56                           | 4 03                           | 19 37                           | 3 54                           | 19 33                           | 3 57                           | 20 05                           | 4 01                           | 19 32                           | 3 45                           | 19 27                           |
|      | 2  | 3 45                           | 19 21                           | 4 06                           | 19 41                           | 3 58                           | 19 44                           | 4 13                           | 19 26                           | 4 04                           | 19 22                           | 4 09                           | 19 53                           | 4 10                           | 19 22                           | 3 55                           | 19 16                           |
|      | 9  | 3 57                           | 19 08                           | 4 18                           | 19 28                           | 4 10                           | 19 30                           | 4 23                           | 19 15                           | 4 15                           | 19 10                           | 4 21                           | 19 39                           | 4 20                           | 19 10                           | 4 06                           | 19 04                           |
| IX   | 16 | 4 09                           | 18 53                           | 4 30                           | 19 14                           | 4 23                           | 19 15                           | 4 34                           | 19 02                           | 4 26                           | 18 57                           | 4 33                           | 19 25                           | 4 31                           | 18 58                           | 4 17                           | 18 50                           |
|      | 23 | 4 21                           | 18 38                           | 4 42                           | 18 59                           | 4 36                           | 18 59                           | 4 44                           | 18 48                           | 4 36                           | 18 43                           | 4 46                           | 19 09                           | 4 41                           | 18 44                           | 4 28                           | 18 36                           |
|      | 30 | 4 33                           | 18 22                           | 4 54                           | 18 43                           | 4 48                           | 18 43                           | 4 55                           | 18 33                           | 4 47                           | 18 28                           | 4 59                           | 18 52                           | 4 51                           | 18 29                           | 4 39                           | 18 21                           |
|      | 6  | 4 45                           | 18 06                           | 5 06                           | 18 26                           | 5 01                           | 18 25                           | 5 05                           | 18 18                           | 4 58                           | 18 13                           | 5 11                           | 18 35                           | 5 02                           | 18 15                           | 4 50                           | 18 06                           |
| X    | 13 | 4 57                           | 17 49                           | 5 18                           | 18 09                           | 5 14                           | 18 08                           | 5 16                           | 18 03                           | 5 09                           | 17 57                           | 5 24                           | 18 18                           | 5 12                           | 17 59                           | 5 01                           | 17 50                           |
|      | 20 | 5 09                           | 17 32                           | 5 30                           | 17 52                           | 5 26                           | 17 50                           | 5 26                           | 17 48                           | 5 20                           | 17 41                           | 5 36                           | 18 00                           | 5 23                           | 17 44                           | 5 12                           | 17 34                           |
|      | 27 | 5 21                           | 17 15                           | 5 42                           | 17 36                           | 5 39                           | 17 33                           | 5 37                           | 17 32                           | 5 31                           | 17 25                           | 5 49                           | 17 43                           | 5 33                           | 17 28                           | 5 23                           | 17 18                           |
|      | 4  | 5 33                           | 16 58                           | 5 54                           | 17 19                           | 5 52                           | 17 15                           | 5 48                           | 17 17                           | 5 42                           | 17 10                           | 6 02                           | 17 25                           | 5 44                           | 17 13                           | 5 34                           | 17 02                           |
| XI   | 11 | 5 46                           | 16 42                           | 6 06                           | 17 02                           | 6 05                           | 16 58                           | 5 59                           | 17 02                           | 5 53                           | 16 55                           | 6 15                           | 17 08                           | 5 55                           | 16 58                           | 5 46                           | 16 46                           |
|      | 18 | 5 58                           | 16 26                           | 6 19                           | 16 47                           | 6 19                           | 16 42                           | 6 10                           | 16 47                           | 6 05                           | 16 40                           | 6 28                           | 16 52                           | 6 06                           | 16 44                           | 5 58                           | 16 32                           |
|      | 25 | 6 11                           | 16 11                           | 6 32                           | 16 31                           | 6 32                           | 16 26                           | 6 22                           | 16 34                           | 6 17                           | 16 26                           | 6 42                           | 16 36                           | 6 18                           | 16 30                           | 6 10                           | 16 17                           |
|      | 1  | 6 25                           | 15 57                           | 6 45                           | 16 17                           | 6 46                           | 16 11                           | 6 33                           | 16 21                           | 6 29                           | 16 13                           | 6 56                           | 16 21                           | 6 29                           | 16 18                           | 6 22                           | 16 04                           |
| XII  | 8  | 6 38                           | 15 44                           | 6 58                           | 16 04                           | 7 00                           | 15 57                           | 6 45                           | 16 09                           | 6 41                           | 16 01                           | 7 09                           | 16 08                           | 6 41                           | 16 06                           | 6 34                           | 15 52                           |
|      | 15 | 6 51                           | 15 33                           | 7 11                           | 15 53                           | 7 14                           | 15 45                           | 6 57                           | 16 00                           | 6 52                           | 15 51                           | 7 23                           | 15 56                           | 6 52                           | 15 57                           | 6 46                           | 15 42                           |
|      | 22 | 7 03                           | 15 23                           | 7 24                           | 15 44                           | 7 27                           | 15 35                           | 7 08                           | 15 51                           | 7 04                           | 15 43                           | 7 36                           | 15 46                           | 7 04                           | 15 49                           | 6 58                           | 15 34                           |
|      | 29 | 7 15                           | 15 16                           | 7 35                           | 15 37                           | 7 39                           | 15 28                           | 7 18                           | 15 45                           | 7 14                           | 15 36                           | 7 48                           | 15 39                           | 7 14                           | 15 43                           | 7 08                           | 15 27                           |
| XII  | 6  | 7 25                           | 15 11                           | 7 45                           | 15 32                           | 7 49                           | 15 23                           | 7 28                           | 15 42                           | 7 24                           | 15 33                           | 7 58                           | 15 34                           | 7 23                           | 15 39                           | 7 18                           | 15 23                           |
|      | 13 | 7 33                           | 15 10                           | 7 53                           | 15 30                           | 7 58                           | 15 21                           | 7 35                           | 15 41                           | 7 31                           | 15 31                           | 8 07                           | 15 32                           | 7 30                           | 15 38                           | 7 25                           | 15 22                           |
|      | 20 | 7 39                           | 15 11                           | 7 59                           | 15 32                           | 8 04                           | 15 22                           | 7 40                           | 15 42                           | 7 37                           | 15 33                           | 8 13                           | 15 33                           | 7 36                           | 15 40                           | 7 31                           | 15 23                           |
|      | 27 | 7 41                           | 15 15                           | 8 02                           | 15 36                           | 8 06                           | 15 26                           | 7 43                           | 15 47                           | 7 40                           | 15 37                           | 8 15                           | 15 37                           | 7 39                           | 15 44                           | 7 34                           | 15 28                           |

**Wschód i zachód Słońca w 2015 roku w niektórych miastach Polski**  
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| Data   | Łódź                           |                                 | Olsztyn                        |                                 | Opole                          |                                 | Poznań                         |                                 | Rzeszów                        |                                 | Szczecin                       |                                 | Wrocław                        |                                 | Zielona Góra                   |                                 |
|--------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|
|        | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           | wsch.                          | zach.                           |
| I 4    | 7 <sup>h</sup> 49 <sup>m</sup> | 15 <sup>h</sup> 46 <sup>m</sup> | 7 <sup>h</sup> 55 <sup>m</sup> | 15 <sup>h</sup> 31 <sup>m</sup> | 7 <sup>h</sup> 49 <sup>m</sup> | 15 <sup>h</sup> 57 <sup>m</sup> | 8 <sup>h</sup> 02 <sup>m</sup> | 15 <sup>h</sup> 53 <sup>m</sup> | 7 <sup>h</sup> 30 <sup>m</sup> | 15 <sup>h</sup> 43 <sup>m</sup> | 8 <sup>h</sup> 17 <sup>m</sup> | 15 <sup>h</sup> 57 <sup>m</sup> | 7 <sup>h</sup> 55 <sup>m</sup> | 15 <sup>h</sup> 58 <sup>m</sup> | 8 <sup>h</sup> 05 <sup>m</sup> | 16 <sup>h</sup> 01 <sup>m</sup> |
| 11     | 7 45                           | 15 55                           | 7 51                           | 15 41                           | 7 47                           | 16 06                           | 7 59                           | 16 02                           | 7 28                           | 15 52                           | 8 13                           | 16 06                           | 7 52                           | 16 07                           | 8 02                           | 16 10                           |
| 18     | 7 40                           | 16 06                           | 7 45                           | 15 52                           | 7 41                           | 16 16                           | 7 53                           | 16 13                           | 7 23                           | 16 02                           | 8 07                           | 16 18                           | 7 47                           | 16 18                           | 7 56                           | 16 21                           |
| 25     | 7 32                           | 16 18                           | 7 36                           | 16 05                           | 7 34                           | 16 28                           | 7 44                           | 16 25                           | 7 15                           | 16 14                           | 7 58                           | 16 31                           | 7 39                           | 16 30                           | 7 48                           | 16 33                           |
| II 1   | 7 22                           | 16 30                           | 7 25                           | 16 19                           | 7 24                           | 16 40                           | 7 34                           | 16 38                           | 7 06                           | 16 25                           | 7 47                           | 16 44                           | 7 30                           | 16 42                           | 7 38                           | 16 45                           |
| 8      | 7 10                           | 16 43                           | 7 12                           | 16 33                           | 7 13                           | 16 52                           | 7 22                           | 16 51                           | 6 55                           | 16 37                           | 7 35                           | 16 58                           | 7 18                           | 16 54                           | 7 27                           | 16 58                           |
| 15     | 6 57                           | 16 56                           | 6 58                           | 16 47                           | 7 01                           | 17 04                           | 7 09                           | 17 05                           | 6 43                           | 16 50                           | 7 21                           | 17 12                           | 7 06                           | 17 07                           | 7 14                           | 17 11                           |
| 22     | 6 43                           | 17 09                           | 6 43                           | 17 01                           | 6 48                           | 17 17                           | 6 55                           | 17 18                           | 6 30                           | 17 02                           | 7 06                           | 17 25                           | 6 52                           | 17 20                           | 7 00                           | 17 24                           |
| III 1  | 6 29                           | 17 21                           | 6 27                           | 17 15                           | 6 33                           | 17 29                           | 6 40                           | 17 31                           | 6 16                           | 17 13                           | 6 50                           | 17 39                           | 6 37                           | 17 32                           | 6 45                           | 17 37                           |
| 8      | 6 13                           | 17 34                           | 6 11                           | 17 28                           | 6 18                           | 17 41                           | 6 24                           | 17 43                           | 6 02                           | 17 25                           | 6 34                           | 17 52                           | 6 22                           | 17 44                           | 6 29                           | 17 49                           |
| 15     | 5 57                           | 17 46                           | 5 54                           | 17 41                           | 6 03                           | 17 52                           | 6 08                           | 17 56                           | 5 47                           | 17 36                           | 6 17                           | 18 05                           | 6 07                           | 17 56                           | 6 13                           | 18 02                           |
| 22     | 5 41                           | 17 58                           | 5 37                           | 17 54                           | 5 48                           | 18 04                           | 5 51                           | 18 08                           | 5 32                           | 17 47                           | 6 01                           | 18 18                           | 5 51                           | 18 08                           | 5 57                           | 18 14                           |
| 29     | 5 25                           | 18 10                           | 5 20                           | 18 07                           | 5 32                           | 18 15                           | 5 35                           | 18 21                           | 5 16                           | 17 58                           | 5 44                           | 18 31                           | 5 35                           | 18 19                           | 5 41                           | 18 26                           |
| IV 5   | 5 09                           | 18 22                           | 5 03                           | 18 20                           | 5 17                           | 18 26                           | 5 19                           | 18 33                           | 5 01                           | 18 09                           | 5 27                           | 18 44                           | 5 20                           | 18 31                           | 5 25                           | 18 38                           |
| 12     | 4 54                           | 18 34                           | 4 46                           | 18 33                           | 5 02                           | 18 38                           | 5 03                           | 18 45                           | 4 46                           | 18 20                           | 5 10                           | 18 56                           | 5 04                           | 18 42                           | 5 09                           | 18 50                           |
| 19     | 4 38                           | 18 45                           | 4 30                           | 18 46                           | 4 47                           | 18 49                           | 4 47                           | 18 57                           | 4 32                           | 18 31                           | 4 54                           | 19 09                           | 4 50                           | 18 54                           | 4 54                           | 19 02                           |
| 26     | 4 24                           | 18 57                           | 4 14                           | 18 59                           | 4 33                           | 19 00                           | 4 32                           | 19 09                           | 4 18                           | 18 42                           | 4 39                           | 19 22                           | 4 35                           | 19 05                           | 4 39                           | 19 14                           |
| V 3    | 4 10                           | 19 09                           | 3 59                           | 19 12                           | 4 20                           | 19 11                           | 4 18                           | 19 21                           | 4 06                           | 18 53                           | 4 24                           | 19 34                           | 4 22                           | 19 16                           | 4 26                           | 19 25                           |
| 10     | 3 58                           | 19 20                           | 3 46                           | 19 24                           | 4 08                           | 19 22                           | 4 06                           | 19 33                           | 3 54                           | 19 04                           | 4 11                           | 19 46                           | 4 10                           | 19 27                           | 4 13                           | 19 37                           |
| 17     | 3 47                           | 19 31                           | 3 34                           | 19 36                           | 3 58                           | 19 32                           | 3 54                           | 19 44                           | 3 44                           | 19 14                           | 3 59                           | 19 58                           | 3 59                           | 19 38                           | 4 02                           | 19 48                           |
| 24     | 3 38                           | 19 41                           | 3 24                           | 19 47                           | 3 49                           | 19 42                           | 3 45                           | 19 54                           | 3 35                           | 19 23                           | 3 49                           | 20 09                           | 3 51                           | 19 48                           | 3 53                           | 19 58                           |
| 31     | 3 31                           | 19 50                           | 3 16                           | 19 57                           | 3 42                           | 19 50                           | 3 37                           | 20 03                           | 3 29                           | 19 31                           | 3 41                           | 20 18                           | 3 44                           | 19 56                           | 3 46                           | 20 06                           |
| VI 7   | 3 26                           | 19 57                           | 3 10                           | 20 04                           | 3 38                           | 19 57                           | 3 32                           | 20 10                           | 3 24                           | 19 38                           | 3 36                           | 20 26                           | 3 39                           | 20 03                           | 3 41                           | 20 14                           |
| 14     | 3 23                           | 20 02                           | 3 07                           | 20 10                           | 3 35                           | 20 02                           | 3 30                           | 20 16                           | 3 22                           | 19 42                           | 3 33                           | 20 31                           | 3 36                           | 20 08                           | 3 38                           | 20 19                           |
| 21     | 3 23                           | 20 04                           | 3 07                           | 20 13                           | 3 35                           | 20 05                           | 3 30                           | 20 18                           | 3 22                           | 19 45                           | 3 33                           | 20 34                           | 3 37                           | 20 11                           | 3 38                           | 20 21                           |
| 28     | 3 26                           | 20 05                           | 3 10                           | 20 13                           | 3 38                           | 20 05                           | 3 32                           | 20 19                           | 3 25                           | 19 45                           | 3 36                           | 20 34                           | 3 39                           | 20 11                           | 3 41                           | 20 22                           |
| VII 5  | 3 31                           | 20 02                           | 3 15                           | 20 10                           | 3 43                           | 20 03                           | 3 37                           | 20 16                           | 3 29                           | 19 43                           | 3 41                           | 20 31                           | 3 44                           | 20 09                           | 3 45                           | 20 19                           |
| 12     | 3 37                           | 19 57                           | 3 22                           | 20 04                           | 3 49                           | 19 58                           | 3 44                           | 20 11                           | 3 36                           | 19 39                           | 3 48                           | 20 26                           | 3 50                           | 20 04                           | 3 52                           | 20 14                           |
| 19     | 3 46                           | 19 50                           | 3 31                           | 19 56                           | 3 57                           | 19 51                           | 3 53                           | 20 04                           | 3 43                           | 19 32                           | 3 57                           | 20 18                           | 3 59                           | 19 57                           | 4 01                           | 20 07                           |
| 26     | 3 55                           | 19 41                           | 3 42                           | 19 46                           | 4 06                           | 19 43                           | 4 03                           | 19 54                           | 3 52                           | 19 24                           | 4 07                           | 20 08                           | 4 08                           | 19 48                           | 4 10                           | 19 58                           |
| VIII 2 | 4 06                           | 19 30                           | 3 53                           | 19 34                           | 4 16                           | 19 32                           | 4 13                           | 19 43                           | 4 02                           | 19 14                           | 4 19                           | 19 56                           | 4 18                           | 19 37                           | 4 21                           | 19 47                           |
| 9      | 4 17                           | 19 18                           | 4 05                           | 19 21                           | 4 26                           | 19 20                           | 4 25                           | 19 30                           | 4 12                           | 19 02                           | 4 30                           | 19 43                           | 4 28                           | 19 25                           | 4 32                           | 19 34                           |
| 16     | 4 28                           | 19 04                           | 4 18                           | 19 06                           | 4 37                           | 19 07                           | 4 36                           | 19 16                           | 4 22                           | 18 49                           | 4 42                           | 19 29                           | 4 39                           | 19 12                           | 4 43                           | 19 20                           |
| 23     | 4 39                           | 18 50                           | 4 30                           | 18 50                           | 4 48                           | 18 53                           | 4 48                           | 19 01                           | 4 33                           | 18 36                           | 4 55                           | 19 13                           | 4 50                           | 18 58                           | 4 54                           | 19 06                           |
| 30     | 4 50                           | 18 34                           | 4 42                           | 18 34                           | 4 58                           | 18 39                           | 4 59                           | 18 46                           | 4 43                           | 18 21                           | 5 07                           | 18 57                           | 5 01                           | 18 43                           | 5 06                           | 18 50                           |
| IX 6   | 5 02                           | 18 19                           | 4 55                           | 18 17                           | 5 09                           | 18 23                           | 5 11                           | 18 30                           | 4 54                           | 18 06                           | 5 19                           | 18 40                           | 5 12                           | 18 27                           | 5 17                           | 18 35                           |
| 13     | 5 13                           | 18 02                           | 5 07                           | 18 00                           | 5 20                           | 18 08                           | 5 23                           | 18 13                           | 5 04                           | 17 51                           | 5 31                           | 18 23                           | 5 23                           | 18 12                           | 5 29                           | 18 18                           |
| 20     | 5 24                           | 17 46                           | 5 19                           | 17 43                           | 5 31                           | 17 52                           | 5 34                           | 17 57                           | 5 15                           | 17 36                           | 5 43                           | 18 06                           | 5 34                           | 17 56                           | 5 40                           | 18 02                           |
| 27     | 5 36                           | 17 30                           | 5 32                           | 17 25                           | 5 42                           | 17 36                           | 5 46                           | 17 40                           | 5 25                           | 17 20                           | 5 56                           | 17 49                           | 5 45                           | 17 40                           | 5 51                           | 17 46                           |
| X 4    | 5 47                           | 17 14                           | 5 44                           | 17 08                           | 5 53                           | 17 21                           | 5 58                           | 17 24                           | 5 36                           | 17 05                           | 6 08                           | 17 32                           | 5 56                           | 17 24                           | 6 03                           | 17 30                           |
| 11     | 5 59                           | 16 58                           | 5 57                           | 16 52                           | 6 04                           | 17 06                           | 6 10                           | 17 08                           | 5 47                           | 16 50                           | 6 21                           | 17 16                           | 6 08                           | 17 09                           | 6 15                           | 17 14                           |
| 18     | 6 11                           | 16 43                           | 6 10                           | 16 35                           | 6 15                           | 16 51                           | 6 22                           | 16 52                           | 5 58                           | 16 36                           | 6 33                           | 17 00                           | 6 20                           | 16 54                           | 6 27                           | 16 59                           |
| 25     | 6 23                           | 16 29                           | 6 24                           | 16 20                           | 6 27                           | 16 37                           | 6 35                           | 16 37                           | 6 09                           | 16 22                           | 6 47                           | 16 44                           | 6 31                           | 16 40                           | 6 39                           | 16 44                           |
| XI 1   | 6 36                           | 16 15                           | 6 37                           | 16 05                           | 6 39                           | 16 24                           | 6 47                           | 16 24                           | 6 21                           | 16 10                           | 7 00                           | 16 30                           | 6 44                           | 16 27                           | 6 52                           | 16 31                           |
| 8      | 6 48                           | 16 03                           | 6 51                           | 15 52                           | 6 51                           | 16 13                           | 7 00                           | 16 11                           | 6 33                           | 15 58                           | 7 13                           | 16 17                           | 6 56                           | 16 15                           | 7 04                           | 16 18                           |
| 15     | 7 00                           | 15 52                           | 7 04                           | 15 41                           | 7 03                           | 16 03                           | 7 13                           | 16 00                           | 6 44                           | 15 48                           | 7 26                           | 16 06                           | 7 08                           | 16 05                           | 7 17                           | 16 08                           |
| 22     | 7 12                           | 15 44                           | 7 17                           | 15 31                           | 7 14                           | 15 54                           | 7 25                           | 15 51                           | 6 55                           | 15 40                           | 7 39                           | 15 56                           | 7 19                           | 15 56                           | 7 29                           | 15 59                           |
| 29     | 7 23                           | 15 37                           | 7 29                           | 15 23                           | 7 24                           | 15 48                           | 7 36                           | 15 44                           | 7 06                           | 15 34                           | 7 51                           | 15 49                           | 7 30                           | 15 50                           | 7 40                           | 15 52                           |
| XII 6  | 7 33                           | 15 33                           | 7 39                           | 15 19                           | 7 34                           | 15 44                           | 7 46                           | 15 40                           | 7 15                           | 15 31                           | 8 01                           | 15 44                           | 7 39                           | 15 46                           | 7 49                           | 15 48                           |
| 13     | 7 40                           | 15 32                           | 7 47                           | 15 17                           | 7 41                           | 15 43                           | 7 54                           | 15 39                           | 7 22                           | 15 30                           | 8 09                           | 15 43                           | 7 47                           | 15 45                           | 7 57                           | 15 47                           |
| 20     | 7 46                           | 15 33                           | 7 53                           | 15 18                           | 7 47                           | 15 45                           | 7 59                           | 15 40                           | 7 27                           | 15 32                           | 8 15                           | 15 44                           | 7 52                           | 15 46                           | 8 03                           | 15 48                           |
| 27     | 7 49                           | 15 37                           | 7 56                           | 15 22                           | 7 49                           | 15 49                           | 8 02                           | 15 44                           | 7 30                           | 15 36                           | 8 17                           | 15 48                           | 7 55                           | 15 50                           | 8 06                           | 15 52                           |

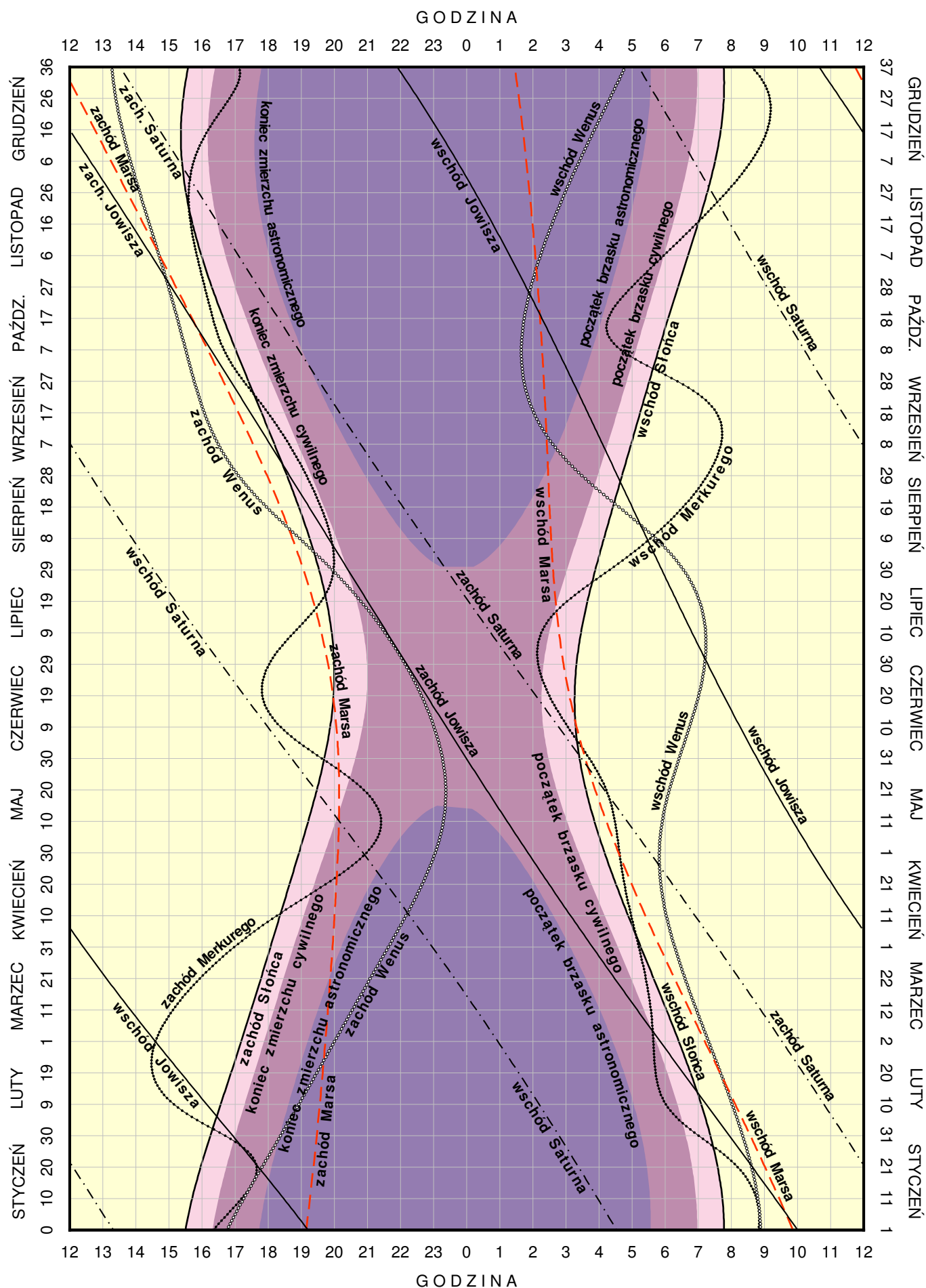
**Wschód i zachód Słońca w 2015 roku w niektórych stolicach europejskich**  
w CSE

| Data |    | Ateny      |             | Belgrad    |             | Berlin     |             | Budapeszt  |             | Bukareszt  |             | Helsinki   |             | Lizbona    |             | Londyn     |             |
|------|----|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|
|      |    | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       |
| I    | 7  | $6^h 41^m$ | $16^h 21^m$ | $7^h 15^m$ | $16^h 13^m$ | $8^h 15^m$ | $16^h 10^m$ | $7^h 31^m$ | $16^h 09^m$ | $6^h 52^m$ | $15^h 52^m$ | $8^h 20^m$ | $14^h 33^m$ | $8^h 55^m$ | $18^h 31^m$ | $9^h 05^m$ | $17^h 09^m$ |
|      | 22 | 6 37       | 16 37       | 7 08       | 16 32       | 8 03       | 16 33       | 7 22       | 16 29       | 6 44       | 16 10       | 7 58       | 15 07       | 8 50       | 18 46       | 8 53       | 17 32       |
| II   | 7  | 6 24       | 16 54       | 6 51       | 16 54       | 7 38       | 17 03       | 7 02       | 16 54       | 6 27       | 16 33       | 7 21       | 15 48       | 8 37       | 19 05       | 8 30       | 18 00       |
|      | 22 | 6 07       | 17 11       | 6 28       | 17 16       | 7 09       | 17 32       | 6 38       | 17 17       | 6 05       | 16 53       | 6 41       | 16 28       | 8 19       | 19 22       | 8 01       | 18 28       |
| III  | 7  | 5 49       | 17 24       | 6 06       | 17 33       | 6 40       | 17 56       | 6 14       | 17 37       | 5 43       | 17 11       | 6 03       | 17 01       | 8 01       | 19 35       | 7 33       | 18 51       |
|      | 22 | 5 26       | 17 38       | 5 39       | 17 52       | 6 05       | 18 22       | 5 44       | 17 59       | 5 16       | 17 30       | 5 17       | 17 39       | 7 38       | 19 50       | 7 00       | 19 16       |
| IV   | 7  | 5 02       | 17 53       | 5 09       | 18 13       | 5 28       | 18 50       | 5 12       | 18 21       | 4 47       | 17 50       | 4 29       | 18 18       | 7 13       | 20 05       | 6 23       | 19 43       |
|      | 22 | 4 41       | 18 07       | 4 43       | 18 31       | 4 54       | 19 17       | 4 43       | 18 42       | 4 21       | 18 08       | 3 44       | 18 55       | 6 51       | 20 20       | 5 51       | 20 08       |
| V    | 7  | 4 23       | 18 21       | 4 20       | 18 50       | 4 25       | 19 42       | 4 19       | 19 03       | 3 59       | 18 26       | 3 02       | 19 33       | 6 33       | 20 34       | 5 22       | 20 33       |
|      | 22 | 4 10       | 18 34       | 4 03       | 19 07       | 4 01       | 20 06       | 3 59       | 19 22       | 3 42       | 18 43       | 2 27       | 20 08       | 6 19       | 20 47       | 5 00       | 20 55       |
| VI   | 7  | 4 03       | 18 45       | 3 53       | 19 21       | 3 46       | 20 25       | 3 48       | 19 38       | 3 32       | 18 57       | 2 01       | 20 38       | 6 12       | 20 59       | 4 45       | 21 14       |
|      | 22 | 4 03       | 18 51       | 3 52       | 19 28       | 3 43       | 20 33       | 3 47       | 19 45       | 3 31       | 19 04       | 1 54       | 20 50       | 6 12       | 21 05       | 4 43       | 21 22       |
| VII  | 7  | 4 09       | 18 51       | 4 00       | 19 26       | 3 52       | 20 30       | 3 54       | 19 43       | 3 38       | 19 02       | 2 08       | 20 41       | 6 18       | 21 04       | 4 52       | 21 18       |
|      | 22 | 4 20       | 18 43       | 4 13       | 19 16       | 4 10       | 20 14       | 4 09       | 19 31       | 3 51       | 18 52       | 2 36       | 20 16       | 6 29       | 20 56       | 5 09       | 21 04       |
| VIII | 7  | 4 33       | 18 28       | 4 30       | 18 57       | 4 35       | 19 48       | 4 29       | 19 10       | 4 09       | 18 33       | 3 13       | 19 37       | 6 43       | 20 41       | 5 33       | 20 39       |
|      | 22 | 4 46       | 18 10       | 4 48       | 18 33       | 5 00       | 19 18       | 4 49       | 18 44       | 4 26       | 18 10       | 3 50       | 18 55       | 6 56       | 20 22       | 5 57       | 20 09       |
| IX   | 7  | 5 00       | 17 46       | 5 07       | 18 05       | 5 26       | 18 41       | 5 10       | 18 13       | 4 45       | 17 42       | 4 28       | 18 07       | 7 11       | 19 58       | 6 22       | 19 34       |
|      | 22 | 5 12       | 17 23       | 5 25       | 17 37       | 5 52       | 18 06       | 5 30       | 17 43       | 5 02       | 17 14       | 5 03       | 17 21       | 7 24       | 19 34       | 6 46       | 19 00       |
| X    | 7  | 5 26       | 17 00       | 5 43       | 17 09       | 6 17       | 17 31       | 5 50       | 17 12       | 5 20       | 16 46       | 5 39       | 16 36       | 7 38       | 19 11       | 7 10       | 18 26       |
|      | 22 | 5 40       | 16 39       | 6 02       | 16 43       | 6 44       | 16 57       | 6 12       | 16 44       | 5 39       | 16 21       | 6 16       | 15 52       | 7 52       | 18 49       | 7 36       | 17 53       |
| XI   | 7  | 5 57       | 16 21       | 6 24       | 16 19       | 7 13       | 16 26       | 6 36       | 16 18       | 6 00       | 15 58       | 6 58       | 15 09       | 8 10       | 18 30       | 8 04       | 17 24       |
|      | 22 | 6 13       | 16 09       | 6 44       | 16 04       | 7 40       | 16 05       | 6 58       | 16 01       | 6 20       | 15 43       | 7 35       | 14 37       | 8 26       | 18 19       | 8 30       | 17 03       |
| XII  | 7  | 6 27       | 16 05       | 7 01       | 15 57       | 8 02       | 15 53       | 7 17       | 15 53       | 6 38       | 15 36       | 8 07       | 14 16       | 8 41       | 18 15       | 8 51       | 16 52       |
|      | 22 | 6 38       | 16 09       | 7 13       | 16 00       | 8 15       | 15 54       | 7 29       | 15 55       | 6 49       | 15 39       | 8 24       | 14 13       | 8 51       | 18 19       | 9 04       | 16 54       |

| Data |    | Madryt     |             | Moskwa     |             | Paryż      |             | Praga      |             | Rzym       |             | Sofia      |             | Sztokholm  |             | Wiedeń     |             |
|------|----|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|
|      |    | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       | wsch.      | zach.       |
| I    | 7  | $8^h 38^m$ | $18^h 04^m$ | $6^h 57^m$ | $14^h 15^m$ | $8^h 43^m$ | $17^h 11^m$ | $8^h 00^m$ | $16^h 17^m$ | $7^h 38^m$ | $16^h 55^m$ | $6^h 57^m$ | $16^h 09^m$ | $8^h 40^m$ | $15^h 08^m$ | $7^h 44^m$ | $16^h 17^m$ |
|      | 22 | 8 32       | 18 20       | 6 41       | 14 42       | 8 33       | 17 32       | 7 49       | 16 39       | 7 32       | 17 12       | 6 50       | 16 26       | 8 19       | 15 40       | 7 35       | 16 38       |
| II   | 7  | 8 18       | 18 40       | 6 12       | 15 16       | 8 13       | 17 58       | 7 28       | 17 06       | 7 17       | 17 32       | 6 35       | 16 47       | 7 45       | 16 20       | 7 15       | 17 03       |
|      | 22 | 7 59       | 18 58       | 5 39       | 15 48       | 7 47       | 18 22       | 7 01       | 17 32       | 6 57       | 17 51       | 6 14       | 17 07       | 7 06       | 16 58       | 6 50       | 17 27       |
| III  | 7  | 7 40       | 19 12       | 5 07       | 16 16       | 7 22       | 18 43       | 6 34       | 17 54       | 6 36       | 18 07       | 5 53       | 17 23       | 6 29       | 17 30       | 6 25       | 17 47       |
|      | 22 | 7 16       | 19 29       | 4 28       | 16 46       | 6 50       | 19 06       | 6 02       | 18 18       | 6 11       | 18 24       | 5 27       | 17 41       | 5 45       | 18 06       | 5 54       | 18 10       |
| IV   | 7  | 6 50       | 19 45       | 3 46       | 17 19       | 6 17       | 19 30       | 5 27       | 18 43       | 5 44       | 18 42       | 5 00       | 17 59       | 4 58       | 18 44       | 5 22       | 18 33       |
|      | 22 | 6 27       | 20 01       | 3 09       | 17 49       | 5 47       | 19 52       | 4 56       | 19 07       | 5 20       | 18 58       | 4 35       | 18 16       | 4 15       | 19 20       | 4 53       | 18 55       |
| V    | 7  | 6 07       | 20 16       | 2 35       | 18 19       | 5 21       | 20 14       | 4 29       | 19 30       | 4 59       | 19 15       | 4 14       | 18 33       | 3 35       | 19 55       | 4 27       | 19 16       |
|      | 22 | 5 53       | 20 30       | 2 07       | 18 46       | 5 01       | 20 34       | 4 08       | 19 51       | 4 44       | 19 30       | 3 58       | 18 49       | 3 01       | 20 29       | 4 07       | 19 36       |
| VI   | 7  | 5 45       | 20 43       | 1 48       | 19 09       | 4 49       | 20 51       | 3 54       | 20 08       | 4 35       | 19 43       | 3 49       | 19 02       | 2 37       | 20 57       | 3 55       | 19 52       |
|      | 22 | 5 45       | 20 49       | 1 45       | 19 18       | 4 47       | 20 58       | 3 53       | 20 16       | 4 35       | 19 49       | 3 49       | 19 08       | 2 31       | 21 08       | 3 54       | 19 59       |
| VII  | 7  | 5 51       | 20 48       | 1 55       | 19 13       | 4 55       | 20 55       | 4 01       | 20 13       | 4 42       | 19 48       | 3 56       | 19 07       | 2 44       | 21 00       | 4 02       | 19 56       |
|      | 22 | 6 03       | 20 39       | 2 16       | 18 55       | 5 11       | 20 43       | 4 17       | 19 59       | 4 54       | 19 39       | 4 08       | 18 58       | 3 10       | 20 37       | 4 17       | 19 44       |
| VIII | 7  | 6 17       | 20 23       | 2 45       | 18 24       | 5 32       | 20 21       | 4 39       | 19 36       | 5 09       | 19 22       | 4 24       | 18 40       | 3 46       | 20 00       | 4 37       | 19 22       |
|      | 22 | 6 32       | 20 03       | 3 14       | 17 50       | 5 53       | 19 54       | 5 02       | 19 08       | 5 25       | 19 01       | 4 40       | 18 18       | 4 20       | 19 20       | 4 58       | 18 56       |
| IX   | 7  | 6 47       | 19 38       | 3 45       | 17 09       | 6 15       | 19 21       | 5 25       | 18 34       | 5 42       | 18 34       | 4 57       | 17 52       | 4 57       | 18 33       | 5 20       | 18 25       |
|      | 22 | 7 02       | 19 13       | 4 14       | 16 30       | 6 37       | 18 50       | 5 48       | 18 01       | 5 57       | 18 08       | 5 13       | 17 25       | 5 31       | 17 49       | 5 40       | 17 53       |
| X    | 7  | 7 17       | 18 48       | 4 43       | 15 51       | 6 58       | 18 18       | 6 11       | 17 29       | 6 13       | 17 42       | 5 30       | 16 59       | 6 06       | 17 05       | 6 02       | 17 22       |
|      | 22 | 7 33       | 18 25       | 5 14       | 15 14       | 7 21       | 17 49       | 6 35       | 16 58       | 6 30       | 17 19       | 5 48       | 16 34       | 6 41       | 16 22       | 6 24       | 16 54       |
| XI   | 7  | 7 51       | 18 05       | 5 47       | 14 38       | 7 47       | 17 22       | 7 01       | 16 30       | 6 49       | 16 58       | 6 08       | 16 13       | 7 21       | 15 41       | 6 48       | 16 27       |
|      | 22 | 8 08       | 17 53       | 6 18       | 14 13       | 8 10       | 17 03       | 7 26       | 16 10       | 7 08       | 16 44       | 6 26       | 15 59       | 7 57       | 15 10       | 7 11       | 16 09       |
| XII  | 7  | 8 24       | 17 48       | 6 43       | 13 58       | 8 29       | 16 54       | 7 46       | 16 01       | 7 24       | 16 39       | 6 43       | 15 53       | 8 27       | 14 50       | 7 30       | 16 01       |
|      | 22 | 8 35       | 17 52       | 6 58       | 13 58       | 8 42       | 16 57       | 7 59       | 16 03       | 7 35       | 16 42       | 6 54       | 15 56       | 8 44       | 14 49       | 7 43       | 16 03       |

# KALENDARZ ASTRONOMICZNY NA ROK 2015

WSCHODY I ZACHODY SŁOŃCA ORAZ JASNYCH PLANET W WARSZAWIE W CSE





# Konfiguracje planet 2015

| Data TT                            | Zjawisko                               | Data TT                              | Zjawisko                               |
|------------------------------------|----------------------------------------|--------------------------------------|----------------------------------------|
| I 8 5 <sup>h</sup> 39 <sup>m</sup> | Jowisz w koniunkcji z Księżycem 4.9 N  | VI 29 1 <sup>h</sup> 40 <sup>m</sup> | Saturn w koniunkcji z Księżycem 1.9 S  |
| 11 1 01                            | Merkury w koniunkcji z Wenus 0.6 N     | VII 1 3 50                           | Wenus w koniunkcji z Jowiszem 0.3 S    |
| 14 20 32                           | Merkury w elongacji wsch. 18.9         | 6 6 54                               | Neptun w koniunkcji z Księżycem 2.9 S  |
| 16 12 01                           | Saturn w koniunkcji z Księżycem 1.8 S  | 9 3 11                               | Uran w koniunkcji z Księżycem 0.7 N    |
| 20 0 15                            | Mars w koniunkcji z Neptunem 0.2 S     | 16 4 30                              | Merkury w koniunkcji z Marsem 0.1 S    |
| 21 16 33                           | Merkury w koniunkcji z Księżycem 2.9 S | 18 15 26                             | Jowisz w koniunkcji z Księżycem 4.0 N  |
| 22 2 22                            | Wenus w koniunkcji z Księżycem 5.4 S   | 19 0 55                              | Wenus w koniunkcji z Księżycem 0.4 N   |
| 22 22 53                           | Neptun w koniunkcji z Księżycem 3.7 S  | 23 17 29                             | Merkury w koniunkcji d. ze Słońcem     |
| 23 2 41                            | Mars w koniunkcji z Księżycem 3.7 S    | 26 9 03                              | Saturn w koniunkcji z Księżycem 2.2 S  |
| 25 11 33                           | Uran w koniunkcji z Księżycem 0.6 S    | VIII 2 13 51                         | Neptun w koniunkcji z Księżycem 2.8 S  |
| 30 11 47                           | Merkury w koniunkcji g. ze Słońcem     | 5 9 15                               | Uran w koniunkcji z Księżycem 1.0 N    |
| II 1 17 47                         | Wenus w koniunkcji z Neptunem 0.8 S    | 7 7 35                               | Merkury w koniunkcji z Jowiszem 0.5 N  |
| 4 6 03                             | Jowisz w koniunkcji z Księżycem 5.0 N  | 14 17 47                             | Wenus w koniunkcji z Księżycem 4.5 S   |
| 6 18 19                            | Jowisz w opozycji do Słońca            | 15 10 02                             | Jowisz w koniunkcji z Księżycem 3.5 N  |
| 13 0 21                            | Saturn w koniunkcji z Księżycem 2.1 S  | 16 13 18                             | Merkury w koniunkcji z Księżycem 1.9 N |
| 17 5 08                            | Merkury w koniunkcji z Księżycem 3.4 S | 22 17 48                             | Saturn w koniunkcji z Księżycem 2.5 S  |
| 19 11 15                           | Neptun w koniunkcji z Księżycem 3.6 S  | 26 22 01                             | Jowisz w koniunkcji ze Słońcem         |
| 20 23 51                           | Wenus w koniunkcji z Księżycem 1.9 S   | 29 22 44                             | Neptun w koniunkcji z Księżycem 2.8 S  |
| 21 0 43                            | Mars w koniunkcji z Księżycem 1.5 S    | IX 1 3 39                            | Neptun w opozycji do Słońca            |
| 21 22 08                           | Uran w koniunkcji z Księżycem 0.3 S    | 1 16 30                              | Uran w koniunkcji z Księżycem 1.0 N    |
| 22 6 23                            | Wenus w koniunkcji z Marsem 0.4 S      | 4 10 20                              | Merkury w elongacji wsch. 27.1         |
| 24 16 24                           | Merkury w elongacji zach. 26.7         | 10 7 09                              | Wenus w koniunkcji z Księżycem 2.6 S   |
| 26 4 56                            | Neptun w koniunkcji ze Słońcem         | 10 20 43                             | Mars w koniunkcji z Księżycem 4.6 N    |
| III 3 5 25                         | Jowisz w koniunkcji z Księżycem 5.3 N  | 12 4 18                              | Jowisz w koniunkcji z Księżycem 3.0 N  |
| 4 18 43                            | Wenus w koniunkcji z Uranem 0.1 N      | 15 9 33                              | Merkury w koniunkcji z Księżycem 5.1 S |
| 11 15 58                           | Mars w koniunkcji z Uranem 0.3 N       | 19 3 26                              | Saturn w koniunkcji z Księżycem 2.8 S  |
| 12 8 36                            | Saturn w koniunkcji z Księżycem 2.2 S  | 26 8 36                              | Neptun w koniunkcji z Księżycem 2.9 S  |
| 18 8 24                            | Merkury w koniunkcji z Neptunem 1.5 S  | 29 1 23                              | Uran w koniunkcji z Księżycem 1.0 N    |
| 19 0 12                            | Neptun w koniunkcji z Księżycem 3.5 S  | 30 18 35                             | Merkury w koniunkcji g. ze Słońcem     |
| 19 2 15                            | Merkury w koniunkcji z Księżycem 4.9 S | X 8 20 08                            | Wenus w koniunkcji z Księżycem 0.7 N   |
| 21 11 16                           | Uran w koniunkcji z Księżycem 0.1 S    | 9 14 44                              | Mars w koniunkcji z Księżycem 3.3 N    |
| 21 22 43                           | Mars w koniunkcji z Księżycem 0.9 N    | 9 21 54                              | Jowisz w koniunkcji z Księżycem 2.6 N  |
| 22 21 05                           | Wenus w koniunkcji z Księżycem 2.8 N   | 11 11 22                             | Merkury w koniunkcji z Księżycem 0.9 N |
| IV 6 14 09                         | Uran w koniunkcji ze Słońcem           | 12 3 51                              | Uran w opozycji do Słońca              |
| 8 12 45                            | Merkury w koniunkcji z Uranem 0.5 S    | 16 3 17                              | Merkury w elongacji zach. 18.1         |
| 8 13 18                            | Saturn w koniunkcji z Księżycem 2.1 S  | 16 13 52                             | Saturn w koniunkcji z Księżycem 2.9 S  |
| 10 6 34                            | Merkury w koniunkcji d. ze Słońcem     | 17 22 38                             | Mars w koniunkcji z Jowiszem 0.4 N     |
| 15 11 20                           | Neptun w koniunkcji z Księżycem 3.5 S  | 23 17 42                             | Neptun w koniunkcji z Księżycem 2.9 S  |
| 18 0 36                            | Uran w koniunkcji z Księżycem 0.0 N    | 25 23 39                             | Wenus w koniunkcji z Jowiszem 1.0 S    |
| 19 12 31                           | Merkury w koniunkcji z Księżycem 3.4 N | 26 7 12                              | Wenus w elongacji zach. 46.4           |
| 19 20 14                           | Mars w koniunkcji z Księżycem 3.0 N    | 26 10 51                             | Uran w koniunkcji z Księżycem 0.9 N    |
| 22 19 46                           | Merkury w koniunkcji z Marsem 1.3 N    | XI 3 7 39                            | Wenus w koniunkcji z Marsem 0.7 S      |
| 26 15 38                           | Jowisz w koniunkcji z Księżycem 5.3 N  | 6 14 29                              | Jowisz w koniunkcji z Księżycem 2.1 N  |
| V 5 16 27                          | Saturn w koniunkcji z Księżycem 2.0 S  | 7 8 46                               | Mars w koniunkcji z Księżycem 1.7 N    |
| 7 4 51                             | Merkury w elongacji wsch. 21.2         | 7 13 03                              | Wenus w koniunkcji z Księżycem 1.2 N   |
| 12 19 30                           | Neptun w koniunkcji z Księżycem 3.3 S  | 11 9 14                              | Merkury w koniunkcji z Księżycem 3.2 S |
| 15 12 03                           | Uran w koniunkcji z Księżycem 0.2 N    | 13 1 35                              | Saturn w koniunkcji z Księżycem 3.0 S  |
| 18 17 00                           | Mars w koniunkcji z Księżycem 4.6 N    | 17 13 01                             | Merkury w koniunkcji d. ze Słońcem     |
| 23 1 39                            | Saturn w opozycji do Słońca            | 20 0 51                              | Neptun w koniunkcji z Księżycem 2.7 S  |
| 24 4 39                            | Jowisz w koniunkcji z Księżycem 5.0 N  | 22 19 10                             | Uran w koniunkcji z Księżycem 0.9 N    |
| 27 2 56                            | Merkury w koniunkcji z Marsem 1.6 S    | 25 1 58                              | Merkury w koniunkcji z Saturnem 2.7 S  |
| 30 11 10                           | Merkury w koniunkcji g. ze Słońcem     | 30 0 19                              | Saturn w koniunkcji ze Słońcem         |
| VI 1 20 11                         | Saturn w koniunkcji z Księżycem 1.9 S  | XII 4 5 19                           | Jowisz w koniunkcji z Księżycem 1.7 N  |
| 6 18 31                            | Wenus w elongacji wsch. 45.4           | 6 2 39                               | Mars w koniunkcji z Księżycem 0.1 N    |
| 9 1 23                             | Neptun w koniunkcji z Księżycem 3.1 S  | 7 17 20                              | Wenus w koniunkcji z Księżycem 0.6 S   |
| 11 20 42                           | Uran w koniunkcji z Księżycem 0.5 N    | 10 14 53                             | Saturn w koniunkcji z Księżycem 3.1 S  |
| 14 14 18                           | Mars w koniunkcji ze Słońcem           | 17 6 42                              | Neptun w koniunkcji z Księżycem 2.4 S  |
| 15 2 28                            | Merkury w koniunkcji z Księżycem 0.0 N | 20 1 27                              | Uran w koniunkcji z Księżycem 1.1 N    |
| 20 21 12                           | Jowisz w koniunkcji z Księżycem 4.5 N  | 29 3 13                              | Merkury w elongacji wsch. 19.7         |
| 24 17 09                           | Merkury w elongacji zach. 22.5         | 31 17 06                             | Jowisz w koniunkcji z Księżycem 1.4 N  |

Tabela zawiera wszystkie koniunkcje, w których odległość kątowa ciał niebieskich nie przekracza 5.4.

## Zaćmienia Słońca, Księżyca w 2015 roku

### 1. Całkowite zaćmienie Słońca 20 marca 2015 roku.

Zaćmienie będzie widoczne we wschodniej części Atlantyku, w Europie, w północnej Afryce, na Bliskim Wschodzie oraz w północno-zachodniej części Azji.

Moment koniunkcji Słońca i Księżyca w rektascensji: 2015 marzec 20<sup>d</sup> 10<sup>h</sup>17<sup>m</sup>04<sup>s</sup>.8 UT.

| Fazy zaćmienia                 |                        | UT                                | Szer. geogr. | Dług. geogr. |
|--------------------------------|------------------------|-----------------------------------|--------------|--------------|
| Wejście w półcień              | marzec 20 <sup>d</sup> | 7 <sup>h</sup> 40 <sup>m</sup> .8 |              |              |
| Początek częściowego zaćmienia |                        | 9 09.5                            |              |              |
| Moment największego zaćmienia  |                        | 9 45.6                            | 64°26.3 N    | 6°38.0 W     |
| Koniec częściowego zaćmienia   |                        | 10 21.3                           |              |              |
| Wyjście z półcienia            |                        | 11 50.2                           |              |              |

Równikowa horyzontalna paralaksa Słońca = 8<sup>''</sup>, Księżyca = 61'15.8 w momencie koniunkcji.

Kątowy geocentryczny promień tarczy Słońca = 16'03.7, Księżyca = 16'41.6 w momencie koniunkcji.

### 2. Całkowite zaćmienie Księżyca 4 kwietnia 2015 roku.

Początek zaćmienia będzie widoczny we wschodniej części Australii i wschodniej części archipelagu wysp Sundajskich, w Japonii, na dalekim wschodzie Rosji, na całym obszarze Pacyfiku, w Ameryce Północnej, w Ameryce Południowej z wyjątkiem jej wschodniego krańca i zachodniej części Atlantyku.

Koniec zaćmienia będzie widoczny w środkowej i wschodniej części Azji, na Madagaskarze, Oceanie Indyjskim, w Australii i Oceanii, w zachodniej i środkowej części Oceanu Spokojnego oraz na Alasce.

Moment opozycji Słońca i Księżyca w rektascensji: 2015 kwiecień 4<sup>d</sup> 12<sup>h</sup>05<sup>m</sup>32<sup>s</sup>.7 UT.

| Fazy zaćmienia                 |                         | UT                                |
|--------------------------------|-------------------------|-----------------------------------|
| Wejście Księżyca w półcień     | kwiecień 4 <sup>d</sup> | 9 <sup>h</sup> 01 <sup>m</sup> .5 |
| Początek częściowego zaćmienia |                         | 10 15.8                           |
| Początek całkowitego zaćmienia |                         | 11 57.9                           |
| Moment największej fazy        |                         | 12 00.2                           |
| Koniec całkowitego zaćmienia   |                         | 12 02.6                           |
| Koniec częściowego zaćmienia   |                         | 13 44.8                           |
| Wyjście Księżyca z półcienia   |                         | 14 59.0                           |

Kątowy promień półcienia = 4267<sup>''</sup>.08, kątowy promień cienia = 2347<sup>''</sup>.92.

Wielkość największej fazy zaćmienia = 1.0008 średnicy tarczy Księżyca.

Równikowa horyzontalna paralaksa Słońca = 8<sup>''</sup>, Księżyca = 54'25.9 w momencie opozycji.

Kątowy geocentryczny promień tarczy Słońca = 15'59<sup>''</sup>.6, Księżyca = 14'49<sup>''</sup>.9 w momencie opozycji.

### 3. Częściowe zaćmienie Słońca 13 września 2015 roku.

Zaćmienie widoczne będzie w południowej części Oceanu Indyjskiego, w Antarktyce i na Antarktydzie, w południowej części Afryki i południowej części Madagaskaru oraz na południowo-wschodnim skraju Oceanu Atlantyckiego.

Moment koniunkcji Słońca i Księżyca w rektascensji: 2015 wrzesień 13<sup>d</sup> 7<sup>h</sup>35<sup>m</sup>14<sup>s</sup>.2 UT.

| Fazy zaćmienia          |                          | UT                                |
|-------------------------|--------------------------|-----------------------------------|
| Wejście w półcień       | wrzesień 13 <sup>d</sup> | 4 <sup>h</sup> 41 <sup>m</sup> .6 |
| Moment największej fazy |                          | 6 54.1                            |
| Wyjście z półcienia     |                          | 9 06.3                            |

Równikowa horyzontalna paralaksa Słońca = 8<sup>''</sup>.7, Księżyca = 54'00<sup>''</sup>.6 w momencie koniunkcji.

Kątowy geocentryczny promień tarczy Słońca = 15'53<sup>''</sup>.6, Księżyca = 14'43<sup>''</sup>.0 w momencie koniunkcji.

#### 4. Całkowite zaćmienie Księżyca 28 września 2015 roku.

Początek zaćmienia będzie widoczny we wschodniej części Ameryki Północnej, na południowo-wschodnim wybrzeżu Pacyfiku, w Ameryce Południowej, na Oceanie Atlantyckim, w Europie, w Afryce, w Azji Środkowej oraz w zachodniej części Oceanu Indyjskiego.

Koniec zaćmienia będzie widoczny we wschodniej części Oceanu Spokojnego, w Ameryce Północnej i Południowej, na Atlantyku z wyjątkiem jego południowo-wschodniego wybrzeża oraz w zachodniej części Europy i Afryki.

Moment opozycji Słońca i Księżyca w rektascensji: 2015 wrzesień 28<sup>d</sup> 2<sup>h</sup>50<sup>m</sup>29<sup>s</sup>.0 UT.

| Fazy zaćmienia                 | UT                                                         |
|--------------------------------|------------------------------------------------------------|
| Wejście Księżyca w półcień     | wrzesień 28 <sup>d</sup> 0 <sup>h</sup> 11 <sup>m</sup> .8 |
| Początek częściowego zaćmienia | 1 07.2                                                     |
| Początek całkowitego zaćmienia | 2 11.2                                                     |
| Moment największej fazy        | 2 47.1                                                     |
| Koniec całkowitego zaćmienia   | 3 23.1                                                     |
| Koniec częściowego zaćmienia   | 4 27.1                                                     |
| Wyjście Księżyca z półcienia   | 5 22.5                                                     |

Kątowy promień półcienia = 4689<sup>''</sup>.72, kątowy promień cienia = 2774<sup>''</sup>.52.

Wielkość największej fazy zaćmienia = 1.2764 średnicy tarczy Księżyca.

Równikowa horyzontalna paralaksa Słońca = 8<sup>''</sup>.8, Księżyca = 61<sup>'</sup>26<sup>''</sup>.6 w momencie opozycji.

Kątowy geocentryczny promień tarczy Słońca = 15<sup>'</sup>57<sup>''</sup>.6, Księżyca = 16<sup>'</sup>44<sup>''</sup>.5 w momencie opozycji.



**Współrzędne bieguna CIP („chwilowego” bieguna północnego Ziemi) w odniesieniu do IRP  
oraz poprawka do czasu uniwersalnego, 0<sup>h</sup> UTC**

| Data  | MJD   | $x_{\text{IERS}}$ | $y_{\text{IERS}}$ | $UT1 - UTC$ | Data   | MJD   | $x_{\text{IERS}}$ | $y_{\text{IERS}}$ | $UT1 - UTC$ |
|-------|-------|-------------------|-------------------|-------------|--------|-------|-------------------|-------------------|-------------|
| 2013  |       | 0°00001           | 0°00001           | 0°000001    | 2014   |       | 0°00001           | 0°00001           | 0°000001    |
| X 14  | 56579 | +11386            | +28452            | − 3263      | IV 22  | 56769 | + 6381            | +43863            | −232312     |
| 19    | 56584 | +10596            | +28314            | − 10601     | 27     | 56774 | + 7180            | +44174            | −241447     |
| 24    | 56589 | + 9688            | +28249            | − 15181     | V 2    | 56779 | + 7975            | +44355            | −249024     |
| 29    | 56594 | + 9121            | +28363            | − 20615     | 7      | 56784 | + 8740            | +44550            | −254805     |
| XI 3  | 56599 | + 8551            | +28479            | − 27898     | 12     | 56789 | + 9545            | +44666            | −261813     |
| 8     | 56604 | + 7983            | +28663            | − 34037     | 17     | 56794 | +10394            | +44804            | −267426     |
| 13    | 56609 | + 7310            | +28496            | − 40721     | 22     | 56799 | +11085            | +44803            | −273780     |
| 18    | 56614 | + 6665            | +28681            | − 46869     | 27     | 56804 | +11807            | +44633            | −279933     |
| 23    | 56619 | + 6091            | +28950            | − 51410     | VI 1   | 56809 | +12938            | +44290            | −282615     |
| 28    | 56624 | + 5788            | +29279            | − 57784     | 6      | 56814 | +13633            | +43784            | −285233     |
| XII 3 | 56629 | + 5721            | +29560            | − 64488     | 11     | 56819 | +14574            | +43472            | −288760     |
| 8     | 56634 | + 5697            | +30153            | − 70639     | 16     | 56824 | +15420            | +43068            | −292260     |
| 13    | 56639 | + 5651            | +30727            | − 77061     | 21     | 56829 | +16094            | +42727            | −297746     |
| 18    | 56644 | + 4995            | +30807            | − 80844     | 26     | 56834 | +16682            | +42145            | −300713     |
| 23    | 56649 | + 4429            | +31044            | − 85172     | VII 1  | 56839 | +17058            | +41498            | −301825     |
| 28    | 56654 | + 4049            | +31594            | − 91960     | 6      | 56844 | +17635            | +40985            | −304274     |
| 2014  |       |                   |                   |             | 11     | 56849 | +18005            | +40478            | −305967     |
| I 2   | 56659 | + 3839            | +31956            | − 98241     | 16     | 56854 | +18358            | +39923            | −309430     |
| 7     | 56664 | + 3527            | +32279            | −104994     | 21     | 56859 | +18776            | +39187            | −312807     |
| 12    | 56669 | + 3163            | +32892            | −109476     | 26     | 56864 | +19039            | +38707            | −313185     |
| 17    | 56674 | + 2658            | +33372            | −112604     | 31     | 56869 | +19469            | +38174            | −314467     |
| 22    | 56679 | + 2408            | +33899            | −118237     | VIII 5 | 56874 | +19858            | +37453            | −316108     |
| 27    | 56684 | + 2421            | +34259            | −123826     | 10     | 56879 | +20427            | +36911            | −317066     |
| II 1  | 56689 | + 2374            | +34877            | −129653     | 15     | 56884 | +20883            | +36487            | −320794     |
| 6     | 56694 | + 2432            | +35369            | −135788     | 20     | 56889 | +20973            | +35777            | −322888     |
| 11    | 56699 | + 2401            | +36175            | −139005     | 25     | 56894 | +20947            | +34884            | −323900     |
| 16    | 56704 | + 2100            | +37037            | −143658     | 30     | 56899 | +20943            | +33946            | −326047     |
| 21    | 56709 | + 2033            | +37735            | −150343     | IX 4   | 56904 | +20903            | +33151            | −328682     |
| 26    | 56714 | + 1877            | +38358            | −156384     | 9      | 56909 | +20795            | +32403            | −333396     |
| III 3 | 56719 | + 2044            | +38934            | −165664     | 14     | 56914 | +20335            | +31363            | −338497     |
| 8     | 56724 | + 2012            | +39506            | −173349     | 19     | 56919 | +20049            | +30673            | −341608     |
| 13    | 56729 | + 2032            | +40018            | −178771     | 24     | 56924 | +19666            | +29793            | −345749     |
| 18    | 56734 | + 2489            | +40558            | −185036     | 29     | 56929 | +19213            | +29184            | −349867     |
| 23    | 56739 | + 2945            | +40978            | −190827     | X 4    | 56934 | +18458            | +28510            | −354009     |
| 28    | 56744 | + 3679            | +41598            | −198098     | 9      | 56939 | +17448            | +27799            | −361464     |
| IV 2  | 56749 | + 4473            | +42250            | −206473     | 14     | 56944 | +16320            | +27159            | −367016     |
| 7     | 56754 | + 4773            | +42641            | −212671     | 19     | 56949 | +15617            | +26639            | −371846     |
| 12    | 56759 | + 5423            | +43049            | −219070     | 24     | 56954 | +14937            | +26156            | −378306     |
| 17    | 56764 | + 5828            | +43334            | −225940     | 29     | 56959 | +13888            | +25674            | −383604     |

Dane stanowią wynik obliczeń prowadzonych na bieżąco przez IERS, aktualizowanych dwa razy w tygodniu i publikowanych jako tzw. rozwiązanie C04. Tablica zawiera dane dostępne w chwili wydawania Rocznika.

Dane są na bieżąco dostępne na serwerze IERS pod adresem <ftp://ftp.iers.org/products/eop/long-term/>.

Przewidywane współrzędne bieguna *CIP* („chwilowego” bieguna północnego Ziemi) w odniesieniu do *IRP* oraz poprawka do czasu uniwersalnego, 0<sup>h</sup> *UTC*

| Data |    | <i>MJD</i> | $x_{\text{IERS}}$   | $y_{\text{IERS}}$   | $UT1-UTC$          | Data |    | <i>MJD</i> | $x_{\text{IERS}}$   | $y_{\text{IERS}}$   | $UT1-UTC$          |
|------|----|------------|---------------------|---------------------|--------------------|------|----|------------|---------------------|---------------------|--------------------|
| 2014 |    |            |                     |                     |                    | 2015 |    |            |                     |                     |                    |
| XI   | 28 | 56989      | +0.09 <sup>''</sup> | +0.25 <sup>''</sup> | -0.42 <sup>s</sup> | V    | 27 | 57169      | +0.11 <sup>''</sup> | +0.47 <sup>''</sup> | -0.64 <sup>s</sup> |
| XII  | 3  | 56994      | +0.08               | +0.26               | -0.43              | VI   | 1  | 57174      | +0.13               | +0.47               | -0.65              |
|      | 8  | 56999      | +0.07               | +0.26               | -0.43              |      | 6  | 57179      | +0.14               | +0.47               | -0.65              |
|      | 13 | 57004      | +0.06               | +0.26               | -0.43              |      | 11 | 57184      | +0.15               | +0.47               | -0.66              |
|      | 18 | 57009      | +0.06               | +0.26               | -0.44              |      | 16 | 57189      | +0.16               | +0.46               | -0.66              |
|      | 23 | 57014      | +0.05               | +0.27               | -0.44              |      | 21 | 57194      | +0.17               | +0.46               | -0.66              |
|      | 28 | 57019      | +0.04               | +0.27               | -0.45              |      | 26 | 57199      | +0.18               | +0.45               | -0.67              |
| 2015 |    |            |                     |                     |                    | VII  | 1  | 57204      | +0.19               | +0.45               | -0.67              |
| I    | 2  | 57024      | +0.03               | +0.28               | -0.45              |      | 6  | 57209      | +0.20               | +0.44               | -0.67              |
|      | 7  | 57029      | +0.03               | +0.28               | -0.46              |      | 11 | 57214      | +0.21               | +0.44               | -0.67              |
|      | 12 | 57034      | +0.02               | +0.29               | -0.46              |      | 16 | 57219      | +0.22               | +0.43               | -0.67              |
|      | 17 | 57039      | +0.01               | +0.29               | -0.47              |      | 21 | 57224      | +0.22               | +0.42               | -0.67              |
|      | 22 | 57044      | +0.01               | +0.30               | -0.47              |      | 26 | 57229      | +0.23               | +0.41               | -0.67              |
| II   | 27 | 57049      | +0.00               | +0.31               | -0.48              |      | 31 | 57234      | +0.24               | +0.40               | -0.67              |
|      | 1  | 57054      | -0.00               | +0.32               | -0.48              | VIII | 5  | 57239      | +0.24               | +0.39               | -0.68              |
|      | 6  | 57059      | -0.00               | +0.32               | -0.49              |      | 10 | 57244      | +0.25               | +0.38               | -0.68              |
|      | 11 | 57064      | -0.01               | +0.33               | -0.49              |      | 15 | 57249      | +0.25               | +0.37               | -0.68              |
|      | 16 | 57069      | -0.01               | +0.34               | -0.50              |      | 20 | 57254      | +0.25               | +0.36               | -0.68              |
|      | 21 | 57074      | -0.01               | +0.35               | -0.51              |      | 25 | 57259      | +0.25               | +0.35               | -0.68              |
| III  | 26 | 57079      | -0.01               | +0.36               | -0.51              |      | 30 | 57264      | +0.25               | +0.34               | -0.68              |
|      | 3  | 57084      | -0.01               | +0.37               | -0.52              | IX   | 4  | 57269      | +0.25               | +0.33               | -0.68              |
|      | 8  | 57089      | -0.01               | +0.38               | -0.53              |      | 9  | 57274      | +0.25               | +0.32               | -0.69              |
|      | 13 | 57094      | -0.00               | +0.39               | -0.53              |      | 14 | 57279      | +0.25               | +0.31               | -0.69              |
|      | 18 | 57099      | -0.00               | +0.40               | -0.54              |      | 19 | 57284      | +0.25               | +0.29               | -0.69              |
|      | 23 | 57104      | +0.00               | +0.40               | -0.55              |      | 24 | 57289      | +0.24               | +0.28               | -0.70              |
| IV   | 28 | 57109      | +0.01               | +0.41               | -0.56              |      | 29 | 57294      | +0.24               | +0.27               | -0.71              |
|      | 2  | 57114      | +0.01               | +0.42               | -0.57              | X    | 4  | 57299      | +0.23               | +0.26               | -0.71              |
|      | 7  | 57119      | +0.02               | +0.43               | -0.58              |      | 9  | 57304      | +0.22               | +0.25               | -0.72              |
|      | 12 | 57124      | +0.03               | +0.43               | -0.58              |      | 14 | 57309      | +0.21               | +0.24               | -0.72              |
|      | 17 | 57129      | +0.04               | +0.44               | -0.59              |      | 19 | 57314      | +0.21               | +0.24               | -0.73              |
|      | 22 | 57134      | +0.04               | +0.45               | -0.60              |      | 24 | 57319      | +0.20               | +0.23               | -0.73              |
| V    | 27 | 57139      | +0.05               | +0.45               | -0.61              |      | 29 | 57324      | +0.19               | +0.22               | -0.74              |
|      | 2  | 57144      | +0.06               | +0.46               | -0.61              | XI   | 3  | 57329      | +0.18               | +0.22               | -0.75              |
|      | 7  | 57149      | +0.07               | +0.46               | -0.62              |      | 8  | 57334      | +0.16               | +0.21               | -0.76              |
|      | 12 | 57154      | +0.08               | +0.46               | -0.63              |      | 13 | 57339      | +0.15               | +0.21               | -0.76              |
|      | 17 | 57159      | +0.09               | +0.47               | -0.63              |      | 18 | 57344      | +0.14               | +0.20               | -0.77              |
|      | 22 | 57164      | +0.10               | +0.47               | -0.64              |      | 23 | 57349      | +0.13               | +0.20               | -0.78              |

Tablica zawiera wartości przewidywane, publikowane przez IERS Rapid Service/Prediction Center w USNO, w wydawanych co kilka dni tzw. biuletynach A. Tablica przedstawia wartości opracowane w oparciu o dane dostępne w chwili wydawania Rocznika.

Bieżące przewidywane współrzędne bieguna i poprawki do czasu uniwersalnego są dostępne pod adresem <ftp://maia.usno.navy.mil/ser7/ser7.dat>.

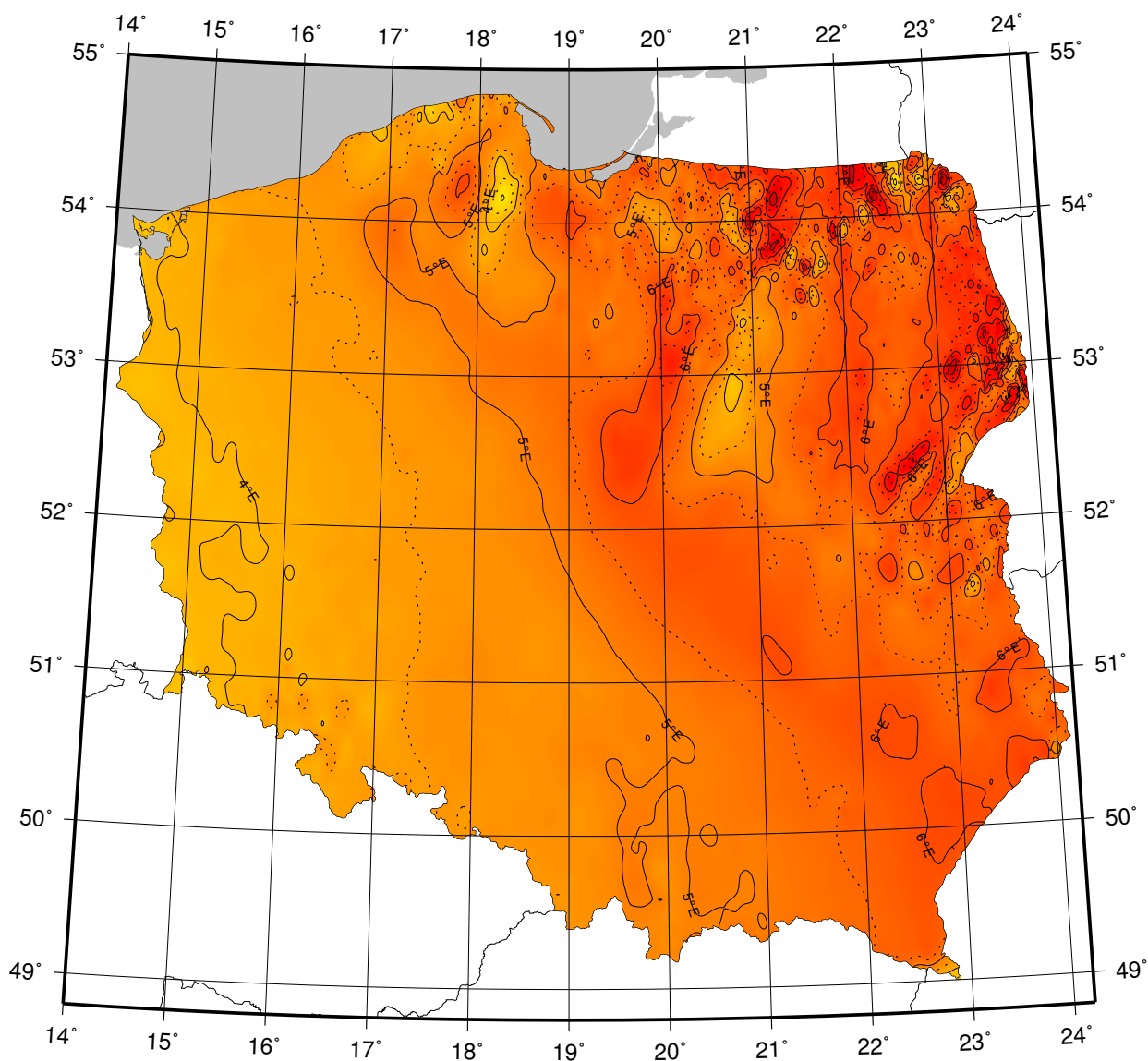
## Sygnaly czasu

wybrane stacje nadawcze

| Znak stacji | Położenie stacji         | Szerokość i długość geogr. | Częstotliwość (kHz)            | Godziny nadawania w czasie UTC                                                                                                                                              | Skrócony opis sygnałów                                                                                                                                                                                                                                                                                        |
|-------------|--------------------------|----------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BPM         | Pucheng, Chiny           | 35°00'N<br>109°31'E        | 2500<br>5000<br>10000<br>15000 | 7 <sup>h</sup> 30 <sup>m</sup> – 1 <sup>h</sup> 00 <sup>m</sup><br>Przez całą dobę<br>Przez całą dobę<br>od 1 <sup>h</sup> 00 <sup>m</sup> – 9 <sup>h</sup> 30 <sup>m</sup> | Modulowany sygnał 1 kHz. Impulsy sekundowe (10 ms) i minutowe (300 ms). Sygnały zgodne z chińskim czasem urzędowym UTC + 8 h, wyprzedzają UTC o 20 ms. Pomiędzy 0 – 10, 15 – 25, 30 – 40 i 45 – 50 minutą sygnały UTC. Pomiędzy 25 – 29 i 55 – 59 minutą sygnały UT1                                          |
| CHU         | Ottawa, Kanada           | 45°18'N<br>75°45'W         | 3330<br>7850<br>14670          | Przez całą dobę                                                                                                                                                             | Impulsy sekundowe (300 okresów modulacji 1 kHz), 29 oraz od 51 do 59 każdej minuty opuszczone. Impulsy minutowe o długości 0.5 s, godzinne 1 s. Co minutę informacja głosowa. Poprawka DUT1 kodowana                                                                                                          |
| DCF77       | Mainflingen, Niemcy      | 50°01'N<br>9°00'E          | 77.5                           | Przez całą dobę                                                                                                                                                             | Sygnały czasu zgodne z niemieckim czasem urzędowym UTC + 1 h lub UTC + 2 h. Redukcje do 15% amplitudy fali nośnej o czasie trwania 0.1 s lub 0.2 s (odpowiednio bit 0 lub 1) na początku każdej sekundy, za wyjątkiem 59. Kodowana (BCD) informacja o dacie, godzinie, minucie i sekundzie oraz czasie letnim |
| MIKES       | Espoo, Finlandia         | 60°11'N<br>24°50'E         | 25000                          | Przez całą dobę                                                                                                                                                             | Modulacja sygnałów taka sama jak w DCF77; sygnały czasu UTC                                                                                                                                                                                                                                                   |
| MSF         | Anthorn, Wielka Brytania | 54°54'N<br>3°16'W          | 60                             | Przez całą dobę z przerwą w drugi czwartek marca i grudnia 10 <sup>h</sup> – 14 <sup>h</sup> oraz czerwca i września 9 <sup>h</sup> – 13 <sup>h</sup>                       | Przerwy w fali nośnej o długości 100 ms co sekundę i 500 ms co minutę. Data, godzina, minuta i sekunda, poprawka DUT1 oraz informacja o czasie letnim kodowana (BCD)                                                                                                                                          |
| RBU         | Moskwa, Rosja            | 56°44'N<br>37°40'E         | 200/3                          | Przez całą dobę                                                                                                                                                             | Sygnały typu DXXXW 0.1 s; data, godzina, minuta, sekunda, a także różnica UTC i czasu lokalnego oraz poprawka DUT1 kodowana                                                                                                                                                                                   |
| RWM         | Moskwa, Rosja            | 56°44'N<br>37°38'E         | 4996<br>9996<br>14996          | Stacja działa jednocześnie na trzech częstotliwościach                                                                                                                      | Impulsy sekundowe typu A1X i A1N. A1X pomiędzy 10 i 20 oraz 40 i 50 minutą. A1N pomiędzy 20 a 30 minutą. Poprawka DUT1 kodowana                                                                                                                                                                               |
| TDF         | Allouis, Francja         | 47°10'N<br>2°12'E          | 162                            | Przez całą dobę z wyjątkiem wtorków między 1 <sup>h</sup> 00 <sup>m</sup> a 5 <sup>h</sup> 00 <sup>m</sup>                                                                  | Sygnały w modulacji fazowej, zgodne z francuskim czasem urzędowym. Kodowane informacje o czasie letnim oraz świętach państwowych                                                                                                                                                                              |
| WWVH        | Kauai, USA               | 21°59'N<br>159°46'W        | 2500<br>5000<br>10000<br>15000 | Przez całą dobę                                                                                                                                                             | Impulsy sekundowe o długości 5 ms i modulacji 1200 Hz; 29 i 59 sekunda opuszczona. Godziny i minuty: 8 ms, 1500 Hz oraz 8 ms, 1200 Hz. Poprawka DUT1 zakodowana (BCD)                                                                                                                                         |

Opracowano na podstawie: *BIPM Annual Report on Time Activities, Vol. 8, 2013.*

## MAPA DEKLINACJI MAGNETYCZNEJ NA EPOKĘ 2015.5



Izogony poprowadzono co 30'

Zmiana roczna wynosi 8'

*Przykład obliczania wartości deklinacji magnetycznej.*

Dla punktu o współrzędnych  $\varphi = 21^{\circ}00'$  i  $\lambda = 51^{\circ}00'$   
wartość deklinacji wschodniej na epokę 2015.5 wynosi

$$D_{2015.5} \approx 5^{\circ}42'$$

Obliczenie wartości deklinacji magnetycznej na epokę 2015.9

$$D_{2015.9} = D_{2015.5} + (\text{zmiana roczna} \times (2015.9 - 2015.5))$$

$$D_{2015.9} \approx 5^{\circ}45'$$

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5  | magn. | Sp  | $\pi$               | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$    | $\delta_{2015.5}$           | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$   |
|------|-------|-----|---------------------|-----------------------------------------------------|--------------------------------------|-------------------|-----------------------------|--------------------------------------|------------------|
|      |       |     |                     |                                                     |                                      | <sup>0°0001</sup> |                             |                                      | <sup>0°001</sup> |
| 902  | 4.03  | F5  | 0 <sup>''</sup> 012 | 0 <sup>h</sup> 00 <sup>m</sup> 06 <sup>s</sup> .522 | +3 <sup>s</sup> .086                 | + 103             | + 6°56'56 <sup>''</sup> .69 | +19 <sup>''</sup> .93                | − 115            |
| 903  | 4.71  | B9  | 0.000               | 0 00 42.694                                         | +3.074                               | + 76              | −65 29 27.44                | +20.02                               | − 24             |
| 904  | 4.73  | K0  | 0.011               | 0 02 22.256                                         | +2.997                               | − 187             | −76 58 48.66                | +19.86                               | − 177            |
| 1630 | 4.66  | M3  | 0.043               | 0 02 45.326                                         | +3.077                               | + 34              | − 5 55 40.70                | +20.00                               | − 41             |
| 905  | 4.62  | A0  | 0.000               | 0 04 31.967                                         | +3.069                               | + 18              | −17 14 59.12                | +20.03                               | − 9              |
| 1002 | 4.68  | K0  | 0.000               | 0 06 07.748                                         | +3.071                               | − 6               | − 5 37 15.47                | +20.12                               | + 89             |
| 1    | 2.15  | A0p | 0.024               | 0 09 11.533                                         | +3.116                               | + 104             | +29 10 33.48                | +19.86                               | − 163            |
| 2 *  | 2.27  | F5  | 0.072               | 0 10 00.872                                         | +3.242                               | + 684             | +59 14 06.76                | +19.84                               | − 181            |
| 3    | 3.94  | K0  | 0.059               | 0 10 11.599                                         | +3.026                               | + 118             | −45 39 43.22                | +19.84                               | − 181            |
| 4    | 5.08  | F0  | 0.000               | 0 11 07.940                                         | +3.144                               | + 7               | +46 09 30.53                | +20.02                               | + 0              |
| 6    | 5.19  | F5  | 0.027               | 0 12 31.127                                         | +3.038                               | + 141             | −35 02 47.11                | +20.13                               | + 119            |
| 7    | 2.87  | B2  | 0.000               | 0 14 02.156                                         | +3.098                               | + 2               | +15 16 10.72                | +19.99                               | − 12             |
| 1004 | 4.94  | M0  | 0.000               | 0 15 24.435                                         | +3.115                               | + 66              | +20 17 34.05                | +20.00                               | − 0              |
| 1005 | 4.51  | A2  | 0.015               | 0 19 08.515                                         | +3.154                               | − 53              | +36 52 15.90                | +19.93                               | − 41             |
| 9    | 3.75  | K0  | 0.010               | 0 20 13.047                                         | +3.056                               | − 9               | − 8 44 17.20                | +19.93                               | − 36             |
| 10   | 4.34  | F8  | 0.134               | 0 20 52.128                                         | +3.084                               | +2669             | −64 47 01.79                | +21.12                               | +1164            |
| 1009 | 5.20  | F5  | 0.015               | 0 21 56.538                                         | +3.180                               | + 50              | +38 03 15.62                | +19.91                               | − 40             |
| 11   | 2.90  | G0  | 0.153               | 0 26 32.671                                         | +3.062                               | +6647             | −77 10 01.75                | +20.23                               | + 324            |
| 12   | 2.44  | K0  | 0.035               | 0 27 02.793                                         | +2.951                               | + 183             | −42 13 19.39                | +19.51                               | − 396            |
| 15   | 4.88  | A2  | 0.019               | 0 32 09.610                                         | +2.877                               | + 145             | −48 43 04.72                | +19.86                               | + 17             |
| 16   | 4.24  | B0  | 0.000               | 0 33 53.557                                         | +3.462                               | + 4               | +63 01 01.70                | +19.82                               | − 3              |
| 18   | 4.47  | B3  | 0.000               | 0 37 42.784                                         | +3.223                               | + 12              | +33 48 16.12                | +19.77                               | − 4              |
| 17   | 3.72  | B3  | 0.000               | 0 37 50.611                                         | +3.380                               | + 22              | +53 58 55.31                | +19.76                               | − 9              |
| 19   | 4.52  | G5  | 0.031               | 0 39 22.715                                         | +3.187                               | − 174             | +29 23 44.54                | +19.49                               | − 254            |
| 20   | 3.49  | K2  | 0.024               | 0 40 09.664                                         | +3.226                               | + 106             | +30 56 44.01                | +19.64                               | − 92             |
| 21 * | 2.23  | K0  | 0.000               | 0 41 23.791                                         | +3.446                               | + 64              | +56 37 19.68                | +19.68                               | − 32             |
| 1015 | 4.65  | K0  | 0.000               | 0 42 03.335                                         | +2.821                               | − 13              | −46 00 00.50                | +19.70                               | − 1              |
| 23   | 4.53  | A0  | 0.039               | 0 44 02.733                                         | +2.676                               | − 8               | −57 22 41.85                | +19.68                               | + 11             |
| 22 * | 2.04  | K0  | 0.053               | 0 44 22.011                                         | +3.009                               | + 164             | −17 54 06.36                | +19.70                               | + 32             |
| 25   | 4.70  | B2  | 0.000               | 0 45 35.773                                         | +3.374                               | + 20              | +48 22 08.25                | +19.64                               | − 8              |
| 27   | 4.30  | K0  | 0.032               | 0 48 09.816                                         | +3.194                               | − 73              | +24 21 04.41                | +19.52                               | − 83             |
| 31   | 4.96  | K5  | 0.017               | 0 49 07.356                                         | +2.060                               | + 331             | −74 50 21.14                | +19.55                               | − 33             |
| 28   | 4.55  | K5  | 0.016               | 0 49 29.292                                         | +3.120                               | + 57              | + 7 40 08.89                | +19.52                               | − 52             |
| 1021 | 4.42  | B3  | 0.000               | 0 50 40.476                                         | +3.333                               | + 20              | +41 09 46.99                | +19.53                               | − 19             |
| 1022 | 4.92  | K0  | 0.000               | 0 53 48.078                                         | +3.070                               | + 5               | − 1 03 37.47                | +19.48                               | − 17             |
| 33   | 3.94  | A2  | 0.032               | 0 57 37.154                                         | +3.353                               | + 130             | +38 34 59.14                | +19.44                               | + 33             |
| 32 * | 2.80  | B0p | 0.034               | 0 57 39.379                                         | +3.674                               | + 36              | +60 48 01.15                | +19.41                               | − 5              |
| 35   | 4.39  | B5  | 0.000               | 0 59 21.093                                         | +2.885                               | + 17              | −29 16 26.41                | +19.38                               | + 4              |
| 36   | 4.45  | K0  | 0.029               | 1 03 44.983                                         | +3.121                               | − 53              | + 7 58 23.53                | +19.29                               | + 23             |
| 1031 | 5.15  | A3  | 0.010               | 1 08 30.214                                         | +2.732                               | + 33              | −41 24 15.89                | +19.16                               | + 10             |
| 40   | 3.60  | K0  | 0.032               | 1 09 22.190                                         | +3.019                               | + 147             | −10 06 01.62                | +18.99                               | − 138            |
| 42 * | 2.06  | M0  | 0.043               | 1 10 36.300                                         | +3.381                               | + 146             | +35 42 08.40                | +18.98                               | − 114            |
| 1032 | 4.89  | K0  | 0.013               | 1 12 17.381                                         | +3.238                               | + 27              | +21 07 00.06                | +19.04                               | − 11             |
| 43   | 4.70  | K0  | 0.035               | 1 12 31.098                                         | +3.322                               | + 56              | +30 10 17.57                | +19.01                               | − 35             |
| 45   | 4.67  | A2  | 0.014               | 1 20 19.339                                         | +3.314                               | + 19              | +27 20 42.29                | +18.81                               | − 13             |
| 1035 | 4.99  | K0  | 0.025               | 1 23 15.601                                         | +3.563                               | + 31              | +45 36 34.36                | +18.74                               | + 9              |
| 47   | 3.83  | K0  | 0.034               | 1 24 47.921                                         | +3.001                               | − 53              | − 8 06 13.85                | +18.47                               | − 218            |
| 48 * | 2.68  | A5  | 0.029               | 1 26 50.585                                         | +3.982                               | + 400             | +60 18 55.04                | +18.57                               | − 51             |
| 46   | 4.97  | K0  | 0.012               | 1 27 02.941                                         | +4.328                               | + 134             | +68 12 37.25                | +18.64                               | + 26             |
| 1040 | 4.96  | F5  | 0.024               | 1 28 35.429                                         | +3.621                               | + 334             | +45 29 10.56                | +18.46                               | − 107            |
| 49   | 3.40  | K5  | 0.000               | 1 29 02.225                                         | +2.598                               | − 13              | −43 14 21.21                | +18.34                               | − 208            |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5          | magn. | Sp  | $\pi$               | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$      | $\delta_{2015.5}$           | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$     |
|--------------|-------|-----|---------------------|-----------------------------------------------------|--------------------------------------|---------------------|-----------------------------|--------------------------------------|--------------------|
|              |       |     |                     |                                                     |                                      | 0 <sup>s</sup> 0001 |                             |                                      | 0 <sup>s</sup> 001 |
| 1043         | 5.13  | A0  | 0 <sup>''</sup> 021 | 1 <sup>h</sup> 30 <sup>m</sup> 20 <sup>s</sup> .725 | +2 <sup>s</sup> .877                 | + 40                | −21°32′58 <sup>''</sup> .50 | +18 <sup>''</sup> .51                | + 6                |
| 1044         | 3.96  | K0  | 0.023               | 1 31 53.729                                         | +2.490                               | + 144               | −48 59 33.24                | +18.60                               | +151               |
| 50           | 3.72  | G5  | 0.018               | 1 32 18.931                                         | +3.222                               | + 19                | +15 25 30.74                | +18.43                               | − 6                |
| 1045         | 4.18  | G0  | 0.062               | 1 37 42.799                                         | +3.549                               | − 153               | +41 28 56.82                | +17.87                               | −382               |
| 54           | 0.60  | B5  | 0.023               | 1 38 17.372                                         | +2.226                               | + 117               | −57 09 30.03                | +18.19                               | − 35               |
| 52           | 3.77  | K0  | 0.021               | 1 38 57.135                                         | +3.718                               | + 65                | +48 42 22.21                | +18.09                               | −113               |
| 56           | 4.68  | K0  | 0.034               | 1 42 14.400                                         | +3.130                               | − 14                | + 5 33 55.81                | +18.08                               | + 2                |
| 57           | 4.19  | B0p | 0.018               | 1 44 38.463                                         | +3.799                               | + 27                | +50 45 58.39                | +17.97                               | − 14               |
| 59           | 3.65  | K0  | 0.275               | 1 44 47.314                                         | +2.789                               | −1190               | −15 51 22.64                | +18.84                               | +858               |
| 60           | 4.50  | K0  | 0.018               | 1 46 12.863                                         | +3.177                               | + 50                | + 9 14 06.68                | +17.98                               | + 48               |
| 1051         | 4.77  | F0  | 0.041               | 1 50 20.819                                         | +2.949                               | − 99                | −10 36 36.95                | +17.67                               | − 93               |
| 62           | 3.92  | K0  | 0.038               | 1 52 13.583                                         | +2.964                               | + 28                | −10 15 32.41                | +17.65                               | − 39               |
| 64           | 3.58  | F5  | 0.050               | 1 53 58.179                                         | +3.439                               | + 9                 | +29 39 13.49                | +17.38                               | −235               |
| 67           | 4.41  | M3  | 0.000               | 1 54 15.968                                         | +2.400                               | − 83                | −46 13 37.73                | +17.52                               | − 87               |
| 65           | 4.84  | K0  | 0.000               | 1 54 21.590                                         | +3.113                               | + 15                | + 3 15 48.37                | +17.62                               | + 23               |
| 1053         | 5.00  | B9  | 0.000               | 1 55 00.580                                         | +2.485                               | − 26                | −42 25 17.16                | +17.54                               | − 31               |
| 69           | 4.72  | K0  | 0.008               | 1 55 19.777                                         | +1.527                               | + 130               | −67 34 16.74                | +17.63                               | + 74               |
| 66           | 2.72  | A5  | 0.063               | 1 55 29.966                                         | +3.328                               | + 68                | +20 52 59.41                | +17.44                               | −111               |
| 63 *         | 3.38  | B3  | 0.000               | 1 55 31.605                                         | +4.388                               | + 48                | +63 44 44.34                | +17.53                               | − 21               |
| 68           | 3.73  | G5  | 0.052               | 1 56 33.604                                         | +2.329                               | + 730               | −51 31 55.93                | +17.80                               | +291               |
| 72           | 3.02  | F0  | 0.041               | 1 59 15.482                                         | +1.889                               | + 369               | −61 29 41.31                | +17.42                               | + 26               |
| 71           | 4.18  | M0  | 0.000               | 2 00 44.127                                         | +2.827                               | + 97                | −21 00 11.79                | +17.30                               | − 24               |
| 1054         | 4.99  | B8  | 0.000               | 2 03 20.671                                         | +4.042                               | + 40                | +54 33 42.33                | +17.21                               | − 2                |
| 70           | 4.06  | A2  | 0.000               | 2 04 47.371                                         | +5.260                               | − 99                | +72 29 43.24                | +17.17                               | + 22               |
| 73 <i>pr</i> | 2.28  | K0  | 0.000               | 2 04 51.445                                         | +3.712                               | + 40                | +42 24 12.21                | +17.09                               | − 52               |
| 1055         | 4.74  | A0p | 0.000               | 2 05 11.105                                         | +2.688                               | + 9                 | −29 13 22.75                | +17.13                               | + 8                |
| 74 *         | 2.00  | K2  | 0.043               | 2 08 03.040                                         | +3.398                               | + 138               | +23 32 06.09                | +16.85                               | −148               |
| 75           | 3.08  | A5  | 0.012               | 2 10 28.277                                         | +3.593                               | + 122               | +35 03 35.61                | +16.84                               | − 40               |
| 1056         | 5.92  | M0  | 0.000               | 2 11 29.330                                         | +3.339                               | + 62                | +19 34 21.99                | +16.80                               | − 28               |
| 1058         | 4.54  | G5  | 0.015               | 2 13 49.422                                         | +3.189                               | − 15                | + 8 55 07.54                | +16.71                               | − 9                |
| 82           | 3.78  | B8  | 0.000               | 2 17 03.805                                         | +2.142                               | + 102               | −51 26 27.51                | +16.54                               | − 27               |
| 79           | 4.07  | A0  | 0.036               | 2 18 14.459                                         | +3.589                               | + 38                | +33 55 05.40                | +16.45                               | − 51               |
| 1063         | 5.12  | A0  | 0.012               | 2 20 17.274                                         | +3.906                               | − 58                | +47 27 02.40                | +16.39                               | − 8                |
| 1065         | 4.26  | A2  | 0.042               | 2 22 01.765                                         | +1.087                               | − 92                | −68 35 20.82                | +16.32                               | + 2                |
| 1066         | 4.90  | A0  | 0.022               | 2 26 41.977                                         | +2.902                               | − 7                 | −12 13 16.40                | +16.07                               | − 9                |
| 86           | 4.44  | B5  | 0.000               | 2 27 33.212                                         | +2.198                               | + 23                | −47 38 05.47                | +16.02                               | − 10               |
| 85           | 4.34  | A0  | 0.022               | 2 28 59.115                                         | +3.199                               | + 27                | + 8 31 43.69                | +15.95                               | − 9                |
| 1071         | 4.82  | F5  | 0.023               | 2 32 49.352                                         | +2.846                               | − 49                | −15 10 38.05                | +15.63                               | −120               |
| 1072         | 5.04  | G5  | 0.000               | 2 36 41.392                                         | +3.157                               | − 18                | + 5 39 36.40                | +15.51                               | − 25               |
| 95           | 4.26  | B9  | 0.000               | 2 39 49.975                                         | +0.945                               | + 155               | −68 12 02.79                | +15.36                               | − 2                |
| 91           | 4.04  | B2  | 0.000               | 2 40 16.716                                         | +3.082                               | + 9                 | + 0 23 40.60                | +15.33                               | − 4                |
| 1075         | 4.06  | K0  | 0.030               | 2 41 16.731                                         | +2.367                               | + 120               | −39 47 22.90                | +15.25                               | − 32               |
| 94           | 4.58  | B3  | 0.000               | 2 44 21.927                                         | +3.538                               | + 6                 | +27 46 20.04                | +15.09                               | − 12               |
| 97           | 4.39  | B5  | 0.000               | 2 44 51.655                                         | +2.859                               | − 5                 | −13 47 37.59                | +15.06                               | − 15               |
| 93           | 4.22  | F8  | 0.077               | 2 45 16.014                                         | +4.135                               | + 343               | +49 17 34.89                | +14.96                               | − 90               |
| 98           | 4.36  | F0  | 0.040               | 2 45 46.948                                         | +3.253                               | + 192               | +10 10 43.44                | +14.99                               | − 36               |
| 101          | 4.50  | K0  | 0.018               | 2 49 44.358                                         | +2.512                               | + 71                | −32 20 29.42                | +14.95                               | +155               |
| 100          | 3.68  | B8  | 0.031               | 2 50 54.005                                         | +3.549                               | + 50                | +27 19 24.62                | +14.61                               | −118               |
| 102          | 4.81  | K0  | 0.024               | 2 51 44.538                                         | +2.724                               | − 33                | −20 56 27.05                | +14.65                               | − 19               |
| 99           | 3.95  | K0  | 0.000               | 2 51 50.318                                         | +4.425                               | + 20                | +55 57 31.46                | +14.65                               | − 14               |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5               | magn.   | Sp    | $\pi$ | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------------------|---------|-------|-------|-----------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
|                   |         |       |       |                                                     |                                      | 0°0001         |                   |                                      | 0°001          |
| 103               | 4.06    | G0+A5 | 0.012 | 2 <sup>h</sup> 55 <sup>m</sup> 21. <sup>s</sup> 968 | +4. <sup>s</sup> 296                 | − 0            | +52°49′29.45      | +14.45                               | − 5            |
| 104               | 4.05    | K0    | 0.027 | 2 57 11.145                                         | +2.936                               | + 53           | − 8 50 14.10      | +14.13                               | −220           |
| 106 <sub>pr</sub> | 3.42    | A2    | 0.028 | 2 58 50.970                                         | +2.276                               | − 39           | −40 14 35.62      | +14.26                               | + 19           |
| 1082              | 4.97    | K0    | 0.000 | 3 00 01.597                                         | +3.739                               | − 38           | +35 14 39.44      | +14.18                               | + 6            |
| 1083              | 4.69    | B5    | 0.000 | 3 00 32.872                                         | +3.225                               | + 3            | + 8 58 05.84      | +14.12                               | − 14           |
| 1085              | 4.16    | A3    | 0.051 | 3 03 04.536                                         | +2.647                               | − 105          | −23 33 51.79      | +13.93                               | − 54           |
| 107               | 2.82    | M0    | 0.000 | 3 03 05.494                                         | +3.144                               | − 6            | + 4 08 58.80      | +13.90                               | − 78           |
| 110               | 5.16    | F0    | 0.018 | 3 03 58.847                                         | +1.422                               | − 97           | −59 40 41.03      | +13.86                               | − 66           |
| 108               | 3.08    | F5+A3 | 0.011 | 3 05 55.730                                         | +4.388                               | − 0            | +53 33 57.69      | +13.80                               | − 5            |
| 109               | 3.3–4.1 | M3    | 0.000 | 3 06 10.522                                         | +3.869                               | + 111          | +38 53 57.53      | +13.68                               | −106           |
| 111               | 2.2–3.5 | B8    | 0.031 | 3 09 10.996                                         | +3.930                               | + 3            | +41 00 51.61      | +13.59                               | − 1            |
| 112               | 4.17    | G0    | 0.084 | 3 10 11.637                                         | +4.367                               | +1301          | +49 40 16.71      | +13.43                               | − 93           |
| 114               | 4.53    | K0    | 0.025 | 3 12 31.116                                         | +3.444                               | + 107          | +19 47 03.69      | +13.37                               | − 11           |
| 116               | 5.14    | F8    | 0.049 | 3 13 33.990                                         | +3.068                               | + 131          | − 1 08 20.23      | +13.24                               | − 67           |
| 1089              | 4.95    | A0    | 0.015 | 3 15 47.732                                         | +3.462                               | − 20           | +21 06 03.40      | +13.09                               | − 73           |
| 1091              | 4.90    | A3    | 0.020 | 3 16 35.266                                         | +2.919                               | − 1            | − 8 45 46.72      | +13.16                               | + 46           |
| 1093              | 4.96    | G5    | 0.105 | 3 20 10.582                                         | +3.155                               | + 181          | + 3 25 33.94      | +12.96                               | + 92           |
| 119               | 4.30    | G5    | 0.156 | 3 20 32.807                                         | +2.396                               | +2775          | −43 00 40.65      | +13.57                               | +720           |
| 1094              | 5.17    | B3    | 0.000 | 3 22 07.497                                         | +3.477                               | + 18           | +21 12 06.97      | +12.72                               | − 24           |
| 120 *             | 1.79    | F5    | 0.029 | 3 25 26.232                                         | +4.318                               | + 25           | +49 54 54.53      | +12.49                               | − 25           |
| 121               | 3.80    | G5    | 0.011 | 3 25 38.971                                         | +3.238                               | − 45           | + 9 04 56.86      | +12.42                               | − 78           |
| 123               | 3.75    | B8    | 0.000 | 3 28 00.688                                         | +3.261                               | + 40           | + 9 47 08.82      | +12.30                               | − 39           |
| 126               | 4.80    | F5    | 0.052 | 3 29 39.142                                         | +1.064                               | + 562          | −62 52 59.69      | +12.60                               | +371           |
| 122               | 4.44    | B9p   | 0.000 | 3 30 20.183                                         | +4.912                               | − 3            | +59 59 34.45      | +12.17                               | − 4            |
| 1097              | 4.80    | B9    | 0.000 | 3 31 23.275                                         | +2.983                               | + 10           | − 5 01 22.36      | +12.11                               | + 7            |
| 124               | 4.55    | K0    | 0.000 | 3 31 40.487                                         | +4.262                               | + 4            | +48 02 51.10      | +12.10                               | + 20           |
| 125               | 4.28    | K0    | 0.000 | 3 31 43.865                                         | +3.323                               | + 13           | +12 59 19.72      | +12.08                               | − 2            |
| 127               | 3.81    | K0    | 0.303 | 3 33 39.731                                         | +2.832                               | − 658          | − 9 24 23.83      | +11.97                               | + 22           |
| 1099              | 4.32    | B8    | 0.000 | 3 34 28.401                                         | +2.653                               | + 34           | −21 34 54.15      | +11.86                               | − 27           |
| 130               | 4.58    | K0    | 0.000 | 3 37 39.090                                         | +2.156                               | − 5            | −40 13 28.18      | +11.63                               | − 30           |
| 1101              | 4.40    | G5    | 0.054 | 3 37 39.924                                         | +3.068                               | − 156          | + 0 26 59.61      | +11.18                               | −483           |
| 133               | 4.93    | B5    | 0.000 | 3 42 51.939                                         | +2.389                               | + 7            | −31 53 22.57      | +11.30                               | + 14           |
| 135               | 3.72    | K0    | 0.109 | 3 43 59.528                                         | +2.880                               | − 62           | − 9 42 42.56      | +11.95                               | +745           |
| 131               | 3.10    | B5    | 0.000 | 3 44 02.119                                         | +4.301                               | + 28           | +47 50 09.07      | +11.17                               | − 34           |
| 141               | 3.80    | K0    | 0.042 | 3 44 23.914                                         | +0.772                               | + 490          | −64 45 30.52      | +11.25                               | + 75           |
| 137               | 5.09    | B8    | 0.000 | 3 45 17.827                                         | +3.054                               | + 1            | − 1 06 54.65      | +11.11                               | − 7            |
| 136               | 3.81    | B5p   | 0.019 | 3 45 47.942                                         | +3.576                               | + 14           | +24 09 39.51      | +11.03                               | − 46           |
| 134               | 3.93    | F5    | 0.014 | 3 46 15.146                                         | +4.100                               | − 13           | +42 37 34.45      | +11.04                               | − 2            |
| 146               | 3.17    | M0    | 0.000 | 3 47 00.870                                         | −0.860                               | + 116          | −74 11 28.31      | +11.10                               | +114           |
| 140               | 4.33    | F8    | 0.053 | 3 47 30.938                                         | +2.584                               | − 115          | −23 12 17.04      | +10.42                               | −529           |
| 139               | 2.96    | B5p   | 0.000 | 3 48 24.537                                         | +3.580                               | + 14           | +24 09 06.92      | +10.84                               | − 46           |
| 143               | 4.24    | K0    | 0.018 | 3 50 02.097                                         | +2.248                               | − 38           | −36 09 14.37      | +10.71                               | − 51           |
| 142               | 3.80    | B8    | 0.000 | 3 50 05.220                                         | +3.581                               | + 13           | +24 05 58.86      | +10.72                               | − 47           |
| 138 *             | 4.63    | A0    | 0.000 | 3 52 01.156                                         | +6.442                               | + 34           | +71 22 41.06      | +10.58                               | − 43           |
| 144               | 2.91    | B1    | 0.000 | 3 55 06.605                                         | +3.788                               | + 4            | +31 55 42.45      | +10.38                               | − 10           |
| 149               | 3.19    | K5    | 0.000 | 3 58 45.208                                         | +2.803                               | + 42           | −13 27 55.22      | +10.00                               | −111           |
| 147               | 2.96    | B1    | 0.000 | 3 58 53.920                                         | +4.047                               | + 16           | +40 03 13.55      | +10.08                               | − 26           |
| 1110              | 4.41    | M0    | 0.000 | 3 58 59.657                                         | +0.964                               | + 15           | −61 21 24.47      | +10.08                               | − 18           |
| 148               | 4.05    | O5e   | 0.000 | 3 59 58.491                                         | +3.911                               | + 2            | +35 50 03.54      | +10.02                               | + 0            |
| 150               | 3.8–4.1 | B3    | 0.000 | 4 01 32.468                                         | +3.333                               | − 4            | +12 31 59.07      | + 9.89                               | − 12           |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5   | magn.             | Sp    | $\pi$ | $\alpha_{2015.5}$                                 | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$          | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------|-------------------|-------|-------|---------------------------------------------------|--------------------------------------|-------------------------|-------------------|--------------------------------------|----------------|
| 151   | 3.94              | A0    | 0.022 | <sup>h</sup> 03 <sup>m</sup> 58 <sup>s</sup> .952 | +3.199                               | <sup>0°00'01"</sup> + 3 | + 6°01'52".55     | +9.71                                | - 3            |
| 1112  | 4.50              | K0    | 0.013 | 4 05 36.852                                       | +3.559                               | + 65                    | +22 07 23.22      | +9.53                                | - 59           |
| 1113  | 4.33              | A0    | 0.000 | 4 07 44.714                                       | +4.498                               | - 15                    | +50 23 30.87      | +9.39                                | - 36           |
| 152   | 4.03              | B3p   | 0.015 | 4 09 47.557                                       | +4.382                               | + 20                    | +47 45 08.99      | +9.24                                | - 31           |
| 154   | 4.14              | F2    | 0.028 | 4 12 37.403                                       | +2.934                               | + 7                     | - 6 47 53.29      | +9.13                                | + 82           |
| 155   | 3.87              | K0    | 0.019 | 4 14 30.994                                       | +1.992                               | + 42                    | -42 15 24.93      | +8.69                                | -209           |
| 156   | 3.36              | G5    | 0.000 | 4 14 37.676                                       | +0.788                               | + 65                    | -62 26 07.18      | +8.94                                | + 45           |
| 1117  | 4.28              | G0    | 0.012 | 4 16 02.489                                       | +4.431                               | + 5                     | +48 26 50.16      | +8.76                                | - 18           |
| 1118  | 4.32              | B3    | 0.000 | 4 16 22.665                                       | +3.266                               | + 14                    | + 8 55 48.29      | +8.73                                | - 24           |
| 157   | 4.36              | F5    | 0.053 | 4 16 26.055                                       | +1.578                               | +114                    | -51 26 53.21      | +8.93                                | +182           |
| 159   | 3.86              | K0    | 0.000 | 4 20 40.650                                       | +3.423                               | + 80                    | +15 39 50.02      | +8.39                                | - 25           |
| 158   | 5.10              | G5    | 0.000 | 4 21 25.238                                       | +3.911                               | - 20                    | +34 36 10.35      | +8.35                                | - 5            |
| 163   | 5.18              | K0    | 0.000 | 4 22 03.627                                       | +0.666                               | +133                    | -63 20 59.46      | +8.48                                | +173           |
| 162   | 3.93              | K0    | 0.016 | 4 23 49.850                                       | +3.469                               | + 75                    | +17 34 39.64      | +8.14                                | - 30           |
| 1121  | 4.06              | K5    | 0.000 | 4 24 37.194                                       | +2.257                               | + 56                    | -33 58 54.03      | +8.15                                | + 50           |
| 164   | 3.63              | K0    | 0.018 | 4 29 31.429                                       | +3.513                               | + 76                    | +19 12 48.92      | +7.67                                | - 38           |
| 167   | 5.16              | B3    | 0.000 | 4 31 18.661                                       | +1.842                               | + 6                     | -44 55 16.25      | +7.56                                | - 8            |
| 171   | 3.47              | A0p   | 0.011 | 4 34 19.981                                       | +1.304                               | + 60                    | -55 00 48.62      | +7.31                                | - 4            |
| 1125  | 4.75              | A5    | 0.022 | 4 34 43.803                                       | +3.413                               | + 71                    | +14 52 32.90      | +7.26                                | - 27           |
| 170   | 3.88              | K0    | 0.000 | 4 36 09.246                                       | +2.336                               | - 35                    | -30 31 53.09      | +7.16                                | - 12           |
| 168 * | 0.85              | K5    | 0.048 | 4 36 48.709                                       | +3.451                               | + 44                    | +16 32 21.32      | +6.93                                | -190           |
| 169   | 4.12              | B2    | 0.000 | 4 37 05.675                                       | +3.003                               | + 1                     | - 3 19 18.54      | +7.09                                | - 5            |
| 172   | 3.98              | K0    | 0.036 | 4 38 53.447                                       | +2.751                               | - 52                    | -14 16 28.43      | +6.79                                | -155           |
| 1129  | 4.52              | F2    | 0.038 | 4 41 03.724                                       | +1.937                               | -126                    | -41 50 05.71      | +6.69                                | - 77           |
| 1130  | 5.08              | F5    | 0.051 | 4 42 36.421                                       | +2.125                               | + 41                    | -37 06 53.42      | +6.83                                | +193           |
| 174   | 4.33              | B5    | 0.000 | 4 43 10.649                                       | +3.610                               | - 1                     | +22 59 07.43      | +6.58                                | - 16           |
| 176   | 4.18              | B5    | 0.000 | 4 46 16.714                                       | +3.005                               | + 10                    | - 3 13 38.24      | +6.32                                | - 13           |
| 1134  | 3.31              | F8    | 0.125 | 4 50 40.980                                       | +3.263                               | +313                    | + 6 59 13.79      | +5.98                                | + 11           |
| 1133  | 5.10              | K2    | 0.026 | 4 50 57.418                                       | +4.052                               | - 32                    | +37 30 51.28      | +5.99                                | + 40           |
| 179   | 3.78              | B3    | 0.000 | 4 52 01.972                                       | +3.201                               | - 1                     | + 5 37 49.64      | +5.86                                | + 1            |
| 1135  | 5.12              | F0    | 0.000 | 4 52 16.970                                       | +3.518                               | + 56                    | +18 51 53.93      | +5.80                                | - 35           |
| 1136  | 5.19              | M0    | 0.000 | 4 53 24.671                                       | +3.401                               | + 0                     | +14 16 30.85      | +5.68                                | - 57           |
| 180   | 3.87              | B3    | 0.000 | 4 55 03.605                                       | +3.130                               | + 0                     | + 2 27 53.71      | +5.60                                | - 0            |
| 178   | 4.38              | B0    | 0.000 | 4 55 36.082                                       | +6.009                               | - 1                     | +66 22 00.88      | +5.56                                | + 6            |
| 181   | 2.90              | K2    | 0.015 | 4 58 00.326                                       | +3.918                               | + 3                     | +33 11 21.33      | +5.34                                | - 18           |
| 183   | 3.1-3.8           | F5p   | 0.000 | 5 03 05.058                                       | +4.319                               | - 1                     | +43 50 40.86      | +4.92                                | - 4            |
| 1137  | 3.94 <sup>v</sup> | K0+B1 | 0.000 | 5 03 33.864                                       | +4.206                               | + 8                     | +41 05 49.06      | +4.86                                | - 22           |
| 184   | 4.70              | A5    | 0.000 | 5 04 01.429                                       | +3.594                               | + 47                    | +21 36 38.88      | +4.80                                | - 42           |
| 182   | 4.22              | G0p   | 0.000 | 5 04 48.194                                       | +5.364                               | - 9                     | +60 27 46.80      | +4.76                                | - 16           |
| 187   | 4.92              | K5    | 0.000 | 5 05 22.185                                       | +1.559                               | + 73                    | -49 33 26.65      | +4.73                                | - 3            |
| 1140  | 4.65              | B9    | 0.012 | 5 05 27.371                                       | +3.435                               | + 11                    | +15 25 27.95      | +4.69                                | - 34           |
| 189   | 4.76              | F8    | 0.078 | 5 05 46.704                                       | +1.036                               | - 37                    | -57 27 07.15      | +4.81                                | +115           |
| 186   | 3.29              | K5    | 0.000 | 5 06 07.071                                       | +2.543                               | + 18                    | -22 21 04.15      | +4.59                                | - 74           |
| 185   | 3.28              | B3    | 0.013 | 5 07 36.267                                       | +4.219                               | + 26                    | +41 15 14.22      | +4.47                                | - 68           |
| 188   | 2.92              | A3    | 0.042 | 5 08 36.745                                       | +2.953                               | - 63                    | - 5 04 02.90      | +4.38                                | - 81           |
| 190   | 4.34              | B2    | 0.000 | 5 09 53.341                                       | +2.875                               | + 1                     | - 8 44 06.96      | +4.34                                | - 4            |
| 1144  | 3.30              | A0p   | 0.018 | 5 13 37.705                                       | +2.698                               | + 30                    | -16 11 17.48      | +4.00                                | - 26           |
| 196   | 4.78              | K0    | 0.000 | 5 13 44.940                                       | -0.031                               | + 33                    | -67 10 04.31      | +4.05                                | + 36           |
| 192   | 4.78              | A3    | 0.019 | 5 14 29.493                                       | +4.116                               | - 16                    | +38 30 04.95      | +3.88                                | - 75           |
| 194 * | 0.12              | B8p   | 0.000 | 5 15 17.008                                       | +2.887                               | + 0                     | - 8 11 05.27      | +3.88                                | - 1            |



# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5   | magn.             | Sp  | $\pi$ | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------|-------------------|-----|-------|-----------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
| 193 * | 0.08              | G0  | 0.073 | 5 <sup>h</sup> 17 <sup>m</sup> 50. <sup>s</sup> 208 | +4.443                               | 0°00'01" + 72  | +46°00'43.91"     | +3.24                                | 0°00' -425     |
| 197   | 4.91              | K0  | 0.012 | 5 18 02.659                                         | +2.167                               | + 72           | -34 52 51.17      | +3.31                                | -337           |
| 195   | 3.68              | B5  | 0.000 | 5 18 21.595                                         | +2.917                               | - 10           | - 6 49 43.35      | +3.61                                | - 8            |
| 1145  | 4.85              | G0  | 0.066 | 5 20 14.009                                         | +4.229                               | +451           | +40 06 40.67      | +2.79                                | -665           |
| 1146  | 4.29              | B1  | 0.000 | 5 20 17.408                                         | +2.767                               | - 1            | -13 09 42.48      | +3.45                                | - 3            |
| 1147  | 4.65              | B3  | 0.000 | 5 22 33.273                                         | +3.067                               | - 0            | - 0 22 06.02      | +3.26                                | - 1            |
| 201   | 1.70              | B2  | 0.026 | 5 25 57.793                                         | +3.222                               | - 6            | + 6 21 45.05      | +2.95                                | - 14           |
| 202   | 1.78              | B8  | 0.018 | 5 27 16.381                                         | +3.799                               | + 17           | +28 37 08.82      | +2.68                                | -175           |
| 204   | 2.96              | G0  | 0.014 | 5 28 54.605                                         | +2.573                               | - 3            | -20 44 53.00      | +2.62                                | - 89           |
| 214   | 5.06              | K0  | 0.012 | 5 31 16.559                                         | -2.343                               | +319           | -76 19 44.85      | +2.79                                | +282           |
| 206   | 2.48              | B0  | 0.000 | 5 32 47.958                                         | +3.069                               | + 1            | - 0 17 19.60      | +2.37                                | - 2            |
| 207   | 2.69              | F0  | 0.000 | 5 33 24.857                                         | +2.649                               | + 1            | -17 48 43.81      | +2.32                                | + 2            |
| 1151  | 4.88              | B1  | 0.000 | 5 33 44.287                                         | +3.911                               | - 1            | +32 12 07.44      | +2.29                                | - 3            |
| 212   | 3.81 <sup>v</sup> | F5p | 0.000 | 5 33 45.685                                         | +0.528                               | + 3            | -62 28 47.76      | +2.30                                | + 9            |
| 208   | 4.53              | B0  | 0.000 | 5 35 40.349                                         | +3.298                               | + 1            | + 9 29 55.78      | +2.12                                | - 4            |
| 209   | 2.89              | O5e | 0.021 | 5 36 11.508                                         | +2.938                               | + 0            | - 5 54 02.87      | +2.08                                | + 1            |
| 210 * | 1.70              | B0  | 0.000 | 5 37 00.043                                         | +3.048                               | + 1            | - 1 11 35.40      | +2.01                                | - 2            |
| 211   | 3.00              | B3p | 0.000 | 5 38 34.320                                         | +3.590                               | + 0            | +21 09 02.36      | +1.85                                | - 21           |
| 215   | 2.75              | B5p | 0.000 | 5 40 12.666                                         | +2.176                               | + 5            | -34 04 00.25      | +1.70                                | - 26           |
| 1154  | 4.52              | A5  | 0.019 | 5 44 48.119                                         | +0.114                               | - 49           | -65 43 47.22      | +1.34                                | + 8            |
| 217   | 3.80              | F8  | 0.122 | 5 45 06.583                                         | +2.503                               | -212           | -22 26 39.43      | +0.93                                | -369           |
| 219   | 3.67              | A2  | 0.042 | 5 47 39.508                                         | +2.721                               | - 11           | -14 49 01.93      | +1.08                                | - 1            |
| 220   | 2.20              | B0  | 0.000 | 5 48 29.530                                         | +2.848                               | + 1            | - 9 39 54.70      | +1.00                                | - 2            |
| 1156  | 4.38              | K0  | 0.011 | 5 50 06.605                                         | +1.094                               | + 99           | -56 09 47.69      | +0.79                                | - 76           |
| 1159  | 4.98              | K0  | 0.016 | 5 51 14.311                                         | +1.360                               | + 6            | -52 06 21.21      | +0.69                                | - 78           |
| 223   | 3.22              | K0  | 0.023 | 5 51 30.426                                         | +2.118                               | + 49           | -35 45 48.09      | +1.14                                | +401           |
| 222   | 3.90              | K0  | 0.022 | 5 51 59.306                                         | +2.582                               | +162           | -20 52 43.64      | +0.05                                | -649           |
| 221   | 4.18              | K0  | 0.017 | 5 52 33.897                                         | +4.162                               | - 4            | +39 09 05.47      | +0.66                                | + 7            |
| 1158  | 4.54              | A0  | 0.019 | 5 54 18.143                                         | +3.774                               | + 2            | +27 36 52.13      | +0.49                                | - 12           |
| 224 * | 0.4-1.3           | M0  | 0.000 | 5 56 00.690                                         | +3.251                               | + 17           | + 7 24 31.46      | +0.36                                | + 9            |
| 1157  | 4.92              | A2  | 0.012 | 5 56 08.773                                         | +5.033                               | - 15           | +55 42 31.57      | +0.36                                | + 20           |
| 226   | 3.77              | F0  | 0.061 | 5 57 06.681                                         | +2.735                               | - 28           | -14 09 57.32      | +0.39                                | +139           |
| 1160  | 4.36              | B3  | 0.000 | 5 58 05.221                                         | +2.130                               | - 0            | -35 16 56.80      | +0.18                                | + 9            |
| 229   | 4.03              | K0  | 0.014 | 5 59 37.313                                         | +1.839                               | + 20           | -42 48 54.22      | +0.02                                | - 14           |
| 227 * | 1.90              | A0p | 0.037 | 6 00 39.973                                         | +4.403                               | - 54           | +44 56 50.65      | -0.06                                | + 0            |
| 225   | 3.88              | K0  | 0.020 | 6 00 48.245                                         | +4.943                               | + 92           | +54 17 02.78      | -0.20                                | -126           |
| 1163  | 4.30              | G5  | 0.026 | 6 05 03.761                                         | +3.649                               | - 6            | +23 15 40.39      | -0.54                                | -100           |
| 232   | 4.40              | B2  | 0.000 | 6 08 27.448                                         | +3.428                               | + 4            | +14 45 55.21      | -0.76                                | - 21           |
| 239   | 5.14              | K0  | 0.115 | 6 09 46.638                                         | -1.794                               | +295           | -74 45 27.92      | -1.07                                | -214           |
| 235   | 4.84              | B1  | 0.000 | 6 10 36.041                                         | +1.171                               | - 4            | -54 58 21.31      | -0.92                                | + 5            |
| 1168  | 4.45              | K0  | 0.016 | 6 16 21.950                                         | +3.823                               | - 57           | +29 29 27.39      | -1.69                                | -262           |
| 238   | 4.51              | K0  | 0.019 | 6 17 06.249                                         | +2.137                               | - 0            | -35 08 47.47      | -1.41                                | + 86           |
| 1169  | 5.11              | F5  | 0.042 | 6 17 18.859                                         | +3.371                               | + 56           | +12 15 59.73      | -1.33                                | +186           |
| 1170  | 5.13              | B3  | 0.000 | 6 20 27.618                                         | +2.892                               | - 3            | - 7 49 49.76      | -1.79                                | + 0            |
| 234   | 4.73              | A0  | 0.013 | 6 20 33.107                                         | +6.599                               | + 2            | +69 18 42.94      | -1.90                                | -107           |
| 240   | 3.10              | B3  | 0.000 | 6 20 54.526                                         | +2.306                               | + 7            | -30 04 16.12      | -1.82                                | + 3            |
| 237   | 4.42              | A0  | 0.035 | 6 20 59.372                                         | +5.289                               | - 10           | +59 00 12.41      | -1.81                                | + 26           |
| 243   | 1.99              | B1  | 0.014 | 6 23 22.947                                         | +2.644                               | - 4            | -17 57 52.54      | -2.04                                | + 0            |
| 241   | 3.19              | M0  | 0.021 | 6 23 53.883                                         | +3.630                               | + 39           | +22 30 15.37      | -2.20                                | -111           |
| 245   | -0.86             | F0  | 0.018 | 6 24 17.785                                         | +1.333                               | + 25           | -52 42 16.82      | -2.10                                | + 21           |
| 244   | 4.48              | A5  | 0.024 | 6 24 35.382                                         | +3.181                               | - 12           | + 4 35 01.70      | -2.14                                | + 11           |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5                 | magn.                                                                 | Sp                                                                | $\pi$               | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$      | $\delta_{2015.5}$            | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$     |
|---------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------|---------------------|-----------------------------------------------------|--------------------------------------|---------------------|------------------------------|--------------------------------------|--------------------|
|                     |                                                                       |                                                                   |                     |                                                     |                                      | 0 <sup>s</sup> 0001 |                              |                                      | 0 <sup>o</sup> 001 |
| 242                 | 5.10 <sub>v</sub>                                                     | K2                                                                | 0 <sup>o</sup> .000 | 6 <sup>h</sup> 26 <sup>m</sup> 05 <sup>s</sup> .468 | +4.617                               | − 2                 | +49° 16' 42 <sup>o</sup> .03 | −2 <sup>o</sup> .28                  | − 1                |
| 246                 | 4.98                                                                  | B3                                                                | 0.000               | 6 28 43.507                                         | +2.964                               | − 4                 | − 4 46 22.03                 | −2.51                                | − 1                |
| 1173                | 4.06                                                                  | B5                                                                | 0.013               | 6 29 52.997                                         | +3.562                               | − 5                 | +20 12 03.57                 | −2.62                                | − 14               |
| 1174                | 4.50                                                                  | A0p                                                               | 0.000               | 6 33 44.528                                         | +3.245                               | − 1                 | + 7 19 13.48                 | −2.95                                | − 6                |
| 1175                | 5.02                                                                  | B3                                                                | 0.000               | 6 34 25.131                                         | +3.047                               | − 2                 | − 1 13 59.06                 | −3.02                                | − 21               |
| 249                 | 4.54                                                                  | A0                                                                | 0.017               | 6 35 42.374                                         | +2.516                               | + 8                 | −22 58 40.88                 | −3.09                                | + 16               |
| 252                 | 3.18                                                                  | B8                                                                | 0.000               | 6 38 14.156                                         | +1.838                               | + 2                 | −43 12 36.87                 | −3.33                                | − 6                |
| 251                 | 1.93                                                                  | A0                                                                | 0.031               | 6 38 36.443                                         | +3.465                               | + 29                | +16 23 05.30                 | −3.40                                | − 42               |
| 254                 | 3.18                                                                  | G5                                                                | 0.000               | 6 44 53.111                                         | +3.689                               | − 4                 | +25 06 51.88                 | −3.91                                | − 13               |
| 257 <sub>cg</sub> * | −1.46                                                                 | A0                                                                | 0.375               | 6 45 49.836                                         | +2.643                               | −386                | −16 44 17.92                 | −5.19                                | −1205              |
| 256                 | 3.40                                                                  | F5                                                                | 0.051               | 6 46 09.548                                         | +3.367                               | − 79                | +12 52 39.49                 | −4.20                                | − 191              |
| 262                 | 3.30                                                                  | A5                                                                | 0.046               | 6 48 20.941                                         | +0.613                               | − 97                | −61 57 29.73                 | −3.93                                | + 269              |
| 258                 | 4.70                                                                  | K0                                                                | 0.015               | 6 48 40.135                                         | +3.129                               | − 12                | + 2 23 38.52                 | −4.24                                | − 12               |
| 263                 | 2.83                                                                  | K0                                                                | 0.000               | 6 50 19.262                                         | +1.490                               | + 38                | −50 38 01.22                 | −4.44                                | − 70               |
| 1180                | 3.78                                                                  | B2p                                                               | 0.000               | 6 50 25.223                                         | +2.243                               | − 5                 | −32 31 37.95                 | −4.37                                | + 4                |
| 261                 | 3.64                                                                  | A2                                                                | 0.021               | 6 53 48.567                                         | +3.950                               | − 2                 | +33 56 28.10                 | −4.71                                | − 48               |
| 266                 | 4.25                                                                  | K2                                                                | 0.021               | 6 54 54.619                                         | +2.789                               | − 93                | −12 03 32.58                 | −4.77                                | − 13               |
| 259                 | 5.13                                                                  | B5                                                                | 0.000               | 6 55 22.016                                         | +6.432                               | + 6                 | +68 52 04.82                 | −4.79                                | + 8                |
| 268                 | 1.63                                                                  | B1                                                                | 0.000               | 6 59 14.122                                         | +2.360                               | + 3                 | −28 59 38.46                 | −5.12                                | + 3                |
| 260*                | 4.55                                                                  | K5                                                                | 0.020               | 7 02 18.291                                         | +8.651                               | +210                | +76 57 16.56                 | −5.40                                | − 14               |
| 1183                | 3.68                                                                  | K5                                                                | 0.017               | 7 02 20.219                                         | +2.392                               | − 4                 | −27 57 28.43                 | −5.38                                | + 5                |
| 270                 | 3.12                                                                  | B5p                                                               | 0.000               | 7 03 40.315                                         | +2.507                               | − 3                 | −23 51 24.69                 | −5.49                                | + 3                |
| 271                 | 4.07                                                                  | B5                                                                | 0.000               | 7 04 27.573                                         | +2.715                               | − 1                 | −15 39 25.64                 | −5.57                                | − 8                |
| 269                 | 3.7–4.1                                                               | G0p                                                               | 0.000               | 7 05 01.637                                         | +3.555                               | − 6                 | +20 32 46.62                 | −5.61                                | − 0                |
| 1189                | 3.87                                                                  | K0                                                                | 0.000               | 7 08 36.699                                         | −0.530                               | + 47                | −70 31 26.40                 | −5.80                                | + 106              |
| 273                 | 1.98                                                                  | F8p                                                               | 0.000               | 7 09 01.316                                         | +2.441                               | − 2                 | −26 25 07.22                 | −5.94                                | + 4                |
| 1186                | 5.02                                                                  | K0                                                                | 0.021               | 7 10 59.877                                         | +2.980                               | + 0                 | − 4 15 44.59                 | −5.89                                | + 215              |
| 1187                | 4.09                                                                  | A0                                                                | 0.015               | 7 12 39.344                                         | +3.064                               | − 1                 | − 0 31 10.24                 | −6.24                                | + 5                |
| 274                 | 5.07                                                                  | K2                                                                | 0.022               | 7 12 43.162                                         | +4.118                               | + 38                | +39 17 37.76                 | −6.25                                | + 3                |
| 275                 | 4.47                                                                  | F0                                                                | 0.040               | 7 13 00.172                                         | +1.712                               | −128                | −46 47 09.24                 | −6.17                                | + 103              |
| 281                 | 4.02                                                                  | F5                                                                | 0.000               | 7 16 49.111                                         | −0.047                               | − 12                | −67 59 08.15                 | −6.59                                | + 5                |
| 278                 | 2.74                                                                  | K5                                                                | 0.023               | 7 17 41.422                                         | +2.121                               | − 8                 | −37 07 33.97                 | −6.66                                | + 4                |
| 277                 | 3.65                                                                  | A2                                                                | 0.041               | 7 18 58.972                                         | +3.445                               | − 33                | +16 30 40.36                 | −6.81                                | − 37               |
| 279                 | 3.52                                                                  | F0                                                                | 0.059               | 7 21 02.845                                         | +3.579                               | − 19                | +21 57 09.10                 | −6.95                                | − 12               |
| 283                 | 2.43                                                                  | B5p                                                               | 0.000               | 7 24 42.507                                         | +2.375                               | − 3                 | −29 20 02.99                 | −7.23                                | + 5                |
| 282                 | 3.89                                                                  | K0                                                                | 0.031               | 7 26 41.263                                         | +3.720                               | − 93                | +27 45 57.53                 | −7.49                                | − 86               |
| 285                 | 3.09                                                                  | B8                                                                | 0.020               | 7 27 59.443                                         | +3.252                               | − 35                | + 8 15 25.07                 | −7.55                                | − 38               |
| 1194                | 3.28                                                                  | K5                                                                | 0.013               | 7 29 43.375                                         | +1.905                               | − 50                | −43 20 00.62                 | −7.46                                | + 187              |
| 286                 | 4.18                                                                  | F0                                                                | 0.059               | 7 30 06.409                                         | +3.851                               | +121                | +31 45 08.19                 | −7.50                                | + 175              |
| 1193                | 4.85                                                                  | K0                                                                | 0.025               | 7 30 39.508                                         | +3.337                               | + 0                 | +11 58 24.18                 | −7.74                                | − 19               |
| 288                 | 4.52                                                                  | F8                                                                | 0.047               | 7 34 43.006                                         | +2.570                               | − 29                | −22 19 49.73                 | −8.00                                | + 46               |
| 287 <sub>cg</sub>   | $\left\{ \begin{smallmatrix} 1.99 \\ 2.85 \end{smallmatrix} \right\}$ | $\left\{ \begin{smallmatrix} A0 \\ A0 \end{smallmatrix} \right\}$ | 0.072               | 7 35 35.236                                         | +3.821                               | −135                | +31 51 11.77                 | −8.22                                | − 98               |
| 1198                | 4.92                                                                  | K5                                                                | 0.000               | 7 36 02.714                                         | +1.483                               | + 26                | −52 34 08.52                 | −8.17                                | − 16               |
| 1196                | 4.22                                                                  | K5                                                                | 0.012               | 7 36 52.552                                         | +3.690                               | − 26                | +26 51 36.10                 | −8.33                                | − 106              |
| 290                 | 4.62                                                                  | B8                                                                | 0.000               | 7 37 56.532                                         | +2.222                               | − 18                | −35 00 14.81                 | −8.29                                | + 14               |
| 289                 | 5.17                                                                  | F5                                                                | 0.027               | 7 38 02.919                                         | +2.983                               | − 45                | − 4 08 47.79                 | −8.30                                | + 17               |
| 291 <sub>cg</sub>   | 0.48                                                                  | F5                                                                | 0.288               | 7 40 06.750                                         | +3.137                               | −476                | + 5 11 03.28                 | −9.50                                | −1022              |
| 297                 | 3.89                                                                  | K0                                                                | 0.011               | 7 41 37.228                                         | −0.780                               | + 67                | −72 38 34.96                 | −8.58                                | + 18               |
| 293                 | 4.07                                                                  | K0                                                                | 0.019               | 7 41 59.269                                         | +2.867                               | − 49                | − 9 35 17.76                 | −8.65                                | − 19               |
| 292                 | 4.96                                                                  | A2                                                                | 0.017               | 7 44 18.626                                         | +5.042                               | − 48                | +58 40 20.86                 | −8.86                                | − 51               |
| 294                 | 3.70                                                                  | G5                                                                | 0.025               | 7 45 22.889                                         | +3.615                               | − 24                | +24 21 34.61                 | −8.95                                | − 52               |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5               | magn. | Sp   | $\pi$ | $\alpha_{2015.5}$    | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$             | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------------------|-------|------|-------|----------------------|--------------------------------------|----------------------------|-------------------|--------------------------------------|----------------|
| 295 *             | 1.14  | K0   | 0.093 | $7^h 46^m 15.^s 738$ | +3.663                               | $0^{\circ}00'01''$<br>-474 | +27°59'15.20      | - 9.01                               | 0.001<br>- 45  |
| 1202              | 5.11  | F0   | 0.023 | 7 46 39.693          | +2.763                               | - 8                        | -14 36 08.65      | - 8.99                               | + 6            |
| 1200              | 5.02  | K2   | 0.016 | 7 47 01.217          | +3.468                               | - 53                       | +18 28 15.83      | - 9.08                               | - 58           |
| 1204              | 3.47  | G0p  | 0.000 | 7 49 56.789          | +2.525                               | - 2                        | -24 53 58.33      | - 9.25                               | - 2            |
| 1205              | 5.11  | B8   | 0.000 | 7 52 30.185          | +3.110                               | - 10                       | + 1 43 34.64      | - 9.45                               | - 3            |
| 301               | 3.76  | G5   | 0.023 | 7 52 45.037          | +2.064                               | - 8                        | -40 36 59.47      | - 9.46                               | + 3            |
| 1207              | 4.99  | A2   | 0.000 | 7 54 26.601          | +3.663                               | - 26                       | +26 43 28.08      | - 9.63                               | - 31           |
| 303               | 3.60  | B3   | 0.000 | 7 57 10.338          | +1.524                               | - 32                       | -53 01 27.87      | - 9.78                               | + 21           |
| 1210              | 4.85  | A2   | 0.019 | 7 58 17.212          | +2.394                               | - 4                        | -30 22 37.35      | - 9.88                               | + 7            |
| 304               | 5.06  | K0   | 0.025 | 8 00 30.596          | +2.996                               | - 36                       | - 3 43 22.21      | -10.06                               | - 3            |
| 1212              | 4.64  | A2   | 0.015 | 8 00 33.735          | +2.690                               | - 2                        | -18 26 33.52      | -10.10                               | - 39           |
| 306               | 2.27  | Od   | 0.000 | 8 04 07.764          | +2.111                               | - 24                       | -40 02 51.29      | -10.32                               | + 12           |
| 305               | 5.04  | K0   | 0.014 | 8 04 28.061          | +3.675                               | - 19                       | +27 44 58.79      | -10.40                               | - 42           |
| 308               | 2.88  | F5   | 0.031 | 8 08 12.272          | +2.557                               | - 61                       | -24 20 59.17      | -10.59                               | + 49           |
| 307               | 4.87  | A2   | 0.000 | 8 09 37.007          | +4.485                               | - 63                       | +51 27 38.11      | -10.74                               | - 4            |
| 309               | 1.92  | Oap  | 0.000 | 8 10 00.643          | +1.850                               | - 4                        | -47 22 58.47      | -10.76                               | + 6            |
| 311               | 5.05  | G5   | 0.020 | 8 14 02.718          | +2.758                               | - 9                        | -15 50 08.93      | -11.07                               | - 4            |
| 312               | 3.76  | K2   | 0.014 | 8 17 21.307          | +3.250                               | - 30                       | + 9 08 12.38      | -11.35                               | - 49           |
| 313               | 4.43  | A5   | 0.036 | 8 19 08.163          | +2.248                               | - 88                       | -36 42 29.08      | -11.34                               | + 97           |
| 318               | 4.26  | K0   | 0.027 | 8 20 09.051          | -1.914                               | -412                       | -77 32 02.09      | -11.46                               | + 42           |
| 1217              | 5.16  | F5   | 0.061 | 8 21 00.200          | +3.634                               | - 14                       | +27 09 59.01      | -11.94                               | -378           |
| 1219              | 4.94  | K0   | 0.021 | 8 21 59.691          | +2.365                               | - 7                        | -33 06 15.78      | -11.63                               | + 4            |
| 315               | 1.74  | K0+B | 0.000 | 8 22 49.840          | +1.226                               | - 35                       | -59 33 35.43      | -11.68                               | + 14           |
| 314               | 4.43  | K5   | 0.020 | 8 23 53.501          | +4.086                               | - 20                       | +43 08 13.92      | -11.87                               | - 96           |
| 319               | 3.65  | K0   | 0.033 | 8 25 54.063          | +0.635                               | - 60                       | -66 11 20.01      | -12.07                               | -155           |
| 316               | 3.95  | A0   | 0.019 | 8 26 26.079          | +2.997                               | - 44                       | - 3 57 28.34      | -11.97                               | - 23           |
| 317               | 3.47  | G0   | 0.000 | 8 31 32.433          | +4.934                               | -182                       | +60 39 53.69      | -12.41                               | -107           |
| 324               | 4.13  | A5   | 0.012 | 8 38 11.390          | +2.112                               | - 5                        | -43 02 38.26      | -12.75                               | + 8            |
| 1223              | 4.18  | A0   | 0.027 | 8 38 28.554          | +3.173                               | - 44                       | + 5 38 55.67      | -12.79                               | - 7            |
| 1224              | 4.54  | K0   | 0.025 | 8 39 34.010          | +3.133                               | - 12                       | + 3 17 09.87      | -12.87                               | - 18           |
| 1227              | 3.68  | B3   | 0.000 | 8 40 44.245          | +1.719                               | - 24                       | -52 58 39.02      | -12.91                               | + 20           |
| 325               | 5.15  | K2   | 0.022 | 8 40 45.529          | +2.843                               | - 55                       | -12 31 51.61      | -12.94                               | - 2            |
| 1226              | 4.06  | F5p  | 0.023 | 8 41 08.491          | +1.994                               | + 0                        | -46 42 16.13      | -12.96                               | + 3            |
| 1228              | 4.73  | A0   | 0.000 | 8 44 10.834          | +3.463                               | - 76                       | +21 24 42.37      | -13.20                               | - 39           |
| 327               | 3.70  | B2   | 0.000 | 8 44 12.958          | +2.414                               | - 9                        | -33 14 34.56      | -13.15                               | + 11           |
| 326               | 4.17  | K0   | 0.015 | 8 45 33.836          | +3.402                               | - 13                       | +18 05 46.96      | -13.48                               | -228           |
| 328               | 4.20  | G5   | 0.021 | 8 47 37.913          | +3.618                               | - 19                       | +28 42 08.00      | -13.43                               | - 42           |
| 1230              | 5.19  | B9   | 0.000 | 8 50 08.439          | +3.014                               | - 14                       | - 3 30 04.94      | -13.57                               | - 23           |
| 332               | 4.19  | K2   | 0.025 | 8 51 11.445          | +2.549                               | - 98                       | -27 46 04.97      | -13.53                               | + 87           |
| 336               | 3.98  | B8   | 0.000 | 8 55 23.845          | +1.355                               | - 28                       | -60 42 15.19      | -13.85                               | + 38           |
| 334               | 3.30  | K0   | 0.029 | 8 56 12.735          | +3.168                               | - 66                       | + 5 53 08.50      | -13.92                               | + 15           |
| 337               | 4.27  | A3   | 0.018 | 8 59 20.005          | +3.275                               | + 23                       | +11 47 48.69      | -14.16                               | - 31           |
| 335 *             | 3.14  | A5   | 0.066 | 9 00 15.709          | +4.078                               | -443                       | +47 58 47.17      | -14.41                               | -226           |
| 1234              | 4.42  | F8   | 0.023 | 9 00 40.190          | +2.244                               | - 35                       | -41 18 52.84      | -14.17                               | + 45           |
| 339 <sub>cg</sub> | 4.09  | F5   | 0.070 | 9 01 38.451          | +3.872                               | -393                       | +41 43 13.41      | -14.52                               | -245           |
| 343               | 4.18  | A5   | 0.044 | 9 02 41.278          | +0.932                               | - 3                        | -66 27 29.59      | -14.43                               | - 96           |
| 338               | 4.99  | M0   | 0.000 | 9 03 55.331          | +5.321                               | - 37                       | +67 34 04.21      | -14.39                               | + 19           |
| 341               | 3.68  | A0   | 0.010 | 9 04 40.626          | +4.068                               | - 32                       | +47 05 39.11      | -14.51                               | - 54           |
| 342               | 3.69  | K0   | 0.014 | 9 04 41.420          | +2.073                               | - 44                       | -47 09 36.07      | -14.47                               | - 13           |
| 1237              | 4.71  | G5   | 0.019 | 9 07 30.646          | +3.796                               | - 24                       | +38 23 21.41      | -14.64                               | - 14           |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5   | magn.   | Sp    | $\pi$ | $\alpha_{2015.5}$                                  | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------|---------|-------|-------|----------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
|       |         |       |       |                                                    |                                      | 0°0001         |                   |                                      | 0°001          |
| 345   | 2.22    | K5    | 0.015 | 9 <sup>h</sup> 08 <sup>m</sup> 34.044 <sup>s</sup> | +2.211                               | − 17           | −43°29′44.64″     | −14.68                               | + 13           |
| 1238  | 5.14    | B8    | 0.000 | 9 08 35.113                                        | +3.244                               | − 14           | +10 36 17.94      | −14.70                               | − 10           |
| 348   | 1.80    | A0    | 0.038 | 9 13 21.811                                        | +0.633                               | − 311          | −69 46 52.30      | −14.87                               | +108           |
| 347   | 3.84    | A0    | 0.019 | 9 15 10.212                                        | +3.118                               | + 86           | + 2 14 53.07      | −15.39                               | −310           |
| 351   | 2.25    | F0    | 0.011 | 9 17 30.286                                        | +1.605                               | − 26           | −59 20 26.53      | −15.20                               | + 8            |
| 352   | 3.30    | K5    | 0.021 | 9 21 59.719                                        | +3.638                               | − 179          | +34 19 34.18      | −15.45                               | + 19           |
| 1243  | 4.93    | M0    | 0.000 | 9 22 10.818                                        | +2.660                               | − 8            | −26 01 55.37      | −15.48                               | − 8            |
| 353   | 2.63    | B3    | 0.000 | 9 22 35.668                                        | +1.861                               | − 10           | −55 04 38.48      | −15.49                               | + 9            |
| 1244  | 4.61    | K0    | 0.000 | 9 25 33.242                                        | +3.482                               | − 25           | +26 06 53.19      | −15.71                               | − 48           |
| 354 * | 1.98    | K2    | 0.017 | 9 28 20.947                                        | +2.948                               | − 9            | − 8 43 35.42      | −15.78                               | + 33           |
| 356   | 4.64    | K2    | 0.000 | 9 29 53.184                                        | +2.482                               | − 18           | −36 01 11.21      | −15.89                               | + 1            |
| 361   | 3.04    | K5    | 0.015 | 9 31 41.621                                        | +1.826                               | − 39           | −57 06 11.45      | −15.99                               | + 4            |
| 355   | 3.75    | F0    | 0.034 | 9 32 44.101                                        | +4.662                               | + 160          | +62 59 34.92      | −16.02                               | + 27           |
| 1246  | 5.12    | G5    | 0.027 | 9 32 46.780                                        | +3.228                               | − 64           | +11 13 49.59      | −16.13                               | − 82           |
| 358   | 3.26    | F8p   | 0.052 | 9 33 53.111                                        | +3.976                               | −1024          | +51 36 20.94      | −16.63                               | −530           |
| 1247  | 5.16    | K0    | 0.045 | 9 33 55.327                                        | +2.766                               | − 14           | −21 11 05.88      | −16.09                               | + 15           |
| 360   | 4.62    | G5    | 0.000 | 9 35 10.083                                        | +3.656                               | + 5            | +36 19 40.53      | −16.19                               | − 22           |
| 357   | 4.57    | G0    | 0.039 | 9 35 49.595                                        | +5.195                               | − 122          | +69 45 39.79      | −16.13                               | + 78           |
| 1249  | 4.78    | K0    | 0.000 | 9 39 15.756                                        | +3.126                               | − 109          | + 4 34 42.94      | −16.43                               | − 51           |
| 1250  | 4.10    | K0    | 0.020 | 9 40 38.834                                        | +3.062                               | + 32           | − 1 12 50.04      | −16.51                               | − 64           |
| 364   | 4.96    | B3    | 0.000 | 9 41 02.966                                        | +2.878                               | − 19           | −14 24 11.71      | −16.49                               | − 20           |
| 365   | 3.76    | F5+A3 | 0.028 | 9 41 58.597                                        | +3.197                               | − 96           | + 9 49 16.04      | −16.55                               | − 37           |
| 366   | 4.98    | F5p   | 0.045 | 9 44 53.633                                        | +2.679                               | − 36           | −27 50 27.73      | −16.62                               | + 35           |
| 1254  | 3.6–4.8 | G0    | 0.019 | 9 45 40.360                                        | +1.649                               | − 20           | −62 34 47.02      | −16.69                               | + 7            |
| 367   | 3.12    | G0p   | 0.000 | 9 46 43.700                                        | +3.394                               | − 34           | +23 42 07.77      | −16.76                               | − 11           |
| 1255  | 5.20    | G0    | 0.066 | 9 49 34.965                                        | +3.841                               | + 215          | +45 56 52.85      | −16.98                               | − 92           |
| 368   | 3.89    | F0    | 0.036 | 9 52 04.768                                        | +4.213                               | − 379          | +58 57 53.99      | −17.15                               | −151           |
| 371   | 4.10    | K0    | 0.022 | 9 53 38.536                                        | +3.400                               | − 160          | +25 55 59.74      | −17.13                               | − 56           |
| 373   | 5.16    | M0    | 0.000 | 9 55 36.119                                        | +2.833                               | − 33           | −19 05 00.21      | −17.20                               | − 37           |
| 375   | 3.70    | B5    | 0.000 | 9 57 24.513                                        | +2.114                               | − 12           | −54 38 31.18      | −17.24                               | + 3            |
| 374   | 5.19    | F5    | 0.038 | 9 58 37.689                                        | +3.651                               | − 103          | +40 58 52.16      | −17.32                               | − 24           |
| 378   | 4.89    | M0    | 0.016 | 10 01 01.892                                       | +3.166                               | − 21           | + 7 58 09.30      | −17.42                               | − 23           |
| 1261  | 4.72    | B8    | 0.000 | 10 05 52.786                                       | +2.924                               | − 25           | −13 08 25.27      | −17.59                               | + 18           |
| 379   | 3.58    | A0p   | 0.000 | 10 08 10.542                                       | +3.263                               | − 1            | +16 41 11.40      | −17.70                               | − 0            |
| 380 * | 1.35    | B8    | 0.039 | 10 09 11.758                                       | +3.189                               | − 169          | +11 53 27.20      | −17.74                               | + 7            |
| 381   | 3.83    | K0    | 0.014 | 10 11 20.648                                       | +2.927                               | − 138          | −12 25 52.25      | −17.92                               | − 88           |
| 385   | 3.56    | B8    | 0.000 | 10 14 06.232                                       | +1.421                               | − 76           | −70 06 54.43      | −17.93                               | + 7            |
| 382   | 4.09    | A2    | 0.028 | 10 15 23.341                                       | +2.528                               | − 131          | −42 11 57.30      | −17.94                               | + 45           |
| 384   | 3.65    | F0    | 0.000 | 10 17 32.979                                       | +3.326                               | + 13           | +23 20 22.27      | −18.08                               | − 7            |
| 1264  | 3.44    | K5    | 0.000 | 10 17 36.156                                       | +2.013                               | − 34           | −61 24 36.32      | −18.07                               | + 5            |
| 383   | 3.52    | A2    | 0.021 | 10 18 01.540                                       | +3.594                               | − 149          | +42 50 11.09      | −18.13                               | − 38           |
| 1268  | 4.99    | K5    | 0.017 | 10 22 59.637                                       | +2.584                               | − 20           | −41 43 42.41      | −18.22                               | + 56           |
| 386   | 3.21    | K5    | 0.031 | 10 23 14.824                                       | +3.551                               | − 72           | +41 25 15.67      | −18.25                               | + 35           |
| 391   | 4.08    | F5    | 0.079 | 10 24 41.887                                       | +1.174                               | − 52           | −74 06 38.31      | −18.36                               | − 26           |
| 387   | 4.92    | A0    | 0.040 | 10 25 13.879                                       | +4.251                               | − 13           | +65 29 14.50      | −18.37                               | − 22           |
| 389   | 4.06    | K5    | 0.013 | 10 26 50.462                                       | +2.906                               | − 89           | −16 54 57.23      | −18.49                               | − 80           |
| 392   | 4.42    | K5    | 0.017 | 10 27 51.786                                       | +2.753                               | − 58           | −31 08 49.65      | −18.43                               | + 11           |
| 393   | 4.08    | F0    | 0.000 | 10 28 27.037                                       | +2.215                               | − 17           | −58 49 08.15      | −18.46                               | − 0            |
| 390   | 4.41    | K0    | 0.021 | 10 28 46.525                                       | +3.450                               | − 98           | +36 37 38.35      | −18.58                               | −101           |
| 394   | 4.84    | F5    | 0.080 | 10 31 36.510                                       | +3.797                               | − 209          | +55 54 01.95      | −18.60                               | − 30           |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5   | magn. | Sp  | $\pi$ | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------|-------|-----|-------|-----------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
| 397   | 3.58  | B5p | 0.000 | 10 <sup>h</sup> 32 <sup>m</sup> 34.688 <sup>s</sup> | +2.146                               | 0.0001<br>− 27 | −61° 45′ 55.38″   | −18.59                               | + 9            |
| 1273  | 5.14  | K0  | 0.000 | 10 33 36.312                                        | +2.544                               | − 18           | −47 05 00.92      | −18.63                               | + 3            |
| 396   | 3.85  | B0p | 0.000 | 10 33 37.577                                        | +3.155                               | − 4            | + 9 13 34.97      | −18.64                               | − 3            |
| 401   | 4.10  | M0  | 0.000 | 10 35 38.358                                        | +0.657                               | −143           | −78 41 17.56      | −18.69                               | + 14           |
| 398   | 5.16  | F0  | 0.023 | 10 36 08.982                                        | +3.820                               | + 82           | +57 00 08.31      | −18.68                               | + 39           |
| 395 * | 4.84  | G5  | 0.024 | 10 36 22.210                                        | +4.928                               | − 82           | +75 37 56.61      | −18.73                               | − 3            |
| 1275  | 4.77  | G0  | 0.015 | 10 39 35.339                                        | +3.361                               | + 0            | +31 53 42.96      | −18.81                               | + 8            |
| 402   | 4.37  | G0  | 0.015 | 10 39 55.619                                        | +2.403                               | − 22           | −55 41 03.49      | −18.83                               | + 5            |
| 406   | 3.03  | B0  | 0.000 | 10 43 30.746                                        | +2.155                               | − 35           | −64 28 33.32      | −18.93                               | + 10           |
| 405   | 5.05  | A2  | 0.013 | 10 44 15.373                                        | +3.252                               | − 84           | +23 06 24.72      | −18.95                               | + 9            |
| 411   | 4.62  | B3  | 0.000 | 10 45 54.482                                        | +0.485                               | −200           | −80 37 19.07      | −19.00                               | + 8            |
| 410   | 3.32  | K0  | 0.022 | 10 50 23.446                                        | +2.965                               | + 65           | −16 16 30.44      | −18.92                               | +200           |
| 412   | 3.92  | K0  | 0.017 | 10 54 10.481                                        | +3.339                               | + 70           | +34 07 51.46      | −19.50                               | −279           |
| 414   | 4.70  | K0  | 0.017 | 10 57 26.565                                        | +2.808                               | + 65           | −37 13 17.25      | −19.43                               | −128           |
| 1282  | 5.14  | G0  | 0.073 | 11 00 19.773                                        | +3.340                               | −278           | +40 20 49.83      | −19.31                               | + 57           |
| 1283  | 4.20  | K0  | 0.024 | 11 00 31.860                                        | +2.929                               | −323           | −18 22 53.76      | −19.24                               | +130           |
| 415   | 4.56  | A2  | 0.000 | 11 00 52.148                                        | +2.767                               | + 25           | −42 18 33.55      | −19.38                               | + 3            |
| 1284  | 5.05  | K0  | 0.000 | 11 01 21.658                                        | +3.097                               | + 10           | + 3 32 02.20      | −19.41                               | − 16           |
| 416 * | 2.37  | A0  | 0.042 | 11 02 46.046                                        | +3.580                               | + 99           | +56 17 56.31      | −19.39                               | + 34           |
| 417 * | 1.79  | K0  | 0.031 | 11 04 40.347                                        | +3.651                               | −167           | +61 40 00.69      | −19.53                               | − 66           |
| 418   | 4.66  | F0  | 0.014 | 11 05 48.969                                        | +3.092                               | −229           | + 7 15 06.97      | −19.53                               | − 46           |
| 419   | 5.06  | F5  | 0.033 | 11 06 04.851                                        | +2.900                               | −141           | −27 22 39.01      | −19.49                               | − 4            |
| 1289  | 4.02  | F8p | 0.000 | 11 09 15.400                                        | +2.585                               | − 9            | −59 03 33.22      | −19.55                               | − 0            |
| 420   | 3.15  | K0  | 0.000 | 11 10 31.758                                        | +3.350                               | − 60           | +44 24 50.85      | −19.60                               | − 28           |
| 421   | 4.52  | A2  | 0.045 | 11 12 25.344                                        | +2.959                               | + 2            | −22 54 38.53      | −19.71                               | −100           |
| 422   | 2.58  | A3  | 0.040 | 11 14 55.841                                        | +3.183                               | +101           | +20 26 18.73      | −19.79                               | −130           |
| 423   | 3.41  | A0  | 0.019 | 11 15 03.121                                        | +3.142                               | − 42           | +15 20 40.55      | −19.74                               | − 79           |
| 1292  | 4.58  | A5  | 0.014 | 11 17 27.007                                        | +3.052                               | − 72           | − 3 44 11.67      | −19.73                               | − 36           |
| 425   | 3.71  | K0  | 0.013 | 11 19 18.774                                        | +3.226                               | − 20           | +33 00 34.21      | −19.70                               | + 28           |
| 1293  | 4.78  | A2  | 0.021 | 11 19 58.349                                        | +3.252                               | − 48           | +38 06 01.11      | −19.80                               | − 68           |
| 426   | 3.82  | K0  | 0.019 | 11 20 07.028                                        | +3.005                               | − 84           | −14 51 45.49      | −19.53                               | +208           |
| 428   | 4.26  | B5  | 0.000 | 11 21 43.148                                        | +2.759                               | − 41           | −54 34 34.16      | −19.77                               | − 6            |
| 427   | 4.13  | A0  | 0.000 | 11 21 56.126                                        | +3.092                               | − 62           | + 5 56 39.06      | −19.78                               | − 12           |
| 431   | 4.14  | A5  | 0.022 | 11 25 39.482                                        | +3.004                               | − 69           | −17 46 09.50      | −19.81                               | + 4            |
| 1297  | 5.18  | K0  | 0.031 | 11 28 44.069                                        | +3.085                               | + 12           | + 2 46 14.47      | −19.87                               | − 12           |
| 433   | 4.06  | M0  | 0.024 | 11 32 18.508                                        | +3.493                               | − 73           | +69 14 43.29      | −19.91                               | − 17           |
| 434   | 3.72  | G5  | 0.019 | 11 33 46.047                                        | +2.964                               | −162           | −31 56 36.69      | −19.95                               | − 39           |
| 436   | 3.34  | B9  | 0.000 | 11 36 30.180                                        | +2.800                               | − 61           | −63 06 20.37      | −19.94                               | − 5            |
| 1299  | 4.81  | B9  | 0.000 | 11 37 28.156                                        | +3.048                               | − 41           | − 9 53 17.14      | −19.94                               | + 8            |
| 437   | 4.47  | K0  | 0.015 | 11 37 44.573                                        | +3.073                               | + 3            | − 0 54 34.13      | −19.90                               | + 43           |
| 439   | 4.88  | B8  | 0.000 | 11 40 59.189                                        | +2.995                               | − 34           | −34 49 50.36      | −19.97                               | + 0            |
| 1301  | 4.90  | G5  | 0.022 | 11 45 33.039                                        | +3.049                               | + 22           | −18 26 13.20      | −20.03                               | − 30           |
| 442   | 3.80  | A5  | 0.000 | 11 46 20.831                                        | +2.872                               | −174           | −66 48 52.97      | −19.97                               | + 37           |
| 1302  | 4.20  | M0  | 0.013 | 11 46 39.350                                        | +3.083                               | − 12           | + 6 26 32.60      | −20.19                               | −184           |
| 441   | 3.85  | K0  | 0.014 | 11 46 51.817                                        | +3.146                               | −136           | +47 41 36.24      | −19.98                               | + 30           |
| 443   | 4.22  | G0  | 0.000 | 11 47 16.248                                        | +2.936                               | − 37           | −61 15 52.62      | −20.03                               | − 15           |
| 1304  | 4.54  | F8  | 0.028 | 11 48 47.014                                        | +3.089                               | −106           | +20 07 57.81      | −20.02                               | − 3            |
| 444   | 2.23  | A2  | 0.076 | 11 49 50.961                                        | +3.056                               | −342           | +14 29 07.25      | −20.14                               | −114           |
| 445   | 3.80  | F8  | 0.098 | 11 51 30.178                                        | +3.126                               | +495           | + 1 40 38.23      | −20.30                               | −271           |
| 446   | 4.71  | K0  | 0.016 | 11 51 55.488                                        | +3.021                               | − 67           | −45 15 35.33      | −20.04                               | − 10           |
| 447 * | 2.44  | A0  | 0.020 | 11 54 38.374                                        | +3.128                               | +107           | +53 36 30.75      | −20.02                               | + 12           |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5                | magn.   | Sp  | $\pi$ | $\alpha_{2015.5}$    | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$     | $\delta_{2015.5}$         | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|--------------------|---------|-----|-------|----------------------|--------------------------------------|--------------------|---------------------------|--------------------------------------|----------------|
|                    |         |     |       |                      |                                      | $0^{\circ}00'01''$ |                           |                                      | $0^{\circ}00'$ |
| 1309               | 5.16    | A0  | 0.036 | $11^h 56^m 48^s.458$ | +3.066                               | − 36               | $-17^{\circ} 14' 13''.74$ | −20.05                               | − 6            |
| 1311               | 4.57    | A3  | 0.017 | 12 01 40.043         | +3.074                               | + 1                | + 6 31 40.31              | −20.07                               | − 30           |
| 450                | 4.24    | G5  | 0.037 | 12 05 59.894         | +3.055                               | −148               | + 8 38 48.73              | −19.99                               | + 46           |
| 452                | 2.88    | B3p | 0.020 | 12 09 10.093         | +3.137                               | − 36               | −50 48 31.30              | −20.03                               | − 8            |
| 453                | 3.21    | K0  | 0.020 | 12 10 55.467         | +3.097                               | − 51               | −22 42 21.27              | −20.01                               | + 13           |
| 454                | 5.12    | A5  | 0.027 | 12 12 54.481         | +2.738                               | + 29               | +77 31 48.66              | −19.99                               | + 22           |
| 455                | 3.08    | B3  | 0.000 | 12 15 58.584         | +3.224                               | − 53               | −58 50 06.16              | −20.00                               | − 9            |
| 456                | 3.44    | A2  | 0.052 | 12 16 11.224         | +2.943                               | +127               | +56 56 47.65              | −19.98                               | + 9            |
| 457                | 2.78    | B8  | 0.000 | 12 16 36.320         | +3.095                               | −112               | −17 37 40.49              | −19.97                               | + 23           |
| 459                | 4.38    | B5  | 0.000 | 12 19 17.141         | +3.658                               | −174               | −79 23 53.27              | −19.95                               | + 17           |
| 460                | 4.00    | A0  | 0.010 | 12 20 41.980         | +3.073                               | − 42               | − 0 45 10.23              | −19.98                               | − 18           |
| 1317               | 5.10    | K0  | 0.000 | 12 21 08.240         | +3.049                               | −195               | + 3 13 34.65              | −20.02                               | − 65           |
| 1318               | 4.78    | F5  | 0.011 | 12 23 16.967         | +3.009                               | − 8                | +25 45 36.83              | −19.95                               | − 9            |
| 462                | 1.58    | B1  | 0.000 | 12 27 28.267         | +3.386                               | − 53               | −63 11 05.27              | −19.91                               | − 12           |
| 464                | 4.16    | B3  | 0.000 | 12 28 53.091         | +3.274                               | − 32               | −50 18 58.96              | −19.90                               | − 15           |
| 465                | 3.11    | A0  | 0.018 | 12 30 40.104         | +3.114                               | −146               | −16 36 05.66              | −20.00                               | − 138          |
| 468                | 1.61    | M3  | 0.000 | 12 32 02.047         | +3.367                               | + 29               | −57 11 59.28              | −20.11                               | − 262          |
| 469                | 4.04    | B5  | 0.000 | 12 33 24.654         | +3.668                               | −126               | −72 13 06.13              | −19.83                               | − 2            |
| 472                | 3.88    | B5p | 0.010 | 12 34 08.192         | +2.528                               | −113               | +69 42 10.52              | −19.81                               | + 12           |
| 470                | 4.32    | G0  | 0.108 | 12 34 28.540         | +2.837                               | −625               | +41 16 24.20              | −19.52                               | + 292          |
| 471                | 2.84    | G5  | 0.027 | 12 35 12.263         | +3.164                               | + 2                | −23 28 56.23              | −19.86                               | − 54           |
| 1323               | 4.78    | A0  | 0.000 | 12 35 37.337         | +2.985                               | − 47               | +22 32 38.52              | −19.78                               | + 21           |
| 473 <sub>sq</sub>  | 5.18    | K0  | 0.000 | 12 35 54.350         | +3.006                               | − 4                | +18 17 30.75              | −19.77                               | + 23           |
| 474                | 2.94    | B3  | 0.000 | 12 38 07.390         | +3.649                               | − 90               | −69 13 14.63              | −19.78                               | − 13           |
| 475                | 4.78    | K0  | 0.014 | 12 40 02.861         | +3.103                               | − 51               | − 8 04 50.63              | −19.76                               | − 25           |
| 1326               | 4.95    | A0  | 0.000 | 12 42 40.131         | +3.037                               | + 57               | +10 09 01.35              | −19.79                               | − 90           |
| 1327               | 4.8–6.0 | N3  | 0.000 | 12 45 51.361         | +2.806                               | − 1                | +45 21 20.66              | −19.63                               | + 15           |
| 481                | 1.50    | B1  | 0.000 | 12 48 38.208         | +3.552                               | − 63               | −59 46 23.49              | −19.61                               | − 14           |
| 1331               | 5.01    | A0  | 0.012 | 12 51 31.898         | +3.275                               | − 23               | −34 05 00.94              | −19.56                               | − 20           |
| 1332               | 5.07    | G0  | 0.010 | 12 52 27.141         | +2.917                               | − 9                | +27 27 23.68              | −19.53                               | − 8            |
| 482                | 4.34    | A5  | 0.047 | 12 54 18.008         | +3.346                               | + 55               | −40 15 46.61              | −19.50                               | − 22           |
| 483 <sup>*</sup>   | 1.77    | A0p | 0.000 | 12 54 42.424         | +2.622                               | +133               | +55 52 33.42              | −19.48                               | − 6            |
| 1335               | 4.91    | M3  | 0.014 | 12 55 09.629         | +3.128                               | − 17               | − 9 37 22.35              | −19.48                               | − 15           |
| 484                | 3.66    | M0  | 0.017 | 12 56 23.098         | +3.025                               | −313               | + 3 18 48.48              | −19.49                               | − 54           |
| 485 <sub>sq</sub>  | 2.90    | A0p | 0.023 | 12 56 45.040         | +2.797                               | −198               | +38 14 05.78              | −19.37                               | + 56           |
| 488                | 2.95    | K0  | 0.036 | 13 02 56.902         | +2.987                               | −185               | +10 52 34.03              | −19.27                               | + 20           |
| 487                | 3.63    | K2  | 0.023 | 13 03 21.562         | +4.228                               | +543               | −71 37 55.26              | −19.30                               | − 21           |
| 1337               | 5.11    | B9  | 0.000 | 13 06 27.833         | +2.798                               | − 25               | +35 42 58.55              | −19.18                               | + 21           |
| 489                | 4.40    | B3  | 0.000 | 13 07 49.399         | +3.537                               | − 27               | −49 59 20.00              | −19.18                               | − 12           |
| 490                | 4.45    | A0  | 0.022 | 13 10 45.242         | +3.113                               | − 21               | − 5 37 17.06              | −19.13                               | − 33           |
| 492                | 4.32    | G0  | 0.120 | 13 12 35.732         | +2.795                               | −604               | +27 47 59.71              | −18.16                               | + 881          |
| 493                | 4.94    | B8  | 0.000 | 13 16 19.029         | +4.148                               | − 74               | −67 58 34.43              | −18.95                               | − 9            |
| 494                | 4.66    | F0  | 0.014 | 13 18 14.132         | +2.682                               | −110               | +40 29 28.88              | −18.86                               | + 21           |
| 1344               | 5.01    | M0  | 0.011 | 13 18 23.290         | +3.033                               | − 4                | + 5 23 18.82              | −18.87                               | + 13           |
| 1345               | 4.80    | G5  | 0.115 | 13 19 13.130         | +3.151                               | −751               | −18 23 49.56              | −19.92                               | −1066          |
| 495                | 3.33    | G5  | 0.021 | 13 19 46.043         | +3.276                               | + 47               | −23 15 10.58              | −18.88                               | − 45           |
| 496                | 2.91    | A2  | 0.046 | 13 21 28.402         | +3.395                               | −284               | −36 47 37.08              | −18.87                               | − 86           |
| 1347               | 4.62    | B5  | 0.000 | 13 23 38.756         | +3.933                               | − 53               | −61 04 08.69              | −18.74                               | − 14           |
| 497 <sup>*pr</sup> | 2.27    | A2p | 0.037 | 13 24 32.839         | +2.405                               | +141               | +54 50 41.16              | −18.71                               | − 20           |
| 498 <sup>*</sup>   | 0.98    | B2  | 0.021 | 13 26 00.705         | +3.170                               | − 28               | −11 14 30.39              | −18.68                               | − 28           |
| 1349               | 5.16    | G0  | 0.041 | 13 29 11.309         | +2.936                               | −162               | +13 41 46.93              | −19.12                               | − 577          |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5           | magn.                                        | Sp                                       | $\pi$     | $\alpha_{2015.5}$ | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$  | $\delta_{2015.5}$       | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|---------------|----------------------------------------------|------------------------------------------|-----------|-------------------|--------------------------------------|-----------------|-------------------------|--------------------------------------|----------------|
|               |                                              |                                          |           |                   |                                      | $0^{\circ}0001$ |                         |                                      | $0^{\circ}001$ |
| 1351          | 4.93                                         | A2p                                      | $0''.016$ | $13^h34^m55.s117$ | $+3.s045$                            | $+ 30$          | $+ 3^{\circ}34'47''.15$ | $-18''.37$                           | $- 24$         |
| 501           | 3.44                                         | A2                                       | 0.035     | 13 35 29.047      | +3.063                               | $- 190$         | $- 0 40 29.04$          | $-18.29$                             | $+ 42$         |
| 502           | 4.96                                         | F0                                       | 0.019     | 13 35 29.256      | +2.673                               | $+ 72$          | $+37 06 12.28$          | $-18.34$                             | $- 9$          |
| 504           | 2.56                                         | B1                                       | 0.000     | 13 40 52.734      | +3.843                               | $- 32$          | $-53 32 40.58$          | $-18.15$                             | $- 17$         |
| 1355          | 5.16                                         | M0                                       | 0.011     | 13 42 25.712      | +3.158                               | $- 64$          | $- 8 46 50.69$          | $-18.03$                             | $+ 40$         |
| 506           | 4.36                                         | F5                                       | 0.045     | 13 46 34.369      | +3.429                               | $- 367$         | $-33 07 17.77$          | $-18.06$                             | $- 146$        |
| 507           | 4.51                                         | F5                                       | 0.056     | 13 47 59.942      | +2.852                               | $- 336$         | $+17 22 48.03$          | $-17.82$                             | $+ 40$         |
| 509 *         | 1.86                                         | B3                                       | 0.029     | 13 48 08.998      | +2.358                               | $- 125$         | $+49 14 10.89$          | $-17.86$                             | $- 11$         |
| 508           | 3.32                                         | B2p                                      | 0.000     | 13 50 33.398      | +3.642                               | $- 21$          | $-42 33 01.34$          | $-17.77$                             | $- 20$         |
| 510           | 5.11                                         | K0                                       | 0.038     | 13 50 42.989      | +3.272                               | $- 70$          | $-18 12 39.07$          | $-17.79$                             | $- 38$         |
| 511           | 4.77                                         | M0                                       | 0.014     | 13 51 53.089      | +1.753                               | $+ 1$           | $+64 38 49.20$          | $-17.70$                             | $- 2$          |
| 513           | 2.80                                         | G0                                       | 0.102     | 13 55 25.363      | +2.857                               | $- 44$          | $+18 19 13.84$          | $-17.91$                             | $- 358$        |
| 512           | 3.06                                         | B2p                                      | 0.000     | 13 56 30.859      | +3.776                               | $- 56$          | $-47 21 50.47$          | $-17.55$                             | $- 42$         |
| 514           | 4.68                                         | K0                                       | 0.025     | 13 58 47.113      | +4.412                               | $- 67$          | $-63 45 42.68$          | $-17.44$                             | $- 30$         |
| 515           | 5.17                                         | B8                                       | 0.000     | 13 59 23.550      | +3.382                               | $- 36$          | $-25 02 50.28$          | $-17.41$                             | $- 29$         |
| 516           | 4.34                                         | A2                                       | 0.015     | 14 02 26.203      | +3.059                               | $+ 12$          | $+ 1 28 12.27$          | $-17.27$                             | $- 21$         |
| 521           | 3.64                                         | A0p                                      | 0.011     | 14 04 48.576      | +1.628                               | $- 84$          | $+64 18 07.47$          | $-17.12$                             | $+ 18$         |
| 518           | 0.86                                         | B1                                       | 0.016     | 14 04 55.842      | +4.293                               | $- 43$          | $-60 26 49.11$          | $-17.16$                             | $- 19$         |
| 519           | 3.48                                         | K0                                       | 0.039     | 14 07 15.494      | +3.434                               | $+ 33$          | $-26 45 22.97$          | $-17.17$                             | $- 139$        |
| 520           | 2.26                                         | K0                                       | 0.059     | 14 07 35.995      | +3.554                               | $- 429$         | $-36 26 44.15$          | $-17.53$                             | $- 519$        |
| 524 *         | 4.82                                         | K0                                       | 0.000     | 14 08 48.581      | $-0.140$                             | $- 98$          | $+77 28 28.65$          | $-16.93$                             | $+ 34$         |
| 522           | 4.82                                         | F5                                       | 0.041     | 14 11 06.348      | +2.736                               | $- 16$          | $+25 01 07.49$          | $-16.91$                             | $- 61$         |
| 523           | 4.31                                         | K0                                       | 0.017     | 14 13 43.495      | +3.210                               | $+ 6$           | $-10 20 42.83$          | $-16.59$                             | $+ 140$        |
| 526 *         | $-0.04$                                      | K0                                       | 0.090     | 14 16 22.126      | +2.739                               | $- 770$         | $+19 06 08.19$          | $-18.60$                             | $-1999$        |
| 528           | 4.87                                         | A5                                       | 0.044     | 14 16 42.825      | +2.122                               | $- 160$         | $+51 17 46.38$          | $-16.49$                             | $+ 92$         |
| 525           | 4.16                                         | F5                                       | 0.039     | 14 16 49.806      | +3.155                               | $- 2$           | $- 6 04 25.96$          | $-17.01$                             | $- 432$        |
| 527           | 4.26                                         | A0                                       | 0.043     | 14 16 58.338      | +2.278                               | $- 179$         | $+46 01 03.43$          | $-16.41$                             | $+ 161$        |
| 1370          | 4.83                                         | K0                                       | 0.000     | 14 18 39.106      | +2.535                               | $+ 3$           | $+35 26 18.76$          | $-16.47$                             | $+ 16$         |
| 1371          | 4.60                                         | A2                                       | 0.010     | 14 19 57.064      | +3.257                               | $- 11$          | $-13 26 30.37$          | $-16.39$                             | $+ 30$         |
| 529           | 4.41                                         | B5                                       | 0.000     | 14 21 25.154      | +4.240                               | $- 16$          | $-56 27 25.53$          | $-16.36$                             | $- 9$          |
| 1373          | 4.17                                         | A0                                       | 0.000     | 14 21 30.331      | +3.673                               | $- 53$          | $-37 57 21.11$          | $-16.35$                             | $- 12$         |
| 1375          | 5.08                                         | A3                                       | 0.023     | 14 24 57.693      | +2.991                               | $- 52$          | $+ 5 45 01.55$          | $-16.16$                             | $+ 5$          |
| 531           | 4.06                                         | F8                                       | 0.067     | 14 25 43.449      | +2.042                               | $- 253$         | $+51 46 46.45$          | $-16.52$                             | $- 398$        |
| 1377          | 4.65                                         | B3                                       | 0.000     | 14 27 08.352      | +3.882                               | $- 12$          | $-45 17 26.59$          | $-16.06$                             | $- 13$         |
| 1379          | 4.37                                         | K2                                       | 0.017     | 14 27 30.602      | $-0.051$                             | $+ 23$          | $+75 37 37.43$          | $-16.01$                             | $+ 23$         |
| 533           | 4.99                                         | K0                                       | 0.043     | 14 29 00.159      | +3.098                               | $- 93$          | $- 2 17 48.31$          | $-15.96$                             | $- 2$          |
| 532           | 5.00                                         | B8                                       | 0.000     | 14 29 05.147      | +3.532                               | $- 18$          | $-29 33 37.81$          | $-15.97$                             | $- 23$         |
| 534           | 3.78                                         | K0                                       | 0.025     | 14 32 29.867      | +2.585                               | $- 77$          | $+30 18 14.30$          | $-15.65$                             | $+ 119$        |
| 535           | 3.00                                         | F0                                       | 0.016     | 14 32 42.106      | +2.415                               | $- 97$          | $+38 14 27.64$          | $-15.60$                             | $+ 153$        |
| 1380          | 4.48                                         | F0                                       | 0.063     | 14 35 21.311      | +2.612                               | $+ 145$         | $+29 40 42.25$          | $-15.48$                             | $+ 133$        |
| 537           | 2.65                                         | B3p+A2p                                  | 0.000     | 14 36 29.860      | +3.837                               | $- 31$          | $-42 13 30.35$          | $-15.58$                             | $- 35$         |
| 538 <i>cg</i> | $\begin{Bmatrix} 0.33 \\ 1.70 \end{Bmatrix}$ | $\begin{Bmatrix} G0 \\ K5 \end{Bmatrix}$ | 0.752     | 14 40 39.717      | +4.124                               | $-4997$         | $-60 53 54.50$          | $-14.62$                             | $+ 694$        |
| 541           | 2.89                                         | B2                                       | 0.000     | 14 42 58.071      | +4.023                               | $- 21$          | $-47 27 13.62$          | $-15.20$                             | $- 18$         |
| 539           | 3.42                                         | F0                                       | 0.049     | 14 43 46.627      | +4.926                               | $- 302$         | $-65 02 29.32$          | $-15.37$                             | $- 232$        |
| 545           | 3.95                                         | F5                                       | 0.039     | 14 43 52.757      | +3.170                               | $+ 73$          | $- 5 43 29.38$          | $-15.45$                             | $- 316$        |
| 1383          | $4.93v$                                      | M0                                       | 0.000     | 14 44 06.251      | +2.638                               | $- 10$          | $+26 27 45.17$          | $-15.14$                             | $- 17$         |
| 544           | 4.13                                         | K0                                       | 0.000     | 14 44 36.612      | +3.691                               | $- 52$          | $-35 14 22.50$          | $-15.27$                             | $- 180$        |
| 547           | 3.76                                         | A0                                       | 0.030     | 14 47 02.034      | +3.039                               | $- 76$          | $+ 1 49 41.66$          | $-14.98$                             | $- 27$         |
| 546           | 5.20                                         | K0                                       | 0.015     | 14 48 06.911      | +4.237                               | $- 17$          | $-52 26 53.40$          | $-14.97$                             | $- 82$         |
| 542           | 3.81                                         | K5                                       | 0.020     | 14 49 51.344      | +7.759                               | $- 41$          | $-79 06 31.48$          | $-14.80$                             | $- 16$         |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5               | magn.             | Sp  | $\pi$ | $\alpha_{2015.5}$  | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$     | $\delta_{2015.5}$       | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$     |
|-------------------|-------------------|-----|-------|--------------------|--------------------------------------|--------------------|-------------------------|--------------------------------------|--------------------|
|                   |                   |     |       |                    |                                      | $0^{\circ}00'01''$ |                         |                                      | $0^{\circ}00'01''$ |
| 550 *             | 2.08              | K5  | 0.031 | $14^h50^m40^s.534$ | $-0^s.110$                           | - 76               | $+74^{\circ}05'31''.56$ | $-14''.72$                           | + 12               |
| 548               | 2.90              | A3  | 0.049 | 14 51 44.320       | +3.331                               | - 73               | -16 06 19.30            | -14.74                               | - 67               |
| 554               | 4.86 <sub>v</sub> | M3  | 0.011 | 14 57 50.047       | +0.973                               | -129               | +65 52 15.43            | -14.27                               | + 32               |
| 552               | 2.81              | B2p | 0.000 | 14 59 33.222       | +3.957                               | - 32               | -43 11 43.59            | -14.24                               | - 39               |
| 553               | 3.35              | B3  | 0.000 | 15 00 10.558       | +3.930                               | - 17               | -42 09 55.73            | -14.19                               | - 24               |
| 1394              | 4.8-5.9           | A0  | 0.021 | 15 01 48.167       | +3.215                               | - 43               | - 8 34 46.69            | -14.06                               | - 5                |
| 555               | 3.63              | G5  | 0.022 | 15 02 31.799       | +2.261                               | - 36               | +40 19 48.16            | -14.04                               | - 28               |
| 556               | 3.41              | M3  | 0.056 | 15 04 58.860       | +3.527                               | - 54               | -25 20 31.08            | -13.90                               | - 43               |
| 557               | 4.67              | K0  | 0.016 | 15 05 06.618       | +2.573                               | -130               | +26 53 16.30            | -13.86                               | - 6                |
| 1396              | 5.03              | F0  | 0.061 | 15 07 58.943       | +2.637                               | +136               | +24 48 34.18            | -13.83                               | - 165              |
| 1398              | 4.14              | B9  | 0.000 | 15 13 01.189       | +4.204                               | - 96               | -48 47 44.44            | -13.39                               | - 49               |
| 559               | 4.66              | A0p | 0.023 | 15 13 06.476       | +3.433                               | - 25               | -19 50 58.07            | -13.38                               | - 39               |
| 558               | 3.50              | K0  | 0.036 | 15 13 24.438       | +4.348                               | -122               | -52 09 25.53            | -13.39                               | - 73               |
| 1399              | 4.95              | F0  | 0.000 | 15 15 34.555       | +3.694                               | - 4                | -31 34 33.72            | -13.18                               | + 1                |
| 563               | 3.54              | K0  | 0.028 | 15 16 07.686       | +2.421                               | + 69               | +33 15 27.57            | -13.25                               | - 112              |
| 564               | 2.74              | B8  | 0.000 | 15 17 50.589       | +3.238                               | - 65               | - 9 26 21.18            | -13.05                               | - 19               |
| 561               | 4.16              | A3  | 0.046 | 15 18 44.350       | +4.748                               | -129               | -58 51 28.23            | -13.10                               | - 137              |
| 560               | 3.06              | A0  | 0.000 | 15 20 22.665       | +5.696                               | -132               | -68 44 06.92            | -12.89                               | - 31               |
| 569 *             | 3.05              | A2  | 0.000 | 15 20 42.915       | -0.046                               | - 40               | +71 46 43.87            | -12.81                               | + 20               |
| 1402              | 3.43              | B2  | 0.000 | 15 22 23.701       | +3.962                               | - 13               | -40 42 09.52            | -12.75                               | - 26               |
| 566               | 3.59              | K5  | 0.000 | 15 22 47.674       | +3.828                               | - 74               | -36 18 59.63            | -12.78                               | - 84               |
| 1403              | 4.69              | B3  | 0.000 | 15 24 09.056       | +3.854                               | - 15               | -36 54 46.96            | -12.63                               | - 23               |
| 568 <sub>pr</sub> | 4.47              | F0  | 0.030 | 15 25 04.591       | +2.268                               | -122               | +37 19 24.46            | -12.45                               | + 87               |
| 571               | 3.47              | K0  | 0.032 | 15 25 16.583       | +1.344                               | - 12               | +58 54 43.76            | -12.51                               | + 17               |
| 572               | 3.72              | F0p | 0.031 | 15 28 28.110       | +2.476                               | -137               | +29 03 10.82            | -12.22                               | + 86               |
| 573               | 5.15              | K5  | 0.020 | 15 31 29.198       | +2.157                               | + 10               | +40 46 51.11            | -12.10                               | - 7                |
| 576               | 4.17              | B5  | 0.020 | 15 33 33.315       | +2.421                               | - 15               | +31 18 26.93            | -11.96                               | - 11               |
| 1409              | 4.83              | K0  | 0.024 | 15 35 01.663       | +3.288                               | +209               | -10 07 00.15            | -12.08                               | - 234              |
| 578 *             | 2.23              | A0  | 0.043 | 15 35 20.684       | +2.543                               | + 91               | +26 39 47.89            | -11.92                               | - 88               |
| 577               | 4.02              | K0  | 0.033 | 15 36 23.743       | +3.366                               | + 45               | -14 50 24.91            | -11.74                               | + 9                |
| 579               | 3.78              | K2  | 0.037 | 15 37 58.128       | +3.657                               | - 7                | -28 11 07.06            | -11.64                               | + 3                |
| 574               | 4.11              | K0  | 0.030 | 15 38 09.363       | +5.566                               | + 39               | -66 22 03.31            | -11.68                               | - 55               |
| 1413              | 4.96              | K5  | 0.032 | 15 42 50.541       | +3.468                               | - 26               | -19 43 41.00            | -11.39                               | - 103              |
| 590 *             | 4.32              | A2  | 0.011 | 15 43 32.094       | -2.012                               | + 62               | +77 44 46.15            | -11.24                               | - 1                |
| 582               | 2.75              | K0  | 0.046 | 15 45 01.963       | +2.960                               | + 92               | + 6 22 40.05            | -11.09                               | + 47               |
| 583               | 3.74              | A2  | 0.034 | 15 46 54.234       | +2.773                               | + 46               | +15 22 27.02            | -11.04                               | - 45               |
| 587               | 5.13              | A2  | 0.013 | 15 46 54.384       | +0.930                               | + 57               | +62 33 06.99            | -11.05                               | - 55               |
| 584               | 4.28              | K5  | 0.019 | 15 49 26.293       | +2.704                               | - 36               | +18 05 40.28            | -10.90                               | - 88               |
| 585               | 3.63              | A0  | 0.000 | 15 50 25.854       | +3.138                               | - 57               | - 3 28 36.07            | -10.76                               | - 24               |
| 588               | 3.75              | A2  | 0.035 | 15 51 35.402       | +2.996                               | + 86               | + 4 25 55.28            | -10.59                               | + 63               |
| 1414              | 4.77              | K0  | 0.036 | 15 51 49.017       | +2.264                               | - 5                | +35 36 36.03            | -10.98                               | - 347              |
| 586               | 4.11              | B9  | 0.000 | 15 51 56.868       | +3.830                               | - 5                | -33 40 23.56            | -10.65                               | - 30               |
| 1416              | 4.61              | G0  | 0.056 | 15 53 12.726       | +2.077                               | +396               | +42 24 31.91            | - 9.90                               | + 633              |
| 1415              | 5.06              | B3  | 0.000 | 15 54 14.203       | +3.494                               | - 8                | -20 12 44.43            | -10.48                               | - 24               |
| 589               | 3.04              | F0  | 0.078 | 15 56 31.289       | +5.345                               | -283               | -63 28 36.73            | -10.68                               | - 398              |
| 591               | 3.86              | F5  | 0.069 | 15 57 10.207       | +2.776                               | +217               | +15 36 42.96            | -11.52                               | -1281              |
| 595               | 4.96              | A5  | 0.019 | 15 58 09.601       | +1.431                               | -173               | +54 42 23.24            | -10.05                               | + 109              |
| 593               | 4.22              | K0  | 0.021 | 15 58 13.799       | +2.487                               | - 57               | +26 50 01.61            | -10.22                               | - 62               |
| 1417              | 4.68              | B3p | 0.000 | 15 59 03.581       | +3.369                               | - 8                | -14 19 22.90            | -10.11                               | - 15               |
| 592               | 3.00              | B2  | 0.000 | 15 59 47.557       | +3.642                               | - 8                | -26 09 27.27            | -10.06                               | - 26               |
| 1418              | 5.07              | G5  | 0.014 | 16 00 33.895       | +4.107                               | - 36               | -41 47 15.64            | -10.00                               | - 18               |



# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5               | magn.                                                                  | Sp                                                                | $\pi$ | $\alpha_{2015.5}$                                    | przemiana<br>roczna<br>$VA_\alpha$ | $\mu_\alpha$                | $\delta_{2015.5}$          | przemiana<br>roczna<br>$VA_\delta$ | $\mu_\delta$                |
|-------------------|------------------------------------------------------------------------|-------------------------------------------------------------------|-------|------------------------------------------------------|------------------------------------|-----------------------------|----------------------------|------------------------------------|-----------------------------|
| 594               | 2.54                                                                   | B0                                                                | 0.000 | 16 <sup>h</sup> 01 <sup>m</sup> 15. <sup>s</sup> 156 | +3. <sup>s</sup> 559               | 0 <sup>s</sup> .0001<br>− 8 | −22°39′52. <sup>″</sup> 78 | −9. <sup>″</sup> 95                | 0 <sup>″</sup> .001<br>− 22 |
| 598               | 4.11                                                                   | F8                                                                | 0.046 | 16 02 10.895                                         | +1.134                             | −410                        | +58 31 27.22               | −9.52                              | +335                        |
| 597 <sub>pr</sub> | 2.90                                                                   | B1                                                                | 0.000 | 16 06 20.451                                         | +3.499                             | − 4                         | −19 50 48.16               | −9.56                              | − 19                        |
| 596               | 4.84                                                                   | A3p                                                               | 0.012 | 16 07 35.478                                         | +4.263                             | + 2                         | −45 12 50.19               | −9.41                              | + 28                        |
| 599               | 4.33                                                                   | B3                                                                | 0.000 | 16 07 36.848                                         | +3.957                             | − 14                        | −36 50 35.66               | −9.47                              | − 29                        |
| 601               | 4.26                                                                   | B9p                                                               | 0.012 | 16 09 15.530                                         | +1.894                             | − 24                        | +44 53 41.67               | −9.27                              | + 38                        |
| 1423              | 4.94                                                                   | K0                                                                | 0.027 | 16 09 32.340                                         | +2.196                             | − 45                        | +36 27 08.04               | −8.96                              | +333                        |
| 600               | 5.09                                                                   | K0                                                                | 0.016 | 16 14 42.535                                         | +4.764                             | − 3                         | −54 40 08.67               | −8.91                              | − 24                        |
| 603               | 3.03                                                                   | M0                                                                | 0.029 | 16 15 09.567                                         | +3.151                             | − 29                        | − 3 43 59.47               | −8.99                              | −143                        |
| 602               | 4.03                                                                   | G0                                                                | 0.022 | 16 16 51.620                                         | +5.512                             | + 3                         | −63 43 24.49               | −8.73                              | − 11                        |
| 612               | 5.04                                                                   | F0                                                                | 0.038 | 16 17 04.204                                         | −1.677                             | −233                        | +75 43 08.24               | −8.45                              | +252                        |
| 605               | 3.34                                                                   | K0                                                                | 0.036 | 16 19 08.585                                         | +3.181                             | + 57                        | − 4 43 45.20               | −8.50                              | + 41                        |
| 608               | 3.91                                                                   | B5                                                                | 0.027 | 16 20 12.450                                         | +1.807                             | − 11                        | +46 16 37.51               | −8.41                              | + 40                        |
| 604               | 4.14                                                                   | K0                                                                | 0.037 | 16 21 00.384                                         | +4.515                             | −161                        | −50 11 31.58               | −8.44                              | − 54                        |
| 607               | 3.10 <sub>v</sub>                                                      | B1                                                                | 0.000 | 16 22 07.997                                         | +3.658                             | − 8                         | −25 37 43.74               | −8.32                              | − 21                        |
| 609               | 3.79                                                                   | F0                                                                | 0.015 | 16 22 36.287                                         | +2.650                             | − 33                        | +19 07 03.37               | −8.22                              | + 43                        |
| 1424              | 4.78                                                                   | M3                                                                | 0.013 | 16 22 42.699                                         | +9.181                             | − 47                        | −78 43 54.63               | −8.29                              | − 35                        |
| 1427              | 4.80                                                                   | F0                                                                | 0.035 | 16 22 51.524                                         | +3.044                             | −104                        | + 0 59 37.04               | −8.19                              | + 50                        |
| 613               | 4.53                                                                   | A0p                                                               | 0.033 | 16 26 07.934                                         | +2.773                             | + 30                        | +13 59 54.67               | −8.04                              | − 59                        |
| 619               | 4.98                                                                   | B8p                                                               | 0.031 | 16 27 57.572                                         | −0.089                             | − 46                        | +68 44 04.44               | −7.80                              | + 36                        |
| 610               | 4.93                                                                   | G0                                                                | 0.083 | 16 30 09.175                                         | +6.528                             | +383                        | −70 07 02.04               | −7.55                              | +109                        |
| 616 <sub>cg</sub> | $\left\{ \begin{smallmatrix} 1.22_v \\ 5.2 \end{smallmatrix} \right\}$ | $\left\{ \begin{smallmatrix} M0 \\ A3 \end{smallmatrix} \right\}$ | 0.019 | 16 30 21.609                                         | +3.689                             | − 7                         | −26 27 54.49               | −7.66                              | − 20                        |
| 618 <sub>*</sub>  | 2.77                                                                   | K0                                                                | 0.017 | 16 30 53.222                                         | +2.582                             | − 70                        | +21 27 24.14               | −7.61                              | − 15                        |
| 1431              | 4.33                                                                   | B3                                                                | 0.000 | 16 32 23.898                                         | +3.934                             | − 7                         | −34 44 12.38               | −7.49                              | − 17                        |
| 621               | 4.25                                                                   | A0                                                                | 0.000 | 16 34 36.219                                         | +1.938                             | − 10                        | +42 24 20.60               | −7.25                              | + 45                        |
| 611               | 3.90                                                                   | K0                                                                | 0.048 | 16 35 52.453                                         | +9.404                             | −452                        | −78 55 43.86               | −7.27                              | − 77                        |
| 620               | 2.91                                                                   | B0                                                                | 0.014 | 16 36 51.002                                         | +3.746                             | − 6                         | −28 14 48.93               | −7.14                              | − 22                        |
| 622               | 2.70                                                                   | B0                                                                | 0.000 | 16 38 00.842                                         | +3.310                             | + 9                         | −10 35 50.47               | −6.99                              | + 26                        |
| 1434              | 5.14                                                                   | M0                                                                | 0.017 | 16 39 10.159                                         | +1.633                             | − 48                        | +48 53 55.10               | −6.89                              | + 31                        |
| 624               | 5.04                                                                   | K0                                                                | 0.038 | 16 42 28.284                                         | +3.478                             | − 14                        | −17 46 15.53               | −6.65                              | − 1                         |
| 626               | 3.61                                                                   | K0                                                                | 0.053 | 16 43 25.700                                         | +2.060                             | + 32                        | +38 53 36.81               | −6.65                              | − 82                        |
| 627               | 4.88                                                                   | F0                                                                | 0.042 | 16 45 35.548                                         | +1.146                             | + 22                        | +56 45 16.52               | −6.33                              | + 66                        |
| 625               | 1.88                                                                   | K2                                                                | 0.024 | 16 50 19.103                                         | +6.408                             | + 26                        | −69 03 14.42               | −6.03                              | − 34                        |
| 1438              | 4.73                                                                   | F5                                                                | 0.013 | 16 50 41.568                                         | +3.325                             | + 65                        | −10 48 33.42               | −6.06                              | − 93                        |
| 1435              | 3.68                                                                   | K5                                                                | 0.017 | 16 51 07.851                                         | +5.210                             | + 49                        | −59 04 02.39               | −5.96                              | − 28                        |
| 628               | 2.36                                                                   | K0                                                                | 0.049 | 16 51 10.210                                         | +3.897                             | −493                        | −34 19 12.24               | −6.19                              | −256                        |
| 1440              | 5.20                                                                   | K0                                                                | 0.010 | 16 52 23.855                                         | +2.490                             | + 8                         | +24 37 52.48               | −5.82                              | + 6                         |
| 1439              | 3.09 <sub>v</sub>                                                      | B3p                                                               | 0.000 | 16 52 55.400                                         | +4.076                             | − 9                         | −38 04 21.43               | −5.81                              | − 25                        |
| 1442              | 4.29                                                                   | B8                                                                | 0.024 | 16 54 44.535                                         | +2.842                             | − 34                        | +10 08 26.86               | −5.67                              | − 36                        |
| 633               | 3.42                                                                   | K0                                                                | 0.026 | 16 58 24.170                                         | +2.843                             | −197                        | + 9 21 06.95               | −5.33                              | − 11                        |
| 631               | 3.06                                                                   | K5                                                                | 0.036 | 16 59 54.471                                         | +4.987                             | − 23                        | −56 00 46.44               | −5.23                              | − 36                        |
| 632               | 4.15                                                                   | K2                                                                | 0.000 | 17 00 49.457                                         | +4.801                             | + 4                         | −53 10 57.70               | −5.10                              | + 17                        |
| 634               | 3.92                                                                   | A0                                                                | 0.022 | 17 00 53.000                                         | +2.298                             | − 36                        | +30 54 15.89               | −5.09                              | + 28                        |
| 1445              | 5.00                                                                   | K0                                                                | 0.014 | 17 01 52.703                                         | +3.169                             | − 27                        | − 4 14 41.07               | −5.10                              | − 75                        |
| 635               | 4.91                                                                   | A3                                                                | 0.018 | 17 06 05.864                                         | +2.785                             | + 35                        | +12 43 14.01               | −4.68                              | − 10                        |
| 639               | 3.22                                                                   | B5                                                                | 0.017 | 17 08 50.070                                         | +0.187                             | − 33                        | +65 41 44.32               | −4.42                              | + 22                        |
| 638               | 3.44                                                                   | F2                                                                | 0.063 | 17 13 15.976                                         | +4.309                             | + 23                        | −43 15 29.08               | −4.35                              | −287                        |
| 643               | 3.36                                                                   | K5                                                                | 0.020 | 17 15 35.269                                         | +2.093                             | − 22                        | +36 47 32.88               | −3.86                              | + 4                         |
| 641               | 3.16                                                                   | A2                                                                | 0.034 | 17 15 40.150                                         | +2.467                             | − 15                        | +24 49 18.60               | −4.01                              | −157                        |
| 1454              | 5.17                                                                   | M0                                                                | 0.000 | 17 20 59.895                                         | +2.647                             | + 6                         | +18 02 31.62               | −3.45                              | − 55                        |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5           | magn.   | Sp    | $\pi$               | $\alpha_{2015.5}$                                    | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$      | $\delta_{2015.5}$           | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$     |
|---------------|---------|-------|---------------------|------------------------------------------------------|--------------------------------------|---------------------|-----------------------------|--------------------------------------|--------------------|
|               |         |       |                     |                                                      |                                      | 0 <sup>s</sup> 0001 |                             |                                      | 0 <sup>s</sup> 001 |
| 644           | 3.37    | B3    | 0 <sup>''</sup> 000 | 17 <sup>h</sup> 22 <sup>m</sup> 57 <sup>s</sup> .778 | +3 <sup>s</sup> .690                 | − 3                 | −25°00′49 <sup>''</sup> .18 | −3 <sup>''</sup> .24                 | − 20               |
| 645           | 2.80    | K2    | 0.026               | 17 26 35.491                                         | +5.001                               | − 10                | −55 32 33.99                | −2.94                                | − 25               |
| 1459          | 4.44    | K0    | 0.000               | 17 27 17.072                                         | +2.980                               | + 3                 | + 4 07 40.62                | −2.84                                | + 7                |
| 1457          | 4.28    | F0    | 0.043               | 17 27 19.089                                         | +3.669                               | + 0                 | −24 11 17.72                | −2.96                                | −116               |
| 647           | 4.61    | F0    | 0.027               | 17 27 27.276                                         | +3.187                               | − 62                | − 5 05 56.94                | −2.88                                | − 43               |
| 646           | 4.37    | F5    | 0.015               | 17 28 20.755                                         | +3.837                               | + 16                | −29 52 47.08                | −2.90                                | −139               |
| 653 *         | 2.79    | G0    | 0.000               | 17 30 47.020                                         | +1.359                               | − 17                | +52 17 25.62                | −2.53                                | + 15               |
| 1460          | 4.48    | K0    | 0.012               | 17 31 21.938                                         | +2.427                               | + 15                | +26 05 59.54                | −2.48                                | + 18               |
| 649           | 2.80    | B3    | 0.000               | 17 31 49.160                                         | +4.086                               | − 1                 | −37 18 24.32                | −2.49                                | − 31               |
| 655           | 4.98    | A5    | 0.026               | 17 32 28.925                                         | +1.186                               | + 171               | +55 10 26.87                | −2.34                                | + 57               |
| 648           | 3.79    | B8    | 0.000               | 17 32 30.045                                         | +5.431                               | − 80                | −60 41 41.31                | −2.50                                | − 96               |
| 657           | 4.95    | A5    | 0.026               | 17 32 34.401                                         | +1.186                               | + 173               | +55 09 46.18                | −2.34                                | + 57               |
| 651           | 2.97    | B3p   | 0.000               | 17 33 02.525                                         | +4.647                               | − 32                | −49 53 12.64                | −2.42                                | − 70               |
| 652           | 1.71    | B2    | 0.000               | 17 34 39.765                                         | +4.080                               | − 1                 | −37 06 49.16                | −2.24                                | − 29               |
| 656           | 2.14    | A5    | 0.056               | 17 35 39.282                                         | +2.788                               | + 82                | +12 32 59.21                | −2.35                                | −226               |
| 664           | 4.87    | F5    | 0.039               | 17 36 51.751                                         | −0.343                               | + 1                 | +68 45 02.48                | −1.70                                | +323               |
| 654           | 2.04    | F0    | 0.020               | 17 38 26.060                                         | +4.317                               | + 14                | −43 00 22.18                | −1.88                                | − 2                |
| 658           | 3.64    | A5    | 0.026               | 17 38 28.501                                         | +3.439                               | − 29                | −15 24 25.42                | −1.94                                | − 58               |
| 663           | 3.79    | B3    | 0.000               | 17 39 54.185                                         | +1.697                               | − 5                 | +45 59 55.48                | −1.75                                | + 5                |
| 670 <i>pr</i> | 4.90    | F5    | 0.046               | 17 41 40.001                                         | −1.053                               | + 57                | +72 08 27.11                | −1.87                                | −267               |
| 660           | 2.51    | B2    | 0.000               | 17 43 33.678                                         | +4.155                               | − 5                 | −39 02 11.49                | −1.46                                | − 27               |
| 665           | 2.94    | K0    | 0.023               | 17 44 14.331                                         | +2.966                               | − 27                | + 4 33 42.87                | −1.22                                | +159               |
| 1463          | 4.89    | F5    | 0.054               | 17 44 21.577                                         | +3.599                               | − 68                | −21 41 21.99                | −1.41                                | − 43               |
| 667           | 3.48    | G5    | 0.108               | 17 47 03.957                                         | +2.351                               | − 233               | +27 42 44.77                | −1.88                                | −752               |
| 661           | 3.58    | K0    | 0.017               | 17 47 15.386                                         | +5.899                               | − 22                | −64 43 44.91                | −1.17                                | − 54               |
| 1464          | 4.4–5.0 | F5-G0 | 0.028               | 17 48 32.221                                         | +3.780                               | − 1                 | −27 50 07.27                | −1.01                                | − 10               |
| 666           | 3.14    | F5p   | 0.013               | 17 48 40.184                                         | +4.200                               | − 0                 | −40 07 53.57                | −1.00                                | − 8                |
| 668           | 3.74    | A0    | 0.032               | 17 48 40.228                                         | +3.011                               | − 15                | + 2 42 09.17                | −1.06                                | − 74               |
| 675           | 5.04    | F5    | 0.031               | 17 48 45.504                                         | −2.676                               | + 103               | +76 57 35.35                | −0.73                                | +248               |
| 669           | 3.25    | K2    | 0.032               | 17 50 54.842                                         | +4.087                               | + 41                | −37 02 48.37                | −0.76                                | + 33               |
| 671           | 3.90    | K0    | 0.031               | 17 53 47.843                                         | +1.040                               | + 114               | +56 52 14.21                | −0.46                                | + 80               |
| 672           | 3.99    | K0    | 0.000               | 17 56 47.108                                         | +2.060                               | + 4                 | +37 14 57.28                | −0.27                                | + 6                |
| 676 *         | 2.23    | K5    | 0.017               | 17 56 57.995                                         | +1.396                               | − 8                 | +51 29 15.55                | −0.28                                | − 19               |
| 674           | 3.82    | K0    | 0.018               | 17 58 22.062                                         | +2.334                               | + 64                | +29 14 49.58                | −0.16                                | − 17               |
| 673           | 3.50    | K0    | 0.015               | 17 59 52.823                                         | +3.305                               | − 4                 | − 9 46 27.64                | −0.13                                | −116               |
| 1469          | 4.71    | K0    | 0.000               | 18 00 44.840                                         | +2.673                               | − 5                 | +16 45 03.67                | +0.06                                | − 10               |
| 677           | 3.95    | B5p   | 0.000               | 18 01 25.325                                         | +3.007                               | + 1                 | + 2 55 54.87                | +0.12                                | − 8                |
| 679           | 3.07    | K0    | 0.018               | 18 06 48.249                                         | +3.855                               | − 41                | −30 25 21.01                | +0.41                                | −185               |
| 1471          | 3.90    | B1p   | 0.000               | 18 07 50.260                                         | +4.671                               | − 10                | −50 05 19.98                | +0.67                                | − 14               |
| 680           | 3.73    | A3    | 0.037               | 18 08 05.101                                         | +2.846                               | − 41                | + 9 34 01.57                | +0.79                                | + 80               |
| 681           | 3.83    | A0    | 0.000               | 18 08 08.858                                         | +2.342                               | + 1                 | +28 45 55.79                | +0.72                                | + 10               |
| 1473          | 4.60    | K0    | 0.016               | 18 12 22.787                                         | +4.453                               | − 16                | −45 57 00.40                | +1.05                                | − 37               |
| 685           | 5.03    | F5    | 0.047               | 18 13 59.153                                         | +0.345                               | + 538               | +64 24 09.63                | +1.26                                | + 36               |
| 682           | 4.01    | B8p   | 0.000               | 18 14 41.436                                         | +3.589                               | + 1                 | −21 03 12.50                | +1.29                                | + 1                |
| 683           | 3.16    | M3    | 0.038               | 18 18 40.562                                         | +4.059                               | − 106               | −36 45 20.16                | +1.46                                | −167               |
| 1477          | 4.34    | K0    | 0.000               | 18 20 24.329                                         | +2.105                               | − 13                | +36 04 20.37                | +1.82                                | + 43               |
| 695 *         | 3.57    | F8    | 0.120               | 18 20 46.535                                         | −1.087                               | +1198               | +72 44 21.25                | +1.47                                | −347               |
| 1476          | 4.92    | G5    | 0.016               | 18 21 38.513                                         | +2.997                               | + 0                 | + 3 23 06.64                | +1.90                                | + 11               |
| 687           | 2.84    | K0    | 0.039               | 18 21 59.182                                         | +3.840                               | + 27                | −29 49 12.68                | +1.89                                | − 28               |
| 688           | 3.42    | K0    | 0.054               | 18 22 06.743                                         | +3.106                               | − 364               | − 2 53 37.22                | +1.23                                | −701               |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5               | magn.             | Sp      | $\pi$               | $\alpha_{2015.5}$                                    | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$      | $\delta_{2015.5}$           | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$     |
|-------------------|-------------------|---------|---------------------|------------------------------------------------------|--------------------------------------|---------------------|-----------------------------|--------------------------------------|--------------------|
|                   |                   |         |                     |                                                      |                                      | 0 <sup>s</sup> 0001 |                             |                                      | 0 <sup>s</sup> 001 |
| 690               | 3.92              | K0      | 0 <sup>''</sup> 016 | 18 <sup>h</sup> 24 <sup>m</sup> 21 <sup>s</sup> .544 | +2 <sup>s</sup> 559                  | +141                | +21°46'39 <sup>''</sup> .84 | +1 <sup>''</sup> .88                 | −242               |
| 686               | 4.25              | K2      | 0.010               | 18 24 39.192                                         | +5.520                               | + 2                 | −61 29 05.65                | +2.15                                | + 3                |
| 689               | 1.95              | A0      | 0.015               | 18 25 12.032                                         | +3.981                               | − 31                | −34 22 33.26                | +2.08                                | −124               |
| 691               | 3.76              | B3      | 0.000               | 18 28 07.326                                         | +4.445                               | − 15                | −45 57 30.01                | +2.40                                | − 54               |
| 692               | 2.94              | K0      | 0.046               | 18 28 55.626                                         | +3.702                               | − 32                | −25 24 42.56                | +2.34                                | −185               |
| 696               | 4.73              | A3      | 0.017               | 18 30 04.859                                         | +3.419                               | + 2                 | −14 33 16.89                | +2.62                                | − 2                |
| 697               | 4.69              | G5      | 0.000               | 18 34 36.528                                         | +4.280                               | + 28                | −42 17 59.44                | +2.99                                | − 22               |
| 1482              | 4.06              | K0      | 0.013               | 18 36 03.047                                         | +3.265                               | − 10                | − 8 13 55.37                | +2.83                                | −312               |
| 699 *             | 0.03              | A0      | 0.123               | 18 37 27.836                                         | +2.033                               | +172                | +38 47 55.81                | +3.55                                | +286               |
| 1486              | 4.70 <sub>v</sub> | F0      | 0.020               | 18 43 07.346                                         | +3.285                               | + 6                 | − 9 02 11.63                | +3.75                                | + 2                |
| 702               | 5.09              | G5      | 0.013               | 18 44 21.900                                         | +3.267                               | + 15                | − 8 15 31.49                | +3.86                                | + 8                |
| 698               | 4.10              | K0      | 0.027               | 18 44 50.226                                         | +6.972                               | − 8                 | −71 24 44.46                | +3.74                                | −156               |
| 703               | 4.26              | F5      | 0.049               | 18 46 19.771                                         | +2.584                               | − 5                 | +20 33 43.46                | +3.69                                | −335               |
| 1487              | 3.30              | B8      | 0.000               | 18 46 37.446                                         | +3.745                               | + 40                | −26 58 24.69                | +4.05                                | + 0                |
| 1488              | 4.92              | K0      | 0.023               | 18 46 41.975                                         | +2.419                               | + 13                | +26 40 46.44                | +4.08                                | + 24               |
| 1491              | 4.37              | A3      | 0.045               | 18 47 42.348                                         | +2.651                               | + 51                | +18 11 58.94                | +4.26                                | +116               |
| 1489              | 4.47              | G0      | 0.016               | 18 47 59.820                                         | +3.183                               | − 3                 | − 4 43 48.57                | +4.15                                | − 16               |
| 705               | 3.4–4.3           | B8p+B2p | 0.000               | 18 50 39.155                                         | +2.217                               | + 3                 | +33 22 53.33                | +4.39                                | − 3                |
| 707               | 4.85              | K0      | 0.000               | 18 51 25.766                                         | +0.882                               | +104                | +59 24 27.52                | +4.49                                | + 27               |
| 704               | 4.42              | B2      | 0.000               | 18 53 38.862                                         | +5.536                               | − 8                 | −62 10 04.47                | +4.63                                | − 14               |
| 714 *             | 4.82              | K0      | 0.010               | 18 54 12.170                                         | −0.756                               | +102                | +71 19 03.52                | +4.74                                | + 44               |
| 711               | 4.0–4.5           | M3      | 0.000               | 18 55 48.423                                         | +1.827                               | + 21                | +43 58 01.86                | +4.91                                | + 83               |
| 706 *             | 2.02              | B3      | 0.000               | 18 56 13.532                                         | +3.716                               | + 10                | −26 16 34.25                | +4.81                                | − 54               |
| 709 <sub>pr</sub> | 4.50              | A5      | 0.026               | 18 56 59.425                                         | +2.983                               | + 32                | + 4 13 29.34                | +4.96                                | + 31               |
| 710               | 3.61              | K0      | 0.000               | 18 58 39.231                                         | +3.576                               | + 24                | −21 05 06.12                | +5.06                                | − 12               |
| 713               | 3.30              | A0p     | 0.011               | 18 59 31.428                                         | +2.246                               | − 2                 | +32 42 41.86                | +5.15                                | + 2                |
| 708               | 5.03              | B9      | 0.000               | 18 59 41.935                                         | +4.784                               | + 11                | −52 55 00.11                | +5.15                                | − 11               |
| 712               | 4.21              | K0      | 0.025               | 19 00 19.582                                         | +2.724                               | − 35                | +15 05 25.03                | +5.14                                | − 73               |
| 716               | 3.02              | A0      | 0.036               | 19 06 07.363                                         | +2.758                               | − 3                 | +13 53 14.87                | +5.61                                | − 96               |
| 717               | 3.55              | B9      | 0.025               | 19 07 04.278                                         | +3.183                               | − 11                | − 4 51 29.44                | +5.69                                | − 90               |
| 719               | 5.13              | B5      | 0.000               | 19 07 51.335                                         | +2.143                               | + 1                 | +36 07 30.84                | +5.84                                | − 4                |
| 1496              | 3.42              | K0      | 0.038               | 19 07 54.405                                         | +3.741                               | − 40                | −27 38 47.37                | +5.60                                | −251               |
| 718               | 4.12              | A2      | 0.029               | 19 10 31.483                                         | +4.073                               | + 71                | −37 52 44.32                | +5.97                                | − 98               |
| 720               | 3.02              | F2      | 0.016               | 19 10 41.084                                         | +3.564                               | − 0                 | −20 59 51.90                | +6.05                                | − 35               |
| 723               | 3.24              | K0      | 0.028               | 19 12 33.275                                         | −0.002                               | +164                | +67 41 19.72                | +6.33                                | + 93               |
| 729 *             | 4.45              | K0      | 0.013               | 19 15 14.543                                         | −1.196                               | −327                | +73 23 01.67                | +6.57                                | +106               |
| 724               | 4.46              | K0      | 0.010               | 19 16 54.391                                         | +2.084                               | − 1                 | +38 09 43.47                | +6.60                                | + 4                |
| 726               | 3.98              | K0      | 0.023               | 19 17 27.620                                         | +1.385                               | + 66                | +53 23 51.26                | +6.77                                | +125               |
| 722               | 5.03              | K0      | 0.000               | 19 18 32.428                                         | +3.506                               | − 8                 | −18 55 27.13                | +6.72                                | − 14               |
| 725               | 5.14              | A5      | 0.000               | 19 18 32.660                                         | +2.817                               | + 2                 | +11 37 27.63                | +6.75                                | + 13               |
| 727               | 4.58              | B8p+F2p | 0.000               | 19 22 36.831                                         | +3.432                               | + 1                 | −15 55 29.17                | +7.06                                | − 6                |
| 1502              | 4.31              | B8      | 0.000               | 19 23 44.962                                         | +4.299                               | + 9                 | −44 25 42.28                | +7.14                                | − 20               |
| 728               | 4.11              | B8      | 0.000               | 19 24 57.434                                         | +4.145                               | + 27                | −40 35 07.62                | +7.14                                | −123               |
| 730               | 3.44              | F0      | 0.062               | 19 26 16.780                                         | +3.024                               | +171                | + 3 08 48.16                | +7.45                                | + 83               |
| 1508              | 4.63              | M0      | 0.012               | 19 29 21.046                                         | +2.498                               | − 92                | +24 41 49.68                | +7.51                                | −106               |
| 733 *             | 3.79              | A2      | 0.000               | 19 30 05.774                                         | +1.511                               | + 22                | +51 45 48.03                | +7.81                                | +130               |
| 732 <sub>pr</sub> | 3.24              | K0+A0   | 0.010               | 19 31 20.823                                         | +2.421                               | + 2                 | +27 59 34.98                | +7.78                                | − 2                |
| 1510              | 4.85              | B3      | 0.000               | 19 32 20.896                                         | +2.231                               | + 1                 | +34 29 12.15                | +7.86                                | − 3                |
| 1511              | 4.65              | K0      | 0.038               | 19 34 50.789                                         | +2.931                               | +146                | + 7 24 46.20                | +7.90                                | −156               |
| 735               | 5.02              | K0      | 0.000               | 19 36 21.715                                         | +4.432                               | − 9                 | −48 03 51.74                | +8.14                                | − 38               |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5                | magn.             | Sp    | $\pi$ | $\alpha_{2015.5}$                                    | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|--------------------|-------------------|-------|-------|------------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
|                    |                   |       |       |                                                      |                                      | 0°0001         |                   |                                      | 0°001          |
| 738                | 4.64              | F5    | 0.066 | 19 <sup>h</sup> 36 <sup>m</sup> 51 <sup>s</sup> .420 | +1.608                               | − 19           | +50°15′26.95      | + 8.48                               | + 257          |
| 736                | 4.66              | B9    | 0.000 | 19 37 38.925                                         | +3.644                               | + 51           | −24 50 53.46      | + 8.26                               | − 21           |
| 737                | 5.04              | B0    | 0.000 | 19 37 43.443                                         | +3.225                               | + 2            | − 6 59 31.06      | + 8.29                               | − 4            |
| 1513               | 4.45              | K0    | 0.020 | 19 41 44.718                                         | +2.695                               | + 7            | +17 30 46.25      | + 8.58                               | − 32           |
| 1514               | 5.10              | F0    | 0.031 | 19 43 24.259                                         | +3.427                               | + 47           | −16 05 11.65      | + 8.73                               | − 9            |
| 740                | 5.02              | K0    | 0.018 | 19 44 50.168                                         | +2.165                               | + 63           | +37 23 33.05      | + 8.89                               | + 35           |
| 741                | 2.80              | K2    | 0.000 | 19 46 59.793                                         | +2.852                               | + 12           | +10 39 07.12      | + 9.02                               | − 2            |
| 1517               | 5.06              | K0    | 0.018 | 19 47 15.901                                         | +3.494                               | − 91           | −19 43 21.79      | + 8.95                               | − 89           |
| 743                | 3.78              | M0+A0 | 0.000 | 19 48 04.744                                         | +2.676                               | + 5            | +18 34 24.18      | + 9.11                               | + 8            |
| 745 *              | 0.77              | A5    | 0.198 | 19 51 32.363                                         | +2.926                               | + 363          | + 8 54 36.86      | + 9.76                               | + 387          |
| 746                | 3.7–4.4           | G0p   | 0.000 | 19 53 15.722                                         | +3.054                               | + 7            | + 1 02 47.14      | + 9.50                               | − 7            |
| 749                | 3.90              | K0    | 0.070 | 19 56 04.472                                         | +2.947                               | + 33           | + 6 26 47.07      | + 9.24                               | − 482          |
| 1520               | 4.21              | K0    | 0.028 | 19 56 19.609                                         | +4.122                               | + 15           | −41 49 34.82      | + 9.80                               | + 56           |
| 1521               | 4.03              | K0    | 0.000 | 19 56 53.286                                         | +2.252                               | − 26           | +35 07 31.23      | + 9.76                               | − 27           |
| 1522               | 5.05              | A0    | 0.046 | 19 58 49.697                                         | +3.397                               | + 12           | −15 26 57.55      | + 9.83                               | − 100          |
| 752                | 3.71              | K5    | 0.011 | 19 59 26.794                                         | +2.669                               | + 46           | +19 32 06.43      | +10.00                               | + 24           |
| 751                | 4.39              | B3    | 0.000 | 20 00 44.523                                         | +3.892                               | + 5            | −35 13 59.53      | +10.05                               | − 26           |
| 1523               | 4.74              | A5    | 0.025 | 20 01 44.370                                         | +2.472                               | + 44           | +27 47 49.99      | +10.16                               | + 5            |
| 748                | 4.10              | A0    | 0.010 | 20 02 21.469                                         | +6.823                               | + 170          | −72 52 02.80      | +10.07                               | − 132          |
| 753                | 4.60              | M3    | 0.020 | 20 03 36.535                                         | +3.679                               | + 27           | −27 39 56.15      | +10.31                               | + 17           |
| 759 *              | 4.39              | B9    | 0.000 | 20 08 20.401                                         | −2.138                               | + 35           | +77 45 26.75      | +10.67                               | + 24           |
| 755                | 4.86              | M0    | 0.000 | 20 08 33.982                                         | +4.566                               | − 15           | −52 50 06.17      | +10.67                               | + 8            |
| 1525               | 4.82              | B2p   | 0.000 | 20 10 00.186                                         | +2.230                               | + 4            | +36 53 09.46      | +10.78                               | + 14           |
| 754                | 3.64              | G5    | 0.170 | 20 10 13.925                                         | +5.821                               | +1996          | −66 08 26.63      | + 9.66                               | −1127          |
| 756                | 3.37              | A0    | 0.000 | 20 12 06.233                                         | +3.093                               | + 26           | − 0 46 28.37      | +10.93                               | + 4            |
| 758                | 4.32              | A3    | 0.016 | 20 13 45.435                                         | +1.391                               | + 76           | +56 36 56.15      | +11.13                               | + 83           |
| 757                | 3.95 <sub>v</sub> | K0+B8 | 0.000 | 20 14 07.200                                         | +1.890                               | + 4            | +46 47 20.23      | +11.07                               | + 3            |
| 1526               | 4.96              | A0    | 0.020 | 20 14 59.662                                         | +2.776                               | + 40           | +15 14 44.32      | +11.19                               | + 57           |
| 1527               | 4.55              | G0p   | 0.000 | 20 18 30.337                                         | +3.320                               | + 15           | −12 27 33.44      | +11.39                               | + 1            |
| 761                | 3.77              | G5    | 0.033 | 20 18 54.778                                         | +3.323                               | + 44           | −12 29 44.87      | +11.42                               | + 4            |
| 762                | 3.25              | G0+A0 | 0.000 | 20 21 52.831                                         | +3.364                               | + 29           | −14 43 53.18      | +11.63                               | + 2            |
| 765                | 2.32              | F8p   | 0.000 | 20 22 47.106                                         | +2.155                               | + 4            | +40 18 25.10      | +11.69                               | + 0            |
| 764                | 2.12              | B3    | 0.000 | 20 26 51.862                                         | +4.706                               | + 8            | −56 41 02.70      | +11.89                               | − 89           |
| 767                | 4.28              | A5    | 0.032 | 20 29 50.341                                         | +0.996                               | + 65           | +63 02 47.33      | +12.18                               | − 13           |
| 1534               | 4.09              | F5p   | 0.000 | 20 30 01.761                                         | +2.453                               | + 5            | +30 25 15.65      | +12.20                               | + 0            |
| 1533               | 5.11              | K0    | 0.000 | 20 30 27.563                                         | +3.132                               | + 48           | − 2 49 59.01      | +12.21                               | − 21           |
| 770                | 5.18              | A2p   | 0.000 | 20 31 17.150                                         | −0.864                               | + 14           | +75 00 27.04      | +12.27                               | − 15           |
| 768                | 3.98              | B5    | 0.016 | 20 33 57.206                                         | +2.866                               | + 9            | +11 21 24.42      | +12.45                               | − 22           |
| 769                | 3.21              | K0    | 0.039 | 20 38 39.078                                         | +4.193                               | + 52           | −47 14 10.68      | +12.86                               | + 66           |
| 1539               | 4.78              | A0    | 0.000 | 20 39 12.887                                         | +2.681                               | + 51           | +21 15 22.95      | +12.84                               | + 5            |
| 774                | 3.86              | B8    | 0.000 | 20 40 21.496                                         | +2.787                               | + 46           | +15 58 02.94      | +12.90                               | − 2            |
| 777 *              | 1.25              | A2p   | 0.000 | 20 41 57.648                                         | +2.047                               | + 3            | +45 20 10.79      | +13.02                               | + 2            |
| 778                | 4.53              | A5    | 0.000 | 20 44 10.960                                         | +2.801                               | − 13           | +15 07 51.38      | +13.12                               | − 43           |
| 776                | 4.70              | F0    | 0.029 | 20 45 10.153                                         | +4.371                               | + 171          | −51 51 52.25      | +13.17                               | − 58           |
| 783                | 3.59              | K0    | 0.071 | 20 45 36.157                                         | +1.210                               | + 120          | +61 53 57.62      | +14.07                               | + 819          |
| 782                | 4.63              | G0    | 0.041 | 20 45 44.171                                         | +1.487                               | − 79           | +57 38 08.78      | +13.03                               | − 237          |
| 775                | 3.60              | A5    | 0.026 | 20 46 20.191                                         | +5.328                               | − 76           | −66 08 45.77      | +13.31                               | + 11           |
| 780                | 2.64              | K0    | 0.044 | 20 46 50.350                                         | +2.430                               | + 286          | +34 01 44.39      | +13.66                               | + 328          |
| 779                | 4.26              | F8    | 0.090 | 20 47 00.647                                         | +3.541                               | − 37           | −25 12 51.30      | +13.19                               | − 157          |
| 1541 <sub>sq</sub> | 4.49              | G5    | 0.022 | 20 47 22.654                                         | +2.784                               | − 22           | +16 10 51.26      | +13.17                               | − 197          |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5   | magn.   | Sp    | $\pi$ | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------|---------|-------|-------|-----------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
|       |         |       |       |                                                     |                                      | 0°0001         |                   |                                      | 0°001          |
| 781   | 3.83    | A0    | 0.015 | 20 <sup>h</sup> 48 <sup>m</sup> 30.825 <sup>s</sup> | +3.242                               | + 24           | − 9°26′17.31″     | +13.41                               | − 34           |
| 1543  | 4.60    | M0    | 0.000 | 20 48 33.255                                        | +3.162                               | + 2            | − 4 58 12.35      | +13.41                               | − 40           |
| 1542  | 5.14    | F0    | 0.043 | 20 49 31.873                                        | +4.043                               | + 171          | −43 55 51.39      | +13.40                               | − 106          |
| 1546  | 4.24    | M0    | 0.000 | 20 52 44.629                                        | +3.568                               | − 5            | −26 51 36.79      | +13.71                               | − 1            |
| 1547  | 4.80    | A3    | 0.012 | 20 53 29.324                                        | +3.231                               | + 30           | − 8 55 27.47      | +13.73                               | − 30           |
| 785   | 3.72    | K0    | 0.000 | 20 56 00.579                                        | +4.639                               | + 21           | −58 23 40.18      | +13.90                               | − 26           |
| 788   | 4.04    | A0    | 0.000 | 20 57 45.139                                        | +2.240                               | + 11           | +41 13 38.86      | +14.02                               | − 16           |
| 1551  | 4.88    | B0p   | 0.000 | 21 00 21.221                                        | +2.043                               | + 6            | +47 34 55.32      | +14.20                               | + 2            |
| 1550  | 4.71    | G5    | 0.026 | 21 02 14.287                                        | +3.664                               | − 2            | −32 11 46.49      | +14.31                               | + 5            |
| 792   | 3.92    | K5    | 0.000 | 21 05 29.743                                        | +2.186                               | + 8            | +43 59 24.91      | +14.51                               | + 1            |
| 1552  | 4.19    | A0    | 0.010 | 21 06 48.993                                        | +3.364                               | + 58           | −17 10 13.45      | +14.53                               | − 60           |
| 791   | 4.60    | M0    | 0.016 | 21 08 01.911                                        | +3.497                               | − 17           | −24 56 34.90      | +14.62                               | − 43           |
| 794   | 4.52    | K0    | 0.014 | 21 10 26.224                                        | +3.262                               | + 65           | −11 18 29.30      | +14.79                               | − 15           |
| 1555  | 4.76    | F0p   | 0.021 | 21 11 05.742                                        | +2.918                               | + 38           | +10 11 40.89      | +14.69                               | − 153          |
| 797   | 3.40    | K0    | 0.021 | 21 13 35.815                                        | +2.557                               | + 1            | +30 17 28.21      | +14.93                               | − 56           |
| 1554  | 5.08    | M0    | 0.000 | 21 14 46.158                                        | +5.514                               | + 78           | −70 03 42.46      | +15.03                               | − 24           |
| 800   | 4.14    | F8+A3 | 0.013 | 21 16 35.910                                        | +2.998                               | + 39           | + 5 18 45.54      | +15.07                               | − 88           |
| 1558  | 4.28    | A0p   | 0.000 | 21 18 01.544                                        | +2.361                               | + 1            | +39 27 36.80      | +15.24                               | − 3            |
| 1559  | 4.42    | B3p   | 0.016 | 21 18 33.378                                        | +2.471                               | + 12           | +34 57 45.08      | +15.27                               | − 2            |
| 801   | 4.79    | A0    | 0.027 | 21 18 52.463                                        | +3.622                               | + 46           | −32 06 25.10      | +15.26                               | − 26           |
| 803 * | 2.44    | A5    | 0.063 | 21 18 56.904                                        | +1.427                               | + 218          | +62 39 05.75      | +15.34                               | + 50           |
| 802   | 4.92    | A2p   | 0.000 | 21 21 44.801                                        | +3.814                               | + 61           | −40 44 35.54      | +15.45                               | − 5            |
| 804   | 4.27    | K0    | 0.013 | 21 22 48.237                                        | +2.777                               | + 75           | +19 52 17.34      | +15.57                               | + 64           |
| 1561  | 4.30    | K0    | 0.024 | 21 23 06.466                                        | +3.332                               | + 23           | −16 46 04.12      | +15.53                               | + 5            |
| 806   | 3.86    | G5p   | 0.000 | 21 27 32.975                                        | +3.414                               | + 1            | −22 20 36.39      | +15.79                               | + 23           |
| 805   | 4.30    | F8    | 0.111 | 21 27 42.359                                        | +4.879                               | + 124          | −65 17 42.01      | +16.58                               | + 799          |
| 809 * | 3.23    | B1    | 0.000 | 21 28 51.252                                        | +0.749                               | + 21           | +70 37 44.15      | +15.85                               | + 7            |
| 1565  | 4.76    | K5    | 0.011 | 21 30 39.069                                        | +2.721                               | + 18           | +23 42 26.61      | +15.94                               | + 4            |
| 808   | 3.07    | G0    | 0.000 | 21 32 22.432                                        | +3.154                               | + 14           | − 5 30 08.30      | +16.02                               | − 8            |
| 1568  | 4.22    | K0    | 0.000 | 21 34 33.914                                        | +2.262                               | − 22           | +45 39 39.11      | +16.05                               | − 94           |
| 811   | 5.09    | A5    | 0.015 | 21 37 34.340                                        | +2.411                               | − 1            | +40 29 01.29      | +16.31                               | + 13           |
| 1569  | 4.78    | A5    | 0.000 | 21 38 34.548                                        | +3.189                               | + 78           | − 7 47 02.56      | +16.32                               | − 25           |
| 812   | 3.80    | F0p   | 0.025 | 21 40 56.862                                        | +3.315                               | + 132          | −16 35 29.88      | +16.44                               | − 23           |
| 817 * | 4.56    | K0    | 0.000 | 21 42 08.593                                        | +0.855                               | + 243          | +71 22 58.82      | +16.62                               | + 99           |
| 810   | 3.74    | K0    | 0.045 | 21 43 08.610                                        | +6.428                               | + 139          | −77 19 11.65      | +16.33                               | − 240          |
| 815 * | 0.7–3.5 | K0    | 0.000 | 21 44 56.844                                        | +2.947                               | + 21           | + 9 56 47.89      | +16.66                               | − 1            |
| 814   | 4.35    | A0    | 0.032 | 21 45 51.973                                        | +3.556                               | + 27           | −32 57 15.72      | +16.61                               | − 94           |
| 1572  | 4.46    | A2p   | 0.000 | 21 45 53.787                                        | +1.733                               | − 4            | +61 11 33.64      | +16.70                               | − 3            |
| 821   | 4.26    | B3    | 0.000 | 21 47 22.065                                        | +2.224                               | + 4            | +49 22 54.29      | +16.78                               | − 2            |
| 819   | 2.98    | A5    | 0.065 | 21 47 53.661                                        | +3.303                               | + 183          | −16 03 22.72      | +16.51                               | − 296          |
| 1575  | 5.00    | A0    | 0.000 | 21 50 31.909                                        | +2.660                               | + 15           | +30 14 48.87      | +16.90                               | − 27           |
| 823   | 5.05    | B3    | 0.000 | 21 53 46.150                                        | +2.735                               | + 7            | +25 59 54.87      | +17.08                               | − 2            |
| 1577  | 5.18    | F0    | 0.041 | 21 54 08.381                                        | +3.264                               | + 215          | −13 28 41.56      | +17.11                               | + 13           |
| 822   | 3.16    | B8    | 0.000 | 21 54 51.756                                        | +3.612                               | + 86           | −37 17 28.77      | +17.11                               | − 21           |
| 824   | 4.56    | F0    | 0.015 | 21 58 57.768                                        | +4.039                               | + 55           | −54 55 05.50      | +17.30                               | − 7            |
| 825   | 4.74    | K5    | 0.285 | 22 04 32.101                                        | +4.540                               | +4818          | −56 43 17.19      | +15.02                               | −2531          |
| 827   | 3.19    | G0    | 0.000 | 22 06 34.771                                        | +3.079                               | + 13           | − 0 14 38.49      | +17.63                               | − 10           |
| 1581  | 4.60    | K2    | 0.000 | 22 07 02.639                                        | +3.594                               | − 19           | −39 28 04.59      | +17.53                               | − 124          |
| 828   | 4.35    | B8    | 0.000 | 22 07 16.354                                        | +3.233                               | + 29           | −13 47 38.07      | +17.61                               | − 56           |
| 831   | 3.96    | F5    | 0.074 | 22 07 44.041                                        | +2.798                               | + 220          | +25 25 16.60      | +17.71                               | + 25           |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5   | magn.             | Sp     | $\pi$ | $\alpha_{2015.5}$                                    | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------|-------------------|--------|-------|------------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
| 829   | 2.16              | B5     | 0.051 | 22 <sup>h</sup> 09 <sup>m</sup> 12 <sup>s</sup> .197 | +3.751                               | 0.0001<br>+126 | -46°53'07.18      | +17.59                               | 0.001<br>-151  |
| 832   | 4.62              | A2     | 0.023 | 22 09 17.040                                         | +3.483                               | + 63           | -32 54 44.33      | +17.72                               | - 31           |
| 837 * | 4.79              | G5     | 0.011 | 22 10 06.083                                         | +1.137                               | + 72           | +72 25 04.02      | +17.78                               | + 3            |
| 835   | 4.38              | F5     | 0.000 | 22 10 40.644                                         | +2.672                               | - 11           | +33 15 16.97      | +17.78                               | - 21           |
| 834   | 3.70              | A2     | 0.042 | 22 10 58.898                                         | +3.026                               | +185           | + 6 16 28.61      | +17.84                               | + 27           |
| 836   | 3.62              | K0     | 0.019 | 22 11 23.677                                         | +2.091                               | + 19           | +58 16 40.82      | +17.84                               | + 4            |
| 1583  | 4.64              | K2     | 0.018 | 22 14 32.777                                         | +2.584                               | + 33           | +39 47 31.95      | +17.97                               | + 13           |
| 840   | 4.32              | K0     | 0.017 | 22 17 39.053                                         | +3.161                               | + 82           | - 7 42 20.30      | +18.05                               | - 22           |
| 841   | 2.91              | K2     | 0.019 | 22 19 33.048                                         | +4.055                               | - 96           | -60 10 54.27      | +18.10                               | - 43           |
| 839   | 5.11              | M3     | 0.000 | 22 21 40.766                                         | +6.365                               | +171           | -80 21 41.83      | +18.18                               | - 45           |
| 843   | 4.93              | B3p    | 0.000 | 22 22 16.893                                         | +2.956                               | + 6            | +12 17 01.40      | +18.25                               | + 6            |
| 842   | 3.97              | A0     | 0.040 | 22 22 27.380                                         | +3.097                               | + 88           | - 1 18 31.61      | +18.26                               | + 7            |
| 844   | 4.58              | K0     | 0.018 | 22 24 10.364                                         | +2.372                               | - 14           | +52 18 25.45      | +18.13                               | -186           |
| 1585  | 4.64              | B1p    | 0.000 | 22 26 04.106                                         | +3.063                               | + 13           | + 1 27 23.24      | +18.38                               | + 1            |
| 847   | 3.7-4.4           | F5-G0  | 0.000 | 22 29 44.976                                         | +2.241                               | + 19           | +58 29 41.37      | +18.51                               | + 1            |
| 846   | 4.02              | B5     | 0.017 | 22 30 11.420                                         | +3.561                               | + 26           | -43 24 57.34      | +18.52                               | - 5            |
| 1591  | 4.89              | A0     | 0.016 | 22 31 27.963                                         | +3.170                               | + 2            | -10 35 53.58      | +18.53                               | - 30           |
| 848   | 3.85              | A0     | 0.036 | 22 31 55.992                                         | +2.485                               | +144           | +50 21 45.18      | +18.60                               | + 19           |
| 1592  | 4.40              | A0     | 0.015 | 22 32 22.999                                         | +3.395                               | + 51           | -32 15 58.04      | +18.58                               | - 18           |
| 850   | 4.13              | B8     | 0.017 | 22 36 09.152                                         | +3.082                               | + 61           | - 0 02 13.97      | +18.66                               | - 56           |
| 852   | 4.91              | O5e    | 0.000 | 22 39 57.569                                         | +2.703                               | + 1            | +39 07 52.68      | +18.83                               | - 5            |
| 854   | 4.22              | B8     | 0.000 | 22 41 30.619                                         | +3.306                               | + 23           | -26 57 44.64      | +18.88                               | - 1            |
| 855   | 3.61              | B8     | 0.017 | 22 42 14.149                                         | +2.995                               | + 55           | +10 54 45.43      | +18.89                               | - 12           |
| 856   | 2.24              | M3     | 0.000 | 22 43 35.205                                         | +3.554                               | +133           | -46 48 11.47      | +18.93                               | - 8            |
| 857   | 3.10              | G0     | 0.000 | 22 43 43.859                                         | +2.821                               | + 11           | +30 18 09.58      | +18.92                               | - 25           |
| 859   | 4.14              | K0     | 0.037 | 22 47 16.775                                         | +2.897                               | + 42           | +23 38 51.19      | +19.03                               | - 10           |
| 860   | 3.69              | A2     | 0.038 | 22 49 29.015                                         | +3.591                               | +115           | -51 14 05.97      | +19.03                               | - 71           |
| 863   | 3.68              | K0     | 0.036 | 22 50 14.162                                         | +2.153                               | -108           | +66 16 55.83      | +19.00                               | -125           |
| 861   | 4.21              | K5     | 0.011 | 22 50 24.658                                         | +3.170                               | - 8            | -13 30 37.75      | +19.09                               | - 38           |
| 862   | 3.67              | K0     | 0.032 | 22 50 45.190                                         | +2.903                               | +108           | +24 41 01.49      | +19.09                               | - 42           |
| 864   | 3.84              | M0     | 0.012 | 22 53 25.328                                         | +3.126                               | + 8            | - 7 29 48.54      | +19.24                               | + 37           |
| 866   | 3.51              | A2     | 0.039 | 22 55 28.274                                         | +3.177                               | - 28           | -15 44 17.07      | +19.23                               | - 25           |
| 867 * | 1.16              | A3     | 0.144 | 22 58 30.252                                         | +3.301                               | +255           | -29 32 23.26      | +19.16                               | -165           |
| 868   | 4.18              | G5     | 0.031 | 23 01 47.244                                         | +3.508                               | - 74           | -52 40 14.58      | +19.38                               | - 14           |
| 869   | 3.63 <sub>v</sub> | B5+A2p | 0.000 | 23 02 38.255                                         | +2.775                               | + 20           | +42 24 34.26      | +19.41                               | - 6            |
| 1601  | 5.13              | F0     | 0.044 | 23 04 21.052                                         | +3.304                               | + 61           | -34 39 55.39      | +19.53                               | + 80           |
| 870   | 2.61 <sub>v</sub> | M0     | 0.015 | 23 04 31.679                                         | +2.918                               | +143           | +28 10 01.71      | +19.60                               | +137           |
| 1602  | 4.58              | B5p    | 0.000 | 23 04 39.958                                         | +3.054                               | + 9            | + 3 54 13.49      | +19.45                               | - 11           |
| 871 * | 2.49              | A0     | 0.030 | 23 05 32.051                                         | +2.994                               | + 44           | +15 17 20.04      | +19.44                               | - 42           |
| 1603  | 4.69              | M0     | 0.011 | 23 07 47.161                                         | +3.026                               | + 8            | + 9 29 36.38      | +19.51                               | - 14           |
| 873   | 3.80              | K0     | 0.000 | 23 10 16.264                                         | +3.190                               | + 40           | -21 05 16.89      | +19.60                               | + 31           |
| 1605  | 4.10              | K0     | 0.023 | 23 11 13.862                                         | +3.372                               | +129           | -45 09 45.19      | +19.56                               | - 30           |
| 1606  | 5.15              | A3     | 0.023 | 23 12 31.192                                         | +3.032                               | - 4            | + 8 48 16.20      | +19.61                               | - 6            |
| 1607  | 4.40              | M0     | 0.000 | 23 15 07.496                                         | +3.105                               | + 28           | - 5 57 54.83      | +19.46                               | -196           |
| 1608  | 4.48              | K0     | 0.043 | 23 16 42.181                                         | +3.140                               | +251           | - 9 00 11.08      | +19.67                               | - 16           |
| 878   | 3.85              | K0     | 0.025 | 23 17 58.175                                         | +3.112                               | +509           | + 3 22 01.79      | +19.72                               | + 17           |
| 877   | 4.10              | F2     | 0.035 | 23 18 19.477                                         | +3.461                               | - 37           | -58 09 01.97      | +19.79                               | + 79           |
| 879   | 4.51              | K0     | 0.037 | 23 19 39.462                                         | +3.226                               | + 15           | -32 26 50.50      | +19.66                               | - 70           |
| 1609  | 5.16              | A0     | 0.000 | 23 19 46.014                                         | +3.118                               | + 32           | - 9 31 32.80      | +19.73                               | - 2            |
| 880   | 4.65              | A5     | 0.034 | 23 21 24.403                                         | +2.979                               | + 24           | +23 49 31.31      | +19.75                               | - 7            |

# MIEJSCA ŚREDNIE GWIAZD 2015.5

| FK5   | magn.             | Sp    | $\pi$ | $\alpha_{2015.5}$                                   | przemiana<br>roczna<br>$VA_{\alpha}$ | $\mu_{\alpha}$ | $\delta_{2015.5}$ | przemiana<br>roczna<br>$VA_{\delta}$ | $\mu_{\delta}$ |
|-------|-------------------|-------|-------|-----------------------------------------------------|--------------------------------------|----------------|-------------------|--------------------------------------|----------------|
|       |                   |       |       |                                                     |                                      | 0°0001         |                   |                                      | 0°001          |
| 1612  | 4.20              | K0    | 0.029 | 23 <sup>h</sup> 23 <sup>m</sup> 46.961 <sup>s</sup> | + 3.143                              | − 85           | −20°00′56.78″     | +19.70                               | − 96           |
| 882   | 5.20              | K5    | 0.000 | 23 25 31.969                                        | + 2.694                              | + 15           | +62 22 05.00      | +19.80                               | − 12           |
| 881   | 4.57              | G0    | 0.028 | 23 26 09.334                                        | + 3.004                              | + 140          | +23 29 22.57      | +19.86                               | + 37           |
| 884   | 4.94              | A2p   | 0.036 | 23 27 43.646                                        | + 3.077                              | + 59           | + 1 20 26.07      | +19.75                               | − 97           |
| 1614  | 4.45              | G5    | 0.014 | 23 28 45.321                                        | + 3.047                              | − 82           | + 6 27 51.24      | +19.81                               | − 45           |
| 885   | 4.67              | K0    | 0.000 | 23 29 56.413                                        | + 3.040                              | + 44           | +12 50 46.34      | +19.90                               | + 27           |
| 886   | 4.46              | B9    | 0.000 | 23 33 47.900                                        | + 3.201                              | + 74           | −37 43 57.40      | +19.93                               | + 21           |
| 1617  | 4.80              | A2p   | 0.000 | 23 35 54.324                                        | + 3.208                              | + 42           | −42 31 45.53      | +19.93                               | − 1            |
| 890   | 4.00 <sub>v</sub> | K0    | 0.043 | 23 38 19.664                                        | + 2.958                              | + 157          | +46 32 32.12      | +19.53                               | −421           |
| 889   | 4.86              | A2    | 0.000 | 23 38 40.766                                        | + 3.208                              | + 69           | −45 24 23.52      | +19.94                               | − 14           |
| 891   | 4.28              | B8    | 0.000 | 23 38 54.090                                        | + 2.962                              | + 27           | +43 21 14.37      | +19.96                               | − 1            |
| 893 * | 3.21              | K0    | 0.064 | 23 39 59.764                                        | + 2.519                              | − 212          | +77 43 08.58      | +20.12                               | +151           |
| 892   | 4.28              | F8    | 0.064 | 23 40 44.922                                        | + 3.089                              | + 253          | + 5 42 37.29      | +19.53                               | −438           |
| 1619  | 4.33              | A0    | 0.012 | 23 41 10.607                                        | + 2.976                              | + 78           | +44 25 11.46      | +19.96                               | − 19           |
| 1620  | 4.61              | A5    | 0.024 | 23 42 50.291                                        | + 3.063                              | − 86           | + 1 51 55.50      | +19.83                               | −155           |
| 894   | 4.62              | A0    | 0.035 | 23 43 31.515                                        | + 3.107                              | + 70           | −14 27 32.85      | +19.92                               | − 66           |
| 1622  | 5.09              | K0+A5 | 0.000 | 23 46 48.448                                        | + 2.995                              | + 10           | +46 30 23.13      | +20.00                               | − 5            |
| 895   | 5.02              | A0    | 0.012 | 23 48 39.864                                        | + 2.915                              | + 26           | +67 53 34.79      | +20.02                               | − 1            |
| 896   | 4.64              | A0    | 0.033 | 23 49 43.863                                        | + 3.115                              | + 79           | −28 02 40.40      | +19.92                               | −106           |
| 899   | 4.4–5.1           | F8p   | 0.016 | 23 55 09.959                                        | + 3.031                              | − 3            | +57 35 08.43      | +20.04                               | − 2            |
| 1629  | 4.75              | M0    | 0.000 | 23 58 33.082                                        | + 3.069                              | − 25           | +25 13 39.11      | +20.01                               | − 33           |
| 900   | 5.07              | K0    | 0.026 | 23 59 28.010                                        | + 3.072                              | − 34           | − 3 28 12.04      | +19.97                               | − 72           |
| 901   | 5.14              | K0    | 0.000 | 23 59 43.604                                        | + 3.083                              | + 61           | −52 39 33.36      | +20.10                               | + 61           |

gwiazdy okołobiegunowe północne

|        |                   |                 |       |                                                    |         |        |               |        |       |
|--------|-------------------|-----------------|-------|----------------------------------------------------|---------|--------|---------------|--------|-------|
|        |                   |                 |       |                                                    |         | 0°0001 |               |        | 0°001 |
| 906    | 4.52              | K0              | 0.000 | 1 <sup>h</sup> 11 <sup>m</sup> 09.825 <sup>s</sup> | + 9.536 | + 797  | +86°20′21.60″ | +19.07 | − 13  |
| 907 *  | 2.02 <sub>v</sub> | F8 <sub>v</sub> | 0.000 | 2 50 52.266                                        | +80.777 | +2107  | +89 19 47.45  | +14.71 | − 18  |
| 1636   | 5.78              | K0              | 0.022 | 3 36 16.568                                        | +15.393 | + 461  | +84 57 42.13  | +11.62 | −137  |
| 909    | 5.26              | M0              | 0.000 | 7 47 12.752                                        | +25.638 | − 581  | +86 58 56.01  | − 9.06 | − 27  |
| 1640   | 6.26              | F0              | 0.000 | 9 18 21.190                                        | +11.498 | + 180  | +84 06 56.67  | −15.25 | + 14  |
| 910 *  | 4.29              | K2              | 0.014 | 9 39 11.216                                        | + 8.075 | − 83   | +81 15 21.88  | −16.39 | − 14  |
| 911    | 5.34              | F2              | 0.043 | 10 32 50.673                                       | + 6.789 | − 423  | +82 28 43.56  | −18.58 | + 32  |
| 1643   | 6.16              | G5              | 0.000 | 13 42 01.180                                       | − 1.382 | + 182  | +82 40 27.70  | −18.13 | − 41  |
| 1644   | 5.73              | G0              | 0.016 | 14 49 23.546                                       | − 3.623 | + 903  | +82 26 50.37  | −15.03 | −221  |
| 912 *  | 4.23              | G5              | 0.014 | 16 44 25.932                                       | − 5.922 | + 81   | +82 00 34.71  | − 6.48 | + 6   |
| 913 *  | 4.36              | A0              | 0.000 | 17 27 17.032                                       | −19.017 | + 81   | +86 34 31.30  | − 2.80 | + 56  |
| 1646   | 6.15              | A2              | 0.000 | 18 22 04.688                                       | − 8.043 | + 85   | +83 11 02.08  | + 1.90 | − 26  |
| 915    | 5.69              | A0              | 0.000 | 20 41 22.498                                       | − 4.737 | + 147  | +82 35 14.43  | +13.00 | + 24  |
| 1648   | 5.38              | A0              | 0.000 | 22 11 39.946                                       | − 5.996 | + 512  | +86 11 06.45  | +17.89 | + 46  |
| 1649 * | 4.71              | K5              | 0.000 | 22 54 13.828                                       | − 0.739 | + 632  | +84 25 44.89  | +19.25 | + 26  |

gwiazdy okołobiegunowe południowe

|     |      |    |       |                                                    |         |        |               |        |       |
|-----|------|----|-------|----------------------------------------------------|---------|--------|---------------|--------|-------|
|     |      |    |       |                                                    |         | 0°0001 |               |        | 0°001 |
| 918 | 5.38 | F0 | 0.000 | 8 <sup>h</sup> 54 <sup>m</sup> 08.882 <sup>s</sup> | − 9.980 | −1041  | −85°43′21.90″ | −13.77 | + 39  |
| 919 | 5.38 | K0 | 0.000 | 12 56 46.142                                       | + 7.032 | + 495  | −85 12 25.12  | −19.40 | + 28  |
| 922 | 5.22 | K0 | 0.000 | 19 03 30.528                                       | +33.486 | − 546  | −87 35 04.08  | + 5.34 | −140  |
| 923 | 5.48 | F0 | 0.000 | 21 21 41.438                                       | +47.149 | + 790  | −88 53 29.45  | +15.45 | + 6   |
| 924 | 4.34 | F0 | 0.000 | 22 47 33.252                                       | + 5.760 | − 294  | −81 17 58.98  | +19.05 | − 2   |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                | FK5  | magn. | $\alpha_{ICRF}$                                     | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp          |
|--------------------|------|-------|-----------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|-------------|
| 122                | 904  | 4.78  | <sup>h</sup> 0 <sup>m</sup> 01 <sup>s</sup> 35.7037 | −77°03′56″.608  | −16.8344                 | −176.9483                 | 14.770         | 23.70           | K2III       |
| 154                | 1630 | 4.37  | 0 01 57.6190                                        | − 6 00 50.660   | 3.1252                   | −41.3201                  | 7.860          | −11.80          | M3III       |
| 301                | 905  | 4.55  | 0 03 44.3898                                        | −17 20 09.556   | 1.9953                   | −7.2800                   | 14.310         | −5.00           | B9IVn       |
| 443 <sub>cg</sub>  | 1002 | 4.61  | 0 05 20.1409                                        | − 5 42 27.426   | −0.5554                  | 88.1902                   | 25.380         | −6.10           | K1III       |
| 677 <sub>cg</sub>  | 1    | 2.07  | 0 08 23.2586                                        | +29 05 25.555   | 10.3511                  | −162.9516                 | 33.600         | −11.70          | B9p         |
| 746*               | 2    | 2.28  | 0 09 10.6851                                        | +59 08 59.207   | 68.0423                  | −180.4372                 | 59.890         | 11.80           | F2III-IV    |
| 765                | 3    | 3.88  | 0 09 24.6420                                        | −45 44 50.734   | 11.6698                  | −180.1300                 | 23.280         | −9.20           | K0III       |
| 841                | 4    | 5.01  | 0 10 19.2458                                        | +46 04 20.178   | 0.4334                   | 0.2100                    | 3.240          | −5.40           | F2II        |
| 950                | 6    | 5.24  | 0 11 44.0086                                        | −35 07 59.230   | 13.7773                  | 113.7511                  | 45.850         | −2.20           | F3/F5V      |
| 1067               | 7    | 2.83  | 0 13 14.1528                                        | +15 11 00.945   | 0.3247                   | −8.2400                   | 9.790          | 4.10            | B2IV        |
| 1168               | 1004 | 4.79  | 0 14 36.1645                                        | +20 12 24.126   | 6.4404                   | 1.8799                    | 10.010         | −45.80          | M2III       |
| 1473               | 1005 | 4.51  | 0 18 19.6569                                        | +36 47 06.807   | −5.5364                  | −42.4803                  | 23.110         | −8.00           | A2V         |
| 1562               | 9    | 3.56  | 0 19 25.6746                                        | − 8 49 26.117   | −0.9695                  | −37.8399                  | 11.260         | 18.60           | K2III       |
| 1599               | 10   | 4.23  | 0 20 04.2601                                        | −64 52 29.246   | 268.0727                 | 1165.6009                 | 116.379        | 9.41            | F9V         |
| 1686               | 1009 | 5.16  | 0 21 07.2690                                        | +37 58 06.971   | 4.9318                   | −39.6500                  | 20.420         | 9.10            | F5III       |
| 2021               | 11   | 2.82  | 0 25 45.0719                                        | −77 15 15.284   | 670.7790                 | 325.2762                  | 133.776        | 23.31           | G2IV        |
| 2081               | 12   | 2.40  | 0 26 17.0510                                        | −42 18 21.533   | 20.9809                  | −353.6180                 | 42.139         | 74.60           | K0III...    |
| 2472               | 15   | 4.76  | 0 31 24.9807                                        | −48 48 12.652   | 14.2455                  | 19.4710                   | 18.970         | −5.00           | A0V         |
| 2599               | 16   | 4.17  | 0 32 59.9917                                        | +62 55 54.418   | 0.5845                   | −2.1000                   | 0.790          | −2.30           | B1Ia        |
| 2912 <sub>cg</sub> | 18   | 4.34  | 0 36 52.8497                                        | +33 43 09.637   | 1.2207                   | −3.5600                   | 4.970          | 8.70            | B5V         |
| 2920               | 17   | 3.69  | 0 36 58.2846                                        | +53 53 48.874   | 2.0105                   | −9.1500                   | 5.460          | 2.00            | B2IV        |
| 3031               | 19   | 4.34  | 0 38 33.3458                                        | +29 18 42.305   | −17.5400                 | −254.0886                 | 19.340         | −83.60          | G5III...    |
| 3092               | 20   | 3.27  | 0 39 19.6758                                        | +30 51 39.686   | 8.9607                   | −83.0507                  | 32.190         | −7.30           | K3III...    |
| 3179*              | 21   | 2.24  | 0 40 30.4405                                        | +56 32 14.392   | 6.0888                   | −32.1702                  | 14.270         | −3.80           | K0II-IIIvar |
| 3245               | 1015 | 4.59  | 0 41 19.5517                                        | −46 05 06.025   | −2.7797                  | 1.0400                    | 13.190         | 18.80           | G8III       |
| 3405               | 23   | 4.36  | 0 43 21.2384                                        | −57 27 47.016   | −0.6396                  | 15.5000                   | 13.570         | 10.00           | A0IV        |
| 3419*              | 22   | 2.04  | 0 43 35.3711                                        | −17 59 11.777   | 16.3166                  | 32.7105                   | 34.040         | 12.90           | K0III       |
| 3504 <sub>cg</sub> | 25   | 4.48  | 0 44 43.5177                                        | +48 17 03.711   | 1.7823                   | −7.6200                   | 3.600          | −8.00           | B5III       |
| 3693               | 27   | 4.08  | 0 47 20.3254                                        | +24 16 01.841   | −7.4028                  | −81.8908                  | 17.980         | −23.70          | K1II        |
| 3781               | 31   | 5.09  | 0 48 35.4173                                        | −74 55 24.375   | 34.1421                  | −34.5871                  | 15.940         | 9.50            | K5III       |
| 3786               | 28   | 4.44  | 0 48 40.9443                                        | + 7 35 06.285   | 5.5916                   | −50.4797                  | 10.690         | 32.30           | K5III       |
| 3881               | 1021 | 4.53  | 0 49 48.8473                                        | +41 04 44.079   | 2.0058                   | −18.0501                  | 4.800          | −23.90          | B5V SB      |
| 4147               | 1022 | 4.78  | 0 53 00.4943                                        | − 1 08 39.337   | 0.4328                   | −16.2900                  | 6.280          | 15.80           | M0III       |
| 4427*              | 32   | 2.15  | 0 56 42.5317                                        | +60 43 00.265   | 3.4960                   | −3.8201                   | 5.320          | −6.80           | B0IV:evan   |
| 4436               | 33   | 3.86  | 0 56 45.2116                                        | +38 29 57.641   | 13.0145                  | 36.8191                   | 23.930         | 7.60            | A5V         |
| 4577               | 35   | 4.30  | 0 58 36.3609                                        | −29 21 26.817   | 1.7164                   | 6.3000                    | 4.850          | 10.20           | B7IIIp      |
| 4906               | 36   | 4.27  | 1 02 56.6084                                        | + 7 53 24.488   | −5.4227                  | 25.8799                   | 17.140         | 7.00            | K0III       |
| 5300 <sub>ph</sub> | 1031 | 5.21  | 1 07 47.8533                                        | −41 29 12.898   | 3.2038                   | 7.8500                    | 16.480         | 9.00            | A3V         |
| 5364               | 40   | 3.46  | 1 08 35.3916                                        | −10 10 56.151   | 14.6175                  | −138.3288                 | 27.730         | 11.90           | K2III       |
| 5447*              | 42   | 2.07  | 1 09 43.9236                                        | +35 37 14.008   | 14.4004                  | −112.2309                 | 16.360         | 0.30            | M0IIIvar    |
| 5571               | 1032 | 4.66  | 1 11 27.2202                                        | +21 02 04.740   | 2.9756                   | −10.5500                  | 7.420          | 15.80           | K0III       |
| 5586               | 43   | 4.51  | 1 11 39.6368                                        | +30 05 22.698   | 5.7240                   | −37.6097                  | 20.110         | 29.80           | K0III-IV... |
| 6193               | 45   | 4.74  | 1 19 27.9951                                        | +27 15 50.611   | 1.9657                   | −11.6200                  | 10.490         | 8.00            | A3V         |
| 6411               | 1035 | 4.87  | 1 22 20.4198                                        | +45 31 43.600   | 3.0652                   | 8.7300                    | 16.680         | −11.70          | K0III-IV    |
| 6537               | 47   | 3.60  | 1 24 01.4050                                        | − 8 10 59.724   | −5.2790                  | −206.8782                 | 28.480         | 16.50           | K0III       |
| 6686*              | 48   | 2.66  | 1 25 48.9523                                        | +60 14 07.019   | 39.9159                  | −49.4964                  | 32.810         | 6.70            | A5Vv SB     |
| 6692               | 46   | 4.72  | 1 25 56.0217                                        | +68 07 48.045   | 13.4354                  | 26.8195                   | 16.890         | −11.50          | K0III       |
| 6813               | 1040 | 4.83  | 1 27 39.3817                                        | +45 24 24.074   | 33.8984                  | −109.3247                 | 35.330         | 10.80           | F5IV        |
| 6867 <sub>cg</sub> | 49   | 3.41  | 1 28 21.9271                                        | −43 19 05.642   | −1.6686                  | −207.7087                 | 13.940         | 25.70           | K5II-III    |
| 6960               | 1043 | 5.11  | 1 29 36.1352                                        | −21 37 45.620   | 3.9903                   | 3.2201                    | 14.720         | −7.70           | A0V         |
| 7083               | 1044 | 3.93  | 1 31 15.1046                                        | −49 04 21.728   | 14.0660                  | 154.2014                  | 22.150         | −7.30           | K0III-IV    |



# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                      | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp           |
|---------------------|------|-------|------------------------------------------------------|-----------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|--------------|
| 7097 <sub>A</sub>   | 50   | 3.62  | 1 <sup>h</sup> 31 <sup>m</sup> 29 <sup>s</sup> .0094 | +15°20′44″.963  | 1.7787                            | −3.2900                            | 11.090                  | 14.80                    | G8III        |
| 7513                | 1045 | 4.10  | 1 36 47.8428                                         | +41 24 19.652   | −15.3389                          | −381.0257                          | 74.251                  | −28.90                   | F8V          |
| 7588                | 54   | 0.45  | 1 37 42.8466                                         | −57 14 12.327   | 10.8431                           | −40.0792                           | 22.680                  | 19.00                    | B3Vp         |
| 7607                | 52   | 3.59  | 1 37 59.5561                                         | +48 37 41.567   | 6.1427                            | −112.4196                          | 18.760                  | 16.10                    | K3III        |
| 7884                | 56   | 4.45  | 1 41 25.8942                                         | + 5 29 15.408   | −1.5223                           | 3.6100                             | 8.860                   | 0.40                     | K3III        |
| 8068                | 57   | 4.01  | 1 43 39.6375                                         | +50 41 19.437   | 2.5339                            | −13.5900                           | 4.550                   | 0.80                     | B2Vpe        |
| 8102                | 59   | 3.49  | 1 44 04.0829                                         | −15 56 14.928   | −119.3853                         | 854.1772                           | 274.181                 | −17.00                   | G8V          |
| 8198                | 60   | 4.26  | 1 45 23.6306                                         | + 9 09 27.849   | 4.7823                            | 38.9898                            | 12.630                  | 13.60                    | K0III        |
| 8497                | 1051 | 4.66  | 1 49 35.1027                                         | −10 41 11.077   | −10.1019                          | −94.4699                           | 42.350                  | −0.90                    | F3III        |
| 8645                | 62   | 3.74  | 1 51 27.6336                                         | −10 20 06.136   | 2.6280                            | −38.0399                           | 12.590                  | 9.00                     | K2III        |
| 8796                | 64   | 3.42  | 1 53 04.9079                                         | +29 34 43.785   | 0.9214                            | −233.6927                          | 50.870                  | −12.60                   | F6IV         |
| 8833 <sub>cg</sub>  | 65   | 4.61  | 1 53 33.3504                                         | + 3 11 15.132   | 1.5818                            | 23.8998                            | 17.110                  | 30.30                    | K0III SB     |
| 8837                | 67   | 4.39  | 1 53 38.7417                                         | −46 18 09.607   | −8.9147                           | −91.4596                           | 10.150                  | 1.50                     | M4III SB     |
| 8882 <sub>cg</sub>  | 1053 | 5.12  | 1 54 22.0332                                         | −42 29 49.020   | −3.1032                           | −28.3399                           | 10.550                  | 12.00                    | A3V          |
| 8886*               | 63   | 3.35  | 1 54 23.7255                                         | +63 40 12.365   | 4.8068                            | −18.6601                           | 7.380                   | −8.10                    | B2pvar       |
| 8903 <sub>cg</sub>  | 66   | 2.64  | 1 54 38.4092                                         | +20 48 28.926   | 6.8694                            | −108.8004                          | 54.740                  | −1.90                    | A5V...       |
| 8928                | 69   | 4.68  | 1 54 56.1314                                         | −67 38 50.292   | 13.3225                           | 73.1709                            | 15.040                  | −16.20                   | G5III        |
| 9007                | 68   | 3.69  | 1 55 57.4724                                         | −51 36 32.025   | 73.1299                           | 284.2567                           | 57.190                  | −6.30                    | G5IV         |
| 9236 <sub>cg</sub>  | 72   | 2.86  | 1 58 46.1935                                         | −61 34 11.493   | 36.7633                           | 26.8852                            | 45.740                  | 7.00                     | F0V          |
| 9347                | 71   | 3.99  | 2 00 00.3080                                         | −21 04 40.194   | 9.5031                            | −24.5296                           | 10.840                  | 18.00                    | K5/M0III     |
| 9505                | 1054 | 4.99  | 2 02 18.1081                                         | +54 29 15.148   | 3.8780                            | −3.4001                            | 4.410                   | −2.00                    | B8III        |
| 9598                | 70   | 3.95  | 2 03 26.1054                                         | +72 25 16.660   | −9.7126                           | 22.5099                            | 20.120                  | −14.30                   | A2V          |
| 9640 <sub>A</sub>   | 73   | 2.10  | 2 03 53.9531                                         | +42 19 47.009   | 3.8849                            | −50.8502                           | 9.190                   | −11.70                   | B8V          |
| 9677                | 1055 | 4.68  | 2 04 29.4385                                         | −29 17 48.548   | 0.9601                            | 8.5400                             | 9.030                   | 18.50                    | B9.5p (Si)   |
| 9884*               | 74   | 2.01  | 2 07 10.4071                                         | +23 27 44.723   | 13.8615                           | −145.7726                          | 49.480                  | −14.80                   | K2III        |
| 10064 <sub>cg</sub> | 75   | 3.00  | 2 09 32.6269                                         | +34 59 14.269   | 12.1065                           | −39.1305                           | 26.240                  | 9.90                     | A5III        |
| 10155               | 1056 | 5.68  | 2 10 37.5969                                         | +19 30 01.216   | 6.2753                            | −27.1000                           | 4.900                   | 60.20                    | M3III        |
| 10324 <sub>cg</sub> | 1058 | 4.36  | 2 12 59.9955                                         | + 8 50 48.182   | −1.7697                           | −14.4000                           | 9.010                   | −4.20                    | G8II:        |
| 10602               | 82   | 3.56  | 2 16 30.5853                                         | −51 30 43.793   | 9.7212                            | −21.8995                           | 21.060                  | 10.20                    | B8IV-V       |
| 10670               | 79   | 4.03  | 2 17 18.8673                                         | +33 50 49.897   | 3.6049                            | −52.4198                           | 27.730                  | 9.90                     | A1Vnn        |
| 10819               | 1063 | 5.31  | 2 19 16.7959                                         | +47 22 47.903   | −5.9122                           | −6.0602                            | 12.770                  | −29.60                   | A1V          |
| 11001               | 1065 | 4.08  | 2 21 44.9427                                         | −68 39 33.905   | −9.1726                           | 2.3803                             | 24.100                  | 6.00                     | A3V          |
| 11345               | 1066 | 4.88  | 2 25 57.0053                                         | −12 17 25.727   | −0.7990                           | −11.3700                           | 6.170                   | 10.00                    | A0V          |
| 11407               | 86   | 4.24  | 2 26 59.1223                                         | −47 42 13.825   | 1.9783                            | −5.4400                            | 6.170                   | 27.70                    | B5IV         |
| 11484               | 85   | 4.30  | 2 28 09.5425                                         | + 8 27 36.193   | 2.8119                            | −14.4600                           | 18.530                  | 11.20                    | B9III        |
| 11783               | 1071 | 4.74  | 2 32 05.2283                                         | −15 14 40.837   | −5.5915                           | −146.8429                          | 38.730                  | −29.20                   | F5V          |
| 12093               | 1072 | 4.87  | 2 35 52.4721                                         | + 5 35 35.687   | −1.9352                           | −22.7600                           | 8.770                   | 5.00                     | G8III        |
| 12387               | 91   | 4.08  | 2 39 28.9567                                         | + 0 19 42.638   | 0.9627                            | −2.5300                            | 5.040                   | 13.00                    | B2IV         |
| 12394               | 95   | 4.12  | 2 39 35.3614                                         | −68 16 01.006   | 15.7357                           | 0.5608                             | 21.270                  | 6.00                     | B9III        |
| 12486               | 1075 | 4.11  | 2 40 40.0344                                         | −39 51 19.352   | 11.7387                           | −27.3395                           | 22.420                  | −9.30                    | K0III        |
| 12719 <sub>cg</sub> | 94   | 4.65  | 2 43 27.1128                                         | +27 42 25.728   | 0.2643                            | −9.9700                            | 8.820                   | 19.00                    | B3V          |
| 12770               | 97   | 4.24  | 2 44 07.3499                                         | −13 51 31.307   | −0.5205                           | −8.4000                            | 7.400                   | 15.40                    | B7IV         |
| 12777               | 93   | 4.10  | 2 44 11.9863                                         | +49 13 42.412   | 34.0982                           | −89.9619                           | 89.028                  | 25.00                    | F7V          |
| 12828               | 98   | 4.27  | 2 44 56.5423                                         | +10 06 50.925   | 19.3110                           | −30.4000                           | 38.710                  | 28.80                    | F1III-IV     |
| 13147               | 101  | 4.45  | 2 49 05.4196                                         | −32 24 21.232   | 6.8666                            | 158.9593                           | 19.310                  | 16.80                    | G8III        |
| 13209               | 100  | 3.61  | 2 49 59.0323                                         | +27 15 37.825   | 4.9100                            | −116.5899                          | 20.450                  | 4.00                     | B8Vn         |
| 13268               | 99   | 3.77  | 2 50 41.8101                                         | +55 53 43.786   | 1.9785                            | −13.7600                           | 2.450                   | −1.00                    | K3Ib comp SB |
| 13288               | 102  | 4.76  | 2 51 02.3215                                         | −21 00 14.470   | −2.7851                           | −16.6300                           | 17.850                  | −8.60                    | K0III        |
| 13531 <sub>cg</sub> | 103  | 3.93  | 2 54 15.4606                                         | +52 45 44.924   | −0.2192                           | −4.5300                            | 13.150                  | 2.20                     | G4III...     |
| 13701               | 104  | 3.89  | 2 56 25.6497                                         | − 8 53 53.320   | 5.2452                            | −219.9919                          | 24.490                  | −20.30                   | K1III-IV     |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                      | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp          |
|---------------------|------|-------|------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|-------------|
| 13847 <sub>A</sub>  | 106  | 2.88  | 2 <sup>h</sup> 58 <sup>m</sup> 15 <sup>s</sup> .6747 | −40°18′16″.821  | −4.6795                  | 25.7100                   | 20.220         | 11.90           | A4III+...   |
| 13905               | 1082 | 4.94  | 2 59 03.6766                                         | +35 10 59.262   | −3.7921                  | 5.8100                    | 9.310          | −36.00          | K2III       |
| 13954               | 1083 | 4.71  | 2 59 42.9018                                         | + 8 54 26.513   | 0.6222                   | −14.9200                  | 7.690          | 10.20           | B6III       |
| 14135               | 107  | 2.54  | 3 02 16.7722                                         | + 4 05 23.042   | −0.7894                  | −78.7605                  | 14.820         | −26.10          | M2III       |
| 14146               | 1085 | 4.08  | 3 02 23.5002                                         | −23 37 28.098   | −10.6209                 | −55.7600                  | 37.850         | −9.80           | A4V         |
| 14240               | 110  | 5.12  | 3 03 36.8194                                         | −59 44 15.991   | −9.6317                  | −63.8891                  | 23.670         | 17.30           | F0IV        |
| 14328 <sub>cg</sub> | 108  | 2.91  | 3 04 47.7907                                         | +53 30 23.184   | 0.0560                   | −4.1900                   | 12.720         | 2.50            | G8III+...   |
| 14354               | 109  | 3.32  | 3 05 10.5934                                         | +38 50 24.986   | 11.0146                  | −106.6100                 | 10.030         | 28.20           | M3IIIvar    |
| 14576 <sub>cg</sub> | 111  | 2.09  | 3 08 10.1316                                         | +40 57 20.332   | 0.2110                   | −1.4400                   | 35.140         | 4.00            | B8V         |
| 14632               | 112  | 4.05  | 3 09 04.0196                                         | +49 36 47.799   | 129.8651                 | −91.6018                  | 94.926         | 49.40           | G0V         |
| 14838               | 114  | 4.35  | 3 11 37.7655                                         | +19 43 36.039   | 10.9499                  | −8.3903                   | 19.440         | 24.70           | K2IIIvar    |
| 14954               | 116  | 5.07  | 3 12 46.4365                                         | − 1 11 45.964   | 12.8980                  | −69.2290                  | 44.690         | 18.30           | F8V         |
| 15110               | 1089 | 4.87  | 3 14 54.0961                                         | +21 02 39.988   | −2.1308                  | −77.1499                  | 9.590          | 7.00            | A1V         |
| 15197               | 1091 | 4.80  | 3 15 50.0245                                         | − 8 49 11.027   | −0.2577                  | 45.5202                   | 27.180         | −7.00           | A5m         |
| 15457               | 1093 | 4.84  | 3 19 21.6960                                         | + 3 22 12.712   | 17.9557                  | 93.5264                   | 109.178        | 18.80           | G5Vvar      |
| 15510               | 119  | 4.26  | 3 19 55.6505                                         | −43 04 11.221   | 277.1751                 | 726.5259                  | 165.000        | 83.91           | G8V         |
| 15627 <sub>A</sub>  | 1094 | 5.27  | 3 21 13.6245                                         | +21 08 49.510   | 1.5497                   | −22.4100                  | 7.060          | 14.00           | B5IV        |
| 15863*              | 120  | 1.79  | 3 24 19.3704                                         | +49 51 40.247   | 2.4934                   | −26.0100                  | 5.510          | −2.40           | F5Ib        |
| 15900               | 121  | 3.61  | 3 24 48.7938                                         | + 9 01 43.931   | −5.0121                  | −80.3105                  | 15.420         | −21.00          | G8III       |
| 16083 <sub>A</sub>  | 123  | 3.73  | 3 27 10.1526                                         | + 9 43 57.647   | 3.6262                   | −38.1200                  | 14.680         | −2.00           | B9Vn        |
| 16228 <sub>A</sub>  | 122  | 4.21  | 3 29 04.1335                                         | +59 56 25.188   | −0.1091                  | −1.8500                   | 0.760          | −6.80           | B9Ia        |
| 16245               | 126  | 4.71  | 3 29 22.6776                                         | −62 56 15.099   | 56.1270                  | 373.1184                  | 46.650         | 12.00           | F5IV-V      |
| 16335               | 124  | 4.36  | 3 30 34.4836                                         | +47 59 42.778   | 0.1554                   | 18.1300                   | 9.230          | 15.90           | K3III       |
| 16341               | 1097 | 4.74  | 3 30 37.0577                                         | − 5 04 30.524   | 0.8908                   | 7.3400                    | 8.570          | 15.00           | B9Vs        |
| 16369 <sub>cg</sub> | 125  | 4.14  | 3 30 52.3783                                         | +12 56 12.041   | 1.2956                   | −1.5500                   | 9.050          | 14.70           | K0II-III... |
| 16537               | 127  | 3.72  | 3 32 55.8442                                         | − 9 27 29.744   | −65.9875                 | 17.9752                   | 310.737        | 15.40           | K2V         |
| 16611               | 1099 | 4.26  | 3 33 47.2761                                         | −21 37 58.378   | 3.2209                   | −27.4699                  | 11.020         | 14.00           | B9V         |
| 16852               | 1101 | 4.29  | 3 36 52.3832                                         | + 0 24 05.982   | −15.5125                 | −481.9825                 | 72.889         | 27.90           | F9V         |
| 16870               | 130  | 4.57  | 3 37 05.6802                                         | −40 16 28.363   | 0.2420                   | −14.2300                  | 14.880         | 11.50           | K0III       |
| 17304               | 133  | 4.99  | 3 42 14.9027                                         | −31 56 18.101   | 0.4054                   | 14.2300                   | 4.450          | 26.00           | B5III       |
| 17358 <sub>A</sub>  | 131  | 3.01  | 3 42 55.5028                                         | +47 47 15.185   | 2.3645                   | −41.9301                  | 6.180          | −9.00           | B5III SB    |
| 17378               | 135  | 3.52  | 3 43 14.9018                                         | − 9 45 48.221   | −6.2039                  | 742.2398                  | 110.581        | −6.60           | K0IV        |
| 17440 <sub>cg</sub> | 141  | 3.84  | 3 44 11.9775                                         | −64 48 24.850   | 48.2969                  | 78.7262                   | 32.709         | 51.10           | K0IV SB     |
| 17457               | 137  | 5.24  | 3 44 30.5101                                         | − 1 09 47.128   | 0.2414                   | −5.2600                   | 4.990          | 27.00           | B7V         |
| 17499               | 136  | 3.72  | 3 44 52.5373                                         | +24 06 48.021   | 1.5740                   | −44.9199                  | 8.800          | 12.40           | B6III       |
| 17529               | 134  | 3.77  | 3 45 11.6319                                         | +42 34 42.775   | −1.3209                  | 1.7500                    | 5.860          | −12.70          | F5IIvar     |
| 17651               | 140  | 4.22  | 3 46 50.8875                                         | −23 14 59.002   | −11.5993                 | −528.5361                 | 55.790         | 6.50            | F3/F5V      |
| 17678               | 146  | 3.26  | 3 47 14.3412                                         | −74 14 20.264   | 12.5341                  | 115.2699                  | 15.230         | 15.80           | M2III       |
| 17702               | 139  | 2.85  | 3 47 29.0765                                         | +24 06 18.494   | 1.4132                   | −43.1099                  | 8.870          | 10.10           | B7III       |
| 17847 <sub>cg</sub> | 142  | 3.62  | 3 49 09.7426                                         | +24 03 12.296   | 1.2973                   | −44.6999                  | 8.570          | 8.50            | B8III       |
| 17874               | 143  | 4.17  | 3 49 27.2452                                         | −36 12 00.901   | −4.0828                  | −56.6299                  | 15.540         | 2.00            | G8III       |
| 17959*              | 138  | 4.59  | 3 50 21.5091                                         | +71 19 56.156   | 3.8053                   | −42.0000                  | 9.730          | −1.00           | A2IVn       |
| 18246               | 144  | 2.84  | 3 54 07.9215                                         | +31 53 01.088   | 0.3462                   | −9.1500                   | 3.320          | 20.60           | B1Ib        |
| 18532               | 147  | 2.90  | 3 57 51.2307                                         | +40 00 36.773   | 1.0976                   | −24.0600                  | 6.060          | −1.00           | B0.5V       |
| 18543               | 149  | 2.97  | 3 58 01.7664                                         | −13 30 30.655   | 4.1487                   | −111.3381                 | 14.750         | 61.70           | M1IIIb Ca-1 |
| 18597               | 1110 | 4.56  | 3 58 44.7494                                         | −61 24 00.668   | 1.3634                   | −14.3900                  | 6.150          | −1.40           | M2III       |
| 18614               | 148  | 3.98  | 3 58 57.9011                                         | +35 47 27.717   | 0.1578                   | 2.3000                    | 1.840          | 70.10           | O7.5Iab:    |
| 18724               | 150  | 3.41  | 4 00 40.8157                                         | +12 29 25.248   | −0.5565                  | −11.9800                  | 8.810          | 14.80           | B3V + A     |
| 18907               | 151  | 3.91  | 4 03 09.3800                                         | + 5 59 21.498   | 0.3700                   | −1.6300                   | 25.240         | −5.70           | A1V         |
| 19038               | 1112 | 4.36  | 4 04 41.7156                                         | +22 04 54.932   | 6.5994                   | −58.5200                  | 18.040         | 9.10            | K0III       |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                   | FK5  | magn. | $\alpha_{ICRF}$                                     | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp          |
|-----------------------|------|-------|-----------------------------------------------------|-----------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|-------------|
| 19167                 | 1113 | 4.25  | 4 <sup>h</sup> 06 <sup>m</sup> 35.0434 <sup>s</sup> | +50°21′04″543   | −1.3614                           | −36.3700                           | 9.410                   | 6.10                     | A0IVn       |
| 19343                 | 152  | 3.96  | 4 08 39.6908                                        | +47 42 45.046   | 2.0004                            | −33.2600                           | 5.890                   | 3.00                     | B3Ve        |
| 19587                 | 154  | 4.04  | 4 11 51.9402                                        | − 6 50 15.292   | 0.8004                            | 81.2796                            | 25.980                  | 11.00                    | F2II-III    |
| 19747                 | 155  | 3.85  | 4 14 00.1143                                        | −42 17 39.725   | 3.7754                            | −203.6477                          | 27.850                  | 21.70                    | K1III       |
| 19780                 | 156  | 3.33  | 4 14 25.4837                                        | −62 28 25.889   | 6.0066                            | 49.7195                            | 19.980                  | 35.60                    | G7III       |
| 19812                 | 1117 | 4.12  | 4 14 53.8622                                        | +48 24 33.591   | 0.5062                            | −17.3500                           | 4.510                   | 7.70                     | G0Ib...     |
| 19860                 | 1118 | 4.27  | 4 15 32.0573                                        | + 8 53 32.485   | 1.3759                            | −21.7500                           | 7.500                   | 17.30                    | B3IV        |
| 19893                 | 157  | 4.26  | 4 16 01.5856                                        | −51 29 11.933   | 10.7668                           | 184.2264                           | 49.259                  | 25.20                    | F4III       |
| 20205                 | 159  | 3.65  | 4 19 47.6037                                        | +15 37 39.512   | 7.9809                            | −23.8598                           | 21.170                  | 38.50                    | G8III       |
| 20252                 | 158  | 4.93  | 4 20 24.6384                                        | +34 34 00.211   | −2.0199                           | −7.0001                            | 14.420                  | −27.40                   | G8III       |
| 20384                 | 163  | 5.24  | 4 21 53.3267                                        | −63 23 11.009   | 12.6791                           | 174.3694                           | 8.580                   | 45.00                    | G7III       |
| 20455                 | 162  | 3.77  | 4 22 56.0933                                        | +17 32 33.051   | 7.5336                            | −28.8397                           | 21.290                  | 38.40                    | G8III       |
| 20535                 | 1121 | 3.97  | 4 24 02.2173                                        | −34 01 00.647   | 5.9333                            | 57.5699                            | 11.950                  | 24.10                    | K4III       |
| 20889                 | 164  | 3.53  | 4 28 36.9995                                        | +19 10 49.554   | 7.5687                            | −36.7696                           | 21.040                  | 39.00                    | K0III       |
| 21060                 | 167  | 5.07  | 4 30 50.0997                                        | −44 57 13.498   | 0.2299                            | −2.4800                            | 4.590                   | 14.20                    | B2IV-V      |
| 21273 <sub>cg</sub>   | 1125 | 4.65  | 4 33 50.9178                                        | +14 50 39.928   | 7.1512                            | −25.9397                           | 21.390                  | 37.50                    | A8V         |
| 21281 <sub>A</sub>    | 171  | 3.30  | 4 33 59.7776                                        | −55 02 41.909   | 6.7558                            | 12.7301                            | 18.560                  | 25.60                    | A0V:        |
| 21393                 | 170  | 3.81  | 4 35 33.0386                                        | −30 33 44.429   | −3.7875                           | −12.7500                           | 15.620                  | −4.00                    | G8III       |
| 21421*                | 168  | 0.87  | 4 35 55.2387                                        | +16 30 33.485   | 4.3651                            | −189.3509                          | 50.089                  | 54.10                    | K5III       |
| 21444                 | 169  | 3.93  | 4 36 19.1416                                        | − 3 21 08.853   | 0.1155                            | −4.5400                            | 5.560                   | 14.90                    | B2III SB    |
| 21594 <sub>A</sub>    | 172  | 3.86  | 4 38 10.8241                                        | −14 18 14.471   | −5.3566                           | −178.0560                          | 29.840                  | 41.80                    | K1III       |
| 21770                 | 1129 | 4.44  | 4 40 33.7125                                        | −41 51 49.509   | −12.6381                          | −74.9493                           | 49.670                  | −1.30                    | F2V         |
| 21861                 | 1130 | 5.04  | 4 42 03.4806                                        | −37 08 39.468   | 3.9224                            | 193.1367                           | 36.160                  | 26.80                    | F3V         |
| 21881 <sub>ph</sub>   | 174  | 4.27  | 4 42 14.7017                                        | +22 57 24.934   | −0.2056                           | −20.3300                           | 8.140                   | 14.60                    | B3V         |
| 22109                 | 176  | 4.01  | 4 45 30.1511                                        | − 3 15 16.767   | 1.1532                            | −13.5100                           | 6.130                   | 7.00                     | B5IV        |
| 22449                 | 1134 | 3.19  | 4 49 50.4106                                        | + 6 57 40.592   | 31.1238                           | 11.6183                            | 124.597                 | 24.30                    | F6V         |
| 22453                 | 1133 | 4.89  | 4 49 54.6383                                        | +37 29 17.789   | −3.2263                           | 38.4801                            | 6.180                   | −23.30                   | K4II        |
| 22549                 | 179  | 3.68  | 4 51 12.3639                                        | + 5 36 18.374   | −0.2425                           | 1.0300                             | 2.590                   | 23.30                    | B2III SB    |
| 22565                 | 1135 | 5.08  | 4 51 22.4624                                        | +18 50 23.500   | 5.6112                            | −32.7597                           | 17.270                  | 36.80                    | A7IV-V      |
| 22667 <sub>ph</sub>   | 1136 | 4.71  | 4 52 31.9621                                        | +14 15 02.311   | −0.1802                           | −56.1300                           | 6.020                   | −6.90                    | M3Sv        |
| 22783                 | 178  | 4.26  | 4 54 03.0113                                        | +66 20 33.641   | 0.0814                            | 7.3100                             | 0.470                   | 6.10                     | O9.5Ia SB:  |
| 22797                 | 180  | 3.71  | 4 54 15.0965                                        | + 2 26 26.419   | 0.0954                            | 0.2300                             | 2.430                   | 23.40                    | B2III SB    |
| 23015                 | 181  | 2.69  | 4 56 59.6188                                        | +33 09 57.925   | 0.2891                            | −18.5400                           | 6.370                   | 17.50                    | K3IIvar     |
| 23416 <sub>cg</sub>   | 183  | 3.03  | 5 01 58.1342                                        | +43 49 23.910   | 0.0166                            | −2.3100                            | 1.600                   | −2.50                    | F0Ia        |
| 23453 <sub>cg</sub>   | 1137 | 3.69  | 5 02 28.6869                                        | +41 04 33.015   | 0.7853                            | −21.4300                           | 4.140                   | 12.80                    | K4II comp   |
| 23497                 | 184  | 4.62  | 5 03 05.7473                                        | +21 35 23.865   | 4.9427                            | −40.8495                           | 20.010                  | 40.60                    | A7V         |
| 23522                 | 182  | 4.03  | 5 03 25.0901                                        | +60 26 32.084   | −0.8257                           | −14.7800                           | 3.270                   | −1.70                    | G0Ib        |
| 23607                 | 1140 | 4.65  | 5 04 34.1495                                        | +15 24 14.779   | 1.2724                            | −30.9899                           | 8.150                   | 16.80                    | A0p Si      |
| 23649                 | 187  | 5.05  | 5 04 58.0144                                        | −49 34 40.215   | 7.0675                            | −3.0298                            | 6.880                   | 36.00                    | M2IIIvar    |
| 23685                 | 186  | 3.19  | 5 05 27.6642                                        | −22 22 15.717   | 1.3892                            | −72.3500                           | 14.390                  | 1.00                     | K4III       |
| 23693                 | 189  | 4.71  | 5 05 30.6558                                        | −57 28 21.734   | −3.9514                           | 117.4203                           | 85.830                  | −1.40                    | F7V         |
| 23767                 | 185  | 3.18  | 5 06 30.8928                                        | +41 14 04.108   | 2.7127                            | −68.4099                           | 14.870                  | 7.30                     | B3V         |
| 23875                 | 188  | 2.78  | 5 07 50.9851                                        | − 5 05 11.206   | −5.5813                           | −75.4404                           | 36.710                  | −9.20                    | A3IIIvar    |
| 23972                 | 190  | 4.25  | 5 09 08.7830                                        | − 8 45 14.691   | 0.0000                            | −2.0100                            | 1.860                   | 3.00                     | B2IVn       |
| 24305                 | 1144 | 3.29  | 5 12 55.9008                                        | −16 12 19.686   | 3.1699                            | −16.1298                           | 17.690                  | 27.70                    | B9IV: HgMn  |
| 24340                 | 192  | 4.82  | 5 13 25.7177                                        | +38 29 04.193   | −1.5892                           | −72.4094                           | 20.080                  | 23.00                    | A4m         |
| 24372                 | 196  | 4.81  | 5 13 45.4542                                        | −67 11 06.918   | 3.1257                            | 38.9600                            | 5.970                   | 10.50                    | K2III       |
| 24436*                | 194  | 0.18  | 5 14 32.2723                                        | − 8 12 05.906   | 0.1260                            | −0.5600                            | 4.220                   | 20.70                    | B8Ia        |
| 24608 <sub>cg</sub> * | 193  | 0.08  | 5 16 41.3591                                        | +45 59 52.768   | 7.2470                            | −427.1124                          | 77.288                  | 30.20                    | M1: comp    |
| 24659                 | 197  | 4.81  | 5 17 29.0900                                        | −34 53 42.747   | 7.6168                            | −336.5260                          | 29.630                  | 21.10                    | K0/K1III/IV |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                      | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp        |
|---------------------|------|-------|------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|-----------|
| 24674               | 195  | 3.59  | 5 <sup>h</sup> 17 <sup>m</sup> 36 <sup>s</sup> .3899 | − 6°50′39″.874  | −1.0280                  | −9.5700                   | 5.880          | 20.10           | B5III     |
| 24813               | 1145 | 4.69  | 5 19 08.4744                                         | +40 05 56.586   | 45.2614                  | −664.7372                 | 79.076         | 66.40           | G0V       |
| 24845               | 1146 | 4.29  | 5 19 34.5245                                         | −13 10 36.439   | −0.1705                  | −4.7400                   | 3.030          | 20.20           | B0.5IV    |
| 25044               | 1147 | 4.72  | 5 21 45.7479                                         | − 0 22 56.875   | 0.0300                   | 1.6700                    | 2.530          | 28.80           | B2IV-V    |
| 25336               | 201  | 1.64  | 5 25 07.8631                                         | + 6 20 58.928   | −0.5869                  | −13.2799                  | 13.420         | 18.20           | B2III     |
| 25428               | 202  | 1.65  | 5 26 17.5134                                         | +28 36 26.820   | 1.7678                   | −174.2194                 | 24.890         | 8.00            | B7III     |
| 25606               | 204  | 2.81  | 5 28 14.7232                                         | −20 45 33.988   | −0.3586                  | −85.9204                  | 20.490         | −13.50          | G5II      |
| 25918               | 214  | 5.18  | 5 31 53.0156                                         | −76 20 27.470   | 40.4240                  | 287.7441                  | 32.429         | 56.70           | K4III     |
| 25930 <sub>ph</sub> | 206  | 2.25  | 5 32 00.4007                                         | − 0 17 56.731   | 0.1113                   | 0.5600                    | 3.560          | 16.00           | O9.5II    |
| 25984               | 1151 | 4.71  | 5 32 43.6730                                         | +32 11 31.278   | −0.1426                  | −4.0000                   | 0.800          | −0.20           | B5Iab     |
| 25985               | 207  | 2.58  | 5 32 43.8159                                         | −17 49 20.239   | 0.2290                   | 1.5400                    | 2.540          | 24.70           | F0Ib      |
| 26069 <sub>ph</sub> | 212  | 3.76  | 5 33 37.5177                                         | −62 29 23.371   | 0.1530                   | 12.5600                   | 3.140          | 6.80            | F6Ia      |
| 26176               | 208  | 4.39  | 5 34 49.2371                                         | + 9 29 22.485   | −0.0838                  | −2.4900                   | 3.310          | 33.20           | B0IV...   |
| 26241               | 209  | 2.75  | 5 35 25.9825                                         | − 5 54 35.645   | 0.1521                   | −0.6200                   | 2.460          | 21.50           | O9III     |
| 26311*              | 210  | 1.69  | 5 36 12.8134                                         | − 1 12 06.911   | 0.0994                   | −1.0600                   | 2.430          | 25.90           | B0Ia      |
| 26451 <sub>ph</sub> | 211  | 2.97  | 5 37 38.6858                                         | +21 08 33.177   | 0.1708                   | −18.0399                  | 7.820          | 24.30           | B4IIIp    |
| 26634               | 215  | 2.65  | 5 39 38.9399                                         | −34 04 26.788   | −0.0080                  | −24.0498                  | 12.160         | 35.00           | B7IV      |
| 27072               | 217  | 3.59  | 5 44 27.7904                                         | −22 26 54.176   | −21.0936                 | −368.4556                 | 111.491        | −9.70           | F7V       |
| 27100               | 1154 | 4.34  | 5 44 46.3788                                         | −65 44 07.893   | −4.6040                  | 6.1201                    | 22.480         | −3.00           | A7V       |
| 27288               | 219  | 3.55  | 5 46 57.3408                                         | −14 49 19.020   | −1.0234                  | −1.1800                   | 46.470         | 18.60           | A2Vann    |
| 27366               | 220  | 2.07  | 5 47 45.3889                                         | − 9 40 10.577   | 0.1048                   | −1.2000                   | 4.520          | 20.50           | B0.5Iavar |
| 27530               | 1156 | 4.50  | 5 49 49.6623                                         | −56 09 59.987   | 9.7717                   | −71.7692                  | 18.780         | 15.70           | K1III     |
| 27621               | 1159 | 5.16  | 5 50 53.2209                                         | −52 06 31.942   | 0.2627                   | −76.2900                  | 12.330         | 1.30            | G8III     |
| 27628               | 223  | 3.12  | 5 50 57.5929                                         | −35 46 05.911   | 4.5795                   | 404.6557                  | 37.939         | 88.90           | K1.5III   |
| 27654               | 222  | 3.76  | 5 51 19.2958                                         | −20 52 44.719   | 16.3361                  | −647.9257                 | 29.049         | 99.30           | G8III/IV  |
| 27673               | 221  | 3.97  | 5 51 29.3990                                         | +39 08 54.529   | 0.7290                   | 0.3900                    | 15.170         | 9.70            | K0III     |
| 27830               | 1158 | 4.56  | 5 53 19.6461                                         | +27 36 44.143   | 0.2874                   | −9.5800                   | 7.450          | −16.10          | A0V       |
| 27949               | 1157 | 4.96  | 5 54 50.7821                                         | +55 42 25.008   | −0.4319                  | 17.2000                   | 13.540         | −11.80          | A2V       |
| 27989*              | 224  | 0.45  | 5 55 10.3053                                         | + 7 24 25.426   | 1.8373                   | 10.8600                   | 7.630          | 21.00           | M2Ib      |
| 28103               | 226  | 3.71  | 5 56 24.2929                                         | −14 10 03.721   | −2.9037                  | 139.0203                  | 66.470         | −1.50           | F1V       |
| 28199               | 1160 | 4.36  | 5 57 32.2100                                         | −35 16 59.807   | −0.2164                  | 11.1900                   | 3.820          | −7.00           | B2.5IV    |
| 28328               | 229  | 3.96  | 5 59 08.8053                                         | −42 48 54.488   | 1.6840                   | −11.4500                  | 6.140          | 17.00           | K0III     |
| 28358               | 225  | 3.72  | 5 59 31.6366                                         | +54 17 04.762   | 9.8567                   | −134.0500                 | 23.220         | 8.20            | K0III     |
| 28360 <sub>cg</sub> | 227  | 1.90  | 5 59 31.7229                                         | +44 56 50.758   | −5.3136                  | −0.8801                   | 39.720         | −18.20          | A2V       |
| 28734 <sub>ph</sub> | 1163 | 4.16  | 6 04 07.2149                                         | +23 15 48.028   | −0.1887                  | −119.7191                 | 21.640         | 20.20           | G7III     |
| 29038               | 232  | 4.42  | 6 07 34.3248                                         | +14 46 06.498   | 0.3413                   | −21.1799                  | 6.100          | 22.10           | B3IV      |
| 29271               | 239  | 5.08  | 6 10 14.4736                                         | −74 45 10.963   | 30.8861                  | −212.8046                 | 98.537         | 34.90           | G5V       |
| 29276               | 235  | 4.72  | 6 10 17.9089                                         | −54 58 07.121   | −0.4773                  | 6.5300                    | 1.970          | −2.00           | B0.5IV    |
| 29696               | 1168 | 4.32  | 6 15 22.6891                                         | +29 29 53.074   | −5.4306                  | −261.7283                 | 19.310         | 20.30           | G8IIIvar  |
| 29800               | 1169 | 5.04  | 6 16 26.6196                                         | +12 16 19.787   | 5.6675                   | 186.2785                  | 51.000         | 8.70            | F5IV-V    |
| 29807               | 238  | 4.37  | 6 16 33.1356                                         | −35 08 25.867   | 0.0318                   | 87.5793                   | 17.830         | 24.20           | G8II      |
| 29997               | 234  | 4.76  | 6 18 50.7771                                         | +69 19 11.234   | −0.3096                  | −101.6502                 | 18.550         | −7.00           | A0Vn      |
| 30060 <sub>cg</sub> | 237  | 4.44  | 6 19 37.3868                                         | +59 00 39.472   | −0.4545                  | 24.4300                   | 21.880         | −3.60           | A2Vs      |
| 30073               | 1170 | 5.27  | 6 19 42.7984                                         | − 7 49 22.471   | −0.2900                  | 0.7000                    | 3.960          | 29.00           | B2.5V     |
| 30122               | 240  | 3.02  | 6 20 18.7925                                         | −30 03 48.122   | 0.6162                   | 3.8100                    | 9.700          | 32.20           | B2.5V     |
| 30324               | 243  | 1.98  | 6 22 41.9853                                         | −17 57 21.304   | −0.2418                  | −0.4700                   | 6.530          | 33.70           | B1II/III  |
| 30343               | 241  | 2.87  | 6 22 57.6270                                         | +22 30 48.909   | 4.1019                   | −108.7886                 | 14.070         | 54.80           | M3IIIvar  |
| 30419 <sub>A</sub>  | 244  | 4.39  | 6 23 46.0855                                         | + 4 35 34.314   | −1.3965                  | 10.7499                   | 25.390         | 15.80           | A5IV      |
| 30438               | 245  | −0.62 | 6 23 57.1099                                         | −52 41 44.378   | 2.1989                   | 23.6699                   | 10.430         | 20.50           | F0Ib      |
| 30520               | 242  | 4.92  | 6 24 53.9027                                         | +49 17 16.415   | 0.0838                   | −2.4800                   | 0.850          | 4.70            | K5Iabvar  |
| 30772               | 246  | 5.06  | 6 27 57.5695                                         | − 4 45 43.756   | −0.2830                  | −3.1400                   | 2.410          | 24.50           | B2V       |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                  | FK5  | magn. | $\alpha_{ICRF}$                                     | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp                   |
|----------------------|------|-------|-----------------------------------------------------|-----------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|----------------------|
| 30883                | 1173 | 4.13  | 6 <sup>h</sup> 28 <sup>m</sup> 57.7867 <sup>s</sup> | +20°12′43.679″  | −0.4248                           | −14.0799                           | 6.490                   | 39.40                    | B6III                |
| 31216                | 1174 | 4.47  | 6 32 54.2273                                        | + 7 19 58.674   | −0.2615                           | −5.8000                            | 2.160                   | 12.30                    | A0Ib                 |
| 31278                | 1175 | 5.09  | 6 33 37.9220                                        | − 1 13 12.553   | 0.1427                            | −17.6800                           | 6.080                   | 25.00                    | B5Vn                 |
| 31416                | 249  | 4.54  | 6 35 03.3882                                        | −22 57 53.255   | 0.9492                            | 16.5199                            | 7.920                   | 32.00                    | A0III                |
| 31681                | 251  | 1.93  | 6 37 42.7011                                        | +16 23 57.308   | −0.1418                           | −66.9205                           | 31.120                  | −12.50                   | A0IV                 |
| 31685                | 252  | 3.17  | 6 37 45.6713                                        | −43 11 45.361   | −0.0393                           | −3.9900                            | 7.710                   | 28.20                    | B8III SB             |
| 32246                | 254  | 3.06  | 6 43 55.9260                                        | +25 07 52.047   | −0.4367                           | −12.8100                           | 3.610                   | 9.90                     | A3mA6-A9             |
| 32349 <sup>*cg</sup> | 257  | −1.44 | 6 45 08.9173                                        | −16 42 58.017   | −38.0093                          | −1223.1393                         | 379.220                 | −7.60                    | A0m...               |
| 32362                | 256  | 3.35  | 6 45 17.3646                                        | +12 53 44.128   | −7.8758                           | −190.9051                          | 57.019                  | 25.60                    | F5IV                 |
| 32578 <sup>cg</sup>  | 258  | 4.48  | 6 47 51.6493                                        | + 2 24 43.773   | −0.8654                           | −12.3600                           | 8.740                   | 11.30                    | K0III                |
| 32607                | 262  | 3.24  | 6 48 11.4523                                        | −61 56 29.010   | −9.6927                           | 242.0274                           | 32.960                  | 20.60                    | A7IV                 |
| 32759                | 1180 | 3.50  | 6 49 50.4591                                        | −32 30 30.520   | −0.7257                           | 4.0400                             | 4.130                   | 14.00                    | B1.5IV <sub>ne</sub> |
| 32768 <sup>cg</sup>  | 263  | 2.94  | 6 49 56.1683                                        | −50 36 52.415   | 3.5963                            | −65.8492                           | 17.850                  | 36.40                    | K0III...             |
| 33018                | 261  | 3.60  | 6 52 47.3382                                        | +33 57 40.514   | −0.2138                           | −47.6697                           | 16.590                  | 21.00                    | A3III                |
| 33104                | 259  | 5.11  | 6 53 42.2484                                        | +68 53 17.914   | 0.8385                            | 7.3000                             | 3.260                   | −21.00                   | B7III                |
| 33160                | 266  | 4.08  | 6 54 11.3978                                        | −12 02 19.060   | −9.4776                           | −14.4695                           | 12.940                  | 97.30                    | K4III                |
| 33579                | 268  | 1.50  | 6 58 37.5484                                        | −28 58 19.501   | 0.2004                            | 2.2900                             | 7.570                   | 27.40                    | B2II                 |
| 33694 <sup>*</sup>   | 260  | 4.55  | 7 00 04.0374                                        | +76 58 38.668   | 21.6508                           | −13.8811                           | 17.430                  | −26.20                   | K4III                |
| 33856                | 1183 | 3.49  | 7 01 43.1477                                        | −27 56 05.389   | −0.4535                           | 4.6400                             | 2.680                   | 21.50                    | K4III                |
| 33977                | 270  | 3.02  | 7 03 01.4726                                        | −23 49 59.847   | −0.1137                           | 4.2800                             | 1.270                   | 48.40                    | B3Ia                 |
| 34045                | 271  | 4.11  | 7 03 45.4927                                        | −15 37 59.830   | −0.0561                           | −11.1999                           | 8.110                   | 32.00                    | B8II                 |
| 34088                | 269  | 4.01  | 7 04 06.5318                                        | +20 34 13.069   | −0.4073                           | −0.9600                            | 2.790                   | 6.70                     | G3Ibv SB             |
| 34444                | 273  | 1.83  | 7 08 23.4843                                        | −26 23 35.519   | −0.2047                           | 3.3300                             | 1.820                   | 34.30                    | F8Ia                 |
| 34481 <sub>A</sub>   | 1189 | 3.78  | 7 08 44.8660                                        | −70 29 56.154   | 4.7350                            | 108.0599                           | 23.020                  | 2.80                     | G8IIIvar             |
| 34622                | 1186 | 4.91  | 7 10 13.6819                                        | − 4 14 13.582   | 0.0000                            | 217.8453                           | 15.450                  | 78.80                    | K0III                |
| 34752                | 274  | 4.91  | 7 11 39.3257                                        | +39 19 13.976   | 3.8064                            | 2.0899                             | 7.020                   | −27.00                   | K4II-III             |
| 34769                | 1187 | 4.15  | 7 11 51.8602                                        | − 0 29 33.952   | −0.0147                           | 6.6800                             | 8.700                   | 15.00                    | A2V                  |
| 34834                | 275  | 4.49  | 7 12 33.6255                                        | −46 45 33.498   | −13.1958                          | 106.7909                           | 47.220                  | −0.60                    | F0IV                 |
| 35228                | 281  | 3.97  | 7 16 49.8244                                        | −67 57 25.747   | −0.7301                           | 8.5000                             | 4.940                   | 22.50                    | F6II                 |
| 35264 <sub>A</sub>   | 278  | 2.71  | 7 17 08.5564                                        | −37 05 50.892   | −0.8835                           | 7.0000                             | 2.980                   | 15.80                    | K3Ib                 |
| 35350                | 277  | 3.58  | 7 18 05.5787                                        | +16 32 25.379   | −3.2053                           | −37.9002                           | 34.590                  | −9.20                    | A3V...               |
| 35550 <sup>cg</sup>  | 279  | 3.50  | 7 20 07.3776                                        | +21 58 56.354   | −1.3458                           | −7.7600                            | 55.450                  | 2.60                     | F0IV...              |
| 35904                | 283  | 2.45  | 7 24 05.7025                                        | −29 18 11.173   | −0.2874                           | 6.6600                             | 1.020                   | 41.10                    | B5Ia                 |
| 36046                | 282  | 3.78  | 7 25 43.5961                                        | +27 47 53.089   | −9.1401                           | −84.4300                           | 25.900                  | 8.40                     | G9III+...            |
| 36188                | 285  | 2.89  | 7 27 09.0427                                        | + 8 17 21.536   | −3.3874                           | −38.4497                           | 19.160                  | 22.00                    | B8Vvar               |
| 36366                | 286  | 4.16  | 7 29 06.7190                                        | +31 47 04.381   | 12.4961                           | 193.8204                           | 54.060                  | −5.70                    | F0V...               |
| 36377 <sup>cg</sup>  | 1194 | 3.25  | 7 29 13.8303                                        | −43 18 05.157   | −5.4833                           | 188.7249                           | 17.740                  | 88.10                    | K5III SB             |
| 36425                | 1193 | 4.55  | 7 29 47.7828                                        | +12 00 23.631   | 0.0859                            | −19.2600                           | 5.820                   | −15.40                   | K2III                |
| 36795                | 288  | 4.44  | 7 34 03.1805                                        | −22 17 45.841   | −2.9094                           | 46.8380                            | 38.909                  | 61.40                    | F6V                  |
| 36850 <sub>A</sub>   | 287  | 1.58  | 7 34 35.8628                                        | +31 53 17.795   | −16.2001                          | −148.1801                          | 63.270                  | 6.00                     | A2Vm                 |
| 36942                | 1198 | 4.93  | 7 35 39.7227                                        | −52 32 01.810   | 2.5689                            | −11.5699                           | 8.280                   | 62.00                    | K3III                |
| 36962                | 1196 | 4.06  | 7 35 55.3464                                        | +26 53 44.667   | −2.9587                           | −108.0806                          | 13.570                  | −20.60                   | K5III                |
| 37088                | 289  | 5.14  | 7 37 16.6911                                        | − 4 06 39.526   | −4.5055                           | 17.7398                            | 16.110                  | 46.00                    | F6III                |
| 37096 <sub>A</sub>   | 290  | 4.53  | 7 37 22.1103                                        | −34 58 06.709   | −1.1105                           | 16.5299                            | 9.100                   | 24.00                    | B8IV/V               |
| 37279 <sup>cg</sup>  | 291  | 0.40  | 7 39 18.1183                                        | + 5 13 29.975   | −47.9713                          | −1034.5989                         | 285.932                 | −3.20                    | F5IV-V               |
| 37447                | 293  | 3.94  | 7 41 14.8324                                        | − 9 33 04.071   | −5.0567                           | −19.6399                           | 22.610                  | 10.50                    | K0III                |
| 37504                | 297  | 3.93  | 7 41 49.2612                                        | −72 36 21.953   | 7.4439                            | 15.2898                            | 24.360                  | 48.10                    | K0III                |
| 37609                | 292  | 4.93  | 7 43 00.4161                                        | +58 42 37.297   | −4.7481                           | −52.1100                           | 13.750                  | 8.70                     | A3IVn                |
| 37740                | 294  | 3.57  | 7 44 26.8542                                        | +24 23 52.773   | −1.6434                           | −56.2395                           | 22.730                  | 20.60                    | G8III                |
| 37826 <sup>*</sup>   | 295  | 1.16  | 7 45 18.9504                                        | +28 01 34.315   | −47.2537                          | −45.9586                           | 96.740                  | 3.30                     | K0IIIvar             |
| 37891                | 1202 | 5.03  | 7 45 56.8700                                        | −14 33 49.698   | −0.7694                           | 6.2800                             | 13.800                  | −2.00                    | F2V                  |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                      | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp        |
|---------------------|------|-------|------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|-----------|
| 37908               | 1200 | 4.89  | 7 <sup>h</sup> 46 <sup>m</sup> 07 <sup>s</sup> .4472 | +18°30'36".157  | -5.3114                  | -51.5294                  | 9.550          | 81.10           | K5III     |
| 38170               | 1204 | 3.34  | 7 49 17.6552                                         | -24 51 35.229   | -0.4085                  | -0.7100                   | 2.420          | 2.70            | G6Ia      |
| 38373               | 1205 | 5.12  | 7 51 41.9886                                         | + 1 46 00.726   | -0.9318                  | -3.7800                   | 7.760          | 32.30           | B8II      |
| 38414               | 301  | 3.71  | 7 52 13.0348                                         | -40 34 32.830   | -1.2191                  | 5.3000                    | 9.460          | 24.00           | G5III...  |
| 38538 <sub>cg</sub> | 1207 | 4.97  | 7 53 29.8143                                         | +26 45 56.818   | -2.5402                  | -31.1700                  | 12.820         | 8.00            | A3V       |
| 38827               | 303  | 3.46  | 7 56 46.7143                                         | -52 58 56.496   | -3.1425                  | 16.7600                   | 8.430          | 19.10           | B3IVp     |
| 38901               | 1210 | 4.76  | 7 57 40.1063                                         | -30 20 04.451   | -0.6264                  | 7.1400                    | 2.260          | 28.40           | A7III     |
| 39079               | 304  | 4.93  | 7 59 44.1525                                         | - 3 40 46.498   | -3.6856                  | -1.8400                   | 13.060         | -28.70          | K2III     |
| 39095               | 1212 | 4.61  | 7 59 52.0507                                         | -18 23 57.220   | -0.5122                  | -35.0701                  | 13.690         | -12.00          | A1V       |
| 39424               | 305  | 4.94  | 8 03 31.0803                                         | +27 47 39.596   | -2.1501                  | -35.2501                  | 12.660         | -10.90          | K2III     |
| 39429               | 306  | 2.21  | 8 03 35.0467                                         | -40 00 11.332   | -2.6823                  | 16.7701                   | 2.330          | -24.00          | O5IAf     |
| 39757               | 308  | 2.83  | 8 07 32.6488                                         | -24 18 15.567   | -6.0924                  | 46.3781                   | 51.989         | 46.60           | F2mF5IIp  |
| 39847               | 307  | 4.78  | 8 08 27.4472                                         | +51 30 24.014   | -6.4372                  | -2.1502                   | 14.960         | 5.00            | A2V       |
| 39953               | 309  | 1.75  | 8 09 31.9502                                         | -47 20 11.716   | -0.5834                  | 9.9000                    | 3.880          | 35.00           | WC8 + O9I |
| 40259               | 311  | 4.99  | 8 13 19.9681                                         | -15 47 17.597   | -0.7981                  | -2.8500                   | 2.650          | 16.60           | G5Ib/II   |
| 40526               | 312  | 3.53  | 8 16 30.9206                                         | + 9 11 07.961   | -3.1605                  | -48.6498                  | 11.230         | 22.30           | K4III     |
| 40706               | 313  | 4.44  | 8 18 33.3123                                         | -36 39 33.438   | -9.2470                  | 100.6201                  | 35.060         | 5.10            | A4m...    |
| 40843               | 1217 | 5.13  | 8 20 03.8603                                         | +27 13 03.745   | -1.3778                  | -376.2477                 | 55.169         | 33.00           | F6V       |
| 40888               | 318  | 4.34  | 8 20 38.5404                                         | -77 29 04.118   | -39.7125                 | 40.7828                   | 21.220         | 21.90           | K0III-IV  |
| 40945               | 1219 | 4.83  | 8 21 23.0265                                         | -33 03 15.718   | -0.8996                  | 2.3800                    | 3.890          | 33.20           | K2/K3III  |
| 41037 <sub>A</sub>  | 315  | 1.86  | 8 22 30.8356                                         | -59 30 34.139   | -3.3294                  | 22.7200                   | 5.160          | 11.50           | K3III+B2V |
| 41075               | 314  | 4.25  | 8 22 50.1096                                         | +43 11 17.270   | -2.3426                  | -99.4397                  | 8.390          | 24.40           | K5III     |
| 41307               | 316  | 3.91  | 8 25 39.6323                                         | - 3 54 23.125   | -4.4136                  | -24.1999                  | 26.090         | 10.00           | A0V       |
| 41312               | 319  | 3.77  | 8 25 44.1946                                         | -66 08 12.805   | -5.9045                  | -152.1476                 | 30.210         | 27.40           | K2IIIvar  |
| 41704               | 317  | 3.35  | 8 30 15.8700                                         | +60 43 05.409   | -18.3066                 | -107.7307                 | 17.760         | 19.80           | G4II-III  |
| 42312               | 324  | 4.11  | 8 37 38.6331                                         | -42 59 20.690   | -0.9460                  | 9.4700                    | 2.270          | 18.70           | A6II      |
| 42313               | 1223 | 4.14  | 8 37 39.3662                                         | + 5 42 13.614   | -4.7080                  | -6.9900                   | 18.210         | 11.30           | A1Vnn     |
| 42402               | 1224 | 4.45  | 8 38 45.4377                                         | + 3 20 29.167   | -1.2708                  | -16.2899                  | 9.250          | 26.50           | K2III     |
| 42509               | 325  | 4.98  | 8 40 01.4716                                         | -12 28 31.340   | -5.4541                  | 0.9301                    | 7.780          | -10.60          | K3III     |
| 42536               | 1227 | 3.60  | 8 40 17.5854                                         | -52 55 18.794   | -2.7224                  | 35.0900                   | 6.590          | 17.10           | B3IV      |
| 42570               | 1226 | 3.77  | 8 40 37.5699                                         | -46 38 55.480   | -0.6118                  | 4.2900                    | 1.050          | 25.30           | F3Ia      |
| 42806               | 1228 | 4.66  | 8 43 17.1461                                         | +21 28 06.602   | -7.6608                  | -39.2498                  | 20.580         | 28.70           | A1IV      |
| 42828               | 327  | 3.68  | 8 43 35.5375                                         | -33 11 10.988   | -1.1375                  | 10.6000                   | 3.860          | 15.30           | B1.5III   |
| 42911               | 326  | 3.94  | 8 44 41.0996                                         | +18 09 15.511   | -1.1997                  | -228.4583                 | 23.970         | 17.10           | K0III     |
| 43103 <sub>A</sub>  | 328  | 4.03  | 8 46 41.8205                                         | +28 45 35.634   | -1.5734                  | -43.9499                  | 10.940         | 16.00           | G8Iab:    |
| 43305               | 1230 | 5.30  | 8 49 21.7262                                         | - 3 26 34.884   | -1.3070                  | -21.6999                  | 7.450          | 32.60           | B9MNp...  |
| 43409               | 332  | 4.02  | 8 50 31.9234                                         | -27 42 35.440   | -10.0521                 | 88.1598                   | 15.630         | 24.50           | K3III     |
| 43783               | 336  | 3.84  | 8 55 02.8281                                         | -60 38 40.593   | -3.8322                  | 42.2399                   | 10.450         | 25.00           | B8III     |
| 43813               | 334  | 3.11  | 8 55 23.6263                                         | + 5 56 44.028   | -6.6866                  | 14.6498                   | 21.640         | 22.80           | G8III-IV  |
| 44066               | 337  | 4.26  | 8 58 29.2217                                         | +11 51 27.723   | 2.8236                   | -29.2202                  | 18.790         | -13.80          | A5m       |
| 44127*              | 335  | 3.12  | 8 59 12.4539                                         | +48 02 30.575   | -43.9841                 | -215.2160                 | 68.320         | 12.20           | A7IV      |
| 44191               | 1234 | 4.45  | 9 00 05.4086                                         | -41 15 12.979   | -3.6065                  | 54.5902                   | 16.190         | -6.50           | Fp        |
| 44248 <sub>A</sub>  | 339  | 3.96  | 9 00 38.3707                                         | +41 46 58.480   | -43.5983                 | -219.2927                 | 60.859         | 26.40           | F5V       |
| 44382               | 343  | 4.00  | 9 02 26.7959                                         | -66 23 45.876   | -0.3347                  | -95.7998                  | 26.240         | 4.90            | Am        |
| 44390               | 338  | 4.74  | 9 02 32.6921                                         | +67 37 46.628   | -3.8677                  | 18.1499                   | 11.350         | 4.60            | M3III     |
| 44471 <sub>ph</sub> | 341  | 3.57  | 9 03 37.5267                                         | +47 09 23.489   | -3.6637                  | -55.3900                  | 7.710          | 4.00            | A1Vn      |
| 44511               | 342  | 3.75  | 9 04 09.2804                                         | -47 05 51.853   | -4.5851                  | -9.5699                   | 10.550         | 24.30           | K2III     |
| 44700               | 1237 | 4.56  | 9 06 31.7669                                         | +38 27 07.975   | -2.4151                  | -14.3400                  | 4.810          | 17.30           | G8Ib-II   |
| 44798               | 1238 | 5.23  | 9 07 44.8123                                         | +10 40 05.488   | -1.3812                  | -9.9600                   | 6.740          | 24.20           | B8IIIMNp  |
| 44816               | 345  | 2.23  | 9 07 59.7585                                         | -43 25 57.322   | -2.1308                  | 14.2800                   | 5.690          | 18.40           | K4Ib-II   |

**POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0**

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                                           | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp       |
|---------------------|------|-------|---------------------------------------------------------------------------|-----------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|----------|
| 45238               | 348  | 1.67  | 9 <sup><i>h</i></sup> 13 <sup><i>m</i></sup> 11 <sup><i>s</i></sup> .9755 | −69°43′01″.948  | −30.3201                          | 108.9132                           | 29.340                  | −5.20                    | A2IV     |
| 45336               | 347  | 3.89  | 9 14 21.8590                                                              | + 2 18 51.409   | 7.5108                            | −306.0711                          | 25.340                  | −8.00                    | B9.5V    |
| 45556               | 351  | 2.21  | 9 17 05.4067                                                              | −59 16 30.825   | −2.4831                           | 13.1100                            | 4.710                   | 13.30                    | A8Ib     |
| 45860               | 352  | 3.14  | 9 21 03.3013                                                              | +34 23 33.223   | −17.9998                          | 14.7784                            | 14.690                  | 37.60                    | M0IIIvar |
| 45902               | 1243 | 4.71  | 9 21 29.5908                                                              | −25 57 55.580   | −0.9106                           | −9.2000                            | 6.250                   | 20.00                    | M0III    |
| 45941               | 353  | 2.47  | 9 22 06.8183                                                              | −55 00 38.405   | −1.2463                           | 11.2400                            | 6.050                   | 21.90                    | B2IV     |
| 46146               | 1244 | 4.47  | 9 24 39.2591                                                              | +26 10 56.367   | −2.3126                           | −48.0596                           | 15.280                  | 28.20                    | K2III    |
| 46390*              | 354  | 1.99  | 9 27 35.2433                                                              | − 8 39 30.969   | −0.9771                           | 33.2500                            | 18.400                  | −4.30                    | K3III    |
| 46515               | 356  | 4.51  | 9 29 14.7196                                                              | −35 57 04.808   | −2.0374                           | 5.0700                             | 4.660                   | 22.20                    | K3III    |
| 46701               | 361  | 3.16  | 9 31 13.3188                                                              | −57 02 03.757   | −3.9917                           | 6.0801                             | 13.720                  | −13.90                   | K5III    |
| 46733               | 355  | 3.65  | 9 31 31.7081                                                              | +63 03 42.699   | 15.8270                           | 26.8592                            | 43.200                  | −9.50                    | F0IV     |
| 46771               | 1246 | 4.99  | 9 31 56.7388                                                              | +11 17 59.376   | −6.1131                           | −83.9995                           | 13.670                  | 29.40                    | K0IIIvar |
| 46853               | 358  | 3.17  | 9 32 51.4343                                                              | +51 40 38.281   | −101.8146                         | −535.6372                          | 74.149                  | 15.40                    | F6IV     |
| 46880               | 1247 | 5.02  | 9 33 12.4599                                                              | −21 06 56.601   | −1.4429                           | 15.0900                            | 9.760                   | 15.70                    | K0III    |
| 46952               | 360  | 4.54  | 9 34 13.3819                                                              | +36 23 51.208   | 0.5649                            | −22.8901                           | 18.520                  | −11.70                   | G8III    |
| 46977               | 357  | 4.54  | 9 34 28.8598                                                              | +69 49 49.234   | −12.3552                          | 77.5907                            | 30.890                  | −27.40                   | G4III-IV |
| 47310               | 1249 | 4.68  | 9 38 27.2883                                                              | + 4 38 57.454   | −11.0663                          | −49.9296                           | 11.900                  | 45.20                    | K3III    |
| 47431               | 1250 | 3.90  | 9 39 51.3619                                                              | − 1 08 34.117   | 3.1880                            | −62.9197                           | 11.830                  | 23.20                    | K3IIIvar |
| 47452               | 364  | 5.07  | 9 40 18.3633                                                              | −14 19 56.252   | −1.8110                           | −19.2500                           | 6.330                   | 18.00                    | B4IV/V   |
| 47508               | 365  | 3.52  | 9 41 09.0328                                                              | + 9 53 32.309   | −9.7224                           | −37.4497                           | 24.120                  | 27.00                    | A5V+...  |
| 47758 <sub>ph</sub> | 366  | 4.78  | 9 44 12.0952                                                              | −27 46 10.096   | −3.9977                           | 37.7599                            | 8.490                   | 24.00                    | A7V+...  |
| 47854               | 1254 | 3.69  | 9 45 14.8113                                                              | −62 30 28.451   | −1.8601                           | 8.2800                             | 2.160                   | 3.30                     | G5Iab/Ib |
| 47908               | 367  | 2.97  | 9 45 51.0730                                                              | +23 46 27.317   | −3.3576                           | −9.5700                            | 13.010                  | 4.30                     | G0II     |
| 48113               | 1255 | 5.08  | 9 48 35.3714                                                              | +46 01 15.629   | 21.3201                           | −92.6217                           | 54.260                  | 5.10                     | G2V      |
| 48319               | 368  | 3.78  | 9 50 59.3578                                                              | +59 02 19.448   | −38.1556                          | −151.7538                          | 28.350                  | 30.70                    | F0IV     |
| 48455               | 371  | 3.88  | 9 52 45.8173                                                              | +26 00 25.025   | −16.0438                          | −54.9206                           | 24.520                  | 13.80                    | K0III    |
| 48615               | 373  | 4.94  | 9 54 52.2087                                                              | −19 00 33.696   | −3.2499                           | −37.0398                           | 4.620                   | 50.00                    | K5III    |
| 48774               | 375  | 3.52  | 9 56 51.7416                                                              | −54 34 04.046   | −1.5099                           | 2.8300                             | 1.690                   | 14.10                    | B5Ib     |
| 48833               | 374  | 5.11  | 9 57 41.0540                                                              | +41 03 20.281   | −10.3386                          | −26.2607                           | 34.610                  | −9.80                    | F6Vs     |
| 49029               | 378  | 4.68  | 10 00 12.8066                                                             | + 8 02 39.203   | −2.0239                           | −22.1099                           | 6.210                   | 23.40                    | M2III    |
| 49402               | 1261 | 4.60  | 10 05 07.4700                                                             | −13 03 52.654   | −2.5650                           | 19.8999                            | 11.770                  | 28.00                    | B8V      |
| 49583               | 379  | 3.48  | 10 07 19.9523                                                             | +16 45 45.592   | −0.1351                           | −0.5300                            | 1.530                   | 2.90                     | A0Ib     |
| 49669*              | 380  | 1.36  | 10 08 22.3107                                                             | +11 58 01.945   | −16.9960                          | 4.9094                             | 42.090                  | 3.50                     | B7V      |
| 49841 <sub>cg</sub> | 381  | 3.61  | 10 10 35.2775                                                             | −12 21 14.699   | −13.6718                          | −100.2786                          | 28.440                  | 19.40                    | K0III    |
| 50099               | 385  | 3.29  | 10 13 44.2179                                                             | −70 02 16.452   | −6.9772                           | 7.5501                             | 8.810                   | 7.00                     | B8III    |
| 50191               | 382  | 3.85  | 10 14 44.1553                                                             | −42 07 18.990   | −13.5432                          | 49.8407                            | 31.720                  | 7.40                     | A2V      |
| 50335               | 384  | 3.43  | 10 16 41.4169                                                             | +23 25 02.318   | 1.4414                            | −7.3000                            | 12.560                  | −15.60                   | F0III    |
| 50371               | 1264 | 3.39  | 10 17 04.9758                                                             | −61 19 56.295   | −3.3700                           | 6.3800                             | 4.430                   | 8.60                     | K3II     |
| 50372               | 383  | 3.45  | 10 17 05.7915                                                             | +42 54 51.714   | −15.4847                          | −42.6408                           | 24.270                  | 18.30                    | A2IV     |
| 50799               | 1268 | 4.82  | 10 22 19.5848                                                             | −41 38 59.857   | −2.4294                           | 60.7697                            | 16.260                  | 20.90                    | K1IIIvar |
| 50801               | 386  | 3.06  | 10 22 19.7406                                                             | +41 29 58.259   | −7.1629                           | 34.0999                            | 13.110                  | −20.50                   | M0III SB |
| 50933               | 387  | 4.94  | 10 24 07.8462                                                             | +65 33 59.123   | −1.4393                           | −20.8300                           | 10.840                  | −0.10                    | A0sp...  |
| 50954               | 391  | 3.99  | 10 24 23.7063                                                             | −74 01 53.803   | −3.9064                           | −27.6301                           | 61.670                  | −4.80                    | F2IV     |
| 51069               | 389  | 3.83  | 10 26 05.4267                                                             | −16 50 10.646   | −8.9509                           | −80.0590                           | 13.140                  | 39.60                    | K4III    |
| 51172               | 392  | 4.28  | 10 27 09.1011                                                             | −31 04 04.004   | −6.2591                           | 9.6301                             | 8.900                   | 12.20                    | K4III    |
| 51232               | 393  | 3.81  | 10 27 52.7302                                                             | −58 44 21.851   | −1.7022                           | 2.2100                             | 3.130                   | 9.40                     | F2II     |
| 51233 <sub>ph</sub> | 390  | 4.20  | 10 27 52.9997                                                             | +36 42 25.962   | −10.6041                          | −109.6203                          | 22.340                  | 5.60                     | G8III-IV |
| 51459               | 394  | 4.82  | 10 30 37.5798                                                             | +55 58 49.931   | −21.0933                          | −33.4515                           | 77.820                  | 9.20                     | F8V      |
| 51576               | 397  | 3.30  | 10 32 01.4634                                                             | −61 41 07.197   | −2.3318                           | 11.4200                            | 6.560                   | 26.00                    | B4Vne    |
| 51624               | 396  | 3.84  | 10 32 48.6718                                                             | + 9 18 23.708   | −0.3763                           | −3.5900                            | 0.570                   | 42.00                    | B1Ib SB  |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp          |
|---------------------|------|-------|-------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|-------------|
| 51635 <sub>A</sub>  | 1273 | 5.02  | 10 <sup>h</sup> 32 <sup>m</sup> 56 <sup>s</sup> .8602 | −47°00′12″.069  | −2.3501                  | 6.8300                    | 3.380          | 4.20            | K4III       |
| 51808*              | 395  | 4.86  | 10 35 05.4806                                         | +75 42 46.612   | −12.3132                 | −14.9603                  | 12.680         | 16.60           | K0III       |
| 51814               | 398  | 5.16  | 10 35 09.6929                                         | +57 04 57.492   | 8.0539                   | 37.1100                   | 37.800         | −10.60          | F1V         |
| 51839               | 401  | 4.11  | 10 35 28.1062                                         | −78 36 28.029   | −12.8254                 | 11.5303                   | 7.890          | −22.40          | M0III       |
| 52098               | 1275 | 4.68  | 10 38 43.2127                                         | +31 58 34.455   | 0.0079                   | 7.1800                    | 6.880          | −6.80           | G0II        |
| 52154               | 402  | 4.29  | 10 39 18.3930                                         | −55 36 11.767   | −2.2269                  | 4.3100                    | 3.620          | 20.00           | G2II        |
| 52419 <sub>cg</sub> | 406  | 2.74  | 10 42 57.4013                                         | −64 23 40.020   | −2.9109                  | 12.0600                   | 7.430          | 24.00           | B0Vp        |
| 52457               | 405  | 5.08  | 10 43 24.9558                                         | +23 11 18.256   | −8.4608                  | 8.2697                    | 15.720         | 18.50           | A3Vn        |
| 52633               | 411  | 4.45  | 10 45 47.0033                                         | −80 32 24.676   | −15.1419                 | 6.1903                    | 8.970          | 22.60           | B2.5IV      |
| 52943               | 410  | 3.11  | 10 49 37.4884                                         | −16 11 37.134   | 6.4402                   | 199.0202                  | 23.540         | −1.20           | K0/K1III    |
| 53229               | 412  | 3.79  | 10 53 18.7051                                         | +34 12 53.536   | 7.4547                   | −286.0575                 | 33.400         | 16.10           | K0III-IV    |
| 53502               | 414  | 4.60  | 10 56 43.0512                                         | −37 08 15.956   | 6.2687                   | −124.4998                 | 16.400         | −0.20           | K0III       |
| 53721               | 1282 | 5.03  | 10 59 27.9737                                         | +40 25 48.925   | −27.6684                 | 55.1456                   | 71.040         | 11.30           | G0V         |
| 53740               | 1283 | 4.08  | 10 59 46.4647                                         | −18 17 55.620   | −32.4673                 | 129.1110                  | 18.710         | 46.80           | K1III       |
| 53773               | 415  | 4.37  | 11 00 09.2640                                         | −42 13 33.091   | 2.0707                   | 4.5000                    | 15.990         | −5.10           | A3IV        |
| 53807               | 1284 | 4.84  | 11 00 33.6486                                         | + 3 37 02.979   | 1.0461                   | −16.2400                  | 9.540          | 6.40            | K1III       |
| 53910*              | 416  | 2.34  | 11 01 50.4768                                         | +56 22 56.736   | 9.8331                   | 33.7399                   | 41.070         | −12.00          | A1V         |
| 54061 <sub>A</sub>  | 417  | 1.81  | 11 03 43.6687                                         | +61 45 03.720   | −19.2209                 | −35.2516                  | 26.380         | −8.90           | F7V comp    |
| 54182               | 418  | 4.62  | 11 05 01.0273                                         | + 7 20 09.626   | −23.1501                 | −47.4005                  | 34.540         | 4.70            | F2III-IVvar |
| 54204 <sub>cg</sub> | 419  | 4.92  | 11 05 19.9074                                         | −27 17 37.004   | −14.3090                 | −6.8692                   | 22.980         | 17.00           | F3IV/V      |
| 54463               | 1289 | 3.93  | 11 08 35.3899                                         | −58 58 30.133   | −0.6506                  | 2.0900                    | 0.550          | 7.20            | G0Ia0       |
| 54539               | 420  | 3.00  | 11 09 39.8084                                         | +44 29 54.553   | −5.8276                  | −27.3802                  | 22.210         | −3.80           | K1III       |
| 54682               | 421  | 4.46  | 11 11 39.4893                                         | −22 49 33.050   | 0.3421                   | −99.0599                  | 12.260         | 6.40            | A1V         |
| 54872               | 422  | 2.56  | 11 14 06.5014                                         | +20 31 25.381   | 10.2017                  | −130.4330                 | 56.521         | −20.20          | A4V         |
| 54879               | 423  | 3.33  | 11 14 14.4052                                         | +15 25 46.453   | −4.0811                  | −79.3698                  | 18.360         | 7.60            | A2V         |
| 55084               | 1292 | 4.45  | 11 16 39.7009                                         | − 3 39 05.764   | −7.2247                  | −35.7600                  | 16.690         | −3.00           | A7IVn       |
| 55219               | 425  | 3.49  | 11 18 28.7368                                         | +33 05 39.500   | −2.1175                  | 27.5100                   | 7.740          | −9.20           | K3III SB    |
| 55266 <sub>cg</sub> | 1293 | 4.76  | 11 19 07.9010                                         | +38 11 08.004   | −4.8472                  | −68.1002                  | 17.820         | −3.00           | A2V         |
| 55282               | 426  | 3.56  | 11 19 20.4476                                         | −14 46 42.749   | −8.5819                  | 206.6105                  | 16.750         | −5.20           | K0III       |
| 55425 <sub>A</sub>  | 428  | 3.90  | 11 21 00.4068                                         | −54 29 27.669   | −4.0540                  | −2.1999                   | 10.150         | 16.00           | B5Vn        |
| 55434               | 427  | 4.05  | 11 21 08.1943                                         | + 6 01 45.558   | −6.1514                  | −12.8301                  | 15.240         | −5.30           | B9.5Vs      |
| 55705               | 431  | 4.06  | 11 24 52.9238                                         | −17 41 02.435   | −6.7881                  | 3.2201                    | 38.900         | 1.00            | A9V         |
| 55945               | 1297 | 4.95  | 11 27 56.2400                                         | + 2 51 22.555   | 1.1561                   | −10.4100                  | 5.250          | −9.10           | G8II-III    |
| 56211               | 433  | 3.82  | 11 31 24.2205                                         | +69 19 51.873   | −7.7703                  | −18.7902                  | 9.760          | 7.20            | M0IIIvar    |
| 56343               | 434  | 3.54  | 11 33 00.1154                                         | −31 51 27.451   | −16.4116                 | −41.5989                  | 25.230         | −4.60           | G8III       |
| 56561               | 436  | 3.11  | 11 35 46.8848                                         | −63 01 11.430   | −4.9726                  | −6.8699                   | 7.960          | 7.90            | B9II:       |
| 56633               | 1299 | 4.70  | 11 36 40.9134                                         | − 9 48 08.089   | −4.0133                  | 2.8200                    | 10.700         | 1.00            | B9.5Vn      |
| 56647               | 437  | 4.30  | 11 36 56.9306                                         | − 0 49 25.495   | 0.0867                   | 43.4300                   | 18.310         | 1.00            | G9III       |
| 56922               | 439  | 4.70  | 11 40 12.7891                                         | −34 44 40.775   | −3.5731                  | −1.8399                   | 6.590          | 5.90            | B9V         |
| 57283 <sub>ph</sub> | 1301 | 4.71  | 11 44 45.7756                                         | −18 21 02.428   | 1.9070                   | −24.5600                  | 9.310          | −4.60           | G8III       |
| 57363 <sub>cg</sub> | 442  | 3.63  | 11 45 36.4191                                         | −66 43 43.546   | −16.9447                 | 33.2107                   | 25.420         | 16.30           | A7III       |
| 57380               | 1302 | 4.04  | 11 45 51.5590                                         | + 6 31 45.755   | −1.3185                  | −180.0183                 | 10.420         | 50.70           | M0III       |
| 57399               | 441  | 3.69  | 11 46 03.0140                                         | +47 46 45.861   | −13.7285                 | 28.3692                   | 16.640         | −8.80           | K0III       |
| 57439               | 443  | 4.11  | 11 46 30.8226                                         | −61 10 42.235   | −3.0216                  | −16.2300                  | 7.510          | −3.50           | G0II        |
| 57565 <sub>cg</sub> | 1304 | 4.50  | 11 47 59.1359                                         | +20 13 08.153   | −10.3348                 | −4.0403                   | 14.400         | 0.20            | A comp SB   |
| 57632               | 444  | 2.14  | 11 49 03.5776                                         | +14 34 19.417   | −34.3737                 | −113.7828                 | 90.160         | −0.10           | A3Vvar      |
| 57757               | 445  | 3.59  | 11 50 41.7186                                         | + 1 45 52.985   | 49.4204                  | −271.1788                 | 91.740         | 4.40            | F8V         |
| 57803               | 446  | 4.47  | 11 51 08.6917                                         | −45 10 24.494   | −6.8486                  | −8.6198                   | 7.030          | 2.20            | K4III       |
| 58001*              | 447  | 2.41  | 11 53 49.8475                                         | +53 41 41.136   | 12.1335                  | 11.1594                   | 38.990         | −12.60          | A0V SB      |
| 58188               | 1309 | 5.17  | 11 56 00.9536                                         | −17 09 02.983   | −3.4236                  | −8.2299                   | 11.420         | 15.00           | A0V         |
| 58590 <sub>cg</sub> | 1311 | 4.65  | 12 00 52.3901                                         | + 6 36 51.561   | −0.0168                  | −29.7101                  | 9.160          | −23.00          | A5V         |



# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp                    |
|---------------------|------|-------|-------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|-----------------------|
| 58948               | 450  | 4.12  | 12 <sup>h</sup> 05 <sup>m</sup> 12 <sup>s</sup> .5396 | + 8°43′58″.748  | −14.8604                 | 57.5203                   | 19.080         | −31.30          | G8III                 |
| 59196 <sub>ph</sub> | 452  | 2.58  | 12 08 21.4998                                         | −50 43 20.732   | −5.0052                  | −6.4199                   | 8.250          | 9.00            | B2IV <sub>ne</sub>    |
| 59316               | 453  | 3.02  | 12 10 07.4807                                         | −22 37 11.159   | −5.1653                  | 10.5501                   | 10.750         | 4.90            | K2III                 |
| 59504               | 454  | 5.14  | 12 12 11.9418                                         | +77 36 58.469   | 3.2734                   | 20.1800                   | 29.700         | −0.20           | A5m                   |
| 59747               | 455  | 2.79  | 12 15 08.7157                                         | −58 44 56.140   | −4.7135                  | −10.7199                  | 8.960          | 22.20           | B2IV                  |
| 59774               | 456  | 3.32  | 12 15 25.5601                                         | +57 01 57.421   | 12.6875                  | 7.8094                    | 40.050         | −13.40          | A3V <sub>var</sub>    |
| 59803               | 457  | 2.58  | 12 15 48.3702                                         | −17 32 30.946   | −11.1575                 | 22.3104                   | 19.780         | −4.20           | B8III                 |
| 60000               | 459  | 4.24  | 12 18 20.8242                                         | −79 18 44.063   | −13.6850                 | 12.0003                   | 12.050         | 23.00           | B5V <sub>n</sub>      |
| 60129               | 460  | 3.89  | 12 19 54.3569                                         | − 0 40 00.492   | −3.9429                  | −23.1300                  | 13.060         | 2.30            | A2IV                  |
| 60172               | 1317 | 4.97  | 12 20 20.9809                                         | + 3 18 45.267   | −19.6206                 | −62.8498                  | 11.430         | 35.70           | K1III                 |
| 60351               | 1318 | 4.78  | 12 22 30.3122                                         | +25 50 46.177   | −0.7963                  | −8.8500                   | 11.930         | 0.50            | F8:p...               |
| 60718 <sub>A</sub>  | 462  | 0.77  | 12 26 35.8958                                         | −63 05 56.730   | −5.2117                  | −14.7299                  | 10.170         | −11.20          | B0.5IV                |
| 60823               | 464  | 3.91  | 12 28 02.3820                                         | −50 13 50.286   | −3.3860                  | −12.4099                  | 7.360          | 8.00            | B3V                   |
| 60965               | 465  | 2.94  | 12 29 51.8554                                         | −16 30 55.557   | −14.6003                 | −139.2986                 | 37.110         | 9.00            | B9.5V                 |
| 61084               | 468  | 1.59  | 12 31 09.9593                                         | −57 06 47.562   | 3.4305                   | −264.3263                 | 37.090         | 20.60           | M4III                 |
| 61199               | 469  | 3.84  | 12 32 28.0148                                         | −72 07 58.758   | −10.9927                 | −5.1597                   | 10.070         | 2.50            | B5V                   |
| 61281               | 472  | 3.85  | 12 33 28.9443                                         | +69 47 17.656   | −11.2189                 | 11.4196                   | 6.550          | −11.40          | B6III <sub>p</sub>    |
| 61317               | 470  | 4.24  | 12 33 44.5446                                         | +41 21 26.927   | −62.6215                 | 292.9071                  | 119.459        | 6.90            | G0V                   |
| 61359               | 471  | 2.65  | 12 34 23.2346                                         | −23 23 48.333   | 0.0625                   | −56.0002                  | 23.340         | −7.60           | G5II                  |
| 61394 <sub>ph</sub> | 1323 | 4.80  | 12 34 51.0815                                         | +22 37 45.332   | −4.1473                  | 28.5300                   | 8.940          | −16.00          | A0IV                  |
| 61418 <sub>A</sub>  | 473  | 5.03  | 12 35 07.7597                                         | +18 22 37.408   | −0.3217                  | 23.3000                   | 5.310          | 3.90            | K2III                 |
| 61585               | 474  | 2.69  | 12 37 11.0184                                         | −69 08 08.030   | −7.4630                  | −12.4398                  | 10.670         | 18.00           | B2IV-V                |
| 61740               | 475  | 4.66  | 12 39 14.7669                                         | − 7 59 44.032   | −5.2039                  | −24.6601                  | 10.240         | −19.70          | K2III                 |
| 61960               | 1326 | 4.88  | 12 41 53.0565                                         | +10 14 08.251   | 5.5971                   | −89.5100                  | 27.100         | 1.60            | A0V                   |
| 62223               | 1327 | 5.42  | 12 45 07.8270                                         | +45 26 24.922   | −0.2090                  | 13.0500                   | 4.590          | 11.70           | C7Iab                 |
| 62434               | 481  | 1.25  | 12 47 43.2631                                         | −59 41 19.549   | −6.3721                  | −12.8198                  | 9.250          | 20.00           | B0.5III               |
| 62683               | 1331 | 4.90  | 12 50 41.1665                                         | −33 59 57.489   | −2.3408                  | −14.2899                  | 8.390          | 18.00           | B9V                   |
| 62763               | 1332 | 4.93  | 12 51 41.9216                                         | +27 32 26.565   | −0.7143                  | −8.8200                   | 10.620         | −1.40           | G0III                 |
| 62896               | 482  | 4.25  | 12 53 26.1992                                         | −40 10 43.938   | 6.0765                   | −21.8298                  | 21.030         | −2.50           | A4IV                  |
| 62956*              | 483  | 1.76  | 12 54 01.7494                                         | +55 57 35.356   | 13.3078                  | −8.9908                   | 40.300         | −9.30           | A0p                   |
| 62985               | 1335 | 4.77  | 12 54 21.1633                                         | − 9 32 20.380   | −1.2344                  | −19.7199                  | 7.820          | 17.60           | M3III <sub>ivar</sub> |
| 63090               | 484  | 3.39  | 12 55 36.2078                                         | + 3 23 50.893   | −31.4848                 | −52.8108                  | 16.110         | −17.80          | M3III                 |
| 63125 <sub>A</sub>  | 485  | 2.89  | 12 56 01.6674                                         | +38 19 06.167   | −19.8349                 | 54.9783                   | 29.600         | −3.30           | A0spe...              |
| 63608               | 488  | 2.85  | 13 02 10.5971                                         | +10 57 32.941   | −18.6774                 | 19.9595                   | 31.900         | −14.60          | G8III <sub>ivar</sub> |
| 63613 <sub>cg</sub> | 487  | 3.61  | 13 02 16.2633                                         | −71 32 55.879   | 55.5193                  | −23.2706                  | 35.910         | 36.50           | K2III                 |
| 63901               | 1337 | 5.20  | 13 05 44.4360                                         | +35 47 56.035   | −3.0207                  | 19.3200                   | 11.550         | −13.00          | B9V                   |
| 64004               | 489  | 4.27  | 13 06 54.6393                                         | −49 54 22.486   | −2.7162                  | −12.4299                  | 7.920          | 14.30           | B1.5V                 |
| 64238 <sub>A</sub>  | 490  | 4.38  | 13 09 56.9915                                         | − 5 32 20.435   | −2.3496                  | −32.8000                  | 7.860          | −2.90           | A1V                   |
| 64394               | 492  | 4.23  | 13 11 52.3935                                         | +27 52 41.459   | −60.4826                 | 882.6766                  | 109.229        | 5.20            | G0V                   |
| 64661               | 493  | 4.79  | 13 15 14.9406                                         | −67 53 40.521   | −6.5407                  | −10.6298                  | 8.040          | 5.00            | B8V                   |
| 64844               | 494  | 4.72  | 13 17 32.5406                                         | +40 34 21.387   | −11.0297                 | 18.4494                   | 11.390         | 7.50            | F3III                 |
| 64852               | 1344 | 4.78  | 13 17 36.2827                                         | + 5 28 11.530   | −0.4795                  | 10.0000                   | 6.030          | −26.80          | M2III                 |
| 64924               | 1345 | 4.74  | 13 18 24.3146                                         | −18 18 40.306   | −75.1334                 | −1063.7820                | 117.301        | −8.10           | G5V                   |
| 64962               | 495  | 2.99  | 13 18 55.2968                                         | −23 10 17.444   | 4.9609                   | −41.0900                  | 24.690         | −5.40           | G8III                 |
| 65109               | 496  | 2.75  | 13 20 35.8176                                         | −36 42 44.262   | −28.3384                 | −87.9763                  | 55.640         | 0.10            | A2V                   |
| 65271               | 1347 | 4.52  | 13 22 37.9371                                         | −60 59 18.215   | −4.8798                  | −15.1898                  | 9.200          | 26.00           | B3V                   |
| 65378 <sub>A</sub>  | 497  | 2.23  | 13 23 55.5429                                         | +54 55 31.302   | 14.0645                  | −22.0110                  | 41.730         | −9.00           | A2V                   |
| 65474*              | 498  | 0.98  | 13 25 11.5793                                         | −11 09 40.759   | −2.8880                  | −31.7300                  | 12.440         | 1.00            | B1V                   |
| 65721               | 1349 | 4.97  | 13 28 25.8094                                         | +13 46 43.634   | −16.1177                 | −576.1879                 | 55.220         | 4.70            | G5V                   |
| 66200               | 1351 | 4.92  | 13 34 07.9309                                         | + 3 39 32.280   | 2.9320                   | −24.0301                  | 17.790         | −11.90          | A1p SrCrEu            |
| 66249               | 501  | 3.38  | 13 34 41.5920                                         | − 0 35 44.953   | −18.5939                 | 48.5605                   | 44.550         | −13.20          | A3V                   |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                  | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp       |
|----------------------|------|-------|-------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|----------|
| 66257                | 502  | 4.91  | 13 <sup>h</sup> 34 <sup>m</sup> 47 <sup>s</sup> .8083 | +37°10'56".694  | 7.0874                   | -9.8102                   | 22.460         | 7.40            | F2IV SB  |
| 66657                | 504  | 2.29  | 13 39 53.2584                                         | -53 27 59.018   | -1.6350                  | -12.7900                  | 8.680          | 5.60            | B1III    |
| 66803                | 1355 | 5.03  | 13 41 36.7766                                         | - 8 42 10.743   | -6.1812                  | 40.2802                   | 7.130          | -36.60          | M2III    |
| 67153                | 506  | 4.23  | 13 45 41.2452                                         | -33 02 37.397   | -36.7320                 | -146.1671                 | 51.910         | -21.80          | F3V      |
| 67275                | 507  | 4.50  | 13 47 15.7429                                         | +17 27 24.862   | -33.5687                 | 54.1779                   | 64.121         | -15.60          | F7V      |
| 67301*               | 509  | 1.85  | 13 47 32.4376                                         | +49 18 47.754   | -12.3972                 | -15.5608                  | 32.390         | -10.90          | B3V SB   |
| 67472                | 508  | 3.47  | 13 49 36.9890                                         | -42 28 25.434   | -2.1557                  | -19.2200                  | 6.190          | 12.60           | B2IV-Ve  |
| 67494                | 510  | 4.96  | 13 49 52.2835                                         | -18 08 03.004   | -6.9689                  | -37.7102                  | 13.480         | -39.70          | K0III    |
| 67627                | 511  | 4.58  | 13 51 25.9396                                         | +64 43 23.778   | 0.2264                   | -4.5500                   | 8.330          | -10.70          | M3III    |
| 67927 <sub>cg</sub>  | 513  | 2.68  | 13 54 41.0787                                         | +18 23 51.781   | -4.2822                  | -358.1001                 | 88.170         | -0.10           | G0IV     |
| 68002                | 512  | 2.55  | 13 55 32.3858                                         | -47 17 18.150   | -5.6159                  | -44.7498                  | 8.480          | 6.50            | B2.5IV   |
| 68191                | 514  | 4.71  | 13 57 38.8836                                         | -63 41 12.105   | -6.0834                  | -32.8297                  | 15.610         | 22.20           | K4III    |
| 68269                | 515  | 5.20  | 13 58 31.1460                                         | -24 58 20.095   | -3.6712                  | -29.2899                  | 9.610          | 5.00            | B8V      |
| 68520                | 516  | 4.23  | 14 01 38.7933                                         | + 1 32 40.315   | 1.1611                   | -21.2000                  | 14.940         | -2.00           | A3V      |
| 68702 <sub>A</sub>   | 518  | 0.61  | 14 03 49.4045                                         | -60 22 22.942   | -4.5798                  | -25.0599                  | 6.210          | -12.00          | B1III    |
| 68756 <sub>cg</sub>  | 521  | 3.67  | 14 04 23.3498                                         | +64 22 33.062   | -8.7129                  | 17.1898                   | 10.560         | -16.00          | A0III SB |
| 68895                | 519  | 3.25  | 14 06 22.2971                                         | -26 40 56.500   | 3.2120                   | -140.8178                 | 32.170         | 26.70           | K2III    |
| 68933                | 520  | 2.06  | 14 06 40.9485                                         | -36 22 11.836   | -42.9951                 | -517.8609                 | 53.520         | 1.30            | K0IIIb   |
| 69112* <sub>cg</sub> | 524  | 4.80  | 14 08 50.9269                                         | +77 32 51.051   | -9.3865                  | 33.3898                   | 6.520          | 10.50           | K3III    |
| 69226                | 522  | 4.82  | 14 10 23.9336                                         | +25 05 30.037   | -1.6946                  | -60.0697                  | 27.270         | 10.80           | F9IVw    |
| 69427                | 523  | 4.18  | 14 12 53.7458                                         | -10 16 25.326   | 0.5447                   | 140.7901                  | 14.590         | -4.00           | K3III    |
| 69673* <sub>ph</sub> | 526  | -0.05 | 14 15 39.6720                                         | +19 10 56.677   | -77.1804                 | -1999.4342                | 88.850         | -5.19           | K2IIIp   |
| 69701                | 525  | 4.07  | 14 16 00.8698                                         | - 6 00 01.968   | -1.7321                  | -419.8356                 | 46.740         | 12.50           | F7V      |
| 69713                | 528  | 4.75  | 14 16 09.9294                                         | +51 22 02.033   | -16.0154                 | 89.4197                   | 33.540         | -17.00          | A9V      |
| 69732                | 527  | 4.18  | 14 16 23.0187                                         | +46 05 17.900   | -18.0158                 | 159.0092                  | 33.580         | -8.10           | A0sh     |
| 69879 <sub>cg</sub>  | 1370 | 4.80  | 14 17 59.8196                                         | +35 30 34.219   | 0.4029                   | 14.1801                   | 14.630         | -25.60          | K1III    |
| 69974                | 1371 | 4.52  | 14 19 06.5916                                         | -13 22 15.942   | -1.1731                  | 29.3901                   | 17.470         | -10.90          | A1V      |
| 70069                | 529  | 4.30  | 14 20 19.5430                                         | -56 23 11.391   | -1.1188                  | -7.5700                   | 2.750          | 4.20            | B6Ib     |
| 70090                | 1373 | 4.05  | 14 20 33.4316                                         | -37 53 07.061   | -5.4483                  | -11.3899                  | 13.190         | -4.00           | A0IV     |
| 70400                | 1375 | 5.10  | 14 24 11.3447                                         | + 5 49 12.470   | -5.2209                  | 6.4900                    | 21.560         | -10.00          | A5V      |
| 70497                | 531  | 4.04  | 14 25 11.7964                                         | +51 51 02.677   | -25.4766                 | -399.0784                 | 68.630         | -10.90          | F7V      |
| 70574                | 1377 | 4.56  | 14 26 08.2239                                         | -45 13 17.127   | -1.2787                  | -14.0200                  | 3.150          | -21.50          | B2IV     |
| 70692                | 1379 | 4.25  | 14 27 31.5431                                         | +75 41 45.574   | 2.3502                   | 22.0899                   | 9.460          | 10.10           | K4III    |
| 70753                | 532  | 4.97  | 14 28 10.4267                                         | -29 29 29.895   | -1.9048                  | -23.8100                  | 7.850          | 6.00            | B7/B8V   |
| 70755 <sub>A</sub>   | 533  | 4.81  | 14 28 12.1381                                         | - 2 13 40.646   | -9.4031                  | -2.9200                   | 24.150         | -9.50           | G2III    |
| 71053                | 534  | 3.57  | 14 31 49.7899                                         | +30 22 17.174   | -7.7611                  | 120.2204                  | 21.920         | -13.70          | K3III    |
| 71075                | 535  | 3.04  | 14 32 04.6719                                         | +38 18 29.709   | -9.8174                  | 151.8732                  | 38.291         | -35.50          | A7IIIvar |
| 71284                | 1380 | 4.47  | 14 34 40.8170                                         | +29 44 42.468   | 14.4599                  | 132.7190                  | 64.660         | 0.80            | F3Vwvar  |
| 71352                | 537  | 2.33  | 14 35 30.4238                                         | -42 09 28.168   | -3.1755                  | -32.4400                  | 10.570         | -0.20           | B1Vn + A |
| 71681 <sub>B</sub>   | 538  | 1.35  | 14 39 35.0802                                         | -60 50 13.761   | -492.6738                | 953.3766                  | 742.229        | -22.20          | K1V      |
| 71860                | 541  | 2.30  | 14 41 55.7556                                         | -47 23 17.520   | -2.0826                  | -24.2200                  | 5.950          | 7.30            | B1.5III  |
| 71908                | 539  | 3.18  | 14 42 30.4194                                         | -64 58 30.499   | -30.3605                 | -234.0647                 | 60.970         | 7.40            | F1Vp     |
| 71957                | 545  | 3.87  | 14 43 03.6234                                         | - 5 39 29.544   | 6.9827                   | -319.8984                 | 53.540         | 5.20            | F2III    |
| 71995                | 1383 | 4.80  | 14 43 25.3632                                         | +26 31 40.261   | -0.9903                  | -16.6800                  | 3.670          | 5.60            | M3III    |
| 72010                | 544  | 4.06  | 14 43 39.4400                                         | -35 10 25.159   | -4.9694                  | -176.8218                 | 15.890         | -38.10          | K3III    |
| 72220                | 547  | 3.73  | 14 46 14.9241                                         | + 1 53 34.388   | -7.7402                  | -21.7501                  | 25.350         | -6.10           | A0V      |
| 72290                | 546  | 5.22  | 14 47 01.2935                                         | -52 23 00.664   | -1.9584                  | -82.3204                  | 12.580         | -20.80          | G6III    |
| 72370                | 542  | 3.83  | 14 47 51.7088                                         | -79 02 41.103   | -1.9890                  | -15.7500                  | 7.930          | -0.10           | K5III    |
| 72607*               | 550  | 2.07  | 14 50 42.3264                                         | +74 09 19.818   | -7.8844                  | 11.9098                   | 25.790         | 16.80           | K4IIIvar |
| 72622                | 548  | 2.75  | 14 50 52.7131                                         | -16 02 30.401   | -7.3315                  | -69.0004                  | 42.250         | -10.00          | A3IV     |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                  | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp         |
|----------------------|------|-------|-------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|------------|
| 73199 <sub>cg</sub>  | 554  | 4.63  | 14 <sup>h</sup> 57 <sup>m</sup> 35 <sup>s</sup> .0072 | +65°55'56".857  | −12.7935                 | 32.4794                   | 8.200          | 7.30            | M5III      |
| 73273                | 552  | 2.68  | 14 58 31.9268                                         | −43 08 02.256   | −3.1115                  | −38.3000                  | 6.230          | 0.20            | B2III      |
| 73334 <sub>ph</sub>  | 553  | 3.13  | 14 59 09.6850                                         | −42 06 15.098   | −1.5958                  | −21.3300                  | 6.050          | 9.10            | B2IV       |
| 73473                | 1394 | 4.91  | 15 00 58.3486                                         | − 8 31 08.195   | −4.4626                  | −3.4000                   | 10.720         | −38.70          | B9.5V      |
| 73555                | 555  | 3.49  | 15 01 56.7623                                         | +40 23 26.036   | −3.5187                  | −29.2202                  | 14.910         | −19.90          | G8III      |
| 73714                | 556  | 3.25  | 15 04 04.2156                                         | −25 16 55.073   | −5.2974                  | −44.6899                  | 11.170         | −4.20           | M3/M4III   |
| 73745                | 557  | 4.52  | 15 04 26.7417                                         | +26 56 51.536   | −13.1858                 | −4.5207                   | 13.040         | −25.50          | K2III      |
| 73996                | 1396 | 4.93  | 15 07 18.0659                                         | +24 52 09.104   | 13.5800                  | −163.5121                 | 50.700         | −9.80           | F5V        |
| 74376 <sub>A</sub>   | 1398 | 3.88  | 15 11 56.0757                                         | −48 44 16.147   | −9.7568                  | −47.9695                  | 17.890         | 3.00            | B9V        |
| 74392                | 559  | 4.54  | 15 12 13.2901                                         | −19 47 30.158   | −2.5216                  | −32.5500                  | 8.660          | −11.60          | Asp...     |
| 74395                | 558  | 3.41  | 15 12 17.0950                                         | −52 05 57.290   | −12.3655                 | −70.9996                  | 28.060         | −9.70           | G8III      |
| 74604                | 1399 | 4.91  | 15 14 37.3192                                         | −31 31 08.836   | −0.7601                  | 1.8300                    | 2.860          | −22.80          | F3III      |
| 74666                | 563  | 3.46  | 15 15 30.1630                                         | +33 18 53.401   | 6.7683                   | −110.5709                 | 27.940         | −12.20          | G8III      |
| 74785                | 564  | 2.61  | 15 17 00.4148                                         | − 9 22 58.503   | −6.5132                  | −20.7602                  | 20.380         | −35.20          | B8V        |
| 74824                | 561  | 4.07  | 15 17 30.8494                                         | −58 48 04.349   | −12.6626                 | −135.4585                 | 33.750         | 9.60            | A3V        |
| 74946                | 560  | 2.87  | 15 18 54.5822                                         | −68 40 46.362   | −12.1898                 | −31.9996                  | 17.850         | −3.00           | A1V        |
| 75097*               | 569  | 3.00  | 15 20 43.7155                                         | +71 50 02.458   | −3.8554                  | 17.6800                   | 6.790          | −3.90           | A3II-III   |
| 75141                | 1402 | 3.22  | 15 21 22.3217                                         | −40 38 51.064   | −1.6791                  | −24.0500                  | 6.390          | 2.00            | B1.5IV     |
| 75177                | 566  | 3.57  | 15 21 48.3700                                         | −36 15 40.955   | −7.5942                  | −86.0302                  | 9.990          | −29.40          | K5III      |
| 75304                | 1403 | 4.54  | 15 23 09.3501                                         | −36 51 30.559   | −1.5039                  | −21.5300                  | 5.380          | 2.30            | B4V        |
| 75411                | 568  | 4.31  | 15 24 29.4278                                         | +37 22 37.800   | −12.3895                 | 84.6897                   | 26.960         | −9.50           | F0V        |
| 75458                | 571  | 3.29  | 15 24 55.7747                                         | +58 57 57.836   | −1.0694                  | 17.3001                   | 31.920         | −11.10          | K2III      |
| 75695 <sub>cg</sub>  | 572  | 3.66  | 15 27 49.7308                                         | +29 06 20.530   | −13.8405                 | 86.8401                   | 28.600         | −18.70          | F0p        |
| 75973                | 573  | 5.04  | 15 30 55.7593                                         | +40 49 58.968   | 0.9710                   | −8.8100                   | 3.740          | −10.40          | K5III      |
| 76127 <sub>A</sub>   | 576  | 4.14  | 15 32 55.7825                                         | +31 21 32.880   | −1.5318                  | −8.9401                   | 10.490         | −25.00          | B6Vnn      |
| 76219                | 1409 | 4.61  | 15 34 10.7008                                         | −10 03 52.303   | 20.6925                  | −234.1124                 | 34.539         | 47.70           | K1IV       |
| 76267* <sub>cg</sub> | 578  | 2.22  | 15 34 41.2681                                         | +26 42 52.895   | 8.9843                   | −89.4402                  | 43.650         | 1.70            | A0V        |
| 76333                | 577  | 3.91  | 15 35 31.5790                                         | −14 47 22.333   | 4.5281                   | 6.9301                    | 21.420         | −27.50          | K0III      |
| 76440                | 574  | 4.11  | 15 36 43.2225                                         | −66 19 01.335   | 4.0680                   | −54.6602                  | 15.090         | −15.50          | K0III      |
| 76470                | 579  | 3.60  | 15 37 01.4498                                         | −28 08 06.286   | −1.0025                  | −3.4800                   | 16.760         | −24.90          | K3III      |
| 76880                | 1413 | 4.75  | 15 41 56.7981                                         | −19 40 43.781   | −2.3513                  | −104.3300                 | 8.160          | −3.80           | K5III      |
| 77055*               | 590  | 4.29  | 15 44 03.5193                                         | +77 47 40.175   | 6.3287                   | −2.5001                   | 8.680          | −13.10          | A3Vn       |
| 77070                | 582  | 2.63  | 15 44 16.0748                                         | + 6 25 32.257   | 9.0341                   | 44.1398                   | 44.540         | 2.90            | K2III      |
| 77233                | 583  | 3.65  | 15 46 11.2564                                         | +15 25 18.572   | 4.7400                   | −41.3101                  | 21.310         | −0.80           | A3V        |
| 77277                | 587  | 5.19  | 15 46 40.0053                                         | +62 35 58.405   | 5.7945                   | −56.5402                  | 12.000         | −6.30           | A2IV       |
| 77450                | 584  | 4.09  | 15 48 44.3768                                         | +18 08 29.629   | −3.6326                  | −88.7206                  | 9.360          | −38.70          | M1III      |
| 77516                | 585  | 3.54  | 15 49 37.2084                                         | − 3 25 48.748   | −6.5498                  | −27.4101                  | 20.940         | −9.40           | A0V        |
| 77622                | 588  | 3.71  | 15 50 48.9661                                         | + 4 28 39.829   | 8.5582                   | 61.8704                   | 46.390         | −9.40           | A2m        |
| 77634                | 586  | 3.97  | 15 50 57.5376                                         | −33 37 37.796   | −0.4740                  | −24.9101                  | 15.860         | −18.00          | B9.5III-IV |
| 77655                | 1414 | 4.79  | 15 51 13.9316                                         | +35 39 26.575   | −0.6621                  | −347.4148                 | 32.130         | −24.00          | K0III-IV   |
| 77760 <sub>cg</sub>  | 1416 | 4.60  | 15 52 40.5415                                         | +42 27 05.465   | 39.6656                  | 629.5518                  | 63.082         | −55.20          | F9V        |
| 77811                | 1415 | 5.04  | 15 53 20.0586                                         | −20 10 01.345   | −0.2564                  | −19.0000                  | 9.150          | −4.00           | B3V        |
| 77952                | 589  | 2.83  | 15 55 08.5623                                         | −63 25 50.616   | −28.0893                 | −401.9172                 | 81.240         | −0.30           | F2III      |
| 78072                | 591  | 3.85  | 15 56 27.1828                                         | +15 39 41.821   | 21.5461                  | −1282.1577                | 89.919         | 6.50            | F6V        |
| 78159                | 593  | 4.14  | 15 57 35.2518                                         | +26 52 40.368   | −5.7214                  | −60.2406                  | 14.200         | −30.50          | K3III      |
| 78180                | 595  | 4.96  | 15 57 47.4411                                         | +54 44 59.145   | −17.3476                 | 106.4693                  | 29.570         | −11.00          | F0IV       |
| 78207                | 1417 | 4.95  | 15 58 11.3689                                         | −14 16 45.691   | −0.8455                  | −16.7700                  | 6.360          | −5.60           | B8Ia/Iab   |
| 78265                | 592  | 2.89  | 15 58 51.1129                                         | −26 06 50.779   | −0.8909                  | −25.7100                  | 7.100          | −3.00           | B1V + B2V  |
| 78323                | 1418 | 4.99  | 15 59 30.2663                                         | −41 44 39.970   | −3.3739                  | −16.5100                  | 8.590          | −27.00          | G8III      |
| 78401 <sub>ph</sub>  | 594  | 2.29  | 16 00 20.0063                                         | −22 37 18.156   | −0.6262                  | −36.9001                  | 8.120          | −14.00          | B0.2IV     |
| 78527                | 598  | 4.01  | 16 01 53.3457                                         | +58 33 54.905   | −40.9157                 | 334.9553                  | 47.790         | −8.50           | F8IV-V     |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                   | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp           |
|-----------------------|------|-------|-------------------------------------------------------|-----------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|--------------|
| 78820 <sub>A</sub>    | 597  | 2.56  | 16 <sup>h</sup> 05 <sup>m</sup> 26 <sup>s</sup> .2307 | −19°48′19″.632  | −0.4783                           | −24.8900                           | 6.150                   | −6.60                    | B0.5V        |
| 78914                 | 596  | 4.73  | 16 06 29.4381                                         | −45 10 23.467   | 1.6521                            | 37.0303                            | 26.410                  | −15.50                   | Am           |
| 78918 <sub>cg</sub>   | 599  | 4.22  | 16 06 35.5448                                         | −36 48 08.238   | −1.3188                           | −31.0599                           | 7.940                   | 14.60                    | B2.5Vn       |
| 79101 <sub>cg</sub>   | 601  | 4.23  | 16 08 46.1779                                         | +44 56 05.662   | −2.4466                           | 35.8601                            | 14.270                  | −15.60                   | B9MNp...     |
| 79119                 | 1423 | 4.73  | 16 08 58.2990                                         | +36 29 27.399   | −3.3759                           | 343.4732                           | 28.840                  | −18.20                   | K0III-IV     |
| 79509                 | 600  | 4.95  | 16 13 28.7289                                         | −54 37 49.683   | −0.6139                           | −22.4800                           | 7.450                   | −13.50                   | G4III        |
| 79593                 | 603  | 2.73  | 16 14 20.7395                                         | − 3 41 39.563   | −3.0617                           | −142.9110                          | 19.160                  | −19.90                   | M1III        |
| 79664                 | 602  | 3.86  | 16 15 26.2708                                         | −63 41 08.454   | 0.5279                            | −13.4900                           | 5.250                   | −4.70                    | G5II         |
| 79822                 | 612  | 4.95  | 16 17 30.2878                                         | +75 45 19.190   | −24.3689                          | 257.8001                           | 33.520                  | −9.50                    | F5V          |
| 79882                 | 605  | 3.23  | 16 18 19.2890                                         | − 4 41 33.038   | 5.5112                            | 40.0802                            | 30.340                  | −10.30                   | G8III        |
| 79992                 | 608  | 3.91  | 16 19 44.4368                                         | +46 18 48.119   | −1.2692                           | 39.3101                            | 10.370                  | −13.80                   | B5IV         |
| 80000                 | 604  | 4.01  | 16 19 50.4225                                         | −50 09 19.828   | −16.5820                          | −52.8394                           | 25.580                  | −29.20                   | G8III        |
| 80047                 | 1424 | 4.68  | 16 20 20.8056                                         | −78 41 44.682   | −3.3705                           | −36.5900                           | 4.260                   | −12.00                   | M5III        |
| 80112 <sub>A</sub>    | 607  | 2.90  | 16 21 11.3160                                         | −25 35 34.067   | −0.7414                           | −18.0300                           | 4.440                   | −0.40                    | B1III        |
| 80170                 | 609  | 3.74  | 16 21 55.2144                                         | +19 09 11.269   | −3.3480                           | 44.6104                            | 16.690                  | −35.30                   | A9III        |
| 80179                 | 1427 | 4.82  | 16 22 04.3490                                         | + 1 01 44.541   | −10.4027                          | 48.0914                            | 36.560                  | −45.50                   | F0V          |
| 80463                 | 613  | 4.57  | 16 25 24.9533                                         | +14 01 59.770   | 2.7068                            | −59.8901                           | 13.870                  | −6.60                    | B9p Cr       |
| 80650                 | 619  | 4.94  | 16 27 59.0137                                         | +68 46 05.294   | −4.5157                           | 33.8200                            | 6.640                   | −6.70                    | A0III        |
| 80686                 | 610  | 4.90  | 16 28 28.1436                                         | −70 05 03.843   | 39.1200                           | 110.7733                           | 82.609                  | 8.50                     | F9V          |
| 80763                 | 616  | 1.06  | 16 29 24.4609                                         | −26 25 55.209   | −0.7564                           | −23.2100                           | 5.400                   | −3.20                    | M1Ib + B2.5V |
| 80816 <sub>cg</sub> * | 618  | 2.78  | 16 30 13.2000                                         | +21 29 22.608   | −7.0523                           | −14.4903                           | 22.070                  | −25.50                   | G8III        |
| 80911                 | 1431 | 4.24  | 16 31 22.9333                                         | −34 42 15.718   | −0.9334                           | −18.5600                           | 4.370                   | 1.00                     | B2III-IV     |
| 81065                 | 611  | 3.86  | 16 33 27.0835                                         | −78 53 49.732   | −43.5102                          | −77.5864                           | 20.440                  | 6.10                     | K0IV SB      |
| 81126                 | 621  | 4.20  | 16 34 06.1821                                         | +42 26 13.348   | −0.8157                           | 59.8001                            | 10.790                  | −10.90                   | B9Vvar       |
| 81266                 | 620  | 2.82  | 16 35 52.9537                                         | −28 12 57.658   | −0.6499                           | −22.5000                           | 7.590                   | 2.00                     | B0V          |
| 81377                 | 622  | 2.54  | 16 37 09.5378                                         | −10 34 01.524   | 0.8864                            | 25.4400                            | 7.120                   | −15.00                   | O9.5V        |
| 81497                 | 1434 | 4.86  | 16 38 44.8453                                         | +48 55 42.033   | −4.8808                           | 26.8101                            | 8.670                   | −55.20                   | M2.5III      |
| 81724                 | 624  | 4.91  | 16 41 34.3830                                         | −17 44 31.801   | −1.5161                           | −0.9200                            | 8.340                   | −24.40                   | G8II/III     |
| 81833                 | 626  | 3.48  | 16 42 53.7652                                         | +38 55 20.116   | 3.0488                            | −84.9797                           | 29.110                  | 8.10                     | G8III-IV     |
| 82020 <sub>cg</sub>   | 627  | 4.84  | 16 45 17.8177                                         | +56 46 54.686   | 3.2017                            | 69.9600                            | 37.410                  | 0.00                     | F2V          |
| 82273                 | 625  | 1.91  | 16 48 39.8949                                         | −69 01 39.774   | 3.3248                            | −32.9200                           | 7.850                   | −3.30                    | K2IIb-IIIa   |
| 82363                 | 1435 | 3.77  | 16 49 47.1563                                         | −59 02 28.961   | 5.1307                            | −25.2798                           | 10.410                  | 9.00                     | K5III        |
| 82369                 | 1438 | 4.64  | 16 49 50.0288                                         | −10 46 58.799   | 6.3590                            | −81.9400                           | 27.040                  | −0.60                    | F7IV         |
| 82396                 | 628  | 2.29  | 16 50 09.8130                                         | −34 17 35.634   | −49.3716                          | −255.8597                          | 49.850                  | −2.50                    | K2IIIb       |
| 82504                 | 1440 | 5.03  | 16 51 45.2620                                         | +24 39 23.158   | 0.7556                            | 5.4500                             | 4.300                   | −15.70                   | K2II-III     |
| 82514 <sub>ph</sub>   | 1439 | 3.00  | 16 51 52.2323                                         | −38 02 50.567   | −0.7484                           | −21.6000                           | 3.970                   | −25.00                   | B1.5IV + B   |
| 82673                 | 1442 | 4.39  | 16 54 00.4715                                         | +10 09 55.293   | −3.6405                           | −34.6802                           | 13.950                  | −21.00                   | B8V          |
| 83000                 | 633  | 3.19  | 16 57 40.0974                                         | + 9 22 30.118   | −19.8005                          | −9.7010                            | 37.991                  | −55.60                   | K2IIIvar     |
| 83081                 | 631  | 3.12  | 16 58 37.2117                                         | −55 59 24.507   | −2.1824                           | −35.2900                           | 5.680                   | −6.00                    | K5III        |
| 83153                 | 632  | 4.06  | 16 59 35.0477                                         | −53 09 37.576   | 0.1245                            | 21.5299                            | 10.720                  | 23.10                    | K4III        |
| 83207                 | 634  | 3.92  | 17 00 17.3738                                         | +30 55 35.057   | −3.7055                           | 26.8902                            | 20.040                  | −25.10                   | A0V          |
| 83262                 | 1445 | 4.82  | 17 01 03.6020                                         | − 4 13 21.517   | −2.6926                           | −77.9201                           | 8.110                   | −6.70                    | K4III        |
| 83613                 | 635  | 4.89  | 17 05 22.6905                                         | +12 44 26.980   | 3.4605                            | −11.0200                           | 22.680                  | −4.20                    | A4IV         |
| 83895                 | 639  | 3.17  | 17 08 47.1956                                         | +65 42 52.860   | −3.3651                           | 19.1500                            | 9.600                   | −14.10                   | B6III        |
| 84143                 | 638  | 3.32  | 17 12 09.1935                                         | −43 14 21.080   | 2.0142                            | −287.4163                          | 45.560                  | −27.00                   | F3p          |
| 84379                 | 641  | 3.12  | 17 15 01.9106                                         | +24 50 21.135   | −1.5530                           | −157.6848                          | 41.551                  | −41.00                   | A3IVv SB     |
| 84380                 | 643  | 3.16  | 17 15 02.8343                                         | +36 48 32.983   | −2.2774                           | 2.7000                             | 8.890                   | −25.70                   | K3IIvar      |
| 84833 <sub>ph</sub>   | 1454 | 5.01  | 17 20 18.8712                                         | +18 03 25.490   | 0.6304                            | −55.6903                           | 6.900                   | −46.00                   | M2III        |
| 84970                 | 644  | 3.27  | 17 22 00.5784                                         | −24 59 58.364   | −0.6503                           | −23.6400                           | 5.790                   | −3.60                    | B2IV         |
| 85258                 | 645  | 2.84  | 17 25 17.9887                                         | −55 31 47.583   | −0.9694                           | −24.7100                           | 5.410                   | −0.40                    | K3Ib-II      |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                   | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp         |
|-----------------------|------|-------|-------------------------------------------------------|-----------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|------------|
| 85340                 | 1457 | 4.16  | 17 <sup>h</sup> 26 <sup>m</sup> 22 <sup>s</sup> .2161 | −24°10′31″.114  | −0.1440                           | −117.6931                          | 38.961                  | −37.20                   | A3IV:m     |
| 85355                 | 1459 | 4.34  | 17 26 30.8803                                         | + 4 08 25.295   | 0.0836                            | 7.0900                             | 2.780                   | −27.10                   | K3IIvar    |
| 85365                 | 647  | 4.53  | 17 26 37.8814                                         | − 5 05 11.745   | −6.1261                           | −42.7500                           | 33.280                  | 0.40                     | F3V        |
| 85423                 | 646  | 4.28  | 17 27 21.2737                                         | −29 52 01.320   | 1.1055                            | −137.4073                          | 29.260                  | 37.30                    | F3III      |
| 85670*                | 653  | 2.79  | 17 30 25.9620                                         | +52 18 04.994   | −1.6996                           | 11.5700                            | 9.020                   | −20.00                   | G2II       |
| 85693                 | 1460 | 4.41  | 17 30 44.3100                                         | +26 06 38.323   | 1.3653                            | 16.7801                            | 8.880                   | −26.40                   | K3IIIvar   |
| 85696                 | 649  | 2.70  | 17 30 45.8357                                         | −37 17 44.920   | −0.3511                           | −29.1400                           | 6.290                   | 8.00                     | B2IV       |
| 85727 <sub>cg</sub>   | 648  | 3.60  | 17 31 05.9130                                         | −60 41 01.853   | −7.3049                           | −99.3694                           | 17.420                  | 12.00                    | B8V        |
| 85792                 | 651  | 2.84  | 17 31 50.4933                                         | −49 52 34.121   | −3.2348                           | −67.1500                           | 13.460                  | −2.00                    | B2Vne      |
| 85819                 | 655  | 4.89  | 17 32 10.5697                                         | +55 11 03.273   | 17.3436                           | 54.2391                            | 32.960                  | −15.20                   | Am...      |
| 85829                 | 657  | 4.86  | 17 32 16.0258                                         | +55 10 22.651   | 16.7760                           | 62.4593                            | 32.640                  | −16.00                   | Am         |
| 85927                 | 652  | 1.62  | 17 33 36.5200                                         | −37 06 13.756   | −0.7440                           | −29.9500                           | 4.640                   | 0.00                     | B1.5IV+... |
| 86032                 | 656  | 2.08  | 17 34 56.0706                                         | +12 33 36.125   | 7.5185                            | −222.6066                          | 69.839                  | 12.70                    | A5III      |
| 86201                 | 664  | 4.77  | 17 36 57.0921                                         | +68 45 28.691   | 0.2466                            | 321.0534                           | 42.620                  | −14.00                   | F5V        |
| 86228 <sub>A</sub>    | 654  | 1.86  | 17 37 19.1306                                         | −42 59 52.166   | 0.5524                            | −0.9500                            | 11.990                  | 1.40                     | F1II       |
| 86263                 | 658  | 3.54  | 17 37 35.2015                                         | −15 23 54.806   | −2.7176                           | −61.2714                           | 30.930                  | −42.80                   | F0IIp      |
| 86414                 | 663  | 3.82  | 17 39 27.8864                                         | +46 00 22.795   | −0.6882                           | 3.9700                             | 6.580                   | −20.00                   | B3V SB     |
| 86614 <sub>A</sub>    | 670  | 4.57  | 17 41 56.3577                                         | +72 08 55.836   | 5.7847                            | −269.7723                          | 45.380                  | −10.30                   | F5IV-V     |
| 86670                 | 660  | 2.39  | 17 42 29.2749                                         | −39 01 47.939   | −0.5570                           | −25.5500                           | 7.030                   | −14.00                   | B1.5III    |
| 86736                 | 1463 | 4.86  | 17 43 25.7935                                         | −21 40 59.498   | −7.0257                           | −44.5694                           | 57.000                  | 9.60                     | F6/F7V     |
| 86742                 | 665  | 2.76  | 17 43 28.3531                                         | + 4 34 02.290   | −2.7200                           | 158.8014                           | 39.780                  | −12.60                   | K2III      |
| 86929                 | 661  | 3.61  | 17 45 43.9873                                         | −64 43 25.937   | −1.7300                           | −56.3701                           | 8.790                   | −7.60                    | K1III      |
| 86974                 | 667  | 3.42  | 17 46 27.5269                                         | +27 43 14.434   | −21.9473                          | −750.0268                          | 119.052                 | −15.60                   | G5IV       |
| 87072                 | 1464 | 4.53  | 17 47 33.6247                                         | −27 49 50.839   | −0.2729                           | −10.6700                           | 3.030                   | −13.00                   | F7II       |
| 87073                 | 666  | 2.99  | 17 47 35.0815                                         | −40 07 37.191   | 0.0384                            | −6.4000                            | 1.820                   | −27.60                   | F3Ia       |
| 87108                 | 668  | 3.75  | 17 47 53.5605                                         | + 2 42 26.194   | −1.5451                           | −75.1202                           | 34.420                  | −5.00                    | A0V        |
| 87234                 | 675  | 5.02  | 17 49 27.0334                                         | +76 57 46.371   | 11.0328                           | 247.9829                           | 31.130                  | −23.00                   | F6IV-Vs    |
| 87261                 | 669  | 3.19  | 17 49 51.4820                                         | −37 02 35.893   | 3.5155                            | 27.7697                            | 25.710                  | 24.70                    | K0/K1III   |
| 87585                 | 671  | 3.73  | 17 53 31.7295                                         | +56 52 21.514   | 11.4244                           | 78.4405                            | 29.260                  | −25.70                   | K2III      |
| 87808                 | 672  | 3.86  | 17 56 15.1805                                         | +37 15 01.941   | 0.2295                            | 7.2400                             | 4.870                   | −27.20                   | K1IIvar    |
| 87833*                | 676  | 2.24  | 17 56 36.3699                                         | +51 29 20.022   | −0.9122                           | −23.0503                           | 22.100                  | −27.60                   | K5III      |
| 87933                 | 674  | 3.70  | 17 57 45.8857                                         | +29 14 52.367   | 6.2906                            | −18.7302                           | 24.120                  | −1.50                    | K0III      |
| 88048                 | 673  | 3.32  | 17 59 01.5915                                         | − 9 46 25.075   | −0.6975                           | −116.1194                          | 21.350                  | 12.60                    | K0III      |
| 88128                 | 1469 | 4.67  | 18 00 03.4161                                         | +16 45 03.308   | −0.5242                           | −10.6100                           | 4.970                   | −23.50                   | K0II-III   |
| 88192                 | 677  | 3.93  | 18 00 38.7158                                         | + 2 55 53.643   | 0.0274                            | −8.2200                            | 2.300                   | −4.40                    | B5Ib       |
| 88635                 | 679  | 2.98  | 18 05 48.4869                                         | −30 25 26.729   | −4.3101                           | −181.5275                          | 33.940                  | 22.00                    | K0III      |
| 88714                 | 1471 | 3.65  | 18 06 37.8711                                         | −50 05 29.318   | −0.8760                           | −9.2600                            | 3.220                   | 3.40                     | B2Ib       |
| 88771                 | 680  | 3.71  | 18 07 20.9842                                         | + 9 33 49.850   | −4.1646                           | 79.7113                            | 39.400                  | −23.90                   | A4IVs      |
| 88794                 | 681  | 3.84  | 18 07 32.5507                                         | +28 45 44.959   | −0.0129                           | 7.5100                             | 9.390                   | −29.50                   | B9.5V      |
| 89112                 | 1473 | 4.52  | 18 11 13.7626                                         | −45 57 15.903   | −1.5611                           | −37.2601                           | 7.980                   | −26.30                   | G5III      |
| 89341                 | 682  | 3.84  | 18 13 45.8098                                         | −21 03 31.801   | 0.1229                            | −1.3900                            | 0.110                   | −6.00                    | B2III:     |
| 89348                 | 685  | 4.99  | 18 13 53.8332                                         | +64 23 50.233   | 54.2479                           | 36.0400                            | 42.561                  | −35.60                   | F5V        |
| 89642                 | 683  | 3.10  | 18 17 37.6350                                         | −36 45 42.070   | −10.7573                          | −166.6094                          | 21.870                  | 0.50                     | M2III      |
| 89826                 | 1477 | 4.33  | 18 19 51.7096                                         | +36 03 52.371   | −1.3311                           | 41.3202                            | 13.710                  | −22.30                   | K2IIIvar   |
| 89918                 | 1476 | 4.85  | 18 20 52.0631                                         | + 3 22 37.795   | 0.1142                            | 8.4500                             | 12.110                  | 4.80                     | G8III      |
| 89931                 | 687  | 2.72  | 18 20 59.6418                                         | −29 49 41.172   | 2.3024                            | −26.3801                           | 10.670                  | −20.00                   | K3III      |
| 89937 <sub>cg</sub> * | 695  | 3.55  | 18 21 03.3826                                         | +72 43 58.235   | 119.2648                          | −351.6031                          | 124.106                 | 32.50                    | F7Vvar     |
| 89962                 | 688  | 3.23  | 18 21 18.6008                                         | − 2 53 55.770   | −36.5512                          | −700.7138                          | 52.810                  | 8.40                     | K0III-IV   |
| 90098                 | 686  | 4.35  | 18 23 13.6212                                         | −61 29 38.043   | 0.0740                            | 1.7000                             | 7.760                   | 12.20                    | M1III SB   |
| 90139                 | 690  | 3.85  | 18 23 41.8896                                         | +21 46 11.107   | 14.0374                           | −242.9270                          | 25.400                  | −57.50                   | K2III      |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                 | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp           |
|---------------------|------|-------|-------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|--------------|
| 90185               | 689  | 1.79  | 18 <sup>h</sup> 24 <sup>m</sup> 10 <sup>s</sup> .3183 | −34°23′04″.618  | −3.1998                  | −124.0505                 | 22.550         | −11.00          | B9.5III      |
| 90422               | 691  | 3.49  | 18 26 58.4163                                         | −45 58 06.452   | −1.5999                  | −53.3300                  | 13.080         | −0.20           | B3IV         |
| 90496               | 692  | 2.82  | 18 27 58.2406                                         | −25 25 18.120   | −3.3077                  | −186.2961                 | 42.201         | −43.50          | K1IIIb       |
| 90595               | 696  | 4.67  | 18 29 11.8538                                         | −14 33 56.928   | 0.2115                   | −3.4800                   | 11.190         | −41.00          | A1IV/V       |
| 90982               | 697  | 4.62  | 18 33 30.1857                                         | −42 18 45.035   | 2.9282                   | −21.0300                  | 3.760          | −2.10           | G5III        |
| 91117               | 1482 | 3.85  | 18 35 12.4267                                         | − 8 14 38.662   | −1.2785                  | −314.6262                 | 18.720         | 35.80           | K2III        |
| 91262*              | 699  | 0.03  | 18 36 56.3364                                         | +38 47 01.291   | 17.1926                  | 287.4676                  | 128.932        | −13.50          | A0Vvar       |
| 91726               | 1486 | 4.70  | 18 42 16.4268                                         | − 9 03 09.175   | 0.5313                   | 2.0200                    | 17.440         | −45.30          | F2IIIp d Del |
| 91792               | 698  | 4.01  | 18 43 02.1361                                         | −71 25 41.208   | 0.2616                   | −158.2907                 | 15.550         | −17.00          | K2III        |
| 91845               | 702  | 4.88  | 18 43 31.2528                                         | − 8 16 30.773   | 1.4343                   | 11.5800                   | 6.240          | −10.60          | G8II         |
| 92041               | 1487 | 3.17  | 18 45 39.3865                                         | −26 59 26.802   | 3.8268                   | 0.4501                    | 14.140         | 21.50           | B8.5III      |
| 92043               | 703  | 4.19  | 18 45 39.7254                                         | +20 32 46.708   | −0.6585                  | −335.6425                 | 52.369         | 23.70           | F6V          |
| 92088               | 1488 | 4.83  | 18 46 04.4803                                         | +26 39 43.667   | 1.3935                   | 24.3901                   | 12.960         | −16.70          | K3III        |
| 92161               | 1491 | 4.34  | 18 47 01.2738                                         | +18 10 53.468   | 5.8762                   | 119.0132                  | 35.170         | −44.60          | A5III        |
| 92175 <sub>cg</sub> | 1489 | 4.22  | 18 47 10.4728                                         | − 4 44 52.322   | −0.5158                  | −15.8900                  | 4.730          | −21.50          | G5II...      |
| 92420               | 705  | 3.52  | 18 50 04.7947                                         | +33 21 45.601   | 0.0878                   | −4.4600                   | 3.700          | −19.20          | A8:V comp SB |
| 92512 <sub>cg</sub> | 707  | 4.63  | 18 51 12.0955                                         | +59 23 18.063   | 10.1542                  | 25.4297                   | 10.120         | −19.50          | K0II-III SB  |
| 92609               | 704  | 4.22  | 18 52 13.0349                                         | −62 11 15.337   | −0.1900                  | −13.5300                  | 1.800          | 9.00            | B2II-III     |
| 92782*              | 714  | 4.82  | 18 54 23.8547                                         | +71 17 49.891   | 10.1022                  | 42.1098                   | 9.470          | −7.10           | K0III        |
| 92855*              | 706  | 2.05  | 18 55 15.9257                                         | −26 17 48.200   | 1.0314                   | −52.6501                  | 14.540         | −11.20          | B2.5V        |
| 92862               | 711  | 4.08  | 18 55 20.1013                                         | +43 56 45.919   | 1.8463                   | 80.6004                   | 9.330          | −28.30          | M5IIIvar     |
| 92946 <sub>A</sub>  | 709  | 4.62  | 18 56 13.1824                                         | + 4 12 12.942   | 2.5195                   | 26.9805                   | 24.730         | −45.00          | A5V          |
| 93085               | 710  | 3.52  | 18 57 43.8016                                         | −21 06 23.955   | 2.4947                   | −12.3300                  | 8.760          | −19.90          | G8/K0II/III  |
| 93148               | 708  | 4.85  | 18 58 27.7664                                         | −52 56 19.064   | 1.2754                   | −8.8100                   | 6.140          | −2.00           | A0V          |
| 93194               | 713  | 3.25  | 18 58 56.6227                                         | +32 41 22.407   | −0.2186                  | 1.7700                    | 5.140          | −21.50          | B9III        |
| 93244 <sub>cg</sub> | 712  | 4.02  | 18 59 37.3574                                         | +15 04 05.873   | −3.6371                  | −73.8114                  | 21.220         | −48.00          | K2III        |
| 93747               | 716  | 2.99  | 19 05 24.6082                                         | +13 51 48.521   | −0.4834                  | −95.3118                  | 39.180         | −26.30          | A0Vn         |
| 93805               | 717  | 3.43  | 19 06 14.9384                                         | − 4 52 57.195   | −1.3168                  | −90.3705                  | 26.050         | −12.00          | B9Vn         |
| 93864 <sub>cg</sub> | 1496 | 3.32  | 19 06 56.4089                                         | −27 40 13.523   | −3.8232                  | −250.5044                 | 27.090         | 45.40           | K1/K2III     |
| 93903               | 719  | 5.25  | 19 07 18.1290                                         | +36 06 00.566   | −0.0528                  | −4.2800                   | 3.920          | −18.00          | B6IV         |
| 94114               | 718  | 4.11  | 19 09 28.3417                                         | −37 54 16.108   | 7.2435                   | −96.6506                  | 25.150         | −18.40          | A0/A1V       |
| 94141               | 720  | 2.88  | 19 09 45.8330                                         | −21 01 25.013   | −0.0836                  | −36.8300                  | 7.410          | −9.80           | F2II/III     |
| 94376               | 723  | 3.07  | 19 12 33.3000                                         | +67 39 41.549   | 16.5737                  | 92.2977                   | 32.540         | 24.80           | G9III        |
| 94648*              | 729  | 4.45  | 19 15 33.0562                                         | +73 21 19.685   | −27.1391                 | 104.2493                  | 21.730         | −29.70          | K3III        |
| 94713               | 724  | 4.35  | 19 16 22.0951                                         | +38 08 01.431   | −0.0415                  | 1.2300                    | 4.240          | −30.90          | K0II         |
| 94779               | 726  | 3.80  | 19 17 06.1688                                         | +53 22 06.454   | 6.7286                   | 122.9315                  | 26.480         | −29.30          | K0III        |
| 94820               | 722  | 4.88  | 19 17 38.0794                                         | −18 57 10.469   | −0.7084                  | −10.6400                  | 6.090          | 15.20           | K0III        |
| 94834               | 725  | 5.28  | 19 17 48.9986                                         | +11 35 43.519   | 0.0170                   | 12.6200                   | 7.720          | −14.30          | F0IV         |
| 95176               | 727  | 4.52  | 19 21 43.6231                                         | −15 57 18.063   | 0.1241                   | −6.2700                   | 1.950          | 8.90            | F2p          |
| 95241               | 1502 | 3.96  | 19 22 38.2925                                         | −44 27 32.273   | 0.6828                   | −22.4300                  | 8.620          | −8.60           | B9V          |
| 95347               | 728  | 3.96  | 19 23 53.1765                                         | −40 36 57.384   | 2.8692                   | −120.8100                 | 19.200         | −0.70           | B8V          |
| 95501 <sub>cg</sub> | 730  | 3.36  | 19 25 29.9005                                         | + 3 06 53.191   | 16.8962                  | 80.6727                   | 65.051         | −29.90          | F0IV         |
| 95771               | 1508 | 4.44  | 19 28 42.3299                                         | +24 39 53.657   | −9.2765                  | −106.9921                 | 11.000         | −85.50          | M0 comp      |
| 95853*              | 733  | 3.76  | 19 29 42.3590                                         | +51 43 47.204   | 2.2518                   | 128.1212                  | 26.630         | −19.50          | A5Vn         |
| 95947 <sub>A</sub>  | 732  | 3.05  | 19 30 43.2806                                         | +27 57 34.852   | −0.5351                  | −5.6300                   | 8.460          | −24.00          | K3II+...     |
| 96052               | 1510 | 4.74  | 19 31 46.3218                                         | +34 27 10.686   | 0.0857                   | −3.5800                   | 5.200          | −21.80          | B3IV         |
| 96229               | 1511 | 4.45  | 19 34 05.3529                                         | + 7 22 44.189   | 14.3026                  | −155.3922                 | 29.500         | −23.90          | K3III        |
| 96341               | 735  | 4.88  | 19 35 12.9876                                         | −48 05 57.126   | −0.7028                  | −37.4299                  | 8.190          | 22.30           | G9III        |
| 96441               | 738  | 4.49  | 19 36 26.5350                                         | +50 13 15.970   | −0.8492                  | 262.9871                  | 53.781         | −28.00          | F4V          |
| 96465               | 736  | 4.59  | 19 36 42.4332                                         | −24 53 01.043   | 5.0487                   | −23.1900                  | 17.240         | −19.00          | B8/B9V       |

**POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0**

| HIP                  | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp           |
|----------------------|------|-------|-------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|--------------|
| 96483                | 737  | 4.93  | 19 <sup>h</sup> 36 <sup>m</sup> 53. <sup>s</sup> 4493 | − 7°01′38″918   | 0.0867                   | −2.6900                   | 2.240          | −19.40          | B0.5III      |
| 96837                | 1513 | 4.39  | 19 41 02.9392                                         | +17 28 33.748   | 0.6332                   | −33.9001                  | 6.990          | −22.40          | G8II         |
| 96950                | 1514 | 5.06  | 19 42 31.1338                                         | −16 07 26.387   | 4.7037                   | −9.2300                   | 18.670         | −28.00          | F3IV/V       |
| 97118                | 740  | 4.89  | 19 44 16.6049                                         | +37 21 15.678   | 6.0872                   | 35.1400                   | 11.700         | −24.40          | G8III        |
| 97278                | 741  | 2.72  | 19 46 15.5795                                         | +10 36 47.740   | 1.0662                   | −3.0800                   | 7.080          | −2.10           | K3II         |
| 97290                | 1517 | 4.87  | 19 46 21.7394                                         | −19 45 40.007   | −9.1303                  | −89.8092                  | 15.920         | 19.80           | K0III        |
| 97365 <sub>ph</sub>  | 743  | 3.68  | 19 47 23.2624                                         | +18 32 03.430   | −0.3220                  | 11.1000                   | 7.280          | 2.50            | M2II + B6    |
| 97649*               | 745  | 0.76  | 19 50 46.9990                                         | + 8 52 05.959   | 36.2244                  | 385.5734                  | 194.449        | −26.30          | A7IV-V       |
| 97804                | 746  | 3.87  | 19 52 28.3679                                         | + 1 00 20.378   | 0.4627                   | −7.3000                   | 2.780          | −14.80          | F6Ibv SB     |
| 98032                | 1520 | 4.12  | 19 55 15.6974                                         | −41 52 05.837   | 2.0921                   | 51.5995                   | 17.240         | 35.80           | K0III        |
| 98036                | 749  | 3.71  | 19 55 18.7934                                         | + 6 24 24.348   | 3.1096                   | −481.3450                 | 72.952         | −39.80          | G8IVvar      |
| 98110                | 1521 | 3.89  | 19 56 18.3719                                         | +35 05 00.325   | −2.7699                  | −27.6003                  | 23.400         | −26.50          | K0IIIvar     |
| 98258                | 1522 | 5.01  | 19 57 57.0311                                         | −15 29 29.365   | 1.2335                   | −93.6601                  | 11.180         | −4.00           | A2V          |
| 98337                | 752  | 3.51  | 19 58 45.4275                                         | +19 29 31.732   | 4.5523                   | 22.5801                   | 11.900         | −32.80          | K5III        |
| 98412                | 751  | 4.37  | 19 59 44.1786                                         | −35 16 34.700   | 0.4916                   | −25.1500                  | 5.280          | 0.90            | B2.5IV       |
| 98495                | 748  | 3.97  | 20 00 35.5532                                         | −72 54 37.813   | 18.2718                  | −131.3392                 | 30.730         | −1.50           | A0V          |
| 98543                | 1523 | 4.66  | 20 01 06.0483                                         | +27 45 12.863   | 4.3686                   | 3.7599                    | 14.670         | −20.90          | A4III        |
| 98688                | 753  | 4.43  | 20 02 39.4806                                         | −27 42 35.441   | 2.4308                   | 14.3500                   | 7.280          | 9.90            | M4III        |
| 99120                | 755  | 4.93  | 20 07 23.1563                                         | −52 52 50.855   | −1.4052                  | 6.8800                    | 2.600          | 36.00           | M1III        |
| 99240                | 754  | 3.55  | 20 08 43.6084                                         | −66 10 55.446   | 199.8353                 | −1130.2698                | 163.735        | −21.30          | G5IV-Vvar    |
| 99255 <sub>A</sub>   | 759  | 4.38  | 20 08 53.3469                                         | +77 42 41.110   | 3.4800                   | 23.7201                   | 9.970          | −22.70          | B9III        |
| 99303                | 1525 | 4.93  | 20 09 25.6190                                         | +36 50 22.638   | 0.2624                   | 12.9600                   | 3.790          | −13.60          | B2.5V        |
| 99473 <sub>cg</sub>  | 756  | 3.24  | 20 11 18.2855                                         | − 0 49 17.260   | 2.3656                   | 6.0500                    | 11.360         | −27.30          | B9.5III      |
| 99655                | 758  | 4.28  | 20 13 23.8656                                         | +56 34 03.800   | 7.3631                   | 82.2603                   | 21.410         | −18.00          | A3IV-Vn      |
| 99675 <sub>cg</sub>  | 757  | 3.80  | 20 13 37.9063                                         | +46 44 28.783   | 0.4086                   | 1.8700                    | 2.410          | −6.90           | K2II+...     |
| 99742                | 1526 | 4.94  | 20 14 16.6193                                         | +15 11 51.391   | 3.8472                   | 57.9805                   | 21.240         | −23.00          | A2V          |
| 100027 <sub>A</sub>  | 1527 | 4.30  | 20 17 38.8694                                         | −12 30 29.564   | 1.5187                   | 0.7500                    | 4.750          | −25.90          | G3Ib         |
| 100064               | 761  | 3.58  | 20 18 03.2554                                         | −12 32 41.467   | 4.2194                   | 2.8500                    | 30.010         | 0.40            | G6/G8III     |
| 100345 <sub>cg</sub> | 762  | 3.05  | 20 21 00.6756                                         | −14 46 52.922   | 3.3385                   | 14.0001                   | 9.480          | −18.90          | A5:n         |
| 100453               | 765  | 2.23  | 20 22 13.7019                                         | +40 15 24.045   | 0.2123                   | −0.9300                   | 2.140          | −7.50           | F8Ib         |
| 100751               | 764  | 1.94  | 20 25 38.8578                                         | −56 44 06.324   | 0.9371                   | −86.1499                  | 17.800         | 2.00            | B2IV         |
| 101076               | 1534 | 4.01  | 20 29 23.7356                                         | +30 22 06.798   | 0.5308                   | −0.6400                   | 4.300          | −18.40          | F5II         |
| 101093 <sub>cg</sub> | 767  | 4.21  | 20 29 34.8851                                         | +62 59 38.778   | 6.6067                   | −13.3102                  | 24.040         | −8.00           | A7III        |
| 101101               | 1533 | 4.91  | 20 29 39.0006                                         | − 2 53 07.911   | 4.7981                   | −22.3901                  | 17.080         | −23.30          | K2III        |
| 101260               | 770  | 5.18  | 20 31 30.4132                                         | +74 57 16.630   | 1.6334                   | −16.4700                  | 7.820          | 9.20            | A0p...       |
| 101421               | 768  | 4.03  | 20 33 12.7712                                         | +11 18 11.746   | 0.7308                   | −28.5401                  | 9.090          | −19.30          | B6III        |
| 101772               | 769  | 3.11  | 20 37 34.0320                                         | −47 17 29.406   | 4.8358                   | 66.0702                   | 32.210         | −1.10           | K0III        |
| 101867               | 1539 | 4.81  | 20 38 31.3389                                         | +21 12 04.225   | 5.3187                   | −2.4801                   | 15.270         | −18.40          | A0V          |
| 101958 <sub>ph</sub> | 774  | 3.77  | 20 39 38.2874                                         | +15 54 43.459   | 3.7531                   | 7.9100                    | 13.550         | −6.00           | B9V          |
| 102098*              | 777  | 1.25  | 20 41 25.9147                                         | +45 16 49.217   | 0.1478                   | 1.5500                    | 1.010          | −4.50           | A2Ia         |
| 102281               | 778  | 4.43  | 20 43 27.5339                                         | +15 04 28.491   | −1.3539                  | −41.7399                  | 16.030         | 9.30            | A7IIIp d Del |
| 102333               | 776  | 4.51  | 20 44 02.3338                                         | −51 55 15.495   | 16.8076                  | −53.6388                  | 41.380         | −1.60           | A6:var       |
| 102395               | 775  | 3.42  | 20 44 57.4944                                         | −66 12 11.565   | −7.0054                  | 10.5701                   | 23.710         | 9.80            | A5IV         |
| 102422               | 783  | 3.41  | 20 45 17.3750                                         | +61 50 19.615   | 12.1615                  | 817.9785                  | 69.734         | −87.30          | K0IV         |
| 102431               | 782  | 4.52  | 20 45 21.1281                                         | +57 34 47.012   | −7.8278                  | −235.5651                 | 36.870         | −31.40          | F8IV-V       |
| 102485               | 779  | 4.13  | 20 46 05.7330                                         | −25 16 15.231   | −3.7877                  | −156.6550                 | 68.159         | 25.80           | F5V          |
| 102488               | 780  | 2.48  | 20 46 12.6827                                         | +33 58 12.922   | 28.6309                  | 330.2791                  | 45.260         | −10.30          | K0III        |
| 102532 <sub>A</sub>  | 1541 | 4.27  | 20 46 39.5023                                         | +16 07 27.466   | −1.7960                  | −196.2708                 | 32.140         | −6.60           | K1IV         |
| 102618               | 781  | 3.78  | 20 47 40.5514                                         | − 9 29 44.793   | 2.1555                   | −35.3201                  | 14.210         | −16.00          | A1V          |
| 102624               | 1543 | 4.43  | 20 47 44.2360                                         | − 5 01 39.723   | −0.2208                  | −40.2401                  | 7.330          | −22.00          | M3IIIvar     |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                  | FK5  | magn. | $\alpha_{ICRF}$                                      | $\delta_{ICRF}$  | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp          |
|----------------------|------|-------|------------------------------------------------------|------------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|-------------|
| 102693               | 1542 | 5.11  | 20 <sup>h</sup> 48 <sup>m</sup> 29.1421 <sup>s</sup> | −43° 59′ 18.758″ | 16.2879                           | −112.1696                          | 24.350                  | −18.20                   | F1IV        |
| 102978               | 1546 | 4.12  | 20 51 49.2910                                        | −26 55 08.877    | −0.5959                           | −2.5400                            | 5.190                   | 9.00                     | K4III       |
| 103045               | 1547 | 4.73  | 20 52 39.2336                                        | − 8 58 59.944    | 3.1763                            | −32.9101                           | 21.010                  | −9.10                    | A3m         |
| 103227               | 785  | 3.67  | 20 54 48.6031                                        | −58 27 14.957    | 2.6836                            | −24.7500                           | 5.410                   | −4.90                    | K0III       |
| 103413 <sub>ph</sub> | 788  | 3.94  | 20 57 10.4182                                        | +41 10 01.688    | 0.7536                            | −23.9701                           | 9.170                   | −27.00                   | A1Vn        |
| 103632 <sub>ph</sub> | 1551 | 4.74  | 20 59 49.5565                                        | +47 31 15.424    | 0.7157                            | 2.4700                             | 2.900                   | 1.00                     | B1ne        |
| 103738               | 1550 | 4.67  | 21 01 17.4602                                        | −32 15 27.962    | −0.1648                           | −0.1900                            | 14.590                  | 17.60                    | G8III       |
| 104060               | 792  | 3.72  | 21 04 55.8628                                        | +43 55 40.267    | 0.7961                            | 0.3500                             | 2.770                   | −19.70                   | K5Ibv SB    |
| 104139               | 1552 | 4.08  | 21 05 56.8280                                        | −17 13 58.299    | 5.5589                            | −61.6402                           | 20.610                  | −10.90                   | A1V         |
| 104234               | 791  | 4.49  | 21 07 07.6679                                        | −25 00 21.072    | −2.0001                           | −43.3698                           | 6.240                   | 31.90                    | K5/M0III    |
| 104459               | 794  | 4.50  | 21 09 35.6477                                        | −11 22 18.095    | 6.2773                            | −15.7600                           | 19.930                  | −11.80                   | G8III       |
| 104521 <sub>A</sub>  | 1555 | 4.70  | 21 10 20.5002                                        | +10 07 53.686    | 3.3232                            | −151.8513                          | 28.380                  | −17.00                   | F0p         |
| 104732               | 797  | 3.21  | 21 12 56.1862                                        | +30 13 36.897    | 0.5301                            | −68.1195                           | 21.620                  | 17.40                    | G8II SB     |
| 104755               | 1554 | 5.06  | 21 13 20.5095                                        | −70 07 34.560    | 8.1228                            | −20.3398                           | 3.670                   | −19.00                   | M2III       |
| 104987               | 800  | 3.92  | 21 15 49.4317                                        | + 5 14 52.241    | 3.9921                            | −94.3305                           | 17.510                  | −16.20                   | G0III+...   |
| 105102               | 1558 | 4.22  | 21 17 24.9529                                        | +39 23 40.853    | 0.0371                            | −3.6100                            | 0.720                   | −4.10                    | B9Iab       |
| 105138               | 1559 | 4.41  | 21 17 55.0764                                        | +34 53 48.832    | 0.9721                            | 6.8500                             | 3.620                   | 4.00                     | B2Vne       |
| 105140               | 801  | 4.71  | 21 17 56.2848                                        | −32 10 21.141    | 4.3681                            | −22.1199                           | 19.760                  | −1.00                    | A0V         |
| 105199*              | 803  | 2.45  | 21 18 34.7715                                        | +62 35 08.061    | 21.7065                           | 48.2688                            | 66.841                  | −11.50                   | A7IV-V      |
| 105382 <sub>ph</sub> | 802  | 4.80  | 21 20 45.6423                                        | −40 48 34.076    | 6.7099                            | 17.6602                            | 17.490                  | 2.30                     | A2p         |
| 105502               | 804  | 4.08  | 21 22 05.1996                                        | +19 48 16.229    | 7.5069                            | 62.6116                            | 21.190                  | −76.20                   | K1III       |
| 105515               | 1561 | 4.28  | 21 22 14.7962                                        | −16 50 04.353    | 2.1474                            | 5.2600                             | 15.130                  | 11.50                    | G8III       |
| 105858               | 805  | 4.21  | 21 26 26.6056                                        | −65 21 58.314    | 12.9679                           | 800.7263                           | 108.503                 | −29.40                   | F6V         |
| 105881               | 806  | 3.77  | 21 26 40.0261                                        | −22 24 40.797    | −0.1882                           | 18.8800                            | 8.190                   | 3.00                     | G4Ibp...    |
| 106032*              | 809  | 3.23  | 21 28 39.5971                                        | +70 33 38.578    | 2.5240                            | 8.7300                             | 5.480                   | −8.20                    | B2IIIv SB   |
| 106140               | 1565 | 4.52  | 21 29 56.8952                                        | +23 38 19.816    | 1.7749                            | 3.5200                             | 7.370                   | −18.90                   | M1III       |
| 106278               | 808  | 2.90  | 21 31 33.5340                                        | − 5 34 16.220    | 1.5265                            | −6.7000                            | 5.330                   | 6.50                     | G0Ib        |
| 106481               | 1568 | 3.98  | 21 33 58.8525                                        | +45 35 30.615    | −2.3322                           | −93.8797                           | 26.200                  | 6.90                     | G8III       |
| 106711 <sub>cg</sub> | 811  | 5.04  | 21 36 56.9759                                        | +40 24 48.675    | −0.1313                           | 12.4700                            | 15.790                  | 7.00                     | A5V         |
| 106786               | 1569 | 4.68  | 21 37 45.1094                                        | − 7 51 15.125    | 7.6915                            | −24.4401                           | 18.260                  | −18.00                   | A7V         |
| 106985 <sub>cg</sub> | 812  | 3.69  | 21 40 05.4563                                        | −16 39 44.308    | 13.0404                           | −22.3298                           | 23.480                  | −31.20                   | A7III:mp... |
| 107089               | 810  | 3.73  | 21 41 28.6463                                        | −77 23 24.167    | 19.7976                           | −240.3722                          | 47.219                  | 34.40                    | K0III       |
| 107119*              | 817  | 4.55  | 21 41 55.2936                                        | +71 18 41.100    | 24.8593                           | 94.4894                            | 18.550                  | −36.60                   | K0III       |
| 107315*              | 815  | 2.38  | 21 44 11.1581                                        | + 9 52 30.041    | 2.0314                            | 1.3800                             | 4.850                   | 4.70                     | K2Ibvar     |
| 107380               | 814  | 4.35  | 21 44 56.8099                                        | −33 01 32.814    | 2.5278                            | −93.9999                           | 15.930                  | 1.90                     | B9.5V       |
| 107418               | 1572 | 4.25  | 21 45 26.9256                                        | +61 07 14.901    | −0.4252                           | −1.8600                            | 0.640                   | −20.80                   | A2Iavar     |
| 107533 <sub>ph</sub> | 821  | 4.23  | 21 46 47.6091                                        | +49 18 34.453    | 0.3691                            | −1.8600                            | 2.820                   | −12.30                   | B3III       |
| 107556               | 819  | 2.85  | 21 47 02.4451                                        | −16 07 38.229    | 18.2699                           | −296.2320                          | 84.580                  | −6.30                    | A5mF2 (IV)  |
| 107763               | 1575 | 5.07  | 21 49 50.6947                                        | +30 10 27.174    | 1.4567                            | −26.1401                           | 10.780                  | −22.90                   | A1Vs        |
| 108022               | 823  | 5.09  | 21 53 03.7685                                        | +25 55 30.503    | 0.6760                            | 0.3400                             | 6.370                   | −12.00                   | B3V         |
| 108036               | 1577 | 5.08  | 21 53 17.7717                                        | −13 33 06.365    | 21.4666                           | 13.6712                            | 36.150                  | −21.50                   | F3IV        |
| 108085               | 822  | 3.00  | 21 53 55.7245                                        | −37 21 53.468    | 8.0424                            | −12.0997                           | 16.070                  | −2.10                    | B8III       |
| 108431 <sub>ph</sub> | 824  | 4.40  | 21 57 55.0747                                        | −54 59 33.272    | 4.9969                            | −3.6699                            | 17.650                  | 15.00                    | F0IV        |
| 108870               | 825  | 4.69  | 22 03 21.6571                                        | −56 47 09.514    | 482.1257                          | −2538.3198                         | 275.787                 | −39.58                   | K5V         |
| 109074               | 827  | 2.95  | 22 05 47.0357                                        | − 0 19 11.463    | 1.1934                            | −9.9300                            | 4.300                   | 7.50                     | G2Ib        |
| 109111               | 1581 | 4.47  | 22 06 06.8854                                        | −39 32 36.072    | −2.0887                           | −125.1688                          | 13.200                  | 38.80                    | M0III       |
| 109139               | 828  | 4.29  | 22 06 26.2297                                        | −13 52 10.845    | 2.7777                            | −57.1602                           | 18.900                  | −10.00                   | B8V         |
| 109176               | 831  | 3.77  | 22 07 00.6661                                        | +25 20 42.402    | 21.8891                           | 26.9284                            | 85.060                  | −4.30                    | F5V         |
| 109268               | 829  | 1.73  | 22 08 13.9855                                        | −46 57 39.512    | 12.4640                           | −147.9083                          | 32.160                  | 11.80                    | B7IV        |
| 109285               | 832  | 4.50  | 22 08 23.0089                                        | −32 59 18.486    | 6.3624                            | −28.8797                           | 25.010                  | 11.60                    | A2V         |



# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                  | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ <i>ms/rok</i> ] | $\mu_\delta$<br>[ <i>mas/rok</i> ] | $\pi$<br>[ <i>mas</i> ] | $V_R$<br>[ <i>km/s</i> ] | Sp          |
|----------------------|------|-------|-------------------------------------------------------|-----------------|-----------------------------------|------------------------------------|-------------------------|--------------------------|-------------|
| 109400*              | 837  | 4.79  | 22 <sup>h</sup> 09 <sup>m</sup> 48 <sup>s</sup> .4312 | +72°20′28″.345  | 7.3381                            | 3.0899                             | 8.640                   | −14.80                   | G8III       |
| 109410               | 835  | 4.28  | 22 09 59.2440                                         | +33 10 41.606   | −0.9829                           | −17.9400                           | 12.960                  | 2.00                     | F5III       |
| 109427               | 834  | 3.52  | 22 10 11.9852                                         | + 6 11 52.314   | 18.9079                           | 31.2297                            | 33.770                  | −6.00                    | A2V         |
| 109492               | 836  | 3.39  | 22 10 51.2767                                         | +58 12 04.539   | 1.6890                            | 4.4900                             | 4.490                   | −18.40                   | K1Ibv SB    |
| 109754 <sub>A</sub>  | 1583 | 4.50  | 22 13 52.7300                                         | +39 42 53.737   | 3.2630                            | 15.5500                            | 5.790                   | −10.60                   | K3III       |
| 110003               | 840  | 4.17  | 22 16 50.0364                                         | − 7 46 59.845   | 8.0038                            | −21.9100                           | 17.040                  | −14.70                   | G8III-IV    |
| 110130 <sub>cg</sub> | 841  | 2.87  | 22 18 30.0942                                         | −60 15 34.515   | −9.6061                           | −38.1491                           | 16.420                  | 42.20                    | K3III       |
| 110256               | 839  | 5.09  | 22 20 01.6782                                         | −80 26 23.089   | 22.6232                           | −42.7791                           | 12.150                  | 11.70                    | M6III       |
| 110386               | 843  | 4.82  | 22 21 31.0750                                         | +12 12 18.670   | 0.4236                            | 5.5400                             | 3.360                   | 9.60                     | B2IV-V      |
| 110395               | 842  | 3.86  | 22 21 39.3754                                         | − 1 23 14.393   | 8.6186                            | 8.9001                             | 20.670                  | −15.00                   | A0V         |
| 110538               | 844  | 4.42  | 22 23 33.6235                                         | +52 13 44.567   | −1.4759                           | −186.3707                          | 19.210                  | −10.40                   | G9III       |
| 110672               | 1585 | 4.80  | 22 25 16.6232                                         | + 1 22 38.642   | 1.2257                            | 3.3500                             | 2.960                   | 4.00                     | B1Ve        |
| 110991               | 847  | 4.07  | 22 29 10.2663                                         | +58 24 54.715   | 2.0964                            | 3.5500                             | 3.320                   | −16.80                   | G2Ibvar     |
| 110997               | 846  | 3.97  | 22 29 16.1747                                         | −43 29 44.033   | 2.3545                            | −4.2300                            | 11.030                  | 4.90                     | G6/G8III    |
| 111123 <sub>A</sub>  | 1591 | 4.82  | 22 30 38.8161                                         | −10 40 40.620   | 0.1214                            | −26.2599                           | 12.290                  | 11.00                    | A0IVs       |
| 111169               | 848  | 3.76  | 22 31 17.5010                                         | +50 16 56.969   | 14.3161                           | 17.1491                            | 31.860                  | −4.00                    | A1V         |
| 111188               | 1592 | 4.29  | 22 31 30.3307                                         | −32 20 45.864   | 4.7063                            | −18.6999                           | 21.990                  | 6.30                     | A1V         |
| 111497               | 850  | 4.04  | 22 35 21.3806                                         | − 0 07 02.991   | 5.9040                            | −56.1001                           | 17.770                  | −8.00                    | B9IV-Vn     |
| 111841               | 852  | 4.89  | 22 39 15.6787                                         | +39 03 00.969   | −0.0249                           | −5.7000                            | 3.080                   | −9.70                    | O9V         |
| 111954               | 854  | 4.18  | 22 40 39.3400                                         | −27 02 37.021   | 1.6475                            | −0.8800                            | 4.380                   | 3.00                     | B8V         |
| 112029               | 855  | 3.41  | 22 41 27.7208                                         | +10 49 52.912   | 5.2522                            | −10.9800                           | 15.640                  | 7.00                     | B8.5V       |
| 112122               | 856  | 2.07  | 22 42 40.0507                                         | −46 53 04.477   | 13.2344                           | −4.5092                            | 19.170                  | 1.60                     | M5III       |
| 112158 <sub>cg</sub> | 857  | 2.93  | 22 43 00.1374                                         | +30 13 16.483   | 1.0115                            | −26.1100                           | 15.180                  | 4.30                     | G2II-III..  |
| 112440               | 859  | 3.97  | 22 46 31.8787                                         | +23 33 56.354   | 4.1450                            | −10.4601                           | 8.260                   | −4.10                    | G8II-III    |
| 112623               | 860  | 3.49  | 22 48 33.2984                                         | −51 19 00.710   | 11.5699                           | −65.9294                           | 25.160                  | −0.10                    | A3V         |
| 112716               | 861  | 4.05  | 22 49 35.5023                                         | −13 35 33.475   | −0.8628                           | −38.8000                           | 8.580                   | 1.00                     | K5III       |
| 112724               | 863  | 3.50  | 22 49 40.8166                                         | +66 12 01.468   | −10.9200                          | −124.7412                          | 28.270                  | −12.90                   | K0III       |
| 112748               | 862  | 3.51  | 22 50 00.1928                                         | +24 36 05.685   | 10.5664                           | −43.4401                           | 27.950                  | 14.10                    | M2III       |
| 112961 <sub>ph</sub> | 864  | 3.73  | 22 52 36.8759                                         | − 7 34 46.557   | 1.3121                            | 32.7100                            | 8.330                   | −8.80                    | M2IIIvar    |
| 113136               | 866  | 3.27  | 22 54 39.0125                                         | −15 49 14.953   | −3.0543                           | −24.8098                           | 20.440                  | 18.00                    | A3V         |
| 113368*              | 867  | 1.17  | 22 57 39.0465                                         | −29 37 20.050   | 25.2475                           | −164.2149                          | 130.079                 | 6.50                     | A3V         |
| 113638               | 868  | 4.11  | 23 00 52.8116                                         | −52 45 14.893   | −7.1697                           | −12.9098                           | 28.990                  | −1.10                    | G8III       |
| 113726 <sub>ph</sub> | 869  | 3.62  | 23 01 55.2642                                         | +42 19 33.525   | 2.0262                            | 0.2400                             | 4.710                   | −14.00                   | B6pv SB     |
| 113860 <sub>cg</sub> | 1601 | 5.12  | 23 03 29.8161                                         | −34 44 57.883   | 6.0691                            | 84.4509                            | 34.980                  | −14.00                   | A9V         |
| 113881               | 870  | 2.44  | 23 03 46.4575                                         | +28 04 58.041   | 14.1877                           | 137.6089                           | 16.370                  | 8.70                     | M2II-IIIvar |
| 113889               | 1602 | 4.48  | 23 03 52.6140                                         | + 3 49 12.163   | 0.8592                            | −10.1300                           | 6.620                   | 0.30                     | B6Ve        |
| 113963*              | 871  | 2.49  | 23 04 45.6538                                         | +15 12 18.952   | 4.2211                            | −42.5601                           | 23.360                  | −2.20                    | B9.5III     |
| 114144               | 1603 | 4.54  | 23 07 00.2598                                         | + 9 24 34.170   | 0.4548                            | −12.7600                           | 10.130                  | −5.40                    | M2III       |
| 114341               | 873  | 3.68  | 23 09 26.7971                                         | −21 10 20.675   | 4.0028                            | 31.2499                            | 13.960                  | 21.10                    | K1III       |
| 114421 <sub>cg</sub> | 1605 | 3.88  | 23 10 21.5377                                         | −45 14 48.161   | 12.5388                           | −26.2693                           | 17.630                  | −4.40                    | K0III SB    |
| 114520               | 1606 | 5.15  | 23 11 44.1896                                         | + 8 43 12.416   | −0.6023                           | −5.0500                            | 12.890                  | 10.00                    | A5Vn        |
| 114724               | 1607 | 4.22  | 23 14 19.3596                                         | − 6 02 56.410   | 3.0986                            | −195.8500                          | 14.680                  | −0.40                    | M2III       |
| 114855               | 1608 | 4.24  | 23 15 53.4947                                         | − 9 05 15.853   | 24.8833                           | −17.0193                           | 21.970                  | −26.40                   | K0III       |
| 114971               | 878  | 3.70  | 23 17 09.9379                                         | + 3 16 56.240   | 50.7736                           | 17.9587                            | 24.920                  | −13.60                   | G7III       |
| 114996               | 877  | 3.99  | 23 17 25.7733                                         | −58 14 08.643   | −4.4235                           | 79.5889                            | 45.400                  | 18.40                    | F1III       |
| 115102               | 879  | 4.41  | 23 18 49.4404                                         | −32 31 55.296   | 1.5538                            | −78.5696                           | 18.240                  | 15.50                    | K1III       |
| 115115               | 1609 | 4.99  | 23 18 57.6766                                         | − 9 36 38.700   | 2.9393                            | −7.8000                            | 13.100                  | −10.00                   | A0V         |
| 115250               | 880  | 4.58  | 23 20 38.2426                                         | +23 44 25.213   | 2.2198                            | −9.1400                            | 19.500                  | 16.00                    | A5V         |
| 115438               | 1612 | 3.96  | 23 22 58.2268                                         | −20 06 02.088   | −8.5381                           | −96.7000                           | 20.140                  | −6.50                    | K0III       |
| 115590               | 882  | 4.96  | 23 24 50.2624                                         | +62 16 58.104   | 1.7544                            | −13.2500                           | 4.230                   | −37.30                   | M1III       |

# POZYCJE GWIAZD W SYSTEMIE ICRS (BCRS) J2000.0

| HIP                  | FK5  | magn. | $\alpha_{ICRF}$                                       | $\delta_{ICRF}$ | $\mu_\alpha$<br>[ms/rok] | $\mu_\delta$<br>[mas/rok] | $\pi$<br>[mas] | $V_R$<br>[km/s] | Sp          |
|----------------------|------|-------|-------------------------------------------------------|-----------------|--------------------------|---------------------------|----------------|-----------------|-------------|
| 115623               | 881  | 4.42  | 23 <sup>h</sup> 25 <sup>m</sup> 22 <sup>s</sup> .7842 | +23°24′14″.764  | 14.0289                  | 36.4695                   | 18.830         | −11.30          | F8IV        |
| 115738               | 884  | 4.95  | 23 26 55.9553                                         | + 1 15 20.189   | 5.7080                   | −94.4302                  | 20.120         | −4.40           | A0p         |
| 115830               | 1614 | 4.27  | 23 27 58.0951                                         | + 6 22 44.372   | −8.3067                  | −43.2600                  | 20.540         | 5.80            | K1III       |
| 115919               | 885  | 4.54  | 23 29 09.2960                                         | +12 45 37.993   | 4.0753                   | 25.1801                   | 18.340         | −14.80          | G8III       |
| 116231               | 886  | 4.38  | 23 32 58.2593                                         | −37 49 05.763   | 8.1346                   | 37.5803                   | 18.280         | 1.70            | B9.5IVMNpe. |
| 116389               | 1617 | 4.69  | 23 35 04.5640                                         | −42 36 54.269   | 3.8211                   | 10.7800                   | 11.920         | 19.40           | A2V         |
| 116584               | 890  | 3.81  | 23 37 33.8425                                         | +46 27 29.347   | 15.4081                  | −421.4591                 | 38.740         | 6.80            | G8III-IV    |
| 116602               | 889  | 4.74  | 23 37 50.9947                                         | −45 29 32.465   | 6.7864                   | −12.3397                  | 16.260         | 10.00           | A2V         |
| 116631               | 891  | 4.29  | 23 38 08.2013                                         | +43 16 05.063   | 2.5379                   | −1.2100                   | 6.490          | −0.50           | B8V         |
| 116727*              | 893  | 3.21  | 23 39 20.8490                                         | +77 37 56.193   | −15.2061                 | 127.1865                  | 72.502         | −42.40          | K1IV        |
| 116771               | 892  | 4.13  | 23 39 57.0409                                         | + 5 37 34.650   | 25.2092                  | −436.9975                 | 72.510         | 5.40            | F7V         |
| 116805               | 1619 | 4.15  | 23 40 24.5081                                         | +44 20 02.154   | 7.5803                   | −18.9603                  | 19.220         | −9.00           | B9IVn       |
| 116928               | 1620 | 4.49  | 23 42 02.8062                                         | + 1 46 48.147   | −8.6408                  | −154.8689                 | 32.380         | 12.40           | A7V         |
| 116971               | 894  | 4.49  | 23 42 43.3441                                         | −14 32 41.657   | 6.7738                   | −66.7798                  | 21.160         | 3.00            | B9V         |
| 117221 <sub>ph</sub> | 1622 | 4.97  | 23 46 02.0466                                         | +46 25 12.993   | 0.8752                   | −6.2500                   | 2.490          | −24.80          | G5Ib        |
| 117371               | 895  | 5.05  | 23 47 54.7701                                         | +67 48 24.509   | 2.5680                   | −1.8900                   | 10.960         | 10.00           | A1Vn        |
| 117452               | 896  | 4.59  | 23 48 55.5461                                         | −28 07 48.964   | 7.5619                   | −104.0392                 | 22.730         | 14.00           | A0V         |
| 117863               | 899  | 4.51  | 23 54 23.0324                                         | +57 29 57.776   | −0.5633                  | −3.4500                   | 0.280          | −43.10          | F8Iavar     |
| 118131               | 1629 | 4.63  | 23 57 45.5264                                         | +25 08 29.044   | −2.6556                  | −32.2500                  | 7.540          | −4.20           | M3III       |
| 118209               | 900  | 4.88  | 23 58 40.3775                                         | − 3 33 21.540   | −3.7753                  | −72.3400                  | 14.580         | −0.20           | G9III       |
| 118234               | 901  | 5.13  | 23 58 55.7793                                         | −52 44 44.905   | 6.3798                   | 61.4604                   | 12.700         | −14.10          | K1III       |
| 118268               | 902  | 4.03  | 23 59 18.6896                                         | + 6 51 47.956   | 9.9708                   | −112.1600                 | 30.780         | 1.90            | F4IV        |
| 118322               | 903  | 4.49  | 23 59 54.9787                                         | −65 34 37.675   | 7.8410                   | −22.3297                  | 8.710          | 11.00           | B9IV        |

gwiazdy okołobiegunowe północne

|                       |      |      |                                                      |                |          |           |        |        |              |
|-----------------------|------|------|------------------------------------------------------|----------------|----------|-----------|--------|--------|--------------|
| 5372                  | 906  | 4.24 | 1 <sup>h</sup> 08 <sup>m</sup> 44 <sup>s</sup> .8773 | +86°15′25″.525 | 82.0463  | −11.3642  | 10.430 | 8.50   | K2II-III     |
| 11767 <sub>cg</sub> * | 907  | 1.97 | 2 31 48.8460                                         | +89 15 50.773  | 211.8224 | −15.2255  | 7.560  | −17.40 | F7:Ib-IIv SB |
| 16489                 | 1636 | 5.62 | 3 32 20.1251                                         | +84 54 39.743  | 46.8651  | −133.0411 | 9.180  | 33.10  | G3IIp...     |
| 37391                 | 909  | 5.05 | 7 40 30.4914                                         | +87 01 12.328  | −68.5816 | −26.8524  | 6.530  | −25.20 | M2III        |
| 45421                 | 1640 | 6.30 | 9 15 21.4261                                         | +84 10 51.648  | 21.5547  | 10.2996   | 11.100 | −6.00  | F2III        |
| 47193*                | 910  | 4.28 | 9 37 05.2871                                         | +81 19 34.975  | −7.4135  | −15.9501  | 3.030  | −5.10  | K3III        |
| 51502                 | 911  | 5.25 | 10 31 04.6638                                        | +82 33 30.915  | −40.7735 | 20.4278   | 46.540 | 7.00   | F2V          |
| 66878                 | 1643 | 5.92 | 13 42 23.0949                                        | +82 45 08.668  | 17.2641  | −42.5107  | 8.960  | −50.00 | G9III        |
| 72573                 | 1644 | 5.63 | 14 50 20.4227                                        | +82 30 42.999  | 90.8795  | −223.3443 | 23.080 | −44.40 | F9V          |
| 82080 <sub>ph</sub> * | 912  | 4.21 | 16 45 58.2438                                        | +82 02 14.143  | 9.4036   | 4.6699    | 9.410  | −11.40 | G5IIIvar     |
| 85822*                | 913  | 4.35 | 17 32 13.0004                                        | +86 35 11.258  | 11.8016  | 53.9701   | 17.850 | −7.60  | A1Vn         |
| 90182                 | 1646 | 6.16 | 18 24 09.2709                                        | +83 10 31.439  | 10.3172  | −23.4001  | 5.950  | −11.20 | A2V          |
| 102208                | 915  | 5.75 | 20 42 35.2379                                        | +82 31 52.171  | 15.7812  | 21.6798   | 9.110  | −20.00 | A0V          |
| 109693                | 1648 | 5.27 | 22 13 10.6155                                        | +86 06 28.637  | 50.3964  | 40.3183   | 12.750 | 4.00   | B9.5Vn       |
| 113116*               | 1649 | 4.70 | 22 54 24.9673                                        | +84 20 46.236  | 66.6215  | 23.8858   | 8.350  | 2.90   | K4III        |

gwiazdy okołobiegunowe południowe

|                    |     |      |                                                      |                |           |           |        |       |        |
|--------------------|-----|------|------------------------------------------------------|----------------|-----------|-----------|--------|-------|--------|
| 43908              | 918 | 5.43 | 8 <sup>h</sup> 56 <sup>m</sup> 40 <sup>s</sup> .9864 | −85°39′47″.348 | −102.5020 | 33.7476   | 20.730 | −3.60 | F0III  |
| 63031 <sub>A</sub> | 919 | 5.45 | 12 54 58.8107                                        | −85 07 24.127  | 52.9101   | 22.1121   | 8.790  | 53.40 | K0III  |
| 92824              | 922 | 5.29 | 18 54 47.1361                                        | −87 36 21.037  | −58.5610  | −135.2176 | 13.060 | 33.60 | K3III  |
| 104382             | 923 | 5.45 | 21 08 46.8456                                        | −88 57 23.396  | 95.0300   | 5.0216    | 12.070 | 11.90 | F0III  |
| 112405             | 924 | 4.13 | 22 46 03.5079                                        | −81 22 53.815  | −24.6239  | 0.8808    | 23.230 | 23.90 | A9IV/V |

# WIELKOŚCI REDUKCYJNE 2015

| UT1     |        | 0 <sup>h</sup> SDT             |             |            |            |            |             |                            |                           |                           |
|---------|--------|--------------------------------|-------------|------------|------------|------------|-------------|----------------------------|---------------------------|---------------------------|
|         |        | Juliańska<br>data<br>gwiazdowa | $\tau$      | $A + A'$   | $B + B'$   | $C$        | $D$         | $E$                        | $A'$                      | $B'$                      |
| Styczeń | 0.722  | 2463<br>751.0                  | $-0^a.5014$ | $-8''.117$ | $+9''.533$ | $-3''.324$ | $+20''.509$ | 0 <sup>s</sup> 0001<br>+ 7 | 0 <sup>m</sup> 001<br>−55 | 0 <sup>m</sup> 001<br>+10 |
|         | 1.719  | 752.0                          | 0.4987      | 8.038      | 9.561      | 3.650      | 20.442      | + 7                        | −43                       | +44                       |
|         | 2.717  | 753.0                          | 0.4960      | 7.947      | 9.579      | 3.976      | 20.369      | + 7                        | −19                       | +68                       |
|         | 3.714  | 754.0                          | 0.4933      | 7.851      | 9.583      | 4.299      | 20.290      | + 7                        | +10                       | +78                       |
|         | 4.711  | 755.0                          | 0.4905      | 7.755      | 9.571      | 4.622      | 20.205      | + 7                        | +39                       | +73                       |
|         | 5.708  | 756.0                          | −0.4878     | −7.666     | +9.545     | −4.943     | +20.114     | + 7                        | +62                       | +56                       |
|         | 6.706  | 757.0                          | 0.4851      | 7.587      | 9.509      | 5.263      | 20.017      | + 7                        | +75                       | +28                       |
|         | 7.703  | 758.0                          | 0.4823      | 7.521      | 9.468      | 5.582      | 19.915      | + 7                        | +75                       | −3                        |
|         | 8.700  | 759.0                          | 0.4796      | 7.469      | 9.428      | 5.899      | 19.806      | + 7                        | +63                       | −34                       |
|         | 9.697  | 760.0                          | 0.4769      | 7.427      | 9.394      | 6.214      | 19.692      | + 7                        | +40                       | −58                       |
|         | 10.695 | 761.0                          | −0.4741     | −7.394     | +9.368     | −6.528     | +19.572     | + 7                        | +9                        | −73                       |
|         | 11.692 | 762.0                          | 0.4714      | 7.364      | 9.354      | 6.840      | 19.445      | + 7                        | −25                       | −75                       |
|         | 12.689 | 763.0                          | 0.4687      | 7.333      | 9.352      | 7.150      | 19.313      | + 7                        | −58                       | −65                       |
|         | 13.687 | 764.0                          | 0.4660      | 7.296      | 9.361      | 7.458      | 19.175      | + 7                        | −84                       | −43                       |
|         | 14.684 | 765.0                          | 0.4632      | 7.248      | 9.379      | 7.764      | 19.031      | + 7                        | −99                       | −12                       |
|         | 15.681 | 766.0                          | −0.4605     | −7.186     | +9.401     | −8.069     | +18.880     | + 7                        | −98                       | +23                       |
|         | 16.678 | 767.0                          | 0.4578      | 7.107      | 9.419      | 8.370      | 18.724      | + 7                        | −81                       | +56                       |
|         | 17.676 | 768.0                          | 0.4550      | 7.014      | 9.426      | 8.670      | 18.561      | + 7                        | −49                       | +78                       |
|         | 18.673 | 769.0                          | 0.4523      | 6.912      | 9.416      | 8.967      | 18.392      | + 7                        | −7                        | +82                       |
|         | 19.670 | 770.0                          | 0.4496      | 6.810      | 9.385      | 9.261      | 18.217      | + 8                        | +35                       | +67                       |
|         | 20.667 | 771.0                          | −0.4468     | −6.719     | +9.335     | −9.552     | +18.036     | + 8                        | +67                       | +33                       |
|         | 21.665 | 772.0                          | 0.4441      | 6.647      | 9.276      | 9.840      | 17.849      | + 8                        | +80                       | −10                       |
|         | 22.662 | 773.0                          | 0.4414      | 6.598      | 9.219      | 10.124     | 17.656      | + 8                        | +72                       | −50                       |
|         | 23.659 | 774.0                          | 0.4386      | 6.567      | 9.176      | 10.405     | 17.457      | + 8                        | +46                       | −77                       |
|         | 24.657 | 775.0                          | 0.4359      | 6.544      | 9.152      | 10.681     | 17.253      | + 7                        | +11                       | −83                       |
|         | 25.654 | 776.0                          | −0.4332     | −6.521     | +9.149     | −10.954    | +17.043     | + 7                        | −21                       | −69                       |
|         | 26.651 | 777.0                          | 0.4305      | 6.488      | 9.161      | 11.223     | 16.829      | + 7                        | −44                       | −39                       |
|         | 27.648 | 778.0                          | 0.4277      | 6.440      | 9.180      | 11.488     | 16.610      | + 7                        | −51                       | −2                        |
|         | 28.646 | 779.0                          | 0.4250      | 6.378      | 9.197      | 11.749     | 16.386      | + 7                        | −43                       | +33                       |
|         | 29.643 | 780.0                          | 0.4223      | 6.305      | 9.206      | 12.006     | 16.158      | + 7                        | −23                       | +60                       |
| Luty    | 30.640 | 781.0                          | −0.4195     | −6.225     | +9.202     | −12.260    | +15.925     | + 7                        | +4                        | +75                       |
|         | 31.637 | 782.0                          | 0.4168      | 6.144      | 9.184      | 12.509     | 15.687      | + 8                        | +33                       | +76                       |
|         | 1.635  | 783.0                          | 0.4141      | 6.067      | 9.152      | 12.754     | 15.446      | + 8                        | +58                       | +62                       |
|         | 2.632  | 784.0                          | 0.4113      | 6.000      | 9.110      | 12.996     | 15.200      | + 8                        | +74                       | +39                       |
|         | 3.629  | 785.0                          | 0.4086      | 5.946      | 9.061      | 13.234     | 14.949      | + 8                        | +79                       | +9                        |
|         | 4.627  | 786.0                          | −0.4059     | −5.904     | +9.011     | −13.467    | +14.695     | + 8                        | +71                       | −22                       |
|         | 5.624  | 787.0                          | 0.4032      | 5.875      | 8.966      | 13.697     | 14.436      | + 8                        | +52                       | −49                       |
|         | 6.621  | 788.0                          | 0.4004      | 5.855      | 8.929      | 13.923     | 14.174      | + 7                        | +23                       | −67                       |
|         | 7.618  | 789.0                          | 0.3977      | 5.841      | 8.903      | 14.144     | 13.907      | + 7                        | −10                       | −74                       |
|         | 8.616  | 790.0                          | 0.3950      | 5.828      | 8.890      | 14.362     | 13.636      | + 7                        | −44                       | −69                       |
|         | 9.613  | 791.0                          | −0.3922     | −5.811     | +8.889     | −14.575    | +13.361     | + 7                        | −73                       | −52                       |
|         | 10.610 | 792.0                          | 0.3895      | 5.785      | 8.897      | 14.785     | 13.081      | + 7                        | −92                       | −25                       |
|         | 11.607 | 793.0                          | 0.3868      | 5.747      | 8.911      | 14.989     | 12.798      | + 7                        | −99                       | +7                        |
|         | 12.605 | 794.0                          | 0.3840      | 5.695      | 8.926      | 15.190     | 12.511      | + 7                        | −91                       | +40                       |
|         | 13.602 | 795.0                          | 0.3813      | 5.629      | 8.935      | 15.386     | 12.220      | + 7                        | −68                       | +66                       |
|         | 14.599 | 796.0                          | −0.3786     | −5.551     | +8.931     | −15.577    | +11.925     | + 7                        | −33                       | +80                       |
|         | 15.596 | 797.0                          | −0.3758     | −5.469     | +8.909     | −15.764    | +11.626     | + 7                        | +7                        | +76                       |

# WIELKOŚCI REDUKCYJNE 2015

| UT1      |        | 0 <sup>h</sup> SDT             |         |          |          |         |         |                      |                     |                     |
|----------|--------|--------------------------------|---------|----------|----------|---------|---------|----------------------|---------------------|---------------------|
|          |        | Juliańska<br>data<br>gwiazdowa | $\tau$  | $A + A'$ | $B + B'$ | $C$     | $D$     | $E$                  | $A'$                | $B'$                |
| Luty     |        | 2463                           |         |          |          |         |         | 0 <sup>s</sup> .0001 | 0 <sup>s</sup> .001 | 0 <sup>s</sup> .001 |
|          | 15.596 | 797.0                          | −0.3758 | −5.469   | +8.909   | −15.764 | +11.626 | + 7                  | + 7                 | +76                 |
|          | 16.594 | 798.0                          | 0.3731  | 5.390    | 8.868    | 15.945  | 11.323  | + 7                  | +44                 | +52                 |
|          | 17.591 | 799.0                          | 0.3704  | 5.325    | 8.813    | 16.122  | 11.016  | + 7                  | +68                 | +13                 |
|          | 18.588 | 800.0                          | 0.3677  | 5.281    | 8.753    | 16.293  | 10.705  | + 7                  | +72                 | −30                 |
|          | 19.586 | 801.0                          | 0.3649  | 5.258    | 8.701    | 16.458  | 10.391  | + 7                  | +55                 | −66                 |
|          | 20.583 | 802.0                          | −0.3622 | −5.250   | +8.668   | −16.618 | +10.074 | + 7                  | +24                 | −84                 |
|          | 21.580 | 803.0                          | 0.3595  | 5.247    | 8.658    | 16.772  | 9.754   | + 7                  | −11                 | −79                 |
|          | 22.577 | 804.0                          | 0.3567  | 5.236    | 8.668    | 16.921  | 9.432   | + 7                  | −38                 | −54                 |
|          | 23.575 | 805.0                          | 0.3540  | 5.211    | 8.690    | 17.064  | 9.107   | + 6                  | −50                 | −18                 |
|          | 24.572 | 806.0                          | 0.3513  | 5.170    | 8.715    | 17.201  | 8.780   | + 6                  | −47                 | +21                 |
|          | 25.569 | 807.0                          | −0.3485 | −5.116   | +8.733   | −17.332 | + 8.450 | + 6                  | −29                 | +52                 |
|          | 26.566 | 808.0                          | 0.3458  | 5.053    | 8.739    | 17.458  | 8.119   | + 6                  | − 2                 | +72                 |
|          | 27.564 | 809.0                          | 0.3431  | 4.988    | 8.732    | 17.579  | 7.786   | + 6                  | +28                 | +76                 |
|          | 28.561 | 810.0                          | 0.3404  | 4.926    | 8.711    | 17.694  | 7.452   | + 6                  | +55                 | +67                 |
| Marzec   | 1.558  | 811.0                          | 0.3376  | 4.872    | 8.679    | 17.804  | 7.115   | + 6                  | +74                 | +47                 |
|          | 2.556  | 812.0                          | −0.3349 | −4.829   | +8.640   | −17.909 | + 6.777 | + 6                  | +82                 | +19                 |
|          | 3.553  | 813.0                          | 0.3322  | 4.799    | 8.600    | 18.009  | 6.438   | + 6                  | +79                 | −12                 |
|          | 4.550  | 814.0                          | 0.3294  | 4.782    | 8.562    | 18.103  | 6.097   | + 6                  | +63                 | −40                 |
|          | 5.547  | 815.0                          | 0.3267  | 4.774    | 8.532    | 18.192  | 5.755   | + 6                  | +37                 | −61                 |
|          | 6.545  | 816.0                          | 0.3240  | 4.773    | 8.512    | 18.275  | 5.411   | + 6                  | + 6                 | −72                 |
|          | 7.542  | 817.0                          | −0.3212 | −4.774   | +8.506   | −18.354 | + 5.066 | + 6                  | −28                 | −71                 |
|          | 8.539  | 818.0                          | 0.3185  | 4.773    | 8.512    | 18.427  | 4.720   | + 5                  | −59                 | −58                 |
|          | 9.536  | 819.0                          | 0.3158  | 4.764    | 8.529    | 18.495  | 4.373   | + 5                  | −82                 | −34                 |
|          | 10.534 | 820.0                          | 0.3130  | 4.745    | 8.553    | 18.558  | 4.024   | + 5                  | −94                 | − 4                 |
|          | 11.531 | 821.0                          | 0.3103  | 4.711    | 8.580    | 18.615  | 3.674   | + 5                  | −92                 | +28                 |
|          | 12.528 | 822.0                          | −0.3076 | −4.664   | +8.604   | −18.667 | + 3.323 | + 5                  | −76                 | +56                 |
|          | 13.525 | 823.0                          | 0.3049  | 4.605    | 8.618    | 18.714  | 2.971   | + 5                  | −48                 | +74                 |
|          | 14.523 | 824.0                          | 0.3021  | 4.539    | 8.618    | 18.755  | 2.618   | + 5                  | −12                 | +77                 |
|          | 15.520 | 825.0                          | 0.2994  | 4.472    | 8.601    | 18.790  | 2.264   | + 5                  | +24                 | +63                 |
|          | 16.517 | 826.0                          | 0.2967  | 4.414    | 8.569    | 18.820  | 1.909   | + 5                  | +52                 | +32                 |
|          | 17.515 | 827.0                          | −0.2939 | −4.370   | +8.527   | −18.844 | + 1.553 | + 5                  | +65                 | − 8                 |
|          | 18.512 | 828.0                          | 0.2912  | 4.346    | 8.486    | 18.861  | 1.197   | + 5                  | +59                 | −49                 |
|          | 19.509 | 829.0                          | 0.2885  | 4.340    | 8.458    | 18.873  | 0.840   | + 5                  | +34                 | −77                 |
|          | 20.506 | 830.0                          | 0.2857  | 4.344    | 8.452    | 18.879  | 0.483   | + 5                  | + 0                 | −85                 |
|          | 21.504 | 831.0                          | 0.2830  | 4.346    | 8.468    | 18.878  | + 0.127 | + 5                  | −32                 | −70                 |
|          | 22.501 | 832.0                          | −0.2803 | −4.336   | +8.503   | −18.871 | − 0.229 | + 4                  | −52                 | −37                 |
|          | 23.498 | 833.0                          | 0.2776  | 4.309    | 8.547    | 18.858  | 0.585   | + 4                  | −55                 | + 3                 |
|          | 24.495 | 834.0                          | 0.2748  | 4.264    | 8.588    | 18.840  | 0.940   | + 4                  | −41                 | +41                 |
|          | 25.493 | 835.0                          | 0.2721  | 4.208    | 8.619    | 18.815  | 1.293   | + 4                  | −15                 | +67                 |
|          | 26.490 | 836.0                          | 0.2694  | 4.146    | 8.635    | 18.785  | 1.646   | + 4                  | +17                 | +77                 |
|          | 27.487 | 837.0                          | −0.2666 | −4.085   | +8.636   | −18.749 | − 1.997 | + 4                  | +47                 | +73                 |
|          | 28.485 | 838.0                          | 0.2639  | 4.030    | 8.625    | 18.708  | 2.347   | + 4                  | +71                 | +55                 |
|          | 29.482 | 839.0                          | 0.2612  | 3.986    | 8.605    | 18.662  | 2.695   | + 4                  | +84                 | +29                 |
|          | 30.479 | 840.0                          | 0.2584  | 3.955    | 8.583    | 18.610  | 3.042   | + 4                  | +85                 | − 2                 |
|          | 31.476 | 841.0                          | 0.2557  | 3.935    | 8.562    | 18.553  | 3.388   | + 4                  | +73                 | −31                 |
| Kwiecień | 1.474  | 842.0                          | −0.2530 | −3.926   | +8.547   | −18.491 | − 3.732 | + 4                  | +50                 | −55                 |
|          | 2.471  | 843.0                          | −0.2503 | −3.924   | +8.542   | −18.424 | − 4.075 | + 4                  | +20                 | −70                 |

# WIELKOŚCI REDUKCYJNE 2015

| UT1      |        | 0 <sup>h</sup> SDT             |                       |                      |                      |                       |                       |                      |                     |                     |
|----------|--------|--------------------------------|-----------------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|---------------------|---------------------|
|          |        | Juliańska<br>data<br>gwiazdowa | $\tau$                | $A + A'$             | $B + B'$             | $C$                   | $D$                   | $E$                  | $A'$                | $B'$                |
| Kwiecień |        | 2463                           |                       |                      |                      |                       |                       | 0 <sup>s</sup> .0001 | 0 <sup>s</sup> .001 | 0 <sup>s</sup> .001 |
|          | 1.474  | 842.0                          | −0. <sup>a</sup> 2530 | −3. <sup>h</sup> 926 | +8. <sup>h</sup> 547 | −18. <sup>h</sup> 491 | − 3. <sup>h</sup> 732 | + 4                  | +50                 | −55                 |
|          | 2.471  | 843.0                          | 0.2503                | 3.924                | 8.542                | 18.424                | 4.075                 | + 4                  | +20                 | −70                 |
|          | 3.468  | 844.0                          | 0.2475                | 3.926                | 8.549                | 18.351                | 4.416                 | + 4                  | −13                 | −73                 |
|          | 4.465  | 845.0                          | 0.2448                | 3.926                | 8.569                | 18.274                | 4.756                 | + 3                  | −45                 | −63                 |
|          | 5.463  | 846.0                          | 0.2421                | 3.919                | 8.601                | 18.192                | 5.094                 | + 3                  | −71                 | −43                 |
|          | 6.460  | 847.0                          | −0.2393               | −3.902               | +8.642               | −18.105               | − 5.430               | + 3                  | −87                 | −14                 |
|          | 7.457  | 848.0                          | 0.2366                | 3.871                | 8.687                | 18.013                | 5.765                 | + 3                  | −89                 | +18                 |
|          | 8.454  | 849.0                          | 0.2339                | 3.826                | 8.729                | 17.916                | 6.098                 | + 3                  | −78                 | +48                 |
|          | 9.452  | 850.0                          | 0.2311                | 3.769                | 8.764                | 17.814                | 6.429                 | + 3                  | −54                 | +69                 |
|          | 10.449 | 851.0                          | 0.2284                | 3.702                | 8.786                | 17.707                | 6.759                 | + 3                  | −22                 | +77                 |
|          | 11.446 | 852.0                          | −0.2257               | −3.633               | +8.792               | −17.595               | − 7.086               | + 3                  | +13                 | +68                 |
|          | 12.444 | 853.0                          | 0.2229                | 3.569                | 8.783                | 17.478                | 7.412                 | + 3                  | +42                 | +44                 |
|          | 13.441 | 854.0                          | 0.2202                | 3.516                | 8.763                | 17.356                | 7.736                 | + 3                  | +59                 | + 8                 |
|          | 14.438 | 855.0                          | 0.2175                | 3.480                | 8.739                | 17.228                | 8.058                 | + 3                  | +59                 | −32                 |
|          | 15.435 | 856.0                          | 0.2148                | 3.461                | 8.722                | 17.096                | 8.377                 | + 3                  | +42                 | −65                 |
|          | 16.433 | 857.0                          | −0.2120               | −3.454               | +8.721               | −16.958               | − 8.694               | + 3                  | +12                 | −83                 |
|          | 17.430 | 858.0                          | 0.2093                | 3.452                | 8.741                | 16.814                | 9.008                 | + 3                  | −23                 | −80                 |
|          | 18.427 | 859.0                          | 0.2066                | 3.442                | 8.783                | 16.665                | 9.320                 | + 2                  | −51                 | −56                 |
|          | 19.424 | 860.0                          | 0.2038                | 3.415                | 8.839                | 16.511                | 9.628                 | + 2                  | −63                 | −18                 |
|          | 20.422 | 861.0                          | 0.2011                | 3.370                | 8.898                | 16.352                | 9.932                 | + 2                  | −56                 | +23                 |
|          | 21.419 | 862.0                          | −0.1984               | −3.308               | +8.951               | −16.188               | −10.234               | + 2                  | −34                 | +57                 |
|          | 22.416 | 863.0                          | 0.1956                | 3.236                | 8.989                | 16.020                | 10.531                | + 2                  | − 1                 | +76                 |
|          | 23.414 | 864.0                          | 0.1929                | 3.162                | 9.010                | 15.847                | 10.825                | + 2                  | +33                 | +78                 |
|          | 24.411 | 865.0                          | 0.1902                | 3.092                | 9.017                | 15.669                | 11.114                | + 2                  | +62                 | +65                 |
|          | 25.408 | 866.0                          | 0.1875                | 3.031                | 9.012                | 15.487                | 11.400                | + 2                  | +81                 | +41                 |
|          | 26.405 | 867.0                          | −0.1847               | −2.983               | +9.001               | −15.301               | −11.683               | + 2                  | +87                 | +11                 |
|          | 27.403 | 868.0                          | 0.1820                | 2.947                | 8.990                | 15.111                | 11.961                | + 2                  | +80                 | −21                 |
|          | 28.400 | 869.0                          | 0.1793                | 2.922                | 8.984                | 14.917                | 12.235                | + 2                  | +62                 | −47                 |
|          | 29.397 | 870.0                          | 0.1765                | 2.906                | 8.986                | 14.720                | 12.506                | + 2                  | +34                 | −66                 |
|          | 30.394 | 871.0                          | 0.1738                | 2.895                | 8.999                | 14.518                | 12.773                | + 2                  | + 1                 | −73                 |
| Maj      | 1.392  | 872.0                          | −0.1711               | −2.883               | +9.024               | −14.313               | −13.035               | + 2                  | −32                 | −68                 |
|          | 2.389  | 873.0                          | 0.1683                | 2.867                | 9.062                | 14.104                | 13.294                | + 2                  | −61                 | −51                 |
|          | 3.386  | 874.0                          | 0.1656                | 2.840                | 9.110                | 13.892                | 13.549                | + 2                  | −81                 | −24                 |
|          | 4.383  | 875.0                          | 0.1629                | 2.801                | 9.162                | 13.676                | 13.800                | + 2                  | −88                 | + 8                 |
|          | 5.381  | 876.0                          | 0.1601                | 2.746                | 9.215                | 13.457                | 14.047                | + 2                  | −80                 | +39                 |
|          | 6.378  | 877.0                          | −0.1574               | −2.677               | +9.261               | −13.234               | −14.291               | + 2                  | −59                 | +64                 |
|          | 7.375  | 878.0                          | 0.1547                | 2.598                | 9.294                | 13.008                | 14.530                | + 2                  | −28                 | +77                 |
|          | 8.373  | 879.0                          | 0.1520                | 2.514                | 9.311                | 12.778                | 14.766                | + 2                  | + 6                 | +74                 |
|          | 9.370  | 880.0                          | 0.1492                | 2.433                | 9.312                | 12.545                | 14.997                | + 2                  | +38                 | +54                 |
|          | 10.367 | 881.0                          | 0.1465                | 2.362                | 9.300                | 12.308                | 15.225                | + 2                  | +59                 | +21                 |
|          | 11.364 | 882.0                          | −0.1438               | −2.306               | +9.282               | −12.067               | −15.448               | + 2                  | +64                 | −17                 |
|          | 12.362 | 883.0                          | 0.1410                | 2.268                | 9.266                | 11.823                | 15.668                | + 2                  | +51                 | −53                 |
|          | 13.359 | 884.0                          | 0.1383                | 2.243                | 9.262                | 11.576                | 15.883                | + 2                  | +24                 | −77                 |
|          | 14.356 | 885.0                          | 0.1356                | 2.224                | 9.277                | 11.324                | 16.093                | + 2                  | −10                 | −83                 |
|          | 15.353 | 886.0                          | 0.1328                | 2.203                | 9.311                | 11.069                | 16.299                | + 2                  | −42                 | −68                 |
|          | 16.351 | 887.0                          | −0.1301               | −2.171               | +9.362               | −10.811               | −16.500               | + 1                  | −62                 | −36                 |
|          | 17.348 | 888.0                          | −0.1274               | −2.120               | +9.421               | −10.549               | −16.695               | + 1                  | −66                 | + 4                 |

# WIELKOŚCI REDUKCYJNE 2015

| UT1      |        | 0 <sup>h</sup> SDT             |         |          |          |         |         |                      |                     |                     |
|----------|--------|--------------------------------|---------|----------|----------|---------|---------|----------------------|---------------------|---------------------|
|          |        | Juliańska<br>data<br>gwiazdowa | $\tau$  | $A + A'$ | $B + B'$ | $C$     | $D$     | $E$                  | $A'$                | $B'$                |
| Maj      |        | 2463                           |         |          |          |         |         | 0 <sup>s</sup> .0001 | 0 <sup>s</sup> '001 | 0 <sup>s</sup> '001 |
|          | 17.348 | 888.0                          | −0.1274 | −2.120   | +9.421   | −10.549 | −16.695 | + 1                  | −66                 | + 4                 |
|          | 18.345 | 889.0                          | 0.1247  | 2.051    | 9.478    | 10.284  | 16.886  | + 2                  | −51                 | +42                 |
|          | 19.343 | 890.0                          | 0.1219  | 1.967    | 9.524    | 10.016  | 17.071  | + 2                  | −23                 | +69                 |
|          | 20.340 | 891.0                          | 0.1192  | 1.877    | 9.554    | 9.746   | 17.250  | + 2                  | +12                 | +80                 |
|          | 21.337 | 892.0                          | 0.1165  | 1.787    | 9.566    | 9.472   | 17.424  | + 2                  | +46                 | +74                 |
|          | 22.334 | 893.0                          | −0.1137 | −1.705   | +9.564   | − 9.197 | −17.593 | + 2                  | +72                 | +54                 |
|          | 23.332 | 894.0                          | 0.1110  | 1.634    | 9.552    | 8.919   | 17.756  | + 2                  | +85                 | +25                 |
|          | 24.329 | 895.0                          | 0.1083  | 1.577    | 9.536    | 8.639   | 17.914  | + 2                  | +84                 | − 7                 |
|          | 25.326 | 896.0                          | 0.1055  | 1.533    | 9.523    | 8.357   | 18.066  | + 2                  | +71                 | −37                 |
|          | 26.323 | 897.0                          | 0.1028  | 1.499    | 9.516    | 8.073   | 18.213  | + 2                  | +46                 | −60                 |
|          | 27.321 | 898.0                          | −0.1001 | −1.472   | +9.520   | − 7.787 | −18.355 | + 2                  | +15                 | −73                 |
|          | 28.318 | 899.0                          | 0.0973  | 1.446    | 9.535    | 7.499   | 18.491  | + 2                  | −19                 | −73                 |
|          | 29.315 | 900.0                          | 0.0946  | 1.418    | 9.562    | 7.210   | 18.622  | + 2                  | −51                 | −60                 |
|          | 30.313 | 901.0                          | 0.0919  | 1.382    | 9.600    | 6.919   | 18.748  | + 2                  | −75                 | −37                 |
|          | 31.310 | 902.0                          | 0.0892  | 1.334    | 9.645    | 6.627   | 18.869  | + 2                  | −87                 | − 5                 |
| Czerwiec | 1.307  | 903.0                          | −0.0864 | −1.271   | +9.692   | − 6.334 | −18.984 | + 2                  | −85                 | +28                 |
|          | 2.304  | 904.0                          | 0.0837  | 1.193    | 9.734    | 6.039   | 19.095  | + 2                  | −69                 | +57                 |
|          | 3.302  | 905.0                          | 0.0810  | 1.103    | 9.765    | 5.742   | 19.200  | + 2                  | −40                 | +76                 |
|          | 4.299  | 906.0                          | 0.0782  | 1.005    | 9.780    | 5.444   | 19.301  | + 2                  | − 4                 | +79                 |
|          | 5.296  | 907.0                          | 0.0755  | 0.908    | 9.777    | 5.145   | 19.396  | + 2                  | +31                 | +64                 |
|          | 6.293  | 908.0                          | −0.0728 | −0.819   | +9.758   | − 4.845 | −19.486 | + 2                  | +58                 | +35                 |
|          | 7.291  | 909.0                          | 0.0700  | 0.745    | 9.730    | 4.543   | 19.571  | + 2                  | +69                 | − 4                 |
|          | 8.288  | 910.0                          | 0.0673  | 0.689    | 9.701    | 4.239   | 19.651  | + 2                  | +62                 | −42                 |
|          | 9.285  | 911.0                          | 0.0646  | 0.649    | 9.681    | 3.934   | 19.726  | + 2                  | +39                 | −71                 |
|          | 10.282 | 912.0                          | 0.0619  | 0.618    | 9.678    | 3.627   | 19.796  | + 2                  | + 6                 | −83                 |
|          | 11.280 | 913.0                          | −0.0591 | −0.589   | +9.693   | − 3.320 | −19.859 | + 2                  | −28                 | −75                 |
|          | 12.277 | 914.0                          | 0.0564  | 0.551    | 9.726    | 3.010   | 19.917  | + 2                  | −54                 | −50                 |
|          | 13.274 | 915.0                          | 0.0537  | 0.499    | 9.769    | 2.700   | 19.970  | + 2                  | −66                 | −13                 |
|          | 14.272 | 916.0                          | 0.0509  | 0.428    | 9.814    | 2.389   | 20.016  | + 2                  | −60                 | +26                 |
|          | 15.269 | 917.0                          | 0.0482  | 0.342    | 9.851    | 2.076   | 20.056  | + 2                  | −38                 | +58                 |
|          | 16.266 | 918.0                          | −0.0455 | −0.246   | +9.875   | − 1.763 | −20.090 | + 2                  | − 6                 | +77                 |
|          | 17.263 | 919.0                          | 0.0427  | 0.147    | 9.881    | 1.450   | 20.118  | + 2                  | +29                 | +79                 |
|          | 18.261 | 920.0                          | 0.0400  | −0.052   | 9.870    | 1.136   | 20.140  | + 3                  | +59                 | +65                 |
|          | 19.258 | 921.0                          | 0.0373  | +0.032   | 9.848    | 0.823   | 20.156  | + 3                  | +78                 | +39                 |
|          | 20.255 | 922.0                          | 0.0346  | 0.102    | 9.818    | 0.509   | 20.166  | + 3                  | +84                 | + 7                 |
|          | 21.252 | 923.0                          | −0.0318 | +0.159   | +9.787   | − 0.195 | −20.170 | + 3                  | +76                 | −25                 |
|          | 22.250 | 924.0                          | 0.0291  | 0.204    | 9.761    | + 0.118 | 20.168  | + 3                  | +56                 | −51                 |
|          | 23.247 | 925.0                          | 0.0264  | 0.240    | 9.744    | 0.430   | 20.160  | + 3                  | +27                 | −69                 |
|          | 24.244 | 926.0                          | 0.0236  | 0.271    | 9.738    | 0.743   | 20.147  | + 3                  | − 6                 | −74                 |
|          | 25.242 | 927.0                          | 0.0209  | 0.302    | 9.744    | 1.054   | 20.128  | + 2                  | −39                 | −67                 |
|          | 26.239 | 928.0                          | −0.0182 | +0.338   | +9.761   | + 1.365 | −20.103 | + 2                  | −67                 | −49                 |
|          | 27.236 | 929.0                          | 0.0154  | 0.385    | 9.787    | 1.676   | 20.073  | + 2                  | −86                 | −20                 |
|          | 28.233 | 930.0                          | 0.0127  | 0.444    | 9.818    | 1.985   | 20.037  | + 2                  | −90                 | +13                 |
|          | 29.231 | 931.0                          | 0.0100  | 0.518    | 9.847    | 2.293   | 19.996  | + 2                  | −80                 | +45                 |
|          | 30.228 | 932.0                          | 0.0072  | 0.607    | 9.867    | 2.601   | 19.950  | + 3                  | −56                 | +70                 |
| Lipiec   | 1.225  | 933.0                          | −0.0045 | +0.705   | +9.873   | + 2.908 | −19.899 | + 3                  | −21                 | +81                 |
|          | 2.222  | 934.0                          | −0.0018 | +0.807   | +9.861   | + 3.214 | −19.842 | + 3                  | +17                 | +74                 |

# WIELKOŚCI REDUKCYJNE 2015

| UT1      |        | 0 <sup>h</sup> SDT             |                       |                      |                      |                       |                       |                     |                    |                    |
|----------|--------|--------------------------------|-----------------------|----------------------|----------------------|-----------------------|-----------------------|---------------------|--------------------|--------------------|
|          |        | Juliańska<br>data<br>gwiazdowa | $\tau$                | $A + A'$             | $B + B'$             | $C$                   | $D$                   | $E$                 | $A'$               | $B'$               |
| Lipiec   |        | 2463                           |                       |                      |                      |                       |                       | 0 <sup>s</sup> 0001 | 0 <sup>s</sup> 001 | 0 <sup>s</sup> 001 |
|          | 1.225  | 933.0                          | −0. <sup>a</sup> 0045 | +0. <sup>h</sup> 705 | +9. <sup>h</sup> 873 | + 2. <sup>h</sup> 908 | −19. <sup>h</sup> 899 | + 3                 | −21                | +81                |
|          | 2.222  | 934.0                          | −0.0018               | 0.807                | 9.861                | 3.214                 | 19.842                | + 3                 | +17                | +74                |
|          | 3.220  | 935.0                          | +0.0009               | 0.904                | 9.830                | 3.518                 | 19.781                | + 3                 | +50                | +49                |
|          | 4.217  | 936.0                          | 0.0037                | 0.986                | 9.787                | 3.823                 | 19.714                | + 3                 | +69                | +12                |
|          | 5.214  | 937.0                          | 0.0064                | 1.050                | 9.739                | 4.126                 | 19.643                | + 3                 | +70                | −28                |
|          | 6.211  | 938.0                          | +0.0091               | +1.096               | +9.698               | + 4.429               | −19.566               | + 3                 | +53                | −62                |
|          | 7.209  | 939.0                          | 0.0119                | 1.128                | 9.670                | 4.730                 | 19.484                | + 3                 | +23                | −81                |
|          | 8.206  | 940.0                          | 0.0146                | 1.155                | 9.663                | 5.031                 | 19.396                | + 3                 | −12                | −80                |
|          | 9.203  | 941.0                          | 0.0173                | 1.188                | 9.673                | 5.332                 | 19.304                | + 3                 | −42                | −60                |
|          | 10.201 | 942.0                          | 0.0201                | 1.232                | 9.696                | 5.631                 | 19.205                | + 3                 | −59                | −27                |
|          | 11.198 | 943.0                          | +0.0228               | +1.293               | +9.724               | + 5.929               | −19.101               | + 3                 | −60                | +12                |
|          | 12.195 | 944.0                          | 0.0255                | 1.369                | 9.748                | 6.225                 | 18.991                | + 3                 | −44                | +46                |
|          | 13.192 | 945.0                          | 0.0282                | 1.457                | 9.760                | 6.520                 | 18.875                | + 3                 | −17                | +70                |
|          | 14.190 | 946.0                          | 0.0310                | 1.550                | 9.756                | 6.813                 | 18.753                | + 3                 | +16                | +78                |
|          | 15.187 | 947.0                          | 0.0337                | 1.641                | 9.737                | 7.105                 | 18.626                | + 3                 | +47                | +71                |
|          | 16.184 | 948.0                          | +0.0364               | +1.724               | +9.703               | + 7.394               | −18.493               | + 3                 | +71                | +50                |
|          | 17.181 | 949.0                          | 0.0392                | 1.795                | 9.660                | 7.681                 | 18.355                | + 3                 | +83                | +21                |
|          | 18.179 | 950.0                          | 0.0419                | 1.851                | 9.614                | 7.966                 | 18.211                | + 3                 | +80                | −11                |
|          | 19.176 | 951.0                          | 0.0446                | 1.894                | 9.571                | 8.248                 | 18.061                | + 3                 | +65                | −41                |
|          | 20.173 | 952.0                          | 0.0474                | 1.926                | 9.535                | 8.528                 | 17.907                | + 3                 | +40                | −62                |
|          | 21.171 | 953.0                          | +0.0501               | +1.952               | +9.509               | + 8.805               | −17.747               | + 3                 | + 7                | −73                |
|          | 22.168 | 954.0                          | 0.0528                | 1.974                | 9.495                | 9.079                 | 17.582                | + 3                 | −26                | −71                |
|          | 23.165 | 955.0                          | 0.0556                | 2.000                | 9.493                | 9.351                 | 17.413                | + 3                 | −57                | −58                |
|          | 24.162 | 956.0                          | 0.0583                | 2.033                | 9.501                | 9.619                 | 17.238                | + 3                 | −80                | −34                |
|          | 25.160 | 957.0                          | 0.0610                | 2.076                | 9.516                | 9.885                 | 17.059                | + 3                 | −92                | − 3                |
|          | 26.157 | 958.0                          | +0.0637               | +2.134               | +9.532               | +10.148               | −16.875               | + 3                 | −89                | +30                |
|          | 27.154 | 959.0                          | 0.0665                | 2.205                | 9.544                | 10.407                | 16.687                | + 3                 | −72                | +59                |
|          | 28.151 | 960.0                          | 0.0692                | 2.288                | 9.545                | 10.664                | 16.494                | + 3                 | −43                | +77                |
|          | 29.149 | 961.0                          | 0.0719                | 2.379                | 9.530                | 10.917                | 16.297                | + 3                 | − 5                | +80                |
|          | 30.146 | 962.0                          | 0.0747                | 2.468                | 9.496                | 11.168                | 16.096                | + 3                 | +32                | +63                |
| Sierpień | 31.143 | 963.0                          | +0.0774               | +2.549               | +9.446               | +11.415               | −15.891               | + 3                 | +60                | +31                |
|          | 1.140  | 964.0                          | 0.0801                | 2.611                | 9.387                | 11.660                | 15.682                | + 3                 | +71                | −10                |
|          | 2.138  | 965.0                          | 0.0829                | 2.654                | 9.329                | 11.902                | 15.468                | + 3                 | +62                | −50                |
|          | 3.135  | 966.0                          | 0.0856                | 2.679                | 9.284                | 12.141                | 15.251                | + 3                 | +37                | −76                |
|          | 4.132  | 967.0                          | 0.0883                | 2.694                | 9.259                | 12.377                | 15.029                | + 3                 | + 3                | −83                |
|          | 5.130  | 968.0                          | +0.0910               | +2.712               | +9.254               | +12.611               | −14.803               | + 3                 | −30                | −70                |
|          | 6.127  | 969.0                          | 0.0938                | 2.739                | 9.266                | 12.841                | 14.573                | + 3                 | −51                | −39                |
|          | 7.124  | 970.0                          | 0.0965                | 2.781                | 9.285                | 13.069                | 14.337                | + 3                 | −57                | − 1                |
|          | 8.121  | 971.0                          | 0.0992                | 2.839                | 9.303                | 13.293                | 14.098                | + 3                 | −46                | +35                |
|          | 9.119  | 972.0                          | 0.1020                | 2.910                | 9.312                | 13.513                | 13.854                | + 3                 | −22                | +63                |
|          | 10.116 | 973.0                          | +0.1047               | +2.988               | +9.307               | +13.730               | −13.605               | + 3                 | + 9                | +76                |
|          | 11.113 | 974.0                          | 0.1074                | 3.065                | 9.286                | 13.944                | 13.352                | + 3                 | +40                | +74                |
|          | 12.110 | 975.0                          | 0.1102                | 3.136                | 9.251                | 14.153                | 13.095                | + 3                 | +66                | +58                |
|          | 13.108 | 976.0                          | 0.1129                | 3.196                | 9.206                | 14.358                | 12.833                | + 3                 | +81                | +31                |
|          | 14.105 | 977.0                          | 0.1156                | 3.243                | 9.157                | 14.559                | 12.568                | + 3                 | +84                | + 0                |
|          | 15.102 | 978.0                          | +0.1183               | +3.276               | +9.108               | +14.756               | −12.298               | + 3                 | +73                | −30                |
|          | 16.100 | 979.0                          | +0.1211               | +3.297               | +9.066               | +14.948               | −12.025               | + 3                 | +51                | −54                |
|          | 17.097 | 980.0                          | +0.1238               | +3.309               | +9.033               | +15.136               | −11.748               | + 3                 | +21                | −69                |

# WIELKOŚCI REDUKCYJNE 2015

| UT1      |        | 0 <sup>h</sup> SDT             |         |          |          |         |         |         |      |      |
|----------|--------|--------------------------------|---------|----------|----------|---------|---------|---------|------|------|
|          |        | Juliańska<br>data<br>gwiazdowa | $\tau$  | $A + A'$ | $B + B'$ | $C$     | $D$     | $E$     | $A'$ | $B'$ |
| Sierpień | 17.097 | $\frac{2463}{2464}$<br>980.0   | +0.1238 | +3.309   | +9.033   | +15.136 | −11.748 | + 3     | +21  | −69  |
|          | 18.094 | 981.0                          | 0.1265  | 3.318    | 9.012    | 15.319  | 11.467  | + 3     | −12  | −72  |
|          | 19.091 | 982.0                          | 0.1293  | 3.327    | 9.004    | 15.498  | 11.184  | + 3     | −45  | −63  |
|          | 20.089 | 983.0                          | 0.1320  | 3.341    | 9.006    | 15.672  | 10.896  | + 2     | −71  | −43  |
|          | 21.086 | 984.0                          | 0.1347  | 3.365    | 9.017    | 15.842  | 10.606  | + 2     | −88  | −16  |
|          | 22.083 | 985.0                          | +0.1375 | +3.400   | +9.031   | +16.007 | −10.313 | + 2     | −92  | +16  |
|          | 23.080 | 986.0                          | 0.1402  | 3.449    | 9.045    | 16.167  | 10.017  | + 2     | −82  | +46  |
|          | 24.078 | 987.0                          | 0.1429  | 3.511    | 9.051    | 16.322  | 9.718   | + 2     | −60  | +69  |
|          | 25.075 | 988.0                          | 0.1457  | 3.581    | 9.045    | 16.473  | 9.416   | + 2     | −28  | +79  |
|          | 26.072 | 989.0                          | 0.1484  | 3.655    | 9.023    | 16.619  | 9.113   | + 2     | + 9  | +72  |
|          | 27.069 | 990.0                          | +0.1511 | +3.725   | +8.984   | +16.760 | − 8.807 | + 2     | +41  | +48  |
|          | 28.067 | 991.0                          | 0.1538  | 3.782    | 8.931    | 16.897  | 8.498   | + 2     | +62  | +11  |
|          | 29.064 | 992.0                          | 0.1566  | 3.821    | 8.875    | 17.030  | 8.188   | + 2     | +64  | −31  |
|          | 30.061 | 993.0                          | 0.1593  | 3.839    | 8.825    | 17.158  | 7.875   | + 2     | +46  | −67  |
|          | 31.059 | 994.0                          | 0.1620  | 3.844    | 8.794    | 17.282  | 7.560   | + 2     | +15  | −84  |
| Wrzesień | 1.056  | 995.0                          | +0.1648 | +3.845   | +8.785   | +17.401 | − 7.243 | + 2     | −19  | −79  |
|          | 2.053  | 996.0                          | 0.1675  | 3.853    | 8.798    | 17.516  | 6.923   | + 2     | −45  | −54  |
|          | 3.050  | 997.0                          | 0.1702  | 3.876    | 8.823    | 17.627  | 6.601   | + 2     | −57  | −16  |
|          | 4.048  | 998.0                          | 0.1730  | 3.917    | 8.851    | 17.733  | 6.276   | + 2     | −50  | +23  |
|          | 5.045  | 999.0                          | 0.1757  | 3.971    | 8.871    | 17.835  | 5.949   | + 2     | −29  | +55  |
|          | 6.042  | 000.0                          | +0.1784 | +4.035   | +8.879   | +17.931 | − 5.620 | + 2     | + 2  | +73  |
|          | 7.039  | 001.0                          | 0.1811  | 4.100    | 8.871    | 18.022  | 5.288   | + 2     | +34  | +76  |
|          | 8.037  | 002.0                          | 0.1839  | 4.161    | 8.849    | 18.108  | 4.954   | + 2     | +63  | +64  |
|          | 9.034  | 003.0                          | 0.1866  | 4.212    | 8.816    | 18.189  | 4.618   | + 2     | +81  | +40  |
|          | 10.031 | 004.0                          | 0.1893  | 4.251    | 8.778    | 18.265  | 4.280   | + 2     | +88  | +10  |
|          | 11.029 | 005.0                          | +0.1921 | +4.276   | +8.739   | +18.335 | − 3.940 | + 1     | +81  | −20  |
|          | 12.026 | 006.0                          | 0.1948  | 4.289    | 8.705    | 18.399  | 3.598   | + 1     | +63  | −47  |
|          | 13.023 | 007.0                          | 0.1975  | 4.293    | 8.680    | 18.458  | 3.256   | + 1     | +35  | −65  |
|          | 14.020 | 008.0                          | 0.2003  | 4.291    | 8.667    | 18.511  | 2.912   | + 1     | + 3  | −72  |
|          | 15.018 | 009.0                          | 0.2030  | 4.289    | 8.666    | 18.559  | 2.566   | + 1     | −31  | −67  |
|          | 16.015 | 010.0                          | +0.2057 | +4.291   | +8.677   | +18.601 | − 2.220 | + 1     | −59  | −51  |
|          | 17.012 | 011.0                          | 0.2085  | 4.301    | 8.698    | 18.637  | 1.873   | + 0     | −80  | −26  |
|          | 18.009 | 012.0                          | 0.2112  | 4.322    | 8.724    | 18.668  | 1.526   | + 0     | −89  | + 4  |
|          | 19.007 | 013.0                          | 0.2139  | 4.356    | 8.751    | 18.693  | 1.178   | + 0     | −85  | +34  |
|          | 20.004 | 014.0                          | 0.2166  | 4.403    | 8.774    | 18.712  | 0.829   | + 0     | −69  | +59  |
|          | 21.001 | 015.0                          | +0.2194 | +4.460   | +8.787   | +18.726 | − 0.481 | + 0     | −42  | +74  |
|          | 21.999 | 016.0                          | 0.2221  | 4.522    | 8.786    | 18.734  | − 0.132 | + 0     | − 9  | +75  |
|          | 22.996 | 017.0                          | 0.2248  | 4.585    | 8.770    | 18.737  | + 0.216 | + 0     | +23  | +60  |
|          | 23.993 | 018.0                          | 0.2276  | 4.639    | 8.740    | 18.734  | 0.565   | + 0     | +48  | +29  |
|          | 24.990 | 019.0                          | 0.2303  | 4.680    | 8.701    | 18.727  | 0.912   | + 0     | +58  | −11  |
|          | 25.988 | 020.0                          | +0.2330 | +4.702   | +8.664   | +18.714 | + 1.260 | + 0     | +50  | −50  |
|          | 26.985 | 021.0                          | 0.2358  | 4.708    | 8.638    | 18.696  | 1.607   | − 0     | +26  | −78  |
|          | 27.982 | 022.0                          | 0.2385  | 4.704    | 8.633    | 18.673  | 1.954   | − 0     | − 8  | −85  |
|          | 28.979 | 023.0                          | 0.2412  | 4.702    | 8.652    | 18.645  | 2.300   | − 0     | −40  | −70  |
|          | 29.977 | 024.0                          | 0.2439  | 4.714    | 8.690    | 18.612  | 2.647   | − 1     | −59  | −36  |
|          | Paźdz. | 30.974                         | 025.0   | +0.2467  | +4.744   | +8.737  | +18.575 | + 2.993 | − 1  | −60  |
| 1.971    |        | 026.0                          | +0.2494 | +4.793   | +8.781   | +18.532 | + 3.339 | − 1     | −41  | +45  |
| 2.968    |        | 027.0                          | +0.2521 | +4.855   | +8.812   | +18.483 | + 3.685 | − 1     | −11  | +70  |



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| UT1    |          | 0 <sup>h</sup> SDT             |                       |                      |                      |                       |                       |                            |                           |                           |
|--------|----------|--------------------------------|-----------------------|----------------------|----------------------|-----------------------|-----------------------|----------------------------|---------------------------|---------------------------|
|        |          | Juliańska<br>data<br>gwiazdowa | $\tau$                | $A + A'$             | $B + B'$             | $C$                   | $D$                   | $E$                        | $A'$                      | $B'$                      |
| Paźdz. | 1.971    | 2464<br>026.0                  | +0. <sup>a</sup> 2494 | +4. <sup>h</sup> 793 | +8. <sup>h</sup> 781 | +18. <sup>h</sup> 532 | + 3. <sup>h</sup> 339 | 0 <sup>s</sup> 0001<br>− 1 | 0 <sup>m</sup> 001<br>−41 | 0 <sup>m</sup> 001<br>+45 |
|        | 2.968    | 027.0                          | 0.2521                | 4.855                | 8.812                | 18.483                | 3.685                 | − 1                        | −11                       | +70                       |
|        | 3.966    | 028.0                          | 0.2549                | 4.921                | 8.828                | 18.430                | 4.030                 | − 1                        | +24                       | +78                       |
|        | 4.963    | 029.0                          | 0.2576                | 4.985                | 8.827                | 18.371                | 4.376                 | − 1                        | +57                       | +70                       |
|        | 5.960    | 030.0                          | 0.2603                | 5.040                | 8.814                | 18.306                | 4.720                 | − 1                        | +80                       | +49                       |
|        | 6.958    | 031.0                          | +0.2631               | +5.083               | +8.794               | +18.235               | + 5.064               | − 1                        | +91                       | +21                       |
|        | 7.955    | 032.0                          | 0.2658                | 5.113                | 8.772                | 18.159                | 5.407                 | − 1                        | +89                       | −11                       |
|        | 8.952    | 033.0                          | 0.2685                | 5.131                | 8.753                | 18.078                | 5.749                 | − 1                        | +74                       | −39                       |
|        | 9.949    | 034.0                          | 0.2713                | 5.138                | 8.742                | 17.990                | 6.089                 | − 1                        | +49                       | −61                       |
|        | 10.947   | 035.0                          | 0.2740                | 5.140                | 8.743                | 17.897                | 6.428                 | − 1                        | +18                       | −71                       |
|        | 11.944   | 036.0                          | +0.2767               | +5.140               | +8.755               | +17.798               | + 6.766               | − 1                        | −16                       | −70                       |
|        | 12.941   | 037.0                          | 0.2794                | 5.143                | 8.781                | 17.693                | 7.102                 | − 2                        | −47                       | −57                       |
|        | 13.938   | 038.0                          | 0.2822                | 5.154                | 8.816                | 17.583                | 7.436                 | − 2                        | −70                       | −34                       |
|        | 14.936   | 039.0                          | 0.2849                | 5.175                | 8.858                | 17.467                | 7.767                 | − 2                        | −83                       | − 5                       |
|        | 15.933   | 040.0                          | 0.2876                | 5.210                | 8.902                | 17.346                | 8.097                 | − 2                        | −84                       | +25                       |
|        | 16.930   | 041.0                          | +0.2904               | +5.258               | +8.944               | +17.219               | + 8.424               | − 2                        | −72                       | +52                       |
|        | 17.928   | 042.0                          | 0.2931                | 5.316                | 8.976                | 17.086                | 8.749                 | − 2                        | −49                       | +70                       |
|        | 18.925   | 043.0                          | 0.2958                | 5.383                | 8.997                | 16.949                | 9.070                 | − 2                        | −19                       | +76                       |
|        | 19.922   | 044.0                          | 0.2986                | 5.451                | 9.003                | 16.806                | 9.389                 | − 2                        | +12                       | +66                       |
|        | 20.919   | 045.0                          | 0.3013                | 5.514                | 8.995                | 16.658                | 9.705                 | − 2                        | +38                       | +42                       |
|        | 21.917   | 046.0                          | +0.3040               | +5.567               | +8.976               | +16.505               | +10.018               | − 2                        | +52                       | + 7                       |
|        | 22.914   | 047.0                          | 0.3067                | 5.604                | 8.954                | 16.347                | 10.328                | − 2                        | +51                       | −32                       |
|        | 23.911   | 048.0                          | 0.3095                | 5.626                | 8.938                | 16.185                | 10.635                | − 2                        | +33                       | −65                       |
|        | 24.908   | 049.0                          | 0.3122                | 5.635                | 8.938                | 16.018                | 10.938                | − 2                        | + 3                       | −83                       |
|        | 25.906   | 050.0                          | 0.3149                | 5.640                | 8.959                | 15.847                | 11.238                | − 2                        | −32                       | −80                       |
|        | 26.903   | 051.0                          | +0.3177               | +5.654               | +9.002               | +15.672               | +11.536               | − 2                        | −59                       | −55                       |
|        | 27.900   | 052.0                          | 0.3204                | 5.685                | 9.060                | 15.492                | 11.830                | − 3                        | −70                       | −16                       |
|        | 28.897   | 053.0                          | 0.3231                | 5.737                | 9.122                | 15.308                | 12.122                | − 3                        | −60                       | +27                       |
|        | 29.895   | 054.0                          | 0.3259                | 5.807                | 9.175                | 15.119                | 12.410                | − 2                        | −33                       | +61                       |
|        | 30.892   | 055.0                          | 0.3286                | 5.887                | 9.212                | 14.926                | 12.696                | − 2                        | + 5                       | +79                       |
|        | Listopad | 31.889                         | 056.0                 | +0.3313              | +5.969               | +9.231                | +14.728               | +12.978                    | − 2                       | +42                       |
| 1.887  |          | 057.0                          | 0.3340                | 6.044                | 9.233                | 14.526                | 13.257                | − 2                        | +73                       | +61                       |
| 2.884  |          | 058.0                          | 0.3368                | 6.107                | 9.225                | 14.318                | 13.533                | − 2                        | +91                       | +33                       |
| 3.881  |          | 059.0                          | 0.3395                | 6.157                | 9.213                | 14.106                | 13.805                | − 2                        | +94                       | + 1                       |
| 4.878  |          | 060.0                          | 0.3422                | 6.193                | 9.202                | 13.890                | 14.074                | − 2                        | +84                       | −30                       |
| 5.876  |          | 061.0                          | +0.3450               | +6.218               | +9.197               | +13.668               | +14.339               | − 2                        | +62                       | −55                       |
| 6.873  |          | 062.0                          | 0.3477                | 6.236                | 9.203                | 13.442                | 14.599                | − 2                        | +32                       | −70                       |
| 7.870  |          | 063.0                          | 0.3504                | 6.251                | 9.220                | 13.212                | 14.856                | − 3                        | − 1                       | −73                       |
| 8.867  |          | 064.0                          | 0.3532                | 6.268                | 9.249                | 12.977                | 15.108                | − 3                        | −34                       | −64                       |
| 9.865  |          | 065.0                          | 0.3559                | 6.291                | 9.289                | 12.737                | 15.356                | − 3                        | −60                       | −44                       |
| 10.862 |          | 066.0                          | +0.3586               | +6.325               | +9.337               | +12.493               | +15.599               | − 3                        | −77                       | −16                       |
| 11.859 |          | 067.0                          | 0.3614                | 6.372                | 9.389                | 12.245                | 15.837                | − 3                        | −82                       | +16                       |
| 12.857 |          | 068.0                          | 0.3641                | 6.432                | 9.438                | 11.993                | 16.071                | − 3                        | −73                       | +45                       |
| 13.854 |          | 069.0                          | 0.3668                | 6.505                | 9.479                | 11.737                | 16.299                | − 3                        | −53                       | +67                       |
| 14.851 |          | 070.0                          | 0.3695                | 6.586                | 9.509                | 11.477                | 16.522                | − 3                        | −25                       | +76                       |
| 15.848 |          | 071.0                          | +0.3723               | +6.671               | +9.523               | +11.213               | +16.740               | − 3                        | + 6                       | +71                       |
| 16.846 | 072.0    | +0.3750                        | +6.753                | +9.523               | +10.946              | +16.952               | − 3                   | +34                        | +52                       |                           |

# WIELKOŚCI REDUKCYJNE 2015

| UT1      |        | 0 <sup>h</sup> SDT             |                       |                      |                      |                       |                       |                             |                            |                            |
|----------|--------|--------------------------------|-----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------------|----------------------------|----------------------------|
|          |        | Juliańska<br>data<br>gwiazdowa | $\tau$                | $A + A'$             | $B + B'$             | $C$                   | $D$                   | $E$                         | $A'$                       | $B'$                       |
| Listopad | 16.846 | 2464<br>072.0                  | +0. <sup>a</sup> 3750 | +6. <sup>h</sup> 753 | +9. <sup>h</sup> 523 | +10. <sup>h</sup> 946 | +16. <sup>h</sup> 952 | 0 <sup>s</sup> .0001<br>− 3 | 0 <sup>s</sup> '001<br>+34 | 0 <sup>s</sup> '001<br>+52 |
|          | 17.843 | 073.0                          | 0.3777                | 6.826                | 9.511                | 10.675                | 17.159                | − 3                         | +52                        | +20                        |
|          | 18.840 | 074.0                          | 0.3805                | 6.886                | 9.492                | 10.401                | 17.361                | − 3                         | +55                        | −17                        |
|          | 19.837 | 075.0                          | 0.3832                | 6.929                | 9.475                | 10.124                | 17.557                | − 3                         | +42                        | −53                        |
|          | 20.835 | 076.0                          | 0.3859                | 6.960                | 9.469                | 9.844                 | 17.747                | − 3                         | +16                        | −77                        |
|          | 21.832 | 077.0                          | +0.3887               | +6.983               | +9.481               | + 9.562               | +17.932               | − 3                         | −18                        | −83                        |
|          | 22.829 | 078.0                          | 0.3914                | 7.009                | 9.513                | 9.277                 | 18.112                | − 3                         | −51                        | −68                        |
|          | 23.826 | 079.0                          | 0.3941                | 7.047                | 9.563                | 8.989                 | 18.287                | − 3                         | −71                        | −36                        |
|          | 24.824 | 080.0                          | 0.3968                | 7.105                | 9.621                | 8.699                 | 18.456                | − 3                         | −73                        | + 5                        |
|          | 25.821 | 081.0                          | 0.3996                | 7.183                | 9.677                | 8.407                 | 18.620                | − 3                         | −55                        | +45                        |
|          | 26.818 | 082.0                          | +0.4023               | +7.277               | +9.721               | + 8.112               | +18.779               | − 3                         | −22                        | +72                        |
|          | 27.816 | 083.0                          | 0.4050                | 7.378                | 9.746                | 7.814                 | 18.933                | − 3                         | +18                        | +82                        |
|          | 28.813 | 084.0                          | 0.4078                | 7.477                | 9.752                | 7.514                 | 19.082                | − 2                         | +56                        | +73                        |
|          | 29.810 | 085.0                          | 0.4105                | 7.566                | 9.743                | 7.211                 | 19.225                | − 2                         | +82                        | +49                        |
|          | 30.807 | 086.0                          | 0.4132                | 7.640                | 9.724                | 6.906                 | 19.363                | − 2                         | +94                        | +17                        |
| Grudzień | 1.805  | 087.0                          | +0.4160               | +7.700               | +9.704               | + 6.598               | +19.495               | − 2                         | +91                        | −17                        |
|          | 2.802  | 088.0                          | 0.4187                | 7.746                | 9.688                | 6.287                 | 19.622                | − 2                         | +74                        | −46                        |
|          | 3.799  | 089.0                          | 0.4214                | 7.783                | 9.681                | 5.975                 | 19.743                | − 2                         | +46                        | −66                        |
|          | 4.796  | 090.0                          | 0.4242                | 7.815                | 9.685                | 5.659                 | 19.857                | − 2                         | +13                        | −74                        |
|          | 5.794  | 091.0                          | 0.4269                | 7.846                | 9.700                | 5.342                 | 19.966                | − 2                         | −20                        | −70                        |
|          | 6.791  | 092.0                          | +0.4296               | +7.881               | +9.727               | + 5.023               | +20.069               | − 2                         | −50                        | −53                        |
|          | 7.788  | 093.0                          | 0.4323                | 7.926                | 9.763                | 4.701                 | 20.165                | − 3                         | −71                        | −28                        |
|          | 8.786  | 094.0                          | 0.4351                | 7.982                | 9.803                | 4.378                 | 20.255                | − 3                         | −81                        | + 3                        |
|          | 9.783  | 095.0                          | 0.4378                | 8.052                | 9.843                | 4.053                 | 20.339                | − 2                         | −77                        | +35                        |
|          | 10.780 | 096.0                          | 0.4405                | 8.135                | 9.877                | 3.726                 | 20.416                | − 2                         | −60                        | +61                        |
|          | 11.777 | 097.0                          | +0.4433               | +8.229               | +9.900               | + 3.398               | +20.486               | − 2                         | −33                        | +76                        |
|          | 12.775 | 098.0                          | 0.4460                | 8.328                | 9.907                | 3.068                 | 20.549                | − 2                         | − 1                        | +77                        |
|          | 13.772 | 099.0                          | 0.4487                | 8.426                | 9.898                | 2.738                 | 20.606                | − 2                         | +30                        | +61                        |
|          | 14.769 | 100.0                          | 0.4515                | 8.516                | 9.875                | 2.407                 | 20.656                | − 2                         | +52                        | +33                        |
|          | 15.766 | 101.0                          | 0.4542                | 8.593                | 9.842                | 2.075                 | 20.700                | − 2                         | +61                        | − 4                        |
|          | 16.764 | 102.0                          | +0.4569               | +8.653               | +9.809               | + 1.743               | +20.736               | − 2                         | +53                        | −41                        |
|          | 17.761 | 103.0                          | 0.4596                | 8.698                | 9.784                | 1.410                 | 20.766                | − 2                         | +30                        | −69                        |
|          | 18.758 | 104.0                          | 0.4624                | 8.734                | 9.774                | 1.077                 | 20.789                | − 2                         | − 2                        | −82                        |
|          | 19.755 | 105.0                          | 0.4651                | 8.768                | 9.782                | 0.745                 | 20.806                | − 2                         | −36                        | −76                        |
|          | 20.753 | 106.0                          | 0.4678                | 8.809                | 9.807                | 0.413                 | 20.817                | − 2                         | −63                        | −51                        |
|          | 21.750 | 107.0                          | +0.4706               | +8.866               | +9.845               | + 0.080               | +20.821               | − 2                         | −74                        | −14                        |
|          | 22.747 | 108.0                          | 0.4733                | 8.942                | 9.884                | − 0.251               | 20.820                | − 2                         | −67                        | +27                        |
|          | 23.745 | 109.0                          | 0.4760                | 9.035                | 9.916                | 0.583                 | 20.812                | − 2                         | −42                        | +60                        |
|          | 24.742 | 110.0                          | 0.4788                | 9.140                | 9.933                | 0.914                 | 20.798                | − 2                         | − 5                        | +79                        |
|          | 25.739 | 111.0                          | 0.4815                | 9.247                | 9.930                | 1.245                 | 20.779                | − 1                         | +34                        | +79                        |
|          | 26.736 | 112.0                          | +0.4842               | +9.348               | +9.910               | − 1.576               | +20.753               | − 1                         | +67                        | +63                        |
|          | 27.734 | 113.0                          | 0.4870                | 9.437                | 9.877                | 1.907                 | 20.721                | − 1                         | +87                        | +34                        |
|          | 28.731 | 114.0                          | 0.4897                | 9.509                | 9.837                | 2.237                 | 20.684                | − 1                         | +92                        | − 1                        |
|          | 29.728 | 115.0                          | 0.4924                | 9.567                | 9.799                | 2.567                 | 20.640                | − 1                         | +81                        | −33                        |
|          | 30.725 | 116.0                          | 0.4951                | 9.611                | 9.767                | 2.896                 | 20.590                | − 1                         | +58                        | −58                        |
|          | 31.723 | 117.0                          | +0.4979               | +9.648               | +9.746               | − 3.225               | +20.534               | − 1                         | +27                        | −72                        |
|          | 32.720 | 118.0                          | +0.5006               | +9.681               | +9.737               | − 3.553               | +20.471               | − 1                         | − 7                        | −73                        |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| <i>UT1</i>                |      | $\beta$ Cassiopeiae     |                      | $\alpha$ Cassiopeiae    |                      | $\beta$ Ceti            |                      | $\gamma$ Cassiopeiae    |                      |
|---------------------------|------|-------------------------|----------------------|-------------------------|----------------------|-------------------------|----------------------|-------------------------|----------------------|
|                           |      | $2^m27$                 | F5                   | $2^m23$                 | K0                   | $2^m04$                 | K0                   | $2^m80$ var.            | B0p                  |
|                           |      | $\alpha_{app}^{\gamma}$ | $\delta_{app}$       | $\alpha_{app}^{\gamma}$ | $\delta_{app}$       | $\alpha_{app}^{\gamma}$ | $\delta_{app}$       | $\alpha_{app}^{\gamma}$ | $\delta_{app}$       |
|                           |      | $0^h09^m$               | $+59^{\circ}13'$     | $0^h41^m$               | $+56^{\circ}37'$     | $0^h44^m$               | $-17^{\circ}53'$     | $0^h57^m$               | $+60^{\circ}47'$     |
| Styczeń                   | −0.3 | 60. <sup>s</sup> 336    | 75. <sup>''</sup> 40 | 23.431                  | 26. <sup>''</sup> 62 | 20. <sup>s</sup> 655    | 83. <sup>''</sup> 83 | 39. <sup>s</sup> 288    | 68. <sup>''</sup> 31 |
|                           | 9.7  | 60.011                  | 74.70                | 23.135                  | 26.27                | 20.523                  | 84.41                | 38.945                  | 68.24                |
|                           | 19.7 | 59.691                  | 73.49                | 22.833                  | 25.42                | 20.390                  | 84.76                | 38.590                  | 67.64                |
|                           | 29.6 | 59.395                  | 71.77                | 22.541                  | 24.07                | 20.262                  | 84.84                | 38.240                  | 66.50                |
| Luty                      | 8.6  | 59.134                  | 69.67                | 22.272                  | 22.31                | 20.145                  | 84.66                | 37.913                  | 64.90                |
|                           | 18.6 | 58.918                  | 67.23                | 22.035                  | 20.19                | 20.042                  | 84.22                | 37.617                  | 62.89                |
|                           | 28.6 | 58.764                  | 64.55                | 21.847                  | 17.78                | 19.961                  | 83.51                | 37.373                  | 60.54                |
| Marzec                    | 10.5 | 58.677                  | 61.77                | 21.718                  | 15.23                | 19.908                  | 82.53                | 37.194                  | 57.99                |
|                           | 20.5 | 58.665                  | 58.98                | 21.654                  | 12.59                | 19.885                  | 81.31                | 37.086                  | 55.30                |
|                           | 30.5 | 58.737                  | 56.30                | 21.667                  | 10.01                | 19.902                  | 79.82                | 37.064                  | 52.60                |
| Kwiecień                  | 9.5  | 58.888                  | 53.86                | 21.755                  | 07.60                | 19.958                  | 78.12                | 37.127                  | 50.02                |
|                           | 19.4 | 59.118                  | 51.71                | 21.919                  | 05.42                | 20.056                  | 76.21                | 37.277                  | 47.62                |
|                           | 29.4 | 59.425                  | 49.97                | 22.161                  | 03.58                | 20.199                  | 74.13                | 37.515                  | 45.53                |
| Maj                       | 9.4  | 59.795                  | 48.70                | 22.467                  | 02.15                | 20.382                  | 71.93                | 37.829                  | 43.82                |
|                           | 19.3 | 60.220                  | 47.91                | 22.834                  | 01.16                | 20.603                  | 69.63                | 38.213                  | 42.52                |
|                           | 29.3 | 60.689                  | 47.67                | 23.251                  | 00.67                | 20.859                  | 67.31                | 38.657                  | 41.71                |
| Czerwiec                  | 8.3  | 61.184                  | 47.95                | 23.701                  | 00.67                | 21.140                  | 65.01                | 39.143                  | 41.40                |
|                           | 18.3 | 61.695                  | 48.74                | 24.176                  | 01.16                | 21.441                  | 62.79                | 39.662                  | 41.58                |
|                           | 28.2 | 62.206                  | 50.05                | 24.661                  | 02.16                | 21.754                  | 60.72                | 40.197                  | 42.28                |
| Lipiec                    | 8.2  | 62.702                  | 51.80                | 25.141                  | 03.59                | 22.069                  | 58.84                | 40.731                  | 43.44                |
|                           | 18.2 | 63.174                  | 53.97                | 25.609                  | 05.44                | 22.379                  | 57.21                | 41.256                  | 45.04                |
|                           | 28.2 | 63.608                  | 56.51                | 26.048                  | 07.67                | 22.675                  | 55.88                | 41.756                  | 47.06                |
| Sierpień                  | 7.1  | 63.994                  | 59.32                | 26.451                  | 10.19                | 22.949                  | 54.86                | 42.219                  | 49.41                |
|                           | 17.1 | 64.329                  | 62.38                | 26.812                  | 12.97                | 23.197                  | 54.20                | 42.642                  | 52.07                |
|                           | 27.1 | 64.602                  | 65.61                | 27.121                  | 15.95                | 23.411                  | 53.90                | 43.009                  | 54.98                |
| Wrzesień                  | 6.0  | 64.814                  | 68.91                | 27.377                  | 19.04                | 23.589                  | 53.95                | 43.321                  | 58.04                |
|                           | 16.0 | 64.963                  | 72.27                | 27.578                  | 22.22                | 23.729                  | 54.34                | 43.574                  | 61.24                |
|                           | 26.0 | 65.044                  | 75.57                | 27.717                  | 25.38                | 23.829                  | 55.04                | 43.760                  | 64.47                |
| Paźdz.                    | 6.0  | 65.065                  | 78.76                | 27.801                  | 28.48                | 23.892                  | 55.99                | 43.885                  | 67.69                |
|                           | 15.9 | 65.025                  | 81.80                | 27.829                  | 31.48                | 23.919                  | 57.16                | 43.946                  | 70.84                |
|                           | 25.9 | 64.927                  | 84.59                | 27.800                  | 34.27                | 23.911                  | 58.47                | 43.942                  | 73.83                |
| Listopad                  | 4.9  | 64.779                  | 87.07                | 27.722                  | 36.81                | 23.876                  | 59.86                | 43.881                  | 76.61                |
|                           | 14.9 | 64.582                  | 89.21                | 27.594                  | 39.07                | 23.813                  | 61.28                | 43.759                  | 79.12                |
|                           | 24.8 | 64.343                  | 90.90                | 27.420                  | 40.93                | 23.729                  | 62.65                | 43.582                  | 81.27                |
| Grudzień                  | 4.8  | 64.071                  | 92.15                | 27.210                  | 42.40                | 23.629                  | 63.92                | 43.357                  | 83.04                |
|                           | 14.8 | 63.767                  | 92.88                | 26.961                  | 43.40                | 23.514                  | 65.06                | 43.084                  | 84.35                |
|                           | 24.7 | 63.447                  | 93.05                | 26.687                  | 43.89                | 23.389                  | 66.00                | 42.776                  | 85.14                |
|                           | 34.7 | 63.117                  | 92.70                | 26.394                  | 43.88                | 23.259                  | 66.73                | 42.440                  | 85.42                |
|                           | 44.7 | 62.786                  | 91.80                | 26.088                  | 43.35                | 23.125                  | 67.23                | 42.084                  | 85.15                |
| Miejsce śr. 2015.5        |      | 60. <sup>s</sup> 872    | 66. <sup>''</sup> 76 | 23. <sup>s</sup> 791    | 19. <sup>''</sup> 68 | 22. <sup>s</sup> 011    | 66. <sup>''</sup> 36 | 39. <sup>s</sup> 379    | 61. <sup>''</sup> 15 |
| sec $\delta$ tan $\delta$ |      | +1.955                  | +1.680               | +1.818                  | +1.518               | +1.051                  | −0.323               | +2.050                  | +1.789               |
| dwukrotne górowanie       |      | IX.23                   |                      | X.01                    |                      | X.02                    |                      | X.06                    |                      |
| <i>a</i> <i>a'</i>        |      | +0.158                  | +0.999               | +0.172                  | +0.984               | +0.149                  | +0.981               | +0.183                  | +0.969               |
| <i>b</i> <i>b'</i>        |      | +0.112                  | −0.044               | +0.100                  | −0.180               | −0.021                  | −0.192               | +0.116                  | −0.249               |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| <i>UT1</i>                |      | $\beta$ Andromedae    |                      | $\delta$ Cassiopeiae  |                      | $\varepsilon$ Cassiopeiae |                      | $\alpha$ Arietis      |                      |
|---------------------------|------|-----------------------|----------------------|-----------------------|----------------------|---------------------------|----------------------|-----------------------|----------------------|
|                           |      | $2^m06$               | M0                   | $2^m68$               | A5                   | $3^m38$                   | B3                   | $2^m00$               | K2                   |
|                           |      | $\alpha_{app}^\gamma$ | $\delta_{app}$       | $\alpha_{app}^\gamma$ | $\delta_{app}$       | $\alpha_{app}^\gamma$     | $\delta_{app}$       | $\alpha_{app}^\gamma$ | $\delta_{app}$       |
|                           |      | $1^h10^m$             | $+35^\circ41'$       | $1^h26^m$             | $+60^\circ18'$       | $1^h55^m$                 | $+63^\circ44'$       | $2^h08^m$             | $+23^\circ31'$       |
| Styczeń                   | −0.2 | 35. <sup>s</sup> 637  | 68. <sup>''</sup> 73 | 50. <sup>s</sup> 646  | 60. <sup>''</sup> 92 | 32. <sup>s</sup> 052      | 49. <sup>''</sup> 52 | 02. <sup>s</sup> 501  | 60. <sup>''</sup> 62 |
|                           | 9.7  | 35.471                | 68.32                | 50.323                | 61.19                | 31.699                    | 50.22                | 02.379                | 60.32                |
|                           | 19.7 | 35.295                | 67.59                | 49.978                | 60.94                | 31.310                    | 50.40                | 02.236                | 59.84                |
|                           | 29.7 | 35.116                | 66.55                | 49.625                | 60.15                | 30.900                    | 50.02                | 02.078                | 59.20                |
| Luty                      | 8.7  | 34.945                | 65.26                | 49.284                | 58.89                | 30.493                    | 49.13                | 01.916                | 58.42                |
|                           | 18.6 | 34.786                | 63.75                | 48.964                | 57.19                | 30.098                    | 47.75                | 01.753                | 57.53                |
|                           | 28.6 | 34.653                | 62.09                | 48.686                | 55.11                | 29.742                    | 45.92                | 01.601                | 56.55                |
| Marzec                    | 10.6 | 34.552                | 60.37                | 48.465                | 52.76                | 29.441                    | 43.76                | 01.470                | 55.55                |
|                           | 20.6 | 34.491                | 58.64                | 48.308                | 50.23                | 29.207                    | 41.34                | 01.366                | 54.56                |
|                           | 30.5 | 34.478                | 57.00                | 48.234                | 47.62                | 29.059                    | 38.75                | 01.300                | 53.65                |
| Kwiecień                  | 9.5  | 34.517                | 55.53                | 48.243                | 45.06                | 29.002                    | 36.12                | 01.277                | 52.86                |
|                           | 19.5 | 34.608                | 54.28                | 48.337                | 42.62                | 29.041                    | 33.54                | 01.301                | 52.25                |
|                           | 29.4 | 34.756                | 53.33                | 48.522                | 40.42                | 29.182                    | 31.11                | 01.376                | 51.85                |
| Maj                       | 9.4  | 34.954                | 52.71                | 48.787                | 38.54                | 29.416                    | 28.94                | 01.499                | 51.70                |
|                           | 19.4 | 35.198                | 52.44                | 49.127                | 37.01                | 29.738                    | 27.07                | 01.670                | 51.81                |
|                           | 29.4 | 35.485                | 52.57                | 49.534                | 35.94                | 30.142                    | 25.61                | 01.886                | 52.21                |
| Czerwiec                  | 8.3  | 35.801                | 53.07                | 49.991                | 35.33                | 30.609                    | 24.57                | 02.138                | 52.87                |
|                           | 18.3 | 36.143                | 53.94                | 50.489                | 35.18                | 31.130                    | 23.97                | 02.421                | 53.79                |
|                           | 28.3 | 36.499                | 55.16                | 51.012                | 35.53                | 31.691                    | 23.86                | 02.727                | 54.95                |
| Lipiec                    | 8.3  | 36.857                | 56.67                | 51.544                | 36.34                | 32.271                    | 24.22                | 03.046                | 56.31                |
|                           | 18.2 | 37.213                | 58.46                | 52.077                | 37.59                | 32.863                    | 25.03                | 03.372                | 57.82                |
|                           | 28.2 | 37.554                | 60.47                | 52.594                | 39.27                | 33.448                    | 26.30                | 03.696                | 59.46                |
| Sierpień                  | 7.2  | 37.872                | 62.63                | 53.083                | 41.30                | 34.011                    | 27.94                | 04.008                | 61.16                |
|                           | 17.1 | 38.166                | 64.91                | 53.540                | 43.66                | 34.549                    | 29.96                | 04.307                | 62.90                |
|                           | 27.1 | 38.425                | 67.26                | 53.949                | 46.29                | 35.044                    | 32.31                | 04.583                | 64.62                |
| Wrzesień                  | 6.1  | 38.648                | 69.60                | 54.309                | 49.11                | 35.491                    | 34.90                | 04.834                | 66.27                |
|                           | 16.1 | 38.834                | 71.93                | 54.617                | 52.10                | 35.887                    | 37.72                | 05.058                | 67.85                |
|                           | 26.0 | 38.980                | 74.17                | 54.862                | 55.19                | 36.219                    | 40.70                | 05.249                | 69.31                |
| Paźdz.                    | 6.0  | 39.088                | 76.30                | 55.050                | 58.29                | 36.490                    | 43.76                | 05.410                | 70.63                |
|                           | 16.0 | 39.157                | 78.29                | 55.176                | 61.38                | 36.695                    | 46.88                | 05.540                | 71.81                |
|                           | 26.0 | 39.189                | 80.08                | 55.237                | 64.37                | 36.827                    | 49.96                | 05.636                | 72.83                |
| Listopad                  | 4.9  | 39.188                | 81.66                | 55.241                | 67.19                | 36.893                    | 52.95                | 05.702                | 73.68                |
|                           | 14.9 | 39.154                | 83.01                | 55.182                | 69.81                | 36.886                    | 55.79                | 05.737                | 74.37                |
|                           | 24.9 | 39.088                | 84.07                | 55.062                | 72.12                | 36.806                    | 58.39                | 05.741                | 74.89                |
| Grudzień                  | 4.8  | 38.996                | 84.86                | 54.890                | 74.10                | 36.659                    | 60.70                | 05.716                | 75.24                |
|                           | 14.8 | 38.877                | 85.34                | 54.663                | 75.67                | 36.443                    | 62.64                | 05.660                | 75.42                |
|                           | 24.8 | 38.736                | 85.47                | 54.391                | 76.76                | 36.165                    | 64.14                | 05.576                | 75.41                |
|                           | 34.8 | 38.577                | 85.29                | 54.083                | 77.37                | 35.836                    | 65.19                | 05.467                | 75.24                |
|                           | 44.7 | 38.403                | 84.76                | 53.743                | 77.46                | 35.461                    | 65.71                | 05.334                | 74.88                |
| Miejsce śr. 2015.5        |      | 36. <sup>s</sup> 300  | 68. <sup>''</sup> 40 | 50. <sup>s</sup> 585  | 55. <sup>''</sup> 04 | 31. <sup>s</sup> 605      | 44. <sup>''</sup> 34 | 03. <sup>s</sup> 040  | 66. <sup>''</sup> 09 |
| sec $\delta$ tan $\delta$ |      | +1.231                | +0.719               | +2.019                | +1.754               | +2.261                    | +2.027               | +1.091                | +0.436               |
| dwukrotne górowanie       |      | X.09                  |                      | X.13                  |                      | X.20                      |                      | X.23                  |                      |
| <i>a</i> <i>a'</i>        |      | +0.168                | +0.953               | +0.197                | +0.929               | +0.219                    | +0.876               | +0.169                | +0.848               |
| <i>b</i> <i>b'</i>        |      | +0.046                | −0.303               | +0.109                | −0.370               | +0.118                    | −0.483               | +0.025                | −0.530               |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       |      | $\alpha$ Persei                |                | $\gamma$ Camelopardalis        |                | $\alpha$ Tauri                 |                | $\beta$ Orionis                |                   |       |     |
|---------------------------|------|--------------------------------|----------------|--------------------------------|----------------|--------------------------------|----------------|--------------------------------|-------------------|-------|-----|
|                           |      | 1 <sup>m</sup> 79              | F5             | 4 <sup>m</sup> 63              | A0             | 0 <sup>m</sup> 85              | Aldebaran      | K5                             | 0 <sup>m</sup> 12 | Rigel | B8p |
|                           |      | $\alpha_{app}^{\gamma}$        | $\delta_{app}$ | $\alpha_{app}^{\gamma}$        | $\delta_{app}$ | $\alpha_{app}^{\gamma}$        | $\delta_{app}$ | $\alpha_{app}^{\gamma}$        | $\delta_{app}$    |       |     |
|                           |      | 3 <sup>h</sup> 25 <sup>m</sup> | +49°54′        | 3 <sup>h</sup> 51 <sup>m</sup> | +71°22′        | 4 <sup>h</sup> 36 <sup>m</sup> | +16°32′        | 5 <sup>h</sup> 15 <sup>m</sup> | −8°11′            |       |     |
| Styczeń                   | −0.1 | 26.418                         | 52.83          | 62.849                         | 41.05          | 48.638                         | 11.24          | 17.141                         | 18.50             |       |     |
|                           | 9.8  | 26.278                         | 53.90          | 62.541                         | 43.16          | 48.614                         | 10.97          | 17.135                         | 20.11             |       |     |
|                           | 19.8 | 26.088                         | 54.65          | 62.127                         | 44.88          | 48.548                         | 10.70          | 17.087                         | 21.54             |       |     |
|                           | 29.8 | 25.856                         | 55.02          | 61.620                         | 46.11          | 48.441                         | 10.44          | 16.996                         | 22.76             |       |     |
| Luty                      | 8.8  | 25.597                         | 55.01          | 61.052                         | 46.82          | 48.302                         | 10.18          | 16.870                         | 23.75             |       |     |
|                           | 18.7 | 25.319                         | 54.63          | 60.439                         | 47.00          | 48.136                         | 09.91          | 16.712                         | 24.50             |       |     |
|                           | 28.7 | 25.039                         | 53.85          | 59.813                         | 46.60          | 47.953                         | 09.63          | 16.533                         | 25.00             |       |     |
| Marzec                    | 10.7 | 24.773                         | 52.76          | 59.208                         | 45.69          | 47.765                         | 09.34          | 16.342                         | 25.24             |       |     |
|                           | 20.6 | 24.532                         | 51.37          | 58.643                         | 44.30          | 47.580                         | 09.06          | 16.148                         | 25.24             |       |     |
|                           | 30.6 | 24.333                         | 49.75          | 58.153                         | 42.46          | 47.411                         | 08.81          | 15.963                         | 24.97             |       |     |
| Kwiecień                  | 9.6  | 24.187                         | 47.99          | 57.759                         | 40.31          | 47.268                         | 08.59          | 15.797                         | 24.47             |       |     |
|                           | 19.6 | 24.100                         | 46.14          | 57.472                         | 37.88          | 47.156                         | 08.44          | 15.655                         | 23.72             |       |     |
|                           | 29.5 | 24.083                         | 44.30          | 57.316                         | 35.30          | 47.087                         | 08.38          | 15.548                         | 22.73             |       |     |
| Maj                       | 9.5  | 24.135                         | 42.56          | 57.291                         | 32.67          | 47.063                         | 08.42          | 15.479                         | 21.53             |       |     |
|                           | 19.5 | 24.255                         | 40.94          | 57.395                         | 30.06          | 47.084                         | 08.59          | 15.452                         | 20.12             |       |     |
|                           | 29.5 | 24.445                         | 39.54          | 57.636                         | 27.58          | 47.154                         | 08.90          | 15.470                         | 18.53             |       |     |
| Czerwiec                  | 8.4  | 24.694                         | 38.39          | 57.995                         | 25.31          | 47.269                         | 09.35          | 15.530                         | 16.81             |       |     |
|                           | 18.4 | 24.997                         | 37.53          | 58.466                         | 23.29          | 47.425                         | 09.93          | 15.631                         | 14.97             |       |     |
|                           | 28.4 | 25.347                         | 36.99          | 59.039                         | 21.62          | 47.621                         | 10.63          | 15.773                         | 13.07             |       |     |
| Lipiec                    | 8.3  | 25.730                         | 36.78          | 59.687                         | 20.31          | 47.848                         | 11.44          | 15.947                         | 11.17             |       |     |
|                           | 18.3 | 26.141                         | 36.89          | 60.404                         | 19.37          | 48.101                         | 12.31          | 16.151                         | 09.30             |       |     |
|                           | 28.3 | 26.567                         | 37.33          | 61.171                         | 18.88          | 48.376                         | 13.23          | 16.381                         | 07.56             |       |     |
| Sierpień                  | 7.3  | 26.997                         | 38.05          | 61.963                         | 18.79          | 48.662                         | 14.15          | 16.629                         | 05.97             |       |     |
|                           | 17.2 | 27.428                         | 39.06          | 62.775                         | 19.11          | 48.958                         | 15.05          | 16.892                         | 04.61             |       |     |
|                           | 27.2 | 27.848                         | 40.33          | 63.585                         | 19.87          | 49.256                         | 15.88          | 17.165                         | 03.53             |       |     |
| Wrzesień                  | 6.2  | 28.249                         | 41.81          | 64.377                         | 20.99          | 49.551                         | 16.61          | 17.442                         | 02.77             |       |     |
|                           | 16.2 | 28.631                         | 43.48          | 65.146                         | 22.49          | 49.843                         | 17.23          | 17.721                         | 02.35             |       |     |
|                           | 26.1 | 28.984                         | 45.31          | 65.869                         | 24.34          | 50.123                         | 17.71          | 17.995                         | 02.32             |       |     |
| Paźdz.                    | 6.1  | 29.305                         | 47.24          | 66.540                         | 26.47          | 50.391                         | 18.05          | 18.263                         | 02.64             |       |     |
|                           | 16.1 | 29.593                         | 49.28          | 67.149                         | 28.89          | 50.644                         | 18.25          | 18.521                         | 03.34             |       |     |
|                           | 26.0 | 29.838                         | 51.37          | 67.677                         | 31.52          | 50.877                         | 18.32          | 18.763                         | 04.37             |       |     |
| Listopad                  | 5.0  | 30.044                         | 53.47          | 68.122                         | 34.32          | 51.088                         | 18.28          | 18.987                         | 05.67             |       |     |
|                           | 15.0 | 30.203                         | 55.56          | 68.469                         | 37.25          | 51.275                         | 18.15          | 19.188                         | 07.21             |       |     |
|                           | 25.0 | 30.310                         | 57.58          | 68.704                         | 40.21          | 51.430                         | 17.96          | 19.360                         | 08.92             |       |     |
| Grudzień                  | 4.9  | 30.366                         | 59.49          | 68.829                         | 43.14          | 51.553                         | 17.72          | 19.502                         | 10.71             |       |     |
|                           | 14.9 | 30.367                         | 61.25          | 68.831                         | 45.98          | 51.638                         | 17.47          | 19.607                         | 12.53             |       |     |
|                           | 24.9 | 30.310                         | 62.79          | 68.707                         | 48.61          | 51.681                         | 17.21          | 19.670                         | 14.30             |       |     |
|                           | 34.9 | 30.200                         | 64.07          | 68.468                         | 50.97          | 51.684                         | 16.96          | 19.693                         | 15.97             |       |     |
|                           | 44.8 | 30.036                         | 65.05          | 68.112                         | 52.98          | 51.642                         | 16.72          | 19.670                         | 17.49             |       |     |
| Miejsce śr. 2015.5        |      | 26.232                         | 54.53          | 61.156                         | 41.06          | 48.709                         | 21.32          | 17.008                         | 05.27             |       |     |
| sec $\delta$ tan $\delta$ |      | +1.553                         | +1.188         | +3.132                         | +2.968         | +1.043                         | +0.297         | +1.010                         | −0.144            |       |     |
| dwukrotne górowanie       |      | XI.12                          |                | XI.19                          |                | XI.30                          |                | XII.10                         |                   |       |     |
| $a$ $a'$                  |      | +0.215                         | +0.624         | +0.321                         | +0.530         | +0.172                         | +0.355         | +0.144                         | +0.194            |       |     |
| $b$ $b'$                  |      | +0.049                         | −0.781         | +0.105                         | −0.848         | +0.007                         | −0.935         | −0.002                         | −0.981            |       |     |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       |      | $\alpha$ Aurigae               |                    | $\varepsilon$ Orionis          |                    | $\alpha$ Orionis               |                    | $\beta$ Aurigae                |                    |                   |     |
|---------------------------|------|--------------------------------|--------------------|--------------------------------|--------------------|--------------------------------|--------------------|--------------------------------|--------------------|-------------------|-----|
|                           |      | 0 <sup>m</sup> 08              | Capella            | G0                             | 1 <sup>m</sup> 70  | B0                             | 0 <sup>m</sup> 60  | Betelgeuse                     | M0                 | 1 <sup>m</sup> 90 | A0p |
|                           |      | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     |                   |     |
|                           |      | 5 <sup>h</sup> 17 <sup>m</sup> | +46°00′            | 5 <sup>h</sup> 36 <sup>m</sup> | −1°11′             | 5 <sup>h</sup> 55 <sup>m</sup> | +7°24′             | 6 <sup>h</sup> 00 <sup>m</sup> | +44°56′            |                   |     |
| Styczeń                   | −0.1 | 50.413                         | 37 <sup>″</sup> 25 | 60.152                         | 47 <sup>″</sup> 13 | 60.754                         | 20 <sup>″</sup> 91 | 40.126                         | 42 <sup>″</sup> 35 |                   |     |
|                           | 9.9  | 50.417                         | 38.62              | 60.172                         | 48.45              | 60.798                         | 20.03              | 40.188                         | 43.71              |                   |     |
|                           | 19.9 | 50.358                         | 39.89              | 60.148                         | 49.63              | 60.795                         | 19.26              | 40.184                         | 45.06              |                   |     |
|                           | 29.9 | 50.236                         | 40.99              | 60.077                         | 50.64              | 60.743                         | 18.61              | 40.113                         | 46.33              |                   |     |
| Luty                      | 8.8  | 50.063                         | 41.87              | 59.969                         | 51.46              | 60.651                         | 18.09              | 39.983                         | 47.46              |                   |     |
|                           | 18.8 | 49.844                         | 42.50              | 59.827                         | 52.11              | 60.520                         | 17.69              | 39.801                         | 48.40              |                   |     |
|                           | 28.8 | 49.593                         | 42.82              | 59.658                         | 52.56              | 60.360                         | 17.41              | 39.576                         | 49.10              |                   |     |
| Marzec                    | 10.8 | 49.326                         | 42.84              | 59.474                         | 52.82              | 60.182                         | 17.24              | 39.325                         | 49.53              |                   |     |
|                           | 20.7 | 49.054                         | 42.56              | 59.284                         | 52.91              | 59.993                         | 17.17              | 39.058                         | 49.67              |                   |     |
|                           | 30.7 | 48.795                         | 41.97              | 59.098                         | 52.79              | 59.806                         | 17.20              | 38.793                         | 49.51              |                   |     |
| Kwiecień                  | 9.7  | 48.564                         | 41.13              | 58.928                         | 52.49              | 59.632                         | 17.33              | 38.546                         | 49.08              |                   |     |
|                           | 19.6 | 48.369                         | 40.07              | 58.780                         | 52.02              | 59.478                         | 17.56              | 38.325                         | 48.40              |                   |     |
|                           | 29.6 | 48.225                         | 38.83              | 58.665                         | 51.35              | 59.354                         | 17.91              | 38.145                         | 47.48              |                   |     |
| Maj                       | 9.6  | 48.136                         | 37.49              | 58.586                         | 50.51              | 59.266                         | 18.36              | 38.014                         | 46.41              |                   |     |
|                           | 19.6 | 48.107                         | 36.08              | 58.547                         | 49.49              | 59.216                         | 18.93              | 37.936                         | 45.20              |                   |     |
|                           | 29.5 | 48.142                         | 34.66              | 58.551                         | 48.32              | 59.210                         | 19.62              | 37.918                         | 43.91              |                   |     |
| Czerwiec                  | 8.5  | 48.238                         | 33.30              | 58.597                         | 47.03              | 59.245                         | 20.40              | 37.957                         | 42.60              |                   |     |
|                           | 18.5 | 48.391                         | 32.03              | 58.684                         | 45.61              | 59.321                         | 21.29              | 38.053                         | 41.30              |                   |     |
|                           | 28.5 | 48.601                         | 30.88              | 58.811                         | 44.13              | 59.437                         | 22.24              | 38.206                         | 40.05              |                   |     |
| Lipiec                    | 8.4  | 48.857                         | 29.90              | 58.971                         | 42.62              | 59.587                         | 23.23              | 38.406                         | 38.90              |                   |     |
|                           | 18.4 | 49.154                         | 29.09              | 59.161                         | 41.11              | 59.769                         | 24.25              | 38.651                         | 37.84              |                   |     |
|                           | 28.4 | 49.487                         | 28.47              | 59.379                         | 39.68              | 59.979                         | 25.23              | 38.937                         | 36.92              |                   |     |
| Sierpień                  | 7.3  | 49.844                         | 28.04              | 59.616                         | 38.37              | 60.210                         | 26.15              | 39.252                         | 36.14              |                   |     |
|                           | 17.3 | 50.223                         | 27.80              | 59.870                         | 37.21              | 60.460                         | 26.96              | 39.595                         | 35.49              |                   |     |
|                           | 27.3 | 50.616                         | 27.77              | 60.136                         | 36.28              | 60.724                         | 27.63              | 39.959                         | 35.01              |                   |     |
|                           |      |                                |                    |                                |                    |                                |                    |                                |                    |                   |     |
| Wrzesień                  | 6.3  | 51.013                         | 27.90              | 60.409                         | 35.59              | 60.996                         | 28.12              | 40.336                         | 34.67              |                   |     |
|                           | 16.2 | 51.415                         | 28.20              | 60.687                         | 35.20              | 61.277                         | 28.41              | 40.726                         | 34.48              |                   |     |
|                           | 26.2 | 51.812                         | 28.68              | 60.964                         | 35.11              | 61.560                         | 28.46              | 41.120                         | 34.45              |                   |     |
| Paźdz.                    | 6.2  | 52.199                         | 29.31              | 61.238                         | 35.33              | 61.842                         | 28.30              | 41.513                         | 34.56              |                   |     |
|                           | 16.2 | 52.576                         | 30.09              | 61.506                         | 35.86              | 62.122                         | 27.90              | 41.904                         | 34.83              |                   |     |
|                           | 26.1 | 52.931                         | 31.01              | 61.762                         | 36.68              | 62.392                         | 27.30              | 42.283                         | 35.26              |                   |     |
| Listopad                  | 5.1  | 53.262                         | 32.06              | 62.003                         | 37.73              | 62.651                         | 26.53              | 42.646                         | 35.85              |                   |     |
|                           | 15.1 | 53.562                         | 33.25              | 62.225                         | 38.98              | 62.893                         | 25.61              | 42.986                         | 36.61              |                   |     |
|                           | 25.0 | 53.822                         | 34.55              | 62.420                         | 40.37              | 63.112                         | 24.61              | 43.292                         | 37.54              |                   |     |
| Grudzień                  | 5.0  | 54.039                         | 35.93              | 62.587                         | 41.84              | 63.302                         | 23.56              | 43.560                         | 38.61              |                   |     |
|                           | 15.0 | 54.203                         | 37.39              | 62.718                         | 43.33              | 63.459                         | 22.51              | 43.780                         | 39.83              |                   |     |
|                           | 25.0 | 54.306                         | 38.86              | 62.808                         | 44.78              | 63.574                         | 21.52              | 43.942                         | 41.14              |                   |     |
|                           | 34.9 | 54.351                         | 40.30              | 62.856                         | 46.15              | 63.647                         | 20.60              | 44.045                         | 42.52              |                   |     |
|                           | 44.9 | 54.329                         | 41.68              | 62.859                         | 47.40              | 63.672                         | 19.78              | 44.081                         | 43.92              |                   |     |
| Miejsce śr. 2015.5        |      | 50.208                         | 43 <sup>″</sup> 91 | 60.043                         | 35 <sup>″</sup> 40 | 60.690                         | 31 <sup>″</sup> 46 | 39.973                         | 50 <sup>″</sup> 65 |                   |     |
| sec $\delta$ tan $\delta$ |      | +1.440                         | +1.036             | +1.000                         | −0.021             | +1.008                         | +0.130             | +1.413                         | +0.998             |                   |     |
| dwukrotne górowanie       |      | XII.11                         |                    | XII.15                         |                    | XII.20                         |                    | XII.21                         |                    |                   |     |
| $a$ $a'$                  |      | +0.221                         | +0.183             | +0.152                         | +0.100             | +0.162                         | +0.017             | +0.220                         | −0.003             |                   |     |
| $b$ $b'$                  |      | +0.013                         | −0.983             | −0.000                         | −0.995             | +0.000                         | −1.000             | −0.000                         | −1.000             |                   |     |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       | $\alpha$ Canis Maioris A*) |                   | 24H Camelopardalis      |                   | $\beta$ Geminorum       |                   | $\iota$ Ursae Maioris   |                   |
|---------------------------|----------------------------|-------------------|-------------------------|-------------------|-------------------------|-------------------|-------------------------|-------------------|
|                           | $-1^m.46$                  | <i>Sirius</i> A0  | $4^m.55$                | K5                | $1^m.14$                | <i>Pollux</i> K0  | $3^m.14$                | A5                |
|                           | $\alpha_{app}^{\gamma}$    | $\delta_{app}$    | $\alpha_{app}^{\gamma}$ | $\delta_{app}$    | $\alpha_{app}^{\gamma}$ | $\delta_{app}$    | $\alpha_{app}^{\gamma}$ | $\delta_{app}$    |
|                           | $6^h 45^m$                 | $-16^{\circ} 44'$ | $7^h 02^m$              | $+76^{\circ} 56'$ | $7^h 46^m$              | $+27^{\circ} 58'$ | $9^h 00^m$              | $+47^{\circ} 58'$ |
| Styczeń 0.0               | 50.029                     | 26.91             | 20.146                  | 66.81             | 15.605                  | 66.13             | 15.235                  | 36.24             |
| 10.0                      | 50.095                     | 29.29             | 20.437                  | 69.64             | 15.774                  | 66.21             | 15.536                  | 37.05             |
| 20.0                      | 50.112                     | 31.51             | 20.531                  | 72.55             | 15.890                  | 66.49             | 15.777                  | 38.21             |
| 29.9                      | 50.078                     | 33.49             | 20.413                  | 75.41             | 15.946                  | 66.93             | 15.946                  | 39.66             |
| Luty 8.9                  | 49.998                     | 35.20             | 20.105                  | 78.08             | 15.947                  | 67.49             | 16.042                  | 41.32             |
| 18.9                      | 49.876                     | 36.62             | 19.618                  | 80.52             | 15.892                  | 68.15             | 16.064                  | 43.14             |
| 28.8                      | 49.718                     | 37.71             | 18.971                  | 82.57             | 15.787                  | 68.84             | 16.014                  | 45.01             |
| Marzec 10.8               | 49.536                     | 38.48             | 18.210                  | 84.17             | 15.644                  | 69.52             | 15.901                  | 46.83             |
| 20.8                      | 49.337                     | 38.94             | 17.359                  | 85.28             | 15.470                  | 70.15             | 15.735                  | 48.55             |
| 30.8                      | 49.132                     | 39.04             | 16.462                  | 85.83             | 15.277                  | 70.70             | 15.525                  | 50.07             |
| Kwiecień 9.7              | 48.933                     | 38.84             | 15.568                  | 85.84             | 15.078                  | 71.13             | 15.289                  | 51.34             |
| 19.7                      | 48.746                     | 38.34             | 14.700                  | 85.31             | 14.881                  | 71.44             | 15.036                  | 52.33             |
| 29.7                      | 48.582                     | 37.52             | 13.905                  | 84.24             | 14.699                  | 71.61             | 14.781                  | 52.96             |
| Maj 9.7                   | 48.448                     | 36.44             | 13.214                  | 82.72             | 14.541                  | 71.65             | 14.537                  | 53.26             |
| 19.6                      | 48.345                     | 35.09             | 12.640                  | 80.79             | 14.410                  | 71.57             | 14.311                  | 53.22             |
| 29.6                      | 48.282                     | 33.51             | 12.218                  | 78.51             | 14.315                  | 71.38             | 14.114                  | 52.83             |
| Czerwiec 8.6              | 48.258                     | 31.75             | 11.951                  | 75.99             | 14.259                  | 71.09             | 13.954                  | 52.13             |
| 18.5                      | 48.271                     | 29.83             | 11.844                  | 73.27             | 14.239                  | 70.73             | 13.830                  | 51.14             |
| 28.5                      | 48.326                     | 27.81             | 11.911                  | 70.45             | 14.262                  | 70.30             | 13.751                  | 49.87             |
| Lipiec 8.5                | 48.416                     | 25.75             | 12.135                  | 67.61             | 14.321                  | 69.82             | 13.716                  | 48.40             |
| 18.5                      | 48.541                     | 23.69             | 12.515                  | 64.78             | 14.417                  | 69.29             | 13.725                  | 46.73             |
| 28.4                      | 48.699                     | 21.72             | 13.048                  | 62.07             | 14.549                  | 68.72             | 13.780                  | 44.89             |
| Sierpień 7.4              | 48.883                     | 19.91             | 13.708                  | 59.53             | 14.710                  | 68.11             | 13.877                  | 42.95             |
| 17.4                      | 49.094                     | 18.30             | 14.494                  | 57.18             | 14.902                  | 67.45             | 14.018                  | 40.90             |
| 27.4                      | 49.326                     | 16.99             | 15.389                  | 55.11             | 15.123                  | 66.74             | 14.201                  | 38.80             |
| Wrzesień 6.3              | 49.575                     | 16.02             | 16.367                  | 53.34             | 15.365                  | 65.98             | 14.423                  | 36.69             |
| 16.3                      | 49.841                     | 15.43             | 17.425                  | 51.89             | 15.632                  | 65.17             | 14.685                  | 34.57             |
| 26.3                      | 50.117                     | 15.29             | 18.539                  | 50.83             | 15.919                  | 64.31             | 14.985                  | 32.51             |
| Paźdz. 6.2                | 50.399                     | 15.58             | 19.685                  | 50.15             | 16.222                  | 63.41             | 15.319                  | 30.53             |
| 16.2                      | 50.686                     | 16.32             | 20.857                  | 49.89             | 16.542                  | 62.49             | 15.687                  | 28.67             |
| 26.2                      | 50.970                     | 17.51             | 22.019                  | 50.08             | 16.871                  | 61.57             | 16.083                  | 27.00             |
| Listopad 5.2              | 51.246                     | 19.07             | 23.153                  | 50.70             | 17.205                  | 60.69             | 16.500                  | 25.52             |
| 15.1                      | 51.510                     | 20.98             | 24.239                  | 51.77             | 17.539                  | 59.86             | 16.934                  | 24.32             |
| 25.1                      | 51.752                     | 23.17             | 25.237                  | 53.28             | 17.863                  | 59.15             | 17.371                  | 23.43             |
| Grudzień 5.1              | 51.968                     | 25.53             | 26.130                  | 55.18             | 18.171                  | 58.56             | 17.803                  | 22.88             |
| 15.1                      | 52.150                     | 28.02             | 26.890                  | 57.46             | 18.453                  | 58.15             | 18.217                  | 22.71             |
| 25.0                      | 52.290                     | 30.52             | 27.481                  | 60.02             | 18.697                  | 57.94             | 18.598                  | 22.94             |
| 35.0                      | 52.387                     | 32.95             | 27.898                  | 62.80             | 18.899                  | 57.92             | 18.935                  | 23.54             |
| 45.0                      | 52.434                     | 35.26             | 28.117                  | 65.72             | 19.048                  | 58.11             | 19.217                  | 24.51             |
| Miejsce śr. 2015.5        | 49.609                     | 18.65             | 18.291                  | 76.56             | 15.738                  | 75.20             | 15.709                  | 47.17             |
| sec $\delta$ tan $\delta$ | +1.044                     | -0.301            | +4.430                  | +4.316            | +1.132                  | +0.531            | +1.494                  | +1.110            |
| dwukrotne górowanie       | I.02                       |                   | I.06                    |                   | I.17                    |                   | II.05                   |                   |
| a a'                      | +0.134                     | -0.199            | +0.431                  | -0.269            | +0.185                  | -0.447            | +0.206                  | -0.708            |
| b b'                      | +0.004                     | -0.980            | -0.077                  | -0.963            | -0.016                  | -0.894            | -0.052                  | -0.706            |

\*)Podwójna; efemerydy dotyczą gwiazdy jaśniejszej.

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                 |      | α Hydrae                       |                    | α Leonis                        |                    | 9H Draconis                     |                    | β Ursae Maioris                 |                    |    |
|---------------------|------|--------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|--------------------|----|
|                     |      | 1 <sup>m</sup> 98              | K2                 | 1 <sup>m</sup> 35               | Regulus            | B8                              | 4 <sup>m</sup> 84  | G5                              | 2 <sup>m</sup> 37  | A0 |
|                     |      | α <sup>γ</sup> <sub>app</sub>  | δ <sub>app</sub>   | α <sup>γ</sup> <sub>app</sub>   | δ <sub>app</sub>   | α <sup>γ</sup> <sub>app</sub>   | δ <sub>app</sub>   | α <sup>γ</sup> <sub>app</sub>   | δ <sub>app</sub>   |    |
|                     |      | 9 <sup>h</sup> 28 <sup>m</sup> | −8°43′             | 10 <sup>h</sup> 09 <sup>m</sup> | +11°53′            | 10 <sup>h</sup> 36 <sup>m</sup> | +75°37′            | 11 <sup>h</sup> 02 <sup>m</sup> | +56°17′            |    |
| Styczeń             | 0.1  | 20 <sup>s</sup> 851            | 34 <sup>″</sup> 07 | 11 <sup>s</sup> 194             | 25 <sup>″</sup> 15 | 20 <sup>s</sup> 667             | 42 <sup>″</sup> 94 | 44 <sup>s</sup> 657             | 45 <sup>″</sup> 12 |    |
|                     | 10.1 | 21.081                         | 36.33              | 11.465                          | 23.71              | 21.567                          | 43.94              | 45.130                          | 45.12              |    |
|                     | 20.1 | 21.271                         | 38.50              | 11.701                          | 22.51              | 22.370                          | 45.49              | 45.562                          | 45.67              |    |
|                     | 30.0 | 21.411                         | 40.51              | 11.891                          | 21.58              | 23.035                          | 47.57              | 45.934                          | 46.76              |    |
| Luty                | 9.0  | 21.501                         | 42.31              | 12.032                          | 20.92              | 23.544                          | 50.03              | 46.236                          | 48.30              |    |
|                     | 19.0 | 21.542                         | 43.88              | 12.124                          | 20.54              | 23.887                          | 52.82              | 46.463                          | 50.24              |    |
|                     | 29.0 | 21.534                         | 45.20              | 12.163                          | 20.42              | 24.044                          | 55.80              | 46.606                          | 52.50              |    |
| Marzec              | 10.9 | 21.484                         | 46.26              | 12.158                          | 20.52              | 24.025                          | 58.83              | 46.667                          | 54.95              |    |
|                     | 20.9 | 21.397                         | 47.06              | 12.112                          | 20.81              | 23.838                          | 61.83              | 46.652                          | 57.50              |    |
|                     | 30.9 | 21.281                         | 47.60              | 12.030                          | 21.26              | 23.489                          | 64.64              | 46.562                          | 60.04              |    |
| Kwiecień            | 9.8  | 21.146                         | 47.91              | 11.924                          | 21.80              | 23.011                          | 67.16              | 46.413                          | 62.45              |    |
|                     | 19.8 | 20.998                         | 47.98              | 11.798                          | 22.42              | 22.422                          | 69.33              | 46.213                          | 64.67              |    |
|                     | 29.8 | 20.846                         | 47.83              | 11.662                          | 23.08              | 21.746                          | 71.03              | 45.971                          | 66.59              |    |
| Maj                 | 9.8  | 20.698                         | 47.48              | 11.524                          | 23.74              | 21.025                          | 72.23              | 45.707                          | 68.15              |    |
|                     | 19.7 | 20.557                         | 46.94              | 11.387                          | 24.39              | 20.271                          | 72.91              | 45.425                          | 69.33              |    |
|                     | 29.7 | 20.430                         | 46.21              | 11.259                          | 25.00              | 19.520                          | 73.02              | 45.139                          | 70.05              |    |
| Czerwiec            | 8.7  | 20.322                         | 45.33              | 11.144                          | 25.56              | 18.800                          | 72.60              | 44.861                          | 70.33              |    |
|                     | 18.7 | 20.232                         | 44.31              | 11.044                          | 26.07              | 18.119                          | 71.65              | 44.595                          | 70.17              |    |
|                     | 28.6 | 20.166                         | 43.17              | 10.963                          | 26.50              | 17.508                          | 70.19              | 44.351                          | 69.55              |    |
| Lipiec              | 8.6  | 20.124                         | 41.96              | 10.902                          | 26.85              | 16.980                          | 68.29              | 44.136                          | 68.52              |    |
|                     | 18.6 | 20.106                         | 40.70              | 10.861                          | 27.11              | 16.539                          | 65.98              | 43.951                          | 67.09              |    |
|                     | 28.5 | 20.116                         | 39.43              | 10.845                          | 27.25              | 16.209                          | 63.30              | 43.806                          | 65.27              |    |
| Sierpień            | 7.5  | 20.152                         | 38.21              | 10.853                          | 27.28              | 15.987                          | 60.35              | 43.700                          | 63.16              |    |
|                     | 17.5 | 20.215                         | 37.06              | 10.886                          | 27.16              | 15.878                          | 57.15              | 43.638                          | 60.73              |    |
|                     | 27.5 | 20.309                         | 36.08              | 10.947                          | 26.88              | 15.897                          | 53.78              | 43.626                          | 58.07              |    |
| Wrzesień            | 6.4  | 20.430                         | 35.29              | 11.036                          | 26.42              | 16.033                          | 50.34              | 43.662                          | 55.22              |    |
|                     | 16.4 | 20.583                         | 34.75              | 11.156                          | 25.77              | 16.294                          | 46.83              | 43.753                          | 52.21              |    |
|                     | 26.4 | 20.766                         | 34.51              | 11.309                          | 24.90              | 16.684                          | 43.38              | 43.902                          | 49.12              |    |
| Paźdz.              | 6.4  | 20.978                         | 34.60              | 11.493                          | 23.83              | 17.187                          | 40.05              | 44.105                          | 46.01              |    |
|                     | 16.3 | 21.221                         | 35.05              | 11.711                          | 22.54              | 17.813                          | 36.88              | 44.370                          | 42.90              |    |
|                     | 26.3 | 21.488                         | 35.86              | 11.960                          | 21.05              | 18.548                          | 34.01              | 44.692                          | 39.92              |    |
| Listopad            | 5.3  | 21.777                         | 37.02              | 12.236                          | 19.41              | 19.376                          | 31.45              | 45.067                          | 37.11              |    |
|                     | 15.2 | 22.083                         | 38.52              | 12.538                          | 17.63              | 20.295                          | 29.29              | 45.493                          | 34.54              |    |
|                     | 25.2 | 22.395                         | 40.31              | 12.855                          | 15.78              | 21.274                          | 27.63              | 45.959                          | 32.31              |    |
| Grudzień            | 5.2  | 22.708                         | 42.31              | 13.180                          | 13.90              | 22.291                          | 26.48              | 46.453                          | 30.46              |    |
|                     | 15.2 | 23.012                         | 44.49              | 13.506                          | 12.07              | 23.326                          | 25.92              | 46.967                          | 29.07              |    |
|                     | 25.1 | 23.294                         | 46.75              | 13.818                          | 10.35              | 24.335                          | 25.97              | 47.477                          | 28.20              |    |
|                     | 35.1 | 23.547                         | 49.02              | 14.109                          | 08.79              | 25.294                          | 26.60              | 47.972                          | 27.86              |    |
|                     | 45.1 | 23.763                         | 51.24              | 14.369                          | 07.45              | 26.172                          | 27.83              | 48.435                          | 28.09              |    |
| Miejsce śr. 2015.5  |      | 20 <sup>s</sup> 947            | 35 <sup>″</sup> 42 | 11 <sup>s</sup> 758             | 27 <sup>″</sup> 20 | 22 <sup>s</sup> 210             | 56 <sup>″</sup> 61 | 46 <sup>s</sup> 046             | 56 <sup>″</sup> 31 |    |
| sec δ      tan δ    |      | +1.012                         | −0.153             | +1.022                          | +0.211             | +4.030                          | +3.904             | +1.802                          | +1.499             |    |
| dwukrotne górowanie |      | II.12                          |                    | II.22                           |                    | III.01                          |                    | III.08                          |                    |    |
| a                   | a′   | +0.147                         | −0.789             | +0.160                          | −0.885             | +0.246                          | −0.934             | +0.178                          | −0.969             |    |
| b                   | b′   | +0.008                         | −0.614             | −0.012                          | −0.465             | −0.243                          | −0.357             | −0.097                          | −0.247             |    |



**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       | $\alpha$ Ursae Maioris          |                      |                      | $\gamma$ Ursae Maioris          |                      | $\varepsilon$ Ursae Maioris     |                      | $\zeta$ Ursae Maioris           |                      |
|---------------------------|---------------------------------|----------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|
|                           | 1 <sup>m</sup> 79               | Dubhe                | K0                   | 2 <sup>m</sup> 44               | A0                   | 1 <sup>m</sup> 77               | A0p                  | 2 <sup>m</sup> 27               | A2p                  |
|                           | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       |                      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       |
|                           | 11 <sup>h</sup> 04 <sup>m</sup> | +61°39'              |                      | 11 <sup>h</sup> 54 <sup>m</sup> | +53°36'              | 12 <sup>h</sup> 54 <sup>m</sup> | +55°52'              | 13 <sup>h</sup> 24 <sup>m</sup> | +54°50'              |
| Styczeń                   | 0.2                             | 38 <sup>s</sup> .853 | 48 <sup>''</sup> .78 | 36 <sup>s</sup> .659            | 21 <sup>''</sup> .33 | 40 <sup>s</sup> .244            | 25 <sup>''</sup> .63 | 30 <sup>s</sup> .515            | 34 <sup>''</sup> .75 |
|                           | 10.2                            | 39.390               | 48.94                | 37.128                          | 20.64                | 40.734                          | 24.29                | 30.987                          | 33.05                |
|                           | 20.1                            | 39.883               | 49.68                | 37.574                          | 20.52                | 41.221                          | 23.54                | 31.463                          | 31.93                |
|                           | 30.1                            | 40.307               | 50.97                | 37.978                          | 20.99                | 41.684                          | 23.44                | 31.927                          | 31.46                |
| Luty                      | 9.1                             | 40.653               | 52.72                | 38.327                          | 21.99                | 42.108                          | 23.94                | 32.361                          | 31.61                |
|                           | 19.0                            | 40.912               | 54.87                | 38.616                          | 23.49                | 42.483                          | 25.02                | 32.756                          | 32.37                |
| Marzec                    | 1.0                             | 41.073               | 57.34                | 38.832                          | 25.43                | 42.795                          | 26.65                | 33.097                          | 33.72                |
|                           | 11.0                            | 41.141               | 59.98                | 38.975                          | 27.67                | 43.039                          | 28.71                | 33.376                          | 35.56                |
|                           | 21.0                            | 41.119               | 62.72                | 39.048                          | 30.14                | 43.213                          | 31.13                | 33.593                          | 37.81                |
|                           | 30.9                            | 41.010               | 65.41                | 39.048                          | 32.74                | 43.313                          | 33.81                | 33.739                          | 40.40                |
| Kwiecień                  | 9.9                             | 40.829               | 67.95                | 38.987                          | 35.33                | 43.344                          | 36.60                | 33.820                          | 43.16                |
|                           | 19.9                            | 40.587               | 70.27                | 38.871                          | 37.84                | 43.312                          | 39.43                | 33.838                          | 46.03                |
|                           | 29.9                            | 40.296               | 72.26                | 38.707                          | 40.15                | 43.219                          | 42.17                | 33.793                          | 48.88                |
| Maj                       | 9.8                             | 39.974               | 73.85                | 38.509                          | 42.19                | 43.077                          | 44.71                | 33.697                          | 51.59                |
|                           | 19.8                            | 39.631               | 75.02                | 38.282                          | 43.91                | 42.891                          | 47.00                | 33.553                          | 54.12                |
|                           | 29.8                            | 39.281               | 75.71                | 38.037                          | 45.22                | 42.668                          | 48.94                | 33.367                          | 56.33                |
| Czerwiec                  | 8.7                             | 38.940               | 75.92                | 37.786                          | 46.12                | 42.422                          | 50.48                | 33.150                          | 58.17                |
|                           | 18.7                            | 38.610               | 75.66                | 37.530                          | 46.59                | 42.154                          | 51.60                | 32.905                          | 59.63                |
|                           | 28.7                            | 38.307               | 74.90                | 37.281                          | 46.58                | 41.875                          | 52.23                | 32.640                          | 60.62                |
| Lipiec                    | 8.7                             | 38.038               | 73.71                | 37.046                          | 46.13                | 41.593                          | 52.40                | 32.365                          | 61.14                |
|                           | 18.6                            | 37.804               | 72.10                | 36.825                          | 45.25                | 41.312                          | 52.09                | 32.081                          | 61.20                |
|                           | 28.6                            | 37.617               | 70.09                | 36.630                          | 43.94                | 41.041                          | 51.29                | 31.800                          | 60.75                |
| Sierpień                  | 7.6                             | 37.478               | 67.77                | 36.462                          | 42.25                | 40.787                          | 50.05                | 31.528                          | 59.84                |
|                           | 17.6                            | 37.391               | 65.14                | 36.326                          | 40.19                | 40.554                          | 48.37                | 31.268                          | 58.47                |
|                           | 27.5                            | 37.363               | 62.26                | 36.230                          | 37.81                | 40.354                          | 46.27                | 31.034                          | 56.66                |
| Wrzesień                  | 6.5                             | 37.393               | 59.21                | 36.176                          | 35.16                | 40.189                          | 43.83                | 30.830                          | 54.46                |
|                           | 16.5                            | 37.487               | 56.00                | 36.169                          | 32.26                | 40.068                          | 41.04                | 30.664                          | 51.89                |
|                           | 26.4                            | 37.648               | 52.74                | 36.217                          | 29.18                | 40.001                          | 37.99                | 30.548                          | 48.99                |
| Paźdz.                    | 6.4                             | 37.873               | 49.47                | 36.319                          | 25.98                | 39.990                          | 34.72                | 30.483                          | 45.84                |
|                           | 16.4                            | 38.169               | 46.24                | 36.481                          | 22.69                | 40.043                          | 31.28                | 30.481                          | 42.46                |
|                           | 26.4                            | 38.531               | 43.17                | 36.705                          | 19.43                | 40.166                          | 27.77                | 30.547                          | 38.95                |
| Listopad                  | 5.3                             | 38.953               | 40.29                | 36.987                          | 16.25                | 40.355                          | 24.25                | 30.680                          | 35.38                |
|                           | 15.3                            | 39.435               | 37.69                | 37.327                          | 13.21                | 40.615                          | 20.79                | 30.886                          | 31.81                |
|                           | 25.3                            | 39.961               | 35.48                | 37.719                          | 10.44                | 40.941                          | 17.52                | 31.161                          | 28.37                |
| Grudzień                  | 5.3                             | 40.521               | 33.68                | 38.150                          | 07.98                | 41.324                          | 14.50                | 31.497                          | 25.13                |
|                           | 15.2                            | 41.103               | 32.38                | 38.615                          | 05.92                | 41.758                          | 11.83                | 31.890                          | 22.19                |
|                           | 25.2                            | 41.682               | 31.64                | 39.094                          | 04.36                | 42.227                          | 09.63                | 32.326                          | 19.67                |
|                           | 35.2                            | 42.245               | 31.44                | 39.573                          | 03.31                | 42.716                          | 07.92                | 32.789                          | 17.62                |
|                           | 45.1                            | 42.773               | 31.84                | 40.040                          | 02.84                | 43.211                          | 06.79                | 33.269                          | 16.12                |
| Miejsce śr. 2015.5        | 40 <sup>s</sup> .347            | 60 <sup>''</sup> .69 |                      | 38 <sup>s</sup> .374            | 30 <sup>''</sup> .75 | 42 <sup>s</sup> .424            | 33 <sup>''</sup> .42 | 32 <sup>s</sup> .839            | 41 <sup>''</sup> .16 |
| sec $\delta$ tan $\delta$ | +2.107                          | +1.855               |                      | +1.685                          | +1.357               | +1.783                          | +1.476               | +1.737                          | +1.420               |
| dwukrotne górowanie       | III.08                          |                      |                      | III.21                          |                      | IV.05                           |                      | IV.13                           |                      |
| $a$ $a'$                  | +0.183                          | -0.971               |                      | +0.156                          | -1.000               | +0.130                          | -0.972               | +0.119                          | -0.933               |
| $b$ $b'$                  | -0.120                          | -0.239               |                      | -0.090                          | -0.023               | -0.096                          | +0.236               | -0.088                          | +0.361               |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| <i>UT1</i>                |      | $\alpha$ Virginis               |                    | $\eta$ Ursae Maioris            |                    | 4 Ursae Minoris                 |                    | $\alpha$ Bootis                 |                    |
|---------------------------|------|---------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|--------------------|---------------------------------|--------------------|
|                           |      | 0 <sup>m</sup> 98               | <i>Spica</i> B2    | 1 <sup>m</sup> 86               | B3                 | 4 <sup>m</sup> 82               | K0                 | −0 <sup>m</sup> 04              | <i>Arcturus</i> K0 |
|                           |      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     |
|                           |      | 13 <sup>h</sup> 25 <sup>m</sup> | −11°14′            | 13 <sup>h</sup> 48 <sup>m</sup> | +49°13′            | 14 <sup>h</sup> 08 <sup>m</sup> | +77°28′            | 14 <sup>h</sup> 16 <sup>m</sup> | +19°05′            |
| Styczeń                   | 0.3  | 59.234                          | 16 <sup>″</sup> 76 | 06.728                          | 66 <sup>″</sup> 58 | 43.686                          | 21 <sup>″</sup> 63 | 20.227                          | 73 <sup>″</sup> 73 |
|                           | 10.3 | 59.563                          | 18.71              | 07.146                          | 64.55              | 44.686                          | 19.81              | 20.543                          | 71.44              |
|                           | 20.2 | 59.889                          | 20.68              | 07.574                          | 63.05              | 45.753                          | 18.60              | 20.868                          | 69.41              |
|                           | 30.2 | 60.199                          | 22.61              | 07.997                          | 62.18              | 46.844                          | 18.09              | 21.189                          | 67.76              |
| Luty                      | 9.2  | 60.486                          | 24.42              | 08.398                          | 61.91              | 47.911                          | 18.24              | 21.497                          | 66.50              |
|                           | 19.1 | 60.745                          | 26.09              | 08.770                          | 62.25              | 48.931                          | 19.06              | 21.786                          | 65.68              |
| Marzec                    | 1.1  | 60.970                          | 27.57              | 09.099                          | 63.20              | 49.854                          | 20.53              | 22.047                          | 65.32              |
|                           | 11.1 | 61.159                          | 28.82              | 09.378                          | 64.66              | 50.652                          | 22.54              | 22.276                          | 65.40              |
|                           | 21.1 | 61.313                          | 29.85              | 09.606                          | 66.60              | 51.310                          | 25.02              | 22.473                          | 65.88              |
|                           | 31.0 | 61.431                          | 30.65              | 09.774                          | 68.91              | 51.793                          | 27.89              | 22.634                          | 66.74              |
| Kwiecień                  | 10.0 | 61.515                          | 31.23              | 09.886                          | 71.47              | 52.100                          | 30.97              | 22.760                          | 67.89              |
|                           | 20.0 | 61.570                          | 31.62              | 09.944                          | 74.20              | 52.231                          | 34.20              | 22.853                          | 69.29              |
|                           | 30.0 | 61.594                          | 31.81              | 09.947                          | 76.98              | 52.174                          | 37.42              | 22.911                          | 70.86              |
| Maj                       | 9.9  | 61.594                          | 31.84              | 09.903                          | 79.70              | 51.951                          | 40.52              | 22.940                          | 72.50              |
|                           | 19.9 | 61.570                          | 31.73              | 09.815                          | 82.30              | 51.570                          | 43.44              | 22.939                          | 74.19              |
|                           | 29.9 | 61.523                          | 31.49              | 09.686                          | 84.65              | 51.040                          | 46.02              | 22.910                          | 75.83              |
| Czerwiec                  | 8.8  | 61.459                          | 31.15              | 09.526                          | 86.70              | 50.395                          | 48.22              | 22.857                          | 77.36              |
|                           | 18.8 | 61.376                          | 30.71              | 09.336                          | 88.41              | 49.641                          | 49.99              | 22.780                          | 78.77              |
|                           | 28.8 | 61.277                          | 30.19              | 09.122                          | 89.69              | 48.804                          | 51.25              | 22.680                          | 79.99              |
| Lipiec                    | 8.8  | 61.167                          | 29.60              | 08.894                          | 90.56              | 47.915                          | 51.99              | 22.563                          | 80.99              |
|                           | 18.7 | 61.045                          | 28.95              | 08.650                          | 90.98              | 46.980                          | 52.21              | 22.429                          | 81.77              |
|                           | 28.7 | 60.919                          | 28.26              | 08.402                          | 90.91              | 46.034                          | 51.86              | 22.282                          | 82.27              |
| Sierpień                  | 7.7  | 60.791                          | 27.56              | 08.155                          | 90.41              | 45.097                          | 51.00              | 22.129                          | 82.52              |
|                           | 17.7 | 60.665                          | 26.85              | 07.913                          | 89.45              | 44.181                          | 49.62              | 21.970                          | 82.48              |
|                           | 27.6 | 60.550                          | 26.17              | 07.688                          | 88.03              | 43.320                          | 47.74              | 21.817                          | 82.15              |
| Wrzesień                  | 6.6  | 60.452                          | 25.56              | 07.485                          | 86.22              | 42.527                          | 45.44              | 21.673                          | 81.53              |
|                           | 16.6 | 60.375                          | 25.04              | 07.311                          | 84.00              | 41.820                          | 42.71              | 21.545                          | 80.62              |
|                           | 26.5 | 60.331                          | 24.66              | 07.178                          | 81.43              | 41.229                          | 39.62              | 21.444                          | 79.41              |
| Paźdz.                    | 6.5  | 60.322                          | 24.46              | 07.089                          | 78.57              | 40.761                          | 36.26              | 21.374                          | 77.92              |
|                           | 16.5 | 60.355                          | 24.47              | 07.055                          | 75.43              | 40.436                          | 32.65              | 21.342                          | 76.15              |
|                           | 26.5 | 60.436                          | 24.74              | 07.082                          | 72.10              | 40.278                          | 28.90              | 21.357                          | 74.11              |
| Listopad                  | 5.4  | 60.564                          | 25.27              | 07.170                          | 68.65              | 40.281                          | 25.08              | 21.419                          | 71.86              |
|                           | 15.4 | 60.740                          | 26.09              | 07.325                          | 65.13              | 40.465                          | 21.26              | 21.532                          | 69.39              |
|                           | 25.4 | 60.962                          | 27.20              | 07.546                          | 61.67              | 40.831                          | 17.59              | 21.696                          | 66.79              |
| Grudzień                  | 5.4  | 61.222                          | 28.56              | 07.824                          | 58.33              | 41.362                          | 14.13              | 21.904                          | 64.11              |
|                           | 15.3 | 61.516                          | 30.17              | 08.158                          | 55.22              | 42.061                          | 10.98              | 22.155                          | 61.42              |
|                           | 25.3 | 61.831                          | 31.96              | 08.535                          | 52.46              | 42.901                          | 08.28              | 22.439                          | 58.81              |
|                           | 35.3 | 62.158                          | 33.87              | 08.942                          | 50.11              | 43.852                          | 06.08              | 22.746                          | 56.35              |
|                           | 45.2 | 62.488                          | 35.85              | 09.369                          | 48.26              | 44.896                          | 04.47              | 23.069                          | 54.12              |
| Miejsce śr. 2015.5        |      | 60.705                          | 30 <sup>″</sup> 39 | 08.998                          | 70 <sup>″</sup> 89 | 48.581                          | 28 <sup>″</sup> 65 | 22.126                          | 68 <sup>″</sup> 19 |
| sec $\delta$ tan $\delta$ |      | +1.020                          | −0.199             | +1.532                          | +1.160             | +4.611                          | +4.501             | +1.058                          | +0.346             |
| dwukrotne górowanie       |      | IV.13                           |                    | IV.19                           |                    | IV.24                           |                    | IV.26                           |                    |
| <i>a</i> <i>a'</i>        |      | +0.158                          | −0.930             | +0.118                          | −0.891             | −0.006                          | −0.846             | +0.141                          | −0.828             |
| <i>b</i> <i>b'</i>        |      | +0.012                          | +0.367             | −0.069                          | +0.455             | −0.254                          | +0.533             | −0.019                          | +0.561             |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       |      | $\beta$ Ursae Minoris           |                      | $\gamma$ Ursae Minoris          |                      | $\alpha$ Coronae Borealis       |                      | $\zeta$ Ursae Minoris           |                      |
|---------------------------|------|---------------------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|
|                           |      | 2 <sup>m</sup> 08               | K5                   | 3 <sup>m</sup> 05               | A2                   | 2 <sup>m</sup> 23               | A0                   | 4 <sup>m</sup> 32               | A2                   |
|                           |      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$       |
|                           |      | 14 <sup>h</sup> 50 <sup>m</sup> | +74°05′              | 15 <sup>h</sup> 20 <sup>m</sup> | +71°46′              | 15 <sup>h</sup> 35 <sup>m</sup> | +26°39′              | 15 <sup>h</sup> 43 <sup>m</sup> | +77°44′              |
| Styczeń                   | 0.3  | 36 <sup>s</sup> .135            | 26 <sup>''</sup> .95 | 38 <sup>s</sup> .775            | 41 <sup>''</sup> .09 | 18 <sup>s</sup> .376            | 52 <sup>''</sup> .53 | 26 <sup>s</sup> .495            | 44 <sup>''</sup> .41 |
|                           | 10.3 | 36.870                          | 24.59                | 39.372                          | 38.38                | 18.659                          | 49.91                | 27.246                          | 41.59                |
|                           | 20.3 | 37.682                          | 22.78                | 40.050                          | 36.18                | 18.965                          | 47.57                | 28.136                          | 39.23                |
|                           | 30.3 | 38.541                          | 21.64                | 40.786                          | 34.61                | 19.285                          | 45.61                | 29.134                          | 37.47                |
| Luty                      | 9.2  | 39.407                          | 21.16                | 41.544                          | 33.68                | 19.608                          | 44.10                | 30.190                          | 36.34                |
|                           | 19.2 | 40.261                          | 21.36                | 42.309                          | 33.43                | 19.927                          | 43.07                | 31.280                          | 35.86                |
| Marzec                    | 1.2  | 41.066                          | 22.26                | 43.047                          | 33.90                | 20.233                          | 42.58                | 32.357                          | 36.11                |
|                           | 11.2 | 41.792                          | 23.75                | 43.733                          | 35.00                | 20.520                          | 42.62                | 33.378                          | 36.99                |
|                           | 21.1 | 42.428                          | 25.81                | 44.354                          | 36.70                | 20.785                          | 43.15                | 34.321                          | 38.50                |
|                           | 31.1 | 42.942                          | 28.35                | 44.881                          | 38.95                | 21.021                          | 44.18                | 35.143                          | 40.57                |
| Kwiecień                  | 10.1 | 43.328                          | 31.21                | 45.305                          | 41.60                | 21.226                          | 45.59                | 35.822                          | 43.08                |
|                           | 20.0 | 43.583                          | 34.34                | 45.622                          | 44.58                | 21.402                          | 47.36                | 36.349                          | 45.96                |
|                           | 30.0 | 43.692                          | 37.58                | 45.815                          | 47.77                | 21.542                          | 49.39                | 36.695                          | 49.09                |
| Maj                       | 10.0 | 43.666                          | 40.81                | 45.891                          | 51.03                | 21.649                          | 51.58                | 36.866                          | 52.33                |
|                           | 20.0 | 43.510                          | 43.97                | 45.851                          | 54.29                | 21.723                          | 53.88                | 36.860                          | 55.62                |
| Czerwiec                  | 29.9 | 43.223                          | 46.90                | 45.692                          | 57.41                | 21.760                          | 56.18                | 36.671                          | 58.80                |
|                           | 8.9  | 42.830                          | 49.52                | 45.432                          | 60.29                | 21.765                          | 58.40                | 36.323                          | 61.78                |
|                           | 18.9 | 42.335                          | 51.80                | 45.072                          | 62.89                | 21.735                          | 60.52                | 35.817                          | 64.52                |
|                           | 28.9 | 41.751                          | 53.63                | 44.623                          | 65.08                | 21.670                          | 62.43                | 35.167                          | 66.88                |
| Lipiec                    | 8.8  | 41.103                          | 54.98                | 44.104                          | 66.85                | 21.577                          | 64.10                | 34.403                          | 68.84                |
|                           | 18.8 | 40.395                          | 55.85                | 43.519                          | 68.16                | 21.453                          | 65.51                | 33.530                          | 70.37                |
|                           | 28.8 | 39.652                          | 56.15                | 42.886                          | 68.94                | 21.303                          | 66.59                | 32.574                          | 71.38                |
| Sierpień                  | 7.7  | 38.893                          | 55.95                | 42.225                          | 69.21                | 21.134                          | 67.35                | 31.566                          | 71.90                |
|                           | 17.7 | 38.126                          | 55.22                | 41.540                          | 68.96                | 20.947                          | 67.77                | 30.512                          | 71.90                |
|                           | 27.7 | 37.379                          | 53.95                | 40.858                          | 68.16                | 20.752                          | 67.81                | 29.450                          | 71.35                |
| Wrzesień                  | 6.7  | 36.667                          | 52.22                | 40.193                          | 66.88                | 20.555                          | 67.50                | 28.403                          | 70.32                |
|                           | 16.6 | 36.003                          | 50.01                | 39.557                          | 65.10                | 20.364                          | 66.82                | 27.385                          | 68.78                |
|                           | 26.6 | 35.416                          | 47.38                | 38.977                          | 62.85                | 20.189                          | 65.77                | 26.438                          | 66.77                |
| Paźdz.                    | 6.6  | 34.914                          | 44.40                | 38.463                          | 60.21                | 20.039                          | 64.37                | 25.577                          | 64.34                |
|                           | 16.5 | 34.517                          | 41.08                | 38.032                          | 57.17                | 19.921                          | 62.62                | 24.824                          | 61.50                |
| Listopad                  | 26.5 | 34.246                          | 37.53                | 37.707                          | 53.83                | 19.846                          | 60.55                | 24.216                          | 58.33                |
|                           | 5.5  | 34.103                          | 33.81                | 37.492                          | 50.27                | 19.816                          | 58.21                | 23.757                          | 54.91                |
|                           | 15.5 | 34.105                          | 29.98                | 37.402                          | 46.51                | 19.839                          | 55.60                | 23.475                          | 51.27                |
| Grudzień                  | 25.4 | 34.259                          | 26.19                | 37.448                          | 42.71                | 19.917                          | 52.80                | 23.386                          | 47.54                |
|                           | 5.4  | 34.554                          | 22.51                | 37.622                          | 38.95                | 20.047                          | 49.89                | 23.484                          | 43.80                |
|                           | 15.4 | 34.996                          | 19.03                | 37.932                          | 35.30                | 20.228                          | 46.92                | 23.783                          | 40.14                |
|                           | 25.4 | 35.569                          | 15.90                | 38.367                          | 31.94                | 20.455                          | 44.00                | 24.273                          | 36.72                |
|                           | 35.3 | 36.250                          | 13.19                | 38.907                          | 28.92                | 20.718                          | 41.22                | 24.931                          | 33.60                |
|                           | 45.3 | 37.028                          | 11.00                | 39.545                          | 26.36                | 21.012                          | 38.66                | 25.749                          | 30.91                |
| Miejsce śr. 2015.5        |      | 40 <sup>s</sup> .534            | 31 <sup>''</sup> .56 | 42 <sup>s</sup> .915            | 43 <sup>''</sup> .87 | 20 <sup>s</sup> .684            | 47 <sup>''</sup> .89 | 32 <sup>s</sup> .094            | 46 <sup>''</sup> .15 |
| sec $\delta$ tan $\delta$ |      | +3.648                          | +3.509               | +3.198                          | +3.038               | +1.119                          | +0.502               | +4.712                          | +4.604               |
| dwukrotne górowanie       |      | V.05                            |                      | V.12                            |                      | V.16                            |                      | V.18                            |                      |
| $a$ $a'$                  |      | -0.005                          | -0.735               | -0.002                          | -0.640               | +0.126                          | -0.590               | -0.101                          | -0.561               |
| $b$ $b'$                  |      | -0.172                          | +0.678               | -0.130                          | +0.768               | -0.020                          | +0.807               | -0.172                          | +0.828               |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       |      | $\beta$ Herculis      |                 | $\beta$ Draconis      |                 | $\gamma$ Draconis     |                 | $\chi$ Draconis       |                 |
|---------------------------|------|-----------------------|-----------------|-----------------------|-----------------|-----------------------|-----------------|-----------------------|-----------------|
|                           |      | $2^m 77$              | K0              | $2^m 79$              | G0              | $2^m 23$              | K5              | $3^m 57$              | F8              |
|                           |      | $\alpha_{app}^\gamma$ | $\delta_{app}$  | $\alpha_{app}^\gamma$ | $\delta_{app}$  | $\alpha_{app}^\gamma$ | $\delta_{app}$  | $\alpha_{app}^\gamma$ | $\delta_{app}$  |
|                           |      | $16^h 30^m$           | $+21^\circ 27'$ | $17^h 30^m$           | $+52^\circ 17'$ | $17^h 56^m$           | $+51^\circ 29'$ | $18^h 20^m$           | $+72^\circ 44'$ |
| Styczeń                   | 0.4  | 50.815                | 30.78           | 44.194                | 30.62           | 55.230                | 21.56           | 42.491                | 28.33           |
|                           | 10.4 | 51.049                | 28.20           | 44.384                | 27.18           | 55.380                | 18.10           | 42.599                | 24.76           |
|                           | 20.4 | 51.313                | 25.80           | 44.634                | 23.94           | 55.591                | 14.78           | 42.845                | 21.27           |
|                           | 30.3 | 51.599                | 23.71           | 44.939                | 21.05           | 55.859                | 11.76           | 43.230                | 18.04           |
| Luty                      | 9.3  | 51.897                | 21.97           | 45.282                | 18.62           | 56.170                | 09.15           | 43.728                | 15.17           |
|                           | 19.3 | 52.201                | 20.65           | 45.659                | 16.70           | 56.519                | 07.01           | 44.329                | 12.74           |
| Marzec                    | 1.2  | 52.504                | 19.83           | 46.058                | 15.42           | 56.897                | 05.47           | 45.014                | 10.89           |
|                           | 11.2 | 52.797                | 19.49           | 46.464                | 14.78           | 57.289                | 04.56           | 45.750                | 09.67           |
|                           | 21.2 | 53.079                | 19.65           | 46.872                | 14.79           | 57.691                | 04.29           | 46.522                | 09.08           |
|                           | 31.2 | 53.342                | 20.30           | 47.268                | 15.48           | 58.088                | 04.70           | 47.302                | 09.21           |
| Kwiecień                  | 10.1 | 53.584                | 21.37           | 47.642                | 16.77           | 58.470                | 05.72           | 48.058                | 09.97           |
|                           | 20.1 | 53.804                | 22.82           | 47.990                | 18.62           | 58.834                | 07.33           | 48.780                | 11.35           |
|                           | 30.1 | 53.995                | 24.59           | 48.299                | 20.96           | 59.165                | 09.47           | 49.434                | 13.31           |
| Maj                       | 10.1 | 54.157                | 26.57           | 48.565                | 23.66           | 59.458                | 12.01           | 50.006                | 15.73           |
|                           | 20.0 | 54.290                | 28.73           | 48.784                | 26.68           | 59.709                | 14.91           | 50.485                | 18.56           |
| Czerwiec                  | 30.0 | 54.386                | 30.96           | 48.946                | 29.88           | 59.907                | 18.05           | 50.849                | 21.69           |
|                           | 9.0  | 54.450                | 33.19           | 49.052                | 33.15           | 60.052                | 21.31           | 51.095                | 25.00           |
|                           | 18.9 | 54.477                | 35.37           | 49.100                | 36.43           | 60.139                | 24.64           | 51.219                | 28.43           |
|                           | 28.9 | 54.466                | 37.41           | 49.085                | 39.60           | 60.164                | 27.90           | 51.210                | 31.85           |
| Lipiec                    | 8.9  | 54.420                | 39.27           | 49.013                | 42.58           | 60.131                | 31.02           | 51.080                | 35.17           |
|                           | 18.9 | 54.338                | 40.93           | 48.882                | 45.33           | 60.037                | 33.95           | 50.825                | 38.35           |
|                           | 28.8 | 54.223                | 42.31           | 48.695                | 47.74           | 59.884                | 36.58           | 50.449                | 41.26           |
| Sierpień                  | 7.8  | 54.080                | 43.42           | 48.461                | 49.77           | 59.682                | 38.87           | 49.974                | 43.87           |
|                           | 17.8 | 53.910                | 44.23           | 48.182                | 51.41           | 59.429                | 40.80           | 49.398                | 46.13           |
|                           | 27.8 | 53.723                | 44.69           | 47.868                | 52.57           | 59.137                | 42.27           | 48.742                | 47.94           |
| Wrzesień                  | 6.7  | 53.525                | 44.84           | 47.530                | 53.27           | 58.816                | 43.29           | 48.025                | 49.32           |
|                           | 16.7 | 53.323                | 44.65           | 47.175                | 53.47           | 58.472                | 43.84           | 47.256                | 50.22           |
|                           | 26.7 | 53.129                | 44.10           | 46.818                | 53.15           | 58.120                | 43.86           | 46.463                | 50.59           |
| Paźdz.                    | 6.6  | 52.951                | 43.22           | 46.471                | 52.35           | 57.772                | 43.41           | 45.666                | 50.46           |
|                           | 16.6 | 52.798                | 41.99           | 46.142                | 51.03           | 57.437                | 42.43           | 44.879                | 49.78           |
| Listopad                  | 26.6 | 52.680                | 40.43           | 45.850                | 49.22           | 57.131                | 40.94           | 44.135                | 48.57           |
|                           | 5.6  | 52.602                | 38.57           | 45.602                | 46.98           | 56.864                | 38.99           | 43.448                | 46.86           |
|                           | 15.5 | 52.572                | 36.42           | 45.407                | 44.31           | 56.644                | 36.59           | 42.838                | 44.65           |
| Grudzień                  | 25.5 | 52.594                | 34.03           | 45.278                | 41.29           | 56.485                | 33.80           | 42.334                | 42.00           |
|                           | 5.5  | 52.666                | 31.46           | 45.214                | 38.00           | 56.388                | 30.69           | 41.940                | 38.99           |
|                           | 15.5 | 52.790                | 28.76           | 45.223                | 34.49           | 56.359                | 27.32           | 41.675                | 35.66           |
|                           | 25.4 | 52.962                | 26.03           | 45.305                | 30.91           | 56.401                | 23.82           | 41.554                | 32.14           |
|                           | 35.4 | 53.173                | 23.34           | 45.453                | 27.36           | 56.509                | 20.29           | 41.570                | 28.53           |
|                           | 45.4 | 53.421                | 20.78           | 45.668                | 23.94           | 56.683                | 16.82           | 41.732                | 24.92           |
| Miejsce śr. 2015.5        |      | 53.222                | 24.14           | 47.020                | 25.62           | 57.995                | 15.55           | 46.535                | 21.25           |
| sec $\delta$ tan $\delta$ |      | +1.074                | +0.393          | +1.635                | +1.293          | +1.606                | +1.257          | +3.370                | +3.218          |
| dwukrotne górowanie       |      | V.30                  |                 | VI.14                 |                 | VI.21                 |                 | VI.27                 |                 |
| $a$ $a'$                  |      | +0.129                | -0.379          | +0.068                | -0.127          | +0.070                | -0.013          | -0.060                | +0.091          |
| $b$ $b'$                  |      | -0.010                | +0.925          | -0.011                | +0.992          | -0.001                | +1.000          | +0.019                | +0.996          |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       |      | $\alpha$ Lyrae                  |                | $\nu$ Draconis                  |                | $\sigma$ Sagittarii             |                | $\tau$ Draconis                 |                |
|---------------------------|------|---------------------------------|----------------|---------------------------------|----------------|---------------------------------|----------------|---------------------------------|----------------|
|                           |      | 0 <sup>m</sup> 03               | Vega A0        | 4 <sup>m</sup> 82               | K0             | 2 <sup>m</sup> 02               | B3             | 4 <sup>m</sup> 45               | K0             |
|                           |      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ |
|                           |      | 18 <sup>h</sup> 37 <sup>m</sup> | +38°47'        | 18 <sup>h</sup> 54 <sup>m</sup> | +71°18'        | 18 <sup>h</sup> 56 <sup>m</sup> | −26°16'        | 19 <sup>h</sup> 15 <sup>m</sup> | +73°22'        |
| Styczeń                   | 0.5  | 25.321                          | 62.63          | 08.603                          | 71.96          | 10.420                          | 29.02          | 10.940                          | 71.00          |
|                           | 10.5 | 25.423                          | 59.51          | 08.606                          | 68.44          | 10.552                          | 28.71          | 10.858                          | 67.54          |
|                           | 20.4 | 25.572                          | 56.44          | 08.737                          | 64.90          | 10.723                          | 28.41          | 10.921                          | 64.02          |
|                           | 30.4 | 25.768                          | 53.56          | 09.001                          | 61.52          | 10.930                          | 28.10          | 11.135                          | 60.59          |
| Luty                      | 9.4  | 26.001                          | 50.99          | 09.377                          | 58.42          | 11.165                          | 27.80          | 11.482                          | 57.39          |
|                           | 19.4 | 26.268                          | 48.80          | 09.860                          | 55.69          | 11.425                          | 27.47          | 11.956                          | 54.50          |
| Marzec                    | 1.3  | 26.562                          | 47.12          | 10.436                          | 53.48          | 11.706                          | 27.11          | 12.544                          | 52.09          |
|                           | 11.3 | 26.874                          | 45.98          | 11.076                          | 51.85          | 12.000                          | 26.70          | 13.215                          | 50.21          |
|                           | 21.3 | 27.201                          | 45.41          | 11.767                          | 50.83          | 12.308                          | 26.25          | 13.958                          | 48.92          |
|                           | 31.3 | 27.534                          | 45.48          | 12.485                          | 50.51          | 12.623                          | 25.77          | 14.742                          | 48.31          |
| Kwiecień                  | 10.2 | 27.865                          | 46.13          | 13.202                          | 50.83          | 12.941                          | 25.25          | 15.538                          | 48.35          |
|                           | 20.2 | 28.190                          | 47.34          | 13.904                          | 51.80          | 13.261                          | 24.71          | 16.330                          | 49.03          |
|                           | 30.2 | 28.499                          | 49.07          | 14.563                          | 53.39          | 13.575                          | 24.19          | 17.085                          | 50.36          |
| Maj                       | 10.1 | 28.786                          | 51.23          | 15.159                          | 55.50          | 13.879                          | 23.70          | 17.779                          | 52.22          |
|                           | 20.1 | 29.048                          | 53.77          | 15.685                          | 58.07          | 14.168                          | 23.27          | 18.403                          | 54.59          |
|                           | 30.1 | 29.274                          | 56.58          | 16.113                          | 61.02          | 14.435                          | 22.92          | 18.925                          | 57.38          |
| Czerwiec                  | 9.1  | 29.461                          | 59.57          | 16.441                          | 64.22          | 14.674                          | 22.68          | 19.339                          | 60.46          |
|                           | 19.0 | 29.605                          | 62.67          | 16.661                          | 67.63          | 14.880                          | 22.55          | 19.636                          | 63.80          |
|                           | 29.0 | 29.700                          | 65.77          | 16.758                          | 71.11          | 15.045                          | 22.54          | 19.799                          | 67.26          |
| Lipiec                    | 9.0  | 29.746                          | 68.79          | 16.741                          | 74.57          | 15.169                          | 22.65          | 19.834                          | 70.75          |
|                           | 19.0 | 29.741                          | 71.69          | 16.607                          | 77.96          | 15.245                          | 22.87          | 19.737                          | 74.22          |
|                           | 28.9 | 29.684                          | 74.36          | 16.354                          | 81.16          | 15.271                          | 23.19          | 19.506                          | 77.55          |
| Sierpień                  | 7.9  | 29.580                          | 76.76          | 15.999                          | 84.11          | 15.251                          | 23.58          | 19.158                          | 80.68          |
|                           | 17.9 | 29.430                          | 78.86          | 15.542                          | 86.78          | 15.183                          | 24.02          | 18.692                          | 83.56          |
|                           | 27.8 | 29.239                          | 80.58          | 14.997                          | 89.05          | 15.072                          | 24.47          | 18.121                          | 86.08          |
| Wrzesień                  | 6.8  | 29.018                          | 81.91          | 14.385                          | 90.92          | 14.926                          | 24.90          | 17.469                          | 88.24          |
|                           | 16.8 | 28.769                          | 82.83          | 13.710                          | 92.35          | 14.750                          | 25.29          | 16.738                          | 89.97          |
|                           | 26.8 | 28.507                          | 83.28          | 12.997                          | 93.26          | 14.557                          | 25.60          | 15.955                          | 91.21          |
| Paźdz.                    | 6.7  | 28.241                          | 83.30          | 12.266                          | 93.68          | 14.356                          | 25.82          | 15.143                          | 91.97          |
|                           | 16.7 | 27.978                          | 82.84          | 11.529                          | 93.55          | 14.157                          | 25.95          | 14.313                          | 92.19          |
|                           | 26.7 | 27.735                          | 81.91          | 10.816                          | 92.86          | 13.973                          | 25.97          | 13.498                          | 91.85          |
| Listopad                  | 5.7  | 27.517                          | 80.54          | 10.142                          | 91.67          | 13.815                          | 25.90          | 12.715                          | 90.99          |
|                           | 15.6 | 27.334                          | 78.73          | 09.525                          | 89.92          | 13.690                          | 25.74          | 11.983                          | 89.56          |
|                           | 25.6 | 27.196                          | 76.51          | 08.993                          | 87.68          | 13.607                          | 25.52          | 11.334                          | 87.62          |
| Grudzień                  | 5.6  | 27.105                          | 73.96          | 08.552                          | 85.02          | 13.569                          | 25.26          | 10.778                          | 85.21          |
|                           | 15.5 | 27.066                          | 71.11          | 08.220                          | 81.96          | 13.579                          | 24.97          | 10.334                          | 82.37          |
|                           | 25.5 | 27.083                          | 68.06          | 08.015                          | 78.63          | 13.639                          | 24.67          | 10.025                          | 79.20          |
|                           | 35.5 | 27.151                          | 64.92          | 07.932                          | 75.12          | 13.742                          | 24.39          | 09.849                          | 75.80          |
|                           | 45.5 | 27.271                          | 61.75          | 07.983                          | 71.52          | 13.889                          | 24.11          | 09.821                          | 72.26          |
| Miejsce śr. 2015.5        |      | 27.836                          | 55.81          | 12.170                          | 63.52          | 13.532                          | 34.25          | 14.543                          | 61.67          |
| sec $\delta$ tan $\delta$ |      | +1.283                          | +0.804         | +3.122                          | +2.957         | +1.115                          | −0.494         | +3.497                          | +3.351         |
| dwukrotne górowanie       |      | VII.01                          |                | VII.05                          |                | VII.06                          |                | VII.11                          |                |
| $a$ $a'$                  |      | +0.101                          | +0.163         | −0.038                          | +0.234         | +0.185                          | +0.243         | −0.058                          | +0.322         |
| $b$ $b'$                  |      | +0.009                          | +0.987         | +0.046                          | +0.972         | −0.008                          | +0.970         | +0.072                          | +0.947         |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| <i>UT1</i>                |      | $\iota$ Cygni                   |                | $\alpha$ Aquilae                |                  | $\kappa$ Cephei                 |                | $\alpha$ Cygni                  |                  |
|---------------------------|------|---------------------------------|----------------|---------------------------------|------------------|---------------------------------|----------------|---------------------------------|------------------|
|                           |      | 3 <sup>m</sup> 79               | A2             | 0 <sup>m</sup> 77               | <i>Altair</i> A5 | 4 <sup>m</sup> 39               | B9             | 1 <sup>m</sup> 25               | <i>Deneb</i> A2p |
|                           |      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ | $\alpha_{app}^{\gamma}$         | $\delta_{app}$   | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ | $\alpha_{app}^{\gamma}$         | $\delta_{app}$   |
|                           |      | 19 <sup>h</sup> 30 <sup>m</sup> | +51°45′        | 19 <sup>h</sup> 51 <sup>m</sup> | +8°54′           | 20 <sup>h</sup> 08 <sup>m</sup> | +77°45′        | 20 <sup>h</sup> 41 <sup>m</sup> | +45°19′          |
| Styczeń                   | 0.5  | 03.298                          | 56.61          | 29.897                          | 40.85            | 16.804                          | 38.16          | 55.560                          | 79.50            |
|                           | 10.5 | 03.305                          | 53.32          | 29.949                          | 39.22            | 16.432                          | 35.01          | 55.493                          | 76.72            |
|                           | 20.5 | 03.374                          | 49.97          | 30.036                          | 37.59            | 16.245                          | 31.65          | 55.474                          | 73.75            |
|                           | 30.5 | 03.507                          | 46.69          | 30.159                          | 36.02            | 16.264                          | 28.21          | 55.508                          | 70.72            |
| Luty                      | 9.4  | 03.697                          | 43.63          | 30.311                          | 34.61            | 16.475                          | 24.85          | 55.592                          | 67.75            |
|                           | 19.4 | 03.940                          | 40.87          | 30.491                          | 33.40            | 16.875                          | 21.65          | 55.725                          | 64.93            |
| Marzec                    | 1.4  | 04.233                          | 38.55          | 30.699                          | 32.47            | 17.458                          | 18.78          | 55.909                          | 62.41            |
|                           | 11.3 | 04.563                          | 36.76          | 30.927                          | 31.87            | 18.190                          | 16.35          | 56.137                          | 60.28            |
|                           | 21.3 | 04.927                          | 35.52          | 31.176                          | 31.61            | 19.053                          | 14.41          | 56.406                          | 58.60            |
|                           | 31.3 | 05.315                          | 34.95          | 31.442                          | 31.75            | 20.019                          | 13.08          | 56.713                          | 57.48            |
| Kwiecień                  | 10.3 | 05.713                          | 35.00          | 31.719                          | 32.26            | 21.041                          | 12.38          | 57.046                          | 56.93            |
|                           | 20.2 | 06.118                          | 35.68          | 32.006                          | 33.14            | 22.100                          | 12.30          | 57.403                          | 56.97            |
|                           | 30.2 | 06.514                          | 36.98          | 32.295                          | 34.36            | 23.150                          | 12.89          | 57.772                          | 57.62            |
| Maj                       | 10.2 | 06.892                          | 38.80          | 32.581                          | 35.86            | 24.156                          | 14.07          | 58.143                          | 58.81            |
|                           | 20.2 | 07.246                          | 41.12          | 32.860                          | 37.60            | 25.100                          | 15.81          | 58.509                          | 60.53            |
| Czerwiec                  | 30.1 | 07.562                          | 43.85          | 33.123                          | 39.52            | 25.938                          | 18.07          | 58.858                          | 62.72            |
|                           | 9.1  | 07.834                          | 46.86          | 33.366                          | 41.55            | 26.652                          | 20.73          | 59.182                          | 65.28            |
|                           | 19.1 | 08.056                          | 50.12          | 33.582                          | 43.64            | 27.230                          | 23.75          | 59.473                          | 68.17            |
|                           | 29.0 | 08.219                          | 53.51          | 33.764                          | 45.72            | 27.641                          | 27.04          | 59.719                          | 71.29            |
| Lipiec                    | 9.0  | 08.322                          | 56.92          | 33.908                          | 47.73            | 27.888                          | 30.47          | 59.919                          | 74.54            |
|                           | 19.0 | 08.361                          | 60.31          | 34.012                          | 49.65            | 27.964                          | 34.01          | 60.066                          | 77.87            |
|                           | 29.0 | 08.334                          | 63.57          | 34.070                          | 51.41            | 27.858                          | 37.54          | 60.153                          | 81.18            |
| Sierpień                  | 7.9  | 08.246                          | 66.62          | 34.084                          | 52.99            | 27.589                          | 40.98          | 60.185                          | 84.39            |
|                           | 17.9 | 08.097                          | 69.44          | 34.054                          | 54.38            | 27.152                          | 44.30          | 60.158                          | 87.47            |
|                           | 27.9 | 07.891                          | 71.91          | 33.982                          | 55.52            | 26.559                          | 47.37          | 60.075                          | 90.31            |
| Wrzesień                  | 6.9  | 07.641                          | 74.02          | 33.875                          | 56.44            | 25.836                          | 50.15          | 59.943                          | 92.88            |
|                           | 16.8 | 07.349                          | 75.73          | 33.736                          | 57.12            | 24.986                          | 52.60          | 59.764                          | 95.13            |
|                           | 26.8 | 07.028                          | 76.95          | 33.574                          | 57.54            | 24.036                          | 54.63          | 59.547                          | 96.99            |
| Paźdz.                    | 6.8  | 06.690                          | 77.72          | 33.399                          | 57.72            | 23.015                          | 56.22          | 59.304                          | 98.44            |
|                           | 16.7 | 06.343                          | 77.97          | 33.216                          | 57.65            | 21.934                          | 57.32          | 59.039                          | 99.45            |
| Listopad                  | 26.7 | 06.003                          | 77.69          | 33.039                          | 57.32            | 20.832                          | 57.86          | 58.766                          | 99.96            |
|                           | 5.7  | 05.681                          | 76.90          | 32.874                          | 56.77            | 19.734                          | 57.88          | 58.494                          | 100.01           |
|                           | 15.7 | 05.385                          | 75.58          | 32.729                          | 55.97            | 18.661                          | 57.32          | 58.230                          | 99.53            |
| Grudzień                  | 25.6 | 05.130                          | 73.75          | 32.614                          | 54.96            | 17.658                          | 56.18          | 57.987                          | 98.54            |
|                           | 5.6  | 04.921                          | 71.49          | 32.530                          | 53.74            | 16.741                          | 54.52          | 57.771                          | 97.09            |
|                           | 15.6 | 04.765                          | 68.80          | 32.482                          | 52.33            | 15.939                          | 52.32          | 57.588                          | 95.16            |
|                           | 25.6 | 04.670                          | 65.80          | 32.473                          | 50.80            | 15.289                          | 49.68          | 57.447                          | 92.84            |
|                           | 35.5 | 04.635                          | 62.57          | 32.501                          | 49.17            | 14.797                          | 46.68          | 57.349                          | 90.20            |
|                           | 45.5 | 04.664                          | 59.20          | 32.566                          | 47.49            | 14.488                          | 43.39          | 57.298                          | 87.30            |
| Miejsce śr. 2015.5        |      | 05.774                          | 48.03          | 32.363                          | 36.86            | 20.401                          | 26.75          | 57.648                          | 70.79            |
| sec $\delta$ tan $\delta$ |      | +1.616                          | +1.269         | +1.012                          | +0.157           | +4.716                          | +4.609         | +1.423                          | +1.012           |
| dwukrotne górowanie       |      | VII.14                          |                | VII.20                          |                  | VII.24                          |                | VIII.02                         |                  |
| <i>a</i> <i>a'</i>        |      | +0.075                          | +0.383         | +0.144                          | +0.468           | −0.107                          | +0.531         | +0.102                          | +0.649           |
| <i>b</i> <i>b'</i>        |      | +0.032                          | +0.924         | +0.005                          | +0.884           | +0.163                          | +0.847         | +0.044                          | +0.761           |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       |      | $\alpha$ Cephei         |                  | $\beta$ Cephei          |                  | 11 Cephei               |                  | $\varepsilon$ Pegasi    |                 |
|---------------------------|------|-------------------------|------------------|-------------------------|------------------|-------------------------|------------------|-------------------------|-----------------|
|                           |      | $2^m44$                 | A5               | $3^m23$                 | B1               | $4^m56$                 | K0               | $0^m7-3^m5$             | K0              |
|                           |      | $\alpha_{app}^{\gamma}$ | $\delta_{app}$   | $\alpha_{app}^{\gamma}$ | $\delta_{app}$   | $\alpha_{app}^{\gamma}$ | $\delta_{app}$   | $\alpha_{app}^{\gamma}$ | $\delta_{app}$  |
|                           |      | $21^h18^m$              | $+62^{\circ}38'$ | $21^h28^m$              | $+70^{\circ}37'$ | $21^h42^m$              | $+71^{\circ}22'$ | $21^h44^m$              | $+9^{\circ}56'$ |
| Styczeń                   | 0.6  | $54^s.971$              | $77''03$         | $49^s.329$              | $56''53$         | $06^s.809$              | $71''32$         | $54^s.794$              | $47''70$        |
|                           | 10.6 | 54.743                  | 74.37            | 48.947                  | 53.99            | 06.382                  | 68.93            | 54.745                  | 46.39           |
|                           | 20.6 | 54.583                  | 71.37            | 48.657                  | 51.07            | 06.046                  | 66.12            | 54.721                  | 45.03           |
|                           | 30.5 | 54.504                  | 68.16            | 48.480                  | 47.87            | 05.823                  | 63.01            | 54.728                  | 43.67           |
| Luty                      | 9.5  | 54.506                  | 64.89            | 48.418                  | 44.56            | 05.717                  | 59.75            | 54.765                  | 42.40           |
|                           | 19.5 | 54.590                  | 61.64            | 48.473                  | 41.22            | 05.733                  | 56.41            | 54.831                  | 41.24           |
| Marzec                    | 1.4  | 54.761                  | 58.57            | 48.655                  | 38.01            | 05.881                  | 53.17            | 54.930                  | 40.29           |
|                           | 11.4 | 55.010                  | 55.81            | 48.949                  | 35.07            | 06.148                  | 50.16            | 55.061                  | 39.60           |
|                           | 21.4 | 55.335                  | 53.43            | 49.352                  | 32.46            | 06.532                  | 47.45            | 55.224                  | 39.20           |
|                           | 31.4 | 55.728                  | 51.57            | 49.856                  | 30.35            | 07.025                  | 45.21            | 55.420                  | 39.14           |
| Kwiecień                  | 10.3 | 56.173                  | 50.27            | 50.434                  | 28.77            | 07.601                  | 43.48            | 55.643                  | 39.43           |
|                           | 20.3 | 56.663                  | 49.56            | 51.078                  | 27.77            | 08.252                  | 42.31            | 55.894                  | 40.08           |
|                           | 30.3 | 57.182                  | 49.50            | 51.764                  | 27.42            | 08.953                  | 41.78            | 56.167                  | 41.08           |
| Maj                       | 10.3 | 57.711                  | 50.05            | 52.465                  | 27.68            | 09.677                  | 41.86            | 56.456                  | 42.39           |
|                           | 20.2 | 58.242                  | 51.19            | 53.171                  | 28.55            | 10.412                  | 42.55            | 56.756                  | 43.99           |
| Czerwiec                  | 30.2 | 58.752                  | 52.92            | 53.851                  | 30.03            | 11.127                  | 43.86            | 57.059                  | 45.83           |
|                           | 9.2  | 59.230                  | 55.11            | 54.486                  | 32.01            | 11.802                  | 45.68            | 57.356                  | 47.83           |
|                           | 19.1 | 59.666                  | 57.76            | 55.066                  | 34.47            | 12.425                  | 48.00            | 57.642                  | 49.95           |
|                           | 29.1 | 60.041                  | 60.77            | 55.566                  | 37.34            | 12.970                  | 50.76            | 57.906                  | 52.14           |
| Lipiec                    | 9.1  | 60.350                  | 64.03            | 55.977                  | 40.51            | 13.428                  | 53.83            | 58.144                  | 54.31           |
|                           | 19.1 | 60.587                  | 67.51            | 56.293                  | 43.94            | 13.790                  | 57.19            | 58.348                  | 56.45           |
| Sierpień                  | 29.0 | 60.740                  | 71.09            | 56.498                  | 47.52            | 14.040                  | 60.74            | 58.513                  | 58.47           |
|                           | 8.0  | 60.815                  | 74.68            | 56.597                  | 51.16            | 14.182                  | 64.37            | 58.636                  | 60.35           |
|                           | 18.0 | 60.806                  | 78.25            | 56.585                  | 54.82            | 14.210                  | 68.06            | 58.715                  | 62.05           |
|                           | 28.0 | 60.713                  | 81.68            | 56.462                  | 58.38            | 14.122                  | 71.68            | 58.748                  | 63.54           |
| Wrzesień                  | 6.9  | 60.549                  | 84.91            | 56.240                  | 61.79            | 13.932                  | 75.17            | 58.741                  | 64.81           |
|                           | 16.9 | 60.312                  | 87.89            | 55.919                  | 64.98            | 13.638                  | 78.47            | 58.693                  | 65.84           |
|                           | 26.9 | 60.012                  | 90.52            | 55.511                  | 67.86            | 13.249                  | 81.48            | 58.610                  | 66.63           |
| Paźdz.                    | 6.8  | 59.665                  | 92.78            | 55.032                  | 70.39            | 12.784                  | 84.16            | 58.500                  | 67.17           |
|                           | 16.8 | 59.272                  | 94.60            | 54.488                  | 72.50            | 12.247                  | 86.46            | 58.367                  | 67.47           |
| Listopad                  | 26.8 | 58.853                  | 95.91            | 53.898                  | 74.12            | 11.656                  | 88.26            | 58.221                  | 67.52           |
|                           | 5.8  | 58.418                  | 96.72            | 53.280                  | 75.23            | 11.031                  | 89.58            | 58.070                  | 67.36           |
|                           | 15.7 | 57.977                  | 96.97            | 52.644                  | 75.78            | 10.379                  | 90.34            | 57.919                  | 66.95           |
|                           | 25.7 | 57.548                  | 96.62            | 52.014                  | 75.73            | 09.727                  | 90.50            | 57.776                  | 66.33           |
| Grudzień                  | 5.7  | 57.141                  | 95.73            | 51.405                  | 75.11            | 09.089                  | 90.09            | 57.646                  | 65.52           |
|                           | 15.7 | 56.766                  | 94.26            | 50.832                  | 73.87            | 08.480                  | 89.06            | 57.533                  | 64.52           |
|                           | 25.6 | 56.440                  | 92.27            | 50.320                  | 72.08            | 07.928                  | 87.45            | 57.444                  | 63.37           |
|                           | 35.6 | 56.167                  | 89.83            | 49.877                  | 69.81            | 07.441                  | 85.34            | 57.377                  | 62.09           |
|                           | 45.6 | 55.960                  | 86.99            | 49.522                  | 67.07            | 07.040                  | 82.74            | 57.336                  | 60.73           |
| Miejsce śr. 2015.5        |      | $56^s.904$              | $65''75$         | $51^s.252$              | $44''15$         | $08^s.593$              | $58''82$         | $56^s.844$              | $47''89$        |
| sec $\delta$ tan $\delta$ |      | +2.177                  | +1.933           | +3.015                  | +2.844           | +3.132                  | +2.969           | +1.015                  | +0.175          |
| dwukrotne górowanie       |      | VIII.11                 |                  | VIII.14                 |                  | VIII.17                 |                  | VIII.18                 |                 |
| $a$ $a'$                  |      | +0.070                  | +0.763           | +0.037                  | +0.790           | +0.041                  | +0.824           | +0.147                  | +0.831          |
| $b$ $b'$                  |      | +0.098                  | +0.646           | +0.150                  | +0.613           | +0.163                  | +0.566           | +0.010                  | +0.556          |

**MIEJSCA POZORNE GWIAZD 2015**  
w momencie ich górowania w południku Greenwich

| UT1                       |      | 24 Cephei                       |                     | $\alpha$ Piscis Austrini        |                     | $\alpha$ Pegasi                 |                     | $\gamma$ Cephei                 |                     |
|---------------------------|------|---------------------------------|---------------------|---------------------------------|---------------------|---------------------------------|---------------------|---------------------------------|---------------------|
|                           |      | 4 <sup>m</sup> 79               | G5                  | 1 <sup>m</sup> 16               | Fomalhaut A3        | 2 <sup>m</sup> 49               | A0                  | 3 <sup>m</sup> 21               | K0                  |
|                           |      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      |
|                           |      | 22 <sup>h</sup> 10 <sup>m</sup> | +72°24'             | 22 <sup>h</sup> 58 <sup>m</sup> | −29°32'             | 23 <sup>h</sup> 05 <sup>m</sup> | +15°17'             | 23 <sup>h</sup> 39 <sup>m</sup> | +77°42'             |
| Styczeń                   | 0.6  | 04. <sup>s</sup> 667            | 76 <sup>''</sup> 71 | 27. <sup>s</sup> 905            | 39 <sup>''</sup> 02 | 30. <sup>s</sup> 458            | 18 <sup>''</sup> 12 | 60. <sup>s</sup> 045            | 80 <sup>''</sup> 65 |
|                           | 10.6 | 04.157                          | 74.64               | 27.800                          | 38.74               | 30.355                          | 16.97               | 59.130                          | 79.82               |
|                           | 20.6 | 03.729                          | 72.10               | 27.715                          | 38.19               | 30.267                          | 15.69               | 58.264                          | 78.39               |
|                           | 30.6 | 03.413                          | 69.19               | 27.657                          | 37.36               | 30.200                          | 14.34               | 57.494                          | 76.39               |
| Luty                      | 9.5  | 03.213                          | 66.05               | 27.627                          | 36.28               | 30.156                          | 13.01               | 56.848                          | 73.95               |
|                           | 19.5 | 03.138                          | 62.76               | 27.626                          | 34.96               | 30.138                          | 11.71               | 56.344                          | 71.13               |
| Marzec                    | 1.5  | 03.202                          | 59.48               | 27.661                          | 33.41               | 30.154                          | 10.55               | 56.021                          | 68.06               |
|                           | 11.5 | 03.397                          | 56.36               | 27.729                          | 31.68               | 30.203                          | 09.58               | 55.881                          | 64.89               |
|                           | 21.4 | 03.721                          | 53.47               | 27.834                          | 29.77               | 30.288                          | 08.84               | 55.933                          | 61.70               |
|                           | 31.4 | 04.169                          | 50.98               | 27.980                          | 27.71               | 30.414                          | 08.40               | 56.188                          | 58.65               |
| Kwiecień                  | 10.4 | 04.718                          | 48.96               | 28.162                          | 25.55               | 30.577                          | 08.29               | 56.623                          | 55.86               |
|                           | 20.3 | 05.357                          | 47.44               | 28.382                          | 23.32               | 30.777                          | 08.52               | 57.232                          | 53.40               |
|                           | 30.3 | 06.066                          | 46.55               | 28.638                          | 21.07               | 31.013                          | 09.13               | 57.997                          | 51.41               |
| Maj                       | 10.3 | 06.814                          | 46.25               | 28.923                          | 18.85               | 31.276                          | 10.07               | 58.878                          | 49.92               |
|                           | 20.3 | 07.588                          | 46.55               | 29.234                          | 16.70               | 31.564                          | 11.34               | 59.861                          | 48.96               |
|                           | 30.2 | 08.357                          | 47.49               | 29.564                          | 14.70               | 31.868                          | 12.92               | 60.907                          | 48.61               |
| Czerwiec                  | 9.2  | 09.098                          | 48.97               | 29.902                          | 12.88               | 32.179                          | 14.73               | 61.980                          | 48.83               |
|                           | 19.2 | 09.798                          | 50.97               | 30.244                          | 11.30               | 32.492                          | 16.75               | 63.061                          | 49.62               |
|                           | 29.2 | 10.428                          | 53.45               | 30.577                          | 10.00               | 32.795                          | 18.91               | 64.108                          | 50.98               |
| Lipiec                    | 9.1  | 10.976                          | 56.30               | 30.893                          | 09.00               | 33.080                          | 21.15               | 65.095                          | 52.83               |
|                           | 19.1 | 11.432                          | 59.48               | 31.185                          | 08.35               | 33.343                          | 23.42               | 66.009                          | 55.15               |
|                           | 29.1 | 11.778                          | 62.92               | 31.443                          | 08.05               | 33.574                          | 25.65               | 66.813                          | 57.89               |
| Sierpień                  | 8.0  | 12.014                          | 66.49               | 31.662                          | 08.09               | 33.769                          | 27.80               | 67.501                          | 60.95               |
|                           | 18.0 | 12.135                          | 70.18               | 31.837                          | 08.48               | 33.926                          | 29.84               | 68.059                          | 64.30               |
|                           | 28.0 | 12.134                          | 73.87               | 31.962                          | 09.18               | 34.039                          | 31.70               | 68.468                          | 67.85               |
| Wrzesień                  | 7.0  | 12.025                          | 77.47               | 32.040                          | 10.14               | 34.111                          | 33.36               | 68.734                          | 71.52               |
|                           | 16.9 | 11.803                          | 80.96               | 32.069                          | 11.34               | 34.142                          | 34.82               | 68.848                          | 75.26               |
|                           | 26.9 | 11.476                          | 84.20               | 32.051                          | 12.70               | 34.134                          | 36.03               | 68.804                          | 78.96               |
| Paźdz.                    | 6.9  | 11.063                          | 87.17               | 31.995                          | 14.15               | 34.094                          | 37.00               | 68.620                          | 82.56               |
|                           | 16.9 | 10.563                          | 89.78               | 31.902                          | 15.65               | 34.024                          | 37.73               | 68.287                          | 86.00               |
| Listopad                  | 26.8 | 09.996                          | 91.95               | 31.780                          | 17.10               | 33.929                          | 38.20               | 67.816                          | 89.15               |
|                           | 5.8  | 09.380                          | 93.67               | 31.641                          | 18.45               | 33.819                          | 38.42               | 67.227                          | 91.98               |
|                           | 15.8 | 08.721                          | 94.84               | 31.486                          | 19.65               | 33.694                          | 38.40               | 66.517                          | 94.40               |
| Grudzień                  | 25.7 | 08.046                          | 95.43               | 31.328                          | 20.63               | 33.564                          | 38.13               | 65.715                          | 96.31               |
|                           | 5.7  | 07.370                          | 95.44               | 31.173                          | 21.38               | 33.432                          | 37.64               | 64.842                          | 97.71               |
|                           | 15.7 | 06.707                          | 94.82               | 31.023                          | 21.87               | 33.301                          | 36.93               | 63.908                          | 98.51               |
|                           | 25.7 | 06.088                          | 93.61               | 30.889                          | 22.06               | 33.179                          | 36.01               | 62.956                          | 98.68               |
|                           | 35.6 | 05.523                          | 91.85               | 30.771                          | 21.98               | 33.067                          | 34.94               | 62.008                          | 98.23               |
|                           | 45.6 | 05.034                          | 89.55               | 30.672                          | 21.61               | 32.967                          | 33.71               | 61.091                          | 97.15               |
| Miejsce śr. 2015.5        |      | 06. <sup>s</sup> 083            | 64 <sup>''</sup> 02 | 30. <sup>s</sup> 252            | 23 <sup>''</sup> 26 | 32. <sup>s</sup> 051            | 20 <sup>''</sup> 04 | 59. <sup>s</sup> 764            | 68 <sup>''</sup> 58 |
| sec $\delta$ tan $\delta$ |      | +3.310                          | +3.156              | +1.149                          | −0.567              | +1.037                          | +0.273              | +4.701                          | +4.594              |
| dwukrotne górowanie       |      | VIII.24                         |                     | IX.05                           |                     | IX.07                           |                     | IX.16                           |                     |
| $a$ $a'$                  |      | +0.056                          | +0.887              | +0.163                          | +0.964              | +0.149                          | +0.972              | +0.127                          | +0.996              |
| $b$ $b'$                  |      | +0.187                          | +0.461              | −0.036                          | +0.265              | +0.018                          | +0.235              | +0.305                          | +0.087              |



**MIEJSCA POZORNE Biegunowej (2<sup>m</sup>02) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i>  | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      | <i>UT1</i>   | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      | <i>UT1</i>   | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      | <i>UT1</i>   | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      |
|-------------|--------------------------------|---------------------|--------------|--------------------------------|---------------------|--------------|--------------------------------|---------------------|--------------|--------------------------------|---------------------|
|             | 2 <sup>h</sup> 50 <sup>m</sup> | +89°19'             |              | 2 <sup>h</sup> 49 <sup>m</sup> | +89°19'             |              | 2 <sup>h</sup> 49 <sup>m</sup> | +89°19'             |              | 2 <sup>h</sup> 49 <sup>m</sup> | +89°19'             |
| Styczeń 0.8 | 124. <sup>s</sup> 78           | 52. <sup>s</sup> 34 | Luty 15.7    | 106. <sup>s</sup> 17           | 56. <sup>s</sup> 56 | Kwiecień 2.6 | 39. <sup>s</sup> 10            | 48. <sup>s</sup> 13 | Maj 18.5     | 35. <sup>s</sup> 81            | 33. <sup>s</sup> 98 |
| 1.8         | 123.60                         | 52.55               | 16.7         | 104.36                         | 56.55               | 3.6          | 38.12                          | 47.83               | 19.5         | 36.75                          | 33.69               |
| 2.8         | 122.40                         | 52.78               | 17.7         | 102.45                         | 56.53               | 4.6          | 37.24                          | 47.51               | 20.5         | 37.68                          | 33.43               |
| 3.8         | 121.13                         | 53.01               | 18.7         | 100.44                         | 56.48               | 5.6          | 36.46                          | 47.19               | 21.5         | 38.56                          | 33.18               |
| 4.8         | 119.78                         | 53.24               | 19.7         | 98.40                          | 56.41               | 6.6          | 35.79                          | 46.87               | 22.5         | 39.37                          | 32.93               |
| 5.8         | 118.32                         | 53.47               | 20.7         | 96.40                          | 56.31               | 7.6          | 35.21                          | 46.55               | 23.5         | 40.14                          | 32.68               |
| 6.8         | 116.77                         | 53.70               | 21.7         | 94.50                          | 56.19               | 8.6          | 34.71                          | 46.25               | 24.4         | 40.87                          | 32.43               |
| 7.8         | 115.13                         | 53.92               | 22.7         | 92.72                          | 56.05               | 9.6          | 34.24                          | 45.95               | 25.4         | 41.58                          | 32.17               |
| 8.8         | 113.42                         | 54.12               | 23.7         | 91.07                          | 55.91               | 10.6         | 33.79                          | 45.67               | 26.4         | 42.32                          | 31.90               |
| 9.8         | 111.67                         | 54.30               | 24.7         | 89.50                          | 55.78               | 11.6         | 33.30                          | 45.41               | 27.4         | 43.10                          | 31.62               |
| 10.8        | 109.92                         | 54.46               | 25.7         | 87.97                          | 55.65               | 12.6         | 32.75                          | 45.14               | 28.4         | 43.96                          | 31.34               |
| 11.8        | 108.19                         | 54.61               | 26.7         | 86.44                          | 55.53               | 13.6         | 32.14                          | 44.87               | 29.4         | 44.91                          | 31.05               |
| 12.8        | 106.50                         | 54.74               | 27.7         | 84.86                          | 55.42               | 14.6         | 31.48                          | 44.59               | 30.4         | 45.96                          | 30.76               |
| 13.8        | 104.87                         | 54.87               | 28.7         | 83.24                          | 55.31               | 15.6         | 30.82                          | 44.29               | 31.4         | 47.11                          | 30.48               |
| 14.8        | 103.30                         | 55.00               | Marzec 1.7   | 81.55                          | 55.20               | 16.6         | 30.22                          | 43.96               | Czerwiec 1.4 | 48.35                          | 30.22               |
| 15.8        | 101.79                         | 55.12               | 2.7          | 79.80                          | 55.08               | 17.5         | 29.73                          | 43.62               | 2.4          | 49.65                          | 29.97               |
| 16.8        | 100.31                         | 55.26               | 3.7          | 78.02                          | 54.94               | 18.5         | 29.40                          | 43.27               | 3.4          | 50.97                          | 29.74               |
| 17.8        | 98.83                          | 55.41               | 4.7          | 76.22                          | 54.79               | 19.5         | 29.22                          | 42.92               | 4.4          | 52.28                          | 29.53               |
| 18.8        | 97.29                          | 55.57               | 5.7          | 74.42                          | 54.62               | 20.5         | 29.16                          | 42.59               | 5.4          | 53.53                          | 29.34               |
| 19.8        | 95.64                          | 55.73               | 6.7          | 72.67                          | 54.44               | 21.5         | 29.17                          | 42.27               | 6.4          | 54.70                          | 29.15               |
| 20.8        | 93.87                          | 55.90               | 7.7          | 70.98                          | 54.24               | 22.5         | 29.18                          | 41.96               | 7.4          | 55.81                          | 28.95               |
| 21.8        | 91.96                          | 56.04               | 8.7          | 69.38                          | 54.03               | 23.5         | 29.17                          | 41.67               | 8.4          | 56.87                          | 28.75               |
| 22.8        | 89.97                          | 56.17               | 9.7          | 67.87                          | 53.81               | 24.5         | 29.10                          | 41.39               | 9.4          | 57.94                          | 28.53               |
| 23.8        | 87.97                          | 56.26               | 10.7         | 66.45                          | 53.60               | 25.5         | 28.99                          | 41.10               | 10.4         | 59.07                          | 28.30               |
| 24.8        | 86.02                          | 56.33               | 11.7         | 65.12                          | 53.38               | 26.5         | 28.83                          | 40.81               | 11.4         | 60.30                          | 28.06               |
| 25.8        | 84.15                          | 56.37               | 12.6         | 63.84                          | 53.18               | 27.5         | 28.66                          | 40.51               | 12.4         | 61.67                          | 27.81               |
| 26.8        | 82.38                          | 56.41               | 13.6         | 62.58                          | 52.99               | 28.5         | 28.50                          | 40.20               | 13.4         | 63.17                          | 27.58               |
| 27.8        | 80.70                          | 56.45               | 14.6         | 61.31                          | 52.80               | 29.5         | 28.37                          | 39.88               | 14.4         | 64.77                          | 27.36               |
| 28.8        | 79.06                          | 56.50               | 15.6         | 59.98                          | 52.63               | 30.5         | 28.30                          | 39.54               | 15.4         | 66.42                          | 27.16               |
| 29.8        | 77.43                          | 56.56               | 16.6         | 58.58                          | 52.45               | Maj 1.5      | 28.32                          | 39.20               | 16.4         | 68.07                          | 26.98               |
| 30.8        | 75.76                          | 56.62               | 17.6         | 57.09                          | 52.26               | 2.5          | 28.45                          | 38.86               | 17.4         | 69.68                          | 26.82               |
| 31.8        | 74.04                          | 56.68               | 18.6         | 55.57                          | 52.05               | 3.5          | 28.68                          | 38.52               | 18.4         | 71.23                          | 26.67               |
| Luty 1.8    | 72.23                          | 56.75               | 19.6         | 54.05                          | 51.82               | 4.5          | 29.02                          | 38.18               | 19.4         | 72.71                          | 26.53               |
| 2.8         | 70.34                          | 56.81               | 20.6         | 52.62                          | 51.56               | 5.5          | 29.44                          | 37.86               | 20.4         | 74.13                          | 26.38               |
| 3.7         | 68.38                          | 56.86               | 21.6         | 51.33                          | 51.28               | 6.5          | 29.91                          | 37.55               | 21.4         | 75.51                          | 26.23               |
| 4.7         | 66.37                          | 56.89               | 22.6         | 50.19                          | 51.00               | 7.5          | 30.40                          | 37.26               | 22.4         | 76.89                          | 26.07               |
| 5.7         | 64.32                          | 56.90               | 23.6         | 49.19                          | 50.72               | 8.5          | 30.86                          | 36.98               | 23.4         | 78.30                          | 25.90               |
| 6.7         | 62.28                          | 56.90               | 24.6         | 48.26                          | 50.45               | 9.5          | 31.28                          | 36.72               | 24.4         | 79.76                          | 25.73               |
| 7.7         | 60.27                          | 56.88               | 25.6         | 47.36                          | 50.19               | 10.5         | 31.62                          | 36.45               | 25.4         | 81.29                          | 25.55               |
| 8.7         | 58.30                          | 56.84               | 26.6         | 46.44                          | 49.95               | 11.5         | 31.91                          | 36.18               | 26.4         | 82.90                          | 25.38               |
| 9.7         | 56.41                          | 56.80               | 27.6         | 45.48                          | 49.71               | 12.5         | 32.19                          | 35.89               | 27.4         | 84.61                          | 25.21               |
| 10.7        | 54.60                          | 56.75               | 28.6         | 44.47                          | 49.47               | 13.5         | 32.49                          | 35.58               | 28.4         | 86.40                          | 25.05               |
| 11.7        | 52.86                          | 56.70               | 29.6         | 43.42                          | 49.23               | 14.5         | 32.89                          | 35.26               | 29.3         | 88.26                          | 24.91               |
| 12.7        | 51.18                          | 56.65               | 30.6         | 42.33                          | 48.98               | 15.5         | 33.42                          | 34.93               | 30.3         | 90.16                          | 24.79               |
| 13.7        | 49.53                          | 56.61               | 31.6         | 41.23                          | 48.71               | 16.5         | 34.09                          | 34.60               | Lipiec 1.3   | 92.04                          | 24.69               |
| 14.7        | 47.88                          | 56.58               | Kwiecień 1.6 | 40.14                          | 48.43               | 17.5         | 34.91                          | 34.28               | 2.3          | 93.88                          | 24.62               |
| 15.7        | 46.17                          | 56.56               | 2.6          | 39.10                          | 48.13               | 18.5         | 35.81                          | 33.98               | 3.3          | 95.62                          | 24.55               |

Dwukrotne dołowanie 5.V, dwukrotne górowanie 4.XI .  
Miejsca średnie 2015.5  $\alpha = 2^h50^m52^s.21$   $\delta = +89^\circ19'47''.46$

**MIEJSCA POZORNE Biegunowej (2<sup>m</sup>02) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i> |      |                     | $\alpha_{app}^{\gamma}$        | $\delta_{app}$ | <i>UT1</i> |                     |                     | $\alpha_{app}^{\gamma}$        | $\delta_{app}$ | <i>UT1</i>          |                     |          | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      | <i>UT1</i>          |          |      | $\alpha_{app}^{\gamma}$        | $\delta_{app}$ |
|------------|------|---------------------|--------------------------------|----------------|------------|---------------------|---------------------|--------------------------------|----------------|---------------------|---------------------|----------|--------------------------------|---------------------|---------------------|----------|------|--------------------------------|----------------|
|            |      |                     | 2 <sup>h</sup> 50 <sup>m</sup> | +89°19'        |            |                     |                     | 2 <sup>h</sup> 52 <sup>m</sup> | +89°19'        |                     |                     |          | 2 <sup>h</sup> 53 <sup>m</sup> | +89°19'             |                     |          |      | 2 <sup>h</sup> 53 <sup>m</sup> | +89°19'        |
| Lipiec     | 3.3  | 35 <sup>s</sup> .62 | 24 <sup>"</sup> .55            | Sierpień       | 18.2       | 02 <sup>s</sup> .70 | 25 <sup>"</sup> .03 | Paźdz.                         | 3.1            | 19 <sup>s</sup> .77 | 35 <sup>"</sup> .21 | Listopad | 18.0                           | 50 <sup>s</sup> .87 | 51 <sup>"</sup> .28 | Grudzień | 1.9  | 47.45                          | 56.26          |
|            | 4.3  | 37.28               | 24.48                          |                | 19.2       | 04.54               | 25.13               |                                | 4.1            | 21.21               | 35.54               |          | 19.0                           | 50.68               | 51.67               |          | 2.9  | 46.78                          | 56.60          |
|            | 5.3  | 38.86               | 24.41                          |                | 20.2       | 06.44               | 25.23               |                                | 5.1            | 22.55               | 35.88               |          | 20.0                           | 50.41               | 52.04               |          | 3.9  | 46.07                          | 56.93          |
|            | 6.3  | 40.42               | 24.32                          |                | 21.2       | 08.40               | 25.34               |                                | 6.1            | 23.79               | 36.22               |          | 21.0                           | 50.09               | 52.40               |          | 4.9  | 45.36                          | 57.25          |
|            | 7.3  | 42.01               | 24.22                          |                | 22.2       | 10.42               | 25.46               |                                | 7.1            | 24.91               | 36.56               |          | 22.0                           | 49.80               | 52.73               |          | 5.9  | 44.67                          | 57.56          |
|            | 8.3  | 43.69               | 24.11                          |                | 23.2       | 12.48               | 25.59               |                                | 8.1            | 25.96               | 36.90               |          | 22.9                           | 49.57               | 53.05               |          | 6.9  | 44.00                          | 57.86          |
|            | 9.3  | 45.47               | 23.99                          |                | 24.2       | 14.55               | 25.75               |                                | 9.1            | 26.94               | 37.23               |          | 23.9                           | 49.44               | 53.37               |          | 7.9  | 43.38                          | 58.15          |
|            | 10.3 | 47.38               | 23.88                          |                | 25.2       | 16.59               | 25.92               |                                | 10.1           | 27.89               | 37.55               |          | 24.9                           | 49.39               | 53.69               |          | 8.9  | 42.79                          | 58.45          |
|            | 11.3 | 49.38               | 23.78                          |                | 26.2       | 18.56               | 26.12               |                                | 11.1           | 28.84               | 37.86               |          | 25.9                           | 49.37               | 54.03               |          | 9.9  | 42.22                          | 58.76          |
|            | 12.3 | 51.44               | 23.71                          |                | 27.2       | 20.43               | 26.32               |                                | 12.1           | 29.80               | 38.16               |          | 26.9                           | 49.33               | 54.39               |          | 10.9 | 41.65                          | 59.08          |
|            | 13.3 | 53.51               | 23.65                          |                | 28.2       | 22.18               | 26.53               |                                | 13.1           | 30.80               | 38.46               |          | 27.9                           | 49.21               | 54.76               |          | 11.9 | 41.03                          | 59.41          |
|            | 14.3 | 55.54               | 23.62                          |                | 29.2       | 23.84               | 26.74               |                                | 14.1           | 31.84               | 38.76               |          | 28.9                           | 48.96               | 55.14               |          | 12.9 | 40.34                          | 59.74          |
|            | 15.3 | 57.51               | 23.59                          |                | 30.2       | 25.44               | 26.92               |                                | 15.1           | 32.93               | 39.07               |          | 29.9                           | 48.57               | 55.52               |          | 13.9 | 39.53                          | 60.09          |
|            | 16.3 | 59.40               | 23.58                          |                | 31.2       | 27.07               | 27.09               |                                | 16.1           | 34.04               | 39.39               |          | 30.9                           | 48.06               | 55.90               |          | 14.9 | 38.61                          | 60.43          |
|            | 17.3 | 61.21               | 23.57                          |                | 1.2        | 28.76               | 27.25               |                                | 17.0           | 35.15               | 39.72               |          | 31.9                           | 37.56               | 60.77               |          | 15.9 | 37.56                          | 60.77          |
|            | 18.3 | 62.98               | 23.56                          |                | 2.2        | 30.57               | 27.40               |                                | 18.0           | 36.24               | 40.07               |          | 16.9                           | 36.42               | 61.08               |          | 16.9 | 36.42                          | 61.08          |
|            | 19.3 | 64.71               | 23.54                          |                | 3.2        | 32.48               | 27.56               |                                | 19.0           | 37.28               | 40.43               |          | 17.9                           | 35.23               | 61.38               |          | 17.9 | 35.23                          | 61.38          |
|            | 20.3 | 66.44               | 23.51                          |                | 4.2        | 34.46               | 27.74               |                                | 20.0           | 38.22               | 40.81               |          | 18.9                           | 34.04               | 61.65               |          | 18.9 | 34.04                          | 61.65          |
|            | 21.3 | 68.20               | 23.47                          |                | 5.2        | 36.45               | 27.94               |                                | 21.0           | 39.05               | 41.19               |          | 19.9                           | 32.90               | 61.91               |          | 19.9 | 32.90                          | 61.91          |
|            | 22.3 | 70.01               | 23.44                          |                | 6.2        | 38.40               | 28.16               |                                | 22.0           | 39.77               | 41.57               |          | 20.9                           | 31.85               | 62.16               |          | 20.9 | 31.85                          | 62.16          |
|            | 23.3 | 71.88               | 23.40                          |                | 7.2        | 40.28               | 28.39               |                                | 23.0           | 40.38               | 41.95               |          | 21.9                           | 30.88               | 62.40               |          | 21.9 | 30.88                          | 62.40          |
|            | 24.3 | 73.84               | 23.36                          |                | 8.2        | 42.07               | 28.64               |                                | 24.0           | 40.92               | 42.30               |          | 22.9                           | 29.97               | 62.66               |          | 22.9 | 29.97                          | 62.66          |
|            | 25.3 | 75.87               | 23.34                          |                | 9.2        | 43.77               | 28.89               |                                | 25.0           | 41.46               | 42.64               |          | 23.9                           | 29.07               | 62.92               |          | 23.9 | 29.07                          | 62.92          |
|            | 26.3 | 77.97               | 23.33                          |                | 10.2       | 45.37               | 29.14               |                                | 26.0           | 42.05               | 42.97               |          | 24.9                           | 28.13               | 63.21               |          | 24.9 | 28.13                          | 63.21          |
|            | 27.3 | 80.10               | 23.34                          |                | 11.1       | 46.91               | 29.38               |                                | 27.0           | 42.73               | 43.28               |          | 25.9                           | 27.08               | 63.50               |          | 25.9 | 27.08                          | 63.50          |
| Sierpień   | 28.3 | 82.24               | 23.37                          | Wrzesień       | 12.1       | 48.41               | 29.62               | Listopad                       | 28.0           | 43.51               | 43.60               | Grudzień | 26.9                           | 25.92               | 63.79               |          | 26.9 | 25.92                          | 63.79          |
|            | 29.3 | 84.33               | 23.42                          |                | 13.1       | 49.89               | 29.84               |                                | 29.0           | 44.36               | 43.94               |          | 27.9                           | 24.62               | 64.08               |          | 27.9 | 24.62                          | 64.08          |
|            | 30.3 | 86.35               | 23.49                          |                | 14.1       | 51.39               | 30.07               |                                | 30.0           | 45.22               | 44.29               |          | 28.9                           | 23.22               | 64.36               |          | 28.9 | 23.22                          | 64.36          |
|            | 31.3 | 88.26               | 23.57                          |                | 15.1       | 52.92               | 30.28               |                                | 31.0           | 46.01               | 44.66               |          | 29.8                           | 21.73               | 64.61               |          | 29.8 | 21.73                          | 64.61          |
|            | 1.3  | 90.07               | 23.64                          |                | 16.1       | 54.49               | 30.50               |                                | 1.0            | 46.69               | 45.05               |          | 30.8                           | 20.21               | 64.85               |          | 30.8 | 20.21                          | 64.85          |
|            | 2.3  | 91.82               | 23.70                          |                | 17.1       | 56.12               | 30.72               |                                | 2.0            | 47.25               | 45.45               |          | 31.8                           | 18.67               | 65.08               |          | 31.8 | 18.67                          | 65.08          |
|            | 3.3  | 93.56               | 23.75                          |                | 18.1       | 57.79               | 30.96               |                                | 3.0            | 47.68               | 45.84               |          | 32.8                           | 17.16               | 65.28               |          | 32.8 | 17.16                          | 65.28          |
|            | 4.3  | 95.36               | 23.78                          |                | 19.1       | 59.49               | 31.20               |                                | 4.0            | 48.01               | 46.22               |          | 33.8                           | 15.68               | 65.48               |          | 33.8 | 15.68                          | 65.48          |
|            | 5.2  | 97.25               | 23.80                          |                | 20.1       | 61.21               | 31.46               |                                | 5.0            | 48.26               | 46.60               |          |                                |                     |                     |          |      |                                |                |
|            | 6.2  | 99.26               | 23.83                          |                | 21.1       | 62.90               | 31.74               |                                | 6.0            | 48.46               | 46.96               |          |                                |                     |                     |          |      |                                |                |
|            | 7.2  | 101.37              | 23.86                          |                | 22.1       | 64.53               | 32.04               |                                | 7.0            | 48.64               | 47.31               |          |                                |                     |                     |          |      |                                |                |
|            | 8.2  | 103.53              | 23.92                          |                | 23.1       | 66.06               | 32.35               |                                | 8.0            | 48.83               | 47.66               |          |                                |                     |                     |          |      |                                |                |
|            | 9.2  | 105.69              | 24.00                          |                | 24.1       | 67.49               | 32.66               |                                | 9.0            | 49.04               | 47.99               |          |                                |                     |                     |          |      |                                |                |
|            | 10.2 | 107.83              | 24.10                          |                | 25.1       | 68.80               | 32.98               |                                | 10.0           | 49.28               | 48.32               |          |                                |                     |                     |          |      |                                |                |
|            | 11.2 | 109.90              | 24.21                          |                | 26.1       | 70.02               | 33.28               |                                | 11.0           | 49.57               | 48.66               |          |                                |                     |                     |          |      |                                |                |
|            | 12.2 | 111.89              | 24.33                          |                | 27.1       | 71.21               | 33.56               |                                | 12.0           | 49.88               | 49.00               |          |                                |                     |                     |          |      |                                |                |
|            | 13.2 | 113.79              | 24.46                          |                | 28.1       | 72.44               | 33.83               |                                | 13.0           | 50.20               | 49.35               |          |                                |                     |                     |          |      |                                |                |
|            | 14.2 | 115.61              | 24.59                          |                | 29.1       | 73.76               | 34.08               |                                | 14.0           | 50.50               | 49.72               |          |                                |                     |                     |          |      |                                |                |
|            | 15.2 | 117.39              | 24.71                          |                | 30.1       | 75.18               | 34.34               |                                | 15.0           | 50.75               | 50.10               |          |                                |                     |                     |          |      |                                |                |
|            | 16.2 | 119.15              | 24.82                          |                | 1.1        | 76.70               | 34.61               |                                | 16.0           | 50.91               | 50.49               |          |                                |                     |                     |          |      |                                |                |
|            | 17.2 | 120.91              | 24.93                          | Paźdz.         | 2.1        | 78.25               | 34.90               |                                | 17.0           | 50.95               | 50.89               |          |                                |                     |                     |          |      |                                |                |
|            | 18.2 | 122.70              | 25.03                          |                | 3.1        | 79.77               | 35.21               |                                | 18.0           | 50.87               | 51.28               |          |                                |                     |                     |          |      |                                |                |

| $\delta$     | +89°19'10 <sup>"</sup> 0 | +89°19'20 <sup>"</sup> 0 | +89°19'30 <sup>"</sup> 0 | +89°19'40 <sup>"</sup> 0 | +89°19'50 <sup>"</sup> 0 | +89°20'00 <sup>"</sup> 0 | +89°20'10 <sup>"</sup> 0 | +89°20'20 <sup>"</sup> 0 |
|--------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| sec $\delta$ | 84.1917                  | 84.5367                  | 84.8846                  | 85.2353                  | 85.5890                  | 85.9456                  | 86.3052                  | 86.6678                  |
| tan $\delta$ | 84.1858                  | 84.5308                  | 84.8787                  | 85.2295                  | 85.5832                  | 85.9398                  | 86.2994                  | 86.6620                  |

**MIEJSCA POZORNE 1H Draconis (4<sup>m</sup>29) 2015**  
w momencie jej górowania w południku Greenwich

| UT1     |       | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      | UT1   |       | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      | UT1      |        | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      | UT1   |       | $\alpha_{app}^{\gamma}$        | $\delta_{app}$      |
|---------|-------|--------------------------------|---------------------|-------|-------|--------------------------------|---------------------|----------|--------|--------------------------------|---------------------|-------|-------|--------------------------------|---------------------|
|         |       | 9 <sup>h</sup> 39 <sup>m</sup> | +81°15'             |       |       | 9 <sup>h</sup> 39 <sup>m</sup> | +81°15'             |          |        | 9 <sup>h</sup> 39 <sup>m</sup> | +81°15'             |       |       | 9 <sup>h</sup> 39 <sup>m</sup> | +81°15'             |
| Styczeń | 1.1   | 11 <sup>s</sup> .00            | 08 <sup>h</sup> .20 | Luty  | 16.0  | 14 <sup>s</sup> .46            | 19 <sup>h</sup> .90 | Kwiecień | 2.9    | 12 <sup>s</sup> .13            | 32 <sup>h</sup> .85 | Maj   | 18.7  | 06 <sup>s</sup> .39            | 36 <sup>h</sup> .88 |
|         | 2.1   | 11.12                          | 08.34               |       | 17.0  | 14.49                          | 20.20               |          | 3.9    | 12.01                          | 33.08               |       | 19.7  | 06.27                          | 36.80               |
|         | 3.1   | 11.25                          | 08.48               |       | 18.0  | 14.52                          | 20.53               |          | 4.9    | 11.89                          | 33.29               |       | 20.7  | 06.16                          | 36.72               |
|         | 4.1   | 11.39                          | 08.63               |       | 19.0  | 14.54                          | 20.87               |          | 5.9    | 11.77                          | 33.49               |       | 21.7  | 06.05                          | 36.64               |
|         | 5.1   | 11.53                          | 08.79               |       | 20.0  | 14.54                          | 21.22               |          | 6.9    | 11.65                          | 33.68               |       | 22.7  | 05.94                          | 36.58               |
|         | 6.1   | 11.66                          | 08.98               |       | 21.0  | 14.53                          | 21.56               |          | 7.9    | 11.53                          | 33.84               |       | 23.7  | 05.83                          | 36.52               |
|         | 7.1   | 11.79                          | 09.18               |       | 22.0  | 14.50                          | 21.90               |          | 8.9    | 11.41                          | 34.00               |       | 24.7  | 05.72                          | 36.47               |
|         | 8.1   | 11.92                          | 09.40               |       | 23.0  | 14.47                          | 22.21               |          | 9.9    | 11.31                          | 34.14               |       | 25.7  | 05.60                          | 36.42               |
|         | 9.1   | 12.04                          | 09.63               |       | 24.0  | 14.44                          | 22.50               |          | 10.9   | 11.21                          | 34.29               |       | 26.7  | 05.47                          | 36.37               |
|         | 10.1  | 12.15                          | 09.87               |       | 25.0  | 14.42                          | 22.78               |          | 11.8   | 11.11                          | 34.44               |       | 27.7  | 05.34                          | 36.32               |
| 11.1    | 12.25 | 10.12                          | 26.0                | 14.40 | 23.06 | 12.8                           | 11.01               | 34.60    | 28.7   | 05.21                          | 36.25               |       |       |                                |                     |
| 12.1    | 12.34 | 10.36                          | 27.0                | 14.39 | 23.34 | 13.8                           | 10.91               | 34.78    | 29.7   | 05.07                          | 36.16               |       |       |                                |                     |
| 13.1    | 12.43 | 10.59                          | 28.0                | 14.38 | 23.62 | 14.8                           | 10.81               | 34.96    | 30.7   | 04.94                          | 36.06               |       |       |                                |                     |
| 14.1    | 12.52 | 10.82                          | 29.0                | 14.37 | 23.92 | 15.8                           | 10.69               | 35.14    | 31.7   | 04.81                          | 35.93               |       |       |                                |                     |
| 15.1    | 12.61 | 11.04                          | Marzec              | 2.0   | 14.35 | 24.22                          | 16.8                | 10.56    | 35.32  | Czerwiec                       | 1.7                 | 04.69 | 35.79 |                                |                     |
| 16.1    | 12.70 | 11.25                          |                     | 3.0   | 14.33 | 24.54                          | 17.8                | 10.42    | 35.48  |                                | 2.7                 | 04.57 | 35.64 |                                |                     |
| 17.1    | 12.79 | 11.45                          |                     | 4.0   | 14.31 | 24.87                          | 18.8                | 10.27    | 35.61  |                                | 3.7                 | 04.47 | 35.48 |                                |                     |
| 18.1    | 12.90 | 11.65                          |                     | 5.0   | 14.27 | 25.20                          | 19.8                | 10.13    | 35.72  |                                | 4.7                 | 04.37 | 35.33 |                                |                     |
| 19.1    | 13.01 | 11.87                          |                     | 5.9   | 14.23 | 25.53                          | 20.8                | 10.00    | 35.81  |                                | 5.7                 | 04.29 | 35.18 |                                |                     |
| 20.1    | 13.12 | 12.10                          |                     | 6.9   | 14.17 | 25.86                          | 21.8                | 09.87    | 35.88  |                                | 6.7                 | 04.20 | 35.04 |                                |                     |
| 21.1    | 13.23 | 12.36                          |                     | 7.9   | 14.11 | 26.18                          | 22.8                | 09.76    | 35.96  |                                | 7.7                 | 04.10 | 34.92 |                                |                     |
| 22.1    | 13.33 | 12.64                          |                     | 8.9   | 14.05 | 26.48                          | 23.8                | 09.64    | 36.04  |                                | 8.7                 | 04.01 | 34.81 |                                |                     |
| 23.1    | 13.42 | 12.93                          |                     | 9.9   | 13.98 | 26.77                          | 24.8                | 09.53    | 36.12  |                                | 9.7                 | 03.90 | 34.69 |                                |                     |
| 24.1    | 13.49 | 13.24                          |                     | 10.9  | 13.92 | 27.05                          | 25.8                | 09.42    | 36.22  |                                | 10.7                | 03.78 | 34.56 |                                |                     |
| 25.1    | 13.55 | 13.53                          | 11.9                | 13.85 | 27.31 | 26.8                           | 09.30               | 36.32    | 11.7   | 03.66                          | 34.42               |       |       |                                |                     |
| 26.1    | 13.61 | 13.82                          | 12.9                | 13.80 | 27.57 | 27.8                           | 09.18               | 36.43    | 12.7   | 03.54                          | 34.25               |       |       |                                |                     |
| 27.1    | 13.66 | 14.09                          | 13.9                | 13.74 | 27.82 | 28.8                           | 09.05               | 36.54    | 13.7   | 03.42                          | 34.06               |       |       |                                |                     |
| 28.0    | 13.71 | 14.34                          | 14.9                | 13.70 | 28.07 | 29.8                           | 08.91               | 36.64    | 14.7   | 03.31                          | 33.85               |       |       |                                |                     |
| 29.0    | 13.77 | 14.59                          | 15.9                | 13.65 | 28.34 | 30.8                           | 08.77               | 36.73    | 15.7   | 03.22                          | 33.63               |       |       |                                |                     |
| 30.0    | 13.83 | 14.84                          | 16.9                | 13.61 | 28.62 | Maj                            | 1.8                 | 08.63    | 36.81  | 16.7                           | 03.13               | 33.40 |       |                                |                     |
| Luty    | 31.0  | 13.90                          | 15.10               | 17.9  | 13.56 |                                | 28.91               | 2.8      | 08.48  | 36.87                          | 17.7                | 03.05 | 33.19 |                                |                     |
|         | 1.0   | 13.97                          | 15.36               | 18.9  | 13.49 |                                | 29.21               | 3.8      | 08.33  | 36.91                          | 18.7                | 02.98 | 32.98 |                                |                     |
|         | 2.0   | 14.03                          | 15.64               | 19.9  | 13.41 |                                | 29.52               | 4.8      | 08.19  | 36.94                          | 19.7                | 02.90 | 32.78 |                                |                     |
|         | 3.0   | 14.10                          | 15.94               | 20.9  | 13.32 |                                | 29.81               | 5.8      | 08.06  | 36.94                          | 20.7                | 02.83 | 32.59 |                                |                     |
|         | 4.0   | 14.16                          | 16.25               | 21.9  | 13.22 |                                | 30.08               | 6.8      | 07.93  | 36.94                          | 21.7                | 02.74 | 32.41 |                                |                     |
|         | 5.0   | 14.21                          | 16.57               | 22.9  | 13.12 |                                | 30.32               | 7.8      | 07.81  | 36.94                          | 22.7                | 02.66 | 32.23 |                                |                     |
|         | 6.0   | 14.25                          | 16.90               | 23.9  | 13.02 |                                | 30.55               | 8.8      | 07.70  | 36.93                          | 23.6                | 02.57 | 32.05 |                                |                     |
|         | 7.0   | 14.28                          | 17.23               | 24.9  | 12.93 |                                | 30.76               | 9.8      | 07.59  | 36.94                          | 24.6                | 02.47 | 31.85 |                                |                     |
|         | 8.0   | 14.30                          | 17.56               | 25.9  | 12.85 |                                | 30.97               | 10.8     | 07.48  | 36.96                          | 25.6                | 02.38 | 31.64 |                                |                     |
|         | 9.0   | 14.32                          | 17.89               | 26.9  | 12.77 | 31.18                          | 11.8                | 07.36    | 36.99  | 26.6                           | 02.28               | 31.42 |       |                                |                     |
| 10.0    | 14.33 | 18.20                          | 27.9                | 12.69 | 31.40 | 12.8                           | 07.24               | 37.02    | 27.6   | 02.19                          | 31.18               |       |       |                                |                     |
| 11.0    | 14.34 | 18.50                          | 28.9                | 12.61 | 31.63 | 13.8                           | 07.10               | 37.05    | 28.6   | 02.10                          | 30.92               |       |       |                                |                     |
| 12.0    | 14.36 | 18.79                          | 29.9                | 12.53 | 31.86 | 14.8                           | 06.96               | 37.06    | 29.6   | 02.02                          | 30.65               |       |       |                                |                     |
| 13.0    | 14.37 | 19.06                          | 30.9                | 12.44 | 32.11 | 15.8                           | 06.81               | 37.05    | 30.6   | 01.96                          | 30.37               |       |       |                                |                     |
| 14.0    | 14.40 | 19.34                          | 31.9                | 12.35 | 32.36 | 16.8                           | 06.66               | 37.01    | Lipiec | 1.6                            | 01.90               | 30.09 |       |                                |                     |
| 15.0    | 14.43 | 19.61                          | Kwiecień            | 1.9   | 12.24 | 32.60                          | 17.7                | 06.52    |        | 36.96                          | 2.6                 | 01.86 | 29.82 |                                |                     |
| 16.0    | 14.46 | 19.90                          |                     | 2.9   | 12.13 | 32.85                          | 18.7                | 06.39    |        | 36.88                          | 3.6                 | 01.81 | 29.56 |                                |                     |

Dwukrotne dołowanie 16.VIII, dwukrotne górowanie 15.II .  
Miejsca średnie 2015.5  $\alpha = 9^h39^m11^s22$   $\delta = +81^\circ15'21''88$

**MIEJSCA POZORNE 1H Draconis (4<sup>m</sup>29) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i>   | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     | <i>UT1</i>    | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     | <i>UT1</i>   | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     | <i>UT1</i>    | $\alpha_{app}^{\gamma}$        | $\delta_{app}$     |
|--------------|--------------------------------|--------------------|---------------|--------------------------------|--------------------|--------------|--------------------------------|--------------------|---------------|--------------------------------|--------------------|
|              | 9 <sup>h</sup> 39 <sup>m</sup> | +81°15'            |               | 9 <sup>h</sup> 39 <sup>m</sup> | +81°15'            |              | 9 <sup>h</sup> 39 <sup>m</sup> | +81°14'            |               | 9 <sup>h</sup> 39 <sup>m</sup> | +81°14'            |
| Lipiec 3.6   | 01 <sup>s</sup> 81             | 29 <sup>"</sup> 56 | Sierpień 18.5 | 00 <sup>s</sup> 98             | 15 <sup>"</sup> 37 | Paźdz. 3.4   | 04 <sup>s</sup> 42             | 60 <sup>"</sup> 40 | Listopad 18.2 | 11 <sup>s</sup> 19             | 51 <sup>"</sup> 55 |
| 4.6          | 01.77                          | 29.32              | 19.5          | 01.00                          | 15.04              | 4.4          | 04.55                          | 60.09              | 19.2          | 11.37                          | 51.50              |
| 5.6          | 01.72                          | 29.09              | 20.5          | 01.01                          | 14.70              | 5.4          | 04.68                          | 59.80              | 20.2          | 11.53                          | 51.46              |
| 6.6          | 01.66                          | 28.86              | 21.5          | 01.03                          | 14.35              | 6.4          | 04.82                          | 59.52              | 21.2          | 11.69                          | 51.42              |
| 7.6          | 01.59                          | 28.63              | 22.5          | 01.06                          | 13.99              | 7.4          | 04.96                          | 59.26              | 22.2          | 11.84                          | 51.39              |
| 8.6          | 01.52                          | 28.38              | 23.5          | 01.10                          | 13.62              | 8.4          | 05.09                          | 59.02              | 23.2          | 11.99                          | 51.34              |
| 9.6          | 01.44                          | 28.11              | 24.5          | 01.14                          | 13.25              | 9.4          | 05.22                          | 58.78              | 24.2          | 12.13                          | 51.28              |
| 10.6         | 01.37                          | 27.82              | 25.5          | 01.20                          | 12.87              | 10.4         | 05.34                          | 58.55              | 25.2          | 12.29                          | 51.20              |
| 11.6         | 01.31                          | 27.52              | 26.5          | 01.27                          | 12.51              | 11.3         | 05.46                          | 58.32              | 26.2          | 12.45                          | 51.12              |
| 12.6         | 01.26                          | 27.20              | 27.5          | 01.34                          | 12.17              | 12.3         | 05.57                          | 58.09              | 27.2          | 12.62                          | 51.04              |
| 13.6         | 01.22                          | 26.88              | 28.5          | 01.41                          | 11.84              | 13.3         | 05.69                          | 57.86              | 28.2          | 12.80                          | 50.98              |
| 14.6         | 01.19                          | 26.56              | 29.5          | 01.47                          | 11.53              | 14.3         | 05.80                          | 57.61              | 29.2          | 12.98                          | 50.93              |
| 15.6         | 01.16                          | 26.25              | 30.5          | 01.52                          | 11.23              | 15.3         | 05.93                          | 57.35              | 30.2          | 13.17                          | 50.91              |
| 16.6         | 01.14                          | 25.95              | 31.5          | 01.57                          | 10.92              | 16.3         | 06.05                          | 57.09              | Grudzień 1.2  | 13.34                          | 50.91              |
| 17.6         | 01.11                          | 25.67              | Wrzesień 1.5  | 01.61                          | 10.60              | 17.3         | 06.19                          | 56.83              | 2.2           | 13.52                          | 50.93              |
| 18.6         | 01.08                          | 25.39              | 2.5           | 01.65                          | 10.27              | 18.3         | 06.34                          | 56.57              | 3.2           | 13.68                          | 50.96              |
| 19.6         | 01.05                          | 25.12              | 3.5           | 01.69                          | 09.91              | 19.3         | 06.49                          | 56.32              | 4.2           | 13.84                          | 51.00              |
| 20.6         | 01.01                          | 24.85              | 4.4           | 01.75                          | 09.54              | 20.3         | 06.65                          | 56.08              | 5.2           | 13.99                          | 51.04              |
| 21.6         | 00.97                          | 24.57              | 5.4           | 01.81                          | 09.17              | 21.3         | 06.81                          | 55.86              | 6.2           | 14.14                          | 51.07              |
| 22.6         | 00.93                          | 24.28              | 6.4           | 01.89                          | 08.80              | 22.3         | 06.97                          | 55.66              | 7.2           | 14.28                          | 51.10              |
| 23.6         | 00.89                          | 23.98              | 7.4           | 01.97                          | 08.44              | 23.3         | 07.12                          | 55.48              | 8.2           | 14.42                          | 51.13              |
| 24.6         | 00.85                          | 23.67              | 8.4           | 02.06                          | 08.10              | 24.3         | 07.27                          | 55.31              | 9.2           | 14.57                          | 51.15              |
| 25.6         | 00.81                          | 23.34              | 9.4           | 02.15                          | 07.77              | 25.3         | 07.41                          | 55.14              | 10.2          | 14.73                          | 51.16              |
| 26.6         | 00.79                          | 23.00              | 10.4          | 02.23                          | 07.45              | 26.3         | 07.54                          | 54.96              | 11.2          | 14.89                          | 51.18              |
| 27.6         | 00.77                          | 22.65              | 11.4          | 02.32                          | 07.15              | 27.3         | 07.67                          | 54.77              | 12.2          | 15.06                          | 51.20              |
| 28.6         | 00.76                          | 22.29              | 12.4          | 02.40                          | 06.85              | 28.3         | 07.80                          | 54.56              | 13.2          | 15.23                          | 51.24              |
| 29.5         | 00.77                          | 21.94              | 13.4          | 02.47                          | 06.56              | 29.3         | 07.94                          | 54.33              | 14.2          | 15.41                          | 51.29              |
| 30.5         | 00.78                          | 21.61              | 14.4          | 02.54                          | 06.26              | 30.3         | 08.10                          | 54.11              | 15.2          | 15.58                          | 51.37              |
| 31.5         | 00.79                          | 21.29              | 15.4          | 02.61                          | 05.96              | 31.3         | 08.26                          | 53.89              | 16.2          | 15.75                          | 51.46              |
| Sierpień 1.5 | 00.80                          | 20.98              | 16.4          | 02.68                          | 05.65              | Listopad 1.3 | 08.43                          | 53.69              | 17.2          | 15.91                          | 51.58              |
| 2.5          | 00.80                          | 20.69              | 17.4          | 02.75                          | 05.32              | 2.3          | 08.60                          | 53.52              | 18.2          | 16.06                          | 51.70              |
| 3.5          | 00.80                          | 20.40              | 18.4          | 02.83                          | 04.99              | 3.3          | 08.78                          | 53.36              | 19.2          | 16.20                          | 51.83              |
| 4.5          | 00.78                          | 20.10              | 19.4          | 02.92                          | 04.65              | 4.3          | 08.94                          | 53.22              | 20.2          | 16.33                          | 51.94              |
| 5.5          | 00.76                          | 19.78              | 20.4          | 03.01                          | 04.31              | 5.3          | 09.10                          | 53.09              | 21.2          | 16.46                          | 52.05              |
| 6.5          | 00.75                          | 19.44              | 21.4          | 03.12                          | 03.97              | 6.3          | 09.26                          | 52.98              | 22.2          | 16.59                          | 52.14              |
| 7.5          | 00.74                          | 19.08              | 22.4          | 03.23                          | 03.64              | 7.3          | 09.41                          | 52.86              | 23.1          | 16.73                          | 52.22              |
| 8.5          | 00.74                          | 18.71              | 23.4          | 03.35                          | 03.32              | 8.3          | 09.56                          | 52.75              | 24.1          | 16.87                          | 52.30              |
| 9.5          | 00.75                          | 18.34              | 24.4          | 03.48                          | 03.02              | 9.3          | 09.70                          | 52.63              | 25.1          | 17.03                          | 52.38              |
| 10.5         | 00.77                          | 17.97              | 25.4          | 03.60                          | 02.74              | 10.3         | 09.84                          | 52.51              | 26.1          | 17.19                          | 52.49              |
| 11.5         | 00.80                          | 17.62              | 26.4          | 03.71                          | 02.47              | 11.3         | 09.99                          | 52.38              | 27.1          | 17.35                          | 52.61              |
| 12.5         | 00.84                          | 17.27              | 27.4          | 03.81                          | 02.21              | 12.3         | 10.14                          | 52.24              | 28.1          | 17.50                          | 52.76              |
| 13.5         | 00.87                          | 16.94              | 28.4          | 03.90                          | 01.95              | 13.3         | 10.30                          | 52.10              | 29.1          | 17.65                          | 52.93              |
| 14.5         | 00.90                          | 16.62              | 29.4          | 03.99                          | 01.66              | 14.3         | 10.47                          | 51.96              | 30.1          | 17.79                          | 53.11              |
| 15.5         | 00.93                          | 16.30              | 30.4          | 04.08                          | 01.36              | 15.3         | 10.64                          | 51.83              | 31.1          | 17.92                          | 53.30              |
| 16.5         | 00.95                          | 15.99              | Paźdz. 1.4    | 04.18                          | 01.05              | 16.2         | 10.82                          | 51.72              | 32.1          | 18.04                          | 53.50              |
| 17.5         | 00.97                          | 15.68              | 2.4           | 04.30                          | 00.72              | 17.2         | 11.01                          | 51.62              | 33.1          | 18.16                          | 53.69              |
| 18.5         | 00.98                          | 15.37              | 3.4           | 04.42                          | 00.40              | 18.2         | 11.19                          | 51.55              | 34.1          | 18.27                          | 53.88              |

| $\delta$     | +81°14'40 <sup>"</sup> 0 | +81°14'50 <sup>"</sup> 0 | +81°15'00 <sup>"</sup> 0 | +81°15'10 <sup>"</sup> 0 | +81°15'20 <sup>"</sup> 0 | +81°15'30 <sup>"</sup> 0 | +81°15'40 <sup>"</sup> 0 | +81°15'50 <sup>"</sup> 0 |
|--------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| sec $\delta$ | 6.5695                   | 6.5715                   | 6.5736                   | 6.5757                   | 6.5778                   | 6.5798                   | 6.5819                   | 6.5840                   |
| tan $\delta$ | 6.4929                   | 6.4950                   | 6.4971                   | 6.4992                   | 6.5013                   | 6.5034                   | 6.5055                   | 6.5076                   |

**MIEJSCA POZORNE  $\varepsilon$  Ursae Minoris (4<sup>m</sup>23) 2015**  
w momencie jej górowania w południku Greenwich

| UT1     |       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | UT1   |       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | UT1      |       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | UT1   |       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     |
|---------|-------|---------------------------------|--------------------|-------|-------|---------------------------------|--------------------|----------|-------|---------------------------------|--------------------|-------|-------|---------------------------------|--------------------|
|         |       | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |       |       | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |          |       | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |       |       | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |
| Styczeń | 1.4   | 18 <sup>s</sup> 11              | 36 <sup>u</sup> 24 | Luty  | 16.3  | 23 <sup>s</sup> 46              | 25 <sup>u</sup> 35 | Kwiecień | 3.2   | 30 <sup>s</sup> 59              | 27 <sup>u</sup> 12 | Maj   | 19.0  | 34 <sup>s</sup> 35              | 39 <sup>u</sup> 74 |
|         | 2.4   | 18.17                           | 35.93              |       | 17.3  | 23.61                           | 25.20              |          | 4.2   | 30.73                           | 27.32              |       | 20.0  | 34.36                           | 40.07              |
|         | 3.4   | 18.22                           | 35.60              |       | 18.3  | 23.77                           | 25.05              |          | 5.2   | 30.87                           | 27.54              |       | 21.0  | 34.37                           | 40.39              |
|         | 4.4   | 18.28                           | 35.27              |       | 19.3  | 23.94                           | 24.93              |          | 6.2   | 31.00                           | 27.77              |       | 22.0  | 34.38                           | 40.69              |
|         | 5.4   | 18.35                           | 34.93              |       | 20.3  | 24.11                           | 24.82              |          | 7.2   | 31.12                           | 28.00              |       | 23.0  | 34.39                           | 40.99              |
|         | 6.4   | 18.42                           | 34.58              |       | 21.3  | 24.28                           | 24.75              |          | 8.2   | 31.24                           | 28.23              |       | 24.0  | 34.40                           | 41.28              |
|         | 7.4   | 18.51                           | 34.24              |       | 22.3  | 24.45                           | 24.71              |          | 9.2   | 31.35                           | 28.45              |       | 25.0  | 34.41                           | 41.58              |
|         | 8.4   | 18.59                           | 33.90              |       | 23.3  | 24.61                           | 24.68              |          | 10.1  | 31.46                           | 28.67              |       | 26.0  | 34.43                           | 41.89              |
|         | 9.4   | 18.69                           | 33.57              |       | 24.3  | 24.77                           | 24.66              |          | 11.1  | 31.57                           | 28.87              |       | 27.0  | 34.44                           | 42.21              |
|         | 10.4  | 18.78                           | 33.25              |       | 25.3  | 24.92                           | 24.64              |          | 12.1  | 31.68                           | 29.06              |       | 28.0  | 34.45                           | 42.55              |
| 11.4    | 18.88 | 32.96                           | 26.3               | 25.07 | 24.61 | 13.1                            | 31.80              | 29.25    | 29.0  | 34.45                           | 42.89              |       |       |                                 |                    |
| 12.4    | 18.98 | 32.67                           | 27.3               | 25.22 | 24.57 | 14.1                            | 31.91              | 29.45    | 30.0  | 34.45                           | 43.24              |       |       |                                 |                    |
| 13.4    | 19.08 | 32.40                           | 28.3               | 25.37 | 24.52 | 15.1                            | 32.04              | 29.65    | 31.0  | 34.44                           | 43.60              |       |       |                                 |                    |
| 14.4    | 19.18 | 32.15                           | Marzec             | 1.3   | 25.53 | 24.47                           | 16.1               | 32.16    | 29.88 | Czerwiec                        | 1.0                | 34.42 | 43.96 |                                 |                    |
| 15.4    | 19.27 | 31.89                           |                    | 2.3   | 25.69 | 24.42                           | 17.1               | 32.27    | 30.14 |                                 | 2.0                | 34.40 | 44.30 |                                 |                    |
| 16.4    | 19.36 | 31.63                           |                    | 3.3   | 25.86 | 24.38                           | 18.1               | 32.39    | 30.42 |                                 | 3.0                | 34.37 | 44.64 |                                 |                    |
| 17.4    | 19.46 | 31.37                           |                    | 4.2   | 26.03 | 24.35                           | 19.1               | 32.49    | 30.71 |                                 | 4.0                | 34.34 | 44.96 |                                 |                    |
| 18.4    | 19.55 | 31.09                           |                    | 5.2   | 26.20 | 24.34                           | 20.1               | 32.58    | 31.01 |                                 | 5.0                | 34.31 | 45.26 |                                 |                    |
| 19.4    | 19.65 | 30.79                           |                    | 6.2   | 26.37 | 24.34                           | 21.1               | 32.67    | 31.30 |                                 | 6.0                | 34.28 | 45.54 |                                 |                    |
| 20.4    | 19.75 | 30.49                           |                    | 7.2   | 26.54 | 24.36                           | 22.1               | 32.75    | 31.58 |                                 | 7.0                | 34.25 | 45.82 |                                 |                    |
| 21.4    | 19.87 | 30.18                           |                    | 8.2   | 26.71 | 24.40                           | 23.1               | 32.83    | 31.85 |                                 | 8.0                | 34.23 | 46.10 |                                 |                    |
| 22.4    | 19.99 | 29.88                           |                    | 9.2   | 26.87 | 24.45                           | 24.1               | 32.91    | 32.10 |                                 | 9.0                | 34.21 | 46.39 |                                 |                    |
| 23.4    | 20.12 | 29.61                           |                    | 10.2  | 27.03 | 24.52                           | 25.1               | 33.00    | 32.35 |                                 | 10.0               | 34.18 | 46.70 |                                 |                    |
| 24.4    | 20.25 | 29.36                           | 11.2               | 27.19 | 24.59 | 26.1                            | 33.08              | 32.60    | 11.0  | 34.15                           | 47.03              |       |       |                                 |                    |
| 25.4    | 20.38 | 29.14                           | 12.2               | 27.34 | 24.66 | 27.1                            | 33.17              | 32.86    | 12.0  | 34.12                           | 47.37              |       |       |                                 |                    |
| 26.3    | 20.51 | 28.93                           | 13.2               | 27.49 | 24.72 | 28.1                            | 33.26              | 33.12    | 13.0  | 34.08                           | 47.72              |       |       |                                 |                    |
| 27.3    | 20.64 | 28.74                           | 14.2               | 27.63 | 24.77 | 29.1                            | 33.35              | 33.40    | 14.0  | 34.02                           | 48.07              |       |       |                                 |                    |
| 28.3    | 20.76 | 28.55                           | 15.2               | 27.78 | 24.82 | 30.1                            | 33.43              | 33.69    | 15.0  | 33.96                           | 48.40              |       |       |                                 |                    |
| 29.3    | 20.88 | 28.35                           | 16.2               | 27.93 | 24.85 | Maj                             | 1.1                | 33.51    | 33.99 | 16.0                            | 33.90              | 48.72 |       |                                 |                    |
| 30.3    | 21.00 | 28.15                           | 17.2               | 28.09 | 24.89 |                                 | 2.1                | 33.59    | 34.31 | 17.0                            | 33.83              | 49.02 |       |                                 |                    |
| 31.3    | 21.13 | 27.94                           | 18.2               | 28.25 | 24.93 |                                 | 3.1                | 33.66    | 34.64 | 18.0                            | 33.77              | 49.31 |       |                                 |                    |
| Luty    | 1.3   | 21.25                           | 27.72              | 19.2  | 28.42 |                                 | 25.00              | 4.1      | 33.72 | 34.97                           | 19.0               | 33.70 | 49.58 |                                 |                    |
|         | 2.3   | 21.39                           | 27.49              | 20.2  | 28.58 |                                 | 25.09              | 5.1      | 33.78 | 35.30                           | 20.0               | 33.64 | 49.85 |                                 |                    |
|         | 3.3   | 21.53                           | 27.27              | 21.2  | 28.74 |                                 | 25.22              | 6.1      | 33.83 | 35.63                           | 21.0               | 33.58 | 50.11 |                                 |                    |
|         | 4.3   | 21.67                           | 27.06              | 22.2  | 28.90 |                                 | 25.36              | 7.1      | 33.87 | 35.94                           | 21.9               | 33.52 | 50.38 |                                 |                    |
|         | 5.3   | 21.82                           | 26.85              | 23.2  | 29.05 |                                 | 25.52              | 8.1      | 33.92 | 36.24                           | 22.9               | 33.46 | 50.66 |                                 |                    |
|         | 6.3   | 21.98                           | 26.67              | 24.2  | 29.19 |                                 | 25.68              | 9.1      | 33.96 | 36.52                           | 23.9               | 33.40 | 50.95 |                                 |                    |
|         | 7.3   | 22.13                           | 26.50              | 25.2  | 29.32 |                                 | 25.83              | 10.1     | 34.01 | 36.80                           | 24.9               | 33.34 | 51.25 |                                 |                    |
|         | 8.3   | 22.29                           | 26.34              | 26.2  | 29.46 | 25.97                           | 11.1               | 34.06    | 37.07 | 25.9                            | 33.27              | 51.55 |       |                                 |                    |
|         | 9.3   | 22.44                           | 26.21              | 27.2  | 29.59 | 26.11                           | 12.1               | 34.11    | 37.36 | 26.9                            | 33.19              | 51.86 |       |                                 |                    |
|         | 10.3  | 22.59                           | 26.09              | 28.2  | 29.73 | 26.23                           | 13.1               | 34.16    | 37.65 | 27.9                            | 33.10              | 52.17 |       |                                 |                    |
| 11.3    | 22.74 | 25.97                           | 29.2               | 29.87 | 26.36 | 14.1                            | 34.21              | 37.97    | 28.9  | 33.01                           | 52.47              |       |       |                                 |                    |
| 12.3    | 22.89 | 25.86                           | 30.2               | 30.01 | 26.49 | 15.1                            | 34.26              | 38.31    | 29.9  | 32.92                           | 52.76              |       |       |                                 |                    |
| 13.3    | 23.03 | 25.75                           | 31.2               | 30.16 | 26.62 | 16.0                            | 34.29              | 38.67    | 30.9  | 32.82                           | 53.03              |       |       |                                 |                    |
| 14.3    | 23.17 | 25.63                           | Kwiecień           | 1.2   | 30.30 | 26.77                           | 17.0               | 34.32    | 39.03 | Lipiec                          | 1.9                | 32.71 | 53.28 |                                 |                    |
| 15.3    | 23.31 | 25.50                           |                    | 2.2   | 30.45 | 26.94                           | 18.0               | 34.34    | 39.39 |                                 | 2.9                | 32.61 | 53.51 |                                 |                    |
| 16.3    | 23.46 | 25.35                           |                    | 3.2   | 30.59 | 27.12                           | 19.0               | 34.35    | 39.74 |                                 | 3.9                | 32.52 | 53.72 |                                 |                    |

Dwukrotne dołowanie 2.XII, dwukrotne górowanie 2.VI .  
Miejsca średnie 2015.5  $\alpha = 16^h44^m25^s.93$   $\delta = +82^\circ00'34''.71$

**MIEJSCA POZORNE  $\varepsilon$  Ursae Minoris (4<sup>m</sup>23) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i>   | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | <i>UT1</i>    | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | <i>UT1</i>   | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | <i>UT1</i>    | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     |
|--------------|---------------------------------|--------------------|---------------|---------------------------------|--------------------|--------------|---------------------------------|--------------------|---------------|---------------------------------|--------------------|
|              | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |               | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |              | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |               | 16 <sup>h</sup> 44 <sup>m</sup> | +82°00'            |
| Lipiec 3.9   | 32 <sup>s</sup> 52              | 53 <sup>"</sup> 72 | Sierpień 18.8 | 26 <sup>s</sup> 27              | 61 <sup>"</sup> 17 | Paźdz. 3.7   | 18 <sup>s</sup> 47              | 58 <sup>"</sup> 59 | Listopad 18.5 | 12 <sup>s</sup> 96              | 46 <sup>"</sup> 35 |
| 4.9          | 32.42                           | 53.93              | 19.8          | 26.11                           | 61.25              | 4.7          | 18.30                           | 58.41              | 19.5          | 12.90                           | 45.98              |
| 5.9          | 32.34                           | 54.15              | 20.8          | 25.95                           | 61.32              | 5.7          | 18.14                           | 58.21              | 20.5          | 12.85                           | 45.62              |
| 6.9          | 32.25                           | 54.39              | 21.8          | 25.78                           | 61.40              | 6.7          | 17.98                           | 57.99              | 21.5          | 12.80                           | 45.28              |
| 7.9          | 32.15                           | 54.64              | 22.8          | 25.60                           | 61.46              | 7.7          | 17.83                           | 57.78              | 22.5          | 12.75                           | 44.95              |
| 8.9          | 32.06                           | 54.90              | 23.8          | 25.43                           | 61.52              | 8.7          | 17.69                           | 57.56              | 23.5          | 12.70                           | 44.64              |
| 9.9          | 31.95                           | 55.18              | 24.8          | 25.25                           | 61.55              | 9.6          | 17.54                           | 57.35              | 24.5          | 12.64                           | 44.33              |
| 10.9         | 31.84                           | 55.45              | 25.8          | 25.07                           | 61.56              | 10.6         | 17.40                           | 57.15              | 25.5          | 12.58                           | 44.02              |
| 11.9         | 31.72                           | 55.71              | 26.8          | 24.89                           | 61.54              | 11.6         | 17.26                           | 56.95              | 26.5          | 12.52                           | 43.69              |
| 12.9         | 31.59                           | 55.96              | 27.8          | 24.72                           | 61.52              | 12.6         | 17.12                           | 56.76              | 27.5          | 12.46                           | 43.34              |
| 13.9         | 31.46                           | 56.18              | 28.8          | 24.55                           | 61.48              | 13.6         | 16.98                           | 56.57              | 28.5          | 12.41                           | 42.97              |
| 14.9         | 31.34                           | 56.39              | 29.8          | 24.39                           | 61.45              | 14.6         | 16.84                           | 56.38              | 29.5          | 12.36                           | 42.59              |
| 15.9         | 31.21                           | 56.58              | 30.8          | 24.23                           | 61.44              | 15.6         | 16.69                           | 56.19              | 30.5          | 12.33                           | 42.20              |
| 16.9         | 31.09                           | 56.76              | 31.8          | 24.07                           | 61.44              | 16.6         | 16.54                           | 55.98              | Grudzień 1.5  | 12.30                           | 41.81              |
| 17.9         | 30.97                           | 56.94              | Wrzesień 1.8  | 23.90                           | 61.46              | 17.6         | 16.39                           | 55.76              | 2.5           | 12.28                           | 41.43              |
| 18.9         | 30.85                           | 57.12              | 2.7           | 23.73                           | 61.49              | 18.6         | 16.24                           | 55.53              | 3.5           | 12.26                           | 41.06              |
| 19.9         | 30.73                           | 57.30              | 3.7           | 23.55                           | 61.50              | 19.6         | 16.10                           | 55.27              | 4.5           | 12.24                           | 40.70              |
| 20.9         | 30.61                           | 57.49              | 4.7           | 23.37                           | 61.51              | 20.6         | 15.96                           | 55.00              | 5.5           | 12.23                           | 40.35              |
| 21.9         | 30.49                           | 57.69              | 5.7           | 23.19                           | 61.49              | 21.6         | 15.83                           | 54.71              | 6.5           | 12.22                           | 40.01              |
| 22.9         | 30.37                           | 57.89              | 6.7           | 23.00                           | 61.45              | 22.6         | 15.70                           | 54.42              | 7.5           | 12.21                           | 39.67              |
| 23.9         | 30.24                           | 58.10              | 7.7           | 22.82                           | 61.40              | 23.6         | 15.58                           | 54.14              | 8.5           | 12.20                           | 39.34              |
| 24.9         | 30.10                           | 58.31              | 8.7           | 22.65                           | 61.32              | 24.6         | 15.46                           | 53.87              | 9.5           | 12.18                           | 39.01              |
| 25.9         | 29.96                           | 58.51              | 9.7           | 22.47                           | 61.24              | 25.6         | 15.35                           | 53.61              | 10.5          | 12.17                           | 38.67              |
| 26.9         | 29.81                           | 58.70              | 10.7          | 22.31                           | 61.16              | 26.6         | 15.23                           | 53.37              | 11.5          | 12.16                           | 38.31              |
| 27.8         | 29.66                           | 58.88              | 11.7          | 22.14                           | 61.08              | 27.6         | 15.11                           | 53.14              | 12.5          | 12.15                           | 37.94              |
| 28.8         | 29.51                           | 59.03              | 12.7          | 21.98                           | 61.00              | 28.6         | 14.99                           | 52.91              | 13.5          | 12.14                           | 37.56              |
| 29.8         | 29.35                           | 59.16              | 13.7          | 21.82                           | 60.93              | 29.6         | 14.85                           | 52.66              | 14.5          | 12.15                           | 37.16              |
| 30.8         | 29.21                           | 59.27              | 14.7          | 21.65                           | 60.86              | 30.6         | 14.73                           | 52.39              | 15.5          | 12.16                           | 36.76              |
| 31.8         | 29.06                           | 59.37              | 15.7          | 21.49                           | 60.80              | 31.6         | 14.60                           | 52.10              | 16.5          | 12.18                           | 36.37              |
| Sierpień 1.8 | 28.92                           | 59.47              | 16.7          | 21.32                           | 60.74              | Listopad 1.6 | 14.48                           | 51.79              | 17.5          | 12.21                           | 35.98              |
| 2.8          | 28.79                           | 59.59              | 17.7          | 21.15                           | 60.68              | 2.6          | 14.37                           | 51.47              | 18.5          | 12.24                           | 35.61              |
| 3.8          | 28.65                           | 59.72              | 18.7          | 20.97                           | 60.61              | 3.6          | 14.26                           | 51.15              | 19.5          | 12.27                           | 35.27              |
| 4.8          | 28.51                           | 59.86              | 19.7          | 20.80                           | 60.53              | 4.6          | 14.16                           | 50.82              | 20.5          | 12.30                           | 34.94              |
| 5.8          | 28.36                           | 60.02              | 20.7          | 20.62                           | 60.43              | 5.6          | 14.07                           | 50.50              | 21.4          | 12.33                           | 34.62              |
| 6.8          | 28.20                           | 60.18              | 21.7          | 20.44                           | 60.31              | 6.6          | 13.98                           | 50.19              | 22.4          | 12.36                           | 34.31              |
| 7.8          | 28.04                           | 60.33              | 22.7          | 20.26                           | 60.17              | 7.6          | 13.89                           | 49.88              | 23.4          | 12.38                           | 33.98              |
| 8.8          | 27.87                           | 60.46              | 23.7          | 20.09                           | 60.02              | 8.6          | 13.80                           | 49.59              | 24.4          | 12.40                           | 33.64              |
| 9.8          | 27.71                           | 60.57              | 24.7          | 19.93                           | 59.85              | 9.6          | 13.72                           | 49.30              | 25.4          | 12.43                           | 33.29              |
| 10.8         | 27.54                           | 60.66              | 25.7          | 19.77                           | 59.68              | 10.6         | 13.63                           | 49.01              | 26.4          | 12.46                           | 32.92              |
| 11.8         | 27.37                           | 60.74              | 26.7          | 19.61                           | 59.52              | 11.6         | 13.54                           | 48.72              | 27.4          | 12.51                           | 32.54              |
| 12.8         | 27.21                           | 60.80              | 27.7          | 19.46                           | 59.38              | 12.6         | 13.44                           | 48.43              | 28.4          | 12.56                           | 32.16              |
| 13.8         | 27.05                           | 60.86              | 28.7          | 19.31                           | 59.25              | 13.6         | 13.35                           | 48.12              | 29.4          | 12.62                           | 31.79              |
| 14.8         | 26.89                           | 60.91              | 29.7          | 19.15                           | 59.14              | 14.5         | 13.26                           | 47.79              | 30.4          | 12.68                           | 31.43              |
| 15.8         | 26.74                           | 60.96              | 30.7          | 18.98                           | 59.03              | 15.5         | 13.18                           | 47.45              | 31.4          | 12.75                           | 31.08              |
| 16.8         | 26.59                           | 61.02              | Paźdz. 1.7    | 18.81                           | 58.90              | 16.5         | 13.10                           | 47.10              | 32.4          | 12.82                           | 30.75              |
| 17.8         | 26.43                           | 61.09              | 2.7           | 18.64                           | 58.76              | 17.5         | 13.02                           | 46.73              | 33.4          | 12.89                           | 30.43              |
| 18.8         | 26.27                           | 61.17              | 3.7           | 18.47                           | 58.59              | 18.5         | 12.96                           | 46.35              | 34.4          | 12.96                           | 30.13              |

| $\delta$     | +82°00'10 <sup>"</sup> 0 | +82°00'20 <sup>"</sup> 0 | +82°00'30 <sup>"</sup> 0 | +82°00'40 <sup>"</sup> 0 | +82°00'50 <sup>"</sup> 0 | +82°01'00 <sup>"</sup> 0 | +82°01'10 <sup>"</sup> 0 | +82°01'20 <sup>"</sup> 0 |
|--------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| sec $\delta$ | 7.1878                   | 7.1903                   | 7.1927                   | 7.1952                   | 7.1977                   | 7.2002                   | 7.2027                   | 7.2052                   |
| tan $\delta$ | 7.1179                   | 7.1204                   | 7.1229                   | 7.1254                   | 7.1279                   | 7.1304                   | 7.1329                   | 7.1354                   |

**MIEJSCA POZORNE  $\delta$  Ursae Minoris (4<sup>m</sup>36) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i> |       | $\alpha_{app}^\gamma$                         | $\delta_{app}$             | <i>UT1</i> |       | $\alpha_{app}^\gamma$                         | $\delta_{app}$             | <i>UT1</i> |       | $\alpha_{app}^\gamma$                         | $\delta_{app}$             | <i>UT1</i> |       | $\alpha_{app}^\gamma$                         | $\delta_{app}$             |
|------------|-------|-----------------------------------------------|----------------------------|------------|-------|-----------------------------------------------|----------------------------|------------|-------|-----------------------------------------------|----------------------------|------------|-------|-----------------------------------------------|----------------------------|
|            |       | 17 <sup><i>h</i></sup> 27 <sup><i>m</i></sup> | +86°34′                    |            |       | 17 <sup><i>h</i></sup> 27 <sup><i>m</i></sup> | +86°34′                    |            |       | 17 <sup><i>h</i></sup> 27 <sup><i>m</i></sup> | +86°34′                    |            |       | 17 <sup><i>h</i></sup> 27 <sup><i>m</i></sup> | +86°34′                    |
| Styczeń    | 1.4   | 01. <sup><i>s</i></sup> 12                    | 35. <sup><i>″</i></sup> 35 | Luty       | 16.3  | 10. <sup><i>s</i></sup> 68                    | 23. <sup><i>″</i></sup> 10 | Kwiecień   | 3.2   | 27. <sup><i>s</i></sup> 09                    | 22. <sup><i>″</i></sup> 28 | Maj        | 19.1  | 37. <sup><i>s</i></sup> 82                    | 33. <sup><i>″</i></sup> 16 |
|            | 2.4   | 01.17                                         | 35.04                      |            | 17.3  | 10.99                                         | 22.90                      |            | 4.2   | 27.45                                         | 22.42                      |            | 20.1  | 37.89                                         | 33.48                      |
|            | 3.4   | 01.21                                         | 34.71                      |            | 18.3  | 11.32                                         | 22.70                      |            | 5.2   | 27.80                                         | 22.58                      |            | 21.1  | 37.95                                         | 33.79                      |
|            | 4.4   | 01.27                                         | 34.38                      |            | 19.3  | 11.68                                         | 22.52                      |            | 6.2   | 28.14                                         | 22.75                      |            | 22.1  | 38.01                                         | 34.08                      |
|            | 5.4   | 01.33                                         | 34.03                      |            | 20.3  | 12.05                                         | 22.36                      |            | 7.2   | 28.46                                         | 22.93                      |            | 23.1  | 38.08                                         | 34.36                      |
|            | 6.4   | 01.42                                         | 33.67                      |            | 21.3  | 12.42                                         | 22.23                      |            | 8.2   | 28.77                                         | 23.11                      |            | 24.1  | 38.16                                         | 34.64                      |
|            | 7.4   | 01.52                                         | 33.31                      |            | 22.3  | 12.80                                         | 22.13                      |            | 9.2   | 29.06                                         | 23.29                      |            | 25.1  | 38.24                                         | 34.93                      |
|            | 8.4   | 01.64                                         | 32.96                      |            | 23.3  | 13.15                                         | 22.05                      |            | 10.2  | 29.34                                         | 23.46                      |            | 26.1  | 38.33                                         | 35.23                      |
|            | 9.4   | 01.78                                         | 32.61                      |            | 24.3  | 13.50                                         | 21.97                      |            | 11.2  | 29.62                                         | 23.62                      |            | 27.0  | 38.42                                         | 35.53                      |
|            | 10.4  | 01.93                                         | 32.28                      |            | 25.3  | 13.83                                         | 21.90                      |            | 12.2  | 29.90                                         | 23.77                      |            | 28.0  | 38.50                                         | 35.85                      |
|            | 11.4  | 02.09                                         | 31.96                      | 26.3       | 14.16 | 21.81                                         | 13.2                       | 30.19      | 23.91 | 29.0                                          | 38.57                      | 36.18      |       |                                               |                            |
|            | 12.4  | 02.26                                         | 31.65                      | 27.3       | 14.48 | 21.73                                         | 14.2                       | 30.49      | 24.06 | 30.0                                          | 38.63                      | 36.52      |       |                                               |                            |
|            | 13.4  | 02.43                                         | 31.36                      | 28.3       | 14.81 | 21.63                                         | 15.2                       | 30.81      | 24.21 | 31.0                                          | 38.67                      | 36.87      |       |                                               |                            |
|            | 14.4  | 02.59                                         | 31.08                      | Marzec     | 1.3   | 15.15                                         | 21.53                      | 16.2       | 31.13 | 24.39                                         | Czerwiec                   | 1.0        | 38.69 | 37.23                                         |                            |
|            | 15.4  | 02.74                                         | 30.80                      |            | 2.3   | 15.50                                         | 21.42                      | 17.2       | 31.45 | 24.59                                         |                            | 2.0        | 38.69 | 37.57                                         |                            |
|            | 16.4  | 02.89                                         | 30.53                      |            | 3.3   | 15.87                                         | 21.32                      | 18.2       | 31.76 | 24.82                                         |                            | 3.0        | 38.67 | 37.91                                         |                            |
|            | 17.4  | 03.03                                         | 30.25                      |            | 4.3   | 16.24                                         | 21.23                      | 19.2       | 32.05 | 25.07                                         |                            | 4.0        | 38.64 | 38.23                                         |                            |
|            | 18.4  | 03.17                                         | 29.95                      |            | 5.3   | 16.63                                         | 21.16                      | 20.1       | 32.31 | 25.32                                         |                            | 5.0        | 38.61 | 38.54                                         |                            |
|            | 19.4  | 03.31                                         | 29.64                      |            | 6.3   | 17.03                                         | 21.10                      | 21.1       | 32.56 | 25.58                                         |                            | 6.0        | 38.58 | 38.83                                         |                            |
|            | 20.4  | 03.47                                         | 29.31                      |            | 7.3   | 17.42                                         | 21.05                      | 22.1       | 32.79 | 25.82                                         |                            | 7.0        | 38.56 | 39.11                                         |                            |
| 21.4       | 03.66 | 28.97                                         | 8.3                        |            | 17.81 | 21.03                                         | 23.1                       | 33.01      | 26.05 | 8.0                                           |                            | 38.55      | 39.39 |                                               |                            |
| 22.4       | 03.87 | 28.65                                         | 9.3                        |            | 18.20 | 21.02                                         | 24.1                       | 33.23      | 26.27 | 9.0                                           |                            | 38.54      | 39.68 |                                               |                            |
| 23.4       | 04.11 | 28.34                                         | 10.3                       |            | 18.58 | 21.03                                         | 25.1                       | 33.46      | 26.49 | 10.0                                          |                            | 38.54      | 39.99 |                                               |                            |
| 24.4       | 04.36 | 28.05                                         | 11.3                       | 18.94      | 21.04 | 26.1                                          | 33.70                      | 26.70      | 11.0  | 38.54                                         | 40.32                      |            |       |                                               |                            |
| 25.4       | 04.61 | 27.79                                         | 12.3                       | 19.29      | 21.06 | 27.1                                          | 33.94                      | 26.91      | 12.0  | 38.52                                         | 40.66                      |            |       |                                               |                            |
| 26.4       | 04.86 | 27.55                                         | 13.3                       | 19.63      | 21.07 | 28.1                                          | 34.19                      | 27.13      | 13.0  | 38.48                                         | 41.02                      |            |       |                                               |                            |
| 27.4       | 05.10 | 27.32                                         | 14.3                       | 19.96      | 21.07 | 29.1                                          | 34.44                      | 27.37      | 14.0  | 38.41                                         | 41.38                      |            |       |                                               |                            |
| 28.4       | 05.33 | 27.10                                         | 15.2                       | 20.30      | 21.06 | 30.1                                          | 34.69                      | 27.62      | 15.0  | 38.33                                         | 41.73                      |            |       |                                               |                            |
| 29.4       | 05.55 | 26.87                                         | 16.2                       | 20.64      | 21.04 | Maj                                           | 1.1                        | 34.94      | 27.88 | 16.0                                          | 38.22                      | 42.06      |       |                                               |                            |
| 30.4       | 05.78 | 26.64                                         | 17.2                       | 21.00      | 21.02 |                                               | 2.1                        | 35.17      | 28.16 | 17.0                                          | 38.11                      | 42.38      |       |                                               |                            |
| 31.4       | 06.00 | 26.39                                         | 18.2                       | 21.37      | 21.00 |                                               | 3.1                        | 35.39      | 28.45 | 18.0                                          | 38.00                      | 42.68      |       |                                               |                            |
| Luty       | 1.4   | 06.24                                         | 26.14                      | 19.2       | 21.76 |                                               | 21.01                      | 4.1        | 35.60 | 28.75                                         | 19.0                       | 37.89      | 42.97 |                                               |                            |
|            | 2.4   | 06.49                                         | 25.88                      | 20.2       | 22.16 |                                               | 21.04                      | 5.1        | 35.78 | 29.05                                         | 20.0                       | 37.78      | 43.25 |                                               |                            |
|            | 3.4   | 06.75                                         | 25.62                      | 21.2       | 22.56 |                                               | 21.10                      | 6.1        | 35.95 | 29.35                                         | 21.0                       | 37.69      | 43.53 |                                               |                            |
|            | 4.4   | 07.03                                         | 25.36                      | 22.2       | 22.94 |                                               | 21.18                      | 7.1        | 36.10 | 29.64                                         | 22.0                       | 37.60      | 43.82 |                                               |                            |
|            | 5.4   | 07.33                                         | 25.11                      | 23.2       | 23.30 |                                               | 21.28                      | 8.1        | 36.24 | 29.92                                         | 23.0                       | 37.51      | 44.11 |                                               |                            |
|            | 6.3   | 07.64                                         | 24.87                      | 24.2       | 23.65 |                                               | 21.39                      | 9.1        | 36.38 | 30.18                                         | 24.0                       | 37.42      | 44.41 |                                               |                            |
|            | 7.3   | 07.96                                         | 24.66                      | 25.2       | 23.98 |                                               | 21.49                      | 10.1       | 36.53 | 30.43                                         | 25.0                       | 37.32      | 44.72 |                                               |                            |
|            | 8.3   | 08.28                                         | 24.45                      | 26.2       | 24.30 | 21.58                                         | 11.1                       | 36.68      | 30.68 | 26.0                                          | 37.21                      | 45.04      |       |                                               |                            |
|            | 9.3   | 08.61                                         | 24.27                      | 27.2       | 24.62 | 21.66                                         | 12.1                       | 36.85      | 30.93 | 27.0                                          | 37.08                      | 45.37      |       |                                               |                            |
|            | 10.3  | 08.92                                         | 24.10                      | 28.2       | 24.95 | 21.73                                         | 13.1                       | 37.03      | 31.20 | 28.0                                          | 36.94                      | 45.70      |       |                                               |                            |
| 11.3       | 09.23 | 23.94                                         | 29.2                       | 25.29      | 21.80 | 14.1                                          | 37.20                      | 31.49      | 29.0  | 36.78                                         | 46.03                      |            |       |                                               |                            |
| 12.3       | 09.53 | 23.78                                         | 30.2                       | 25.64      | 21.88 | 15.1                                          | 37.37                      | 31.81      | 30.0  | 36.59                                         | 46.35                      |            |       |                                               |                            |
| 13.3       | 09.83 | 23.63                                         | 31.2                       | 25.99      | 21.96 | 16.1                                          | 37.52                      | 32.14      | 31.0  | 36.40                                         | 46.65                      |            |       |                                               |                            |
| 14.3       | 10.11 | 23.46                                         | Kwiecień                   | 1.2        | 26.35 | 22.05                                         | 17.1                       | 37.64      | 32.48 | Lipiec                                        | 2.0                        | 36.19      | 46.93 |                                               |                            |
| 15.3       | 10.39 | 23.29                                         |                            | 2.2        | 26.72 | 22.16                                         | 18.1                       | 37.74      | 32.82 |                                               | 2.9                        | 35.99      | 47.19 |                                               |                            |
| 16.3       | 10.68 | 23.10                                         |                            | 3.2        | 27.09 | 22.28                                         | 19.1                       | 37.82      | 33.16 |                                               | 3.9                        | 35.79      | 47.44 |                                               |                            |

Dwukrotne dołowanie 13.XII, dwukrotne górowanie 13.VI .  
Miejsca średnie 2015.5  $\alpha = 17^h27^m17.03$   $\delta = +86^\circ34'31.30$

**MIEJSCA POZORNE  $\delta$  Ursae Minoris (4<sup>m</sup>36) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i> |      |                     | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ | <i>UT1</i> |                     |                      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ | <i>UT1</i>          |                      |          | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      | <i>UT1</i>           |          |      | $\alpha_{app}^{\gamma}$         | $\delta_{app}$ |
|------------|------|---------------------|---------------------------------|----------------|------------|---------------------|----------------------|---------------------------------|----------------|---------------------|----------------------|----------|---------------------------------|---------------------|----------------------|----------|------|---------------------------------|----------------|
|            |      |                     | 17 <sup>h</sup> 27 <sup>m</sup> | +86°34'        |            |                     |                      | 17 <sup>h</sup> 27 <sup>m</sup> | +86°34'        |                     |                      |          | 17 <sup>h</sup> 26 <sup>m</sup> | +86°34'             |                      |          |      | 17 <sup>h</sup> 26 <sup>m</sup> | +86°34'        |
| Lipiec     | 3.9  | 35 <sup>s</sup> .79 | 47 <sup>''</sup> .44            | Sierpień       | 18.8       | 22 <sup>s</sup> .45 | 57 <sup>''</sup> .01 | Paźdz.                          | 3.7            | 63 <sup>s</sup> .68 | 57 <sup>''</sup> .48 | Listopad | 18.6                            | 48 <sup>s</sup> .19 | 47 <sup>''</sup> .88 | Grudzień | 1.5  | 45.61                           | 43.81          |
|            | 4.9  | 35.61               | 47.68                           |                | 19.8       | 22.09               | 57.14                |                                 | 4.7            | 63.24               | 57.37                |          | 19.6                            | 47.97               | 47.54                |          | 2.5  | 45.48                           | 43.46          |
|            | 5.9  | 35.44               | 47.93                           |                | 20.8       | 21.72               | 57.28                |                                 | 5.7            | 62.82               | 57.24                |          | 20.6                            | 47.77               | 47.22                |          | 3.5  | 45.36                           | 43.11          |
|            | 6.9  | 35.27               | 48.19                           |                | 21.8       | 21.34               | 57.42                |                                 | 6.7            | 62.40               | 57.10                |          | 21.6                            | 47.59               | 46.91                |          | 4.5  | 45.25                           | 42.77          |
|            | 7.9  | 35.10               | 48.46                           |                | 22.8       | 20.94               | 57.55                |                                 | 7.7            | 62.01               | 56.94                |          | 22.6                            | 47.41               | 46.62                |          | 5.5  | 45.14                           | 42.44          |
|            | 8.9  | 34.93               | 48.76                           |                | 23.8       | 20.53               | 57.66                |                                 | 8.7            | 61.63               | 56.79                |          | 23.6                            | 47.22               | 46.34                |          | 6.5  | 45.05                           | 42.12          |
|            | 9.9  | 34.73               | 49.06                           |                | 24.8       | 20.11               | 57.76                |                                 | 9.7            | 61.26               | 56.64                |          | 24.6                            | 47.02               | 46.07                |          | 7.5  | 44.94                           | 41.81          |
|            | 10.9 | 34.51               | 49.37                           |                | 25.8       | 19.68               | 57.84                |                                 | 10.7           | 60.89               | 56.50                |          | 25.5                            | 46.80               | 45.80                |          | 8.5  | 44.84                           | 41.50          |
|            | 11.9 | 34.27               | 49.67                           |                | 26.8       | 19.26               | 57.90                |                                 | 11.7           | 60.53               | 56.36                |          | 26.5                            | 46.58               | 45.51                |          | 9.5  | 44.73                           | 41.19          |
|            | 12.9 | 34.02               | 49.96                           |                | 27.8       | 18.85               | 57.94                |                                 | 12.7           | 60.17               | 56.23                |          | 27.5                            | 46.36               | 45.21                |          | 10.5 | 44.61                           | 40.87          |
|            | 13.9 | 33.75               | 50.23                           |                | 28.8       | 18.45               | 57.97                |                                 | 13.7           | 59.81               | 56.10                |          | 28.5                            | 46.14               | 44.88                |          | 11.5 | 44.49                           | 40.54          |
|            | 14.9 | 33.48               | 50.48                           |                | 29.8       | 18.07               | 58.00                |                                 | 14.7           | 59.43               | 55.97                |          | 29.5                            | 45.94               | 44.53                |          | 12.5 | 44.38                           | 40.20          |
|            | 15.9 | 33.21               | 50.71                           |                | 30.8       | 17.70               | 58.04                |                                 | 15.7           | 59.05               | 55.85                |          | 30.5                            | 45.77               | 44.17                |          | 13.5 | 44.27                           | 39.83          |
|            | 16.9 | 32.95               | 50.93                           |                | 31.8       | 17.33               | 58.11                |                                 | 16.7           | 58.66               | 55.71                |          | 31.5                            | 44.07               | 38.69                |          | 14.5 | 44.19                           | 39.46          |
|            | 17.9 | 32.70               | 51.15                           |                | 1.8        | 16.95               | 58.19                |                                 | 17.7           | 58.26               | 55.56                |          | 17.5                            | 44.05               | 38.31                |          | 15.5 | 44.12                           | 39.07          |
|            | 18.9 | 32.45               | 51.36                           | Wrzesień       | 2.8        | 16.56               | 58.27                |                                 | 18.7           | 57.86               | 55.39                |          | 18.5                            | 44.04               | 37.95                |          | 16.5 | 44.07                           | 38.69          |
|            | 19.9 | 32.21               | 51.58                           |                | 3.8        | 16.14               | 58.36                |                                 | 19.6           | 57.46               | 55.20                |          | 19.5                            | 44.04               | 37.61                |          | 17.5 | 44.05                           | 38.31          |
|            | 20.9 | 31.97               | 51.81                           |                | 4.8        | 15.71               | 58.43                |                                 | 20.6           | 57.07               | 54.99                |          | 20.5                            | 44.04               | 37.29                |          | 18.5 | 44.04                           | 37.95          |
|            | 21.9 | 31.73               | 52.05                           |                | 5.8        | 15.27               | 58.49                |                                 | 21.6           | 56.70               | 54.77                |          | 21.5                            | 44.04               | 36.98                |          | 19.5 | 44.04                           | 37.61          |
|            | 22.9 | 31.48               | 52.29                           |                | 6.8        | 14.83               | 58.52                |                                 | 22.6           | 56.35               | 54.54                |          | 22.5                            | 44.02               | 36.67                |          | 20.5 | 44.04                           | 37.29          |
|            | 23.9 | 31.21               | 52.54                           |                | 7.8        | 14.39               | 58.54                |                                 | 23.6           | 56.01               | 54.31                |          | 23.5                            | 43.99               | 36.36                |          | 21.5 | 44.04                           | 36.98          |
|            | 24.9 | 30.93               | 52.79                           |                | 8.8        | 13.96               | 58.53                |                                 | 24.6           | 55.69               | 54.09                |          | 24.5                            | 43.95               | 36.03                |          | 22.5 | 44.02                           | 36.67          |
|            | 25.9 | 30.64               | 53.04                           |                | 9.8        | 13.54               | 58.52                |                                 | 25.6           | 55.38               | 53.89                |          | 25.5                            | 43.92               | 35.68                |          | 23.5 | 43.99                           | 36.36          |
|            | 26.9 | 30.32               | 53.28                           |                | 10.8       | 13.13               | 58.50                |                                 | 26.6           | 55.06               | 53.70                |          | 26.5                            | 43.91               | 35.32                |          | 24.5 | 43.95                           | 36.03          |
|            | 27.9 | 29.99               | 53.51                           |                | 11.8       | 12.73               | 58.48                |                                 | 27.6           | 54.73               | 53.53                |          | 27.5                            | 43.91               | 34.95                |          | 25.5 | 43.92                           | 35.68          |
|            | 28.9 | 29.65               | 53.72                           |                | 12.8       | 12.34               | 58.47                |                                 | 28.6           | 54.38               | 53.36                |          | 28.5                            | 43.94               | 34.57                |          | 26.5 | 43.91                           | 35.32          |
|            | 29.9 | 29.31               | 53.91                           |                | 13.7       | 11.96               | 58.46                |                                 | 29.6           | 54.02               | 53.17                |          | 29.5                            | 43.99               | 34.19                |          | 27.5 | 43.91                           | 34.95          |
|            | 30.9 | 28.97               | 54.07                           |                | 14.7       | 11.57               | 58.46                |                                 | 30.6           | 53.65               | 52.97                |          | 30.5                            | 44.05               | 33.82                |          | 28.5 | 43.94                           | 34.57          |
|            | 31.9 | 28.65               | 54.22                           |                | 15.7       | 11.18               | 58.46                |                                 | 31.6           | 53.29               | 52.74                |          | 31.5                            | 44.13               | 33.47                |          | 29.5 | 43.99                           | 34.19          |
| Sierpień   | 1.9  | 28.34               | 54.37                           |                | 16.7       | 10.78               | 58.46                | Listopad                        | 1.6            | 52.93               | 52.49                |          | 17.5                            | 44.05               | 38.31                |          | 32.4 | 44.22                           | 33.13          |
|            | 2.9  | 28.04               | 54.53                           |                | 17.7       | 10.37               | 58.47                |                                 | 2.6            | 52.60               | 52.23                |          | 18.5                            | 44.04               | 37.95                |          | 33.4 | 44.32                           | 32.80          |
|            | 3.9  | 27.75               | 54.71                           |                | 18.7       | 09.95               | 58.47                |                                 | 3.6            | 52.28               | 51.95                |          | 19.5                            | 44.04               | 37.61                |          | 34.4 | 44.41                           | 32.48          |
|            | 4.9  | 27.45               | 54.90                           |                | 19.7       | 09.51               | 58.46                |                                 | 4.6            | 51.98               | 51.68                |          | 20.5                            | 44.04               | 37.29                |          |      |                                 |                |
|            | 5.9  | 27.13               | 55.11                           |                | 20.7       | 09.07               | 58.43                |                                 | 5.6            | 51.70               | 51.41                |          | 21.5                            | 44.04               | 36.98                |          |      |                                 |                |
|            | 6.9  | 26.80               | 55.32                           |                | 21.7       | 08.62               | 58.39                |                                 | 6.6            | 51.43               | 51.14                |          | 22.5                            | 44.02               | 36.67                |          |      |                                 |                |
|            | 7.8  | 26.44               | 55.53                           |                | 22.7       | 08.18               | 58.32                |                                 | 7.6            | 51.16               | 50.88                |          | 23.5                            | 43.99               | 36.36                |          |      |                                 |                |
|            | 8.8  | 26.07               | 55.72                           |                | 23.7       | 07.74               | 58.24                |                                 | 8.6            | 50.90               | 50.63                |          | 24.5                            | 43.95               | 36.03                |          |      |                                 |                |
|            | 9.8  | 25.69               | 55.90                           |                | 24.7       | 07.32               | 58.14                |                                 | 9.6            | 50.64               | 50.39                |          | 25.5                            | 43.92               | 35.68                |          |      |                                 |                |
|            | 10.8 | 25.31               | 56.05                           |                | 25.7       | 06.92               | 58.03                |                                 | 10.6           | 50.37               | 50.15                |          | 26.5                            | 43.91               | 35.32                |          |      |                                 |                |
|            | 11.8 | 24.93               | 56.19                           |                | 26.7       | 06.53               | 57.94                |                                 | 11.6           | 50.09               | 49.91                |          | 27.5                            | 43.91               | 34.95                |          |      |                                 |                |
|            | 12.8 | 24.55               | 56.31                           |                | 27.7       | 06.16               | 57.86                |                                 | 12.6           | 49.81               | 49.66                |          | 28.5                            | 43.94               | 34.57                |          |      |                                 |                |
|            | 13.8 | 24.19               | 56.42                           |                | 28.7       | 05.78               | 57.79                |                                 | 13.6           | 49.53               | 49.41                |          | 29.5                            | 43.99               | 34.19                |          |      |                                 |                |
|            | 14.8 | 23.83               | 56.53                           |                | 29.7       | 05.39               | 57.74                |                                 | 14.6           | 49.24               | 49.13                |          | 30.5                            | 44.05               | 33.82                |          |      |                                 |                |
|            | 15.8 | 23.48               | 56.64                           |                | 30.7       | 04.98               | 57.70                |                                 | 15.6           | 48.96               | 48.84                |          | 31.5                            | 44.13               | 33.47                |          |      |                                 |                |
|            | 16.8 | 23.14               | 56.75                           |                | 1.7        | 04.55               | 57.65                | Paźdz.                          | 16.6           | 48.68               | 48.53                |          | 32.4                            | 44.22               | 33.13                |          |      |                                 |                |
|            | 17.8 | 22.80               | 56.88                           |                | 2.7        | 04.12               | 57.58                |                                 | 17.6           | 48.43               | 48.21                |          | 33.4                            | 44.32               | 32.80                |          |      |                                 |                |
|            | 18.8 | 22.45               | 57.01                           |                | 3.7        | 03.68               | 57.48                |                                 | 18.6           | 48.19               | 47.88                |          | 34.4                            | 44.41               | 32.48                |          |      |                                 |                |

| $\delta$     | +86°34'10 <sup>''</sup> .0 | +86°34'20 <sup>''</sup> .0 | +86°34'30 <sup>''</sup> .0 | +86°34'40 <sup>''</sup> .0 | +86°34'50 <sup>''</sup> .0 | +86°35'00 <sup>''</sup> .0 | +86°35'10 <sup>''</sup> .0 | +86°35'20 <sup>''</sup> .0 |
|--------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| sec $\delta$ | 16.7116                    | 16.7251                    | 16.7387                    | 16.7522                    | 16.7658                    | 16.7794                    | 16.7931                    | 16.8067                    |
| tan $\delta$ | 16.6816                    | 16.6952                    | 16.7088                    | 16.7224                    | 16.7360                    | 16.7496                    | 16.7633                    | 16.7770                    |



**MIEJSCA POZORNE 36H Cephei (4<sup>m</sup>71) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i> |       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | <i>UT1</i> |       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | <i>UT1</i> |        | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     | <i>UT1</i> |       | $\alpha_{app}^{\gamma}$         | $\delta_{app}$     |
|------------|-------|---------------------------------|--------------------|------------|-------|---------------------------------|--------------------|------------|--------|---------------------------------|--------------------|------------|-------|---------------------------------|--------------------|
|            |       | 22 <sup>h</sup> 54 <sup>m</sup> | +84°25'            |            |       | 22 <sup>h</sup> 54 <sup>m</sup> | +84°25'            |            |        | 22 <sup>h</sup> 54 <sup>m</sup> | +84°25'            |            |       | 22 <sup>h</sup> 54 <sup>m</sup> | +84°25'            |
| Styczeń    | 1.7   | 14.02 <sup>s</sup>              | 58.21 <sup>″</sup> | Luty       | 16.5  | 07.14 <sup>s</sup>              | 47.88 <sup>″</sup> | Kwiecień   | 3.4    | 08.34 <sup>s</sup>              | 33.39 <sup>″</sup> | Maj        | 19.3  | 16.85 <sup>s</sup>              | 26.15 <sup>″</sup> |
|            | 2.7   | 13.83                           | 58.12              |            | 17.5  | 07.04                           | 47.57              |            | 4.4    | 08.47                           | 33.10              |            | 20.3  | 17.08                           | 26.17              |
|            | 3.7   | 13.63                           | 58.04              |            | 18.5  | 06.95                           | 47.25              |            | 5.4    | 08.61                           | 32.82              |            | 21.3  | 17.30                           | 26.18              |
|            | 4.7   | 13.42                           | 57.94              |            | 19.5  | 06.86                           | 46.90              |            | 6.4    | 08.76                           | 32.55              |            | 22.3  | 17.51                           | 26.18              |
|            | 5.7   | 13.21                           | 57.83              |            | 20.5  | 06.80                           | 46.55              |            | 7.4    | 08.91                           | 32.30              |            | 23.3  | 17.71                           | 26.18              |
|            | 6.7   | 12.99                           | 57.70              |            | 21.5  | 06.75                           | 46.19              |            | 8.4    | 09.07                           | 32.07              |            | 24.3  | 17.91                           | 26.17              |
|            | 7.7   | 12.77                           | 57.55              |            | 22.5  | 06.72                           | 45.85              |            | 9.4    | 09.22                           | 31.85              |            | 25.3  | 18.12                           | 26.16              |
|            | 8.7   | 12.55                           | 57.39              |            | 23.5  | 06.70                           | 45.52              |            | 10.4   | 09.37                           | 31.64              |            | 26.3  | 18.33                           | 26.14              |
|            | 9.7   | 12.34                           | 57.21              |            | 24.5  | 06.69                           | 45.21              |            | 11.4   | 09.51                           | 31.43              |            | 27.3  | 18.54                           | 26.12              |
|            | 10.6  | 12.14                           | 57.01              |            | 25.5  | 06.68                           | 44.91              |            | 12.4   | 09.64                           | 31.22              |            | 28.3  | 18.77                           | 26.12              |
| 11.6       | 11.95 | 56.82                           | 26.5               | 06.66      | 44.62 | 13.4                            | 09.77              | 31.00      | 29.3   | 19.00                           | 26.12              |            |       |                                 |                    |
| 12.6       | 11.77 | 56.62                           | 27.5               | 06.64      | 44.32 | 14.4                            | 09.90              | 30.76      | 30.3   | 19.24                           | 26.14              |            |       |                                 |                    |
| 13.6       | 11.60 | 56.43                           | 28.5               | 06.61      | 44.02 | 15.4                            | 10.03              | 30.51      | 31.3   | 19.48                           | 26.17              |            |       |                                 |                    |
| 14.6       | 11.43 | 56.24                           | Marzec             | 1.5        | 06.58 | 43.70                           | 16.4               | 10.19      | 30.26  | Czerwiec                        | 1.3                | 19.73      | 26.23 |                                 |                    |
| 15.6       | 11.27 | 56.06                           |                    | 2.5        | 06.55 | 43.38                           | 17.4               | 10.35      | 30.01  |                                 | 2.3                | 19.97      | 26.31 |                                 |                    |
| 16.6       | 11.11 | 55.90                           |                    | 3.5        | 06.53 | 43.04                           | 18.4               | 10.54      | 29.79  | 3.3                             | 20.20              | 26.40      |       |                                 |                    |
| 17.6       | 10.95 | 55.74                           |                    | 4.5        | 06.50 | 42.69                           | 19.4               | 10.73      | 29.58  | 4.3                             | 20.42              | 26.50      |       |                                 |                    |
| 18.6       | 10.78 | 55.57                           |                    | 5.5        | 06.49 | 42.33                           | 20.4               | 10.94      | 29.40  | 5.3                             | 20.63              | 26.59      |       |                                 |                    |
| 19.6       | 10.59 | 55.40                           |                    | 6.5        | 06.49 | 41.97                           | 21.4               | 11.13      | 29.24  | 6.2                             | 20.83              | 26.69      |       |                                 |                    |
| 20.6       | 10.40 | 55.21                           |                    | 7.5        | 06.50 | 41.62                           | 22.4               | 11.33      | 29.09  | 7.2                             | 21.03              | 26.76      |       |                                 |                    |
| 21.6       | 10.21 | 54.99                           |                    | 8.5        | 06.52 | 41.26                           | 23.4               | 11.51      | 28.94  | 8.2                             | 21.22              | 26.83      |       |                                 |                    |
| 22.6       | 10.02 | 54.75                           |                    | 9.5        | 06.56 | 40.92                           | 24.4               | 11.68      | 28.79  | 9.2                             | 21.42              | 26.89      |       |                                 |                    |
| 23.6       | 09.84 | 54.48                           |                    | 10.5       | 06.60 | 40.60                           | 25.4               | 11.85      | 28.64  | 10.2                            | 21.63              | 26.95      |       |                                 |                    |
| 24.6       | 09.68 | 54.21                           | 11.5               | 06.65      | 40.28 | 26.4                            | 12.02              | 28.47      | 11.2   | 21.86                           | 27.02              |            |       |                                 |                    |
| 25.6       | 09.54 | 53.95                           | 12.5               | 06.69      | 39.98 | 27.4                            | 12.19              | 28.30      | 12.2   | 22.09                           | 27.11              |            |       |                                 |                    |
| 26.6       | 09.41 | 53.69                           | 13.5               | 06.74      | 39.69 | 28.4                            | 12.37              | 28.12      | 13.2   | 22.33                           | 27.23              |            |       |                                 |                    |
| 27.6       | 09.29 | 53.45                           | 14.5               | 06.78      | 39.40 | 29.4                            | 12.55              | 27.94      | 14.2   | 22.57                           | 27.36              |            |       |                                 |                    |
| 28.6       | 09.17 | 53.21                           | 15.5               | 06.81      | 39.11 | 30.3                            | 12.74              | 27.77      | 15.2   | 22.81                           | 27.52              |            |       |                                 |                    |
| 29.6       | 09.05 | 52.98                           | 16.5               | 06.84      | 38.81 | Maj                             | 1.3                | 12.95      | 27.60  | 16.2                            | 23.03              | 27.68      |       |                                 |                    |
| 30.6       | 08.92 | 52.75                           | 17.5               | 06.86      | 38.50 |                                 | 2.3                | 13.16      | 27.45  | 17.2                            | 23.25              | 27.85      |       |                                 |                    |
| 31.6       | 08.79 | 52.52                           | 18.5               | 06.89      | 38.16 | 3.3                             | 13.38              | 27.31      | 18.2   | 23.45                           | 28.02              |            |       |                                 |                    |
| Luty       | 1.6   | 08.65                           | 52.27              | 19.5       | 06.93 | 37.82                           | 4.3                | 13.60      | 27.19  | 19.2                            | 23.64              | 28.18      |       |                                 |                    |
|            | 2.6   | 08.51                           | 52.01              | 20.5       | 07.00 | 37.47                           | 5.3                | 13.82      | 27.10  | 20.2                            | 23.82              | 28.34      |       |                                 |                    |
|            | 3.6   | 08.36                           | 51.74              | 21.5       | 07.08 | 37.13                           | 6.3                | 14.05      | 27.01  | 21.2                            | 24.01              | 28.48      |       |                                 |                    |
|            | 4.6   | 08.23                           | 51.45              | 22.5       | 07.17 | 36.81                           | 7.3                | 14.26      | 26.94  | 22.2                            | 24.20              | 28.62      |       |                                 |                    |
|            | 5.6   | 08.09                           | 51.14              | 23.5       | 07.28 | 36.52                           | 8.3                | 14.47      | 26.88  | 23.2                            | 24.39              | 28.76      |       |                                 |                    |
|            | 6.6   | 07.97                           | 50.83              | 24.4       | 07.38 | 36.24                           | 9.3                | 14.66      | 26.81  | 24.2                            | 24.59              | 28.90      |       |                                 |                    |
|            | 7.6   | 07.86                           | 50.50              | 25.4       | 07.49 | 35.97                           | 10.3               | 14.85      | 26.74  | 25.2                            | 24.79              | 29.05      |       |                                 |                    |
|            | 8.6   | 07.76                           | 50.18              | 26.4       | 07.58 | 35.71                           | 11.3               | 15.04      | 26.65  | 26.2                            | 25.00              | 29.21      |       |                                 |                    |
|            | 9.6   | 07.67                           | 49.87              | 27.4       | 07.67 | 35.44                           | 12.3               | 15.23      | 26.55  | 27.2                            | 25.21              | 29.39      |       |                                 |                    |
|            | 10.6  | 07.59                           | 49.56              | 28.4       | 07.76 | 35.17                           | 13.3               | 15.43      | 26.45  | 28.2                            | 25.43              | 29.59      |       |                                 |                    |
| 11.6       | 07.52 | 49.26                           | 29.4               | 07.84      | 34.89 | 14.3                            | 15.65              | 26.35      | 29.2   | 25.64                           | 29.81              |            |       |                                 |                    |
| 12.6       | 07.45 | 48.98                           | 30.4               | 07.93      | 34.60 | 15.3                            | 15.88              | 26.27      | 30.2   | 25.84                           | 30.04              |            |       |                                 |                    |
| 13.6       | 07.38 | 48.70                           | 31.4               | 08.02      | 34.30 | 16.3                            | 16.12              | 26.20      | Lipiec | 1.2                             | 26.04              | 30.28      |       |                                 |                    |
| 14.6       | 07.31 | 48.43                           | Kwiecień           | 1.4        | 08.12 | 34.00                           | 17.3               | 16.36      |        | 26.17                           | 2.2                | 26.22      | 30.53 |                                 |                    |
| 15.6       | 07.23 | 48.16                           |                    | 2.4        | 08.22 | 33.69                           | 18.3               | 16.61      |        | 26.15                           | 3.2                | 26.38      | 30.77 |                                 |                    |
| 16.5       | 07.14 | 47.88                           |                    | 3.4        | 08.34 | 33.39                           | 19.3               | 16.85      |        | 26.15                           | 4.2                | 26.54      | 31.00 |                                 |                    |

Dwukrotne dołowanie 6.III, dwukrotne górowanie 4.IX .  
Miejsca średnie 2015.5  $\alpha = 22^h54^m13^s.83$   $\delta = +84^\circ25'44''.89$

**MIEJSCA POZORNE 36H Cephei (4<sup>m</sup>71) 2015**  
w momencie jej górowania w południku Greenwich

| <i>UT1</i>   | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      | <i>UT1</i>    | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      | <i>UT1</i>   | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      | <i>UT1</i>    | $\alpha_{app}^{\gamma}$         | $\delta_{app}$      |
|--------------|---------------------------------|---------------------|---------------|---------------------------------|---------------------|--------------|---------------------------------|---------------------|---------------|---------------------------------|---------------------|
|              | 22 <sup>h</sup> 54 <sup>m</sup> | +84°25'             |               | 22 <sup>h</sup> 54 <sup>m</sup> | +84°25'             |              | 22 <sup>h</sup> 54 <sup>m</sup> | +84°26'             |               | 22 <sup>h</sup> 54 <sup>m</sup> | +84°26'             |
| Lipiec 4.2   | 26 <sup>s</sup> .54             | 31 <sup>o</sup> .00 | Sierpień 19.0 | 31 <sup>s</sup> .98             | 44 <sup>o</sup> .94 | Paźdz. 3.9   | 30 <sup>s</sup> .81             | 01 <sup>o</sup> .89 | Listopad 18.8 | 23 <sup>s</sup> .30             | 14 <sup>o</sup> .12 |
| 5.2          | 26.69                           | 31.22               | 20.0          | 32.04                           | 45.28               | 4.9          | 30.70                           | 02.27               | 19.8          | 23.07                           | 14.25               |
| 6.2          | 26.85                           | 31.42               | 21.0          | 32.11                           | 45.64               | 5.9          | 30.58                           | 02.62               | 20.8          | 22.84                           | 14.37               |
| 7.2          | 27.01                           | 31.62               | 22.0          | 32.17                           | 46.01               | 6.9          | 30.45                           | 02.97               | 21.8          | 22.62                           | 14.48               |
| 8.2          | 27.18                           | 31.82               | 23.0          | 32.22                           | 46.39               | 7.9          | 30.32                           | 03.29               | 22.8          | 22.42                           | 14.60               |
| 9.2          | 27.37                           | 32.04               | 24.0          | 32.27                           | 46.79               | 8.9          | 30.19                           | 03.60               | 23.8          | 22.23                           | 14.72               |
| 10.2         | 27.56                           | 32.28               | 25.0          | 32.30                           | 47.19               | 9.9          | 30.06                           | 03.91               | 24.8          | 22.04                           | 14.86               |
| 11.2         | 27.75                           | 32.54               | 26.0          | 32.33                           | 47.60               | 10.9         | 29.93                           | 04.20               | 25.8          | 21.85                           | 15.01               |
| 12.1         | 27.94                           | 32.82               | 27.0          | 32.33                           | 47.99               | 11.9         | 29.81                           | 04.50               | 26.8          | 21.65                           | 15.17               |
| 13.1         | 28.12                           | 33.12               | 28.0          | 32.33                           | 48.37               | 12.9         | 29.69                           | 04.79               | 27.8          | 21.44                           | 15.33               |
| 14.1         | 28.28                           | 33.42               | 29.0          | 32.31                           | 48.73               | 13.9         | 29.58                           | 05.10               | 28.8          | 21.21                           | 15.47               |
| 15.1         | 28.43                           | 33.71               | 30.0          | 32.31                           | 49.07               | 14.9         | 29.46                           | 05.41               | 29.8          | 20.97                           | 15.59               |
| 16.1         | 28.57                           | 34.00               | 31.0          | 32.31                           | 49.41               | 15.9         | 29.35                           | 05.73               | 30.8          | 20.73                           | 15.69               |
| 17.1         | 28.70                           | 34.28               | Wrzesień 1.0  | 32.32                           | 49.75               | 16.9         | 29.22                           | 06.06               | Grudzień 1.8  | 20.48                           | 15.77               |
| 18.1         | 28.83                           | 34.56               | 2.0           | 32.34                           | 50.10               | 17.9         | 29.09                           | 06.39               | 2.8           | 20.24                           | 15.83               |
| 19.1         | 28.96                           | 34.82               | 3.0           | 32.36                           | 50.48               | 18.9         | 28.95                           | 06.72               | 3.8           | 20.01                           | 15.88               |
| 20.1         | 29.09                           | 35.08               | 4.0           | 32.39                           | 50.87               | 19.9         | 28.80                           | 07.05               | 4.8           | 19.78                           | 15.92               |
| 21.1         | 29.22                           | 35.34               | 5.0           | 32.40                           | 51.27               | 20.9         | 28.63                           | 07.36               | 5.7           | 19.56                           | 15.95               |
| 22.1         | 29.36                           | 35.60               | 6.0           | 32.41                           | 51.68               | 21.9         | 28.46                           | 07.66               | 6.7           | 19.34                           | 15.99               |
| 23.1         | 29.50                           | 35.87               | 7.0           | 32.40                           | 52.09               | 22.9         | 28.28                           | 07.93               | 7.7           | 19.13                           | 16.03               |
| 24.1         | 29.65                           | 36.16               | 8.0           | 32.37                           | 52.48               | 23.9         | 28.10                           | 08.19               | 8.7           | 18.93                           | 16.08               |
| 25.1         | 29.80                           | 36.46               | 9.0           | 32.34                           | 52.87               | 24.9         | 27.93                           | 08.43               | 9.7           | 18.72                           | 16.13               |
| 26.1         | 29.95                           | 36.78               | 10.0          | 32.30                           | 53.25               | 25.9         | 27.77                           | 08.68               | 10.7          | 18.51                           | 16.19               |
| 27.1         | 30.09                           | 37.11               | 11.0          | 32.25                           | 53.61               | 26.9         | 27.63                           | 08.93               | 11.7          | 18.29                           | 16.24               |
| 28.1         | 30.22                           | 37.46               | 12.0          | 32.20                           | 53.96               | 27.9         | 27.49                           | 09.20               | 12.7          | 18.06                           | 16.30               |
| 29.1         | 30.33                           | 37.81               | 13.0          | 32.16                           | 54.30               | 28.9         | 27.35                           | 09.48               | 13.7          | 17.82                           | 16.34               |
| 30.1         | 30.43                           | 38.16               | 14.0          | 32.12                           | 54.64               | 29.8         | 27.20                           | 09.78               | 14.7          | 17.58                           | 16.36               |
| 31.1         | 30.52                           | 38.50               | 15.0          | 32.08                           | 54.98               | 30.8         | 27.04                           | 10.08               | 15.7          | 17.32                           | 16.36               |
| Sierpień 1.1 | 30.60                           | 38.83               | 16.0          | 32.05                           | 55.33               | 31.8         | 26.86                           | 10.37               | 16.7          | 17.07                           | 16.33               |
| 2.1          | 30.68                           | 39.13               | 17.0          | 32.02                           | 55.69               | Listopad 1.8 | 26.68                           | 10.64               | 17.7          | 16.83                           | 16.29               |
| 3.1          | 30.76                           | 39.43               | 18.0          | 31.99                           | 56.06               | 2.8          | 26.48                           | 10.90               | 18.7          | 16.60                           | 16.24               |
| 4.1          | 30.86                           | 39.73               | 19.0          | 31.96                           | 56.44               | 3.8          | 26.28                           | 11.14               | 19.7          | 16.38                           | 16.18               |
| 5.1          | 30.97                           | 40.03               | 20.0          | 31.92                           | 56.83               | 4.8          | 26.07                           | 11.35               | 20.7          | 16.17                           | 16.13               |
| 6.1          | 31.08                           | 40.35               | 21.0          | 31.86                           | 57.22               | 5.8          | 25.87                           | 11.56               | 21.7          | 15.97                           | 16.09               |
| 7.1          | 31.20                           | 40.70               | 22.0          | 31.80                           | 57.62               | 6.8          | 25.67                           | 11.75               | 22.7          | 15.78                           | 16.07               |
| 8.1          | 31.31                           | 41.06               | 23.0          | 31.72                           | 58.01               | 7.8          | 25.48                           | 11.94               | 23.7          | 15.58                           | 16.05               |
| 9.1          | 31.41                           | 41.43               | 23.9          | 31.63                           | 58.39               | 8.8          | 25.30                           | 12.13               | 24.7          | 15.37                           | 16.03               |
| 10.1         | 31.50                           | 41.81               | 24.9          | 31.53                           | 58.75               | 9.8          | 25.12                           | 12.33               | 25.7          | 15.15                           | 16.01               |
| 11.1         | 31.57                           | 42.19               | 25.9          | 31.43                           | 59.08               | 10.8         | 24.94                           | 12.52               | 26.7          | 14.92                           | 15.97               |
| 12.1         | 31.64                           | 42.56               | 26.9          | 31.34                           | 59.41               | 11.8         | 24.76                           | 12.73               | 27.7          | 14.68                           | 15.91               |
| 13.1         | 31.69                           | 42.93               | 27.9          | 31.25                           | 59.73               | 12.8         | 24.58                           | 12.94               | 28.7          | 14.44                           | 15.83               |
| 14.1         | 31.74                           | 43.28               | 28.9          | 31.18                           | 60.05               | 13.8         | 24.39                           | 13.16               | 29.7          | 14.21                           | 15.72               |
| 15.1         | 31.78                           | 43.61               | 29.9          | 31.11                           | 60.39               | 14.8         | 24.19                           | 13.38               | 30.7          | 13.98                           | 15.61               |
| 16.1         | 31.83                           | 43.95               | 30.9          | 31.05                           | 60.75               | 15.8         | 23.98                           | 13.59               | 31.7          | 13.76                           | 15.47               |
| 17.1         | 31.88                           | 44.27               | Paźdz. 1.9    | 30.98                           | 61.13               | 16.8         | 23.76                           | 13.78               | 32.7          | 13.54                           | 15.34               |
| 18.0         | 31.93                           | 44.60               | 2.9           | 30.90                           | 61.51               | 17.8         | 23.53                           | 13.96               | 33.7          | 13.34                           | 15.20               |
| 19.0         | 31.98                           | 44.94               | 3.9           | 30.81                           | 61.89               | 18.8         | 23.30                           | 14.12               | 34.7          | 13.15                           | 15.07               |

| $\delta$     | +84°25'20 <sup>o</sup> .0 | +84°25'30 <sup>o</sup> .0 | +84°25'40 <sup>o</sup> .0 | +84°25'50 <sup>o</sup> .0 | +84°26'00 <sup>o</sup> .0 | +84°26'10 <sup>o</sup> .0 | +84°26'20 <sup>o</sup> .0 | +84°26'30 <sup>o</sup> .0 |
|--------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| sec $\delta$ | 10.2884                   | 10.2935                   | 10.2986                   | 10.3037                   | 10.3089                   | 10.3140                   | 10.3191                   | 10.3243                   |
| tan $\delta$ | 10.2397                   | 10.2448                   | 10.2500                   | 10.2551                   | 10.2602                   | 10.2654                   | 10.2706                   | 10.2757                   |

**Wektor barycentrycznej pozycji [au] i prędkości [au/doba] Ziemi  
oraz wektor heliocentrycznej pozycji [au] Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

| Data   | $X_B$      | $Y_B$     | $Z_B$     | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$      | $Y_H$     | $Z_H$     |
|--------|------------|-----------|-----------|-------------|-------------|-------------|------------|-----------|-----------|
| XII 31 | −151085532 | 890347994 | 385830424 | −17264078   | −2530873    | −1096573    | −153922584 | 891082831 | 386298470 |
| I 1    | −168324140 | 887679121 | 384673990 | −17212292   | −2806696    | −1216223    | −171165170 | 888409118 | 385140044 |
| 2      | −185508433 | 884734959 | 383398123 | −17155456   | −3081449    | −1335438    | −188353434 | 885460109 | 383862182 |
| 3      | −202633386 | 881516584 | 382003264 | −17093621   | −3355119    | −1454204    | −205482353 | 882236882 | 382465325 |
| 4      | −219694018 | 878025087 | 380489869 | −17026816   | −3627692    | −1572509    | −222546944 | 878740527 | 380949930 |
| 5      | −236685367 | 874261571 | 378858405 | −16955057   | −3899152    | −1690338    | −239542246 | 874972148 | 379316463 |
| 6      | −253602481 | 870227161 | 377109356 | −16878345   | −4169477    | −1807675    | −256463307 | 870932868 | 377565409 |
| 7      | −270440403 | 865923006 | 375243226 | −16796671   | −4438635    | −1924498    | −273305170 | 866623837 | 375697271 |
| 8      | −287194164 | 861350293 | 373260539 | −16710020   | −4706586    | −2040785    | −290062865 | 862046243 | 373712573 |
| 9      | −303858777 | 856510255 | 371161844 | −16618373   | −4973277    | −2156508    | −306731407 | 857201317 | 371611865 |
| 10     | −320429237 | 851404179 | 368947720 | −16521710   | −5238649    | −2271638    | −323305789 | 852090348 | 369395725 |
| 11     | −336900519 | 846033418 | 366618776 | −16420013   | −5502636    | −2386142    | −339780987 | 846714688 | 367064763 |
| 12     | −353267579 | 840399393 | 364175655 | −16313263   | −5765166    | −2499987    | −356151957 | 841075757 | 364619621 |
| 13     | −369525354 | 834503599 | 361619034 | −16201441   | −6026161    | −2613137    | −372413636 | 835175051 | 362060976 |
| 14     | −385668763 | 828347610 | 358949625 | −16084525   | −6285540    | −2725555    | −388560943 | 829014144 | 359389541 |
| 15     | −401692699 | 821933086 | 356168182 | −15962491   | −6543215    | −2837201    | −404588770 | 822594696 | 356606068 |
| 16     | −417592029 | 815261780 | 353275495 | −15835309   | −6799086    | −2948033    | −420491986 | 815918459 | 353711348 |
| 17     | −433361590 | 808335553 | 350272403 | −15702946   | −7053037    | −3058003    | −436265426 | 808987295 | 350706221 |
| 18     | −448996183 | 801156392 | 347159796 | −15565371   | −7304929    | −3167053    | −451903893 | 801803191 | 347591576 |
| 19     | −464490589 | 793726437 | 343938624 | −15422568   | −7554596    | −3275120    | −467402164 | 794368286 | 344368364 |
| 20     | −479839580 | 786048005 | 340609908 | −15274548   | −7801848    | −3382131    | −482755016 | 786684897 | 341037604 |
| 21     | −495037963 | 778123614 | 337174739 | −15121365   | −8046479    | −3488010    | −497957253 | 778755543 | 337600389 |
| 22     | −510080622 | 769955989 | 333634290 | −14963122   | −8288285    | −3592682    | −513003760 | 770582948 | 334057889 |
| 23     | −524962571 | 761548047 | 329989799 | −14799973   | −8527086    | −3696082    | −527889550 | 762170030 | 330411346 |
| 24     | −539678993 | 752902865 | 326242567 | −14632099   | −8762744    | −3798158    | −542609806 | 753519866 | 326662058 |
| 25     | −554225260 | 744023638 | 322393936 | −14459695   | −8995167    | −3898876    | −557159900 | 744635649 | 322811368 |
| 26     | −568596935 | 734913627 | 318445276 | −14282945   | −9224306    | −3998214    | −571535396 | 735520641 | 318860646 |
| 27     | −582789755 | 725576128 | 314397972 | −14102010   | −9450141    | −4096160    | −585732030 | 726178140 | 314811278 |
| 28     | −596799605 | 716014446 | 310253421 | −13917027   | −9672673    | −4192710    | −599745687 | 716611448 | 310664658 |
| 29     | −610622496 | 706231882 | 306013020 | −13728108   | −9891907    | −4287859    | −613572378 | 706823867 | 306422186 |
| 30     | −624254540 | 696231727 | 301678171 | −13535344   | −10107854   | −4381603    | −627208214 | 696818690 | 302085264 |
| 31     | −637691928 | 686017267 | 297250282 | −13338810   | −10320521   | −4473940    | −640649389 | 686599199 | 297655297 |
| II 1   | −650930924 | 675591778 | 292730764 | −13138567   | −10529910   | −4564862    | −653892163 | 676168675 | 293133698 |
| 2      | −663967843 | 664958540 | 288121033 | −12934665   | −10736021   | −4654362    | −666932854 | 665530393 | 288521884 |
| 3      | −676799048 | 654120832 | 283422516 | −12727145   | −10938846   | −4742432    | −679767823 | 654687636 | 283821281 |
| 4      | −689420938 | 643081947 | 278636650 | −12516039   | −11138372   | −4829059    | −692393469 | 643643695 | 279033326 |
| 5      | −701829941 | 631845194 | 273764884 | −12301376   | −11334579   | −4914229    | −704806222 | 632401879 | 274159468 |
| 6      | −714022513 | 620413906 | 268808683 | −12083180   | −11527436   | −4997925    | −717002536 | 620965522 | 269201173 |
| 7      | −725995130 | 608791449 | 263769531 | −11861470   | −11716910   | −5080129    | −728978888 | 609337990 | 264159922 |
| 8      | −737744289 | 596981229 | 258648930 | −11636269   | −11902956   | −5160820    | −740731775 | 597522687 | 259037220 |
| 9      | −749266510 | 584986695 | 253448404 | −11407595   | −12085527   | −5239973    | −752257715 | 585523065 | 253834590 |
| 10     | −760558329 | 572811352 | 248169503 | −11175470   | −12264567   | −5317566    | −763553247 | 573342627 | 248553582 |
| 11     | −771616304 | 560458759 | 242813801 | −10939911   | −12440016   | −5393570    | −774614928 | 560984932 | 243195771 |
| 12     | −782437012 | 547932539 | 237382901 | −10700936   | −12611807   | −5467958    | −785439333 | 548453605 | 237762758 |
| 13     | −793017042 | 535236391 | 231878435 | −10458560   | −12779861   | −5540696    | −796023054 | 535752341 | 232256176 |
| 14     | −803353002 | 522374093 | 226302070 | −10212797   | −12944088   | −5611749    | −806362697 | 522884923 | 226677693 |

**Wektor barycentrycznej pozycji [*au*] i prędkości [*au*/doba] Ziemi  
oraz wektor heliocentrycznej pozycji [*au*] Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

|     | Data | $X_B$      | $Y_B$      | $Z_B$     | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$      | $Y_H$      | $Z_H$     |
|-----|------|------------|------------|-----------|-------------|-------------|-------------|------------|------------|-----------|
| II  | 15   | −813441514 | 509349528  | 220655512 | −9963667    | −13104376   | −5681074    | −816454884 | 509855230  | 221029013 |
|     | 16   | −823279224 | 496166698  | 214940514 | −9711201    | −13260592   | −5748621    | −826296261 | 496667267  | 215311891 |
|     | 17   | −832862823 | 482829752  | 209158881 | −9455456    | −13412581   | −5814334    | −835883519 | 483325181  | 209528130 |
|     | 18   | −842189076 | 469343001  | 203312477 | −9196532    | −13560174   | −5878152    | −845213425 | 469833284  | 203679596 |
|     | 19   | −851254876 | 455710926  | 197403227 | −8934577    | −13703204   | −5940019    | −854282870 | 456196056  | 197768212 |
|     | 20   | −860057286 | 441938160  | 191433107 | −8669789    | −13841535   | −5999885    | −863088917 | 442418130  | 191795956 |
|     | 21   | −868593587 | 428029454  | 185404134 | −8402398    | −13975073   | −6057719    | −871628846 | 428504259  | 185764845 |
|     | 22   | −876861293 | 413989624  | 179318350 | −8132639    | −14103782   | −6113508    | −879900174 | 414459256  | 179676918 |
|     | 23   | −884858149 | 399823497  | 173177799 | −7860733    | −14227672   | −6167255    | −887900644 | 400287951  | 173534222 |
|     | 24   | −892582106 | 385535872  | 166984517 | −7586867    | −14346786   | −6218971    | −895628207 | 385995141  | 167338793 |
|     | 25   | −900031281 | 371131496  | 160740527 | −7311192    | −14461185   | −6268675    | −903080980 | 371585574  | 161092652 |
|     | 26   | −907203927 | 356615054  | 154447832 | −7033827    | −14570929   | −6316384    | −910257216 | 357063934  | 154797804 |
|     | 27   | −914098405 | 341991172  | 148108419 | −6754870    | −14676073   | −6362113    | −917155276 | 342434848  | 148456234 |
|     | 28   | −920713162 | 327264425  | 141724261 | −6474398    | −14776665   | −6405876    | −923773608 | 327702891  | 142069917 |
| III | 1    | −927046720 | 312439346  | 135297320 | −6192482    | −14872744   | −6447682    | −930110732 | 312872595  | 135640813 |
|     | 2    | −933097666 | 297520431  | 128829548 | −5909183    | −14964341   | −6487538    | −936165236 | 297948457  | 129170876 |
|     | 3    | −938864644 | 282512149  | 122322892 | −5624557    | −15051482   | −6525450    | −941935765 | 282934945  | 122662052 |
|     | 4    | −944346353 | 267418945  | 115779295 | −5338653    | −15134188   | −6561422    | −947421017 | 267836505  | 116116284 |
|     | 5    | −949541540 | 252245246  | 109200695 | −5051518    | −15212473   | −6595456    | −952619737 | 252657564  | 109535510 |
|     | 6    | −954448992 | 236995470  | 102589029 | −4763192    | −15286346   | −6627551    | −957530716 | 237402539  | 102921668 |
|     | 7    | −959067540 | 221674025  | 95946238  | −4473714    | −15355809   | −6657707    | −962152781 | 222075839  | 96276697  |
|     | 8    | −963396047 | 206285324  | 89274263  | −4183117    | −15420857   | −6685919    | −966484798 | 206681877  | 89602539  |
|     | 9    | −967433412 | 190833787  | 82575050  | −3891435    | −15481479   | −6712180    | −970525665 | 191225072  | 82901141  |
|     | 10   | −971178566 | 175323849  | 75850555  | −3598701    | −15537654   | −6736483    | −974274313 | 175709860  | 76174457  |
|     | 11   | −974630474 | 159759970  | 69102742  | −3304946    | −15589354   | −6758815    | −977729705 | 160140702  | 69424453  |
|     | 12   | −977788130 | 144146643  | 62333588  | −3010204    | −15636544   | −6779162    | −980890837 | 144522088  | 62653104  |
|     | 13   | −980650565 | 128488401  | 55545085  | −2714510    | −15679176   | −6797508    | −983756741 | 128858554  | 55862404  |
|     | 14   | −983216844 | 112789831  | 48739245  | −2417901    | −15717190   | −6813832    | −986326480 | 113154684  | 49054365  |
|     | 15   | −985486077 | 97055585   | 41918104  | −2120424    | −15750512   | −6828107    | −988599164 | 97415133   | 42231021  |
|     | 16   | −987457422 | 81290400   | 35083724  | −1822138    | −15779051   | −6840304    | −990573953 | 81644637   | 35394436  |
|     | 17   | −989130112 | 65499113   | 28238202  | −1523130    | −15802699   | −6850386    | −992250077 | 65848032   | 28546705  |
|     | 18   | −990503482 | 49686670   | 21383670  | −1223521    | −15821343   | −6858316    | −993626873 | 50030265   | 21689962  |
|     | 19   | −991577008 | 33858132   | 14522297  | −923474     | −15834873   | −6864062    | −994703816 | 34196397   | 14826375  |
|     | 20   | −992350353 | 18018655   | 7656283   | −623198     | −15843209   | −6867597    | −995480570 | 18351585   | 7958144   |
|     | 21   | −992823405 | 2173457    | 787843    | −322927     | −15846315   | −6868914    | −995957022 | 2501044    | 1087484   |
|     | 22   | −992996290 | −13672236  | −6080808  | −22904      | −15844207   | −6868021    | −996133298 | −13349997  | −5783390  |
|     | 23   | −992869368 | −29513242  | −12947471 | 276653      | −15836954   | −6864944    | −996009759 | −29196357  | −12652278 |
|     | 24   | −992443202 | −45344464  | −19809979 | 575558      | −15824658   | −6859718    | −995586967 | −45032939  | −19517014 |
|     | 25   | −991718516 | −61160915  | −26666204 | 873672      | −15807433   | −6852384    | −994865646 | −60854757  | −26375470 |
|     | 26   | −990696156 | −76957725  | −33514058 | 1170890     | −15785393   | −6842981    | −993846643 | −76656939  | −33225558 |
|     | 27   | −989377061 | −92730130  | −40351488 | 1467133     | −15758641   | −6831543    | −992530895 | −92434723  | −40065225 |
|     | 28   | −987762236 | −108473465 | −47176477 | 1762340     | −15727265   | −6818102    | −990919409 | −108183443 | −46892453 |
|     | 29   | −985852744 | −124183145 | −53987034 | 2056459     | −15691343   | −6802684    | −989013247 | −123898513 | −53705252 |
|     | 30   | −983649696 | −139854659 | −60781193 | 2349444     | −15650942   | −6785311    | −986813519 | −139575423 | −60501656 |
|     | 31   | −981154248 | −155483556 | −67557011 | 2641251     | −15606120   | −6766005    | −984321384 | −155209722 | −67279722 |
| IV  | 1    | −978367600 | −171065444 | −74312566 | 2931839     | −15556933   | −6744785    | −981538038 | −170797019 | −74037527 |

**Wektor barycentrycznej pozycji [au] i prędkości [au/doba] Ziemi  
oraz wektor heliocentrycznej pozycji [au] Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

| Data | $X_B$ | $Y_B$      | $Z_B$      | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$     | $Y_H$      | $Z_H$      |            |
|------|-------|------------|------------|-------------|-------------|-------------|-----------|------------|------------|------------|
| IV   | 2     | -975290988 | -186595982 | -81045950   | 3221173     | -15503428   | -6721669  | -978464720 | -186332971 | -80773164  |
|      | 3     | -971925683 | -202070876 | -87755278   | 3509219     | -15445651   | -6696673  | -975102700 | -201813285 | -87484748  |
|      | 4     | -968272988 | -217485872 | -94438675   | 3795951     | -15383640   | -6669811  | -971453281 | -217233707 | -94170403  |
|      | 5     | -964334228 | -232836754 | -101094282  | 4081344     | -15317425   | -6641095  | -967517788 | -232590020 | -100828272 |
|      | 6     | -960110753 | -248119328 | -107720250  | 4365378     | -15247028   | -6610534  | -963297571 | -247878032 | -107456504 |
|      | 7     | -955603930 | -263329420 | -114314737  | 4648035     | -15172462   | -6578134  | -958793997 | -263093568 | -114053258 |
|      | 8     | -950815148 | -278462862 | -120875907  | 4929294     | -15093726   | -6543898  | -954008454 | -278232459 | -120616697 |
|      | 9     | -945745817 | -293515479 | -127401920  | 5209130     | -15010810   | -6507823  | -948942353 | -293290531 | -127144983 |
|      | 10    | -940397371 | -308483080 | -133890939  | 5487515     | -14923690   | -6469906  | -943597129 | -308263593 | -133636277 |
|      | 11    | -934771283 | -323361447 | -140341115  | 5764409     | -14832334   | -6430137  | -937974252 | -323147426 | -140088730 |
|      | 12    | -928869067 | -338146320 | -146750591  | 6039760     | -14736694   | -6388505  | -932075239 | -337937771 | -146500488 |
|      | 13    | -922692300 | -352833389 | -153117499  | 6313497     | -14636716   | -6344995  | -925901665 | -352630319 | -152869678 |
|      | 14    | -916242641 | -367418284 | -159439951  | 6585526     | -14532337   | -6299592  | -919455191 | -367220698 | -159194416 |
|      | 15    | -909521859 | -381896575 | -165716045  | 6855720     | -14423496   | -6252278  | -912737583 | -381704478 | -165472800 |
|      | 16    | -902531865 | -396263772 | -171943867  | 7123921     | -14310144   | -6203045  | -905750754 | -396077171 | -171702913 |
|      | 17    | -895274746 | -410515351 | -178121495  | 7389936     | -14192258   | -6151890  | -898496790 | -410334251 | -177882835 |
|      | 18    | -887752790 | -424646783 | -184247011  | 7653557     | -14069858   | -6098826  | -890977981 | -424471191 | -184010648 |
|      | 19    | -879968500 | -438653583 | -190318520  | 7914573     | -13943009   | -6043882  | -883196826 | -438483504 | -190084457 |
|      | 20    | -871924577 | -452531354 | -196334161  | 8172793     | -13811821   | -5987099  | -875156030 | -452366793 | -196102401 |
|      | 21    | -863623897 | -466275825 | -202292123  | 8428065     | -13676433   | -5928531  | -866858466 | -466116788 | -202062668 |
|      | 22    | -855069467 | -479882872 | -208190646  | 8680277     | -13537000   | -5868232  | -858307143 | -479729366 | -207963499 |
|      | 23    | -846264386 | -493348527 | -214028028  | 8929357     | -13393671   | -5806257  | -849505159 | -493200555 | -213803192 |
|      | 24    | -837211812 | -506668961 | -219802617  | 9175259     | -13246581   | -5742655  | -840455671 | -506526530 | -219580095 |
|      | 25    | -827914936 | -519840476 | -225512810  | 9417956     | -13095852   | -5677470  | -831161871 | -519703592 | -225292604 |
|      | 26    | -818376975 | -532859486 | -231157042  | 9657428     | -12941586   | -5610741  | -821626976 | -532728153 | -230939155 |
|      | 27    | -808601160 | -545722501 | -236733788  | 9893661     | -12783877   | -5542502  | -811854216 | -545596725 | -236518223 |
|      | 28    | -798590737 | -558426119 | -242241553  | 10126641    | -12622806   | -5472785  | -801846839 | -558305905 | -242028312 |
|      | 29    | -788348966 | -570967018 | -247678876  | 10356356    | -12458451   | -5401620  | -791608102 | -570852372 | -247467961 |
|      | 30    | -777879117 | -583341950 | -253044321  | 10582795    | -12290884   | -5329036  | -781141278 | -583232876 | -252835736 |
|      | V     | 1          | -767184469 | -595547738  | -258336484  | 10805954    | -12120173 | -5255059   | -770449643 | -595444241 |
| 2    |       | -756268303 | -607581268 | -263553983  | 11025831    | -11946378   | -5179714  | -759536480 | -607483354 | -263350064 |
| 3    |       | -745133899 | -619439485 | -268695464  | 11242431    | -11769555   | -5103025  | -748405069 | -619347158 | -268493882 |
| 4    |       | -733784531 | -631119384 | -273759591  | 11455761    | -11589747   | -5025009  | -737058683 | -631032648 | -273560348 |
| 5    |       | -722223464 | -642617994 | -278745046  | 11665831    | -11406983   | -4945683  | -725500588 | -642536854 | -278548144 |
| 6    |       | -710453954 | -653932370 | -283650523  | 11872649    | -11221281   | -4865055  | -713734038 | -653856831 | -283455965 |
| 7    |       | -698479250 | -665059576 | -288474725  | 12076216    | -11032641   | -4783133  | -701762284 | -664989642 | -288282513 |
| 8    |       | -686302609 | -675996669 | -293216358  | 12276520    | -10841051   | -4699917  | -689588583 | -675932345 | -293026494 |
| 9    |       | -673927306 | -686740688 | -297874127  | 12473536    | -10646489   | -4615405  | -677216208 | -686681977 | -297686613 |
| 10   |       | -661356649 | -697288645 | -302446734  | 12667215    | -10448923   | -4529593  | -664648470 | -697235553 | -302261573 |
| 11   |       | -648594010 | -707637521 | -306932878  | 12857489    | -10248320   | -4442477  | -651888738 | -707590050 | -306750071 |
| 12   |       | -635642838 | -717784264 | -311331253  | 13044262    | -10044653   | -4354055  | -638940463 | -717742420 | -311150803 |
| 13   |       | -622506692 | -727725799 | -315640553  | 13227414    | -9837903    | -4264327  | -625807204 | -727689585 | -315462462 |
| 14   |       | -609189264 | -737459042 | -319859476  | 13406803    | -9628071    | -4173303  | -612492651 | -737428462 | -319683745 |
| 15   |       | -595694395 | -746980924 | -323986732  | 13582266    | -9415187    | -4080999  | -599000648 | -746955981 | -323813364 |
| 16   |       | -582026096 | -756288421 | -328021057  | 13753636    | -9199317    | -3987446  | -585335204 | -756269120 | -327850053 |
| 17   |       | -568188541 | -765378596 | -331961221  | 13920753    | -8980563    | -3892685  | -571500493 | -765364941 | -331792584 |

**Wektor barycentrycznej pozycji [au] i prędkości [au/doba] Ziemi  
oraz wektor heliocentrycznej pozycji [au] Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

|     | Data | $X_B$      | $Y_B$      | $Z_B$      | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$      | $Y_H$      | $Z_H$      |            |
|-----|------|------------|------------|------------|-------------|-------------|-------------|------------|------------|------------|------------|
| V   | 18   | -554186055 | -774248631 | -335806042 | 14083476    | -8759062    | -3796770    | -557500840 | -774240625 | -335639773 |            |
|     | 19   | -540023088 | -782895857 | -339554395 | 14241701    | -8534972    | -3699760    | -543340696 | -782893503 | -339390497 |            |
|     | 20   | -525704175 | -791317769 | -343205219 | 14395360    | -8308463    | -3601720    | -529024596 | -791321071 | -343043692 |            |
|     | 21   | -511233903 | -799512030 | -346757511 | 14544417    | -8079698    | -3502708    | -514557125 | -799520993 | -346598359 |            |
|     | 22   | -496616877 | -807476463 | -350210330 | 14688867    | -7848829    | -3402782    | -499942891 | -807491088 | -350053553 |            |
|     | 23   | -481857701 | -815209031 | -353562787 | 14828720    | -7615988    | -3301991    | -485186496 | -815229322 | -353408387 |            |
|     | 24   | -466960962 | -822707822 | -356814040 | 14963995    | -7381294    | -3200382    | -470292528 | -822733783 | -356662020 |            |
|     | 25   | -451931230 | -829971036 | -359963290 | 15094713    | -7144850    | -3097993    | -455265556 | -830002670 | -359813651 |            |
|     | 26   | -436773047 | -836996970 | -363009778 | 15220898    | -6906748    | -2994861    | -440110123 | -837034280 | -362862521 |            |
|     | 27   | -421490936 | -843784009 | -365952777 | 15342573    | -6667075    | -2891022    | -424830752 | -843826999 | -365807904 |            |
|     | 28   | -406089396 | -850330623 | -368791597 | 15459762    | -6425912    | -2786508    | -409431941 | -850379296 | -368649110 |            |
|     | 29   | -390572899 | -856635361 | -371525579 | 15572492    | -6183334    | -2681351    | -393918162 | -856689719 | -371385479 |            |
|     | 30   | -374945888 | -862696843 | -374154094 | 15680795    | -5939412    | -2575580    | -378293860 | -862756889 | -374016383 |            |
|     | 31   | -359212773 | -868513758 | -376676543 | 15784707    | -5694209    | -2469222    | -362563444 | -868579495 | -376541223 |            |
|     | VI   | 1          | -343377923 | -874084851 | -379092351  | 15884272    | -5447775    | -2362301   | -346731282 | -874156282 | -378959422 |
|     |      | 2          | -327445664 | -879408910 | -381400963  | 15979533    | -5200147    | -2254834   | -330801700 | -879486038 | -381270428 |
|     |      | 3          | -311420279 | -884484752 | -383601841  | 16070530    | -4951342    | -2146834   | -314778983 | -884567580 | -383473701 |
|     |      | 4          | -295306015 | -889311202 | -385694456  | 16157294    | -4701361    | -2038308   | -298667377 | -889399733 | -385568713 |
|     |      | 5          | -279107096 | -893887078 | -387678283  | 16239839    | -4450189    | -1929257   | -282471107 | -893981313 | -387554937 |
|     |      | 6          | -262827746 | -898211174 | -389552795  | 16318154    | -4197799    | -1819680   | -266194394 | -898311117 | -389431848 |
|     |      | 7          | -246472210 | -902282260 | -391317466  | 16392201    | -3944162    | -1709573   | -249841486 | -902387913 | -391198919 |
|     |      | 8          | -230044788 | -906099076 | -392971766  | 16461914    | -3689257    | -1598939   | -233416682 | -906210441 | -392855621 |
|     |      | 9          | -213549858 | -909660349 | -394515170  | 16527200    | -3433077    | -1487783   | -216924359 | -909777430 | -394401429 |
|     |      | 10         | -196991899 | -912964810 | -395947161  | 16587951    | -3175637    | -1376117   | -200368998 | -913087608 | -395835825 |
|     |      | 11         | -180375508 | -916011216 | -397267242  | 16644044    | -2916978    | -1263965   | -183755195 | -916139735 | -397158311 |
|     |      | 12         | -163705405 | -918798383 | -398474939  | 16695354    | -2657172    | -1151357   | -167087670 | -918932625 | -398368415 |
|     |      | 13         | -146986435 | -921325211 | -399569818  | 16741760    | -2396318    | -1038336   | -150371269 | -921465177 | -399465702 |
|     |      | 14         | -130223554 | -923590713 | -400551490  | 16783160    | -2134546    | -924953    | -133610946 | -923736406 | -400449784 |
|     |      | 15         | -113421811 | -925594046 | -401419621  | 16819473    | -1872004    | -811264    | -116811752 | -925745468 | -401320326 |
|     |      | 16         | -96586321  | -927334518 | -402173937  | 16850647    | -1608855    | -697332    | -99978803  | -927491672 | -402077053 |
|     |      | 17         | -79722236  | -928811608 | -402814224  | 16876663    | -1345265    | -583218    | -83117247  | -928974496 | -402719754 |
| 18  |      | -62834711  | -930024956 | -403340333 | 16897530    | -1081396    | -468984     | -66232243  | -930193579 | -403248277 |            |
| 19  |      | -45928883  | -930974356 | -403752171 | 16913278    | -817394     | -354685     | -49328926  | -931148717 | -403662530 |            |
| 20  |      | -29009847  | -931659743 | -404049698 | 16923953    | -553392     | -240371     | -32412392  | -931839845 | -403962473 |            |
| 21  |      | -12082649  | -932081179 | -404232923 | 16929610    | -289507     | -126088     | -15487687  | -932267022 | -404148116 |            |
| 22  |      | 4847721    | -932238830 | -404301897 | 16930308    | -25840      | -11875      | 1440201    | -932430417 | -404219509 |            |
| 23  |      | 21776334   | -932132962 | -404256710 | 16926105    | 237517      | 102229      | 18366340   | -932330296 | -404176741 |            |
| 24  |      | 38698317   | -931763927 | -404097486 | 16917058    | 500482      | 216192      | 35285858   | -931967008 | -404019938 |            |
| 25  |      | 55608855   | -931132155 | -403824384 | 16903227    | 762976      | 329980      | 52193941   | -931340987 | -403749258 |            |
| 26  |      | 72503196   | -930238155 | -403437594 | 16884671    | 1024928     | 443564      | 69085835   | -930452739 | -403364891 |            |
| 27  |      | 89376644   | -929082502 | -402937335 | 16861454    | 1286272     | 556914      | 85956846   | -929302840 | -402867055 |            |
| 28  |      | 106224574  | -927665835 | -402323853 | 16833646    | 1546948     | 670004      | 102802347  | -927891928 | -402255999 |            |
| 29  |      | 123042431  | -925988844 | -401597420 | 16801321    | 1806912     | 782813      | 119617784  | -926220695 | -401531992 |            |
| 30  |      | 139825735  | -924052260 | -400758326 | 16764553    | 2066131     | 895324      | 136398678  | -924289870 | -400695325 |            |
| VII | 1    | 156570081  | -921856833 | -399806875 | 16723416    | 2324597     | 1007526     | 153140622  | -922100205 | -399746302 |            |
|     | 2    | 173271131  | -919403313 | -398743377 | 16677970    | 2582320     | 1119417     | 169839278  | -919652449 | -398685233 |            |

**Wektor barycentrycznej pozycji [au] i prędkości [au/doba] Ziemi  
oraz wektor heliocentrycznej pozycji [au] Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

|     | Data | $X_B$     | $Y_B$      | $Z_B$      | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$     | $Y_H$      | $Z_H$      |            |
|-----|------|-----------|------------|------------|-------------|-------------|-------------|-----------|------------|------------|------------|
| VII | 3    | 189924596 | −916692432 | −397568143 | 16628251    | 2839328     | 1230999     | 186490359 | −916947333 | −397512429 |            |
|     | 4    | 206526211 | −913724883 | −396281480 | 16574266    | 3095660     | 1342278     | 203089597 | −913985552 | −396228196 |            |
|     | 5    | 223071696 | −910501325 | −394883687 | 16515985    | 3351353     | 1453258     | 219632715 | −910767763 | −394832835 |            |
|     | 6    | 239556729 | −907022384 | −393375062 | 16453347    | 3606427     | 1563939     | 236115388 | −907294593 | −393326644 |            |
|     | 7    | 255976909 | −903288678 | −391755910 | 16386264    | 3860877     | 1674311     | 252533218 | −903566660 | −391709926 |            |
|     | 8    | 272327743 | −899300849 | −390026549 | 16314638    | 4114664     | 1784354     | 268881709 | −899584607 | −389983000 |            |
|     | 9    | 288604638 | −895059594 | −388187323 | 16238370    | 4367717     | 1894035     | 285156270 | −895349128 | −388146210 |            |
|     | 10   | 304802906 | −890565694 | −386238614 | 16157372    | 4619934     | 2003313     | 301352212 | −890861008 | −386199938 |            |
|     | 11   | 320917781 | −885820046 | −384180847 | 16071575    | 4871190     | 2112141     | 317464770 | −886121142 | −384144609 |            |
|     | 12   | 336944440 | −880823680 | −382014500 | 15980933    | 5121347     | 2220463     | 333489119 | −881130559 | −381980702 |            |
|     | 13   | 352878025 | −875577770 | −379740107 | 15885426    | 5370251     | 2328223     | 349420403 | −875890434 | −379708750 |            |
|     | 14   | 368713670 | −870083646 | −377358260 | 15785056    | 5617750     | 2435363     | 365253755 | −870402098 | −377329344 |            |
|     | 15   | 384446525 | −864342790 | −374869606 | 15679852    | 5863691     | 2541826     | 380984326 | −864667032 | −374843133 |            |
|     | 16   | 400071780 | −858356831 | −372274851 | 15569865    | 6107932     | 2647558     | 396607304 | −858686865 | −372250822 |            |
|     | 17   | 415584684 | −852127538 | −369574751 | 15455162    | 6350339     | 2752508     | 412117939 | −852463366 | −369553167 |            |
|     | 18   | 430980558 | −845656804 | −366770110 | 15335821    | 6590795     | 2856632     | 427511554 | −845998428 | −366750972 |            |
|     | 19   | 446254809 | −838946632 | −363861776 | 15211930    | 6829198     | 2959889     | 442783553 | −839294056 | −363845086 |            |
|     | 20   | 461402932 | −831999123 | −360850633 | 15083578    | 7065456     | 3062243     | 457929432 | −832352348 | −360836392 |            |
|     | 21   | 476420509 | −824816462 | −357737602 | 14950856    | 7299490     | 3163661     | 472944774 | −825175490 | −357725811 |            |
|     | 22   | 491303217 | −817400909 | −354523633 | 14813854    | 7531230     | 3264114     | 487825255 | −817765742 | −354514293 |            |
|     | 23   | 506046821 | −809754789 | −351209704 | 14672662    | 7760612     | 3363576     | 502566640 | −810125430 | −351202817 |            |
|     | 24   | 520647175 | −801880489 | −347796821 | 14527371    | 7987579     | 3462020     | 517164783 | −802256940 | −347792387 |            |
|     | 25   | 535100227 | −793780452 | −344286012 | 14378073    | 8212080     | 3559423     | 531615633 | −794162715 | −344284033 |            |
|     | 26   | 549402019 | −785457165 | −340678328 | 14224866    | 8434072     | 3655767     | 545915230 | −785845242 | −340678804 |            |
|     | 27   | 563548691 | −776913155 | −336974837 | 14067851    | 8653523     | 3751033     | 560059716 | −777307048 | −336977771 |            |
|     | 28   | 577536486 | −768150971 | −333176624 | 13907130    | 8870419     | 3845212     | 574045333 | −768550682 | −333182015 |            |
|     | 29   | 591361747 | −759173167 | −329284778 | 13742800    | 9084765     | 3938298     | 587868426 | −759578698 | −329292628 |            |
|     | 30   | 605020911 | −749982282 | −325300390 | 13574946    | 9296588     | 4030296     | 601525428 | −750393636 | −325310701 |            |
|     | 31   | 618510486 | −740580817 | −321224546 | 13403628    | 9505936     | 4121213     | 615012849 | −740997995 | −321237319 |            |
|     | VIII | 1         | 631827020  | −730971217 | −317058319  | 13228867    | 9712866     | 4211064   | 628327239  | −731394221 | −317073554 |
|     |      | 2         | 644967067  | −721155873 | −312802769  | 13050645    | 9917430     | 4299859   | 641465148  | −721584705 | −312820468 |
| 3   |      | 657927137 | −711137135 | −308458951 | 12868903    | 10119657    | 4387601     | 654423089 | −711571797 | −308479114 |            |
| 4   |      | 670703673 | −700917341 | −304027920 | 12683561    | 10319537    | 4474281     | 667197503 | −701357835 | −304050549 |            |
| 5   |      | 683293030 | −690498861 | −299510751 | 12494532    | 10517017    | 4559874     | 679784747 | −690945190 | −299535846 |            |
| 6   |      | 695691483 | −679884137 | −294908547 | 12301742    | 10712008    | 4644344     | 692181095 | −680336301 | −294936110 |            |
| 7   |      | 707895243 | −669075715 | −290222452 | 12105142    | 10904390    | 4727648     | 704382758 | −669533717 | −290252483 |            |
| 8   |      | 719900490 | −658076271 | −285453658 | 11904712    | 11094030    | 4809733     | 716385914 | −658540113 | −285486159 |            |
| 9   |      | 731703394 | −646888617 | −280603410 | 11700460    | 11280785    | 4890547     | 728186736 | −647358301 | −280638381 |            |
| 10  |      | 743300148 | −635515710 | −275673004 | 11492421    | 11464515    | 4970040     | 739781416 | −635991237 | −275710447 |            |
| 11  |      | 754686992 | −623960641 | −270663788 | 11280651    | 11645085    | 5048160     | 751166193 | −624442015 | −270703704 |            |
| 12  |      | 765860230 | −612226636 | −265577157 | 11065222    | 11822368    | 5124861     | 762337371 | −612713857 | −265619547 |            |
| 13  |      | 776816247 | −600317040 | −260414554 | 10846225    | 11996248    | 5200099     | 773291337 | −600810110 | −260459418 |            |
| 14  |      | 787551524 | −588235309 | −255177461 | 10623759    | 12166621    | 5273835     | 784024569 | −588734231 | −255224801 |            |
| 15  |      | 798062645 | −575984998 | −249867397 | 10397933    | 12333393    | 5346033     | 794533654 | −576489774 | −249917214 |            |
| 16  |      | 808346307 | −563569750 | −244485918 | 10168860    | 12496484    | 5416662     | 804815286 | −564080381 | −244538213 |            |
| 17  |      | 818399322 | −550993279 | −239034606 | 9936659     | 12655828    | 5485694     | 814866279 | −551509768 | −239089380 |            |

**Wektor barycentrycznej pozycji [ $au$ ] i prędkości [ $au/\text{doba}$ ] Ziemi  
oraz wektor heliocentrycznej pozycji [ $au$ ] Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

|      | Data | $X_B$      | $Y_B$      | $Z_B$      | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$      | $Y_H$      | $Z_H$      |
|------|------|------------|------------|------------|-------------|-------------|-------------|------------|------------|------------|
| VIII | 18   | 828218621  | −538259364 | −233515069 | 9701447     | 12811365    | 5553108     | 824683564  | −538781712 | −233572323 |
|      | 19   | 837801252  | −525371834 | −227928938 | 9463343     | 12963049    | 5618881     | 834264187  | −525900044 | −227988672 |
|      | 20   | 847144382  | −512334564 | −222277861 | 9222463     | 13110839    | 5682996     | 843605317  | −512868638 | −222340077 |
|      | 21   | 856245293  | −499151464 | −216563503 | 8978926     | 13254704    | 5745438     | 852704235  | −499691404 | −216628202 |
|      | 22   | 865101386  | −485826473 | −210787546 | 8732847     | 13394618    | 5806195     | 861558343  | −486372281 | −210854729 |
|      | 23   | 873710180  | −472363550 | −204951678 | 8484348     | 13530566    | 5865256     | 870165158  | −472915229 | −205021347 |
|      | 24   | 882069314  | −458766665 | −199057600 | 8233547     | 13662541    | 5922616     | 878522321  | −459324217 | −199129755 |
|      | 25   | 890176548  | −445039788 | −193107013 | 7980567     | 13790555    | 5978274     | 886627591  | −445603215 | −193181655 |
|      | 26   | 898029759  | −431186866 | −187101618 | 7725520     | 13914637    | 6032235     | 894478844  | −431756170 | −187178748 |
|      | 27   | 905626933  | −417211808 | −181043105 | 7468508     | 14034838    | 6084512     | 902074068  | −417786991 | −181122725 |
|      | 28   | 912966145  | −403118461 | −174933149 | 7209605     | 14151227    | 6135123     | 909411337  | −403699527 | −175015260 |
|      | 29   | 920045525  | −388910599 | −168773406 | 6948847     | 14263883    | 6184091     | 916488781  | −389497548 | −168858009 |
|      | 30   | 926863218  | −374591916 | −162565509 | 6686225     | 14372878    | 6231434     | 923304544  | −375184752 | −162652605 |
|      | 31   | 933417337  | −360166048 | −156311076 | 6421689     | 14478257    | 6277163     | 929856741  | −360764772 | −156400666 |
| IX   | 1    | 939705934  | −345636608 | −150011722 | 6155167     | 14580017    | 6321275     | 936143423  | −346241224 | −150103807 |
|      | 2    | 945726983  | −331007236 | −143669073 | 5886584     | 14678109    | 6363747     | 942162564  | −331617746 | −143763655 |
|      | 3    | 951478397  | −316281645 | −137284785 | 5615889     | 14772437    | 6404546     | 947912077  | −316898052 | −137381865 |
|      | 4    | 956958052  | −301463657 | −130860553 | 5343066     | 14862880    | 6443628     | 953389837  | −302085963 | −130960132 |
|      | 5    | 962163828  | −286557223 | −124398118 | 5068139     | 14949308    | 6480946     | 958593725  | −287185431 | −124500197 |
|      | 6    | 967093646  | −271566423 | −117899264 | 4791163     | 15031592    | 6516456     | 963521663  | −272200534 | −118003844 |
|      | 7    | 971745497  | −256495460 | −111365822 | 4512220     | 15109614    | 6550116     | 968171640  | −257135479 | −111472905 |
|      | 8    | 976117463  | −241348650 | −104799661 | 4231410     | 15183269    | 6581888     | 972541738  | −241994579 | −104909249 |
|      | 9    | 980207732  | −226130407 | −98202687  | 3948844     | 15252467    | 6611739     | 976630146  | −226782248 | −98314780  |
|      | 10   | 984014607  | −210845229 | −91576832  | 3664645     | 15317127    | 6639642     | 980435168  | −211502985 | −91691432  |
|      | 11   | 987536519  | −195497688 | −84924060  | 3378938     | 15377183    | 6665571     | 983955233  | −196161362 | −85041168  |
|      | 12   | 990772024  | −180092417 | −78246354  | 3091854     | 15432579    | 6689507     | 987188898  | −180762012 | −78365972  |
|      | 13   | 993719813  | −164634100 | −71545717  | 2803530     | 15483268    | 6711430     | 990134854  | −165309619 | −71667846  |
|      | 14   | 996378715  | −149127461 | −64824168  | 2514102     | 15529216    | 6731329     | 992791929  | −149808907 | −64948809  |
|      | 15   | 998747696  | −133577256 | −58083737  | 2223709     | 15570399    | 6749193     | 995159090  | −134264631 | −58210891  |
|      | 16   | 1000825858 | −117988256 | −51326463  | 1932489     | 15606802    | 6765015     | 997235439  | −118681564 | −51456132  |
|      | 17   | 1002612443 | −102365246 | −44554389  | 1640579     | 15638420    | 6778792     | 999020218  | −103064490 | −44686574  |
|      | 18   | 1004106830 | −86713010  | −37769560  | 1348114     | 15665257    | 6790524     | 1000512805 | −87418193  | −37904264  |
|      | 19   | 1005308531 | −71036322  | −30974022  | 1055229     | 15687325    | 6800213     | 1001712713 | −71747447  | −31111245  |
|      | 20   | 1006217192 | −55339941  | −24169814  | 762056      | 15704648    | 6807865     | 1002619588 | −56057011  | −24309557  |
|      | 21   | 1006832590 | −39628596  | −17358968  | 468724      | 15717260    | 6813490     | 1003233206 | −40351615  | −17501234  |
|      | 22   | 1007154630 | −23906977  | −10543506  | 175360      | 15725206    | 6817102     | 1003553473 | −24635947  | −10688295  |
|      | 23   | 1007183339 | −8179718   | −3725429   | −117919     | 15728552    | 6818721     | 1003580416 | −8914643   | −3872744   |
|      | 24   | 1006918854 | 7548620    | 3093281    | −411012     | 15727378    | 6818373     | 1003314172 | 6807737    | 2943439    |
|      | 25   | 1006361403 | 23273563   | 9910671    | −703842     | 15721779    | 6816087     | 1002754968 | 22526718   | 9758300    |
|      | 26   | 1005511272 | 38990738   | 16724821   | −996369     | 15711859    | 6811898     | 1001903091 | 38237927   | 16569920   |
|      | 27   | 1004368766 | 54695872   | 23533842   | −1288596    | 15697712    | 6805835     | 1000758845 | 53937093   | 23376409   |
|      | 28   | 1002934166 | 70384774   | 30335873   | −1580565    | 15679402    | 6797918     | 999322513  | 69620023   | 30175906   |
|      | 29   | 1001207701 | 86053297   | 37129063   | −1872340    | 15656951    | 6788155     | 997594322  | 85282569   | 36966562   |
|      | 30   | 999189530  | 101697284  | 43911563   | −2163985    | 15630322    | 6776533     | 995574431  | 100920577  | 43746524   |
| X    | 1    | 996879762  | 117312523  | 50681500   | −2455536    | 15599438    | 6763026     | 993262951  | 116529832  | 50513923   |
|      | 2    | 994278490  | 132894707  | 57436975   | −2746988    | 15564193    | 6747600     | 990659973  | 132106029  | 57266857   |



**Wektor barycentrycznej pozycji [au] i prędkości [au/doba] Ziemi  
oraz wektor heliocentrycznej pozycji [au] Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

| Data | $X_B$ | $Y_B$     | $Z_B$     | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$    | $Y_H$     | $Z_H$     |           |           |
|------|-------|-----------|-----------|-------------|-------------|-------------|----------|-----------|-----------|-----------|-----------|
| X    | 3     | 991385836 | 148439418 | 64176048    | −3038287    | 15524475    | 6730219  | 987765621 | 147644749 | 64003388  |           |
|      | 4     | 988201995 | 163942132 | 70896749    | −3329347    | 15480183    | 6710849  | 984580087 | 163141468 | 70721545  |           |
|      | 5     | 984727260 | 179398231 | 77597074    | −3620053    | 15431232    | 6689464  | 981103667 | 178591567 | 77419324  |           |
|      | 6     | 980962050 | 194803021 | 84274998    | −3910276    | 15377558    | 6666044  | 977336778 | 193990354 | 84094700  |           |
|      | 7     | 976906914 | 210151756 | 90928478    | −4199880    | 15319114    | 6640574  | 973279972 | 209333082 | 90745630  |           |
|      | 8     | 972562543 | 225439648 | 97555459    | −4488725    | 15255869    | 6613044  | 968933936 | 224614963 | 97370059  |           |
|      | 9     | 967929763 | 240661886 | 104153879   | −4776672    | 15187801    | 6583450  | 964299499 | 239831184 | 103965924 |           |
|      | 10    | 963009546 | 255813639 | 110721671   | −5063578    | 15114901    | 6551790  | 959377632 | 254976918 | 110531160 |           |
|      | 11    | 957803003 | 270890076 | 117256770   | −5349300    | 15037168    | 6518064  | 954169445 | 270047330 | 117063701 |           |
|      | 12    | 952311388 | 285886366 | 123757112   | −5633696    | 14954609    | 6482277  | 948676195 | 285037591 | 123561482 |           |
|      | 13    | 946536101 | 300797692 | 130220639   | −5916621    | 14867243    | 6444436  | 942899280 | 299942883 | 130022447 |           |
|      | 14    | 940478685 | 315619259 | 136645303   | −6197930    | 14775097    | 6404553  | 936840243 | 314758412 | 136444546 |           |
|      | 15    | 934140827 | 330346306 | 143029069   | −6477482    | 14678211    | 6362643  | 930500772 | 329479416 | 142825746 |           |
|      | 16    | 927524354 | 344974118 | 149369919   | −6755136    | 14576635    | 6318724  | 923882693 | 344101181 | 149164026 |           |
|      | 17    | 920631232 | 359498032 | 155665855   | −7030758    | 14470428    | 6272818  | 916987974 | 358619043 | 155457390 |           |
|      | 18    | 913463558 | 373913453 | 161914902   | −7304219    | 14359662    | 6224951  | 909818710 | 373028408 | 161703864 |           |
|      | 19    | 906023555 | 388215865 | 168115114   | −7575396    | 14244421    | 6175154  | 902377125 | 387324759 | 167901500 |           |
|      | 20    | 898313564 | 402400835 | 174264577   | −7844178    | 14124798    | 6123460  | 894665560 | 401503664 | 174048385 |           |
|      | 21    | 890336031 | 416464035 | 180361413   | −8110465    | 14000898    | 6069906  | 886686461 | 415560793 | 180142641 |           |
|      | 22    | 882093494 | 430401245 | 186403782   | −8374176    | 13872840    | 6014534  | 878442366 | 429491929 | 186182427 |           |
|      | 23    | 873588558 | 444208370 | 192389889   | −8635255    | 13740748    | 5957388  | 869935881 | 443292975 | 192165949 |           |
|      | 24    | 864823870 | 457881438 | 198317983   | −8893678    | 13604747    | 5898514  | 861169652 | 456959960 | 198091456 |           |
|      | 25    | 855802084 | 471416600 | 204186356   | −9149456    | 13464954    | 5837953  | 852146334 | 470489034 | 203957239 |           |
|      | 26    | 846525825 | 484810110 | 209993337   | −9402634    | 13321452    | 5775736  | 842868550 | 483876451 | 209761629 |           |
|      | 27    | 836997662 | 498058285 | 215737283   | −9653274    | 13174288    | 5711882  | 833338872 | 497118529 | 215502981 |           |
|      | 28    | 827220103 | 511157464 | 221416557   | −9901437    | 13023456    | 5646394  | 823559806 | 510211607 | 221179660 |           |
|      | 29    | 817195603 | 524103958 | 227029522   | −10147155   | 12868907    | 5579259  | 813533808 | 523151995 | 226790026 |           |
|      | 30    | 806926610 | 536894014 | 232574520   | −10390420   | 12710568    | 5510458  | 803263325 | 535935942 | 232332425 |           |
|      | 31    | 796415601 | 549523803 | 238049876   | −10631174   | 12548360    | 5439970  | 792750835 | 548559617 | 237805178 |           |
|      | XI    | 1         | 785665131 | 561989423   | 243453893   | −10869322   | 12382218 | 5367778   | 781998893 | 561019118 | 243206590 |
|      |       | 2         | 774677864 | 574286914   | 248784860   | −11104745   | 12212099 | 5293872   | 771010163 | 573310486 | 248534951 |
| 3    |       | 763456594 | 586412289 | 254041064   | −11337308   | 12037983    | 5218251  | 759787438 | 585429734 | 253788546 |           |
| 4    |       | 752004247 | 598361548 | 259220792   | −11566874   | 11859872    | 5140920  | 748333646 | 597372862 | 258965663 |           |
| 5    |       | 740323891 | 610130706 | 264322339   | −11793306   | 11677782    | 5061891  | 736651853 | 609135884 | 264064596 |           |
| 6    |       | 728418724 | 621715797 | 269344013   | −12016471   | 11491745    | 4981179  | 724745259 | 620714835 | 269083656 |           |
| 7    |       | 716292080 | 633112893 | 274284141   | −12236240   | 11301799    | 4898801  | 712617196 | 632105787 | 274021166 |           |
| 8    |       | 703947420 | 644318108 | 279141068   | −12452482   | 11107991    | 4814780  | 700271126 | 643304854 | 278875474 |           |
| 9    |       | 691388334 | 655327607 | 283913161   | −12665070   | 10910376    | 4729138  | 687710640 | 654308200 | 283644945 |           |
| 10   |       | 678618540 | 666137612 | 288598813   | −12873877   | 10709016    | 4641902  | 674939454 | 665112049 | 288327974 |           |
| 11   |       | 665641883 | 676744414 | 293196444   | −13078774   | 10503984    | 4553103  | 661961416 | 675712690 | 292922980 |           |
| 12   |       | 652462337 | 687144384 | 297704508   | −13279636   | 10295365    | 4462773  | 648780496 | 686106495 | 297428416 |           |
| 13   |       | 639083996 | 697333980 | 302121492   | −13476342   | 10083255    | 4370950  | 635400792 | 696289922 | 301842770 |           |
| 14   |       | 625511075 | 707309766 | 306445926   | −13668778   | 9867764     | 4277679  | 621826517 | 706259535 | 306164572 |           |
| 15   |       | 611747897 | 717068422 | 310676382   | −13856841   | 9649015     | 4183004  | 608061994 | 716012014 | 310392394 |           |
| 16   |       | 597798882 | 726606753 | 314811482   | −14040439   | 9427139     | 4086976  | 594111643 | 725544164 | 314524858 |           |
| 17   |       | 583668532 | 735921705 | 318849901   | −14219500   | 9202279     | 3989649  | 579979967 | 734852930 | 318560639 |           |

**Wektor barycentrycznej pozycji  $[au]$  i prędkości  $[au/\text{doba}]$  Ziemi  
oraz wektor heliocentrycznej pozycji  $[au]$  Ziemi — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  TCB daty

|     | Data | $X_B$      | $Y_B$     | $Z_B$     | $\dot{X}_B$ | $\dot{Y}_B$ | $\dot{Z}_B$ | $X_H$      | $Y_H$     | $Z_H$     |
|-----|------|------------|-----------|-----------|-------------|-------------|-------------|------------|-----------|-----------|
| XI  | 18   | 569361413  | 745010366 | 322790366 | −14393970   | 8974583     | 3891079     | 565671531  | 743935402 | 322498464 |
|     | 19   | 554882135  | 753869975 | 326631663 | −14563814   | 8744201     | 3791322     | 551190946  | 752788818 | 326337119 |
|     | 20   | 540235329  | 762497922 | 330372633 | −14729026   | 8511283     | 3690435     | 536542842  | 761410567 | 330075446 |
|     | 21   | 525425621  | 770891742 | 334012174 | −14889624   | 8275970     | 3588472     | 521731846  | 769798187 | 333712341 |
|     | 22   | 510457604  | 779049106 | 337549235 | −15045652   | 8038387     | 3485482     | 506762552  | 777949345 | 337246753 |
|     | 23   | 495335818  | 786967792 | 340982809 | −15197176   | 7798629     | 3381504     | 491639497  | 785861822 | 340677677 |
|     | 24   | 480064728  | 794645660 | 344311923 | −15344273   | 7556757     | 3276566     | 476367147  | 793533477 | 344004139 |
|     | 25   | 464648725  | 802080609 | 347535626 | −15487011   | 7312791     | 3170683     | 460949896  | 800962210 | 347225188 |
|     | 26   | 449092143  | 809270539 | 350652975 | −15625436   | 7066715     | 3063857     | 445392075  | 808145919 | 350339881 |
|     | 27   | 433399288  | 816213323 | 353663025 | −15759554   | 6818492     | 2956085     | 429697991  | 815082479 | 353347274 |
| XII | 28   | 417574481  | 822906794 | 356564827 | −15889332   | 6568081     | 2847361     | 413871963  | 821769721 | 356246416 |
|     | 29   | 401622095  | 829348746 | 359357428 | −16014697   | 6315453     | 2737683     | 397918368  | 828205442 | 359036356 |
|     | 30   | 385546589  | 835536958 | 362039877 | −16135554   | 6060602     | 2627057     | 381841662  | 834387418 | 361716141 |
|     | 1    | 369352526  | 841469214 | 364611231 | −16251793   | 5803545     | 2515498     | 365646410  | 840313435 | 364284830 |
|     | 2    | 353044578  | 847143327 | 367070569 | −16363305   | 5544324     | 2403027     | 349337282  | 845981305 | 366741500 |
|     | 3    | 336627528  | 852557160 | 369416990 | −16469982   | 5282995     | 2289670     | 332919063  | 851388891 | 369085252 |
|     | 4    | 320106260  | 857708638 | 371649625 | −16571723   | 5019629     | 2175461     | 316396636  | 856534119 | 371315216 |
|     | 5    | 303485759  | 862595764 | 373767638 | −16668434   | 4754304     | 2060432     | 299774985  | 861414992 | 373430556 |
|     | 6    | 286771099  | 867216620 | 375770228 | −16760024   | 4487105     | 1944621     | 283059187  | 866029591 | 375430472 |
|     | 7    | 269967448  | 871569379 | 377656632 | −16846405   | 4218122     | 1828066     | 266254406  | 870376089 | 377314199 |
|     | 8    | 253080056  | 875652303 | 379426125 | −16927489   | 3947454     | 1710807     | 249365895  | 874452750 | 379081014 |
|     | 9    | 236114263  | 879463761 | 381078025 | −17003192   | 3675206     | 1592888     | 232398994  | 878257940 | 380730235 |
|     | 10   | 219075494  | 883002229 | 382611697 | −17073428   | 3401496     | 1474357     | 215359127  | 881790137 | 382261224 |
|     | 11   | 201969255  | 886266308 | 384026552 | −17138118   | 3126453     | 1355265     | 198251801  | 885047942 | 383673396 |
|     | 12   | 184801130  | 889254739 | 385322058 | −17197192   | 2850223     | 1235669     | 181082598  | 888030095 | 384966217 |
|     | 13   | 167576762  | 891966411 | 386497742 | −17250594   | 2572964     | 1115630     | 163857163  | 890735487 | 386139214 |
|     | 14   | 150301844  | 894400380 | 387553192 | −17298288   | 2294846     | 995213      | 146581189  | 893163173 | 387191976 |
|     | 15   | 132982092  | 896555876 | 388488065 | −17340263   | 2016045     | 874487      | 129260390  | 895312381 | 388124159 |
|     | 16   | 115623221  | 898432301 | 389302085 | −17376531   | 1736736     | 753517      | 111900483  | 897182516 | 388935486 |
|     | 17   | 98230919   | 900029234 | 389995040 | −17407133   | 1457086     | 632369      | 94507156   | 898773155 | 389625748 |
|     | 18   | 80810822   | 901346412 | 390566784 | −17432133   | 1177252     | 511105      | 77086045   | 900084038 | 390194797 |
|     | 19   | 63368493   | 902383722 | 391017229 | −17451614   | 897370      | 389779      | 59642711   | 901115048 | 390642545 |
|     | 20   | 45909400   | 903141173 | 391346337 | −17465676   | 617550      | 268438      | 42182624   | 901866196 | 390968955 |
|     | 21   | 28438912   | 903618871 | 391554112 | −17474424   | 337877      | 147120      | 24711153   | 902337589 | 391174031 |
|     | 22   | 10962289   | 903816993 | 391640594 | −17477962   | 58404       | 25853       | 7233557    | 902529403 | 391257811 |
|     | 23   | −6515307   | 903735753 | 391605842 | −17476383   | −220846     | −95345      | −10245001  | 902441852 | 391220355 |
|     | 24   | −23988793  | 903375375 | 391449929 | −17469753   | −499873     | −216466     | −27719440  | 902075160 | 391061738 |
|     | 25   | −41453142  | 902736076 | 391172938 | −17458110   | −778692     | −337503     | −45184730  | 901429544 | 390782041 |
|     | 26   | −58903344  | 901818055 | 390774952 | −17441457   | −1057318    | −458453     | −62635862  | 900505203 | 390381347 |
|     | 27   | −76334378  | 900621501 | 390256062 | −17419767   | −1335757    | −579309     | −80067816  | 899302327 | 389859749 |
|     | 28   | −93741183  | 899146607 | 389616369 | −17392991   | −1613996    | −700057     | −97475531  | 897821107 | 389217345 |
|     | 29   | −111118645 | 897393588 | 388855991 | −17361070   | −1891999    | −820676     | −114853892 | 896061760 | 388454255 |
|     | 30   | −128461586 | 895362707 | 387975070 | −17323940   | −2169710    | −941139     | −132197722 | 894024548 | 387570620 |
|     | 31   | −145764770 | 893054290 | 386973776 | −17281545   | −2447056    | −1061413    | −149501784 | 891709798 | 386566612 |
| I   | 1    | −163022904 | 890468745 | 385852319 | −17233834   | −2723951    | −1181461    | −166760785 | 889117917 | 385442438 |
|     | 2    | −180230650 | 887606569 | 384610944 | −17180761   | −3000303    | −1301242    | −183969388 | 886249401 | 384198345 |

**Wpółrzędne bieguna *CIP* (IAU2006) w odniesieniu do bieguna *GCRS* — 2015**  
 $(\times 10^{-9})$  w momencie  $0^h$  *TT* daty

| Data   | <i>X</i> | <i>Y</i> | Data  | <i>X</i> | <i>Y</i> | Data | <i>X</i> | <i>Y</i> | Data  | <i>X</i> | <i>Y</i> |
|--------|----------|----------|-------|----------|----------|------|----------|----------|-------|----------|----------|
| XII 31 | 1466195  | -48622   | II 15 | 1479038  | -45836   | IV 2 | 1486774  | -44023   | V 18  | 1495714  | -48503   |
| I 1    | 1466530  | -48780   | 16    | 1479438  | -45695   | 3    | 1486771  | -44029   | 19    | 1496099  | -48751   |
| 2      | 1466934  | -48909   | 17    | 1479799  | -45466   | 4    | 1486765  | -44099   | 20    | 1496533  | -48924   |
| 3      | 1467385  | -48980   | 18    | 1480077  | -45183   | 5    | 1486778  | -44230   | 21    | 1496974  | -49012   |
| 4      | 1467856  | -48976   | 19    | 1480249  | -44900   | 6    | 1486835  | -44412   | 22    | 1497389  | -49023   |
| 5      | 1468315  | -48898   | 20    | 1480326  | -44680   | 7    | 1486952  | -44624   | 23    | 1497751  | -48980   |
| 6      | 1468737  | -48757   | 21    | 1480350  | -44564   | 8    | 1487138  | -44841   | 24    | 1498049  | -48909   |
| 7      | 1469102  | -48575   | 22    | 1480377  | -44559   | 9    | 1487392  | -45032   | 25    | 1498284  | -48840   |
| 8      | 1469404  | -48376   | 23    | 1480455  | -44639   | 10   | 1487699  | -45170   | 26    | 1498464  | -48795   |
| 9      | 1469643  | -48188   | 24    | 1480608  | -44759   | 11   | 1488033  | -45237   | 27    | 1498605  | -48795   |
| 10     | 1469832  | -48032   | 25    | 1480836  | -44871   | 12   | 1488361  | -45226   | 28    | 1498729  | -48849   |
| 11     | 1469987  | -47925   | 26    | 1481121  | -44940   | 13   | 1488647  | -45149   | 29    | 1498858  | -48964   |
| 12     | 1470131  | -47875   | 27    | 1481435  | -44945   | 14   | 1488861  | -45035   | 30    | 1499018  | -49134   |
| 13     | 1470287  | -47885   | 28    | 1481749  | -44881   | 15   | 1488989  | -44931   | 31    | 1499230  | -49344   |
| 14     | 1470481  | -47947   | III 1 | 1482035  | -44754   | 16   | 1489043  | -44886   | VI 1  | 1499510  | -49573   |
| 15     | 1470734  | -48042   | 2     | 1482275  | -44583   | 17   | 1489057  | -44939   | 2     | 1499866  | -49790   |
| 16     | 1471061  | -48146   | 3     | 1482457  | -44388   | 18   | 1489084  | -45101   | 3     | 1500289  | -49962   |
| 17     | 1471467  | -48222   | 4     | 1482576  | -44193   | 19   | 1489172  | -45350   | 4     | 1500758  | -50061   |
| 18     | 1471937  | -48234   | 5     | 1482640  | -44024   | 20   | 1489351  | -45639   | 5     | 1501235  | -50073   |
| 19     | 1472439  | -48154   | 6     | 1482660  | -43900   | 21   | 1489620  | -45914   | 6     | 1501683  | -50003   |
| 20     | 1472923  | -47973   | 7     | 1482657  | -43833   | 22   | 1489954  | -46132   | 7     | 1502065  | -49876   |
| 21     | 1473340  | -47712   | 8     | 1482654  | -43831   | 23   | 1490316  | -46272   | 8     | 1502364  | -49734   |
| 22     | 1473653  | -47421   | 9     | 1482673  | -43888   | 24   | 1490669  | -46334   | 9     | 1502580  | -49621   |
| 23     | 1473861  | -47160   | 10    | 1482738  | -43991   | 25   | 1490984  | -46332   | 10    | 1502738  | -49579   |
| 24     | 1473993  | -46980   | 11    | 1482863  | -44120   | 26   | 1491245  | -46291   | 11    | 1502878  | -49628   |
| 25     | 1474098  | -46902   | 12    | 1483056  | -44248   | 27   | 1491443  | -46236   | 12    | 1503045  | -49765   |
| 26     | 1474225  | -46916   | 13    | 1483314  | -44345   | 28   | 1491584  | -46193   | 13    | 1503276  | -49966   |
| 27     | 1474408  | -46992   | 14    | 1483621  | -44385   | 29   | 1491676  | -46183   | 14    | 1503592  | -50189   |
| 28     | 1474664  | -47088   | 15    | 1483950  | -44347   | 30   | 1491738  | -46223   | 15    | 1503990  | -50387   |
| 29     | 1474987  | -47163   | 16    | 1484261  | -44228   | V 1  | 1491791  | -46323   | 16    | 1504448  | -50523   |
| 30     | 1475359  | -47188   | 17    | 1484516  | -44045   | 2    | 1491858  | -46485   | 17    | 1504931  | -50576   |
| 31     | 1475753  | -47147   | 18    | 1484682  | -43838   | 3    | 1491965  | -46700   | 18    | 1505399  | -50547   |
| II 1   | 1476142  | -47034   | 19    | 1484753  | -43663   | 4    | 1492130  | -46951   | 19    | 1505824  | -50450   |
| 2      | 1476499  | -46859   | 20    | 1484752  | -43573   | 5    | 1492366  | -47211   | 20    | 1506185  | -50313   |
| 3      | 1476805  | -46639   | 21    | 1484731  | -43598   | 6    | 1492675  | -47451   | 21    | 1506478  | -50165   |
| 4      | 1477048  | -46399   | 22    | 1484744  | -43730   | 7    | 1493043  | -47641   | 22    | 1506709  | -50033   |
| 5      | 1477228  | -46164   | 23    | 1484832  | -43928   | 8    | 1493445  | -47757   | 23    | 1506891  | -49938   |
| 6      | 1477352  | -45957   | 24    | 1485008  | -44141   | 9    | 1493848  | -47792   | 24    | 1507046  | -49896   |
| 7      | 1477436  | -45797   | 25    | 1485258  | -44319   | 10   | 1494215  | -47754   | 25    | 1507195  | -49911   |
| 8      | 1477500  | -45695   | 26    | 1485551  | -44435   | 11   | 1494515  | -47672   | 26    | 1507363  | -49983   |
| 9      | 1477569  | -45655   | 27    | 1485854  | -44478   | 12   | 1494735  | -47586   | 27    | 1507574  | -50100   |
| 10     | 1477665  | -45670   | 28    | 1486136  | -44453   | 13   | 1494878  | -47541   | 28    | 1507844  | -50245   |
| 11     | 1477810  | -45726   | 29    | 1486376  | -44377   | 14   | 1494974  | -47576   | 29    | 1508187  | -50390   |
| 12     | 1478019  | -45801   | 30    | 1486560  | -44272   | 15   | 1495064  | -47709   | 30    | 1508602  | -50503   |
| 13     | 1478300  | -45865   | 31    | 1486683  | -44162   | 16   | 1495197  | -47934   | VII 1 | 1509072  | -50553   |
| 14     | 1478647  | -45887   | IV 1  | 1486751  | -44073   | 17   | 1495409  | -48215   | 2     | 1509568  | -50516   |

**Wpółrzędne bieguna *CIP* (IAU2006) w odniesieniu do bieguna *GCRS* — 2015**  
( $\times 10^{-9}$ ) w momencie  $0^h$  *TT* daty

| Data |         |         | X      | Y       | Data    |         |         | X       | Y       | Data    |         |         | X       | Y       |         |         |        |
|------|---------|---------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| VII  | 3       | 1510046 | -50388 | VIII    | 18      | 1521847 | -46429  | X       | 3       | 1529310 | -45478  | XI      | 18      | 1538905 | -48874  |         |        |
|      | 4       | 1510466 | -50188 |         | 19      | 1521890 | -46382  |         | 4       | 1529633 | -45552  |         | 19      | 1539182 | -48782  |         |        |
|      | 5       | 1510798 | -49956 |         | 20      | 1521956 | -46391  |         | 5       | 1529943 | -45550  |         | 20      | 1539383 | -48707  |         |        |
|      | 6       | 1511037 | -49743 |         | 21      | 1522066 | -46441  |         | 6       | 1530209 | -45487  |         | 21      | 1539523 | -48690  |         |        |
|      | 7       | 1511204 | -49595 |         | 22      | 1522233 | -46512  |         | 7       | 1530417 | -45388  |         | 22      | 1539636 | -48762  |         |        |
|      | 8       | 1511338 | -49537 |         | 23      | 1522464 | -46579  |         | 8       | 1530561 | -45281  |         | 23      | 1539768 | -48934  |         |        |
|      | 9       | 1511487 | -49572 |         | 24      | 1522757 | -46614  |         | 9       | 1530644 | -45191  |         | 24      | 1539968 | -49187  |         |        |
|      | 10      | 1511688 | -49677 |         | 25      | 1523097 | -46592  |         | 10      | 1530680 | -45140  |         | 25      | 1540264 | -49475  |         |        |
|      | 11      | 1511966 | -49813 |         | 26      | 1523458 | -46491  |         | 11      | 1530687 | -45143  |         | 26      | 1540659 | -49742  |         |        |
|      | 12      | 1512322 | -49937 |         | 27      | 1523801 | -46307  |         | 12      | 1530687 | -45208  |         | 27      | 1541125 | -49941  |         |        |
|      | 13      | 1512740 | -50011 |         | 28      | 1524085 | -46057  |         | 13      | 1530703 | -45333  |         | 28      | 1541618 | -50047  |         |        |
|      | 14      | 1513190 | -50011 |         | 29      | 1524279 | -45782  |         | 14      | 1530758 | -45508  |         | 29      | 1542091 | -50061  |         |        |
|      | 15      | 1513638 | -49931 |         | 30      | 1524376 | -45538  |         | 15      | 1530866 | -45716  |         | 30      | 1542511 | -50007  |         |        |
|      | 16      | 1514052 | -49779 |         | 31      | 1524401 | -45378  |         | 16      | 1531038 | -45932  |         | XII     | 1       | 1542860 | -49917  |        |
|      | 17      | 1514408 | -49578 |         | IX      | 1       | 1524404 |         | -45330  | 17      | 1531274 |         |         | -46131  | 2       | 1543137 | -49823 |
|      | 18      | 1514695 | -49356 |         |         | 2       | 1524440 |         | -45386  | 18      | 1531563 |         |         | -46288  | 3       | 1543353 | -49753 |
|      | 19      | 1514915 | -49142 |         |         | 3       | 1524548 |         | -45507  | 19      | 1531886 |         |         | -46384  | 4       | 1543525 | -49727 |
| 20   | 1515079 | -48959  | 4      | 1524740 |         | -45643  | 20      | 1532215 | -46408  | 5       | 1543676 | -49756  |         |         |         |         |        |
| 21   | 1515206 | -48825  | 5      | 1525004 |         | -45746  | 21      | 1532521 | -46365  | 6       | 1543830 | -49843  |         |         |         |         |        |
| 22   | 1515317 | -48749  | 6      | 1525312 |         | -45788  | 22      | 1532772 | -46272  | 7       | 1544009 | -49983  |         |         |         |         |        |
| 23   | 1515437 | -48732  | 7      | 1525631 |         | -45755  | 23      | 1532948 | -46166  | 8       | 1544235 | -50163  |         |         |         |         |        |
| 24   | 1515589 | -48764  | 8      | 1525928 |         | -45652  | 24      | 1533046 | -46092  | 9       | 1544521 | -50362  |         |         |         |         |        |
| 25   | 1515790 | -48832  | 9      | 1526179 |         | -45496  | 25      | 1533087 | -46098  | 10      | 1544875 | -50554  |         |         |         |         |        |
| 26   | 1516056 | -48912  | 10     | 1526370 |         | -45310  | 26      | 1533116 | -46212  | 11      | 1545292 | -50712  |         |         |         |         |        |
| 27   | 1516392 | -48975  | 11     | 1526495 |         | -45121  | 27      | 1533188 | -46430  | 12      | 1545757 | -50809  |         |         |         |         |        |
| 28   | 1516789 | -48991  | 12     | 1526560 |         | -44954  | 28      | 1533346 | -46717  | 13      | 1546242 | -50829  |         |         |         |         |        |
| 29   | 1517226 | -48932  | 13     | 1526579 |         | -44830  | 29      | 1533607 | -47014  | 14      | 1546713 | -50768  |         |         |         |         |        |
| 30   | 1517666 | -48784  | 14     | 1526571 |         | -44763  | 30      | 1533954 | -47266  | 15      | 1547138 | -50643  |         |         |         |         |        |
| 31   | 1518066 | -48552  | 15     | 1526560 |         | -44759  | 31      | 1534347 | -47439  | 16      | 1547492 | -50482  |         |         |         |         |        |
| VIII | 1       | 1518385 | -48268 | 16      |         | 1526569 | -44813  | XI      | 1       | 1534742 | -47523  | 17      |         | 1547766 | -50326  |         |        |
|      | 2       | 1518605 | -47983 | 17      |         | 1526617 | -44914  |         | 2       | 1535102 | -47531  | 18      | 1547972 | -50218  |         |         |        |
|      | 3       | 1518736 | -47753 | 18      | 1526719 | -45042  | 3       |         | 1535403 | -47491  | 19      | 1548139 | -50188  |         |         |         |        |
|      | 4       | 1518816 | -47616 | 19      | 1526884 | -45175  | 4       |         | 1535637 | -47431  | 20      | 1548309 | -50249  |         |         |         |        |
|      | 5       | 1518895 | -47582 | 20      | 1527109 | -45286  | 5       |         | 1535807 | -47380  | 21      | 1548526 | -50392  |         |         |         |        |
|      | 6       | 1519019 | -47631 | 21      | 1527385 | -45350  | 6       |         | 1535925 | -47362  | 22      | 1548824 | -50582  |         |         |         |        |
|      | 7       | 1519215 | -47724 | 22      | 1527690 | -45348  | 7       |         | 1536010 | -47394  | 23      | 1549215 | -50772  |         |         |         |        |
|      | 8       | 1519489 | -47816 | 23      | 1527994 | -45270  | 8       |         | 1536082 | -47484  | 24      | 1549685 | -50914  |         |         |         |        |
|      | 9       | 1519827 | -47868 | 24      | 1528261 | -45124  | 9       |         | 1536166 | -47633  | 25      | 1550202 | -50974  |         |         |         |        |
|      | 10      | 1520201 | -47853 | 25      | 1528457 | -44936  | 10      |         | 1536284 | -47835  | 26      | 1550720 | -50939  |         |         |         |        |
|      | 11      | 1520579 | -47762 | 26      | 1528565 | -44752  | 11      |         | 1536455 | -48072  | 27      | 1551198 | -50821  |         |         |         |        |
|      | 12      | 1520930 | -47602 | 27      | 1528592 | -44628  | 12      |         | 1536690 | -48322  | 28      | 1551609 | -50649  |         |         |         |        |
|      | 13      | 1521230 | -47389 | 28      | 1528573 | -44607  | 13      |         | 1536992 | -48559  | 29      | 1551942 | -50458  |         |         |         |        |
|      | 14      | 1521465 | -47150 | 29      | 1528566 | -44702  | 14      |         | 1537353 | -48756  | 30      | 1552203 | -50279  |         |         |         |        |
|      | 15      | 1521633 | -46912 | 30      | 1528623 | -44888  | 15      |         | 1537753 | -48891  | 31      | 1552408 | -50139  |         |         |         |        |
|      | 16      | 1521741 | -46701 | X       | 1       | 1528772 | -45115  |         | 16      | 1538166 | -48952  | I       | 1       | 1552579 | -50052  |         |        |
|      | 17      | 1521805 | -46536 |         | 2       | 1529010 | -45326  |         | 17      | 1538560 | -48940  |         | 2       | 1552741 | -50023  |         |        |

W roku 2015 średnia wartość parametru  $s$  wyniesie  $8.0 \pm 0.5 \text{ mas}$  ( $s = 3.88 \times 10^{-8} \text{ rad}$ )

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\beta$ Cassiopeiae            |                      | $\alpha$ Cassiopeiae           |                      | $\beta$ Ceti                   |                      | $\gamma$ Cassiopeiae           |                      |
|----------|------|--------------------------------|----------------------|--------------------------------|----------------------|--------------------------------|----------------------|--------------------------------|----------------------|
|          |      | 2 <sup>m</sup> 28              | F2                   | 2 <sup>m</sup> 24              | K0                   | 2 <sup>m</sup> 04              | K0                   | 2 <sup>m</sup> 15              | B0p                  |
|          |      | $\alpha_{app}^{CIO}$           | $\delta_{app}$       | $\alpha_{app}^{CIO}$           | $\delta_{app}$       | $\alpha_{app}^{CIO}$           | $\delta_{app}$       | $\alpha_{app}^{CIO}$           | $\delta_{app}$       |
|          |      | 0 <sup>h</sup> 09 <sup>m</sup> | +59°13'              | 0 <sup>h</sup> 40 <sup>m</sup> | +56°37'              | 0 <sup>h</sup> 43 <sup>m</sup> | −17°53'              | 0 <sup>h</sup> 56 <sup>m</sup> | +60°47'              |
| Styczeń  | 1.0  | 13 <sup>s</sup> 8549           | 75 <sup>''</sup> 289 | 36 <sup>s</sup> 9509           | 26 <sup>''</sup> 435 | 34 <sup>s</sup> 2079           | 83 <sup>''</sup> 950 | 52 <sup>s</sup> 8259           | 68 <sup>''</sup> 337 |
|          | 8.0  | 13.5518                        | 74.937               | 36.6705                        | 26.331               | 34.0439                        | 84.234               | 52.5137                        | 68.431               |
|          | 15.0 | 13.2573                        | 74.030               | 36.3887                        | 25.680               | 33.8822                        | 84.709               | 52.1941                        | 67.965               |
|          | 22.0 | 12.9704                        | 73.218               | 36.1133                        | 25.125               | 33.7241                        | 84.706               | 51.8816                        | 67.579               |
|          | 29.0 | 12.7109                        | 71.866               | 35.8538                        | 24.020               | 33.5736                        | 84.876               | 51.5811                        | 66.619               |
| Luty     | 5.0  | 12.4590                        | 70.548               | 35.6004                        | 22.956               | 33.4358                        | 84.674               | 51.2861                        | 65.684               |
|          | 12.0 | 12.2452                        | 68.786               | 35.3739                        | 21.423               | 33.3072                        | 84.635               | 51.0168                        | 64.252               |
|          | 19.0 | 12.0481                        | 67.199               | 35.1638                        | 20.061               | 33.1925                        | 84.117               | 50.7660                        | 62.968               |
|          | 26.0 | 11.9054                        | 65.236               | 34.9964                        | 18.281               | 33.0910                        | 83.739               | 50.5594                        | 61.227               |
|          | 5.0  | 11.7759                        | 63.383               | 34.8418                        | 16.611               | 33.0104                        | 83.038               | 50.3664                        | 59.582               |
| Marzec   | 12.0 | 11.7050                        | 61.282               | 34.7361                        | 14.644               | 32.9427                        | 82.461               | 50.2258                        | 57.599               |
|          | 19.0 | 11.6514                        | 59.458               | 34.6493                        | 12.947               | 32.8952                        | 81.448               | 50.1075                        | 55.867               |
|          | 26.0 | 11.6668                        | 57.484               | 34.6221                        | 11.037               | 32.8627                        | 80.531               | 50.0550                        | 53.878               |
|          | 2.0  | 11.6915                        | 55.706               | 34.6064                        | 09.324               | 32.8547                        | 79.367               | 50.0153                        | 52.077               |
|          | 9.0  | 11.7815                        | 53.903               | 34.6491                        | 07.522               | 32.8594                        | 78.284               | 50.0415                        | 50.146               |
| Kwiecień | 16.0 | 11.8785                        | 52.445               | 34.7033                        | 06.067               | 32.8864                        | 76.857               | 50.0821                        | 48.554               |
|          | 23.0 | 12.0446                        | 51.056               | 34.8210                        | 04.609               | 32.9265                        | 75.485               | 50.1955                        | 46.917               |
|          | 30.0 | 12.2076                        | 49.907               | 34.9402                        | 03.403               | 32.9904                        | 73.979               | 50.3109                        | 45.535               |
|          | 7.0  | 12.4293                        | 48.921               | 35.1152                        | 02.293               | 33.0632                        | 72.524               | 50.4916                        | 44.217               |
|          | 14.0 | 12.6410                        | 48.276               | 35.2869                        | 01.541               | 33.1566                        | 70.860               | 50.6703                        | 43.263               |
| Maj      | 21.0 | 12.9109                        | 47.862               | 35.5151                        | 00.951               | 33.2581                        | 69.232               | 50.9157                        | 42.440               |
|          | 28.0 | 13.1614                        | 47.661               | 35.7301                        | 00.599               | 33.3790                        | 67.614               | 51.1469                        | 41.873               |
|          | 4.0  | 13.4560                        | 47.745               | 35.9900                        | 00.474               | 33.5028                        | 66.031               | 51.4324                        | 41.510               |
|          | 11.0 | 13.7233                        | 48.090               | 36.2303                        | 00.640               | 33.6419                        | 64.408               | 51.6971                        | 41.462               |
|          | 18.0 | 14.0314                        | 48.756               | 36.5130                        | 01.072               | 33.7826                        | 62.814               | 52.0139                        | 41.659               |
| Czerwiec | 25.0 | 14.3059                        | 49.540               | 36.7686                        | 01.656               | 33.9354                        | 61.391               | 52.3005                        | 42.039               |
|          | 2.0  | 14.6069                        | 50.663               | 37.0542                        | 02.536               | 34.0838                        | 59.996               | 52.6255                        | 42.705               |
|          | 9.0  | 14.8678                        | 51.917               | 37.3069                        | 03.586               | 34.2398                        | 58.729               | 52.9140                        | 43.575               |
|          | 16.0 | 15.1502                        | 53.518               | 37.5850                        | 04.944               | 34.3902                        | 57.486               | 53.2358                        | 44.745               |
|          | 23.0 | 15.3903                        | 55.099               | 37.8263                        | 06.322               | 34.5435                        | 56.564               | 53.5160                        | 45.974               |
| Lipiec   | 30.0 | 15.6396                        | 57.025               | 38.0818                        | 08.015               | 34.6848                        | 55.651               | 53.8170                        | 47.519               |
|          | 6.0  | 15.8426                        | 58.931               | 38.2967                        | 09.732               | 34.8250                        | 55.000               | 54.0721                        | 49.126               |
|          | 13.0 | 16.0482                        | 61.162               | 38.5194                        | 11.753               | 34.9526                        | 54.352               | 54.3406                        | 51.043               |
|          | 20.0 | 16.2096                        | 63.227               | 38.7014                        | 13.647               | 35.0735                        | 54.129               | 54.5621                        | 52.870               |
|          | 27.0 | 16.3643                        | 65.606               | 38.8824                        | 15.842               | 35.1758                        | 53.869               | 54.7872                        | 55.008               |
| Sierpień | 3.0  | 16.4732                        | 67.822               | 39.0207                        | 17.915               | 35.2684                        | 53.943               | 54.9632                        | 57.061               |
|          | 10.0 | 16.5676                        | 70.311               | 39.1504                        | 20.259               | 35.3433                        | 53.969               | 55.1336                        | 59.399               |
|          | 17.0 | 16.6217                        | 72.502               | 39.2403                        | 22.338               | 35.4031                        | 54.456               | 55.2574                        | 61.505               |
|          | 24.0 | 16.6552                        | 74.952               | 39.3155                        | 24.681               | 35.4406                        | 54.822               | 55.3684                        | 63.890               |
|          | 1.0  | 16.6490                        | 77.113               | 39.3511                        | 26.770               | 35.4620                        | 55.530               | 55.4330                        | 66.052               |
| Paźdz.   | 8.0  | 16.6144                        | 79.474               | 39.3640                        | 29.077               | 35.4637                        | 56.103               | 55.4749                        | 68.449               |
|          | 15.0 | 16.5481                        | 81.430               | 39.3425                        | 31.004               | 35.4457                        | 57.101               | 55.4755                        | 70.493               |
|          | 22.0 | 16.4502                        | 83.570               | 39.2948                        | 33.138               | 35.4056                        | 57.872               | 55.4491                        | 72.758               |
|          | 29.0 | 16.3240                        | 85.316               | 39.2155                        | 34.904               | 35.3474                        | 58.936               | 55.3843                        | 74.676               |
|          | 5.0  | 16.1606                        | 87.173               | 39.1037                        | 36.815               | 35.2724                        | 59.768               | 55.2842                        | 76.758               |
| Listopad | 12.0 | 15.9787                        | 88.549               | 38.9677                        | 38.261               | 35.1778                        | 60.937               | 55.1533                        | 78.388               |
|          | 19.0 | 15.7598                        | 90.016               | 38.7985                        | 39.836               | 35.0669                        | 61.781               | 54.9859                        | 80.161               |
|          | 26.0 | 15.5305                        | 91.013               | 38.6123                        | 40.955               | 34.9409                        | 62.843               | 54.7954                        | 81.481               |
|          | 3.0  | 15.2627                        | 92.022               | 38.3904                        | 42.130               | 34.8058                        | 63.602               | 54.5642                        | 82.874               |
|          | 10.0 | 14.9955                        | 92.516               | 38.1605                        | 42.793               | 34.6565                        | 64.596               | 54.3197                        | 83.751               |
| Grudzień | 17.0 | 14.6944                        | 93.011               | 37.8986                        | 43.501               | 34.5012                        | 65.209               | 54.0382                        | 84.682               |
|          | 24.0 | 14.4078                        | 93.018               | 37.6413                        | 43.714               | 34.3379                        | 65.961               | 53.7575                        | 85.105               |
|          | 31.0 | 14.0904                        | 92.948               | 37.3539                        | 43.896               | 34.1767                        | 66.401               | 53.4405                        | 85.504               |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\beta$ Andromedae             |                       | $\delta$ Cassiopeiae           |                       | $\varepsilon$ Cassiopeiae      |                       | $\alpha$ Arietis               |                       |
|----------|------|--------------------------------|-----------------------|--------------------------------|-----------------------|--------------------------------|-----------------------|--------------------------------|-----------------------|
|          |      | 2 <sup>m</sup> 07              | M0                    | 2 <sup>m</sup> 66              | A5                    | 3 <sup>m</sup> 35              | B2                    | 2 <sup>m</sup> 01              | K2                    |
|          |      | $\alpha_{app}^{CIO}$           | $\delta_{app}$        | $\alpha_{app}^{CIO}$           | $\delta_{app}$        | $\alpha_{app}^{CIO}$           | $\delta_{app}$        | $\alpha_{app}^{CIO}$           | $\delta_{app}$        |
|          |      | 1 <sup>h</sup> 09 <sup>m</sup> | +35°41'               | 1 <sup>h</sup> 26 <sup>m</sup> | +60°18'               | 1 <sup>h</sup> 54 <sup>m</sup> | +63°44'               | 2 <sup>h</sup> 07 <sup>m</sup> | +23°31'               |
| Styczeń  | 1.0  | 49 <sup>s</sup> .1787          | 68 <sup>''</sup> .684 | 04 <sup>s</sup> .1701          | 60 <sup>''</sup> .967 | 45 <sup>s</sup> .5941          | 49 <sup>''</sup> .656 | 16 <sup>s</sup> .0603          | 60 <sup>''</sup> .602 |
|          | 8.0  | 48.9917                        | 68.537                | 03.8740                        | 61.295                | 45.2801                        | 50.283                | 15.9046                        | 60.519                |
|          | 15.0 | 48.7994                        | 67.934                | 03.5610                        | 61.079                | 44.9359                        | 50.377                | 15.7379                        | 60.073                |
|          | 22.0 | 48.6103                        | 67.515                | 03.2544                        | 60.937                | 44.5988                        | 50.526                | 15.5700                        | 59.858                |
|          | 29.0 | 48.4263                        | 66.634                | 02.9494                        | 60.218                | 44.2513                        | 50.090                | 15.3987                        | 59.261                |
| Luty     | 5.0  | 48.2474                        | 65.885                | 02.6485                        | 59.525                | 43.9067                        | 49.667                | 15.2296                        | 58.862                |
|          | 12.0 | 48.0805                        | 64.731                | 02.3636                        | 58.318                | 43.5694                        | 48.709                | 15.0635                        | 58.108                |
|          | 19.0 | 47.9254                        | 63.825                | 02.0973                        | 57.247                | 43.2531                        | 47.857                | 14.9053                        | 57.641                |
|          | 26.0 | 47.7920                        | 62.550                | 01.8658                        | 55.687                | 42.9654                        | 46.476                | 14.7581                        | 56.827                |
| Marzec   | 5.0  | 47.6702                        | 61.455                | 01.6474                        | 54.217                | 42.6916                        | 45.165                | 14.6209                        | 56.249                |
|          | 12.0 | 47.5745                        | 60.081                | 01.4740                        | 52.366                | 42.4601                        | 43.427                | 14.4995                        | 55.379                |
|          | 19.0 | 47.4947                        | 59.028                | 01.3248                        | 50.752                | 42.2576                        | 41.894                | 14.3926                        | 54.855                |
|          | 26.0 | 47.4480                        | 57.760                | 01.2346                        | 48.825                | 42.1148                        | 39.985                | 14.3076                        | 54.077                |
| Kwiecień | 2.0  | 47.4143                        | 56.726                | 01.1589                        | 47.082                | 41.9890                        | 38.247                | 14.2372                        | 53.571                |
|          | 9.0  | 47.4137                        | 55.573                | 01.1449                        | 45.151                | 41.9285                        | 36.257                | 14.1904                        | 52.879                |
|          | 16.0 | 47.4268                        | 54.787                | 01.1494                        | 43.551                | 41.8926                        | 34.578                | 14.1597                        | 52.570                |
|          | 23.0 | 47.4765                        | 53.949                | 01.2236                        | 41.841                | 41.9326                        | 32.720                | 14.1564                        | 52.119                |
| Maj      | 30.0 | 47.5351                        | 53.368                | 01.3037                        | 40.392                | 41.9819                        | 31.121                | 14.1668                        | 51.952                |
|          | 7.0  | 47.6263                        | 52.814                | 01.4482                        | 38.944                | 42.1038                        | 29.461                | 14.2032                        | 51.704                |
|          | 14.0 | 47.7239                        | 52.613                | 01.5963                        | 37.868                | 42.2348                        | 28.173                | 14.2523                        | 51.827                |
|          | 21.0 | 47.8548                        | 52.490                | 01.8115                        | 36.860                | 42.4428                        | 26.888                | 14.3286                        | 51.907                |
| Czerwiec | 28.0 | 47.9864                        | 52.587                | 02.0175                        | 36.125                | 42.6442                        | 25.894                | 14.4140                        | 52.230                |
|          | 4.0  | 48.1446                        | 52.814                | 02.2800                        | 35.542                | 42.9127                        | 25.000                | 14.5223                        | 52.558                |
|          | 11.0 | 48.2994                        | 53.312                | 02.5277                        | 35.296                | 43.1698                        | 24.464                | 14.6365                        | 53.179                |
|          | 18.0 | 48.4798                        | 53.970                | 02.8307                        | 35.242                | 43.4935                        | 24.071                | 14.7733                        | 53.826                |
| Lipiec   | 25.0 | 48.6514                        | 54.747                | 03.1081                        | 35.403                | 43.7921                        | 23.930                | 14.9118                        | 54.618                |
|          | 2.0  | 48.8408                        | 55.709                | 03.4283                        | 35.808                | 44.1448                        | 23.995                | 15.0671                        | 55.464                |
|          | 9.0  | 49.0174                        | 56.812                | 03.7172                        | 36.453                | 44.4667                        | 24.341                | 15.2203                        | 56.477                |
|          | 16.0 | 49.2092                        | 58.112                | 04.0443                        | 37.359                | 44.8379                        | 24.917                | 15.3885                        | 57.559                |
| Sierpień | 23.0 | 49.3842                        | 59.390                | 04.3332                        | 38.365                | 45.1686                        | 25.642                | 15.5505                        | 58.644                |
|          | 30.0 | 49.5671                        | 60.876                | 04.6485                        | 39.658                | 45.5364                        | 26.633                | 15.7214                        | 59.812                |
|          | 6.0  | 49.7299                        | 62.354                | 04.9213                        | 41.057                | 45.8590                        | 27.783                | 15.8824                        | 61.001                |
|          | 13.0 | 49.8969                        | 64.035                | 05.2133                        | 42.742                | 46.2105                        | 29.205                | 16.0493                        | 62.284                |
| Wrzesień | 20.0 | 50.0415                        | 65.548                | 05.4597                        | 44.382                | 46.5114                        | 30.639                | 16.2029                        | 63.419                |
|          | 27.0 | 50.1841                        | 67.271                | 05.7157                        | 46.317                | 46.8308                        | 32.362                | 16.3565                        | 64.662                |
|          | 3.0  | 50.3021                        | 68.847                | 05.9238                        | 48.212                | 47.0972                        | 34.101                | 16.4938                        | 65.787                |
|          | 10.0 | 50.4139                        | 70.621                | 06.1320                        | 50.386                | 47.3708                        | 36.122                | 16.6278                        | 67.031                |
| Paźdz.   | 17.0 | 50.5004                        | 72.099                | 06.2927                        | 52.371                | 47.5895                        | 38.010                | 16.7426                        | 68.000                |
|          | 24.0 | 50.5759                        | 73.784                | 06.4463                        | 54.633                | 47.8075                        | 40.183                | 16.8491                        | 69.108                |
|          | 1.0  | 50.6255                        | 75.209                | 06.5522                        | 56.713                | 47.9702                        | 42.227                | 16.9345                        | 69.989                |
|          | 8.0  | 50.6601                        | 76.819                | 06.6404                        | 59.040                | 48.1194                        | 44.534                | 17.0084                        | 71.021                |
| Listopad | 15.0 | 50.6697                        | 78.044                | 06.6840                        | 61.048                | 48.2146                        | 46.572                | 17.0598                        | 71.695                |
|          | 22.0 | 50.6612                        | 79.468                | 06.7050                        | 63.294                | 48.2903                        | 48.867                | 17.0958                        | 72.549                |
|          | 29.0 | 50.6292                        | 80.544                | 06.6839                        | 65.225                | 48.3143                        | 50.889                | 17.1091                        | 73.100                |
|          | 5.0  | 50.5764                        | 81.788                | 06.6310                        | 67.347                | 48.3070                        | 53.129                | 17.1053                        | 73.837                |
| Grudzień | 12.0 | 50.5027                        | 82.592                | 06.5414                        | 69.042                | 48.2522                        | 54.979                | 17.0788                        | 74.175                |
|          | 19.0 | 50.4075                        | 83.574                | 06.4182                        | 70.909                | 48.1631                        | 57.027                | 17.0333                        | 74.729                |
|          | 26.0 | 50.2957                        | 84.150                | 06.2653                        | 72.345                | 48.0336                        | 58.669                | 16.9677                        | 74.931                |
|          | 3.0  | 50.1623                        | 84.858                | 06.0733                        | 73.889                | 47.8617                        | 60.452                | 16.8834                        | 75.339                |
|          | 10.0 | 50.0167                        | 85.107                | 05.8599                        | 74.929                | 47.6573                        | 61.747                | 16.7813                        | 75.337                |
|          | 17.0 | 49.8516                        | 85.497                | 05.6103                        | 76.059                | 47.4128                        | 63.156                | 16.6613                        | 75.566                |
|          | 24.0 | 49.6823                        | 85.463                | 05.3527                        | 76.680                | 47.1499                        | 64.059                | 16.5291                        | 75.422                |
|          | 31.0 | 49.4961                        | 85.507                | 05.0583                        | 77.316                | 46.8444                        | 65.003                | 16.3819                        | 75.468                |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\alpha$ Persei                |                | $\gamma$ Camelopardalis        |                | $\alpha$ Tauri                     |                | $\beta$ Orionis                |                |
|----------|------|--------------------------------|----------------|--------------------------------|----------------|------------------------------------|----------------|--------------------------------|----------------|
|          |      | 1 <sup>m</sup> 79              | F5             | 4 <sup>m</sup> 59              | A2             | 0 <sup>m</sup> 87 <i>Aldebaran</i> | K5             | 0 <sup>m</sup> 18 <i>Rigel</i> | B8p            |
|          |      | $\alpha_{app}^{CIO}$           | $\delta_{app}$ | $\alpha_{app}^{CIO}$           | $\delta_{app}$ | $\alpha_{app}^{CIO}$               | $\delta_{app}$ | $\alpha_{app}^{CIO}$           | $\delta_{app}$ |
|          |      | 3 <sup>h</sup> 24 <sup>m</sup> | +49°54′        | 3 <sup>h</sup> 51 <sup>m</sup> | +71°22′        | 4 <sup>h</sup> 35 <sup>m</sup>     | +16°32′        | 5 <sup>h</sup> 14 <sup>m</sup> | −8°11′         |
| Styczeń  | 1.0  | 39.9780                        | 52.771         | 16.3912                        | 41.236         | 62.2067                            | 11.249         | 30.7180                        | 18.644         |
|          | 8.0  | 39.8151                        | 53.636         | 16.1239                        | 42.820         | 62.1215                            | 11.134         | 30.6428                        | 19.716         |
|          | 15.0 | 39.6146                        | 54.127         | 15.7616                        | 44.025         | 62.0134                            | 10.875         | 30.5524                        | 20.812         |
|          | 22.0 | 39.4144                        | 54.693         | 15.4071                        | 45.232         | 61.8942                            | 10.777         | 30.4407                        | 21.714         |
|          | 29.0 | 39.1859                        | 54.806         | 14.9748                        | 45.947         | 61.7556                            | 10.487         | 30.3155                        | 22.650         |
| Luty     | 5.0  | 38.9555                        | 54.985         | 14.5388                        | 46.648         | 61.6093                            | 10.412         | 30.1764                        | 23.285         |
|          | 12.0 | 38.7093                        | 54.714         | 14.0520                        | 46.844         | 61.4499                            | 10.117         | 30.0289                        | 23.988         |
|          | 19.0 | 38.4743                        | 54.551         | 13.5929                        | 47.046         | 61.2880                            | 10.047         | 29.8686                        | 24.391         |
|          | 26.0 | 38.2361                        | 53.899         | 13.1088                        | 46.677         | 61.1186                            | 09.718         | 29.7036                        | 24.885         |
| Marzec   | 5.0  | 38.0060                        | 53.352         | 12.6390                        | 46.317         | 60.9507                            | 09.650         | 29.5349                        | 25.003         |
|          | 12.0 | 37.7847                        | 52.365         | 12.1725                        | 45.431         | 60.7823                            | 09.315         | 29.3667                        | 25.247         |
|          | 19.0 | 37.5846                        | 51.563         | 11.7530                        | 44.621         | 60.6208                            | 09.266         | 29.1963                        | 25.119         |
|          | 26.0 | 37.4054                        | 50.328         | 11.3634                        | 43.275         | 60.4647                            | 08.931         | 29.0305                        | 25.136         |
| Kwiecień | 2.0  | 37.2417                        | 49.275         | 11.0028                        | 42.024         | 60.3188                            | 08.901         | 28.8716                        | 24.740         |
|          | 9.0  | 37.1072                        | 47.873         | 10.6932                        | 40.331         | 60.1838                            | 08.600         | 28.7214                        | 24.515         |
|          | 16.0 | 36.9971                        | 46.754         | 10.4373                        | 38.833         | 60.0630                            | 08.645         | 28.5788                        | 23.875         |
|          | 23.0 | 36.9251                        | 45.320         | 10.2533                        | 36.920         | 59.9579                            | 08.416         | 28.4484                        | 23.419         |
| Maj      | 30.0 | 36.8693                        | 44.152         | 10.1000                        | 35.219         | 59.8686                            | 08.526         | 28.3331                        | 22.547         |
|          | 7.0  | 36.8545                        | 42.767         | 10.0288                        | 33.223         | 59.7980                            | 08.392         | 28.2326                        | 21.875         |
|          | 14.0 | 36.8594                        | 41.739         | 10.0007                        | 31.537         | 59.7446                            | 08.637         | 28.1465                        | 20.784         |
|          | 21.0 | 36.9102                        | 40.533         | 10.0673                        | 29.598         | 59.7129                            | 08.645         | 28.0772                        | 19.905         |
| Czerwiec | 28.0 | 36.9710                        | 39.640         | 10.1514                        | 27.962         | 59.6981                            | 08.986         | 28.0281                        | 18.650         |
|          | 4.0  | 37.0758                        | 38.659         | 10.3300                        | 26.192         | 59.7052                            | 09.125         | 27.9962                        | 17.619         |
|          | 11.0 | 37.1898                        | 38.053         | 10.5283                        | 24.798         | 59.7285                            | 09.624         | 27.9823                        | 16.218         |
|          | 18.0 | 37.3491                        | 37.394         | 10.8258                        | 23.312         | 59.7749                            | 09.928         | 27.9863                        | 15.049         |
| Lipiec   | 25.0 | 37.5077                        | 37.029         | 11.1176                        | 22.159         | 59.8357                            | 10.508         | 28.0119                        | 13.599         |
|          | 2.0  | 37.7067                        | 36.681         | 11.5016                        | 21.012         | 59.9176                            | 10.917         | 28.0537                        | 12.399         |
|          | 9.0  | 37.9020                        | 36.659         | 11.8768                        | 20.242         | 60.0110                            | 11.609         | 28.1133                        | 10.935         |
|          | 16.0 | 38.1357                        | 36.682         | 12.3415                        | 19.514         | 60.1250                            | 12.146         | 28.1885                        | 09.718         |
| Sierpień | 23.0 | 38.3568                        | 36.917         | 12.7747                        | 19.082         | 60.2476                            | 12.849         | 28.2831                        | 08.362         |
|          | 30.0 | 38.6101                        | 37.245         | 13.2876                        | 18.765         | 60.3871                            | 13.406         | 28.3895                        | 07.279         |
|          | 6.0  | 38.8474                        | 37.798         | 13.7650                        | 18.761         | 60.5315                            | 14.130         | 28.5100                        | 06.077         |
|          | 13.0 | 39.1124                        | 38.468         | 14.3127                        | 18.906         | 60.6905                            | 14.739         | 28.6407                        | 05.120         |
| Wrzesień | 20.0 | 39.3537                        | 39.227         | 14.8057                        | 19.255         | 60.8508                            | 15.374         | 28.7851                        | 04.192         |
|          | 27.0 | 39.6164                        | 40.132         | 15.3592                        | 19.796         | 61.0210                            | 15.899         | 28.9342                        | 03.535         |
|          | 3.0  | 39.8528                        | 41.135         | 15.8553                        | 20.548         | 61.1880                            | 16.458         | 29.0905                        | 02.908         |
|          | 10.0 | 40.1036                        | 42.309         | 16.3968                        | 21.524         | 61.3618                            | 16.956         | 29.2492                        | 02.495         |
| Paźdz.   | 17.0 | 40.3220                        | 43.437         | 16.8652                        | 22.582         | 61.5283                            | 17.345         | 29.4132                        | 02.259         |
|          | 24.0 | 40.5491                        | 44.753         | 17.3701                        | 23.888         | 61.6962                            | 17.685         | 29.5727                        | 02.246         |
|          | 1.0  | 40.7420                        | 46.035         | 17.8008                        | 25.274         | 61.8524                            | 17.942         | 29.7305                        | 02.382         |
|          | 8.0  | 40.9353                        | 47.527         | 18.2485                        | 26.934         | 62.0063                            | 18.219         | 29.8815                        | 02.649         |
| Listopad | 15.0 | 41.0900                        | 48.849         | 18.6104                        | 28.542         | 62.1446                            | 18.288         | 30.0280                        | 03.186         |
|          | 22.0 | 41.2398                        | 50.391         | 18.9807                        | 30.429         | 62.2753                            | 18.401         | 30.1604                        | 03.832         |
|          | 29.0 | 41.3507                        | 51.769         | 19.2657                        | 32.249         | 62.3866                            | 18.348         | 30.2820                        | 04.691         |
|          | 5.0  | 41.4484                        | 53.382         | 19.5381                        | 34.355         | 62.4871                            | 18.419         | 30.3882                        | 05.542         |
| Grudzień | 12.0 | 41.5051                        | 54.713         | 19.7186                        | 36.272         | 62.5654                            | 18.230         | 30.4810                        | 06.685         |
|          | 19.0 | 41.5448                        | 56.279         | 19.8792                        | 38.462         | 62.6285                            | 18.199         | 30.5524                        | 07.772         |
|          | 26.0 | 41.5456                        | 57.553         | 19.9521                        | 40.419         | 62.6675                            | 17.946         | 30.6060                        | 09.080         |
|          | 3.0  | 41.5231                        | 59.053         | 19.9866                        | 42.628         | 62.6897                            | 17.920         | 30.6388                        | 10.212         |
|          | 10.0 | 41.4630                        | 60.174         | 19.9341                        | 44.504         | 62.6871                            | 17.610         | 30.6532                        | 11.607         |
|          | 17.0 | 41.3790                        | 61.508         | 19.8413                        | 46.597         | 62.6655                            | 17.557         | 30.6430                        | 12.772         |
|          | 24.0 | 41.2640                        | 62.435         | 19.6741                        | 48.288         | 62.6200                            | 17.239         | 30.6129                        | 14.141         |
|          | 31.0 | 41.1220                        | 63.537         | 19.4534                        | 50.147         | 62.5565                            | 17.215         | 30.5621                        | 15.187         |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\alpha$ Aurigae                 |                       | $\varepsilon$ Orionis          |                       | $\alpha$ Orionis                    |                       | $\beta$ Aurigae                |                       |
|----------|------|----------------------------------|-----------------------|--------------------------------|-----------------------|-------------------------------------|-----------------------|--------------------------------|-----------------------|
|          |      | 0 <sup>m</sup> 08 <i>Capella</i> | M1                    | 1 <sup>m</sup> 69              | B0                    | 0 <sup>m</sup> 45 <i>Betelgeuse</i> | M2                    | 1 <sup>m</sup> 90              | A2                    |
|          |      | $\alpha_{app}^{CIO}$             | $\delta_{app}$        | $\alpha_{app}^{CIO}$           | $\delta_{app}$        | $\alpha_{app}^{CIO}$                | $\delta_{app}$        | $\alpha_{app}^{CIO}$           | $\delta_{app}$        |
|          |      | 5 <sup>h</sup> 17 <sup>m</sup>   | +46°00'               | 5 <sup>h</sup> 36 <sup>m</sup> | −1°11'                | 5 <sup>h</sup> 55 <sup>m</sup>      | +7°24'                | 5 <sup>h</sup> 59 <sup>m</sup> | +44°56'               |
| Styczeń  | 1.0  | 03. <sup>s</sup> 9855            | 37. <sup>''</sup> 188 | 13. <sup>s</sup> 7309          | 47. <sup>''</sup> 184 | 14. <sup>s</sup> 3294               | 20. <sup>''</sup> 890 | 53. <sup>s</sup> 7034          | 42. <sup>''</sup> 422 |
|          | 8.0  | 03.9269                          | 38.208                | 13.6747                        | 48.067                | 14.2910                             | 20.303                | 53.6857                        | 43.410                |
|          | 15.0 | 03.8208                          | 39.086                | 13.6000                        | 48.961                | 14.2304                             | 19.718                | 53.6193                        | 44.353                |
|          | 22.0 | 03.7098                          | 39.999                | 13.5058                        | 49.709                | 14.1525                             | 19.233                | 53.5465                        | 45.313                |
|          | 29.0 | 03.5543                          | 40.671                | 13.3946                        | 50.490                | 14.0532                             | 18.715                | 53.4255                        | 46.130                |
| Luty     | 5.0  | 03.3914                          | 41.418                | 13.2693                        | 51.012                | 13.9405                             | 18.411                | 53.2956                        | 47.023                |
|          | 12.0 | 03.1941                          | 41.874                | 13.1320                        | 51.605                | 13.8115                             | 18.029                | 53.1263                        | 47.705                |
|          | 19.0 | 03.0009                          | 42.380                | 12.9828                        | 51.954                | 13.6722                             | 17.832                | 52.9582                        | 48.412                |
|          | 26.0 | 02.7810                          | 42.511                | 12.8252                        | 52.405                | 13.5201                             | 17.514                | 52.7564                        | 48.817                |
| Marzec   | 5.0  | 02.5633                          | 42.738                | 12.6629                        | 52.524                | 13.3629                             | 17.476                | 52.5545                        | 49.311                |
|          | 12.0 | 02.3314                          | 42.579                | 12.4979                        | 52.782                | 13.1995                             | 17.277                | 52.3309                        | 49.466                |
|          | 19.0 | 02.1151                          | 42.517                | 12.3310                        | 52.722                | 13.0351                             | 17.332                | 52.1198                        | 49.683                |
| Kwiecień | 26.0 | 01.8944                          | 42.023                | 12.1657                        | 52.828                | 12.8690                             | 17.191                | 51.8957                        | 49.499                |
|          | 2.0  | 01.6865                          | 41.680                | 12.0057                        | 52.557                | 12.7076                             | 17.379                | 51.6824                        | 49.449                |
|          | 9.0  | 01.4856                          | 40.936                | 11.8525                        | 52.476                | 12.5504                             | 17.348                | 51.4679                        | 49.007                |
|          | 16.0 | 01.3087                          | 40.376                | 11.7066                        | 52.022                | 12.4013                             | 17.635                | 51.2758                        | 48.704                |
|          | 23.0 | 01.1477                          | 39.404                | 11.5711                        | 51.776                | 12.2607                             | 17.681                | 51.0910                        | 47.982                |
| Maj      | 30.0 | 01.0060                          | 38.663                | 11.4492                        | 51.133                | 12.1329                             | 18.089                | 50.9253                        | 47.466                |
|          | 7.0  | 00.8880                          | 37.572                | 11.3413                        | 50.708                | 12.0179                             | 18.252                | 50.7760                        | 46.575                |
|          | 14.0 | 00.7963                          | 36.761                | 11.2472                        | 49.887                | 11.9174                             | 18.777                | 50.6536                        | 45.921                |
|          | 21.0 | 00.7344                          | 35.608                | 11.1696                        | 49.297                | 11.8327                             | 19.042                | 50.5539                        | 44.887                |
|          | 28.0 | 00.6920                          | 34.755                | 11.1105                        | 48.329                | 11.7654                             | 19.674                | 50.4758                        | 44.133                |
| Czerwiec | 4.0  | 00.6831                          | 33.636                | 11.0690                        | 47.598                | 11.7163                             | 20.051                | 50.4260                        | 43.063                |
|          | 11.0 | 00.6960                          | 32.859                | 11.0447                        | 46.495                | 11.6842                             | 20.789                | 50.4010                        | 42.304                |
|          | 18.0 | 00.7454                          | 31.834                | 11.0391                        | 45.637                | 11.6717                             | 21.267                | 50.4077                        | 41.241                |
| Lipiec   | 25.0 | 00.8086                          | 31.132                | 11.0534                        | 44.471                | 11.6776                             | 22.067                | 50.4322                        | 40.494                |
|          | 2.0  | 00.9086                          | 30.251                | 11.0856                        | 43.559                | 11.7031                             | 22.606                | 50.4906                        | 39.503                |
|          | 9.0  | 01.0214                          | 29.716                | 11.1346                        | 42.360                | 11.7448                             | 23.451                | 50.5668                        | 38.848                |
|          | 16.0 | 01.1711                          | 29.031                | 11.2011                        | 41.410                | 11.8060                             | 24.044                | 50.6775                        | 37.977                |
|          | 23.0 | 01.3247                          | 28.634                | 11.2854                        | 40.275                | 11.8832                             | 24.860                | 50.7977                        | 37.406                |
| Sierpień | 30.0 | 01.5129                          | 28.136                | 11.3842                        | 39.411                | 11.9778                             | 25.413                | 50.9519                        | 36.664                |
|          | 6.0  | 01.7028                          | 27.934                | 11.4962                        | 38.385                | 12.0847                             | 26.166                | 51.1138                        | 36.229                |
|          | 13.0 | 01.9247                          | 27.673                | 11.6212                        | 37.601                | 12.2075                             | 26.687                | 51.3078                        | 35.667                |
|          | 20.0 | 02.1390                          | 27.616                | 11.7586                        | 36.785                | 12.3407                             | 27.298                | 51.5003                        | 35.342                |
|          | 27.0 | 02.3818                          | 27.532                | 11.9043                        | 36.235                | 12.4861                             | 27.658                | 51.7227                        | 34.920                |
| Wrzesień | 3.0  | 02.6144                          | 27.655                | 12.0566                        | 35.664                | 12.6371                             | 28.094                | 51.9410                        | 34.735                |
|          | 10.0 | 02.8704                          | 27.806                | 12.2148                        | 35.299                | 12.7976                             | 28.339                | 52.1850                        | 34.515                |
|          | 17.0 | 03.1072                          | 28.056                | 12.3773                        | 35.048                | 12.9607                             | 28.540                | 52.4155                        | 34.444                |
|          | 24.0 | 03.3632                          | 28.355                | 12.5397                        | 35.016                | 13.1281                             | 28.539                | 52.6682                        | 34.359                |
| Paźdz.   | 1.0  | 03.5972                          | 28.757                | 12.7000                        | 35.081                | 13.2925                             | 28.501                | 52.9045                        | 34.422                |
|          | 8.0  | 03.8435                          | 29.274                | 12.8573                        | 35.273                | 13.4580                             | 28.352                | 53.1569                        | 34.551                |
|          | 15.0 | 04.0598                          | 29.787                | 13.0095                        | 35.677                | 13.6168                             | 28.060                | 53.3839                        | 34.736                |
|          | 22.0 | 04.2834                          | 30.432                | 13.1521                        | 36.193                | 13.7707                             | 27.668                | 53.6225                        | 35.005                |
|          | 29.0 | 04.4743                          | 31.073                | 13.2836                        | 36.879                | 13.9125                             | 27.161                | 53.8324                        | 35.330                |
| Listopad | 5.0  | 04.6650                          | 31.913                | 13.4032                        | 37.560                | 14.0462                             | 26.669                | 54.0468                        | 35.821                |
|          | 12.0 | 04.8167                          | 32.653                | 13.5089                        | 38.489                | 14.1644                             | 25.986                | 54.2251                        | 36.285                |
|          | 19.0 | 04.9633                          | 33.602                | 13.5967                        | 39.373                | 14.2690                             | 25.348                | 54.4027                        | 36.929                |
|          | 26.0 | 05.0692                          | 34.435                | 13.6663                        | 40.451                | 14.3538                             | 24.556                | 54.5414                        | 37.529                |
| Grudzień | 3.0  | 05.1630                          | 35.524                | 13.7174                        | 41.366                | 14.4231                             | 23.927                | 54.6724                        | 38.376                |
|          | 10.0 | 05.2133                          | 36.417                | 13.7491                        | 42.518                | 14.4709                             | 23.094                | 54.7603                        | 39.106                |
|          | 17.0 | 05.2483                          | 37.558                | 13.7585                        | 43.461                | 14.4995                             | 22.458                | 54.8366                        | 40.080                |
|          | 24.0 | 05.2412                          | 38.459                | 13.7467                        | 44.601                | 14.5045                             | 21.643                | 54.8692                        | 40.890                |
|          | 31.0 | 05.2138                          | 39.622                | 13.7149                        | 45.437                | 14.4909                             | 21.116                | 54.8846                        | 41.977                |



**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |        | $\alpha$ Canis Majoris A*)     |                | 24H Camelopardalis             |                | $\beta$ Geminorum              |                | $\iota$ Ursae Majoris          |                |
|----------|--------|--------------------------------|----------------|--------------------------------|----------------|--------------------------------|----------------|--------------------------------|----------------|
|          |        | –1 <sup>m</sup> 44             | Sirius A0      | 4 <sup>m</sup> 55              | K4             | 1 <sup>m</sup> 16              | Pollux K0      | 3 <sup>m</sup> 12              | A7             |
|          |        | $\alpha_{app}^{CIO}$           | $\delta_{app}$ | $\alpha_{app}^{CIO}$           | $\delta_{app}$ | $\alpha_{app}^{CIO}$           | $\delta_{app}$ | $\alpha_{app}^{CIO}$           | $\delta_{app}$ |
|          |        | 6 <sup>h</sup> 45 <sup>m</sup> | –16°44′        | 7 <sup>h</sup> 01 <sup>m</sup> | +76°56′        | 7 <sup>h</sup> 45 <sup>m</sup> | +27°58′        | 8 <sup>h</sup> 59 <sup>m</sup> | +47°58′        |
| Styczeń  | 1.0    | 03.6623                        | 27.461         | 33.7661                        | 67.004         | 29.1958                        | 66.200         | 28.8442                        | 36.993         |
|          | 8.0    | 03.6361                        | 29.129         | 33.9433                        | 68.986         | 29.2495                        | 66.223         | 28.9947                        | 37.483         |
|          | 15.0   | 03.5954                        | 30.709         | 33.9420                        | 71.051         | 29.2706                        | 66.433         | 29.1019                        | 38.323         |
|          | 22.0   | 03.5261                        | 32.230         | 33.9423                        | 73.073         | 29.2790                        | 66.611         | 29.2005                        | 39.106         |
|          | 29.0   | 03.4422                        | 33.656         | 33.7529                        | 75.039         | 29.2513                        | 66.918         | 29.2464                        | 40.172         |
| Luty     | 5.0    | 03.3360                        | 34.846         | 33.5472                        | 77.000         | 29.2100                        | 67.319         | 29.2805                        | 41.289         |
|          | 12.0   | 03.2196                        | 35.976         | 33.1742                        | 78.802         | 29.1367                        | 67.771         | 29.2636                        | 42.585         |
|          | 19.0   | 03.0808                        | 36.908         | 32.8183                        | 80.497         | 29.0538                        | 68.225         | 29.2385                        | 43.803         |
|          | 26.0   | 02.9339                        | 37.798         | 32.3036                        | 81.896         | 28.9392                        | 68.651         | 29.1587                        | 45.100         |
|          | 5.0    | 02.7737                        | 38.337         | 31.7922                        | 83.248         | 28.8165                        | 69.204         | 29.0705                        | 46.429         |
| Marzec   | 12.0   | 02.6109                        | 38.883         | 31.1595                        | 84.233         | 28.6695                        | 69.653         | 28.9349                        | 47.727         |
|          | 19.0   | 02.4354                        | 39.130         | 30.5764                        | 85.097         | 28.5209                        | 70.136         | 28.7992                        | 48.923         |
|          | 26.0   | 02.2602                        | 39.412         | 29.8950                        | 85.494         | 28.3516                        | 70.440         | 28.6179                        | 49.984         |
|          | 2.0    | 02.0827                        | 39.275         | 29.2499                        | 85.855         | 28.1834                        | 70.901         | 28.4383                        | 51.062         |
|          | 9.0    | 01.9108                        | 39.221         | 28.5494                        | 85.738         | 28.0032                        | 71.131         | 28.2246                        | 51.922         |
| Kwiecień | 16.0   | 01.7367                        | 38.798         | 27.9318                        | 85.562         | 27.8313                        | 71.453         | 28.0232                        | 52.697         |
|          | 23.0   | 01.5712                        | 38.486         | 27.2855                        | 84.852         | 27.6523                        | 71.487         | 27.7926                        | 53.172         |
|          | 30.0   | 01.4136                        | 37.726         | 26.7047                        | 84.185         | 27.4838                        | 71.725         | 27.5763                        | 53.687         |
|          | 7.0    | 01.2685                        | 37.120         | 26.1340                        | 83.028         | 27.3165                        | 71.658         | 27.3434                        | 53.861         |
|          | 14.0   | 01.1309                        | 36.108         | 25.6641                        | 81.936         | 27.1656                        | 71.760         | 27.1349                        | 54.019         |
| Maj      | 21.0   | 01.0078                        | 35.275         | 25.2269                        | 80.336         | 27.0201                        | 71.522         | 26.9152                        | 53.783         |
|          | 28.0   | 00.9011                        | 34.010         | 24.8664                        | 78.895         | 26.8920                        | 71.542         | 26.7201                        | 53.649         |
|          | 4.0    | 00.8111                        | 32.962         | 24.5673                        | 77.027         | 26.7761                        | 71.226         | 26.5256                        | 53.118         |
|          | 11.0   | 00.7358                        | 31.524         | 24.3654                        | 75.357         | 26.6808                        | 71.151         | 26.3626                        | 52.666         |
|          | 18.0   | 00.6783                        | 30.324         | 24.2395                        | 73.273         | 26.6005                        | 70.727         | 26.2048                        | 51.797         |
| Czerwiec | 25.0   | 00.6425                        | 28.759         | 24.1799                        | 71.453         | 26.5401                        | 70.594         | 26.0760                        | 51.103         |
|          | 2.0    | 00.6246                        | 27.476         | 24.2144                        | 69.309         | 26.4992                        | 70.125         | 25.9617                        | 50.008         |
|          | 9.0    | 00.6253                        | 25.879         | 24.3232                        | 67.466         | 26.4790                        | 69.932         | 25.8801                        | 49.081         |
|          | 16.0   | 00.6436                        | 24.569         | 24.5327                        | 65.334         | 26.4793                        | 69.411         | 25.8161                        | 47.761         |
|          | 23.0   | 00.6856                        | 23.018         | 24.7801                        | 63.533         | 26.4979                        | 69.175         | 25.7795                        | 46.678         |
| Lipiec   | 30.0   | 00.7432                        | 21.809         | 25.1374                        | 61.523         | 26.5394                        | 68.615         | 25.7668                        | 45.221         |
|          | 6.0    | 00.8194                        | 20.412         | 25.5340                        | 59.868         | 26.5981                        | 68.320         | 25.7824                        | 43.991         |
|          | 13.0   | 00.9096                        | 19.336         | 26.0395                        | 58.059         | 26.6793                        | 67.738         | 25.8238                        | 42.426         |
|          | 20.0   | 01.0214                        | 18.180         | 26.5446                        | 56.601         | 26.7735                        | 67.397         | 25.8856                        | 41.130         |
|          | 27.0   | 01.1429                        | 17.403         | 27.1612                        | 55.052         | 26.8901                        | 66.763         | 25.9765                        | 39.512         |
| Sierpień | 3.0    | 01.2789                        | 16.589         | 27.7769                        | 53.861         | 27.0172                        | 66.345         | 26.0872                        | 38.150         |
|          | 10.0   | 01.4219                        | 16.097         | 28.4960                        | 52.654         | 27.1649                        | 65.701         | 26.2273                        | 36.535         |
|          | 17.0   | 01.5802                        | 15.682         | 29.1734                        | 51.775         | 27.3177                        | 65.230         | 26.3774                        | 35.197         |
|          | 24.0   | 01.7391                        | 15.636         | 29.9521                        | 50.923         | 27.4890                        | 64.524         | 26.5577                        | 33.617         |
|          | Paźdz. | 1.0                            | 01.9048        | 30.6871                        | 50.397         | 27.6617                        | 63.974         | 26.7455                        | 32.299         |
| Wrzesień | 8.0    | 02.0678                        | 15.998         | 31.5085                        | 49.985         | 27.8496                        | 63.286         | 26.9623                        | 30.837         |
|          | 15.0   | 02.2367                        | 16.503         | 32.2476                        | 49.849         | 28.0327                        | 62.707         | 27.1760                        | 29.647         |
|          | 22.0   | 02.3951                        | 17.290         | 33.0661                        | 49.858         | 28.2274                        | 61.993         | 27.4168                        | 28.329         |
|          | 29.0   | 02.5507                        | 18.245         | 33.7970                        | 50.126         | 28.4124                        | 61.383         | 27.6502                        | 27.273         |
|          | 5.0    | 02.6929                        | 19.342         | 34.5862                        | 50.620         | 28.6046                        | 60.756         | 27.9073                        | 26.205         |
| Listopad | 12.0   | 02.8306                        | 20.668         | 35.2546                        | 51.313         | 28.7810                        | 60.193         | 28.1464                        | 25.399         |
|          | 19.0   | 02.9474                        | 22.111         | 35.9698                        | 52.245         | 28.9598                        | 59.631         | 28.4051                        | 24.604         |
|          | 26.0   | 03.0524                        | 23.733         | 36.5553                        | 53.328         | 29.1174                        | 59.129         | 28.6392                        | 24.058         |
|          | 3.0    | 03.1355                        | 25.311         | 37.1617                        | 54.706         | 29.2728                        | 58.750         | 28.8872                        | 23.639         |
|          | 10.0   | 03.2057                        | 27.095         | 37.6159                        | 56.164         | 29.4022                        | 58.398         | 29.1019                        | 23.454         |
| Grudzień | 17.0   | 03.2485                        | 28.792         | 38.0791                        | 57.898         | 29.5247                        | 58.182         | 29.3249                        | 23.407         |
|          | 24.0   | 03.2740                        | 30.640         | 38.3831                        | 59.618         | 29.6168                        | 57.971         | 29.5069                        | 23.554         |
|          | 31.0   | 03.2744                        | 32.251         | 38.6686                        | 61.633         | 29.6979                        | 58.000         | 29.6902                        | 23.937         |

\*) Podwójna; efemerydy dotyczą gwiazdy jaśniejszej.

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\alpha$ Hydrae                |                | $\alpha$ Leonis                 |                   | 9H Draconis                     |                | $\beta$ Ursae Maioris           |                |
|----------|------|--------------------------------|----------------|---------------------------------|-------------------|---------------------------------|----------------|---------------------------------|----------------|
|          |      | 1 <sup>m</sup> 99              | K3             | 1 <sup>m</sup> 36               | <i>Regulus</i> B7 | 4 <sup>m</sup> 86               | K0             | 2 <sup>m</sup> 34               | A1             |
|          |      | $\alpha_{app}^{CIO}$           | $\delta_{app}$ | $\alpha_{app}^{CIO}$            | $\delta_{app}$    | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | $\alpha_{app}^{CIO}$            | $\delta_{app}$ |
|          |      | 9 <sup>h</sup> 27 <sup>m</sup> | −8°43′         | 10 <sup>h</sup> 08 <sup>m</sup> | +11°53′           | 10 <sup>h</sup> 35 <sup>m</sup> | +75°37′        | 11 <sup>h</sup> 01 <sup>m</sup> | +56°17′        |
| Styczeń  | 1.0  | 34.4388                        | 34.036         | 24.7818                         | 25.118            | 34.1921                         | 42.957         | 58.2555                         | 45.262         |
|          | 8.0  | 34.5294                        | 35.703         | 24.9034                         | 24.002            | 34.7765                         | 43.523         | 58.5236                         | 45.123         |
|          | 15.0 | 34.6059                        | 37.124         | 25.0088                         | 23.239            | 35.2805                         | 44.626         | 58.7646                         | 45.528         |
|          | 22.0 | 34.6617                        | 38.742         | 25.1009                         | 22.307            | 35.7732                         | 45.691         | 58.9978                         | 45.876         |
|          | 29.0 | 34.6994                        | 40.096         | 25.1708                         | 21.735            | 36.1477                         | 47.246         | 59.1875                         | 46.753         |
| Luty     | 5.0  | 34.7151                        | 41.430         | 25.2251                         | 21.172            | 36.5067                         | 48.841         | 59.3675                         | 47.676         |
|          | 12.0 | 34.7147                        | 42.531         | 25.2572                         | 20.916            | 36.7365                         | 50.808         | 59.4981                         | 49.029         |
|          | 19.0 | 34.6915                        | 43.702         | 25.2731                         | 20.560            | 36.9464                         | 52.663         | 59.6152                         | 50.289         |
|          | 26.0 | 34.6509                        | 44.655         | 25.2636                         | 20.476            | 37.0007                         | 54.789         | 59.6706                         | 51.909         |
| Marzec   | 5.0  | 34.5895                        | 45.461         | 25.2381                         | 20.471            | 37.0385                         | 56.885         | 59.7142                         | 53.534         |
|          | 12.0 | 34.5147                        | 46.107         | 25.1903                         | 20.656            | 36.9262                         | 59.108         | 59.6971                         | 55.386         |
|          | 19.0 | 34.4205                        | 46.721         | 25.1285                         | 20.785            | 36.8065                         | 61.130         | 59.6699                         | 57.076         |
|          | 26.0 | 34.3136                        | 47.211         | 25.0439                         | 21.044            | 36.5266                         | 63.160         | 59.5763                         | 58.891         |
| Kwiecień | 2.0  | 34.1917                        | 47.469         | 24.9479                         | 21.419            | 36.2499                         | 65.081         | 59.4780                         | 60.647         |
|          | 9.0  | 34.0628                        | 47.669         | 24.8348                         | 21.838            | 35.8347                         | 66.886         | 59.3213                         | 62.400         |
|          | 16.0 | 33.9211                        | 47.748         | 24.7139                         | 22.246            | 35.4435                         | 68.439         | 59.1667                         | 63.943         |
|          | 23.0 | 33.7742                        | 47.814         | 24.5774                         | 22.633            | 34.9165                         | 69.770         | 58.9537                         | 65.385         |
| Maj      | 30.0 | 33.6205                        | 47.584         | 24.4371                         | 23.170            | 34.4262                         | 70.962         | 58.7498                         | 66.731         |
|          | 7.0  | 33.4676                        | 47.402         | 24.2879                         | 23.614            | 33.8321                         | 71.850         | 58.5003                         | 67.877         |
|          | 14.0 | 33.3102                        | 47.017         | 24.1390                         | 24.109            | 33.2996                         | 72.511         | 58.2692                         | 68.825         |
|          | 21.0 | 33.1557                        | 46.721         | 23.9835                         | 24.458            | 32.6725                         | 72.796         | 57.9955                         | 69.499         |
| Czerwiec | 28.0 | 33.0033                        | 46.084         | 23.8326                         | 24.999            | 32.1150                         | 72.978         | 57.7459                         | 70.095         |
|          | 4.0  | 32.8591                        | 45.591         | 23.6818                         | 25.338            | 31.4979                         | 72.750         | 57.4684                         | 70.360         |
|          | 11.0 | 32.7188                        | 44.836         | 23.5391                         | 25.797            | 30.9716                         | 72.383         | 57.2235                         | 70.491         |
|          | 18.0 | 32.5885                        | 44.256         | 23.3988                         | 26.019            | 30.3969                         | 71.571         | 56.9550                         | 70.249         |
| Lipiec   | 25.0 | 32.4684                        | 43.320         | 23.2702                         | 26.472            | 29.9120                         | 70.746         | 56.7216                         | 69.994         |
|          | 2.0  | 32.3626                        | 42.617         | 23.1498                         | 26.642            | 29.4104                         | 69.475         | 56.4782                         | 69.338         |
|          | 9.0  | 32.2676                        | 41.635         | 23.0434                         | 26.984            | 29.0125                         | 68.187         | 56.2757                         | 68.646         |
|          | 16.0 | 32.1879                        | 40.902         | 22.9469                         | 27.027            | 28.6094                         | 66.454         | 56.0682                         | 67.543         |
| Sierpień | 23.0 | 32.1245                        | 39.840         | 22.8670                         | 27.322            | 28.2988                         | 64.821         | 55.9000                         | 66.518         |
|          | 30.0 | 32.0792                        | 39.097         | 22.8014                         | 27.270            | 28.0076                         | 62.762         | 55.7377                         | 65.071         |
|          | 6.0  | 32.0493                        | 38.110         | 22.7530                         | 27.408            | 27.8159                         | 60.807         | 55.6179                         | 63.689         |
|          | 13.0 | 32.0371                        | 37.436         | 22.7199                         | 27.208            | 27.6556                         | 58.461         | 55.5090                         | 61.908         |
| Wrzesień | 20.0 | 32.0447                        | 36.506         | 22.7051                         | 27.250            | 27.5744                         | 56.324         | 55.4372                         | 60.295         |
|          | 27.0 | 32.0708                        | 35.972         | 22.7078                         | 26.901            | 27.5410                         | 53.819         | 55.3840                         | 58.280         |
|          | 3.0  | 32.1138                        | 35.272         | 22.7283                         | 26.723            | 27.5892                         | 51.527         | 55.3688                         | 56.420         |
|          | 10.0 | 32.1736                        | 34.931         | 22.7663                         | 26.193            | 27.6970                         | 48.932         | 55.3774                         | 54.211         |
| Paźdz.   | 17.0 | 32.2528                        | 34.436         | 22.8215                         | 25.867            | 27.8593                         | 46.641         | 55.4154                         | 52.250         |
|          | 24.0 | 32.3472                        | 34.385         | 22.8947                         | 25.133            | 28.0909                         | 44.075         | 55.4817                         | 49.945         |
|          | 1.0  | 32.4561                        | 34.260         | 22.9822                         | 24.542            | 28.3753                         | 41.812         | 55.5762                         | 47.876         |
|          | 8.0  | 32.5766                        | 34.501         | 23.0860                         | 23.619            | 28.7386                         | 39.365         | 55.7033                         | 45.545         |
| Listopad | 15.0 | 32.7121                        | 34.686         | 23.2021                         | 22.860            | 29.1245                         | 37.300         | 55.8482                         | 43.531         |
|          | 22.0 | 32.8556                        | 35.300         | 23.3329                         | 21.730            | 29.5925                         | 35.082         | 56.0272                         | 41.273         |
|          | 29.0 | 33.0071                        | 35.906         | 23.4713                         | 20.726            | 30.0754                         | 33.247         | 56.2199                         | 39.330         |
|          | 5.0  | 33.1618                        | 36.821         | 23.6211                         | 19.463            | 30.6447                         | 31.368         | 56.4485                         | 37.248         |
| Grudzień | 12.0 | 33.3232                        | 37.735         | 23.7752                         | 18.346            | 31.1983                         | 29.927         | 56.6795                         | 35.547         |
|          | 19.0 | 33.4824                        | 38.982         | 23.9371                         | 16.963            | 31.8341                         | 28.479         | 56.9445                         | 33.739         |
|          | 26.0 | 33.6407                        | 40.238         | 24.0969                         | 15.714            | 32.4372                         | 27.465         | 57.2038                         | 32.315         |
|          | 3.0  | 33.7917                        | 41.669         | 24.2601                         | 14.340            | 33.1179                         | 26.551         | 57.4951                         | 30.902         |
|          | 10.0 | 33.9398                        | 43.103         | 24.4175                         | 13.120            | 33.7378                         | 26.092         | 57.7694                         | 29.911         |
|          | 17.0 | 34.0750                        | 44.705         | 24.5737                         | 11.785            | 34.4232                         | 25.755         | 58.0703                         | 28.957         |
|          | 24.0 | 34.2001                        | 46.300         | 24.7170                         | 10.601            | 35.0216                         | 25.839         | 58.3418                         | 28.414         |
|          | 31.0 | 34.3089                        | 47.881         | 24.8546                         | 09.461            | 35.6718                         | 26.137         | 58.6343                         | 28.022         |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\alpha$ Ursae Maioris          |                      | $\gamma$ Ursae Maioris |                                 | $\varepsilon$ Ursae Maioris |                                 | $\zeta$ Ursae Maioris |                                 |                |
|----------|------|---------------------------------|----------------------|------------------------|---------------------------------|-----------------------------|---------------------------------|-----------------------|---------------------------------|----------------|
|          |      | 1 <sup>m</sup> 81               | Dubhe                | F7                     | 2 <sup>m</sup> 41               | A0                          | 1 <sup>m</sup> 76               | A0p                   | 2 <sup>m</sup> 23               | A2             |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$       |                        | $\alpha_{app}^{CIO}$            | $\delta_{app}$              | $\alpha_{app}^{CIO}$            | $\delta_{app}$        | $\alpha_{app}^{CIO}$            | $\delta_{app}$ |
|          |      | 11 <sup>h</sup> 03 <sup>m</sup> | +61°39'              |                        | 11 <sup>h</sup> 53 <sup>m</sup> | +53°36'                     | 12 <sup>h</sup> 53 <sup>m</sup> | +55°52'               | 13 <sup>h</sup> 23 <sup>m</sup> | +54°50'        |
| Styczeń  | 1.0  | 52. <sup>s</sup> 4268           | 49. <sup>″</sup> 815 | 50. <sup>s</sup> 2975  | 21. <sup>″</sup> 343            | 53. <sup>s</sup> 8543       | 25. <sup>″</sup> 433            | 44. <sup>s</sup> 1225 | 34. <sup>″</sup> 593            |                |
|          | 8.0  | 52.7420                         | 49.791               | 50.5590                | 20.706                          | 54.1271                     | 24.337                          | 44.3798               | 33.245                          |                |
|          | 15.0 | 53.0256                         | 50.323               | 50.8090                | 20.641                          | 54.4051                     | 23.823                          | 44.6503               | 32.465                          |                |
|          | 22.0 | 53.3011                         | 50.806               | 51.0519                | 20.517                          | 54.6770                     | 23.266                          | 44.9156               | 31.646                          |                |
|          | 29.0 | 53.5253                         | 51.827               | 51.2675                | 20.984                          | 54.9374                     | 23.343                          | 45.1787               | 31.465                          |                |
| Luty     | 5.0  | 53.7394                         | 52.896               | 51.4751                | 21.495                          | 55.1922                     | 23.470                          | 45.4376               | 31.332                          |                |
|          | 12.0 | 53.8950                         | 54.398               | 51.6472                | 22.516                          | 55.4243                     | 24.171                          | 45.6821               | 31.791                          |                |
|          | 19.0 | 54.0358                         | 55.808               | 51.8047                | 23.454                          | 55.6400                     | 24.814                          | 45.9107               | 32.204                          |                |
|          | 26.0 | 54.1032                         | 57.575               | 51.9135                | 24.858                          | 55.8171                     | 26.019                          | 46.1093               | 33.213                          |                |
| Marzec   | 5.0  | 54.1582                         | 59.341               | 52.0098                | 26.274                          | 55.9816                     | 27.243                          | 46.2957               | 34.248                          |                |
|          | 12.0 | 54.1406                         | 61.329               | 52.0550                | 28.029                          | 56.1007                     | 28.912                          | 46.4438               | 35.772                          |                |
|          | 19.0 | 54.1123                         | 63.146               | 52.0856                | 29.632                          | 56.2002                     | 30.447                          | 46.5708               | 37.178                          |                |
|          | 26.0 | 54.0044                         | 65.078               | 52.0572                | 31.488                          | 56.2433                     | 32.361                          | 46.6478               | 39.022                          |                |
| Kwiecień | 2.0  | 53.8925                         | 66.937               | 52.0202                | 33.285                          | 56.2742                     | 34.212                          | 46.7113               | 40.806                          |                |
|          | 9.0  | 53.7101                         | 68.781               | 51.9284                | 35.198                          | 56.2489                     | 36.301                          | 46.7229               | 42.890                          |                |
|          | 16.0 | 53.5318                         | 70.400               | 51.8312                | 36.893                          | 56.2104                     | 38.166                          | 46.7179               | 44.759                          |                |
|          | 23.0 | 53.2827                         | 71.903               | 51.6767                | 38.611                          | 56.1102                     | 40.185                          | 46.6544               | 46.850                          |                |
| Maj      | 30.0 | 53.0459                         | 73.291               | 51.5246                | 40.212                          | 56.0069                     | 42.056                          | 46.5845               | 48.788                          |                |
|          | 7.0  | 52.7535                         | 74.465               | 51.3250                | 41.720                          | 55.8486                     | 43.948                          | 46.4609               | 50.812                          |                |
|          | 14.0 | 52.4845                         | 75.421               | 51.1344                | 42.991                          | 55.6911                     | 45.563                          | 46.3330               | 52.552                          |                |
|          | 21.0 | 52.1633                         | 76.089               | 50.8973                | 44.093                          | 55.4775                     | 47.124                          | 46.1492               | 54.305                          |                |
| Czerwiec | 28.0 | 51.8721                         | 76.658               | 50.6766                | 45.071                          | 55.2748                     | 48.498                          | 45.9718               | 55.852                          |                |
|          | 4.0  | 51.5460                         | 76.882               | 50.4218                | 45.796                          | 55.0268                     | 49.711                          | 45.7476               | 57.295                          |                |
|          | 11.0 | 51.2600                         | 76.954               | 50.1905                | 46.325                          | 54.7956                     | 50.656                          | 45.5347               | 58.446                          |                |
|          | 18.0 | 50.9443                         | 76.640               | 49.9283                | 46.553                          | 54.5212                     | 51.386                          | 45.2763               | 59.438                          |                |
| Lipiec   | 25.0 | 50.6712                         | 76.296               | 49.6944                | 46.705                          | 54.2716                     | 51.953                          | 45.0380               | 60.235                          |                |
|          | 2.0  | 50.3845                         | 75.541               | 49.4420                | 46.502                          | 53.9906                     | 52.231                          | 44.7650               | 60.787                          |                |
|          | 9.0  | 50.1475                         | 74.736               | 49.2236                | 46.187                          | 53.7400                     | 52.301                          | 44.5173               | 61.094                          |                |
|          | 16.0 | 49.9028                         | 73.511               | 48.9909                | 45.498                          | 53.4624                     | 52.053                          | 44.2386               | 61.123                          |                |
| Sierpień | 23.0 | 49.7053                         | 72.353               | 48.7937                | 44.816                          | 53.2197                     | 51.716                          | 43.9911               | 61.022                          |                |
|          | 30.0 | 49.5130                         | 70.770               | 48.5928                | 43.730                          | 52.9608                     | 51.010                          | 43.7230               | 60.583                          |                |
|          | 6.0  | 49.3717                         | 69.244               | 48.4307                | 42.629                          | 52.7407                     | 50.192                          | 43.4898               | 59.986                          |                |
|          | 13.0 | 49.2420                         | 67.316               | 48.2703                | 41.134                          | 52.5107                     | 49.001                          | 43.2420               | 59.039                          |                |
| Wrzesień | 20.0 | 49.1562                         | 65.554               | 48.1466                | 39.740                          | 52.3205                     | 47.823                          | 43.0320               | 58.061                          |                |
|          | 27.0 | 49.0909                         | 63.393               | 48.0324                | 37.934                          | 52.1290                     | 46.241                          | 42.8158               | 56.694                          |                |
|          | 3.0  | 49.0708                         | 61.388               | 47.9563                | 36.211                          | 51.9792                     | 44.654                          | 42.6394               | 55.276                          |                |
|          | 10.0 | 49.0778                         | 59.040               | 47.8957                | 34.114                          | 51.8358                     | 42.684                          | 42.4646               | 53.480                          |                |
| Paźdz.   | 17.0 | 49.1191                         | 56.945               | 47.8682                | 32.211                          | 51.7322                     | 40.836                          | 42.3297               | 51.763                          |                |
|          | 24.0 | 49.1930                         | 54.516               | 47.8614                | 29.927                          | 51.6411                     | 38.592                          | 42.2026               | 49.648                          |                |
|          | 1.0  | 49.3002                         | 52.333               | 47.8870                | 27.823                          | 51.5898                     | 36.458                          | 42.1157               | 47.602                          |                |
|          | 8.0  | 49.4454                         | 49.900               | 47.9388                | 25.405                          | 51.5591                     | 33.975                          | 42.0451               | 45.194                          |                |
| Listopad | 15.0 | 49.6110                         | 47.798               | 48.0160                | 23.270                          | 51.5638                     | 31.725                          | 42.0123               | 42.982                          |                |
|          | 22.0 | 49.8167                         | 45.467               | 48.1219                | 20.830                          | 51.5930                     | 29.131                          | 41.9999               | 40.408                          |                |
|          | 29.0 | 50.0383                         | 43.468               | 48.2498                | 18.672                          | 51.6549                     | 26.776                          | 42.0234               | 38.040                          |                |
|          | 5.0  | 50.3028                         | 41.346               | 48.4100                | 16.305                          | 51.7478                     | 24.154                          | 42.0745               | 35.375                          |                |
| Grudzień | 12.0 | 50.5695                         | 39.624               | 48.5837                | 14.306                          | 51.8671                     | 21.880                          | 42.1569               | 33.030                          |                |
|          | 19.0 | 50.8771                         | 37.813               | 48.7891                | 12.127                          | 52.0181                     | 19.367                          | 42.2685               | 30.416                          |                |
|          | 26.0 | 51.1776                         | 36.406               | 49.0007                | 10.331                          | 52.1888                     | 17.229                          | 42.4052               | 28.156                          |                |
|          | 3.0  | 51.5174                         | 35.026               | 49.2439                | 08.469                          | 52.3942                     | 14.955                          | 42.5751               | 25.720                          |                |
|          | 10.0 | 51.8364                         | 34.087               | 49.4840                | 07.048                          | 52.6108                     | 13.136                          | 42.7632               | 23.726                          |                |
|          | 17.0 | 52.1886                         | 33.202               | 49.7514                | 05.594                          | 52.8588                     | 11.220                          | 42.9818               | 21.598                          |                |
|          | 24.0 | 52.5056                         | 32.745               | 50.0036                | 04.590                          | 53.1059                     | 09.791                          | 43.2073               | 19.956                          |                |
|          | 31.0 | 52.8494                         | 32.452               | 50.2795                | 03.672                          | 53.3830                     | 08.382                          | 43.4630               | 18.294                          |                |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\alpha$ Virginis               |                     | $\eta$ Ursae Majoris            |                     | 4 Ursae Minoris                 |                     | $\alpha$ Bootis                 |                     |
|----------|------|---------------------------------|---------------------|---------------------------------|---------------------|---------------------------------|---------------------|---------------------------------|---------------------|
|          |      | 0 <sup>m</sup> 98               | <i>Spica</i> B1     | 1 <sup>m</sup> 85               | B3                  | 4 <sup>m</sup> 80               | K3                  | −0 <sup>m</sup> 05              | <i>Arcturus</i> K2  |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$      | $\alpha_{app}^{CIO}$            | $\delta_{app}$      | $\alpha_{app}^{CIO}$            | $\delta_{app}$      | $\alpha_{app}^{CIO}$            | $\delta_{app}$      |
|          |      | 13 <sup>h</sup> 25 <sup>m</sup> | −11°14′             | 13 <sup>h</sup> 47 <sup>m</sup> | +49°13′             | 14 <sup>h</sup> 07 <sup>m</sup> | +77°28′             | 14 <sup>h</sup> 15 <sup>m</sup> | +19°05′             |
| Styczeń  | 1.0  | 12 <sup>s</sup> 8169            | 16 <sup>″</sup> 903 | 20 <sup>s</sup> 3350            | 66 <sup>″</sup> 231 | 57 <sup>s</sup> 3579            | 21 <sup>″</sup> 639 | 33 <sup>s</sup> 8122            | 73 <sup>″</sup> 611 |
|          | 8.0  | 12.9768                         | 18.397              | 20.5538                         | 64.658              | 57.9725                         | 20.206              | 33.9611                         | 71.861              |
|          | 15.0 | 13.1378                         | 19.615              | 20.7892                         | 63.621              | 58.6618                         | 19.340              | 34.1209                         | 70.509              |
|          | 22.0 | 13.3002                         | 21.173              | 21.0212                         | 62.537              | 59.3345                         | 18.479              | 34.2829                         | 69.000              |
|          | 29.0 | 13.4581                         | 22.391              | 21.2569                         | 62.074              | 60.0419                         | 18.271              | 34.4487                         | 67.981              |
| Luty     | 5.0  | 13.6085                         | 23.814              | 21.4896                         | 61.647              | 60.7455                         | 18.128              | 34.6127                         | 66.896              |
|          | 12.0 | 13.7518                         | 24.876              | 21.7152                         | 61.811              | 61.4456                         | 18.601              | 34.7746                         | 66.306              |
|          | 19.0 | 13.8859                         | 26.211              | 21.9271                         | 61.932              | 62.1013                         | 19.062              | 34.9295                         | 65.595              |
|          | 26.0 | 14.0082                         | 27.151              | 22.1184                         | 62.665              | 62.7087                         | 20.159              | 35.0748                         | 65.425              |
| Marzec   | 5.0  | 14.1140                         | 28.209              | 22.2985                         | 63.423              | 63.2907                         | 21.283              | 35.2102                         | 65.219              |
|          | 12.0 | 14.2069                         | 28.889              | 22.4500                         | 64.700              | 63.7929                         | 22.940              | 35.3316                         | 65.506              |
|          | 19.0 | 14.2833                         | 29.790              | 22.5817                         | 65.871              | 64.2343                         | 24.495              | 35.4391                         | 65.656              |
|          | 26.0 | 14.3438                         | 30.314              | 22.6740                         | 67.523              | 64.5585                         | 26.543              | 35.5265                         | 66.292              |
| Kwiecień | 2.0  | 14.3829                         | 30.902              | 22.7525                         | 69.123              | 64.8501                         | 28.512              | 35.5992                         | 66.867              |
|          | 9.0  | 14.4072                         | 31.164              | 22.7888                         | 71.074              | 65.0095                         | 30.835              | 35.6503                         | 67.838              |
|          | 16.0 | 14.4118                         | 31.606              | 22.8075                         | 72.823              | 65.1168                         | 32.930              | 35.6852                         | 68.623              |
|          | 23.0 | 14.4005                         | 31.748              | 22.7777                         | 74.856              | 65.0678                         | 35.307              | 35.6948                         | 69.762              |
| Maj      | 30.0 | 14.3670                         | 31.915              | 22.7386                         | 76.742              | 65.0019                         | 37.488              | 35.6896                         | 70.792              |
|          | 7.0  | 14.3208                         | 31.849              | 22.6539                         | 78.775              | 64.7834                         | 39.804              | 35.6605                         | 72.070              |
|          | 14.0 | 14.2556                         | 31.916              | 22.5609                         | 80.531              | 64.5451                         | 41.795              | 35.6178                         | 73.119              |
|          | 21.0 | 14.1777                         | 31.784              | 22.4199                         | 82.364              | 64.1435                         | 43.852              | 35.5499                         | 74.366              |
| Czerwiec | 28.0 | 14.0811                         | 31.633              | 22.2797                         | 83.993              | 63.7580                         | 45.634              | 35.4713                         | 75.472              |
|          | 4.0  | 13.9764                         | 31.353              | 22.0984                         | 85.576              | 63.2270                         | 47.355              | 35.3714                         | 76.669              |
|          | 11.0 | 13.8570                         | 31.143              | 21.9219                         | 86.864              | 62.7198                         | 48.717              | 35.2637                         | 77.634              |
|          | 18.0 | 13.7307                         | 30.839              | 21.7048                         | 88.053              | 62.0673                         | 49.962              | 35.1352                         | 78.643              |
| Lipiec   | 25.0 | 13.5918                         | 30.456              | 21.5006                         | 89.037              | 61.4693                         | 50.926              | 35.0026                         | 79.523              |
|          | 2.0  | 13.4517                         | 30.049              | 21.2646                         | 89.826              | 60.7502                         | 51.679              | 34.8545                         | 80.355              |
|          | 9.0  | 13.3034                         | 29.640              | 21.0458                         | 90.356              | 60.0962                         | 52.106              | 34.7062                         | 80.993              |
|          | 16.0 | 13.1555                         | 29.241              | 20.7985                         | 90.655              | 59.3302                         | 52.286              | 34.5441                         | 81.543              |
|          | 23.0 | 13.0030                         | 28.697              | 20.5744                         | 90.805              | 58.6516                         | 52.247              | 34.3855                         | 82.015              |
| Sierpień | 30.0 | 12.8571                         | 28.237              | 20.3304                         | 90.654              | 57.8849                         | 51.897              | 34.2192                         | 82.322              |
|          | 6.0  | 12.7112                         | 27.712              | 20.1133                         | 90.321              | 57.2138                         | 51.308              | 34.0603                         | 82.498              |
|          | 13.0 | 12.5731                         | 27.303              | 19.8813                         | 89.669              | 56.4721                         | 50.392              | 33.8962                         | 82.478              |
|          | 20.0 | 12.4394                         | 26.699              | 19.6800                         | 88.959              | 55.8389                         | 49.365              | 33.7431                         | 82.452              |
|          | 27.0 | 12.3197                         | 26.293              | 19.4712                         | 87.882              | 55.1551                         | 47.974              | 33.5906                         | 82.164              |
| Wrzesień | 3.0  | 12.2083                         | 25.788              | 19.2954                         | 86.722              | 54.5838                         | 46.465              | 33.4524                         | 81.817              |
|          | 10.0 | 12.1111                         | 25.507              | 19.1188                         | 85.196              | 53.9865                         | 44.595              | 33.3178                         | 81.186              |
|          | 17.0 | 12.0266                         | 25.015              | 18.9767                         | 83.718              | 53.5066                         | 42.744              | 33.2005                         | 80.622              |
|          | 24.0 | 11.9617                         | 24.838              | 18.8396                         | 81.845              | 53.0160                         | 40.520              | 33.0920                         | 79.717              |
| Paźdz.   | 1.0  | 11.9118                         | 24.553              | 18.7378                         | 80.004              | 52.6429                         | 38.319              | 33.0029                         | 78.830              |
|          | 8.0  | 11.8801                         | 24.596              | 18.6483                         | 77.793              | 52.2881                         | 35.768              | 32.9253                         | 77.595              |
|          | 15.0 | 11.8666                         | 24.442              | 18.5936                         | 75.742              | 52.0491                         | 33.380              | 32.8691                         | 76.495              |
|          | 22.0 | 11.8745                         | 24.696              | 18.5553                         | 73.314              | 51.8400                         | 30.650              | 32.8283                         | 75.007              |
|          | 29.0 | 11.9009                         | 24.845              | 18.5506                         | 71.053              | 51.7420                         | 28.106              | 32.8094                         | 73.623              |
| Listopad | 5.0  | 11.9455                         | 25.392              | 18.5686                         | 68.467              | 51.7018                         | 25.271              | 32.8073                         | 71.871              |
|          | 12.0 | 12.0094                         | 25.757              | 18.6174                         | 66.166              | 51.7649                         | 22.748              | 32.8272                         | 70.329              |
|          | 19.0 | 12.0924                         | 26.581              | 18.6910                         | 63.562              | 51.8922                         | 19.968              | 32.8661                         | 68.405              |
|          | 26.0 | 12.1917                         | 27.275              | 18.7906                         | 61.276              | 52.1089                         | 17.548              | 32.9249                         | 66.695              |
| Grudzień | 3.0  | 12.3042                         | 28.366              | 18.9184                         | 58.773              | 52.4106                         | 14.948              | 33.0017                         | 64.664              |
|          | 10.0 | 12.4320                         | 29.264              | 19.0672                         | 56.684              | 52.7862                         | 12.807              | 33.0967                         | 62.935              |
|          | 17.0 | 12.5712                         | 30.586              | 19.2424                         | 54.417              | 53.2428                         | 10.534              | 33.2090                         | 60.899              |
|          | 24.0 | 12.7204                         | 31.725              | 19.4292                         | 52.614              | 53.7448                         | 08.779              | 33.3342                         | 59.202              |
|          | 31.0 | 12.8736                         | 33.170              | 19.6423                         | 50.746              | 54.3376                         | 06.988              | 33.4737                         | 57.299              |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\beta$ Ursae Minoris           |                       | $\gamma$ Ursae Minoris          |                       | $\alpha$ Coronae Borealis       |                       | $\zeta$ Ursae Minoris           |                       |
|----------|------|---------------------------------|-----------------------|---------------------------------|-----------------------|---------------------------------|-----------------------|---------------------------------|-----------------------|
|          |      | 2 <sup>m</sup> 07               | K4                    | 3 <sup>m</sup> 00               | A3                    | 2 <sup>m</sup> 22               | A0                    | 4 <sup>m</sup> 29               | A3                    |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$        | $\alpha_{app}^{CIO}$            | $\delta_{app}$        | $\alpha_{app}^{CIO}$            | $\delta_{app}$        | $\alpha_{app}^{CIO}$            | $\delta_{app}$        |
|          |      | 14 <sup>h</sup> 49 <sup>m</sup> | +74°05'               | 15 <sup>h</sup> 19 <sup>m</sup> | +71°46'               | 15 <sup>h</sup> 34 <sup>m</sup> | +26°39'               | 15 <sup>h</sup> 42 <sup>m</sup> | +77°44'               |
| Styczeń  | 1.0  | 49 <sup>s</sup> .7344           | 26 <sup>''</sup> .903 | 52 <sup>s</sup> .3955           | 40 <sup>''</sup> .906 | 31 <sup>s</sup> .9557           | 52 <sup>''</sup> .375 | 40 <sup>s</sup> .1430           | 44 <sup>''</sup> .344 |
|          | 8.0  | 50.1600                         | 25.100                | 52.7228                         | 38.875                | 32.0780                         | 50.422                | 40.5641                         | 42.238                |
|          | 15.0 | 50.6677                         | 23.806                | 53.1348                         | 37.304                | 32.2227                         | 48.804                | 41.1256                         | 40.552                |
|          | 22.0 | 51.1635                         | 22.528                | 53.5377                         | 35.755                | 32.3729                         | 47.108                | 41.6727                         | 38.895                |
|          | 29.0 | 51.7137                         | 21.871                | 54.0043                         | 34.790                | 32.5398                         | 45.867                | 42.3327                         | 37.792                |
| Luty     | 5.0  | 52.2637                         | 21.281                | 54.4727                         | 33.892                | 32.7099                         | 44.596                | 42.9968                         | 36.754                |
|          | 12.0 | 52.8368                         | 21.298                | 54.9770                         | 33.584                | 32.8891                         | 43.811                | 43.7327                         | 36.284                |
|          | 19.0 | 53.3749                         | 21.332                | 55.4517                         | 33.312                | 33.0646                         | 42.982                | 44.4246                         | 35.864                |
|          | 26.0 | 53.9020                         | 22.022                | 55.9341                         | 33.696                | 33.2415                         | 42.715                | 45.1482                         | 36.089                |
| Marzec   | 5.0  | 54.4097                         | 22.755                | 56.4004                         | 34.135                | 33.4125                         | 42.438                | 45.8495                         | 36.372                |
|          | 12.0 | 54.8777                         | 24.063                | 56.8473                         | 35.166                | 33.5778                         | 42.698                | 46.5401                         | 37.248                |
|          | 19.0 | 55.2933                         | 25.310                | 57.2469                         | 36.166                | 33.7306                         | 42.884                | 47.1590                         | 38.110                |
|          | 26.0 | 55.6384                         | 27.114                | 57.5998                         | 37.758                | 33.8702                         | 43.628                | 47.7265                         | 39.577                |
| Kwiecień | 2.0  | 55.9534                         | 28.863                | 57.9243                         | 39.314                | 33.9969                         | 44.315                | 48.2514                         | 41.013                |
|          | 9.0  | 56.1803                         | 31.043                | 58.1835                         | 41.346                | 34.1055                         | 45.481                | 48.6935                         | 42.946                |
|          | 16.0 | 56.3559                         | 33.033                | 58.3924                         | 43.219                | 34.1969                         | 46.492                | 49.0563                         | 44.737                |
|          | 23.0 | 56.4216                         | 35.398                | 58.5157                         | 45.526                | 34.2648                         | 47.959                | 49.3049                         | 46.992                |
| Maj      | 30.0 | 56.4640                         | 37.582                | 58.6128                         | 47.667                | 34.3171                         | 49.286                | 49.5105                         | 49.085                |
|          | 7.0  | 56.3934                         | 39.995                | 58.6177                         | 50.099                | 34.3444                         | 50.961                | 49.5877                         | 51.503                |
|          | 14.0 | 56.2921                         | 42.102                | 58.5868                         | 52.245                | 34.3549                         | 52.391                | 49.6039                         | 53.645                |
|          | 21.0 | 56.0665                         | 44.375                | 58.4523                         | 54.627                | 34.3375                         | 54.127                | 49.4727                         | 56.062                |
| Czerwiec | 28.0 | 55.8398                         | 46.372                | 58.3081                         | 56.734                | 34.3065                         | 55.649                | 49.3206                         | 58.202                |
|          | 4.0  | 55.4974                         | 48.398                | 58.0643                         | 58.937                | 34.2490                         | 57.362                | 49.0227                         | 60.477                |
|          | 11.0 | 55.1567                         | 50.058                | 57.8109                         | 60.776                | 34.1796                         | 58.775                | 48.7009                         | 62.387                |
|          | 18.0 | 54.6981                         | 51.694                | 57.4546                         | 62.658                | 34.0830                         | 60.334                | 48.2269                         | 64.382                |
| Lipiec   | 25.0 | 54.2681                         | 53.022                | 57.1137                         | 64.218                | 33.9786                         | 61.652                | 47.7678                         | 66.043                |
|          | 2.0  | 53.7354                         | 54.217                | 56.6800                         | 65.705                | 33.8507                         | 63.010                | 47.1681                         | 67.670                |
|          | 9.0  | 53.2379                         | 55.053                | 56.2664                         | 66.816                | 33.7182                         | 64.068                | 46.5883                         | 68.909                |
|          | 16.0 | 52.6434                         | 55.715                | 55.7640                         | 67.810                | 33.5635                         | 65.123                | 45.8724                         | 70.070                |
| Sierpień | 23.0 | 52.1060                         | 56.108                | 55.3029                         | 68.505                | 33.4087                         | 65.962                | 45.2107                         | 70.910                |
|          | 30.0 | 51.4877                         | 56.250                | 54.7652                         | 68.996                | 33.2365                         | 66.715                | 44.4283                         | 71.583                |
|          | 6.0  | 50.9325                         | 56.099                | 54.2737                         | 69.162                | 33.0680                         | 67.210                | 43.7059                         | 71.908                |
|          | 13.0 | 50.3093                         | 55.669                | 53.7161                         | 69.089                | 32.8849                         | 67.575                | 42.8775                         | 72.027                |
| Wrzesień | 20.0 | 49.7648                         | 55.063                | 53.2214                         | 68.797                | 32.7101                         | 67.791                | 42.1377                         | 71.899                |
|          | 27.0 | 49.1668                         | 54.130                | 52.6722                         | 68.211                | 32.5262                         | 67.812                | 41.3067                         | 71.506                |
|          | 3.0  | 48.6508                         | 53.010                | 52.1887                         | 67.394                | 32.3541                         | 67.651                | 40.5677                         | 70.855                |
|          | 10.0 | 48.1003                         | 51.550                | 51.6670                         | 66.259                | 32.1767                         | 67.252                | 39.7612                         | 69.910                |
| Paźdz.   | 17.0 | 47.6418                         | 50.037                | 51.2234                         | 65.019                | 32.0154                         | 66.793                | 39.0690                         | 68.827                |
|          | 24.0 | 47.1608                         | 48.160                | 50.7516                         | 63.431                | 31.8543                         | 66.048                | 38.3228                         | 67.418                |
|          | 1.0  | 46.7722                         | 46.233                | 50.3587                         | 61.741                | 31.7123                         | 65.214                | 37.6917                         | 65.876                |
|          | 8.0  | 46.3843                         | 43.948                | 49.9578                         | 59.695                | 31.5748                         | 64.063                | 37.0367                         | 63.991                |
| Listopad | 15.0 | 46.0940                         | 41.751                | 49.6441                         | 57.681                | 31.4599                         | 62.944                | 36.5130                         | 62.104                |
|          | 22.0 | 45.8140                         | 39.197                | 49.3311                         | 55.307                | 31.3542                         | 61.478                | 35.9779                         | 59.868                |
|          | 29.0 | 45.6291                         | 36.755                | 49.1039                         | 52.990                | 31.2731                         | 60.035                | 35.5725                         | 57.657                |
|          | 5.0  | 45.4779                         | 33.989                | 48.8984                         | 50.333                | 31.2049                         | 58.235                | 35.1879                         | 55.106                |
| Grudzień | 12.0 | 45.4213                         | 31.465                | 48.7820                         | 47.862                | 31.1632                         | 56.575                | 34.9415                         | 52.707                |
|          | 19.0 | 45.4052                         | 28.647                | 48.6941                         | 45.075                | 31.1379                         | 54.552                | 34.7264                         | 49.991                |
|          | 26.0 | 45.4748                         | 26.125                | 48.6890                         | 42.535                | 31.1388                         | 52.694                | 34.6419                         | 47.489                |
|          | 3.0  | 45.6037                         | 23.372                | 48.7302                         | 39.731                | 31.1580                         | 50.504                | 34.6173                         | 44.713                |
|          | 10.0 | 45.8106                         | 21.024                | 48.8504                         | 37.284                | 31.2028                         | 48.579                | 34.7207                         | 42.262                |
|          | 17.0 | 46.0758                         | 18.494                | 49.0173                         | 34.625                | 31.2669                         | 46.348                | 34.8861                         | 39.587                |
|          | 24.0 | 46.3991                         | 16.444                | 49.2480                         | 32.408                | 31.3530                         | 44.445                | 35.1593                         | 37.329                |
|          | 31.0 | 46.7916                         | 14.303                | 49.5368                         | 30.061                | 31.4577                         | 42.305                | 35.5147                         | 34.920                |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\beta$ Herculis                |                      | $\beta$ Draconis                |                      | $\gamma$ Draconis               |                      | $\chi$ Draconis                 |                      |
|----------|------|---------------------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|
|          |      | 2 <sup>m</sup> 78               | G8                   | 2 <sup>m</sup> 79               | G2                   | 2 <sup>m</sup> 24               | K5                   | 3 <sup>m</sup> 55               | F7                   |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | $\alpha_{app}^{CIO}$            | $\delta_{app}$       |
|          |      | 16 <sup>h</sup> 30 <sup>m</sup> | +21°27'              | 17 <sup>h</sup> 29 <sup>m</sup> | +52°17'              | 17 <sup>h</sup> 56 <sup>m</sup> | +51°29'              | 18 <sup>h</sup> 19 <sup>m</sup> | +72°44'              |
| Styczeń  | 1.0  | 04 <sup>s</sup> 3975            | 30 <sup>''</sup> 734 | 57 <sup>s</sup> 7872            | 30 <sup>''</sup> 291 | 08 <sup>s</sup> 8152            | 21 <sup>''</sup> 154 | 56 <sup>s</sup> 0812            | 28 <sup>''</sup> 034 |
|          | 8.0  | 04.4857                         | 28.836               | 57.8346                         | 27.818               | 08.8342                         | 18.687               | 56.0486                         | 25.503               |
|          | 15.0 | 04.5987                         | 27.171               | 57.9395                         | 25.511               | 08.9109                         | 16.324               | 56.1512                         | 23.019               |
|          | 22.0 | 04.7212                         | 25.451               | 58.0479                         | 23.249               | 08.9922                         | 14.016               | 56.2517                         | 20.600               |
|          | 29.0 | 04.8648                         | 24.089               | 58.2114                         | 21.310               | 09.1305                         | 11.970               | 56.4894                         | 18.387               |
| Luty     | 5.0  | 05.0153                         | 22.688               | 58.3825                         | 19.419               | 09.2774                         | 09.972               | 56.7388                         | 16.227               |
|          | 12.0 | 05.1800                         | 21.699               | 58.5972                         | 17.926               | 09.4709                         | 08.321               | 57.1044                         | 14.370               |
|          | 19.0 | 05.3455                         | 20.687               | 58.8059                         | 16.539               | 09.6604                         | 06.792               | 57.4528                         | 12.652               |
|          | 26.0 | 05.5192                         | 20.181               | 59.0499                         | 15.675               | 09.8898                         | 05.742               | 57.9052                         | 11.378               |
| Marzec   | 5.0  | 05.6907                         | 19.654               | 59.2914                         | 14.892               | 10.1181                         | 04.778               | 58.3521                         | 10.203               |
|          | 12.0 | 05.8628                         | 19.634               | 59.5535                         | 14.651               | 10.3721                         | 04.327               | 58.8724                         | 09.517               |
|          | 19.0 | 06.0263                         | 19.567               | 59.7969                         | 14.498               | 10.6095                         | 03.990               | 59.3500                         | 08.974               |
|          | 26.0 | 06.1841                         | 20.049               | 60.0497                         | 14.957               | 10.8624                         | 04.245               | 59.8798                         | 09.012               |
| Kwiecień | 2.0  | 06.3311                         | 20.468               | 60.2882                         | 15.447               | 11.1022                         | 04.545               | 60.3795                         | 09.118               |
|          | 9.0  | 06.4663                         | 21.383               | 60.5224                         | 16.501               | 11.3435                         | 05.403               | 60.8993                         | 09.782               |
|          | 16.0 | 06.5862                         | 22.168               | 60.7281                         | 17.542               | 11.5576                         | 06.280               | 61.3540                         | 10.502               |
|          | 23.0 | 06.6891                         | 23.445               | 60.9191                         | 19.161               | 11.7632                         | 07.742               | 61.8068                         | 11.817               |
| Maj      | 30.0 | 06.7762                         | 24.576               | 61.0881                         | 20.697               | 11.9469                         | 09.137               | 62.2109                         | 13.094               |
|          | 7.0  | 06.8431                         | 26.107               | 61.2325                         | 22.711               | 12.1115                         | 11.029               | 62.5865                         | 14.885               |
|          | 14.0 | 06.8923                         | 27.409               | 61.3459                         | 24.569               | 12.2445                         | 12.794               | 62.8885                         | 16.586               |
|          | 21.0 | 06.9182                         | 29.083               | 61.4273                         | 26.886               | 12.3510                         | 15.043               | 63.1449                         | 18.799               |
| Czerwiec | 28.0 | 06.9276                         | 30.528               | 61.4863                         | 28.986               | 12.4335                         | 17.092               | 63.3489                         | 20.835               |
|          | 4.0  | 06.9133                         | 32.240               | 61.5080                         | 31.423               | 12.4830                         | 19.509               | 63.4895                         | 23.270               |
|          | 11.0 | 06.8834                         | 33.649               | 61.5038                         | 33.569               | 12.5044                         | 21.658               | 63.5648                         | 25.466               |
|          | 18.0 | 06.8286                         | 35.288               | 61.4584                         | 36.015               | 12.4886                         | 24.144               | 63.5665                         | 28.032               |
| Lipiec   | 25.0 | 06.7608                         | 36.654               | 61.3974                         | 38.143               | 12.4542                         | 26.318               | 63.5283                         | 30.301               |
|          | 2.0  | 06.6702                         | 38.151               | 61.2941                         | 40.450               | 12.3800                         | 28.711               | 63.4072                         | 32.824               |
|          | 9.0  | 06.5693                         | 39.323               | 61.1753                         | 42.384               | 12.2868                         | 30.740               | 63.2422                         | 34.997               |
|          | 16.0 | 06.4462                         | 40.582               | 61.0138                         | 44.449               | 12.1531                         | 32.943               | 62.9912                         | 37.380               |
| Sierpień | 23.0 | 06.3164                         | 41.580               | 60.8480                         | 46.152               | 12.0111                         | 34.777               | 62.7244                         | 39.393               |
|          | 30.0 | 06.1682                         | 42.585               | 60.6410                         | 47.887               | 11.8290                         | 36.686               | 62.3686                         | 41.515               |
|          | 6.0  | 06.0170                         | 43.294               | 60.4317                         | 49.226               | 11.6402                         | 38.196               | 61.9974                         | 43.234               |
|          | 13.0 | 05.8495                         | 43.960               | 60.1839                         | 50.541               | 11.4134                         | 39.721               | 61.5404                         | 45.004               |
| Wrzesień | 20.0 | 05.6833                         | 44.421               | 59.9452                         | 51.508               | 11.1914                         | 40.880               | 61.0974                         | 46.388               |
|          | 27.0 | 05.5056                         | 44.780               | 59.6712                         | 52.379               | 10.9336                         | 41.984               | 60.5697                         | 47.748               |
|          | 3.0  | 05.3332                         | 44.906               | 59.4088                         | 52.887               | 10.6829                         | 42.708               | 60.0574                         | 48.709               |
|          | 10.0 | 05.1527                         | 44.875               | 59.1165                         | 53.235               | 10.4013                         | 43.307               | 59.4695                         | 49.574               |
| Paźdz.   | 17.0 | 04.9821                         | 44.721               | 58.8470                         | 53.297               | 10.1383                         | 43.591               | 58.9261                         | 50.089               |
|          | 24.0 | 04.8087                         | 44.363               | 58.5518                         | 53.152               | 09.8479                         | 43.704               | 58.3111                         | 50.457               |
|          | 1.0  | 04.6491                         | 43.862               | 58.2818                         | 52.722               | 09.5786                         | 43.503               | 57.7424                         | 50.480               |
|          | 8.0  | 04.4907                         | 43.104               | 57.9939                         | 52.024               | 09.2891                         | 43.062               | 57.1166                         | 50.282               |
| Listopad | 15.0 | 04.3503                         | 42.317               | 57.7413                         | 51.135               | 09.0314                         | 42.391               | 56.5640                         | 49.809               |
|          | 22.0 | 04.2164                         | 41.241               | 57.4760                         | 49.955               | 08.7583                         | 41.456               | 55.9610                         | 49.087               |
|          | 29.0 | 04.1037                         | 40.130               | 57.2484                         | 48.608               | 08.5199                         | 40.315               | 55.4348                         | 48.117               |
|          | 5.0  | 04.0011                         | 38.695               | 57.0172                         | 46.929               | 08.2746                         | 38.859               | 54.8767                         | 46.842               |
| Grudzień | 12.0 | 03.9227                         | 37.333               | 56.8317                         | 45.184               | 08.0728                         | 37.290               | 54.4176                         | 45.401               |
|          | 19.0 | 03.8588                         | 35.638               | 56.6479                         | 43.113               | 07.8694                         | 35.409               | 53.9360                         | 43.654               |
|          | 26.0 | 03.8206                         | 34.044               | 56.5116                         | 41.040               | 07.7122                         | 33.479               | 53.5578                         | 41.808               |
|          | 3.0  | 03.7988                         | 32.114               | 56.3859                         | 38.633               | 07.5622                         | 31.220               | 53.1780                         | 39.633               |
|          | 10.0 | 03.8035                         | 30.383               | 56.3116                         | 36.329               | 07.4631                         | 29.010               | 52.9151                         | 37.451               |
|          | 17.0 | 03.8268                         | 28.339               | 56.2515                         | 33.733               | 07.3753                         | 26.510               | 52.6586                         | 34.977               |
|          | 24.0 | 03.8750                         | 26.560               | 56.2417                         | 31.347               | 07.3386                         | 24.169               | 52.5201                         | 32.612               |
|          | 31.0 | 03.9415                         | 24.509               | 56.2530                         | 28.704               | 07.3204                         | 21.561               | 52.4081                         | 29.970               |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>*h*</sup> UT1

| UT1      |      | $\alpha$ Lyrae                  |                       | $\nu$ Draconis |                                 | $\sigma$ Sagittarii   |                                 | $\tau$ Draconis       |                                 |                       |
|----------|------|---------------------------------|-----------------------|----------------|---------------------------------|-----------------------|---------------------------------|-----------------------|---------------------------------|-----------------------|
|          |      | 0 <sup>m</sup> 03               | Vega                  | A0             | 4 <sup>m</sup> 82               | K0                    | 2 <sup>m</sup> 05               | B2                    | 4 <sup>m</sup> 45               | K3                    |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$        |                | $\alpha_{app}^{CIO}$            | $\delta_{app}$        | $\alpha_{app}^{CIO}$            | $\delta_{app}$        | $\alpha_{app}^{CIO}$            | $\delta_{app}$        |
|          |      | 18 <sup>h</sup> 36 <sup>m</sup> | +38°47'               |                | 18 <sup>h</sup> 53 <sup>m</sup> | +71°18'               | 18 <sup>h</sup> 55 <sup>m</sup> | −26°16'               | 19 <sup>h</sup> 14 <sup>m</sup> | +73°22'               |
| Styczeń  | 1.0  | 38 <sup>s</sup> .9030           | 62 <sup>''</sup> .628 |                | 22 <sup>s</sup> .1903           | 71 <sup>''</sup> .743 | 23 <sup>s</sup> .9946           | 28 <sup>''</sup> .944 | 24 <sup>s</sup> .6565           | 70 <sup>''</sup> .823 |
|          | 8.0  | 38.8924                         | 60.422                |                | 22.0859                         | 69.268                | 24.0169                         | 28.726                | 24.4893                         | 68.415                |
|          | 15.0 | 38.9244                         | 58.226                |                | 22.1061                         | 66.750                | 24.0518                         | 28.541                | 24.4607                         | 65.909                |
|          | 22.0 | 38.9653                         | 56.101                |                | 22.1266                         | 64.301                | 24.1212                         | 28.308                | 24.4329                         | 63.473                |
|          | 29.0 | 39.0502                         | 54.132                |                | 22.2783                         | 61.966                | 24.2028                         | 28.057                | 24.5542                         | 61.091                |
| Luty     | 5.0  | 39.1456                         | 52.203                |                | 22.4424                         | 59.680                | 24.3116                         | 27.896                | 24.6895                         | 58.753                |
|          | 12.0 | 39.2780                         | 50.526                |                | 22.7212                         | 57.616                | 24.4281                         | 27.663                | 24.9579                         | 56.585                |
|          | 19.0 | 39.4134                         | 48.981                |                | 22.9887                         | 55.705                | 24.5732                         | 27.453                | 25.2156                         | 54.575                |
|          | 26.0 | 39.5822                         | 47.823                |                | 23.3638                         | 54.165                | 24.7241                         | 27.118                | 25.6015                         | 52.885                |
| Marzec   | 5.0  | 39.7540                         | 46.739                |                | 23.7370                         | 52.729                | 24.8926                         | 26.943                | 25.9865                         | 51.300                |
|          | 12.0 | 39.9492                         | 46.094                |                | 24.1910                         | 51.729                | 25.0616                         | 26.597                | 26.4710                         | 50.111                |
|          | 19.0 | 40.1370                         | 45.579                |                | 24.6107                         | 50.901                | 25.2491                         | 26.354                | 26.9197                         | 49.110                |
|          | 26.0 | 40.3417                         | 45.591                |                | 25.0945                         | 50.614                | 25.4343                         | 25.896                | 27.4513                         | 48.616                |
| Kwiecień | 2.0  | 40.5388                         | 45.646                |                | 25.5531                         | 50.414                | 25.6253                         | 25.671                | 27.9559                         | 48.221                |
|          | 9.0  | 40.7420                         | 46.218                |                | 26.0459                         | 50.753                | 25.8091                         | 25.210                | 28.5099                         | 48.345                |
|          | 16.0 | 40.9277                         | 46.836                |                | 26.4813                         | 51.191                | 25.9997                         | 24.947                | 29.0010                         | 48.595                |
|          | 23.0 | 41.1126                         | 48.009                |                | 26.9318                         | 52.220                | 26.1805                         | 24.422                | 29.5214                         | 49.424                |
| Maj      | 30.0 | 41.2809                         | 49.125                |                | 27.3370                         | 53.242                | 26.3554                         | 24.206                | 29.9906                         | 50.266                |
|          | 7.0  | 41.4394                         | 50.731                |                | 27.7309                         | 54.792                | 26.5167                         | 23.729                | 30.4581                         | 51.637                |
|          | 14.0 | 41.5743                         | 52.242                |                | 28.0552                         | 56.301                | 26.6736                         | 23.546                | 30.8465                         | 52.998                |
|          | 21.0 | 41.6938                         | 54.244                |                | 28.3526                         | 58.347                | 26.8150                         | 23.091                | 31.2158                         | 54.904                |
| Czerwiec | 28.0 | 41.7925                         | 56.058                |                | 28.5970                         | 60.250                | 26.9405                         | 23.003                | 31.5233                         | 56.692                |
|          | 4.0  | 41.8698                         | 58.267                |                | 28.7950                         | 62.589                | 27.0483                         | 22.656                | 31.7878                         | 58.933                |
|          | 11.0 | 41.9228                         | 60.235                |                | 28.9265                         | 64.733                | 27.1425                         | 22.664                | 31.9740                         | 61.008                |
|          | 18.0 | 41.9512                         | 62.575                |                | 29.0015                         | 67.291                | 27.2181                         | 22.415                | 32.1057                         | 63.521                |
| Lipiec   | 25.0 | 41.9600                         | 64.612                |                | 29.0313                         | 69.579                | 27.2704                         | 22.545                | 32.1818                         | 65.784                |
|          | 2.0  | 41.9410                         | 66.919                |                | 28.9928                         | 72.172                | 27.3041                         | 22.425                | 32.1879                         | 68.380                |
|          | 9.0  | 41.9021                         | 68.881                |                | 28.9040                         | 74.446                | 27.3182                         | 22.663                | 32.1315                         | 70.680                |
|          | 16.0 | 41.8344                         | 71.070                |                | 28.7427                         | 76.983                | 27.3140                         | 22.668                | 31.9997                         | 73.275                |
| Sierpień | 23.0 | 41.7530                         | 72.892                |                | 28.5561                         | 79.161                | 27.2826                         | 23.007                | 31.8329                         | 75.522                |
|          | 30.0 | 41.6423                         | 74.855                |                | 28.2913                         | 81.505                | 27.2352                         | 23.102                | 31.5824                         | 77.969                |
|          | 6.0  | 41.5195                         | 76.426                |                | 28.0007                         | 83.459                | 27.1663                         | 23.499                | 31.2955                         | 80.038                |
|          | 13.0 | 41.3686                         | 78.080                |                | 27.6332                         | 85.517                | 27.0832                         | 23.690                | 30.9249                         | 82.246                |
| Wrzesień | 20.0 | 41.2130                         | 79.357                |                | 27.2670                         | 87.183                | 26.9735                         | 24.117                | 30.5488                         | 84.061                |
|          | 27.0 | 41.0307                         | 80.655                |                | 26.8228                         | 88.878                | 26.8545                         | 24.313                | 30.0860                         | 85.942                |
|          | 3.0  | 40.8464                         | 81.569                |                | 26.3809                         | 90.167                | 26.7170                         | 24.710                | 29.6183                         | 87.416                |
|          | 10.0 | 40.6384                         | 82.431                |                | 25.8673                         | 91.410                | 26.5730                         | 24.938                | 29.0695                         | 88.877                |
| Paźdz.   | 17.0 | 40.4365                         | 82.955                |                | 25.3838                         | 92.275                | 26.4080                         | 25.281                | 28.5476                         | 89.948                |
|          | 24.0 | 40.2141                         | 83.387                |                | 24.8308                         | 93.041                | 26.2439                         | 25.425                | 27.9458                         | 90.953                |
|          | 1.0  | 40.0009                         | 83.489                |                | 24.3099                         | 93.434                | 26.0688                         | 25.657                | 27.3729                         | 91.571                |
|          | 8.0  | 39.7720                         | 83.420                |                | 23.7306                         | 93.646                | 25.8982                         | 25.781                | 26.7309                         | 92.038                |
| Listopad | 15.0 | 39.5605                         | 83.086                |                | 23.2098                         | 93.535                | 25.7164                         | 25.906                | 26.1486                         | 92.156                |
|          | 22.0 | 39.3376                         | 82.561                |                | 22.6361                         | 93.213                | 25.5479                         | 25.903                | 25.5023                         | 92.089                |
|          | 29.0 | 39.1360                         | 81.797                |                | 22.1251                         | 92.594                | 25.3786                         | 25.892                | 24.9206                         | 91.699                |
|          | 5.0  | 38.9288                         | 80.773                |                | 21.5764                         | 91.694                | 25.2258                         | 25.864                | 24.2907                         | 91.048                |
| Grudzień | 12.0 | 38.7500                         | 79.588                |                | 21.1130                         | 90.564                | 25.0732                         | 25.754                | 23.7520                         | 90.131                |
|          | 19.0 | 38.5706                         | 78.144                |                | 20.6206                         | 89.149                | 24.9457                         | 25.627                | 23.1744                         | 88.944                |
|          | 26.0 | 38.4237                         | 76.598                |                | 20.2196                         | 87.568                | 24.8272                         | 25.417                | 22.6959                         | 87.552                |
|          | 3.0  | 38.2819                         | 74.753                |                | 19.8079                         | 85.663                | 24.7348                         | 25.304                | 22.1982                         | 85.844                |
|          | 10.0 | 38.1772                         | 72.894                |                | 19.5026                         | 83.676                | 24.6519                         | 25.054                | 21.8182                         | 84.007                |
|          | 17.0 | 38.0818                         | 70.769                |                | 19.1950                         | 81.398                | 24.6017                         | 24.904                | 21.4288                         | 81.884                |
|          | 24.0 | 38.0256                         | 68.733                |                | 18.9982                         | 79.151                | 24.5668                         | 24.605                | 21.1641                         | 79.742                |
|          | 31.0 | 37.9836                         | 66.428                |                | 18.8180                         | 76.616                | 24.5611                         | 24.510                | 20.9113                         | 77.307                |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\iota$ Cygni                   |                     | $\alpha$ Aquilae                |                     | $\kappa$ Cephei |                                 | $\alpha$ Cygni      |                                 |                     |    |
|----------|------|---------------------------------|---------------------|---------------------------------|---------------------|-----------------|---------------------------------|---------------------|---------------------------------|---------------------|----|
|          |      | 3 <sup>m</sup> 76               | A5                  | 0 <sup>m</sup> 76               | Altair              | A7              | 4 <sup>m</sup> 38               | B9                  | 1 <sup>m</sup> 25               | Deneb               | A2 |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$      | $\alpha_{app}^{CIO}$            | $\delta_{app}$      |                 | $\alpha_{app}^{CIO}$            | $\delta_{app}$      | $\alpha_{app}^{CIO}$            | $\delta_{app}$      |    |
|          |      | 19 <sup>h</sup> 29 <sup>m</sup> | +51°45′             | 19 <sup>h</sup> 50 <sup>m</sup> | +8°54′              |                 | 20 <sup>h</sup> 07 <sup>m</sup> | +77°45′             | 20 <sup>h</sup> 41 <sup>m</sup> | +45°19′             |    |
| Styczeń  | 1.0  | 16 <sup>s</sup> 8847            | 56 <sup>″</sup> 343 | 43 <sup>s</sup> 4651            | 40 <sup>″</sup> 687 |                 | 30 <sup>s</sup> 3931            | 38 <sup>″</sup> 058 | 09 <sup>s</sup> 1274            | 79 <sup>″</sup> 245 |    |
|          | 8.0  | 16.8031                         | 54.063              | 43.4263                         | 39.574              |                 | 30.0096                         | 35.904              | 08.9979                         | 77.371              |    |
|          | 15.0 | 16.7792                         | 51.664              | 43.4104                         | 38.351              |                 | 29.8021                         | 33.514              | 08.9111                         | 75.233              |    |
|          | 22.0 | 16.7620                         | 49.355              | 43.4124                         | 37.271              |                 | 29.5976                         | 31.193              | 08.8332                         | 73.217              |    |
|          | 29.0 | 16.8077                         | 47.075              | 43.4399                         | 36.180              |                 | 29.5936                         | 28.773              | 08.8061                         | 71.060              |    |
| Luty     | 5.0  | 16.8644                         | 44.847              | 43.4846                         | 35.133              |                 | 29.6086                         | 26.381              | 08.7910                         | 68.965              |    |
|          | 12.0 | 16.9774                         | 42.763              | 43.5511                         | 34.163              |                 | 29.8110                         | 24.018              | 08.8240                         | 66.849              |    |
|          | 19.0 | 17.0923                         | 40.851              | 43.6330                         | 33.346              |                 | 30.0073                         | 21.820              | 08.8648                         | 64.938              |    |
|          | 26.0 | 17.2621                         | 39.229              | 43.7363                         | 32.710              |                 | 30.3951                         | 19.802              | 08.9563                         | 63.145              |    |
| Marzec   | 5.0  | 17.4359                         | 37.714              | 43.8514                         | 32.106              |                 | 30.7867                         | 17.885              | 09.0559                         | 61.471              |    |
|          | 12.0 | 17.6525                         | 36.569              | 43.9821                         | 31.749              |                 | 31.3373                         | 16.250              | 09.1985                         | 60.018              |    |
|          | 19.0 | 17.8595                         | 35.621              | 44.1209                         | 31.516              |                 | 31.8510                         | 14.834              | 09.3406                         | 58.812              |    |
|          | 26.0 | 18.1028                         | 35.153              | 44.2724                         | 31.610              |                 | 32.5097                         | 13.825              | 09.5231                         | 57.945              |    |
| Kwiecień | 2.0  | 18.3376                         | 34.782              | 44.4274                         | 31.689              |                 | 33.1379                         | 12.937              | 09.7037                         | 57.206              |    |
|          | 9.0  | 18.5943                         | 34.908              | 44.5881                         | 32.117              |                 | 33.8678                         | 12.501              | 09.9135                         | 56.858              |    |
|          | 16.0 | 18.8281                         | 35.168              | 44.7480                         | 32.580              |                 | 34.5214                         | 12.250              | 10.1108                         | 56.716              |    |
|          | 23.0 | 19.0756                         | 35.983              | 44.9103                         | 33.439              |                 | 35.2544                         | 12.529              | 10.3323                         | 57.042              |    |
| Maj      | 30.0 | 19.3022                         | 36.811              | 45.0669                         | 34.187              |                 | 35.9199                         | 12.872              | 10.5397                         | 57.433              |    |
|          | 7.0  | 19.5290                         | 38.152              | 45.2193                         | 35.311              |                 | 36.6206                         | 13.727              | 10.7592                         | 58.284              |    |
|          | 14.0 | 19.7236                         | 39.490              | 45.3628                         | 36.337              |                 | 37.2151                         | 14.652              | 10.9553                         | 59.223              |    |
|          | 21.0 | 19.9111                         | 41.357              | 45.4991                         | 37.753              |                 | 37.8233                         | 16.124              | 11.1581                         | 60.657              |    |
| Czerwiec | 28.0 | 20.0707                         | 43.103              | 45.6222                         | 38.942              |                 | 38.3413                         | 17.541              | 11.3376                         | 62.034              |    |
|          | 4.0  | 20.2125                         | 45.295              | 45.7332                         | 40.475              |                 | 38.8354                         | 19.441              | 11.5130                         | 63.855              |    |
|          | 11.0 | 20.3198                         | 47.326              | 45.8295                         | 41.773              |                 | 39.2143                         | 21.258              | 11.6589                         | 65.606              |    |
|          | 18.0 | 20.4045                         | 49.788              | 45.9115                         | 43.407              |                 | 39.5529                         | 23.554              | 11.7963                         | 67.801              |    |
| Lipiec   | 25.0 | 20.4615                         | 51.995              | 45.9760                         | 44.713              |                 | 39.8014                         | 25.661              | 11.9067                         | 69.799              |    |
|          | 2.0  | 20.4888                         | 54.536              | 46.0232                         | 46.304              |                 | 39.9821                         | 28.164              | 12.0004                         | 72.171              |    |
|          | 9.0  | 20.4860                         | 56.782              | 46.0531                         | 47.563              |                 | 40.0605                         | 30.440              | 12.0640                         | 74.322              |    |
|          | 16.0 | 20.4511                         | 59.324              | 46.0649                         | 49.079              |                 | 40.0609                         | 33.078              | 12.1081                         | 76.818              |    |
| Sierpień | 23.0 | 20.3954                         | 61.511              | 46.0582                         | 50.212              |                 | 39.9927                         | 35.413              | 12.1274                         | 78.997              |    |
|          | 30.0 | 20.3040                         | 63.908              | 46.0324                         | 51.565              |                 | 39.8291                         | 38.028              | 12.1217                         | 81.454              |    |
|          | 6.0  | 20.1920                         | 65.925              | 45.9900                         | 52.546              |                 | 39.5926                         | 40.311              | 12.0907                         | 83.579              |    |
|          | 13.0 | 20.0442                         | 68.091              | 45.9291                         | 53.700              |                 | 39.2565                         | 42.815              | 12.0334                         | 85.927              |    |
| Wrzesień | 20.0 | 19.8872                         | 69.854              | 45.8521                         | 54.473              |                 | 38.8879                         | 44.942              | 11.9581                         | 87.880              |    |
|          | 27.0 | 19.6934                         | 71.701              | 45.7575                         | 55.403              |                 | 38.4105                         | 47.222              | 11.8541                         | 90.006              |    |
|          | 3.0  | 19.4918                         | 73.139              | 45.6505                         | 55.978              |                 | 37.9000                         | 49.113              | 11.7332                         | 91.737              |    |
|          | 10.0 | 19.2558                         | 74.580              | 45.5279                         | 56.643              |                 | 37.2822                         | 51.075              | 11.5837                         | 93.565              |    |
| Paźdz.   | 17.0 | 19.0244                         | 75.622              | 45.3948                         | 56.976              |                 | 36.6752                         | 52.629              | 11.4266                         | 94.967              |    |
|          | 24.0 | 18.7599                         | 76.624              | 45.2491                         | 57.401              |                 | 35.9585                         | 54.204              | 11.2407                         | 96.432              |    |
|          | 1.0  | 18.5026                         | 77.235              | 45.0979                         | 57.529              |                 | 35.2548                         | 55.375              | 11.0496                         | 97.487              |    |
|          | 8.0  | 18.2167                         | 77.719              | 44.9375                         | 57.664              |                 | 34.4491                         | 56.470              | 10.8318                         | 98.516              |    |
| Listopad | 15.0 | 17.9505                         | 77.845              | 44.7747                         | 57.546              |                 | 33.7001                         | 57.167              | 10.6189                         | 99.129              |    |
|          | 22.0 | 17.6591                         | 77.818              | 44.6072                         | 57.444              |                 | 32.8533                         | 57.753              | 10.3814                         | 99.696              |    |
|          | 29.0 | 17.3913                         | 77.463              | 44.4436                         | 57.129              |                 | 32.0705                         | 57.960              | 10.1531                         | 99.880              |    |
|          | 5.0  | 17.1049                         | 76.875              | 44.2792                         | 56.738              |                 | 31.2050                         | 57.967              | 09.9042                         | 99.927              |    |
| Grudzień | 12.0 | 16.8533                         | 76.012              | 44.1223                         | 56.186              |                 | 30.4428                         | 57.622              | 09.6743                         | 99.610              |    |
|          | 19.0 | 16.5884                         | 74.911              | 43.9702                         | 55.572              |                 | 29.6089                         | 57.059              | 09.4280                         | 99.152              |    |
|          | 26.0 | 16.3635                         | 73.598              | 43.8318                         | 54.847              |                 | 28.8922                         | 56.196              | 09.2070                         | 98.386              |    |
|          | 3.0  | 16.1333                         | 71.995              | 43.7017                         | 53.977              |                 | 28.1264                         | 55.050              | 08.9755                         | 97.407              |    |
|          | 10.0 | 15.9511                         | 70.252              | 43.5883                         | 53.056              |                 | 27.5076                         | 53.660              | 08.7772                         | 96.167              |    |
|          | 17.0 | 15.7691                         | 68.250              | 43.4883                         | 52.014              |                 | 26.8541                         | 52.003              | 08.5737                         | 94.736              |    |
|          | 24.0 | 15.6397                         | 66.216              | 43.4098                         | 50.998              |                 | 26.3642                         | 50.203              | 08.4103                         | 93.143              |    |
|          | 31.0 | 15.5185                         | 63.907              | 43.3468                         | 49.795              |                 | 25.8672                         | 48.109              | 08.2485                         | 91.314              |    |



**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | $\alpha$ Cephei                 |                | $\beta$ Cephei                  |                | 11 Cephei                       |                | $\varepsilon$ Pegasi            |                |
|----------|------|---------------------------------|----------------|---------------------------------|----------------|---------------------------------|----------------|---------------------------------|----------------|
|          |      | 2 <sup>m</sup> 45               | A7             | 3 <sup>m</sup> 23               | B2             | 4 <sup>m</sup> 55               | K0             | 2 <sup>m</sup> 38               | K2             |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | $\alpha_{app}^{CIO}$            | $\delta_{app}$ |
|          |      | 21 <sup>h</sup> 18 <sup>m</sup> | +62°38'        | 21 <sup>h</sup> 28 <sup>m</sup> | +70°37'        | 21 <sup>h</sup> 41 <sup>m</sup> | +71°22'        | 21 <sup>h</sup> 44 <sup>m</sup> | +9°56'         |
| Styczeń  | 1.0  | 08.5413                         | 76.850         | 02.9007                         | 56.378         | 20.3806                         | 70.962         | 08.3552                         | 47.743         |
|          | 8.0  | 08.2914                         | 75.083         | 02.5348                         | 54.708         | 19.9835                         | 69.402         | 08.2462                         | 46.918         |
|          | 15.0 | 08.1055                         | 72.946         | 02.2563                         | 52.634         | 19.6724                         | 67.412         | 08.1547                         | 45.835         |
|          | 22.0 | 07.9268                         | 70.903         | 01.9851                         | 50.638         | 19.3690                         | 65.499         | 08.0780                         | 45.007         |
|          | 29.0 | 07.8278                         | 68.602         | 01.8248                         | 48.344         | 19.1771                         | 63.255         | 08.0242                         | 43.997         |
| Luty     | 5.0  | 07.7409                         | 66.339         | 01.6783                         | 46.073         | 18.9992                         | 61.030         | 07.9870                         | 43.124         |
|          | 12.0 | 07.7331                         | 63.949         | 01.6432                         | 43.636         | 18.9348                         | 58.606         | 07.9720                         | 42.151         |
|          | 19.0 | 07.7326                         | 61.752         | 01.6164                         | 41.378         | 18.8804                         | 56.361         | 07.9738                         | 41.451         |
|          | 26.0 | 07.8190                         | 59.566         | 01.7133                         | 39.094         | 18.9539                         | 54.051         | 08.0003                         | 40.742         |
| Marzec   | 5.0  | 07.9138                         | 57.499         | 01.8198                         | 36.916         | 19.0381                         | 51.846         | 08.0429                         | 40.160         |
|          | 12.0 | 08.0857                         | 55.565         | 02.0376                         | 34.839         | 19.2389                         | 49.709         | 08.1064                         | 39.647         |
|          | 19.0 | 08.2539                         | 53.898         | 02.2490                         | 33.023         | 19.4354                         | 47.834         | 08.1838                         | 39.395         |
|          | 26.0 | 08.4984                         | 52.495         | 02.5716                         | 31.440         | 19.7500                         | 46.160         | 08.2820                         | 39.297         |
| Kwiecień | 2.0  | 08.7372                         | 51.250         | 02.8849                         | 30.016         | 20.0563                         | 44.647         | 08.3908                         | 39.288         |
|          | 9.0  | 09.0356                         | 50.346         | 03.2870                         | 28.911         | 20.4585                         | 43.427         | 08.5145                         | 39.481         |
|          | 16.0 | 09.3120                         | 49.702         | 03.6571                         | 28.071         | 20.8301                         | 42.483         | 08.6451                         | 39.862         |
|          | 23.0 | 09.6418                         | 49.491         | 04.1081                         | 27.648         | 21.2905                         | 41.930         | 08.7889                         | 40.506         |
| Maj      | 30.0 | 09.9473                         | 49.405         | 04.5240                         | 27.362         | 21.7158                         | 41.525         | 08.9351                         | 41.151         |
|          | 7.0  | 10.2869                         | 49.770         | 04.9937                         | 27.519         | 22.2022                         | 41.546         | 09.0876                         | 42.071         |
|          | 14.0 | 10.5866                         | 50.302         | 05.4062                         | 27.861         | 22.6312                         | 41.770         | 09.2387                         | 43.046         |
|          | 21.0 | 10.9125                         | 51.332         | 05.8620                         | 28.698         | 23.1110                         | 42.475         | 09.3937                         | 44.327         |
| Czerwiec | 28.0 | 11.1992                         | 52.386         | 06.2615                         | 29.581         | 23.5329                         | 43.243         | 09.5428                         | 45.484         |
|          | 4.0  | 11.4936                         | 53.907         | 06.6781                         | 30.937         | 23.9782                         | 44.479         | 09.6893                         | 46.930         |
|          | 11.0 | 11.7374                         | 55.448         | 07.0221                         | 32.337         | 24.3486                         | 45.780         | 09.8268                         | 48.274         |
|          | 18.0 | 11.9820                         | 57.466         | 07.3733                         | 34.224         | 24.7325                         | 47.566         | 09.9594                         | 49.913         |
| Lipiec   | 25.0 | 12.1810                         | 59.368         | 07.6593                         | 36.023         | 25.0478                         | 49.283         | 10.0793                         | 51.295         |
|          | 2.0  | 12.3659                         | 61.691         | 07.9309                         | 38.256         | 25.3536                         | 51.438         | 10.1888                         | 52.945         |
|          | 9.0  | 12.4987                         | 63.874         | 08.1277                         | 40.380         | 25.5806                         | 53.505         | 10.2839                         | 54.353         |
|          | 16.0 | 12.6119                         | 66.454         | 08.3022                         | 42.917         | 25.7896                         | 55.993         | 10.3671                         | 56.013         |
| Sierpień | 23.0 | 12.6829                         | 68.784         | 08.4162                         | 45.231         | 25.9336                         | 58.274         | 10.4332                         | 57.311         |
|          | 30.0 | 12.7238                         | 71.446         | 08.4923                         | 47.899         | 26.0428                         | 60.920         | 10.4835                         | 58.843         |
|          | 6.0  | 12.7198                         | 73.838         | 08.5037                         | 50.322         | 26.0823                         | 63.341         | 10.5167                         | 60.040         |
|          | 13.0 | 12.6817                         | 76.510         | 08.4709                         | 53.048         | 26.0798                         | 66.077         | 10.5335                         | 61.436         |
| Wrzesień | 20.0 | 12.6128                         | 78.827         | 08.3937                         | 55.439         | 26.0279                         | 68.492         | 10.5319                         | 62.414         |
|          | 27.0 | 12.5034                         | 81.369         | 08.2626                         | 58.080         | 25.9234                         | 71.171         | 10.5121                         | 63.594         |
|          | 3.0  | 12.3629                         | 83.549         | 08.0862                         | 60.377         | 25.7681                         | 73.521         | 10.4753                         | 64.402         |
|          | 10.0 | 12.1796                         | 85.878         | 07.8515                         | 62.845         | 25.5548                         | 76.058         | 10.4210                         | 65.359         |
| Paźdz.   | 17.0 | 11.9821                         | 87.785         | 07.5957                         | 64.905         | 25.3153                         | 78.193         | 10.3502                         | 65.898         |
|          | 24.0 | 11.7391                         | 89.800         | 07.2770                         | 67.092         | 25.0122                         | 80.473         | 10.2620                         | 66.607         |
|          | 1.0  | 11.4836                         | 91.400         | 06.9390                         | 68.874         | 24.6848                         | 82.354         | 10.1606                         | 66.959         |
|          | 8.0  | 11.1826                         | 93.015         | 06.5365                         | 70.688         | 24.2911                         | 84.287         | 10.0440                         | 67.412         |
| Listopad | 15.0 | 10.8869                         | 94.181         | 06.1405                         | 72.055         | 23.8992                         | 85.769         | 09.9163                         | 67.489         |
|          | 22.0 | 10.5465                         | 95.330         | 05.6802                         | 73.419         | 23.4407                         | 87.268         | 09.7756                         | 67.699         |
|          | 29.0 | 10.2163                         | 96.051         | 05.2322                         | 74.352         | 22.9903                         | 88.332         | 09.6290                         | 67.600         |
|          | 5.0  | 09.8447                         | 96.661         | 04.7231                         | 75.184         | 22.4751                         | 89.313         | 09.4730                         | 67.552         |
| Grudzień | 12.0 | 09.5003                         | 96.836         | 04.2509                         | 75.569         | 21.9935                         | 89.837         | 09.3144                         | 67.201         |
|          | 19.0 | 09.1191                         | 96.882         | 03.7231                         | 75.830         | 21.4523                         | 90.253         | 09.1505                         | 66.931         |
|          | 26.0 | 08.7740                         | 96.538         | 03.2441                         | 75.683         | 20.9573                         | 90.246         | 08.9905                         | 66.427         |
|          | 3.0  | 08.3991                         | 95.986         | 02.7186                         | 75.328         | 20.4111                         | 90.047         | 08.8296                         | 65.918         |
|          | 10.0 | 08.0749                         | 95.072         | 02.2627                         | 74.587         | 19.9329                         | 89.440         | 08.6763                         | 65.199         |
|          | 17.0 | 07.7283                         | 93.961         | 01.7701                         | 73.644         | 19.4137                         | 88.643         | 08.5270                         | 64.512         |
|          | 24.0 | 07.4439                         | 92.578         | 01.3636                         | 72.395         | 18.9803                         | 87.515         | 08.3920                         | 63.698         |
|          | 31.0 | 07.1476                         | 90.945         | 00.9346                         | 70.891         | 18.5200                         | 86.139         | 08.2652                         | 62.827         |

**MIEJSCA POZORNE (*IRS*) GWIAZD w 2015**  
w momencie 0<sup>h</sup> UT1

| UT1      |      | 24 Cephei                       |                      | $\alpha$ Piscis Austrini        |                      | $\alpha$ Pegasi                 |                      | $\gamma$ Cephei                 |                      |
|----------|------|---------------------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|---------------------------------|----------------------|
|          |      | 4 <sup>m</sup> 79               | G8                   | 1 <sup>m</sup> 17               | Fomalhaut A3         | 2 <sup>m</sup> 49               | B9                   | 3 <sup>m</sup> 21               | K1                   |
|          |      | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | $\alpha_{app}^{CIO}$            | $\delta_{app}$       |
|          |      | 22 <sup>h</sup> 09 <sup>m</sup> | +72°24'              | 22 <sup>h</sup> 57 <sup>m</sup> | −29°32'              | 23 <sup>h</sup> 04 <sup>m</sup> | +15°17'              | 23 <sup>h</sup> 39 <sup>m</sup> | +77°42'              |
| Styczeń  | 1.0  | 18 <sup>s</sup> 2368            | 76 <sup>''</sup> 490 | 41 <sup>s</sup> 4571            | 39 <sup>''</sup> 031 | 44 <sup>s</sup> 0190            | 18 <sup>''</sup> 065 | 13 <sup>s</sup> 7096            | 79 <sup>''</sup> 588 |
|          | 8.0  | 17.7826                         | 75.171               | 41.3124                         | 38.747               | 43.8731                         | 17.377               | 12.9786                         | 79.172               |
|          | 15.0 | 17.4070                         | 73.374               | 41.1758                         | 38.607               | 43.7388                         | 16.346               | 12.2930                         | 78.171               |
|          | 22.0 | 17.0404                         | 71.649               | 41.0589                         | 37.996               | 43.6142                         | 15.597               | 11.6231                         | 77.220               |
|          | 29.0 | 16.7815                         | 69.529               | 40.9543                         | 37.507               | 43.5084                         | 14.557               | 11.0461                         | 75.707               |
| Luty     | 5.0  | 16.5366                         | 67.421               | 40.8760                         | 36.724               | 43.4157                         | 13.695               | 10.4837                         | 74.181               |
|          | 12.0 | 16.4053                         | 65.048               | 40.8088                         | 36.047               | 43.3433                         | 12.618               | 10.0374                         | 72.204               |
|          | 19.0 | 16.2877                         | 62.847               | 40.7691                         | 34.966               | 43.2857                         | 11.860               | 09.6238                         | 70.361               |
|          | 26.0 | 16.3022                         | 60.507               | 40.7424                         | 33.962               | 43.2533                         | 10.963               | 09.3652                         | 68.150               |
| Marzec   | 5.0  | 16.3295                         | 58.265               | 40.7462                         | 32.771               | 43.2365                         | 10.252               | 09.1297                         | 66.010               |
|          | 12.0 | 16.4806                         | 56.021               | 40.7597                         | 31.639               | 43.2434                         | 09.485               | 09.0551                         | 63.644               |
|          | 19.0 | 16.6329                         | 54.042               | 40.8029                         | 30.205               | 43.2651                         | 09.050               | 09.0077                         | 61.524               |
| Kwiecień | 26.0 | 16.9140                         | 52.191               | 40.8560                         | 28.801               | 43.3125                         | 08.641               | 09.1433                         | 59.290               |
|          | 2.0  | 17.1898                         | 50.507               | 40.9382                         | 27.337               | 43.3730                         | 08.404               | 09.2868                         | 57.223               |
|          | 9.0  | 17.5737                         | 49.057               | 41.0254                         | 25.888               | 43.4548                         | 08.257               | 09.5992                         | 55.178               |
|          | 16.0 | 17.9319                         | 47.900               | 41.1398                         | 24.279               | 43.5467                         | 08.403               | 09.9077                         | 53.454               |
|          | 23.0 | 18.3933                         | 47.078               | 41.2582                         | 22.662               | 43.6596                         | 08.704               | 10.3911                         | 51.855               |
| Maj      | 30.0 | 18.8215                         | 46.426               | 41.4002                         | 21.129               | 43.7790                         | 09.117               | 10.8473                         | 50.476               |
|          | 7.0  | 19.3249                         | 46.160               | 41.5405                         | 19.582               | 43.9131                         | 09.717               | 11.4485                         | 49.321               |
|          | 14.0 | 19.7730                         | 46.131               | 41.7021                         | 18.044               | 44.0498                         | 10.504               | 12.0015                         | 48.488               |
|          | 21.0 | 20.2872                         | 46.550               | 41.8603                         | 16.478               | 44.1995                         | 11.518               | 12.6952                         | 47.952               |
| Czerwiec | 28.0 | 20.7423                         | 47.067               | 42.0337                         | 15.147               | 44.3477                         | 12.531               | 13.3211                         | 47.616               |
|          | 4.0  | 21.2346                         | 48.033               | 42.1982                         | 13.787               | 44.5019                         | 13.775               | 14.0505                         | 47.630               |
|          | 11.0 | 21.6501                         | 49.111               | 42.3751                         | 12.602               | 44.6508                         | 15.055               | 14.6909                         | 47.889               |
|          | 18.0 | 22.0928                         | 50.660               | 42.5414                         | 11.382               | 44.8036                         | 16.580               | 15.4248                         | 48.538               |
| Lipiec   | 25.0 | 22.4623                         | 52.184               | 42.7124                         | 10.532               | 44.9473                         | 17.963               | 16.0598                         | 49.296               |
|          | 2.0  | 22.8338                         | 54.146               | 42.8673                         | 09.635               | 45.0884                         | 19.580               | 16.7522                         | 50.459               |
|          | 9.0  | 23.1209                         | 56.070               | 43.0245                         | 09.045               | 45.2173                         | 21.075               | 17.3297                         | 51.741               |
|          | 16.0 | 23.4007                         | 58.421               | 43.1648                         | 08.409               | 45.3417                         | 22.798               | 17.9511                         | 53.431               |
|          | 23.0 | 23.6078                         | 60.606               | 43.2986                         | 08.231               | 45.4511                         | 24.242               | 18.4599                         | 55.101               |
| Sierpień | 30.0 | 23.7885                         | 63.173               | 43.4106                         | 07.970               | 45.5505                         | 25.905               | 18.9827                         | 57.172               |
|          | 6.0  | 23.8911                         | 65.558               | 43.5149                         | 08.086               | 45.6331                         | 27.316               | 19.3838                         | 59.217               |
|          | 13.0 | 23.9587                         | 68.280               | 43.5981                         | 08.123               | 45.7042                         | 28.922               | 19.7823                         | 61.637               |
|          | 20.0 | 23.9670                         | 70.712               | 43.6648                         | 08.641               | 45.7570                         | 30.148               | 20.0728                         | 63.895               |
|          | 27.0 | 23.9277                         | 73.436               | 43.7070                         | 09.014               | 45.7944                         | 31.575               | 20.3391                         | 66.510               |
| Wrzesień | 3.0  | 23.8275                         | 75.863               | 43.7334                         | 09.755               | 45.8132                         | 32.669               | 20.4939                         | 68.959               |
|          | 10.0 | 23.6719                         | 78.511               | 43.7381                         | 10.362               | 45.8160                         | 33.925               | 20.6054                         | 71.711               |
|          | 17.0 | 23.4795                         | 80.772               | 43.7197                         | 11.397               | 45.8001                         | 34.751               | 20.6278                         | 74.172               |
|          | 24.0 | 23.2247                         | 83.216               | 43.6785                         | 12.203               | 45.7661                         | 35.764               | 20.5930                         | 76.912               |
| Paźdz.   | 1.0  | 22.9347                         | 85.276               | 43.6178                         | 13.305               | 45.7151                         | 36.411               | 20.4705                         | 79.359               |
|          | 8.0  | 22.5768                         | 87.427               | 43.5397                         | 14.200               | 45.6466                         | 37.193               | 20.2720                         | 82.011               |
|          | 15.0 | 22.2101                         | 89.128               | 43.4372                         | 15.416               | 45.5626                         | 37.546               | 20.0133                         | 84.260               |
|          | 22.0 | 21.7740                         | 90.886               | 43.3194                         | 16.319               | 45.4612                         | 38.068               | 19.6716                         | 86.685               |
| Listopad | 29.0 | 21.3354                         | 92.204               | 43.1836                         | 17.413               | 45.3480                         | 38.232               | 19.2782                         | 88.705               |
|          | 5.0  | 20.8268                         | 93.480               | 43.0403                         | 18.238               | 45.2198                         | 38.503               | 18.7881                         | 90.811               |
|          | 12.0 | 20.3419                         | 94.280               | 42.8771                         | 19.257               | 45.0827                         | 38.383               | 18.2762                         | 92.429               |
|          | 19.0 | 19.7914                         | 95.009               | 42.7111                         | 19.915               | 44.9329                         | 38.404               | 17.6690                         | 94.099               |
| Grudzień | 26.0 | 19.2783                         | 95.289               | 42.5337                         | 20.657               | 44.7801                         | 38.105               | 17.0597                         | 95.283               |
|          | 3.0  | 18.7060                         | 95.410               | 42.3621                         | 21.119               | 44.6186                         | 37.876               | 16.3518                         | 96.424               |
|          | 10.0 | 18.1945                         | 95.084               | 42.1796                         | 21.659               | 44.4580                         | 37.323               | 15.6725                         | 97.040               |
|          | 17.0 | 17.6341                         | 94.595               | 42.0089                         | 21.848               | 44.2927                         | 36.877               | 14.9064                         | 97.590               |
|          | 24.0 | 17.1548                         | 93.725               | 41.8357                         | 22.035               | 44.1355                         | 36.185               | 14.2021                         | 97.640               |
|          | 31.0 | 16.6400                         | 92.626               | 41.6815                         | 21.994               | 43.9784                         | 35.517               | 13.4198                         | 97.540               |

**MIEJSCA POZORNE (*IRS*) Biegunowej ( $1^m.97$ ) 2015**  
w momencie  $0^h$  UT1

| UT1       | $\alpha_{app}^{CIO}$  | $\delta_{app}$        | UT1        | $\alpha_{app}^{CIO}$  | $\delta_{app}$        | UT1        | $\alpha_{app}^{CIO}$ | $\delta_{app}$        | UT1        | $\alpha_{app}^{CIO}$ | $\delta_{app}$        |
|-----------|-----------------------|-----------------------|------------|-----------------------|-----------------------|------------|----------------------|-----------------------|------------|----------------------|-----------------------|
|           | $2^h 49^m$            | $89^\circ 19'$        |            | $2^h 48^m$            | $89^\circ 19'$        |            | $2^h 48^m$           | $89^\circ 19'$        |            | $2^h 48^m$           | $89^\circ 19'$        |
| Styczeń 1 | 138. <sup>s</sup> 453 | 52. <sup>''</sup> 392 | Luty 16    | 119. <sup>s</sup> 113 | 56. <sup>''</sup> 573 | Kwiecień 3 | 51. <sup>s</sup> 931 | 48. <sup>''</sup> 017 | Maj 19     | 49. <sup>s</sup> 282 | 33. <sup>''</sup> 830 |
| 2         | 137.253               | 52.606                | 17         | 117.261               | 56.556                | 4          | 50.990               | 47.704                | 20         | 50.210               | 33.557                |
| 3         | 136.023               | 52.830                | 18         | 115.302               | 56.528                | 5          | 50.148               | 47.384                | 21         | 51.103               | 33.299                |
| 4         | 134.727               | 53.062                | 19         | 113.269               | 56.477                | 6          | 49.410               | 47.061                | 22         | 51.938               | 33.050                |
| 5         | 133.339               | 53.298                | 20         | 111.225               | 56.397                | 7          | 48.775               | 46.740                | 23         | 52.717               | 32.803                |
| 6         | 131.849               | 53.531                | 21         | 109.241               | 56.288                | 8          | 48.225               | 46.428                | 24         | 53.451               | 32.553                |
| 7         | 130.261               | 53.756                | 22         | 107.371               | 56.159                | 9          | 47.735               | 46.128                | 25         | 54.166               | 32.295                |
| 8         | 128.591               | 53.969                | 23         | 105.630               | 56.019                | 10         | 47.268               | 45.840                | 26         | 54.887               | 32.029                |
| 9         | 126.863               | 54.165                | 24         | 103.999               | 55.880                | 11         | 46.788               | 45.565                | 27         | 55.645               | 31.753                |
| 10        | 125.105               | 54.344                | 25         | 102.436               | 55.747                | 12         | 46.265               | 45.298                | 28         | 56.465               | 31.469                |
| 11        | 123.346               | 54.505                | 26         | 100.896               | 55.625                | 13         | 45.680               | 45.031                | 29         | 57.367               | 31.181                |
| 12        | 121.612               | 54.651                | 27         | 99.340                | 55.510                | 14         | 45.036               | 44.757                | 30         | 58.368               | 30.893                |
| 13        | 119.923               | 54.785                | 28         | 97.739                | 55.400                | 15         | 44.365               | 44.466                | 31         | 59.471               | 30.609                |
| 14        | 118.293               | 54.911                | Marzec 1   | 96.079                | 55.290                | 16         | 43.717               | 44.154                | Czerwiec 1 | 60.670               | 30.337                |
| 15        | 116.725               | 55.036                | 2          | 94.359                | 55.174                | 17         | 43.157               | 43.820                | 2          | 61.942               | 30.080                |
| 16        | 115.207               | 55.164                | 3          | 92.588                | 55.047                | 18         | 42.736               | 43.472                | 3          | 63.253               | 29.843                |
| 17        | 113.715               | 55.303                | 4          | 90.786                | 54.907                | 19         | 42.473               | 43.120                | 4          | 64.561               | 29.626                |
| 18        | 112.205               | 55.454                | 5          | 88.978                | 54.749                | 20         | 42.351               | 42.775                | 5          | 65.827               | 29.425                |
| 19        | 110.627               | 55.616                | 6          | 87.191                | 54.575                | 21         | 42.322               | 42.445                | 6          | 67.023               | 29.233                |
| 20        | 108.935               | 55.783                | 7          | 85.454                | 54.384                | 22         | 42.328               | 42.133                | 7          | 68.145               | 29.042                |
| 21        | 107.109               | 55.944                | 8          | 83.789                | 54.179                | 23         | 42.323               | 41.835                | 8          | 69.212               | 28.843                |
| 22        | 105.165               | 56.088                | 9          | 82.212                | 53.966                | 24         | 42.276               | 41.546                | 9          | 70.267               | 28.631                |
| 23        | 103.155               | 56.204                | 10         | 80.730                | 53.748                | 25         | 42.178               | 41.261                | 10         | 71.364               | 28.403                |
| 24        | 101.148               | 56.291                | 11         | 79.335                | 53.532                | 26         | 42.034               | 40.973                | 11         | 72.552               | 28.162                |
| 25        | 99.202                | 56.352                | 12         | 78.012                | 53.321                | 27         | 41.862               | 40.677                | 12         | 73.865               | 27.917                |
| 26        | 97.351                | 56.398                | 13         | 76.733                | 53.120                | 28         | 41.685               | 40.371                | 13         | 75.311               | 27.676                |
| 27        | 95.596                | 56.437                | 14         | 75.461                | 52.930                | 29         | 41.532               | 40.053                | 14         | 76.868               | 27.448                |
| 28        | 93.913                | 56.479                | 15         | 74.159                | 52.750                | 30         | 41.428               | 39.724                | 15         | 78.496               | 27.241                |
| 29        | 92.265                | 56.527                | 16         | 72.793                | 52.574                | Maj 1      | 41.401               | 39.386                | 16         | 80.143               | 27.055                |
| 30        | 90.612                | 56.583                | 17         | 71.348                | 52.393                | 2          | 41.468               | 39.042                | 17         | 81.764               | 26.888                |
| 31        | 88.917                | 56.647                | 18         | 69.835                | 52.198                | 3          | 41.643               | 38.697                | 18         | 83.326               | 26.735                |
| Luty 1    | 87.155                | 56.713                | 19         | 68.298                | 51.979                | 4          | 41.925               | 38.356                | 19         | 84.820               | 26.590                |
| 2         | 85.314                | 56.778                | 20         | 66.804                | 51.734                | 5          | 42.301               | 38.026                | 20         | 86.253               | 26.444                |
| 3         | 83.392                | 56.835                | 21         | 65.421                | 51.465                | 6          | 42.745               | 37.710                | 21         | 87.644               | 26.294                |
| 4         | 81.402                | 56.880                | 22         | 64.185                | 51.182                | 7          | 43.221               | 37.411                | 22         | 89.021               | 26.137                |
| 5         | 79.366                | 56.908                | 23         | 63.095                | 50.898                | 8          | 43.690               | 37.127                | 23         | 90.413               | 25.972                |
| 6         | 77.311                | 56.919                | 24         | 62.116                | 50.622                | 9          | 44.119               | 36.856                | 24         | 91.848               | 25.800                |
| 7         | 75.265                | 56.911                | 25         | 61.194                | 50.359                | 10         | 44.487               | 36.589                | 25         | 93.348               | 25.624                |
| 8         | 73.256                | 56.885                | 26         | 60.280                | 50.108                | 11         | 44.795               | 36.319                | 26         | 94.929               | 25.447                |
| 9         | 71.304                | 56.847                | 27         | 59.339                | 49.866                | 12         | 45.066               | 36.038                | 27         | 96.601               | 25.275                |
| 10        | 69.426                | 56.798                | 28         | 58.350                | 49.627                | 13         | 45.346               | 35.741                | 28         | 98.362               | 25.113                |
| 11        | 67.623                | 56.746                | 29         | 57.312                | 49.386                | 14         | 45.689               | 35.426                | 29         | 100.195              | 24.966                |
| 12        | 65.892                | 56.694                | 30         | 56.232                | 49.138                | 15         | 46.147               | 35.097                | 30         | 102.074              | 24.840                |
| 13        | 64.211                | 56.649                | 31         | 55.128                | 48.879                | 16         | 46.751               | 34.764                | Lipiec 1   | 103.958              | 24.734                |
| 14        | 62.549                | 56.614                | Kwiecień 1 | 54.025                | 48.606                | 17         | 47.499               | 34.436                | 2          | 105.803              | 24.650                |
| 15        | 60.865                | 56.590                | 2          | 52.950                | 48.319                | 18         | 48.360               | 34.123                | 3          | 107.573              | 24.579                |
| 16        | 59.113                | 56.573                | 3          | 51.931                | 48.017                | 19         | 49.282               | 33.830                | 4          | 109.250              | 24.514                |

**MIEJSCA POZORNE (*IRS*) Biegunowej ( $1^m.97$ ) 2015**  
w momencie  $0^h$  UT1

| UT1        | $\alpha_{app}^{CIO}$ | $\delta_{app}$        | UT1         | $\alpha_{app}^{CIO}$ | $\delta_{app}$        | UT1        | $\alpha_{app}^{CIO}$ | $\delta_{app}$        | UT1         | $\alpha_{app}^{CIO}$ | $\delta_{app}$        |
|------------|----------------------|-----------------------|-------------|----------------------|-----------------------|------------|----------------------|-----------------------|-------------|----------------------|-----------------------|
|            | $2^h 49^m$           | $89^\circ 19'$        |             | $2^h 51^m$           | $89^\circ 19'$        |            | $2^h 52^m$           | $89^\circ 19'$        |             | $2^h 52^m$           | $89^\circ 19'$        |
| Lipiec 4   | 49. <sup>s</sup> 250 | 24. <sup>''</sup> 514 | Sierpień 19 | 16. <sup>s</sup> 298 | 25. <sup>''</sup> 115 | Paźdz. 4   | 32. <sup>s</sup> 991 | 35. <sup>''</sup> 521 | Listopad 19 | 62. <sup>s</sup> 252 | 51. <sup>''</sup> 701 |
| 5          | 50.846               | 24.444                | 20          | 18.190               | 25.215                | 5          | 34.337               | 35.860                | 20          | 61.965               | 52.074                |
| 6          | 52.403               | 24.362                | 21          | 20.144               | 25.322                | 6          | 35.574               | 36.205                | 21          | 61.646               | 52.427                |
| 7          | 53.975               | 24.264                | 22          | 22.154               | 25.440                | 7          | 36.707               | 36.549                | 22          | 61.348               | 52.761                |
| 8          | 55.617               | 24.152                | 23          | 24.203               | 25.573                | 8          | 37.753               | 36.887                | 23          | 61.120               | 53.082                |
| 9          | 57.367               | 24.035                | 24          | 26.266               | 25.725                | 9          | 38.739               | 37.218                | 24          | 60.984               | 53.400                |
| 10         | 59.236               | 23.921                | 25          | 28.306               | 25.898                | 10         | 39.692               | 37.539                | 25          | 60.926               | 53.725                |
| 11         | 61.208               | 23.819                | 26          | 30.287               | 26.090                | 11         | 40.638               | 37.850                | 26          | 60.900               | 54.066                |
| 12         | 63.248               | 23.736                | 27          | 32.173               | 26.295                | 12         | 41.602               | 38.155                | 27          | 60.841               | 54.425                |
| 13         | 65.309               | 23.674                | 28          | 33.946               | 26.506                | 13         | 42.601               | 38.456                | 28          | 60.693               | 54.799                |
| 14         | 67.348               | 23.633                | 29          | 35.616               | 26.710                | 14         | 43.641               | 38.758                | 29          | 60.419               | 55.181                |
| 15         | 69.330               | 23.608                | 30          | 37.227               | 26.901                | 15         | 44.722               | 39.066                | 30          | 60.010               | 55.563                |
| 16         | 71.237               | 23.594                | 31          | 38.843               | 27.073                | 16         | 45.829               | 39.385                | Grudzień 1  | 59.481               | 55.937                |
| 17         | 73.068               | 23.583                | Wrzesień 1  | 40.530               | 27.231                | 17         | 46.940               | 39.718                | 2           | 58.857               | 56.299                |
| 18         | 74.839               | 23.570                | 2           | 42.321               | 27.384                | 18         | 48.027               | 40.066                | 3           | 58.171               | 56.645                |
| 19         | 76.574               | 23.552                | 3           | 44.218               | 27.543                | 19         | 49.055               | 40.429                | 4           | 57.454               | 56.976                |
| 20         | 78.302               | 23.526                | 4           | 46.184               | 27.718                | 20         | 49.996               | 40.806                | 5           | 56.735               | 57.293                |
| 21         | 80.051               | 23.493                | 5           | 48.171               | 27.914                | 21         | 50.827               | 41.189                | 6           | 56.034               | 57.599                |
| 22         | 81.846               | 23.456                | 6           | 50.129               | 28.130                | 22         | 51.540               | 41.572                | 7           | 55.366               | 57.899                |
| 23         | 83.704               | 23.417                | 7           | 52.021               | 28.363                | 23         | 52.149               | 41.947                | 8           | 54.736               | 58.197                |
| 24         | 85.637               | 23.381                | 8           | 53.822               | 28.608                | 24         | 52.692               | 42.307                | 9           | 54.138               | 58.498                |
| 25         | 87.646               | 23.354                | 9           | 55.528               | 28.858                | 25         | 53.226               | 42.647                | 10          | 53.557               | 58.806                |
| 26         | 89.721               | 23.340                | 10          | 57.146               | 29.108                | 26         | 53.812               | 42.971                | 11          | 52.964               | 59.125                |
| 27         | 91.841               | 23.344                | 11          | 58.693               | 29.354                | 27         | 54.493               | 43.288                | 12          | 52.325               | 59.456                |
| 28         | 93.974               | 23.369                | 12          | 60.196               | 29.593                | 28         | 55.272               | 43.608                | 13          | 51.604               | 59.796                |
| 29         | 96.079               | 23.416                | 13          | 61.681               | 29.824                | 29         | 56.114               | 43.944                | 14          | 50.772               | 60.142                |
| 30         | 98.112               | 23.481                | 14          | 63.176               | 30.047                | 30         | 56.955               | 44.300                | 15          | 49.816               | 60.486                |
| 31         | 100.046              | 23.556                | 15          | 64.703               | 30.266                | 31         | 57.736               | 44.674                | 16          | 48.742               | 60.819                |
| Sierpień 1 | 101.876              | 23.632                | 16          | 66.275               | 30.484                | Listopad 1 | 58.410               | 45.063                | 17          | 47.580               | 61.135                |
| 2          | 103.630              | 23.697                | 17          | 67.899               | 30.705                | 2          | 58.960               | 45.458                | 18          | 46.376               | 61.429                |
| 3          | 105.366              | 23.747                | 18          | 69.569               | 30.936                | 3          | 59.388               | 45.851                | 19          | 45.182               | 61.701                |
| 4          | 107.146              | 23.780                | 19          | 71.270               | 31.179                | 4          | 59.712               | 46.238                | 20          | 44.044               | 61.956                |
| 5          | 109.018              | 23.804                | 20          | 72.980               | 31.439                | 5          | 59.958               | 46.615                | 21          | 42.990               | 62.203                |
| 6          | 111.002              | 23.828                | 21          | 74.668               | 31.716                | 6          | 60.155               | 46.979                | 22          | 42.018               | 62.449                |
| 7          | 113.085              | 23.863                | 22          | 76.301               | 32.012                | 7          | 60.332               | 47.332                | 23          | 41.099               | 62.705                |
| 8          | 115.233              | 23.915                | 23          | 77.845               | 32.321                | 8          | 60.515               | 47.674                | 24          | 40.180               | 62.976                |
| 9          | 117.399              | 23.988                | 24          | 79.278               | 32.637                | 9          | 60.722               | 48.010                | 25          | 39.204               | 63.260                |
| 10         | 119.540              | 24.081                | 25          | 80.597               | 32.953                | 10         | 60.964               | 48.344                | 26          | 38.126               | 63.554                |
| 11         | 121.621              | 24.192                | 26          | 81.827               | 33.257                | 11         | 61.244               | 48.679                | 27          | 36.921               | 63.848                |
| 12         | 123.622              | 24.314                | 27          | 83.020               | 33.544                | 12         | 61.550               | 49.022                | 28          | 35.591               | 64.136                |
| 13         | 125.537              | 24.441                | 28          | 84.244               | 33.813                | 13         | 61.862               | 49.377                | 29          | 34.159               | 64.410                |
| 14         | 127.377              | 24.568                | 29          | 85.555               | 34.071                | 14         | 62.150               | 49.744                | 30          | 32.656               | 64.666                |
| 15         | 129.163              | 24.690                | 30          | 86.974               | 34.328                | 15         | 62.381               | 50.126                | 31          | 31.117               | 64.904                |
| 16         | 130.921              | 24.805                | Paźdz. 1    | 88.481               | 34.597                | 16         | 62.523               | 50.518                | Styczeń 1   | 29.574               | 65.124                |
| 17         | 132.680              | 24.913                | 2           | 90.023               | 34.885                | 17         | 62.551               | 50.916                | 2           | 28.052               | 65.329                |
| 18         | 134.465              | 25.015                | 3           | 91.543               | 35.194                | 18         | 62.458               | 51.313                | 3           | 26.567               | 65.523                |
| 19         | 136.298              | 25.115                | 4           | 92.991               | 35.521                | 19         | 62.252               | 51.701                | 4           | 25.128               | 65.712                |

**MIEJSCA POZORNE (*IRS*) 1H Draconis ( $4^m28$ ) 2015**  
w momencie  $0^h$  UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$ | $\delta_{app}$       | <i>UT1</i> | $\alpha_{app}^{CIO}$ | $\delta_{app}$       | <i>UT1</i> | $\alpha_{app}^{CIO}$ | $\delta_{app}$       | <i>UT1</i> | $\alpha_{app}^{CIO}$ | $\delta_{app}$       |
|------------|----------------------|----------------------|------------|----------------------|----------------------|------------|----------------------|----------------------|------------|----------------------|----------------------|
|            | $9^h38^m$            | $81^\circ15'$        |            | $9^h38^m$            | $81^\circ15'$        |            | $9^h38^m$            | $81^\circ15'$        |            | $9^h38^m$            | $81^\circ15'$        |
| Styczeń 1  | 24. <sup>s</sup> 613 | 08. <sup>u</sup> 026 | Luty 16    | 27. <sup>s</sup> 685 | 19. <sup>u</sup> 739 | Kwiecień 3 | 25. <sup>s</sup> 114 | 32. <sup>u</sup> 716 | Maj 19     | 19. <sup>s</sup> 060 | 36. <sup>u</sup> 707 |
| 2          | 24.724               | 08.164               | 17         | 27.708               | 20.043               | 4          | 24.996               | 32.947               | 20         | 18.927               | 36.624               |
| 3          | 24.840               | 08.304               | 18         | 27.727               | 20.368               | 5          | 24.872               | 33.163               | 21         | 18.801               | 36.544               |
| 4          | 24.961               | 08.454               | 19         | 27.738               | 20.711               | 6          | 24.746               | 33.362               | 22         | 18.680               | 36.472               |
| 5          | 25.084               | 08.619               | 20         | 27.737               | 21.062               | 7          | 24.619               | 33.543               | 23         | 18.560               | 36.410               |
| 6          | 25.208               | 08.802               | 21         | 27.723               | 21.409               | 8          | 24.494               | 33.708               | 24         | 18.440               | 36.356               |
| 7          | 25.330               | 09.003               | 22         | 27.698               | 21.742               | 9          | 24.374               | 33.861               | 25         | 18.317               | 36.307               |
| 8          | 25.448               | 09.221               | 23         | 27.666               | 22.055               | 10         | 24.258               | 34.008               | 26         | 18.190               | 36.259               |
| 9          | 25.560               | 09.452               | 24         | 27.633               | 22.350               | 11         | 24.148               | 34.154               | 27         | 18.058               | 36.208               |
| 10         | 25.664               | 09.692               | 25         | 27.602               | 22.632               | 12         | 24.041               | 34.307               | 28         | 17.922               | 36.147               |
| 11         | 25.762               | 09.936               | 26         | 27.575               | 22.908               | 13         | 23.936               | 34.470               | 29         | 17.783               | 36.073               |
| 12         | 25.852               | 10.179               | 27         | 27.551               | 23.186               | 14         | 23.829               | 34.646               | 30         | 17.642               | 35.982               |
| 13         | 25.937               | 10.416               | 28         | 27.530               | 23.471               | 15         | 23.715               | 34.830               | 31         | 17.502               | 35.873               |
| 14         | 26.017               | 10.645               | Marzec 1   | 27.509               | 23.767               | 16         | 23.592               | 35.016               | Czerwiec 1 | 17.365               | 35.745               |
| 15         | 26.096               | 10.864               | 2          | 27.488               | 24.074               | 17         | 23.458               | 35.191               | 2          | 17.233               | 35.601               |
| 16         | 26.176               | 11.073               | 3          | 27.462               | 24.393               | 18         | 23.315               | 35.346               | 3          | 17.109               | 35.446               |
| 17         | 26.259               | 11.277               | 4          | 27.431               | 24.720               | 19         | 23.169               | 35.476               | 4          | 16.994               | 35.287               |
| 18         | 26.348               | 11.480               | 5          | 27.393               | 25.053               | 20         | 23.023               | 35.579               | 5          | 16.886               | 35.133               |
| 19         | 26.443               | 11.693               | 6          | 27.348               | 25.386               | 21         | 22.882               | 35.665               | 6          | 16.783               | 34.989               |
| 20         | 26.542               | 11.925               | 7          | 27.294               | 25.714               | 22         | 22.747               | 35.740               | 7          | 16.681               | 34.857               |
| 21         | 26.640               | 12.181               | 8          | 27.234               | 26.033               | 23         | 22.619               | 35.815               | 8          | 16.578               | 34.737               |
| 22         | 26.733               | 12.461               | 9          | 27.168               | 26.340               | 24         | 22.496               | 35.895               | 9          | 16.468               | 34.622               |
| 23         | 26.815               | 12.758               | 10         | 27.099               | 26.631               | 25         | 22.375               | 35.984               | 10         | 16.351               | 34.503               |
| 24         | 26.884               | 13.061               | 11         | 27.030               | 26.908               | 26         | 22.253               | 36.082               | 11         | 16.228               | 34.371               |
| 25         | 26.942               | 13.359               | 12         | 26.961               | 27.172               | 27         | 22.129               | 36.187               | 12         | 16.100               | 34.218               |
| 26         | 26.992               | 13.644               | 13         | 26.896               | 27.427               | 28         | 22.000               | 36.294               | 13         | 15.973               | 34.042               |
| 27         | 27.037               | 13.914               | 14         | 26.835               | 27.678               | 29         | 21.866               | 36.401               | 14         | 15.849               | 33.844               |
| 28         | 27.082               | 14.171               | 15         | 26.779               | 27.933               | 30         | 21.726               | 36.502               | 15         | 15.732               | 33.629               |
| 29         | 27.129               | 14.422               | 16         | 26.726               | 28.198               | Maj 1      | 21.581               | 36.592               | 16         | 15.625               | 33.406               |
| 30         | 27.180               | 14.672               | 17         | 26.672               | 28.479               | 2          | 21.432               | 36.667               | 17         | 15.526               | 33.184               |
| 31         | 27.235               | 14.927               | 18         | 26.613               | 28.775               | 3          | 21.281               | 36.725               | 18         | 15.434               | 32.970               |
| Luty 1     | 27.292               | 15.194               | 19         | 26.544               | 29.080               | 4          | 21.130               | 36.763               | 19         | 15.345               | 32.765               |
| 2          | 27.349               | 15.475               | 20         | 26.464               | 29.384               | 5          | 20.982               | 36.783               | 20         | 15.259               | 32.571               |
| 3          | 27.404               | 15.772               | 21         | 26.371               | 29.675               | 6          | 20.839               | 36.789               | 21         | 15.170               | 32.386               |
| 4          | 27.455               | 16.083               | 22         | 26.270               | 29.943               | 7          | 20.702               | 36.786               | 22         | 15.080               | 32.204               |
| 5          | 27.500               | 16.405               | 23         | 26.167               | 30.188               | 8          | 20.572               | 36.781               | 23         | 14.985               | 32.021               |
| 6          | 27.538               | 16.735               | 24         | 26.065               | 30.413               | 9          | 20.448               | 36.780               | 24         | 14.887               | 31.832               |
| 7          | 27.567               | 17.067               | 25         | 25.967               | 30.625               | 10         | 20.327               | 36.790               | 25         | 14.786               | 31.633               |
| 8          | 27.589               | 17.397               | 26         | 25.874               | 30.834               | 11         | 20.206               | 36.810               | 26         | 14.684               | 31.420               |
| 9          | 27.604               | 17.720               | 27         | 25.786               | 31.046               | 12         | 20.080               | 36.840               | 27         | 14.582               | 31.190               |
| 10         | 27.614               | 18.033               | 28         | 25.700               | 31.266               | 13         | 19.947               | 36.872               | 28         | 14.483               | 30.943               |
| 11         | 27.621               | 18.334               | 29         | 25.613               | 31.495               | 14         | 19.806               | 36.897               | 29         | 14.389               | 30.680               |
| 12         | 27.627               | 18.623               | 30         | 25.524               | 31.734               | 15         | 19.657               | 36.905               | 30         | 14.303               | 30.405               |
| 13         | 27.635               | 18.903               | 31         | 25.431               | 31.979               | 16         | 19.504               | 36.890               | Lipiec 1   | 14.227               | 30.124               |
| 14         | 27.647               | 19.177               | Kwiecień 1 | 25.332               | 32.228               | 17         | 19.350               | 36.849               | 2          | 14.159               | 29.845               |
| 15         | 27.664               | 19.453               | 2          | 25.227               | 32.475               | 18         | 19.202               | 36.785               | 3          | 14.099               | 29.577               |
| 16         | 27.685               | 19.739               | 3          | 25.114               | 32.716               | 19         | 19.060               | 36.707               | 4          | 14.042               | 29.324               |

**MIEJSCA POZORNE (*IRS*) 1H Draconis (<sup>m</sup>4.28) 2015**  
w momencie 0<sup>h</sup> UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$           | $\delta_{app}$       | <i>UT1</i>  | $\alpha_{app}^{CIO}$           | $\delta_{app}$       | <i>UT1</i> | $\alpha_{app}^{CIO}$           | $\delta_{app}$       | <i>UT1</i>  | $\alpha_{app}^{CIO}$           | $\delta_{app}$       |
|------------|--------------------------------|----------------------|-------------|--------------------------------|----------------------|------------|--------------------------------|----------------------|-------------|--------------------------------|----------------------|
|            | 9 <sup>h</sup> 38 <sup>m</sup> | 81°15′               |             | 9 <sup>h</sup> 38 <sup>m</sup> | 81°15′               |            | 9 <sup>h</sup> 38 <sup>m</sup> | 81°14′               |             | 9 <sup>h</sup> 38 <sup>m</sup> | 81°14′               |
| Lipiec 4   | 14. <sup>s</sup> 042           | 29. <sup>″</sup> 324 | Sierpień 19 | 12. <sup>s</sup> 867           | 15. <sup>″</sup> 064 | Paźdz. 4   | 16. <sup>s</sup> 132           | 60. <sup>″</sup> 063 | Listopad 19 | 22. <sup>s</sup> 653           | 51. <sup>″</sup> 360 |
| 5          | 13.985                         | 29.085               | 20          | 12.880                         | 14.732               | 5          | 16.257                         | 59.762               | 20          | 22.818                         | 51.317               |
| 6          | 13.924                         | 28.856               | 21          | 12.895                         | 14.387               | 6          | 16.386                         | 59.478               | 21          | 22.975                         | 51.284               |
| 7          | 13.855                         | 28.627               | 22          | 12.913                         | 14.029               | 7          | 16.516                         | 59.212               | 22          | 23.124                         | 51.250               |
| 8          | 13.780                         | 28.389               | 23          | 12.938                         | 13.662               | 8          | 16.646                         | 58.962               | 23          | 23.266                         | 51.206               |
| 9          | 13.701                         | 28.134               | 24          | 12.970                         | 13.288               | 9          | 16.772                         | 58.724               | 24          | 23.405                         | 51.147               |
| 10         | 13.621                         | 27.857               | 25          | 13.012                         | 12.913               | 10         | 16.896                         | 58.492               | 25          | 23.546                         | 51.074               |
| 11         | 13.544                         | 27.560               | 26          | 13.062                         | 12.545               | 11         | 17.015                         | 58.264               | 26          | 23.694                         | 50.991               |
| 12         | 13.475                         | 27.247               | 27          | 13.120                         | 12.190               | 12         | 17.132                         | 58.033               | 27          | 23.849                         | 50.910               |
| 13         | 13.414                         | 26.925               | 28          | 13.182                         | 11.853               | 13         | 17.246                         | 57.796               | 28          | 24.013                         | 50.841               |
| 14         | 13.362                         | 26.603               | 29          | 13.243                         | 11.535               | 14         | 17.361                         | 57.552               | 29          | 24.182                         | 50.792               |
| 15         | 13.319                         | 26.288               | 30          | 13.299                         | 11.230               | 15         | 17.477                         | 57.299               | 30          | 24.352                         | 50.766               |
| 16         | 13.280                         | 25.983               | 31          | 13.347                         | 10.927               | 16         | 17.597                         | 57.040               | Grudzień 1  | 24.521                         | 50.762               |
| 17         | 13.245                         | 25.691               | Wrzesień 1  | 13.388                         | 10.615               | 17         | 17.724                         | 56.776               | 2           | 24.686                         | 50.776               |
| 18         | 13.210                         | 25.409               | 2           | 13.426                         | 10.285               | 18         | 17.857                         | 56.513               | 3           | 24.846                         | 50.803               |
| 19         | 13.173                         | 25.134               | 3           | 13.464                         | 09.936               | 19         | 17.998                         | 56.257               | 4           | 24.999                         | 50.839               |
| 20         | 13.133                         | 24.863               | 4           | 13.509                         | 09.571               | 20         | 18.145                         | 56.013               | 5           | 25.147                         | 50.877               |
| 21         | 13.090                         | 24.588               | 5           | 13.561                         | 09.198               | 21         | 18.298                         | 55.786               | 6           | 25.290                         | 50.914               |
| 22         | 13.044                         | 24.307               | 6           | 13.623                         | 08.825               | 22         | 18.451                         | 55.579               | 7           | 25.430                         | 50.947               |
| 23         | 12.997                         | 24.015               | 7           | 13.693                         | 08.461               | 23         | 18.603                         | 55.392               | 8           | 25.568                         | 50.973               |
| 24         | 12.950                         | 23.709               | 8           | 13.770                         | 08.109               | 24         | 18.750                         | 55.218               | 9           | 25.707                         | 50.993               |
| 25         | 12.905                         | 23.387               | 9           | 13.850                         | 07.773               | 25         | 18.888                         | 55.049               | 10          | 25.849                         | 51.009               |
| 26         | 12.865                         | 23.052               | 10          | 13.932                         | 07.451               | 26         | 19.019                         | 54.875               | 11          | 25.995                         | 51.024               |
| 27         | 12.832                         | 22.705               | 11          | 14.014                         | 07.142               | 27         | 19.145                         | 54.685               | 12          | 26.147                         | 51.044               |
| 28         | 12.808                         | 22.350               | 12          | 14.093                         | 06.842               | 28         | 19.272                         | 54.477               | 13          | 26.305                         | 51.076               |
| 29         | 12.794                         | 21.997               | 13          | 14.168                         | 06.546               | 29         | 19.404                         | 54.255               | 14          | 26.467                         | 51.127               |
| 30         | 12.788                         | 21.651               | 14          | 14.241                         | 06.250               | 30         | 19.544                         | 54.029               | 15          | 26.629                         | 51.198               |
| 31         | 12.788                         | 21.321               | 15          | 14.311                         | 05.949               | 31         | 19.694                         | 53.809               | 16          | 26.789                         | 51.292               |
| Sierpień 1 | 12.791                         | 21.008               | 16          | 14.380                         | 05.639               | Listopad 1 | 19.851                         | 53.604               | 17          | 26.942                         | 51.404               |
| 2          | 12.790                         | 20.710               | 17          | 14.450                         | 05.320               | 2          | 20.012                         | 53.420               | 18          | 27.087                         | 51.527               |
| 3          | 12.782                         | 20.419               | 18          | 14.523                         | 04.990               | 3          | 20.175                         | 53.256               | 19          | 27.223                         | 51.653               |
| 4          | 12.767                         | 20.123               | 19          | 14.601                         | 04.653               | 4          | 20.337                         | 53.111               | 20          | 27.351                         | 51.772               |
| 5          | 12.747                         | 19.813               | 20          | 14.686                         | 04.310               | 5          | 20.495                         | 52.981               | 21          | 27.473                         | 51.879               |
| 6          | 12.726                         | 19.484               | 21          | 14.780                         | 03.966               | 6          | 20.649                         | 52.862               | 22          | 27.595                         | 51.972               |
| 7          | 12.707                         | 19.134               | 22          | 14.881                         | 03.629               | 7          | 20.799                         | 52.748               | 23          | 27.719                         | 52.054               |
| 8          | 12.694                         | 18.770               | 23          | 14.990                         | 03.304               | 8          | 20.944                         | 52.634               | 24          | 27.850                         | 52.132               |
| 9          | 12.690                         | 18.398               | 24          | 15.103                         | 02.996               | 9          | 21.085                         | 52.518               | 25          | 27.987                         | 52.218               |
| 10         | 12.696                         | 18.026               | 25          | 15.218                         | 02.708               | 10         | 21.226                         | 52.395               | 26          | 28.130                         | 52.319               |
| 11         | 12.709                         | 17.661               | 26          | 15.330                         | 02.437               | 11         | 21.366                         | 52.265               | 27          | 28.275                         | 52.442               |
| 12         | 12.729                         | 17.307               | 27          | 15.435                         | 02.176               | 12         | 21.510                         | 52.129               | 28          | 28.419                         | 52.587               |
| 13         | 12.752                         | 16.967               | 28          | 15.532                         | 01.912               | 13         | 21.658                         | 51.989               | 29          | 28.559                         | 52.752               |
| 14         | 12.777                         | 16.639               | 29          | 15.622                         | 01.635               | 14         | 21.812                         | 51.851               | 30          | 28.692                         | 52.933               |
| 15         | 12.800                         | 16.322               | 30          | 15.711                         | 01.340               | 15         | 21.973                         | 51.719               | 31          | 28.818                         | 53.123               |
| 16         | 12.821                         | 16.011               | Paźdz. 1    | 15.804                         | 01.026               | 16         | 22.139                         | 51.600               | Styczeń 1   | 28.937                         | 53.318               |
| 17         | 12.839                         | 15.700               | 2           | 15.904                         | 00.703               | 17         | 22.310                         | 51.499               | 2           | 29.049                         | 53.512               |
| 18         | 12.854                         | 15.386               | 3           | 16.013                         | 00.378               | 18         | 22.483                         | 51.419               | 3           | 29.155                         | 53.702               |
| 19         | 12.867                         | 15.064               | 4           | 16.132                         | 00.063               | 19         | 22.653                         | 51.360               | 4           | 29.259                         | 53.885               |

**MIEJSCA POZORNE (*IRS*)  $\varepsilon$  Ursae Minoris (4.21) 2015**  
w momencie 0<sup>*h*</sup> UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              | <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              | <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              | <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              |
|------------|-----------------------------------------------|-----------------------------|------------|-----------------------------------------------|-----------------------------|------------|-----------------------------------------------|-----------------------------|------------|-----------------------------------------------|-----------------------------|
|            | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |            | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |            | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |            | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |
| Styczeń 1  | 31. <sup><i>s</i></sup> 802                   | 36. <sup><i>″</i></sup> 300 | Luty 16    | 36. <sup><i>s</i></sup> 717                   | 25. <sup><i>″</i></sup> 330 | Kwiecień 3 | 43. <sup><i>s</i></sup> 638                   | 27. <sup><i>″</i></sup> 027 | Maj 19     | 47. <sup><i>s</i></sup> 126                   | 39. <sup><i>″</i></sup> 661 |
| 2          | 31.843                                        | 35.994                      | 17         | 36.858                                        | 25.180                      | 4          | 43.779                                        | 27.225                      | 20         | 47.120                                        | 39.994                      |
| 3          | 31.884                                        | 35.677                      | 18         | 37.008                                        | 25.031                      | 5          | 43.915                                        | 27.439                      | 21         | 47.114                                        | 40.310                      |
| 4          | 31.928                                        | 35.347                      | 19         | 37.170                                        | 24.896                      | 6          | 44.045                                        | 27.663                      | 22         | 47.111                                        | 40.614                      |
| 5          | 31.977                                        | 35.007                      | 20         | 37.339                                        | 24.786                      | 7          | 44.166                                        | 27.895                      | 23         | 47.110                                        | 40.911                      |
| 6          | 32.035                                        | 34.660                      | 21         | 37.509                                        | 24.707                      | 8          | 44.279                                        | 28.126                      | 24         | 47.114                                        | 41.208                      |
| 7          | 32.102                                        | 34.312                      | 22         | 37.677                                        | 24.656                      | 9          | 44.384                                        | 28.353                      | 25         | 47.121                                        | 41.509                      |
| 8          | 32.177                                        | 33.969                      | 23         | 37.837                                        | 24.624                      | 10         | 44.486                                        | 28.570                      | 26         | 47.129                                        | 41.820                      |
| 9          | 32.261                                        | 33.635                      | 24         | 37.989                                        | 24.602                      | 11         | 44.585                                        | 28.776                      | 27         | 47.137                                        | 42.142                      |
| 10         | 32.350                                        | 33.314                      | 25         | 38.135                                        | 24.579                      | 12         | 44.686                                        | 28.971                      | 28         | 47.142                                        | 42.475                      |
| 11         | 32.444                                        | 33.009                      | 26         | 38.276                                        | 24.550                      | 13         | 44.791                                        | 29.161                      | 29         | 47.142                                        | 42.820                      |
| 12         | 32.539                                        | 32.720                      | 27         | 38.417                                        | 24.513                      | 14         | 44.902                                        | 29.354                      | 30         | 47.135                                        | 43.174                      |
| 13         | 32.634                                        | 32.445                      | 28         | 38.561                                        | 24.469                      | 15         | 45.019                                        | 29.558                      | 31         | 47.119                                        | 43.532                      |
| 14         | 32.725                                        | 32.181                      | Marzec 1   | 38.708                                        | 24.420                      | 16         | 45.139                                        | 29.784                      | Czerwiec 1 | 47.093                                        | 43.888                      |
| 15         | 32.813                                        | 31.925                      | 2          | 38.862                                        | 24.371                      | 17         | 45.258                                        | 30.036                      | 2          | 47.058                                        | 44.237                      |
| 16         | 32.896                                        | 31.668                      | 3          | 39.021                                        | 24.327                      | 18         | 45.369                                        | 30.313                      | 3          | 47.016                                        | 44.572                      |
| 17         | 32.975                                        | 31.406                      | 4          | 39.186                                        | 24.293                      | 19         | 45.470                                        | 30.606                      | 4          | 46.970                                        | 44.890                      |
| 18         | 33.053                                        | 31.131                      | 5          | 39.355                                        | 24.274                      | 20         | 45.559                                        | 30.906                      | 5          | 46.923                                        | 45.190                      |
| 19         | 33.133                                        | 30.841                      | 6          | 39.527                                        | 24.272                      | 21         | 45.638                                        | 31.200                      | 6          | 46.879                                        | 45.476                      |
| 20         | 33.220                                        | 30.537                      | 7          | 39.699                                        | 24.289                      | 22         | 45.711                                        | 31.483                      | 7          | 46.840                                        | 45.755                      |
| 21         | 33.319                                        | 30.227                      | 8          | 39.868                                        | 24.324                      | 23         | 45.780                                        | 31.752                      | 8          | 46.807                                        | 46.037                      |
| 22         | 33.430                                        | 29.923                      | 9          | 40.033                                        | 24.375                      | 24         | 45.851                                        | 32.010                      | 9          | 46.778                                        | 46.330                      |
| 23         | 33.552                                        | 29.639                      | 10         | 40.192                                        | 24.437                      | 25         | 45.925                                        | 32.261                      | 10         | 46.749                                        | 46.639                      |
| 24         | 33.680                                        | 29.380                      | 11         | 40.345                                        | 24.506                      | 26         | 46.002                                        | 32.511                      | 11         | 46.716                                        | 46.968                      |
| 25         | 33.810                                        | 29.149                      | 12         | 40.491                                        | 24.576                      | 27         | 46.084                                        | 32.765                      | 12         | 46.676                                        | 47.312                      |
| 26         | 33.936                                        | 28.940                      | 13         | 40.632                                        | 24.641                      | 28         | 46.168                                        | 33.028                      | 13         | 46.624                                        | 47.663                      |
| 27         | 34.057                                        | 28.744                      | 14         | 40.769                                        | 24.697                      | 29         | 46.253                                        | 33.304                      | 14         | 46.561                                        | 48.011                      |
| 28         | 34.172                                        | 28.553                      | 15         | 40.907                                        | 24.743                      | 30         | 46.337                                        | 33.593                      | 15         | 46.488                                        | 48.349                      |
| 29         | 34.282                                        | 28.359                      | 16         | 41.048                                        | 24.780                      | Maj 1      | 46.417                                        | 33.898                      | 16         | 46.409                                        | 48.669                      |
| 30         | 34.392                                        | 28.157                      | 17         | 41.196                                        | 24.815                      | 2          | 46.492                                        | 34.216                      | 17         | 46.328                                        | 48.969                      |
| 31         | 34.502                                        | 27.946                      | 18         | 41.353                                        | 24.857                      | 3          | 46.559                                        | 34.544                      | 18         | 46.247                                        | 49.253                      |
| Luty 1     | 34.617                                        | 27.727                      | 19         | 41.516                                        | 24.918                      | 4          | 46.617                                        | 34.878                      | 19         | 46.170                                        | 49.525                      |
| 2          | 34.739                                        | 27.503                      | 20         | 41.683                                        | 25.007                      | 5          | 46.666                                        | 35.211                      | 20         | 46.097                                        | 49.791                      |
| 3          | 34.867                                        | 27.279                      | 21         | 41.847                                        | 25.126                      | 6          | 46.707                                        | 35.537                      | 21         | 46.028                                        | 50.058                      |
| 4          | 35.004                                        | 27.061                      | 22         | 42.003                                        | 25.269                      | 7          | 46.742                                        | 35.851                      | 22         | 45.962                                        | 50.330                      |
| 5          | 35.148                                        | 26.853                      | 23         | 42.148                                        | 25.426                      | 8          | 46.773                                        | 36.151                      | 23         | 45.897                                        | 50.610                      |
| 6          | 35.297                                        | 26.660                      | 24         | 42.284                                        | 25.585                      | 9          | 46.805                                        | 36.438                      | 24         | 45.830                                        | 50.900                      |
| 7          | 35.449                                        | 26.485                      | 25         | 42.413                                        | 25.739                      | 10         | 46.840                                        | 36.715                      | 25         | 45.759                                        | 51.199                      |
| 8          | 35.603                                        | 26.327                      | 26         | 42.539                                        | 25.883                      | 11         | 46.880                                        | 36.990                      | 26         | 45.682                                        | 51.505                      |
| 9          | 35.756                                        | 26.186                      | 27         | 42.664                                        | 26.017                      | 12         | 46.925                                        | 37.272                      | 27         | 45.597                                        | 51.815                      |
| 10         | 35.905                                        | 26.060                      | 28         | 42.792                                        | 26.144                      | 13         | 46.973                                        | 37.570                      | 28         | 45.504                                        | 52.123                      |
| 11         | 36.050                                        | 25.944                      | 29         | 42.925                                        | 26.269                      | 14         | 47.021                                        | 37.889                      | 29         | 45.401                                        | 52.425                      |
| 12         | 36.189                                        | 25.833                      | 30         | 43.062                                        | 26.397                      | 15         | 47.063                                        | 38.229                      | 30         | 45.291                                        | 52.712                      |
| 13         | 36.324                                        | 25.721                      | 31         | 43.203                                        | 26.533                      | 16         | 47.096                                        | 38.586                      | Lipiec 1   | 45.175                                        | 52.981                      |
| 14         | 36.454                                        | 25.602                      | Kwiecień 1 | 43.347                                        | 26.682                      | 17         | 47.117                                        | 38.950                      | 2          | 45.057                                        | 53.228                      |
| 15         | 36.584                                        | 25.472                      | 2          | 43.493                                        | 26.846                      | 18         | 47.126                                        | 39.312                      | 3          | 44.942                                        | 53.457                      |
| 16         | 36.717                                        | 25.330                      | 3          | 43.638                                        | 27.027                      | 19         | 47.126                                        | 39.661                      | 4          | 44.833                                        | 53.673                      |

**MIEJSCA POZORNE (*IRS*)  $\varepsilon$  Ursae Minoris (4.21) 2015**  
w momencie 0<sup>*h*</sup> UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              | <i>UT1</i>  | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              | <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              | <i>UT1</i>  | $\alpha_{app}^{CIO}$                          | $\delta_{app}$              |
|------------|-----------------------------------------------|-----------------------------|-------------|-----------------------------------------------|-----------------------------|------------|-----------------------------------------------|-----------------------------|-------------|-----------------------------------------------|-----------------------------|
|            | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |             | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |            | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |             | 16 <sup><i>h</i></sup> 43 <sup><i>m</i></sup> | 82°00′                      |
| Lipiec 4   | 44. <sup><i>s</i></sup> 833                   | 53. <sup><i>″</i></sup> 673 | Sierpień 19 | 38. <sup><i>s</i></sup> 205                   | 61. <sup><i>″</i></sup> 121 | Paźdz. 4   | 30. <sup><i>s</i></sup> 132                   | 58. <sup><i>″</i></sup> 474 | Listopad 19 | 24. <sup><i>s</i></sup> 345                   | 46. <sup><i>″</i></sup> 118 |
| 5          | 44.730                                        | 53.886                      | 20          | 38.041                                        | 61.200                      | 5          | 29.955                                        | 58.282                      | 20          | 24.283                                        | 45.749                      |
| 6          | 44.633                                        | 54.107                      | 21          | 37.871                                        | 61.279                      | 6          | 29.786                                        | 58.075                      | 21          | 24.228                                        | 45.395                      |
| 7          | 44.538                                        | 54.343                      | 22          | 37.694                                        | 61.352                      | 7          | 29.625                                        | 57.861                      | 22          | 24.176                                        | 45.060                      |
| 8          | 44.442                                        | 54.596                      | 23          | 37.511                                        | 61.415                      | 8          | 29.471                                        | 57.643                      | 23          | 24.121                                        | 44.741                      |
| 9          | 44.338                                        | 54.864                      | 24          | 37.322                                        | 61.462                      | 9          | 29.323                                        | 57.428                      | 24          | 24.061                                        | 44.433                      |
| 10         | 44.225                                        | 55.139                      | 25          | 37.131                                        | 61.489                      | 10         | 29.180                                        | 57.218                      | 25          | 23.993                                        | 44.124                      |
| 11         | 44.102                                        | 55.412                      | 26          | 36.939                                        | 61.493                      | 11         | 29.040                                        | 57.015                      | 26          | 23.919                                        | 43.804                      |
| 12         | 43.969                                        | 55.674                      | 27          | 36.752                                        | 61.478                      | 12         | 28.900                                        | 56.820                      | 27          | 23.844                                        | 43.465                      |
| 13         | 43.830                                        | 55.918                      | 28          | 36.572                                        | 61.448                      | 13         | 28.758                                        | 56.630                      | 28          | 23.772                                        | 43.105                      |
| 14         | 43.687                                        | 56.143                      | 29          | 36.401                                        | 61.414                      | 14         | 28.612                                        | 56.442                      | 29          | 23.708                                        | 42.728                      |
| 15         | 43.545                                        | 56.348                      | 30          | 36.237                                        | 61.387                      | 15         | 28.463                                        | 56.252                      | 30          | 23.653                                        | 42.340                      |
| 16         | 43.407                                        | 56.538                      | 31          | 36.077                                        | 61.377                      | 16         | 28.309                                        | 56.055                      | Grudzień 1  | 23.610                                        | 41.949                      |
| 17         | 43.273                                        | 56.718                      | Wrzesień 1  | 35.916                                        | 61.386                      | 17         | 28.152                                        | 55.845                      | 2           | 23.576                                        | 41.561                      |
| 18         | 43.144                                        | 56.895                      | 2           | 35.747                                        | 61.406                      | 18         | 27.994                                        | 55.619                      | 3           | 23.550                                        | 41.181                      |
| 19         | 43.019                                        | 57.073                      | 3           | 35.569                                        | 61.430                      | 19         | 27.836                                        | 55.374                      | 4           | 23.529                                        | 40.813                      |
| 20         | 42.896                                        | 57.257                      | 4           | 35.383                                        | 61.445                      | 20         | 27.682                                        | 55.110                      | 5           | 23.512                                        | 40.456                      |
| 21         | 42.773                                        | 57.449                      | 5           | 35.190                                        | 61.444                      | 21         | 27.534                                        | 54.831                      | 6           | 23.496                                        | 40.111                      |
| 22         | 42.647                                        | 57.648                      | 6           | 34.995                                        | 61.421                      | 22         | 27.396                                        | 54.542                      | 7           | 23.479                                        | 39.773                      |
| 23         | 42.518                                        | 57.854                      | 7           | 34.801                                        | 61.378                      | 23         | 27.267                                        | 54.252                      | 8           | 23.459                                        | 39.441                      |
| 24         | 42.382                                        | 58.064                      | 8           | 34.612                                        | 61.317                      | 24         | 27.146                                        | 53.970                      | 9           | 23.437                                        | 39.108                      |
| 25         | 42.238                                        | 58.272                      | 9           | 34.428                                        | 61.242                      | 25         | 27.030                                        | 53.703                      | 10          | 23.411                                        | 38.770                      |
| 26         | 42.086                                        | 58.474                      | 10          | 34.250                                        | 61.160                      | 26         | 26.914                                        | 53.455                      | 11          | 23.384                                        | 38.421                      |
| 27         | 41.927                                        | 58.663                      | 11          | 34.079                                        | 61.075                      | 27         | 26.793                                        | 53.221                      | 12          | 23.358                                        | 38.058                      |
| 28         | 41.763                                        | 58.835                      | 12          | 33.913                                        | 60.993                      | 28         | 26.663                                        | 52.991                      | 13          | 23.336                                        | 37.680                      |
| 29         | 41.595                                        | 58.985                      | 13          | 33.750                                        | 60.916                      | 29         | 26.526                                        | 52.753                      | 14          | 23.321                                        | 37.288                      |
| 30         | 41.429                                        | 59.113                      | 14          | 33.588                                        | 60.846                      | 30         | 26.384                                        | 52.497                      | 15          | 23.316                                        | 36.888                      |
| 31         | 41.267                                        | 59.223                      | 15          | 33.424                                        | 60.783                      | 31         | 26.243                                        | 52.218                      | 16          | 23.321                                        | 36.487                      |
| Sierpień 1 | 41.114                                        | 59.324                      | 16          | 33.258                                        | 60.723                      | Listopad 1 | 26.106                                        | 51.918                      | 17          | 23.337                                        | 36.095                      |
| 2          | 40.968                                        | 59.428                      | 17          | 33.087                                        | 60.664                      | 2          | 25.978                                        | 51.603                      | 18          | 23.360                                        | 35.718                      |
| 3          | 40.827                                        | 59.544                      | 18          | 32.910                                        | 60.601                      | 3          | 25.858                                        | 51.278                      | 19          | 23.388                                        | 35.362                      |
| 4          | 40.686                                        | 59.677                      | 19          | 32.728                                        | 60.528                      | 4          | 25.748                                        | 50.950                      | 20          | 23.415                                        | 35.025                      |
| 5          | 40.541                                        | 59.826                      | 20          | 32.542                                        | 60.442                      | 5          | 25.646                                        | 50.625                      | 21          | 23.439                                        | 34.703                      |
| 6          | 40.387                                        | 59.984                      | 21          | 32.354                                        | 60.337                      | 6          | 25.550                                        | 50.307                      | 22          | 23.456                                        | 34.387                      |
| 7          | 40.224                                        | 60.142                      | 22          | 32.165                                        | 60.212                      | 7          | 25.458                                        | 49.997                      | 23          | 23.467                                        | 34.067                      |
| 8          | 40.051                                        | 60.289                      | 23          | 31.981                                        | 60.067                      | 8          | 25.368                                        | 49.696                      | 24          | 23.475                                        | 33.735                      |
| 9          | 39.873                                        | 60.418                      | 24          | 31.803                                        | 59.906                      | 9          | 25.278                                        | 49.402                      | 25          | 23.484                                        | 33.385                      |
| 10         | 39.692                                        | 60.528                      | 25          | 31.633                                        | 59.736                      | 10         | 25.186                                        | 49.114                      | 26          | 23.498                                        | 33.019                      |
| 11         | 39.512                                        | 60.617                      | 26          | 31.473                                        | 59.568                      | 11         | 25.090                                        | 48.826                      | 27          | 23.522                                        | 32.642                      |
| 12         | 39.335                                        | 60.689                      | 27          | 31.319                                        | 59.412                      | 12         | 24.991                                        | 48.534                      | 28          | 23.556                                        | 32.262                      |
| 13         | 39.163                                        | 60.749                      | 28          | 31.168                                        | 59.274                      | 13         | 24.890                                        | 48.232                      | 29          | 23.601                                        | 31.884                      |
| 14         | 38.996                                        | 60.803                      | 29          | 31.012                                        | 59.154                      | 14         | 24.786                                        | 47.916                      | 30          | 23.655                                        | 31.517                      |
| 15         | 38.835                                        | 60.856                      | 30          | 30.848                                        | 59.042                      | 15         | 24.685                                        | 47.582                      | 31          | 23.715                                        | 31.163                      |
| 16         | 38.678                                        | 60.912                      | Paźdz. 1    | 30.675                                        | 58.926                      | 16         | 24.587                                        | 47.232                      | Styczeń 1   | 23.780                                        | 30.825                      |
| 17         | 38.522                                        | 60.975                      | 2           | 30.496                                        | 58.797                      | 17         | 24.497                                        | 46.867                      | 2           | 23.847                                        | 30.501                      |
| 18         | 38.365                                        | 61.045                      | 3           | 30.313                                        | 58.646                      | 18         | 24.416                                        | 46.493                      | 3           | 23.913                                        | 30.190                      |
| 19         | 38.205                                        | 61.121                      | 4           | 30.132                                        | 58.474                      | 19         | 24.345                                        | 46.118                      | 4           | 23.977                                        | 29.889                      |



**MIEJSCA POZORNE (*IRS*)  $\delta$  Ursae Minoris (4.35) 2015**  
w momencie 0<sup>*h*</sup> UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$ | <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$ | <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$ | <i>UT1</i> | $\alpha_{app}^{CIO}$                          | $\delta_{app}$ |
|------------|-----------------------------------------------|----------------|------------|-----------------------------------------------|----------------|------------|-----------------------------------------------|----------------|------------|-----------------------------------------------|----------------|
|            | 17 <sup><i>h</i></sup> 26 <sup><i>m</i></sup> | 86°34′         |            | 17 <sup><i>h</i></sup> 26 <sup><i>m</i></sup> | 86°34′         |            | 17 <sup><i>h</i></sup> 26 <sup><i>m</i></sup> | 86°34′         |            | 17 <sup><i>h</i></sup> 26 <sup><i>m</i></sup> | 86°34′         |
| Styczeń 1  | 14. <sup><i>s</i></sup> 885                   | 35.401         | Luty 16    | 23. <sup><i>s</i></sup> 975                   | 23.084         | Kwiecień 3 | 40. <sup><i>s</i></sup> 168                   | 22.194         | Maj 19     | 50. <sup><i>s</i></sup> 665                   | 33.084         |
| 2          | 14.918                                        | 35.093         | 17         | 24.266                                        | 22.888         | 4          | 40.532                                        | 22.333         | 20         | 50.719                                        | 33.407         |
| 3          | 14.949                                        | 34.775         | 18         | 24.582                                        | 22.689         | 5          | 40.887                                        | 22.489         | 21         | 50.767                                        | 33.714         |
| 4          | 14.983                                        | 34.443         | 19         | 24.925                                        | 22.499         | 6          | 41.228                                        | 22.658         | 22         | 50.818                                        | 34.008         |
| 5          | 15.029                                        | 34.098         | 20         | 25.290                                        | 22.331         | 7          | 41.551                                        | 22.837         | 23         | 50.876                                        | 34.293         |
| 6          | 15.093                                        | 33.744         | 21         | 25.666                                        | 22.193         | 8          | 41.856                                        | 23.020         | 24         | 50.943                                        | 34.577         |
| 7          | 15.176                                        | 33.385         | 22         | 26.040                                        | 22.083         | 9          | 42.144                                        | 23.200         | 25         | 51.018                                        | 34.864         |
| 8          | 15.281                                        | 33.027         | 23         | 26.401                                        | 21.995         | 10         | 42.419                                        | 23.373         | 26         | 51.099                                        | 35.159         |
| 9          | 15.406                                        | 32.676         | 24         | 26.745                                        | 21.919         | 11         | 42.687                                        | 23.535         | 27         | 51.181                                        | 35.465         |
| 10         | 15.548                                        | 32.335         | 25         | 27.074                                        | 21.845         | 12         | 42.956                                        | 23.686         | 28         | 51.258                                        | 35.784         |
| 11         | 15.702                                        | 32.008         | 26         | 27.393                                        | 21.767         | 13         | 43.234                                        | 23.830         | 29         | 51.326                                        | 36.116         |
| 12         | 15.863                                        | 31.696         | 27         | 27.709                                        | 21.680         | 14         | 43.527                                        | 23.973         | 30         | 51.380                                        | 36.459         |
| 13         | 16.026                                        | 31.398         | 28         | 28.028                                        | 21.585         | 15         | 43.835                                        | 24.127         | 31         | 51.414                                        | 36.810         |
| 14         | 16.184                                        | 31.112         | Marzec 1   | 28.357                                        | 21.484         | 16         | 44.155                                        | 24.299         | Czerwiec 1 | 51.426                                        | 37.163         |
| 15         | 16.335                                        | 30.835         | 2          | 28.698                                        | 21.381         | 17         | 44.477                                        | 24.498         | 2          | 51.415                                        | 37.512         |
| 16         | 16.475                                        | 30.559         | 3          | 29.055                                        | 21.280         | 18         | 44.788                                        | 24.724         | 3          | 51.385                                        | 37.851         |
| 17         | 16.604                                        | 30.280         | 4          | 29.426                                        | 21.187         | 19         | 45.078                                        | 24.971         | 4          | 51.341                                        | 38.174         |
| 18         | 16.727                                        | 29.988         | 5          | 29.810                                        | 21.106         | 20         | 45.342                                        | 25.227         | 5          | 51.292                                        | 38.480         |
| 19         | 16.853                                        | 29.680         | 6          | 30.203                                        | 21.041         | 21         | 45.581                                        | 25.483         | 6          | 51.246                                        | 38.771         |
| 20         | 16.992                                        | 29.356         | 7          | 30.600                                        | 20.995         | 22         | 45.803                                        | 25.730         | 7          | 51.212                                        | 39.053         |
| 21         | 17.156                                        | 29.022         | 8          | 30.995                                        | 20.966         | 23         | 46.016                                        | 25.964         | 8          | 51.191                                        | 39.335         |
| 22         | 17.350                                        | 28.690         | 9          | 31.384                                        | 20.955         | 24         | 46.228                                        | 26.186         | 9          | 51.182                                        | 39.626         |
| 23         | 17.573                                        | 28.371         | 10         | 31.761                                        | 20.958         | 25         | 46.447                                        | 26.400         | 10         | 51.178                                        | 39.934         |
| 24         | 17.816                                        | 28.075         | 11         | 32.125                                        | 20.969         | 26         | 46.674                                        | 26.612         | 11         | 51.168                                        | 40.262         |
| 25         | 18.068                                        | 27.806         | 12         | 32.473                                        | 20.984         | 27         | 46.910                                        | 26.826         | 12         | 51.143                                        | 40.608         |
| 26         | 18.316                                        | 27.560         | 13         | 32.808                                        | 20.996         | 28         | 47.155                                        | 27.048         | 13         | 51.094                                        | 40.965         |
| 27         | 18.554                                        | 27.329         | 14         | 33.135                                        | 21.001         | 29         | 47.405                                        | 27.282         | 14         | 51.018                                        | 41.325         |
| 28         | 18.780                                        | 27.104         | 15         | 33.459                                        | 20.995         | 30         | 47.655                                        | 27.529         | 15         | 50.918                                        | 41.676         |
| 29         | 18.995                                        | 26.879         | 16         | 33.790                                        | 20.979         | Maj 1      | 47.900                                        | 27.793         | 16         | 50.800                                        | 42.014         |
| 30         | 19.206                                        | 26.646         | 17         | 34.135                                        | 20.957         | 2          | 48.135                                        | 28.072         | 17         | 50.671                                        | 42.333         |
| 31         | 19.418                                        | 26.403         | 18         | 34.502                                        | 20.940         | 3          | 48.354                                        | 28.364         | 18         | 50.542                                        | 42.636         |
| Luty 1     | 19.637                                        | 26.151         | 19         | 34.889                                        | 20.938         | 4          | 48.554                                        | 28.664         | 19         | 50.418                                        | 42.925         |
| 2          | 19.871                                        | 25.892         | 20         | 35.288                                        | 20.962         | 5          | 48.732                                        | 28.967         | 20         | 50.303                                        | 43.207         |
| 3          | 20.121                                        | 25.629         | 21         | 35.687                                        | 21.016         | 6          | 48.890                                        | 29.267         | 21         | 50.198                                        | 43.488         |
| 4          | 20.391                                        | 25.369         | 22         | 36.074                                        | 21.098         | 7          | 49.031                                        | 29.558         | 22         | 50.100                                        | 43.772         |
| 5          | 20.679                                        | 25.117         | 23         | 36.439                                        | 21.196         | 8          | 49.162                                        | 29.836         | 23         | 50.005                                        | 44.065         |
| 6          | 20.982                                        | 24.876         | 24         | 36.783                                        | 21.301         | 9          | 49.291                                        | 30.100         | 24         | 49.908                                        | 44.368         |
| 7          | 21.297                                        | 24.651         | 25         | 37.109                                        | 21.403         | 10         | 49.426                                        | 30.353         | 25         | 49.804                                        | 44.681         |
| 8          | 21.618                                        | 24.443         | 26         | 37.425                                        | 21.496         | 11         | 49.571                                        | 30.603         | 26         | 49.689                                        | 45.004         |
| 9          | 21.941                                        | 24.253         | 27         | 37.739                                        | 21.580         | 12         | 49.731                                        | 30.857         | 27         | 49.556                                        | 45.334         |
| 10         | 22.258                                        | 24.078         | 28         | 38.057                                        | 21.655         | 13         | 49.900                                        | 31.125         | 28         | 49.402                                        | 45.665         |
| 11         | 22.568                                        | 23.914         | 29         | 38.385                                        | 21.727         | 14         | 50.073                                        | 31.414         | 29         | 49.226                                        | 45.993         |
| 12         | 22.865                                        | 23.758         | 30         | 38.724                                        | 21.800         | 15         | 50.238                                        | 31.726         | 30         | 49.029                                        | 46.310         |
| 13         | 23.151                                        | 23.602         | 31         | 39.074                                        | 21.879         | 16         | 50.384                                        | 32.058         | Lipiec 1   | 48.816                                        | 46.612         |
| 14         | 23.427                                        | 23.441         | Kwiecień 1 | 39.434                                        | 21.968         | 17         | 50.504                                        | 32.402         | 2          | 48.595                                        | 46.893         |
| 15         | 23.698                                        | 23.269         | 2          | 39.800                                        | 22.072         | 18         | 50.596                                        | 32.747         | 3          | 48.375                                        | 47.154         |
| 16         | 23.975                                        | 23.084         | 3          | 40.168                                        | 22.194         | 19         | 50.665                                        | 33.084         | 4          | 48.165                                        | 47.401         |

**MIEJSCA POZORNE (*IRS*)  $\delta$  Ursae Minoris (4.35) 2015**  
w momencie 0<sup>h</sup> UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | <i>UT1</i>  | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$       | <i>UT1</i>  | $\alpha_{app}^{CIO}$            | $\delta_{app}$       |
|------------|---------------------------------|----------------------|-------------|---------------------------------|----------------------|------------|---------------------------------|----------------------|-------------|---------------------------------|----------------------|
|            | 17 <sup>h</sup> 26 <sup>m</sup> | 86°34′               |             | 17 <sup>h</sup> 26 <sup>m</sup> | 86°34′               |            | 17 <sup>h</sup> 25 <sup>m</sup> | 86°34′               |             | 17 <sup>h</sup> 25 <sup>m</sup> | 86°34′               |
| Lipiec 4   | 48. <sup>s</sup> 165            | 47. <sup>″</sup> 401 | Sierpień 19 | 34. <sup>s</sup> 399            | 56. <sup>″</sup> 970 | Paździ. 4  | 75. <sup>s</sup> 311            | 57. <sup>″</sup> 379 | Listopad 19 | 59. <sup>s</sup> 566            | 47. <sup>″</sup> 647 |
| 5          | 47.971                          | 47.643               | 20          | 34.038                          | 57.107               | 5          | 74.867                          | 57.259               | 20          | 59.352                          | 47.316               |
| 6          | 47.791                          | 47.890               | 21          | 33.662                          | 57.245               | 6          | 74.437                          | 57.122               | 21          | 59.156                          | 46.996               |
| 7          | 47.621                          | 48.150               | 22          | 33.270                          | 57.381               | 7          | 74.022                          | 56.975               | 22          | 58.970                          | 46.693               |
| 8          | 47.448                          | 48.429               | 23          | 32.861                          | 57.509               | 8          | 73.625                          | 56.822               | 23          | 58.782                          | 46.408               |
| 9          | 47.264                          | 48.724               | 24          | 32.436                          | 57.623               | 9          | 73.243                          | 56.668               | 24          | 58.583                          | 46.136               |
| 10         | 47.059                          | 49.030               | 25          | 32.001                          | 57.719               | 10         | 72.873                          | 56.519               | 25          | 58.366                          | 45.866               |
| 11         | 46.829                          | 49.338               | 26          | 31.562                          | 57.793               | 11         | 72.511                          | 56.375               | 26          | 58.134                          | 45.587               |
| 12         | 46.576                          | 49.639               | 27          | 31.128                          | 57.846               | 12         | 72.150                          | 56.239               | 27          | 57.894                          | 45.290               |
| 13         | 46.304                          | 49.926               | 28          | 30.707                          | 57.882               | 13         | 71.787                          | 56.109               | 28          | 57.657                          | 44.972               |
| 14         | 46.021                          | 50.194               | 29          | 30.306                          | 57.910               | 14         | 71.416                          | 55.982               | 29          | 57.435                          | 44.634               |
| 15         | 45.736                          | 50.443               | 30          | 29.925                          | 57.944               | 15         | 71.035                          | 55.856               | 30          | 57.232                          | 44.281               |
| 16         | 45.454                          | 50.676               | 31          | 29.555                          | 57.992               | 16         | 70.643                          | 55.723               | Grudzień 1  | 57.054                          | 43.921               |
| 17         | 45.181                          | 50.897               | Wrzesień 1  | 29.185                          | 58.058               | 17         | 70.241                          | 55.580               | 2           | 56.899                          | 43.561               |
| 18         | 44.919                          | 51.113               | 2           | 28.802                          | 58.140               | 18         | 69.831                          | 55.422               | 3           | 56.764                          | 43.206               |
| 19         | 44.667                          | 51.329               | 3           | 28.398                          | 58.229               | 19         | 69.420                          | 55.245               | 4           | 56.645                          | 42.860               |
| 20         | 44.421                          | 51.550               | 4           | 27.972                          | 58.312               | 20         | 69.014                          | 55.049               | 5           | 56.535                          | 42.524               |
| 21         | 44.176                          | 51.779               | 5           | 27.529                          | 58.382               | 21         | 68.619                          | 54.834               | 6           | 56.430                          | 42.199               |
| 22         | 43.927                          | 52.016               | 6           | 27.077                          | 58.432               | 22         | 68.243                          | 54.607               | 7           | 56.324                          | 41.882               |
| 23         | 43.670                          | 52.262               | 7           | 26.622                          | 58.462               | 23         | 67.889                          | 54.375               | 8           | 56.214                          | 41.571               |
| 24         | 43.399                          | 52.513               | 8           | 26.173                          | 58.472               | 24         | 67.556                          | 54.147               | 9           | 56.097                          | 41.262               |
| 25         | 43.110                          | 52.766               | 9           | 25.735                          | 58.467               | 25         | 67.237                          | 53.933               | 10          | 55.972                          | 40.947               |
| 26         | 42.802                          | 53.016               | 10          | 25.311                          | 58.451               | 26         | 66.922                          | 53.738               | 11          | 55.841                          | 40.624               |
| 27         | 42.474                          | 53.257               | 11          | 24.901                          | 58.432               | 27         | 66.597                          | 53.559               | 12          | 55.709                          | 40.286               |
| 28         | 42.129                          | 53.482               | 12          | 24.502                          | 58.413               | 28         | 66.254                          | 53.387               | 13          | 55.583                          | 39.931               |
| 29         | 41.773                          | 53.688               | 13          | 24.112                          | 58.398               | 29         | 65.892                          | 53.210               | 14          | 55.471                          | 39.560               |
| 30         | 41.415                          | 53.871               | 14          | 23.725                          | 58.389               | 30         | 65.515                          | 53.017               | 15          | 55.379                          | 39.178               |
| 31         | 41.065                          | 54.035               | 15          | 23.337                          | 58.388               | 31         | 65.135                          | 52.802               | 16          | 55.312                          | 38.791               |
| Sierpień 1 | 40.731                          | 54.187               | 16          | 22.943                          | 58.392               | Listopad 1 | 64.761                          | 52.565               | 17          | 55.270                          | 38.408               |
| 2          | 40.416                          | 54.339               | 17          | 22.537                          | 58.398               | 2          | 64.403                          | 52.309               | 18          | 55.250                          | 38.038               |
| 3          | 40.115                          | 54.501               | 18          | 22.119                          | 58.403               | 3          | 64.064                          | 52.041               | 19          | 55.243                          | 37.686               |
| 4          | 39.818                          | 54.680               | 19          | 21.687                          | 58.401               | 4          | 63.746                          | 51.766               | 20          | 55.240                          | 37.353               |
| 5          | 39.514                          | 54.876               | 20          | 21.242                          | 58.386               | 5          | 63.447                          | 51.491               | 21          | 55.230                          | 37.037               |
| 6          | 39.192                          | 55.085               | 21          | 20.788                          | 58.355               | 6          | 63.164                          | 51.220               | 22          | 55.206                          | 36.729               |
| 7          | 38.847                          | 55.296               | 22          | 20.330                          | 58.304               | 7          | 62.892                          | 50.956               | 23          | 55.169                          | 36.419               |
| 8          | 38.481                          | 55.501               | 23          | 19.876                          | 58.232               | 8          | 62.626                          | 50.701               | 24          | 55.121                          | 36.098               |
| 9          | 38.097                          | 55.692               | 24          | 19.435                          | 58.141               | 9          | 62.361                          | 50.453               | 25          | 55.073                          | 35.760               |
| 10         | 37.702                          | 55.863               | 25          | 19.011                          | 58.039               | 10         | 62.092                          | 50.210               | 26          | 55.034                          | 35.404               |
| 11         | 37.304                          | 56.015               | 26          | 18.609                          | 57.935               | 11         | 61.816                          | 49.970               | 27          | 55.013                          | 35.034               |
| 12         | 36.911                          | 56.148               | 27          | 18.225                          | 57.841               | 12         | 61.531                          | 49.727               | 28          | 55.016                          | 34.655               |
| 13         | 36.527                          | 56.268               | 28          | 17.849                          | 57.764               | 13         | 61.238                          | 49.476               | 29          | 55.044                          | 34.276               |
| 14         | 36.155                          | 56.379               | 29          | 17.467                          | 57.706               | 14         | 60.938                          | 49.211               | 30          | 55.095                          | 33.904               |
| 15         | 35.795                          | 56.488               | 30          | 17.069                          | 57.659               | 15         | 60.639                          | 48.929               | 31          | 55.164                          | 33.542               |
| 16         | 35.444                          | 56.599               | Paździ. 1   | 16.650                          | 57.612               | 16         | 60.345                          | 48.629               | Styczeń 1   | 55.246                          | 33.193               |
| 17         | 35.097                          | 56.715               | 2           | 16.211                          | 57.555               | 17         | 60.065                          | 48.312               | 2           | 55.335                          | 32.859               |
| 18         | 34.751                          | 56.839               | 3           | 15.762                          | 57.478               | 18         | 59.804                          | 47.982               | 3           | 55.426                          | 32.537               |
| 19         | 34.399                          | 56.970               | 4           | 15.311                          | 57.379               | 19         | 59.566                          | 47.647               | 4           | 55.514                          | 32.224               |

**MIEJSCA POZORNE (*IRS*) 36H Cephei (4.70) 2015**  
w momencie 0<sup>h</sup> UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$ |
|------------|---------------------------------|----------------|------------|---------------------------------|----------------|------------|---------------------------------|----------------|------------|---------------------------------|----------------|
|            | 22 <sup>h</sup> 53 <sup>m</sup> | 84°25′         |            | 22 <sup>h</sup> 53 <sup>m</sup> | 84°25′         |            | 22 <sup>h</sup> 53 <sup>m</sup> | 84°25′         |            | 22 <sup>h</sup> 53 <sup>m</sup> | 84°25′         |
| Styczeń 1  | 28.003                          | 57.944         | Luty 16    | 20.639                          | 47.710         | Kwiecień 3 | 21.518                          | 33.196         | Maj 19     | 29.714                          | 25.834         |
| 2          | 27.802                          | 57.860         | 17         | 20.534                          | 47.418         | 4          | 21.643                          | 32.897         | 20         | 29.933                          | 25.843         |
| 3          | 27.593                          | 57.776         | 18         | 20.430                          | 47.105         | 5          | 21.780                          | 32.610         | 21         | 30.141                          | 25.856         |
| 4          | 27.376                          | 57.687         | 19         | 20.335                          | 46.769         | 6          | 21.924                          | 32.337         | 22         | 30.341                          | 25.865         |
| 5          | 27.151                          | 57.585         | 20         | 20.256                          | 46.416         | 7          | 22.073                          | 32.081         | 23         | 30.536                          | 25.866         |
| 6          | 26.921                          | 57.468         | 21         | 20.198                          | 46.058         | 8          | 22.222                          | 31.842         | 24         | 30.730                          | 25.859         |
| 7          | 26.690                          | 57.331         | 22         | 20.159                          | 45.706         | 9          | 22.368                          | 31.618         | 25         | 30.927                          | 25.845         |
| 8          | 26.462                          | 57.176         | 23         | 20.133                          | 45.369         | 10         | 22.508                          | 31.405         | 26         | 31.130                          | 25.827         |
| 9          | 26.239                          | 57.004         | 24         | 20.114                          | 45.049         | 11         | 22.641                          | 31.196         | 27         | 31.340                          | 25.811         |
| 10         | 26.025                          | 56.819         | 25         | 20.096                          | 44.743         | 12         | 22.766                          | 30.985         | 28         | 31.559                          | 25.800         |
| 11         | 25.821                          | 56.624         | 26         | 20.073                          | 44.446         | 13         | 22.886                          | 30.765         | 29         | 31.786                          | 25.799         |
| 12         | 25.628                          | 56.426         | 27         | 20.044                          | 44.150         | 14         | 23.008                          | 30.533         | 30         | 32.019                          | 25.812         |
| 13         | 25.445                          | 56.229         | 28         | 20.010                          | 43.850         | 15         | 23.137                          | 30.288         | 31         | 32.255                          | 25.844         |
| 14         | 25.270                          | 56.037         | Marzec 1   | 19.972                          | 43.542         | 16         | 23.281                          | 30.036         | Czerwiec 1 | 32.491                          | 25.897         |
| 15         | 25.099                          | 55.853         | 2          | 19.934                          | 43.222         | 17         | 23.443                          | 29.786         | 2          | 32.722                          | 25.968         |
| 16         | 24.930                          | 55.679         | 3          | 19.899                          | 42.889         | 18         | 23.621                          | 29.549         | 3          | 32.945                          | 26.056         |
| 17         | 24.756                          | 55.514         | 4          | 19.871                          | 42.544         | 19         | 23.812                          | 29.334         | 4          | 33.156                          | 26.153         |
| 18         | 24.573                          | 55.353         | 5          | 19.852                          | 42.190         | 20         | 24.007                          | 29.145         | 5          | 33.354                          | 26.253         |
| 19         | 24.380                          | 55.188         | 6          | 19.844                          | 41.830         | 21         | 24.199                          | 28.978         | 6          | 33.543                          | 26.347         |
| 20         | 24.177                          | 55.009         | 7          | 19.849                          | 41.470         | 22         | 24.384                          | 28.825         | 7          | 33.726                          | 26.430         |
| 21         | 23.969                          | 54.806         | 8          | 19.866                          | 41.114         | 23         | 24.559                          | 28.678         | 8          | 33.911                          | 26.501         |
| 22         | 23.765                          | 54.577         | 9          | 19.894                          | 40.766         | 24         | 24.726                          | 28.529         | 9          | 34.103                          | 26.563         |
| 23         | 23.573                          | 54.324         | 10         | 19.931                          | 40.431         | 25         | 24.888                          | 28.375         | 10         | 34.307                          | 26.623         |
| 24         | 23.398                          | 54.056         | 11         | 19.972                          | 40.109         | 26         | 25.049                          | 28.212         | 11         | 34.524                          | 26.691         |
| 25         | 23.242                          | 53.786         | 12         | 20.014                          | 39.802         | 27         | 25.213                          | 28.042         | 12         | 34.751                          | 26.775         |
| 26         | 23.101                          | 53.521         | 13         | 20.053                          | 39.506         | 28         | 25.382                          | 27.865         | 13         | 34.985                          | 26.882         |
| 27         | 22.969                          | 53.268         | 14         | 20.086                          | 39.218         | 29         | 25.560                          | 27.686         | 14         | 35.217                          | 27.012         |
| 28         | 22.841                          | 53.028         | 15         | 20.111                          | 38.930         | 30         | 25.747                          | 27.509         | 15         | 35.442                          | 27.164         |
| 29         | 22.711                          | 52.796         | 16         | 20.130                          | 38.634         | Maj 1      | 25.945                          | 27.339         | 16         | 35.655                          | 27.330         |
| 30         | 22.575                          | 52.567         | 17         | 20.147                          | 38.325         | 2          | 26.151                          | 27.180         | 17         | 35.856                          | 27.502         |
| 31         | 22.433                          | 52.336         | 18         | 20.168                          | 37.998         | 3          | 26.366                          | 27.037         | 18         | 36.045                          | 27.672         |
| Luty 1     | 22.285                          | 52.097         | 19         | 20.202                          | 37.656         | 4          | 26.584                          | 26.912         | 19         | 36.225                          | 27.835         |
| 2          | 22.134                          | 51.845         | 20         | 20.254                          | 37.306         | 5          | 26.802                          | 26.808         | 20         | 36.402                          | 27.989         |
| 3          | 21.982                          | 51.578         | 21         | 20.327                          | 36.961         | 6          | 27.016                          | 26.720         | 21         | 36.578                          | 28.135         |
| 4          | 21.833                          | 51.294         | 22         | 20.416                          | 36.632         | 7          | 27.222                          | 26.647         | 22         | 36.758                          | 28.275         |
| 5          | 21.690                          | 50.995         | 23         | 20.515                          | 36.324         | 8          | 27.419                          | 26.581         | 23         | 36.943                          | 28.413         |
| 6          | 21.558                          | 50.684         | 24         | 20.617                          | 36.037         | 9          | 27.606                          | 26.515         | 24         | 37.135                          | 28.554         |
| 7          | 21.437                          | 50.366         | 25         | 20.715                          | 35.765         | 10         | 27.786                          | 26.442         | 25         | 37.334                          | 28.702         |
| 8          | 21.327                          | 50.044         | 26         | 20.806                          | 35.501         | 11         | 27.965                          | 26.359         | 26         | 37.538                          | 28.863         |
| 9          | 21.230                          | 49.724         | 27         | 20.890                          | 35.237         | 12         | 28.148                          | 26.265         | 27         | 37.744                          | 29.040         |
| 10         | 21.143                          | 49.410         | 28         | 20.969                          | 34.969         | 13         | 28.341                          | 26.164         | 28         | 37.951                          | 29.235         |
| 11         | 21.062                          | 49.106         | 29         | 21.046                          | 34.692         | 14         | 28.548                          | 26.063         | 29         | 38.153                          | 29.450         |
| 12         | 20.986                          | 48.814         | 30         | 21.125                          | 34.405         | 15         | 28.770                          | 25.972         | 30         | 38.346                          | 29.681         |
| 13         | 20.908                          | 48.532         | 31         | 21.209                          | 34.109         | 16         | 29.005                          | 25.902         | Lipiec 1   | 38.527                          | 29.925         |
| 14         | 20.827                          | 48.258         | Kwiecień 1 | 21.301                          | 33.806         | 17         | 29.245                          | 25.856         | 2          | 38.693                          | 30.173         |
| 15         | 20.737                          | 47.987         | 2          | 21.404                          | 33.501         | 18         | 29.483                          | 25.835         | 3          | 38.847                          | 30.417         |
| 16         | 20.639                          | 47.710         | 3          | 21.518                          | 33.196         | 19         | 29.714                          | 25.834         | 4          | 38.991                          | 30.649         |

**MIEJSCA POZORNE (*IRS*) 36H Cephei (4.70) 2015**  
w momencie 0<sup>h</sup> UT1

| <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | <i>UT1</i>  | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | <i>UT1</i> | $\alpha_{app}^{CIO}$            | $\delta_{app}$ | <i>UT1</i>  | $\alpha_{app}^{CIO}$            | $\delta_{app}$ |
|------------|---------------------------------|----------------|-------------|---------------------------------|----------------|------------|---------------------------------|----------------|-------------|---------------------------------|----------------|
|            | 22 <sup>h</sup> 53 <sup>m</sup> | 84°25′         |             | 22 <sup>h</sup> 53 <sup>m</sup> | 84°25′         |            | 22 <sup>h</sup> 53 <sup>m</sup> | 84°26′         |             | 22 <sup>h</sup> 53 <sup>m</sup> | 84°26′         |
| Lipiec 4   | 38.991                          | 30.649         | Sierpień 19 | 44.098                          | 44.609         | Paźdz. 4   | 42.668                          | 01.609         | Listopad 19 | 34.813                          | 13.826         |
| 5          | 39.134                          | 30.867         | 20          | 44.156                          | 44.954         | 5          | 42.549                          | 01.981         | 20          | 34.573                          | 13.959         |
| 6          | 39.281                          | 31.072         | 21          | 44.215                          | 45.311         | 6          | 42.420                          | 02.339         | 21          | 34.343                          | 14.076         |
| 7          | 39.438                          | 31.272         | 22          | 44.270                          | 45.683         | 7          | 42.285                          | 02.680         | 22          | 34.126                          | 14.187         |
| 8          | 39.607                          | 31.476         | 23          | 44.319                          | 46.068         | 8          | 42.148                          | 03.006         | 23          | 33.920                          | 14.302         |
| 9          | 39.786                          | 31.692         | 24          | 44.357                          | 46.464         | 9          | 42.012                          | 03.318         | 24          | 33.722                          | 14.429         |
| 10         | 39.971                          | 31.929         | 25          | 44.381                          | 46.867         | 10         | 41.879                          | 03.619         | 25          | 33.524                          | 14.572         |
| 11         | 40.155                          | 32.187         | 26          | 44.391                          | 47.271         | 11         | 41.752                          | 03.915         | 26          | 33.319                          | 14.727         |
| 12         | 40.333                          | 32.465         | 27          | 44.387                          | 47.667         | 12         | 41.629                          | 04.210         | 27          | 33.101                          | 14.886         |
| 13         | 40.499                          | 32.758         | 28          | 44.373                          | 48.048         | 13         | 41.511                          | 04.508         | 28          | 32.869                          | 15.040         |
| 14         | 40.651                          | 33.057         | 29          | 44.355                          | 48.410         | 14         | 41.395                          | 04.813         | 29          | 32.624                          | 15.178         |
| 15         | 40.791                          | 33.356         | 30          | 44.343                          | 48.756         | 15         | 41.277                          | 05.127         | 30          | 32.372                          | 15.296         |
| 16         | 40.919                          | 33.649         | 31          | 44.341                          | 49.093         | 16         | 41.155                          | 05.449         | Grudzień 1  | 32.116                          | 15.391         |
| 17         | 41.041                          | 33.933         | Wrzesień 1  | 44.352                          | 49.433         | 17         | 41.025                          | 05.779         | 2           | 31.863                          | 15.466         |
| 18         | 41.160                          | 34.206         | 2           | 44.373                          | 49.787         | 18         | 40.884                          | 06.113         | 3           | 31.615                          | 15.523         |
| 19         | 41.281                          | 34.470         | 3           | 44.396                          | 50.160         | 19         | 40.730                          | 06.446         | 4           | 31.374                          | 15.569         |
| 20         | 41.405                          | 34.730         | 4           | 44.414                          | 50.551         | 20         | 40.563                          | 06.772         | 5           | 31.141                          | 15.607         |
| 21         | 41.534                          | 34.989         | 5           | 44.421                          | 50.955         | 21         | 40.386                          | 07.084         | 6           | 30.916                          | 15.642         |
| 22         | 41.669                          | 35.253         | 6           | 44.414                          | 51.366         | 22         | 40.201                          | 07.378         | 7           | 30.696                          | 15.679         |
| 23         | 41.809                          | 35.525         | 7           | 44.393                          | 51.774         | 23         | 40.015                          | 07.652         | 8           | 30.480                          | 15.721         |
| 24         | 41.951                          | 35.811         | 8           | 44.360                          | 52.175         | 24         | 39.834                          | 07.907         | 9           | 30.264                          | 15.769         |
| 25         | 42.093                          | 36.112         | 9           | 44.317                          | 52.563         | 25         | 39.664                          | 08.152         | 10          | 30.045                          | 15.823         |
| 26         | 42.232                          | 36.430         | 10          | 44.269                          | 52.938         | 26         | 39.507                          | 08.396         | 11          | 29.819                          | 15.881         |
| 27         | 42.362                          | 36.764         | 11          | 44.218                          | 53.299         | 27         | 39.359                          | 08.650         | 12          | 29.582                          | 15.938         |
| 28         | 42.481                          | 37.110         | 12          | 44.170                          | 53.650         | 28         | 39.215                          | 08.922         | 13          | 29.336                          | 15.987         |
| 29         | 42.586                          | 37.463         | 13          | 44.125                          | 53.994         | 29         | 39.067                          | 09.210         | 14          | 29.079                          | 16.022         |
| 30         | 42.675                          | 37.815         | 14          | 44.085                          | 54.336         | 30         | 38.906                          | 09.508         | 15          | 28.816                          | 16.038         |
| 31         | 42.752                          | 38.157         | 15          | 44.049                          | 54.679         | 31         | 38.730                          | 09.806         | 16          | 28.553                          | 16.030         |
| Sierpień 1 | 42.822                          | 38.482         | 16          | 44.017                          | 55.029         | Listopad 1 | 38.539                          | 10.095         | 17          | 28.294                          | 16.001         |
| 2          | 42.894                          | 38.791         | 17          | 43.986                          | 55.389         | 2          | 38.337                          | 10.368         | 18          | 28.046                          | 15.954         |
| 3          | 42.973                          | 39.089         | 18          | 43.952                          | 55.759         | 3          | 38.129                          | 10.621         | 19          | 27.811                          | 15.898         |
| 4          | 43.065                          | 39.385         | 19          | 43.912                          | 56.141         | 4          | 37.918                          | 10.856         | 20          | 27.590                          | 15.842         |
| 5          | 43.168                          | 39.690         | 20          | 43.863                          | 56.532         | 5          | 37.708                          | 11.072         | 21          | 27.379                          | 15.795         |
| 6          | 43.278                          | 40.013         | 21          | 43.802                          | 56.929         | 6          | 37.503                          | 11.276         | 22          | 27.173                          | 15.760         |
| 7          | 43.388                          | 40.355         | 22          | 43.728                          | 57.325         | 7          | 37.304                          | 11.470         | 23          | 26.964                          | 15.737         |
| 8          | 43.491                          | 40.717         | 23          | 43.639                          | 57.715         | 8          | 37.110                          | 11.660         | 24          | 26.747                          | 15.722         |
| 9          | 43.583                          | 41.091         | 24          | 43.539                          | 58.092         | 9          | 36.922                          | 11.850         | 25          | 26.518                          | 15.705         |
| 10         | 43.662                          | 41.472         | 25          | 43.434                          | 58.450         | 10         | 36.738                          | 12.044         | 26          | 26.278                          | 15.678         |
| 11         | 43.727                          | 41.853         | 26          | 43.328                          | 58.790         | 11         | 36.555                          | 12.244         | 27          | 26.029                          | 15.632         |
| 12         | 43.780                          | 42.226         | 27          | 43.231                          | 59.114         | 12         | 36.368                          | 12.452         | 28          | 25.778                          | 15.564         |
| 13         | 43.824                          | 42.590         | 28          | 43.147                          | 59.434         | 13         | 36.176                          | 12.667         | 29          | 25.528                          | 15.474         |
| 14         | 43.864                          | 42.941         | 29          | 43.074                          | 59.761         | 14         | 35.974                          | 12.884         | 30          | 25.284                          | 15.364         |
| 15         | 43.904                          | 43.282         | 30          | 43.008                          | 60.104         | 15         | 35.761                          | 13.100         | 31          | 25.049                          | 15.240         |
| 16         | 43.945                          | 43.615         | Paźdz. 1    | 42.941                          | 60.466         | 16         | 35.535                          | 13.307         | Styczeń 1   | 24.825                          | 15.106         |
| 17         | 43.991                          | 43.944         | 2           | 42.864                          | 60.843         | 17         | 35.299                          | 13.500         | 2           | 24.610                          | 14.968         |
| 18         | 44.042                          | 44.274         | 3           | 42.774                          | 61.227         | 18         | 35.057                          | 13.674         | 3           | 24.404                          | 14.830         |
| 19         | 44.098                          | 44.609         | 4           | 42.668                          | 61.609         | 19         | 34.813                          | 13.826         | 4           | 24.205                          | 14.697         |

# Przybliżony azymut Biegunowej 2015

| $\varphi$<br>s                 | 20°    | 25°    | 30°    | 35°    | 40°    | 45°    | 50°    | 55°    | 60°    | $\varphi$<br>s                 |
|--------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------------------------|
| 2 <sup>h</sup> 51 <sup>m</sup> | 00°00' | 00°00' | 00°00' | 00°00' | 00°00' | 00°00' | 00°00' | 00°00' | 00°00' | 2 <sup>h</sup> 51 <sup>m</sup> |
| 3 11                           | 00 04  | 00 04  | 00 04  | 00 04  | 00 05  | 00 05  | 00 06  | 00 06  | 00 07  | 2 31                           |
| 3 31                           | 00 07  | 00 08  | 00 08  | 00 09  | 00 09  | 00 10  | 00 11  | 00 12  | 00 14  | 2 11                           |
| 3 51                           | 00 11  | 00 12  | 00 12  | 00 13  | 00 14  | 00 15  | 00 16  | 00 18  | 00 21  | 1 51                           |
| 4 11                           | 00 15  | 00 15  | 00 16  | 00 17  | 00 18  | 00 20  | 00 22  | 00 24  | 00 28  | 1 31                           |
| 4 31                           | 00 18  | 00 19  | 00 20  | 00 21  | 00 22  | 00 24  | 00 27  | 00 30  | 00 35  | 1 11                           |
| 4 51                           | 00 21  | 00 22  | 00 23  | 00 25  | 00 26  | 00 29  | 00 32  | 00 36  | 00 41  | 0 51                           |
| 5 11                           | 00 25  | 00 26  | 00 27  | 00 28  | 00 30  | 00 33  | 00 36  | 00 41  | 00 47  | 0 31                           |
| 5 31                           | 00 28  | 00 29  | 00 30  | 00 32  | 00 34  | 00 37  | 00 41  | 00 46  | 00 53  | 0 11                           |
| 5 51                           | 00 30  | 00 31  | 00 33  | 00 35  | 00 37  | 00 41  | 00 45  | 00 50  | 00 58  | 23 51                          |
| 6 11                           | 00 33  | 00 34  | 00 36  | 00 38  | 00 40  | 00 44  | 00 48  | 00 54  | 01 02  | 23 31                          |
| 6 31                           | 00 35  | 00 36  | 00 38  | 00 40  | 00 43  | 00 47  | 00 52  | 00 58  | 01 07  | 23 11                          |
| 6 51                           | 00 37  | 00 39  | 00 40  | 00 43  | 00 46  | 00 50  | 00 55  | 01 01  | 01 10  | 22 51                          |
| 7 11                           | 00 39  | 00 40  | 00 42  | 00 45  | 00 48  | 00 52  | 00 57  | 01 04  | 01 14  | 22 31                          |
| 7 31                           | 00 40  | 00 42  | 00 44  | 00 46  | 00 49  | 00 54  | 00 59  | 01 06  | 01 16  | 22 11                          |
| 7 51                           | 00 41  | 00 43  | 00 45  | 00 48  | 00 51  | 00 55  | 01 01  | 01 08  | 01 18  | 21 51                          |
| 8 11                           | 00 42  | 00 44  | 00 46  | 00 48  | 00 52  | 00 56  | 01 02  | 01 09  | 01 19  | 21 31                          |
| 8 31                           | 00 43  | 00 44  | 00 46  | 00 49  | 00 52  | 00 57  | 01 02  | 01 10  | 01 20  | 21 11                          |
| 8 51                           | 00 43  | 00 44  | 00 46  | 00 49  | 00 52  | 00 57  | 01 03  | 01 10  | 01 20  | 20 51                          |
| 9 11                           | 00 43  | 00 44  | 00 46  | 00 49  | 00 52  | 00 57  | 01 02  | 01 10  | 01 20  | 20 31                          |
| 9 31                           | 00 42  | 00 44  | 00 46  | 00 48  | 00 52  | 00 56  | 01 01  | 01 09  | 01 19  | 20 11                          |
| 9 51                           | 00 41  | 00 43  | 00 45  | 00 47  | 00 51  | 00 55  | 01 00  | 01 07  | 01 17  | 19 51                          |
| 10 11                          | 00 40  | 00 42  | 00 44  | 00 46  | 00 49  | 00 53  | 00 58  | 01 05  | 01 15  | 19 31                          |
| 10 31                          | 00 39  | 00 40  | 00 42  | 00 44  | 00 47  | 00 51  | 00 56  | 01 03  | 01 12  | 19 11                          |
| 10 51                          | 00 37  | 00 38  | 00 40  | 00 42  | 00 45  | 00 49  | 00 54  | 01 00  | 01 09  | 18 51                          |
| 11 11                          | 00 35  | 00 36  | 00 38  | 00 40  | 00 43  | 00 46  | 00 51  | 00 57  | 01 05  | 18 31                          |
| 11 31                          | 00 33  | 00 34  | 00 35  | 00 37  | 00 40  | 00 43  | 00 47  | 00 53  | 01 01  | 18 11                          |
| 11 51                          | 00 30  | 00 31  | 00 33  | 00 35  | 00 37  | 00 40  | 00 44  | 00 49  | 00 56  | 17 51                          |
| 12 11                          | 00 27  | 00 28  | 00 30  | 00 31  | 00 33  | 00 36  | 00 40  | 00 44  | 00 51  | 17 31                          |
| 12 31                          | 00 24  | 00 25  | 00 26  | 00 28  | 00 30  | 00 32  | 00 35  | 00 40  | 00 45  | 17 11                          |
| 12 51                          | 00 21  | 00 22  | 00 23  | 00 24  | 00 26  | 00 28  | 00 31  | 00 35  | 00 40  | 16 51                          |
| 13 11                          | 00 18  | 00 19  | 00 20  | 00 21  | 00 22  | 00 24  | 00 26  | 00 29  | 00 33  | 16 31                          |
| 13 31                          | 00 15  | 00 15  | 00 16  | 00 17  | 00 18  | 00 19  | 00 21  | 00 24  | 00 27  | 16 11                          |
| 13 51                          | 00 11  | 00 11  | 00 12  | 00 13  | 00 13  | 00 15  | 00 16  | 00 18  | 00 20  | 15 51                          |
| 14 11                          | 00 07  | 00 08  | 00 08  | 00 08  | 00 09  | 00 10  | 00 11  | 00 12  | 00 14  | 15 31                          |
| 14 31                          | 00 04  | 00 04  | 00 04  | 00 04  | 00 05  | 00 05  | 00 05  | 00 06  | 00 07  | 15 11                          |
| 14 51                          | 00 00  | 00 00  | 00 00  | 00 00  | 00 00  | 00 00  | 00 00  | 00 00  | 00 00  | 14 51                          |

# Przybliżona odległość zenitalna Biegunowej 2015

$$\delta = 89^{\circ}19'$$

| $t$                            | $\Delta z$ | $t$                             | $t$                            | $\Delta z$ | $t$                             | $t$                            | $\Delta z$ | $t$                             | $t$                            | $\Delta z$ | $t$                             |
|--------------------------------|------------|---------------------------------|--------------------------------|------------|---------------------------------|--------------------------------|------------|---------------------------------|--------------------------------|------------|---------------------------------|
| 0 <sup>h</sup> 00 <sup>m</sup> | -42'       | 24 <sup>h</sup> 00 <sup>m</sup> | 3 <sup>h</sup> 57 <sup>m</sup> | -21'       | 20 <sup>h</sup> 03 <sup>m</sup> | 6 <sup>h</sup> 00 <sup>m</sup> | + 0'       | 18 <sup>h</sup> 00 <sup>m</sup> | 8 <sup>h</sup> 04 <sup>m</sup> | +21'       | 15 <sup>h</sup> 56 <sup>m</sup> |
| 0 27                           | -41        | 23 33                           | 4 03                           | -20        | 19 57                           | 6 05                           | + 1        | 17 55                           | 8 10                           | +22        | 15 50                           |
| 0 57                           | -40        | 23 03                           | 4 10                           | -19        | 19 50                           | 6 11                           | + 2        | 17 49                           | 8 17                           | +23        | 15 43                           |
| 1 16                           | -39        | 22 44                           | 4 16                           | -18        | 19 44                           | 6 17                           | + 3        | 17 43                           | 8 24                           | +24        | 15 36                           |
| 1 32                           | -38        | 22 28                           | 4 22                           | -17        | 19 38                           | 6 22                           | + 4        | 17 38                           | 8 31                           | +25        | 15 29                           |
| 1 45                           | -37        | 22 15                           | 4 28                           | -16        | 19 32                           | 6 28                           | + 5        | 17 32                           | 8 38                           | +26        | 15 22                           |
| 1 57                           | -36        | 22 03                           | 4 34                           | -15        | 19 26                           | 6 34                           | + 6        | 17 26                           | 8 46                           | +27        | 15 14                           |
| 2 08                           | -35        | 21 52                           | 4 40                           | -14        | 19 20                           | 6 39                           | + 7        | 17 21                           | 8 53                           | +28        | 15 07                           |
| 2 18                           | -34        | 21 42                           | 4 46                           | -13        | 19 14                           | 6 45                           | + 8        | 17 15                           | 9 01                           | +29        | 14 59                           |
| 2 27                           | -33        | 21 33                           | 4 52                           | -12        | 19 08                           | 6 51                           | + 9        | 17 09                           | 9 09                           | +30        | 14 51                           |
| 2 36                           | -32        | 21 24                           | 4 58                           | -11        | 19 02                           | 6 56                           | +10        | 17 04                           | 9 18                           | +31        | 14 42                           |
| 2 45                           | -31        | 21 15                           | 5 03                           | -10        | 18 57                           | 7 02                           | +11        | 16 58                           | 9 27                           | +32        | 14 33                           |
| 2 53                           | -30        | 21 07                           | 5 09                           | - 9        | 18 51                           | 7 08                           | +12        | 16 52                           | 9 36                           | +33        | 14 24                           |
| 3 01                           | -29        | 20 59                           | 5 15                           | - 8        | 18 45                           | 7 14                           | +13        | 16 46                           | 9 46                           | +34        | 14 14                           |
| 3 09                           | -28        | 20 51                           | 5 21                           | - 7        | 18 39                           | 7 20                           | +14        | 16 40                           | 9 57                           | +35        | 14 03                           |
| 3 16                           | -27        | 20 44                           | 5 26                           | - 6        | 18 34                           | 7 26                           | +15        | 16 34                           | 10 08                          | +36        | 13 52                           |
| 3 23                           | -26        | 20 37                           | 5 32                           | - 5        | 18 28                           | 7 32                           | +16        | 16 28                           | 10 21                          | +37        | 13 39                           |
| 3 30                           | -25        | 20 30                           | 5 37                           | - 4        | 18 23                           | 7 38                           | +17        | 16 22                           | 10 35                          | +38        | 13 25                           |
| 3 37                           | -24        | 20 23                           | 5 43                           | - 3        | 18 17                           | 7 44                           | +18        | 16 16                           | 10 53                          | +39        | 13 07                           |
| 3 44                           | -23        | 20 16                           | 5 49                           | - 2        | 18 11                           | 7 51                           | +19        | 16 09                           | 11 17                          | +40        | 12 43                           |
| 3 51                           | -22        | 20 09                           | 5 54                           | - 1        | 18 06                           | 7 57                           | +20        | 16 03                           | 12 00                          |            | 12 00                           |
| 3 57                           |            | 20 03                           | 6 00                           |            | 18 00                           | 8 04                           |            | 15 56                           |                                |            |                                 |

$$\delta = 89^{\circ}20'$$

| $t$                            | $\Delta z$ | $t$                             | $t$                            | $\Delta z$ | $t$                             | $t$                            | $\Delta z$ | $t$                             | $t$                            | $\Delta z$ | $t$                             |
|--------------------------------|------------|---------------------------------|--------------------------------|------------|---------------------------------|--------------------------------|------------|---------------------------------|--------------------------------|------------|---------------------------------|
| 0 <sup>h</sup> 00 <sup>m</sup> | -41'       | 24 <sup>h</sup> 00 <sup>m</sup> | 4 <sup>h</sup> 00 <sup>m</sup> | -20'       | 20 <sup>h</sup> 00 <sup>m</sup> | 6 <sup>h</sup> 06 <sup>m</sup> | + 1'       | 17 <sup>h</sup> 54 <sup>m</sup> | 8 <sup>h</sup> 14 <sup>m</sup> | +22'       | 15 <sup>h</sup> 46 <sup>m</sup> |
| 0 27                           | -40        | 23 33                           | 4 07                           | -19        | 19 53                           | 6 11                           | + 2        | 17 49                           | 8 21                           | +23        | 15 39                           |
| 0 58                           | -39        | 23 02                           | 4 13                           | -18        | 19 47                           | 6 17                           | + 3        | 17 43                           | 8 28                           | +24        | 15 32                           |
| 1 17                           | -38        | 22 43                           | 4 20                           | -17        | 19 40                           | 6 23                           | + 4        | 17 37                           | 8 35                           | +25        | 15 25                           |
| 1 33                           | -37        | 22 27                           | 4 26                           | -16        | 19 34                           | 6 29                           | + 5        | 17 31                           | 8 43                           | +26        | 15 17                           |
| 1 46                           | -36        | 22 14                           | 4 32                           | -15        | 19 28                           | 6 34                           | + 6        | 17 26                           | 8 51                           | +27        | 15 09                           |
| 1 58                           | -35        | 22 02                           | 4 38                           | -14        | 19 22                           | 6 40                           | + 7        | 17 20                           | 8 59                           | +28        | 15 01                           |
| 2 09                           | -34        | 21 51                           | 4 44                           | -13        | 19 16                           | 6 46                           | + 8        | 17 14                           | 9 07                           | +29        | 14 53                           |
| 2 19                           | -33        | 21 41                           | 4 50                           | -12        | 19 10                           | 6 52                           | + 9        | 17 08                           | 9 16                           | +30        | 14 44                           |
| 2 29                           | -32        | 21 31                           | 4 56                           | -11        | 19 04                           | 6 58                           | +10        | 17 02                           | 9 25                           | +31        | 14 35                           |
| 2 38                           | -31        | 21 22                           | 5 02                           | -10        | 18 58                           | 7 04                           | +11        | 16 56                           | 9 34                           | +32        | 14 26                           |
| 2 47                           | -30        | 21 13                           | 5 08                           | - 9        | 18 52                           | 7 10                           | +12        | 16 50                           | 9 44                           | +33        | 14 16                           |
| 2 55                           | -29        | 21 05                           | 5 14                           | - 8        | 18 46                           | 7 16                           | +13        | 16 44                           | 9 55                           | +34        | 14 05                           |
| 3 03                           | -28        | 20 57                           | 5 20                           | - 7        | 18 40                           | 7 22                           | +14        | 16 38                           | 10 07                          | +35        | 13 53                           |
| 3 11                           | -27        | 20 49                           | 5 25                           | - 6        | 18 35                           | 7 28                           | +15        | 16 32                           | 10 20                          | +36        | 13 40                           |
| 3 19                           | -26        | 20 41                           | 5 31                           | - 5        | 18 29                           | 7 35                           | +16        | 16 25                           | 10 34                          | +37        | 13 26                           |
| 3 26                           | -25        | 20 34                           | 5 37                           | - 4        | 18 23                           | 7 41                           | +17        | 16 19                           | 10 52                          | +38        | 13 08                           |
| 3 33                           | -24        | 20 27                           | 5 43                           | - 3        | 18 17                           | 7 47                           | +18        | 16 13                           | 11 16                          | +39        | 12 44                           |
| 3 40                           | -23        | 20 20                           | 5 48                           | - 2        | 18 12                           | 7 54                           | +19        | 16 06                           | 12 00                          |            | 12 00                           |
| 3 47                           | -22        | 20 13                           | 5 54                           | - 1        | 18 06                           | 8 00                           | +20        | 16 00                           |                                |            |                                 |
| 3 54                           | -21        | 20 06                           | 6 00                           | + 0        | 18 00                           | 8 07                           | +21        | 15 53                           |                                |            |                                 |
| 4 00                           |            | 20 00                           | 6 06                           |            | 17 54                           | 8 14                           |            | 15 46                           |                                |            |                                 |

$$z' = (90^{\circ} - \varphi) + \Delta z$$

# Szerokość geograficzna z wysokości Biegunowej 2015

$$\varphi = h + V_I + V_{II}$$

Tablica poprawek  $V_I$

| $t$ | $p$ | 39'40"  | 40'00"  | 40'20"  | 40'40"  | $p$  | $t$  | $p$ | 39'40"  | 40'00"  | 40'20"  | 40'40"  | $p$  | $t$ |
|-----|-----|---------|---------|---------|---------|------|------|-----|---------|---------|---------|---------|------|-----|
| 0.0 |     | -39'40" | -40'00" | -40'20" | -40'40" | 24.0 | 6.0  |     | +00'14" | +00'14" | +00'14" | +00'14" | 18.0 |     |
| 1   |     | -39 39  | -39 59  | -40 19  | -40 39  | 23.9 | 1    |     | +01 16  | +01 17  | +01 18  | +01 18  | 17.9 |     |
| 2   |     | -39 37  | -39 57  | -40 17  | -40 37  | 8    | 2    |     | +02 18  | +02 20  | +02 21  | +02 22  | 8    |     |
| 3   |     | -39 33  | -39 53  | -40 12  | -40 32  | 7    | 3    |     | +03 20  | +03 22  | +03 24  | +03 26  | 7    |     |
| 4   |     | -39 27  | -39 47  | -40 07  | -40 26  | 6    | 4    |     | +04 22  | +04 25  | +04 27  | +04 29  | 6    |     |
| 5   |     | -39 19  | -39 39  | -39 59  | -40 19  | 5    | 5    |     | +05 24  | +05 27  | +05 30  | +05 33  | 5    |     |
| 6   |     | -39 10  | -39 30  | -39 50  | -40 10  | 4    | 6    |     | +06 26  | +06 29  | +06 32  | +06 36  | 4    |     |
| 7   |     | -39 00  | -39 19  | -39 39  | -39 59  | 3    | 7    |     | +07 27  | +07 31  | +07 35  | +07 39  | 3    |     |
| 8   |     | -38 47  | -39 07  | -39 27  | -39 46  | 2    | 8    |     | +08 28  | +08 32  | +08 37  | +08 41  | 2    |     |
| 0.9 |     | -38 33  | -38 53  | -39 12  | -39 32  | 23.1 | 6.9  |     | +09 29  | +09 33  | +09 38  | +09 43  | 17.1 |     |
| 1.0 |     | -38 18  | -38 37  | -38 57  | -39 16  | 23.0 | 7.0  |     | +10 29  | +10 34  | +10 40  | +10 45  | 17.0 |     |
| 1   |     | -38 01  | -38 20  | -38 39  | -38 58  | 22.9 | 1    |     | +11 29  | +11 34  | +11 40  | +11 46  | 16.9 |     |
| 2   |     | -37 42  | -38 01  | -38 20  | -38 39  | 8    | 2    |     | +12 28  | +12 34  | +12 41  | +12 47  | 8    |     |
| 3   |     | -37 22  | -37 41  | -38 00  | -38 18  | 7    | 3    |     | +13 27  | +13 34  | +13 40  | +13 47  | 7    |     |
| 4   |     | -37 00  | -37 19  | -37 37  | -37 56  | 6    | 4    |     | +14 25  | +14 32  | +14 40  | +14 47  | 6    |     |
| 5   |     | -36 37  | -36 55  | -37 14  | -37 32  | 5    | 5    |     | +15 23  | +15 30  | +15 38  | +15 46  | 5    |     |
| 6   |     | -36 12  | -36 30  | -36 48  | -37 07  | 4    | 6    |     | +16 19  | +16 28  | +16 36  | +16 44  | 4    |     |
| 7   |     | -35 46  | -36 04  | -36 22  | -36 40  | 3    | 7    |     | +17 16  | +17 25  | +17 33  | +17 42  | 3    |     |
| 8   |     | -35 18  | -35 36  | -35 53  | -36 11  | 2    | 8    |     | +18 11  | +18 21  | +18 30  | +18 39  | 2    |     |
| 1.9 |     | -34 48  | -35 06  | -35 24  | -35 41  | 22.1 | 7.9  |     | +19 06  | +19 16  | +19 26  | +19 35  | 16.1 |     |
| 2.0 |     | -34 18  | -34 35  | -34 52  | -35 09  | 22.0 | 8.0  |     | +20 00  | +20 10  | +20 21  | +20 31  | 16.0 |     |
| 1   |     | -33 46  | -34 03  | -34 20  | -34 37  | 21.9 | 1    |     | +20 54  | +21 04  | +21 15  | +21 25  | 15.9 |     |
| 2   |     | -33 12  | -33 29  | -33 45  | -34 02  | 8    | 2    |     | +21 46  | +21 57  | +22 08  | +22 19  | 8    |     |
| 3   |     | -32 37  | -32 53  | -33 10  | -33 26  | 7    | 3    |     | +22 37  | +22 49  | +23 00  | +23 12  | 7    |     |
| 4   |     | -32 01  | -32 17  | -32 33  | -32 49  | 6    | 4    |     | +23 28  | +23 40  | +23 52  | +24 04  | 6    |     |
| 5   |     | -31 23  | -31 39  | -31 55  | -32 10  | 5    | 5    |     | +24 17  | +24 30  | +24 42  | +24 54  | 5    |     |
| 6   |     | -30 44  | -31 00  | -31 15  | -31 31  | 4    | 6    |     | +25 06  | +25 19  | +25 32  | +25 44  | 4    |     |
| 7   |     | -30 04  | -30 19  | -30 34  | -30 49  | 3    | 7    |     | +25 54  | +26 07  | +26 20  | +26 33  | 3    |     |
| 8   |     | -29 23  | -29 37  | -29 52  | -30 07  | 2    | 8    |     | +26 40  | +26 54  | +27 07  | +27 21  | 2    |     |
| 2.9 |     | -28 40  | -28 54  | -29 09  | -29 23  | 21.1 | 8.9  |     | +27 26  | +27 39  | +27 53  | +28 07  | 15.1 |     |
| 3.0 |     | -27 56  | -28 10  | -28 24  | -28 38  | 21.0 | 9.0  |     | +28 10  | +28 24  | +28 38  | +28 53  | 15.0 |     |
| 1   |     | -27 11  | -27 25  | -27 38  | -27 52  | 20.9 | 1    |     | +28 53  | +29 08  | +29 22  | +29 37  | 14.9 |     |
| 2   |     | -26 25  | -26 38  | -26 51  | -27 05  | 8    | 2    |     | +29 35  | +29 50  | +30 05  | +30 20  | 8    |     |
| 3   |     | -25 38  | -25 51  | -26 03  | -26 16  | 7    | 3    |     | +30 16  | +30 31  | +30 46  | +31 01  | 7    |     |
| 4   |     | -24 49  | -25 02  | -25 14  | -25 27  | 6    | 4    |     | +30 55  | +31 11  | +31 26  | +31 42  | 6    |     |
| 5   |     | -24 00  | -24 12  | -24 24  | -24 36  | 5    | 5    |     | +31 33  | +31 49  | +32 05  | +32 21  | 5    |     |
| 6   |     | -23 10  | -23 22  | -23 33  | -23 45  | 4    | 6    |     | +32 10  | +32 26  | +32 43  | +32 59  | 4    |     |
| 7   |     | -22 19  | -22 30  | -22 41  | -22 52  | 3    | 7    |     | +32 46  | +33 02  | +33 19  | +33 35  | 3    |     |
| 8   |     | -21 27  | -21 37  | -21 48  | -21 59  | 2    | 8    |     | +33 20  | +33 37  | +33 54  | +34 11  | 2    |     |
| 3.9 |     | -20 34  | -20 44  | -20 54  | -21 04  | 20.1 | 9.9  |     | +33 53  | +34 10  | +34 27  | +34 44  | 14.1 |     |
| 4.0 |     | -19 40  | -19 50  | -19 59  | -20 09  | 20.0 | 10.0 |     | +34 25  | +34 42  | +34 59  | +35 17  | 14.0 |     |
| 1   |     | -18 45  | -18 54  | -19 04  | -19 13  | 19.9 | 1    |     | +34 55  | +35 12  | +35 30  | +35 48  | 13.9 |     |
| 2   |     | -17 50  | -17 58  | -18 07  | -18 16  | 8    | 2    |     | +35 23  | +35 41  | +35 59  | +36 17  | 8    |     |
| 3   |     | -16 53  | -17 02  | -17 10  | -17 19  | 7    | 3    |     | +35 51  | +36 09  | +36 27  | +36 45  | 7    |     |
| 4   |     | -15 57  | -16 05  | -16 12  | -16 20  | 6    | 4    |     | +36 17  | +36 35  | +36 53  | +37 11  | 6    |     |
| 5   |     | -14 59  | -15 07  | -15 14  | -15 21  | 5    | 5    |     | +36 41  | +36 59  | +37 18  | +37 36  | 5    |     |
| 6   |     | -14 01  | -14 08  | -14 15  | -14 22  | 4    | 6    |     | +37 04  | +37 22  | +37 41  | +38 00  | 4    |     |
| 7   |     | -13 02  | -13 09  | -13 15  | -13 22  | 3    | 7    |     | +37 25  | +37 44  | +38 03  | +38 22  | 3    |     |
| 8   |     | -12 03  | -12 09  | -12 15  | -12 21  | 2    | 8    |     | +37 45  | +38 04  | +38 23  | +38 42  | 2    |     |
| 4.9 |     | -11 03  | -11 09  | -11 14  | -11 20  | 19.1 | 10.9 |     | +38 03  | +38 22  | +38 41  | +39 01  | 13.1 |     |
| 5.0 |     | -10 03  | -10 08  | -10 13  | -10 18  | 19.0 | 11.0 |     | +38 20  | +38 39  | +38 58  | +39 18  | 13.0 |     |
| 1   |     | -09 03  | -09 07  | -09 12  | -09 16  | 18.9 | 1    |     | +38 35  | +38 54  | +39 14  | +39 33  | 12.9 |     |
| 2   |     | -08 02  | -08 06  | -08 10  | -08 13  | 8    | 2    |     | +38 49  | +39 08  | +39 28  | +39 47  | 8    |     |
| 3   |     | -07 00  | -07 04  | -07 07  | -07 11  | 7    | 3    |     | +39 01  | +39 20  | +39 40  | +40 00  | 7    |     |
| 4   |     | -05 59  | -06 02  | -06 05  | -06 08  | 6    | 4    |     | +39 11  | +39 31  | +39 51  | +40 10  | 6    |     |
| 5   |     | -04 57  | -05 00  | -05 02  | -05 04  | 5    | 5    |     | +39 20  | +39 40  | +40 00  | +40 19  | 5    |     |
| 6   |     | -03 55  | -03 57  | -03 59  | -04 01  | 4    | 6    |     | +39 27  | +39 47  | +40 07  | +40 27  | 4    |     |
| 7   |     | -02 53  | -02 54  | -02 56  | -02 57  | 3    | 7    |     | +39 33  | +39 53  | +40 13  | +40 33  | 3    |     |
| 8   |     | -01 51  | -01 52  | -01 52  | -01 53  | 2    | 8    |     | +39 37  | +39 57  | +40 17  | +40 37  | 2    |     |
| 5.9 |     | -00 49  | -00 49  | -00 49  | -00 49  | 18.1 | 11.9 |     | +39 39  | +39 59  | +40 19  | +40 39  | 12.1 |     |
| 6.0 |     | +00 14  | +00 14  | +00 14  | +00 14  | 18.0 | 12.0 |     | +39 40  | +40 00  | +40 20  | +40 40  | 12.0 |     |

Tablica  
poprawek  $V_{II}$   
( $20^\circ \leq h \leq 40^\circ$ )

| $t$ | $h$ | 20° | 30° | 40° |
|-----|-----|-----|-----|-----|
| 0   | $h$ | 0"  | 0"  | 0"  |
| 1   |     | - 1 | - 1 | 0   |
| 2   |     | - 3 | - 2 | - 1 |
| 3   |     | - 6 | - 4 | - 2 |
| 4   |     | -10 | - 6 | - 2 |
| 5   |     | -12 | - 8 | - 3 |
| 6   |     | -13 | - 8 | - 3 |
| 7   |     | -12 | - 8 | - 3 |
| 8   |     | -10 | - 6 | - 2 |
| 9   |     | - 6 | - 4 | - 2 |
| 10  |     | - 3 | - 2 | - 1 |
| 11  |     | - 1 | - 1 | 0   |
| 12  |     | 0   | 0   | 0   |
| 13  |     | - 1 | - 1 | 0   |
| 14  |     | - 3 | - 2 | - 1 |
| 15  |     | - 6 | - 4 | - 2 |
| 16  |     | -10 | - 6 | - 2 |
| 17  |     | -12 | - 8 | - 3 |
| 18  |     | -13 | - 8 | - 3 |
| 19  |     | -12 | - 8 | - 3 |
| 20  |     | -10 | - 6 | - 2 |
| 21  |     | - 6 | - 4 | - 2 |
| 22  |     | - 3 | - 2 | - 1 |
| 23  |     | - 1 | - 1 | 0   |
| 24  |     | 0   | 0   | 0   |

Tablica  
poprawek  $V_{II}$   
( $40^\circ \leq h \leq 60^\circ$ )

| $t$ | $h$ | 40° | 50° | 60° |
|-----|-----|-----|-----|-----|
| 0   | $h$ | 0"  | 0"  | 0"  |
| 1   |     | 0   | 0   | + 1 |
| 2   |     | - 1 | + 1 | + 4 |
| 3   |     | - 2 | + 2 | + 7 |
| 4   |     | - 2 | + 3 | +11 |
| 5   |     | - 3 | + 4 | +14 |
| 6   |     | - 3 | + 4 | +15 |
| 7   |     | - 3 | + 4 | +14 |
| 8   |     | - 2 | + 3 | +11 |
| 9   |     | - 2 | + 2 | + 7 |
| 10  |     | - 1 | + 1 | + 4 |
| 11  |     | 0   | 0   | + 1 |
| 12  |     | 0   | 0   | 0   |
| 13  |     | 0   | 0   | + 1 |
| 14  |     | - 1 | + 1 | + 4 |
| 15  |     | - 2 | + 2 | + 7 |
| 16  |     | - 2 | + 3 | +11 |
| 17  |     | - 3 | + 4 | +14 |
| 18  |     | - 3 | + 4 | +15 |
| 19  |     | - 3 | + 4 | +14 |
| 20  |     | - 2 | + 3 | +11 |
| 21  |     | - 2 | + 2 | + 7 |
| 22  |     | - 1 | + 1 | + 4 |
| 23  |     | 0   | 0   | + 1 |
| 24  |     | 0   | 0   | 0   |

# Współczynniki do wzorów interpolacyjnych

| Stirling                                                                                                                                     |                 |                      |                         | Bessel                                                                                                                                                                          |                    |                                   |                            | Newton                                                                                                                                                                                                                                                                                              |                |                |                |                |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|----------------|----------------|
| $n$                                                                                                                                          | $\frac{n^2}{2}$ | $\frac{n(n^2-1)}{6}$ | $\frac{n^2(n^2-1)}{24}$ | $n$                                                                                                                                                                             | $\frac{n(n-1)}{2}$ | $\frac{n(n-1)(n-\frac{1}{2})}{6}$ | $\frac{n(n^2-1)(n-2)}{24}$ | $n$                                                                                                                                                                                                                                                                                                 | $\binom{n}{2}$ | $\binom{n}{3}$ | $\binom{n}{4}$ | $\binom{n}{5}$ |
| 0.00                                                                                                                                         | 0.00000         | 0.0000               | 0.0000                  | 0.00                                                                                                                                                                            | 0.00000            | 0.0000                            | 0.0000                     | 0.00                                                                                                                                                                                                                                                                                                | 0.00000        | 0.0000         | 0.0000         | 0.0000         |
| 0.01                                                                                                                                         | +0.00005        | -0.0017              | 0.0000                  | 0.01                                                                                                                                                                            | -0.00495           | +0.0008                           | +0.0008                    | 0.01                                                                                                                                                                                                                                                                                                | -0.00495       | +0.0033        | -0.0025        | +0.0020        |
| 0.02                                                                                                                                         | +0.00020        | -0.0033              | 0.0000                  | 0.02                                                                                                                                                                            | -0.00980           | +0.0016                           | +0.0016                    | 0.02                                                                                                                                                                                                                                                                                                | -0.00980       | +0.0065        | -0.0048        | +0.0038        |
| 0.03                                                                                                                                         | +0.00045        | -0.0050              | 0.0000                  | 0.03                                                                                                                                                                            | -0.01455           | +0.0023                           | +0.0025                    | 0.03                                                                                                                                                                                                                                                                                                | -0.01455       | +0.0096        | -0.0071        | +0.0056        |
| 0.04                                                                                                                                         | +0.00080        | -0.0067              | -0.0001                 | 0.04                                                                                                                                                                            | -0.01920           | +0.0029                           | +0.0033                    | 0.04                                                                                                                                                                                                                                                                                                | -0.01920       | +0.0125        | -0.0093        | +0.0074        |
| 0.05                                                                                                                                         | +0.00125        | -0.0083              | -0.0001                 | 0.05                                                                                                                                                                            | -0.02375           | +0.0036                           | +0.0041                    | 0.05                                                                                                                                                                                                                                                                                                | -0.02375       | +0.0154        | -0.0114        | +0.0090        |
| 0.06                                                                                                                                         | +0.00180        | -0.0100              | -0.0001                 | 0.06                                                                                                                                                                            | -0.02820           | +0.0041                           | +0.0048                    | 0.06                                                                                                                                                                                                                                                                                                | -0.02820       | +0.0182        | -0.0134        | +0.0106        |
| 0.07                                                                                                                                         | +0.00245        | -0.0116              | -0.0002                 | 0.07                                                                                                                                                                            | -0.03255           | +0.0047                           | +0.0056                    | 0.07                                                                                                                                                                                                                                                                                                | -0.03255       | +0.0209        | -0.0153        | +0.0121        |
| 0.08                                                                                                                                         | +0.00320        | -0.0132              | -0.0003                 | 0.08                                                                                                                                                                            | -0.03680           | +0.0052                           | +0.0064                    | 0.08                                                                                                                                                                                                                                                                                                | -0.03680       | +0.0236        | -0.0172        | +0.0135        |
| 0.09                                                                                                                                         | +0.00405        | -0.0149              | -0.0003                 | 0.09                                                                                                                                                                            | -0.04095           | +0.0056                           | +0.0071                    | 0.09                                                                                                                                                                                                                                                                                                | -0.04095       | +0.0261        | -0.0190        | +0.0148        |
| 0.10                                                                                                                                         | +0.00500        | -0.0165              | -0.0004                 | 0.10                                                                                                                                                                            | -0.04500           | +0.0060                           | +0.0078                    | 0.10                                                                                                                                                                                                                                                                                                | -0.04500       | +0.0285        | -0.0207        | +0.0161        |
| 0.11                                                                                                                                         | +0.00605        | -0.0181              | -0.0005                 | 0.11                                                                                                                                                                            | -0.04895           | +0.0064                           | +0.0086                    | 0.11                                                                                                                                                                                                                                                                                                | -0.04895       | +0.0308        | -0.0223        | +0.0173        |
| 0.12                                                                                                                                         | +0.00720        | -0.0197              | -0.0006                 | 0.12                                                                                                                                                                            | -0.05280           | +0.0067                           | +0.0093                    | 0.12                                                                                                                                                                                                                                                                                                | -0.05280       | +0.0331        | -0.0238        | +0.0185        |
| 0.13                                                                                                                                         | +0.00845        | -0.0213              | -0.0007                 | 0.13                                                                                                                                                                            | -0.05655           | +0.0070                           | +0.0100                    | 0.13                                                                                                                                                                                                                                                                                                | -0.05655       | +0.0352        | -0.0253        | +0.0196        |
| 0.14                                                                                                                                         | +0.00980        | -0.0229              | -0.0008                 | 0.14                                                                                                                                                                            | -0.06020           | +0.0072                           | +0.0106                    | 0.14                                                                                                                                                                                                                                                                                                | -0.06020       | +0.0373        | -0.0267        | +0.0206        |
| 0.15                                                                                                                                         | +0.01125        | -0.0244              | -0.0009                 | 0.15                                                                                                                                                                            | -0.06375           | +0.0074                           | +0.0113                    | 0.15                                                                                                                                                                                                                                                                                                | -0.06375       | +0.0393        | -0.0280        | +0.0216        |
| 0.16                                                                                                                                         | +0.01280        | -0.0260              | -0.0010                 | 0.16                                                                                                                                                                            | -0.06720           | +0.0076                           | +0.0120                    | 0.16                                                                                                                                                                                                                                                                                                | -0.06720       | +0.0412        | -0.0293        | +0.0225        |
| 0.17                                                                                                                                         | +0.01445        | -0.0275              | -0.0012                 | 0.17                                                                                                                                                                            | -0.07055           | +0.0078                           | +0.0126                    | 0.17                                                                                                                                                                                                                                                                                                | -0.07055       | +0.0430        | -0.0304        | +0.0233        |
| 0.18                                                                                                                                         | +0.01620        | -0.0290              | -0.0013                 | 0.18                                                                                                                                                                            | -0.07380           | +0.0079                           | +0.0132                    | 0.18                                                                                                                                                                                                                                                                                                | -0.07380       | +0.0448        | -0.0316        | +0.0241        |
| 0.19                                                                                                                                         | +0.01805        | -0.0305              | -0.0014                 | 0.19                                                                                                                                                                            | -0.07695           | +0.0080                           | +0.0138                    | 0.19                                                                                                                                                                                                                                                                                                | -0.07695       | +0.0464        | -0.0326        | +0.0249        |
| 0.20                                                                                                                                         | +0.02000        | -0.0320              | -0.0016                 | 0.20                                                                                                                                                                            | -0.08000           | +0.0080                           | +0.0144                    | 0.20                                                                                                                                                                                                                                                                                                | -0.08000       | +0.0480        | -0.0336        | +0.0255        |
| 0.21                                                                                                                                         | +0.02205        | -0.0335              | -0.0018                 | 0.21                                                                                                                                                                            | -0.08295           | +0.0080                           | +0.0150                    | 0.21                                                                                                                                                                                                                                                                                                | -0.08295       | +0.0495        | -0.0345        | +0.0262        |
| 0.22                                                                                                                                         | +0.02420        | -0.0349              | -0.0019                 | 0.22                                                                                                                                                                            | -0.08580           | +0.0080                           | +0.0155                    | 0.22                                                                                                                                                                                                                                                                                                | -0.08580       | +0.0509        | -0.0354        | +0.0267        |
| 0.23                                                                                                                                         | +0.02645        | -0.0363              | -0.0021                 | 0.23                                                                                                                                                                            | -0.08855           | +0.0080                           | +0.0161                    | 0.23                                                                                                                                                                                                                                                                                                | -0.08855       | +0.0522        | -0.0362        | +0.0273        |
| 0.24                                                                                                                                         | +0.02880        | -0.0377              | -0.0023                 | 0.24                                                                                                                                                                            | -0.09120           | +0.0079                           | +0.0166                    | 0.24                                                                                                                                                                                                                                                                                                | -0.09120       | +0.0535        | -0.0369        | +0.0278        |
| 0.25                                                                                                                                         | +0.03125        | -0.0391              | -0.0024                 | 0.25                                                                                                                                                                            | -0.09375           | +0.0078                           | +0.0171                    | 0.25                                                                                                                                                                                                                                                                                                | -0.09375       | +0.0547        | -0.0376        | +0.0282        |
| 0.26                                                                                                                                         | +0.03380        | -0.0404              | -0.0026                 | 0.26                                                                                                                                                                            | -0.09620           | +0.0077                           | +0.0176                    | 0.26                                                                                                                                                                                                                                                                                                | -0.09620       | +0.0558        | -0.0382        | +0.0286        |
| 0.27                                                                                                                                         | +0.03645        | -0.0417              | -0.0028                 | 0.27                                                                                                                                                                            | -0.09855           | +0.0076                           | +0.0180                    | 0.27                                                                                                                                                                                                                                                                                                | -0.09855       | +0.0568        | -0.0388        | +0.0289        |
| 0.28                                                                                                                                         | +0.03920        | -0.0430              | -0.0030                 | 0.28                                                                                                                                                                            | -0.10080           | +0.0074                           | +0.0185                    | 0.28                                                                                                                                                                                                                                                                                                | -0.10080       | +0.0578        | -0.0393        | +0.0292        |
| 0.29                                                                                                                                         | +0.04205        | -0.0443              | -0.0032                 | 0.29                                                                                                                                                                            | -0.10295           | +0.0072                           | +0.0189                    | 0.29                                                                                                                                                                                                                                                                                                | -0.10295       | +0.0587        | -0.0398        | +0.0295        |
| 0.30                                                                                                                                         | +0.04500        | -0.0455              | -0.0034                 | 0.30                                                                                                                                                                            | -0.10500           | +0.0070                           | +0.0193                    | 0.30                                                                                                                                                                                                                                                                                                | -0.10500       | +0.0595        | -0.0402        | +0.0297        |
| 0.31                                                                                                                                         | +0.04805        | -0.0467              | -0.0036                 | 0.31                                                                                                                                                                            | -0.10695           | +0.0068                           | +0.0197                    | 0.31                                                                                                                                                                                                                                                                                                | -0.10695       | +0.0602        | -0.0405        | +0.0299        |
| 0.32                                                                                                                                         | +0.05120        | -0.0479              | -0.0038                 | 0.32                                                                                                                                                                            | -0.10880           | +0.0065                           | +0.0201                    | 0.32                                                                                                                                                                                                                                                                                                | -0.10880       | +0.0609        | -0.0408        | +0.0300        |
| 0.33                                                                                                                                         | +0.05445        | -0.0490              | -0.0040                 | 0.33                                                                                                                                                                            | -0.11055           | +0.0063                           | +0.0205                    | 0.33                                                                                                                                                                                                                                                                                                | -0.11055       | +0.0615        | -0.0411        | +0.0302        |
| 0.34                                                                                                                                         | +0.05780        | -0.0501              | -0.0043                 | 0.34                                                                                                                                                                            | -0.11220           | +0.0060                           | +0.0208                    | 0.34                                                                                                                                                                                                                                                                                                | -0.11220       | +0.0621        | -0.0413        | +0.0302        |
| 0.35                                                                                                                                         | +0.06125        | -0.0512              | -0.0045                 | 0.35                                                                                                                                                                            | -0.11375           | +0.0057                           | +0.0211                    | 0.35                                                                                                                                                                                                                                                                                                | -0.11375       | +0.0626        | -0.0414        | +0.0303        |
| 0.36                                                                                                                                         | +0.06480        | -0.0522              | -0.0047                 | 0.36                                                                                                                                                                            | -0.11520           | +0.0054                           | +0.0214                    | 0.36                                                                                                                                                                                                                                                                                                | -0.11520       | +0.0630        | -0.0416        | +0.0303        |
| 0.37                                                                                                                                         | +0.06845        | -0.0532              | -0.0049                 | 0.37                                                                                                                                                                            | -0.11655           | +0.0051                           | +0.0217                    | 0.37                                                                                                                                                                                                                                                                                                | -0.11655       | +0.0633        | -0.0416        | +0.0302        |
| 0.38                                                                                                                                         | +0.07220        | -0.0542              | -0.0051                 | 0.38                                                                                                                                                                            | -0.11780           | +0.0047                           | +0.0219                    | 0.38                                                                                                                                                                                                                                                                                                | -0.11780       | +0.0636        | -0.0417        | +0.0302        |
| 0.39                                                                                                                                         | +0.07605        | -0.0551              | -0.0054                 | 0.39                                                                                                                                                                            | -0.11895           | +0.0044                           | +0.0222                    | 0.39                                                                                                                                                                                                                                                                                                | -0.11895       | +0.0638        | -0.0417        | +0.0301        |
| 0.40                                                                                                                                         | +0.08000        | -0.0560              | -0.0056                 | 0.40                                                                                                                                                                            | -0.12000           | +0.0040                           | +0.0224                    | 0.40                                                                                                                                                                                                                                                                                                | -0.12000       | +0.0640        | -0.0416        | +0.0300        |
| 0.41                                                                                                                                         | +0.08405        | -0.0568              | -0.0058                 | 0.41                                                                                                                                                                            | -0.12095           | +0.0036                           | +0.0226                    | 0.41                                                                                                                                                                                                                                                                                                | -0.12095       | +0.0641        | -0.0415        | +0.0298        |
| 0.42                                                                                                                                         | +0.08820        | -0.0577              | -0.0061                 | 0.42                                                                                                                                                                            | -0.12180           | +0.0032                           | +0.0228                    | 0.42                                                                                                                                                                                                                                                                                                | -0.12180       | +0.0641        | -0.0414        | +0.0296        |
| 0.43                                                                                                                                         | +0.09245        | -0.0584              | -0.0063                 | 0.43                                                                                                                                                                            | -0.12255           | +0.0029                           | +0.0229                    | 0.43                                                                                                                                                                                                                                                                                                | -0.12255       | +0.0641        | -0.0412        | +0.0294        |
| 0.44                                                                                                                                         | +0.09680        | -0.0591              | -0.0065                 | 0.44                                                                                                                                                                            | -0.12320           | +0.0025                           | +0.0231                    | 0.44                                                                                                                                                                                                                                                                                                | -0.12320       | +0.0641        | -0.0410        | +0.0292        |
| 0.45                                                                                                                                         | +0.10125        | -0.0598              | -0.0067                 | 0.45                                                                                                                                                                            | -0.12375           | +0.0021                           | +0.0232                    | 0.45                                                                                                                                                                                                                                                                                                | -0.12375       | +0.0639        | -0.0408        | +0.0289        |
| 0.46                                                                                                                                         | +0.10580        | -0.0604              | -0.0070                 | 0.46                                                                                                                                                                            | -0.12420           | +0.0017                           | +0.0233                    | 0.46                                                                                                                                                                                                                                                                                                | -0.12420       | +0.0638        | -0.0405        | +0.0287        |
| 0.47                                                                                                                                         | +0.11045        | -0.0610              | -0.0072                 | 0.47                                                                                                                                                                            | -0.12455           | +0.0012                           | +0.0233                    | 0.47                                                                                                                                                                                                                                                                                                | -0.12455       | +0.0635        | -0.0402        | +0.0284        |
| 0.48                                                                                                                                         | +0.11520        | -0.0616              | -0.0074                 | 0.48                                                                                                                                                                            | -0.12480           | +0.0008                           | +0.0234                    | 0.48                                                                                                                                                                                                                                                                                                | -0.12480       | +0.0632        | -0.0398        | +0.0280        |
| 0.49                                                                                                                                         | +0.12005        | -0.0621              | -0.0076                 | 0.49                                                                                                                                                                            | -0.12495           | +0.0004                           | +0.0234                    | 0.49                                                                                                                                                                                                                                                                                                | -0.12495       | +0.0629        | -0.0395        | +0.0277        |
| 0.50                                                                                                                                         | +0.12500        | -0.0625              | -0.0078                 | 0.50                                                                                                                                                                            | -0.12500           | 0.0000                            | +0.0234                    | 0.50                                                                                                                                                                                                                                                                                                | -0.12500       | +0.0625        | -0.0391        | +0.0273        |
| $u = u_0 + n\Delta_0^I + \frac{n^2}{2}\Delta_0^{II} +$ $+ \frac{n(n^2-1)}{6}\Delta_0^{III} +$ $+ \frac{n^2(n^2-1)}{24}\Delta_0^{IV} + \dots$ |                 |                      |                         | $u = u_0 + n\Delta_{1/2}^I + \frac{n(n-1)}{2}\Delta_{1/2}^{II} +$ $+ \frac{n(n-1)(n-\frac{1}{2})}{6}\Delta_{1/2}^{III} +$ $+ \frac{n(n^2-1)(n-2)}{24}\Delta_{1/2}^{IV} + \dots$ |                    |                                   |                            | $u = u_0 + n\Delta_{1/2}^I + \binom{n}{2}\Delta_{1/2}^{II} + \binom{n}{3}\Delta_{3/2}^{III} +$ $+ \binom{n}{4}\Delta_2^{IV} + \binom{n}{5}\Delta_{5/2}^V + \dots$ $\binom{n}{2} = \frac{n(n-1)}{2}, \quad \binom{n}{3} = \frac{n(n-1)(n-2)}{6}$ $\binom{n}{4} = \frac{n(n-1)(n-2)(n-3)}{24}, \dots$ |                |                |                |                |
| $\Delta_0^I = \frac{1}{2}(\Delta_{-1/2}^I + \Delta_{1/2}^I),$                                                                                |                 |                      |                         | $\Delta_{1/2}^{II} = \frac{1}{2}(\Delta_0^{II} + \Delta_1^{II}),$                                                                                                               |                    |                                   |                            | $u_{-2} \Delta_{-3/2}^I \Delta_{-1}^{II}$                                                                                                                                                                                                                                                           |                |                |                |                |
| $\Delta_0^{III} = \frac{1}{2}(\Delta_{-1/2}^{III} + \Delta_{1/2}^{III}), \dots$                                                              |                 |                      |                         | $\Delta_{1/2}^{IV} = \frac{1}{2}(\Delta_0^{IV} + \Delta_1^{IV}), \dots$                                                                                                         |                    |                                   |                            | $u_{-1} \Delta_{-1/2}^I \Delta_0^{II} \Delta_{-1/2}^{III}$                                                                                                                                                                                                                                          |                |                |                |                |
|                                                                                                                                              |                 |                      |                         |                                                                                                                                                                                 |                    |                                   |                            | $u_0 \Delta_{1/2}^I \Delta_1^{II} \Delta_{1/2}^{III} \Delta_0^{IV}$                                                                                                                                                                                                                                 |                |                |                |                |
|                                                                                                                                              |                 |                      |                         |                                                                                                                                                                                 |                    |                                   |                            | $u_1 \Delta_{3/2}^I \Delta_2^{II} \Delta_{3/2}^{III}$                                                                                                                                                                                                                                               |                |                |                |                |
|                                                                                                                                              |                 |                      |                         |                                                                                                                                                                                 |                    |                                   |                            | $u_2 \Delta_{5/2}^I$                                                                                                                                                                                                                                                                                |                |                |                |                |
|                                                                                                                                              |                 |                      |                         |                                                                                                                                                                                 |                    |                                   |                            | $u_3$                                                                                                                                                                                                                                                                                               |                |                |                |                |



**Refrakcja normalna  $R_0$  (Radau)**  
i ekstynkcja średnia  $E_0$

| $z'$ | $R_0$ |      | $E_0$ | $z'$   | $R_0$   |      | $E_0$ | $z'$   | $R_0$   |       | $E_0$ |
|------|-------|------|-------|--------|---------|------|-------|--------|---------|-------|-------|
| 0°   | 00.00 |      | 0.25  | 50°00' | 1'11.51 | 0.86 | 0.39  | 70°00' | 2'43.78 | 2.97  | 0.72  |
| 1    | 01.05 | 1.05 | 0.25  | 20     | 1 12.37 | 0.86 |       | 20     | 2 46.75 | 3.06  |       |
| 2    | 02.10 | 1.05 | 0.25  | 40     | 1 13.23 | 0.87 |       | 40     | 2 49.81 | 3.16  |       |
| 3    | 03.15 | 1.05 | 0.25  | 51 00  | 1 14.10 | 0.88 | 0.40  | 71 00  | 2 52.97 | 3.26  | 0.76  |
| 4    | 04.20 | 1.05 | 0.25  | 20     | 1 14.98 | 0.89 |       | 20     | 2 56.23 | 3.38  |       |
|      |       | 1.05 |       | 40     | 1 15.87 | 0.92 |       | 40     | 2 59.61 | 3.49  |       |
| 5    | 05.25 | 1.06 | 0.25  | 52 00  | 1 16.79 | 0.92 | 0.41  | 72 00  | 3 03.10 | 3.61  | 0.80  |
| 6    | 06.31 | 1.07 | 0.25  | 20     | 1 17.71 | 0.94 |       | 20     | 3 06.71 | 3.75  |       |
| 7    | 07.38 | 1.07 | 0.25  | 40     | 1 18.65 | 0.95 |       | 40     | 3 10.46 | 3.88  |       |
| 8    | 08.45 | 1.07 | 0.25  | 53 00  | 1 19.60 | 0.98 | 0.41  | 73 00  | 3 14.34 | 4.03  | 0.84  |
| 9    | 09.52 | 1.08 | 0.25  | 20     | 1 20.58 | 0.97 |       | 20     | 3 18.37 | 4.18  |       |
|      |       | 1.08 |       | 40     | 1 21.55 | 1.01 |       | 40     | 3 22.55 | 4.34  |       |
| 10   | 10.60 | 1.08 | 0.25  | 54 00  | 1 22.56 | 1.01 | 0.42  | 74 00  | 3 26.89 | 4.51  | 0.89  |
| 11   | 11.68 | 1.09 | 0.25  | 20     | 1 23.57 | 1.03 |       | 20     | 3 31.40 | 4.70  |       |
| 12   | 12.77 | 1.10 | 0.26  | 40     | 1 24.60 | 1.04 |       | 40     | 3 36.10 | 4.90  |       |
| 13   | 13.87 | 1.11 | 0.26  | 55 00  | 1 25.64 | 1.07 | 0.43  | 75 00  | 3 41.00 | 5.09  | 0.95  |
| 14   | 14.98 | 1.12 | 0.26  | 20     | 1 26.71 | 1.09 |       | 20     | 3 46.09 | 5.33  |       |
|      |       | 1.12 |       | 40     | 1 27.80 | 1.09 |       | 40     | 3 51.42 | 5.55  |       |
| 15   | 16.10 | 1.13 | 0.26  | 56 00  | 1 28.89 | 1.12 | 0.45  | 76 00  | 3 56.97 | 5.81  | 1.02  |
| 16   | 17.23 | 1.14 | 0.26  | 20     | 1 30.01 | 1.14 |       | 20     | 4 02.78 | 6.08  |       |
| 17   | 18.37 | 1.16 | 0.26  | 40     | 1 31.15 | 1.16 |       | 40     | 4 08.86 | 6.37  |       |
| 18   | 19.53 | 1.16 | 0.26  | 57 00  | 1 32.31 | 1.18 | 0.46  | 77 00  | 4 15.23 | 6.7   | 1.09  |
| 19   | 20.69 | 1.18 | 0.26  | 20     | 1 33.49 | 1.20 |       | 20     | 4 21.9  | 7.0   |       |
|      |       | 1.18 |       | 40     | 1 34.69 | 1.23 |       | 40     | 4 28.9  | 7.4   |       |
| 20   | 21.87 | 1.20 | 0.27  | 58 00  | 1 35.92 | 1.24 | 0.47  | 78 00  | 4 36.3  | 7.7   | 1.17  |
| 21   | 23.07 | 1.21 | 0.27  | 20     | 1 37.16 | 1.27 |       | 20     | 4 44.0  | 8.2   |       |
| 22   | 24.28 | 1.23 | 0.27  | 40     | 1 38.43 | 1.30 |       | 40     | 4 52.2  | 8.6   |       |
| 23   | 25.51 | 1.24 | 0.27  | 59 00  | 1 39.73 | 1.32 | 0.48  | 79 00  | 5 00.8  | 9.1   | 1.27  |
| 24   | 26.75 | 1.27 | 0.27  | 20     | 1 41.05 | 1.34 |       | 20     | 5 09.9  | 9.7   |       |
|      |       | 1.27 |       | 40     | 1 42.39 | 1.37 |       | 40     | 5 19.6  | 10.2  |       |
| 25   | 28.02 | 1.29 | 0.28  | 60 00  | 1 43.76 | 1.40 | 0.50  | 80 00  | 5 29.8  | 10.8  | 1.39  |
| 26   | 29.31 | 1.30 | 0.28  | 20     | 1 45.16 | 1.43 |       | 20     | 5 40.6  | 11.6  |       |
| 27   | 30.61 | 1.34 | 0.28  | 40     | 1 46.59 | 1.45 |       | 40     | 5 52.2  | 12.3  |       |
| 28   | 31.95 | 1.36 | 0.28  | 61 00  | 1 48.04 | 1.49 | 0.51  | 81 00  | 6 04.5  | 13.2  | 1.53  |
| 29   | 33.31 | 1.38 | 0.29  | 20     | 1 49.53 | 1.52 |       | 20     | 6 17.7  | 14.0  |       |
|      |       | 1.38 |       | 40     | 1 51.05 | 1.55 |       | 40     | 6 31.7  | 15.1  |       |
| 30   | 34.69 | 1.41 | 0.29  | 62 00  | 1 52.60 | 1.59 | 0.53  | 82 00  | 6 46.8  | 16.2  | 1.70  |
| 31   | 36.10 | 1.44 | 0.29  | 20     | 1 54.19 | 1.62 |       | 20     | 7 03.0  | 17.4  |       |
| 32   | 37.54 | 1.47 | 0.29  | 40     | 1 55.81 | 1.66 |       | 40     | 7 20.4  | 18.9  |       |
| 33   | 39.01 | 1.51 | 0.30  | 63 00  | 1 57.47 | 1.68 | 0.55  | 83 00  | 7 39.3  | 20.4  | 1.92  |
| 34   | 40.52 | 1.54 | 0.30  | 20     | 1 59.15 | 1.74 |       | 20     | 7 59.7  | 22.2  |       |
|      |       | 1.54 |       | 40     | 2 00.89 | 1.78 |       | 40     | 8 21.9  | 24.2  |       |
| 35   | 42.06 | 1.58 | 0.30  | 64 00  | 2 02.67 | 1.82 | 0.57  | 84 00  | 8 46.1  | 26.4  | 2.19  |
| 36   | 43.64 | 1.62 | 0.31  | 20     | 2 04.49 | 1.86 |       | 20     | 9 12.5  | 29.1  |       |
| 37   | 45.26 | 1.66 | 0.31  | 40     | 2 06.35 | 1.90 |       | 40     | 9 41.6  | 31.9  |       |
| 38   | 46.92 | 1.72 | 0.32  | 65 00  | 2 08.25 | 1.95 | 0.59  | 85 00  | 10 13.5 | 35.4  | 2.55  |
| 39   | 48.64 | 1.76 | 0.32  | 20     | 2 10.20 | 2.00 |       | 20     | 10 48.9 | 39.2  |       |
|      |       | 1.76 |       | 40     | 2 12.20 | 2.06 |       | 40     | 11 28.1 | 43.7  |       |
| 40   | 50.40 | 1.81 | 0.33  | 66 00  | 2 14.26 | 2.10 | 0.62  | 86 00  | 12 11.8 | 49.1  | 3.03  |
| 41   | 52.21 | 1.86 | 0.33  | 20     | 2 16.36 | 2.17 |       | 20     | 13 00.9 | 55.3  |       |
| 42   | 54.07 | 1.93 | 0.34  | 40     | 2 18.53 | 2.21 |       | 40     | 13 56.2 | 62.6  |       |
| 43   | 56.00 | 1.98 | 0.34  | 67 00  | 2 20.74 | 2.29 | 0.64  | 87 00  | 14 58.8 | 71.4  | 3.71  |
| 44   | 57.98 | 2.06 | 0.35  | 20     | 2 23.03 | 2.33 |       | 20     | 16 10.2 | 81.9  |       |
|      |       | 2.06 |       | 40     | 2 25.36 | 2.42 |       | 40     | 17 32.1 | 94.5  |       |
| 45   | 60.04 | 2.13 | 0.35  | 68 00  | 2 27.78 | 2.47 | 0.66  | 88 00  | 19 06.6 | 109.8 | 4.71  |
| 46   | 62.17 | 2.20 | 0.36  | 20     | 2 30.25 | 2.55 |       | 20     | 20 56.4 | 128.7 |       |
| 47   | 64.37 | 2.30 | 0.37  | 40     | 2 32.80 | 2.63 |       | 40     | 23 05.1 | 151.9 |       |
| 48   | 66.67 | 2.37 | 0.37  | 69 00  | 2 35.43 | 2.70 | 0.69  | 89 00  | 25 37.0 | 180.6 |       |
| 49   | 69.04 | 2.47 | 0.38  | 20     | 2 38.13 | 2.79 |       | 20     | 28 37.6 | 216.6 |       |
|      |       | 2.47 |       | 40     | 2 40.92 | 2.86 |       | 40     | 32 14.2 | 261.8 |       |
| 50   | 71.51 |      | 0.39  | 70 00  | 2 43.78 |      | 0.72  | 90 00  | 36 36.0 | 318.7 |       |
|      |       |      |       |        |         |      |       | 20     | 41 54.7 | 390.8 |       |
|      |       |      |       |        |         |      |       | 40     | 48 25.5 | 482.0 |       |
|      |       |      |       |        |         |      |       | 91 00  | 56 27.5 |       |       |

# Współczynniki do obliczania refrakcji całkowitej

| $t$ [°C] | $A$     | $H$               | $B$     | $H$               | $B$     | $z'$ | $\alpha$ | $R_1$                                 | $\beta$ |
|----------|---------|-------------------|---------|-------------------|---------|------|----------|---------------------------------------|---------|
| – 30°    | +0.1291 | 649 <sup>mm</sup> | –0.1461 | 720 <sup>mm</sup> | –0.0526 | 45°  | 1.000    | 0'                                    | 1.000   |
| – 29     | 1243    | 650               | 1447    | 721               | 0513    | 46   | 1.001    | 2                                     | 1.001   |
| – 28     | 1195    | 651               | 1434    | 722               | 0500    | 47   | 1.001    | 4                                     | 1.002   |
| – 27     | 1148    | 652               | 1421    | 723               | 0487    | 48   | 1.001    | 6                                     | 1.004   |
| – 26     | 1101    | 653               | 1408    | 724               | 0474    | 49   | 1.001    | 8                                     | 1.008   |
| – 25     | +0.1054 | 654               | –0.1395 | 725               | –0.0461 | 50   | 1.002    | 10                                    | 1.012   |
| – 24     | 1008    | 655               | 1382    | 726               | 0447    | 51   | 1.002    | 12                                    | 1.017   |
| – 23     | 0962    | 656               | 1368    | 727               | 0434    | 52   | 1.002    | 14                                    | 1.023   |
| – 22     | 0917    | 657               | 1355    | 728               | 0421    | 53   | 1.002    | 16                                    | 1.029   |
| – 21     | 0872    | 658               | 1342    | 729               | 0408    | 54   | 1.002    | 18                                    | 1.035   |
| – 20     | +0.0827 | 659               | –0.1329 | 730               | –0.0395 | 55   | 1.002    | 20                                    | 1.041   |
| – 19     | 0782    | 660               | 1316    | 731               | 0382    | 56   | 1.003    | 22                                    | 1.048   |
| – 18     | 0738    | 661               | 1303    | 732               | 0368    | 57   | 1.003    | 24                                    | 1.055   |
| – 17     | 0694    | 662               | 1289    | 733               | 0355    | 58   | 1.003    | 26                                    | 1.062   |
| – 16     | 0651    | 663               | 1276    | 734               | 0342    | 59   | 1.003    | 28                                    | 1.069   |
| – 15     | +0.0608 | 664               | –0.1263 | 735               | –0.0329 | 60   | 1.004    | 30                                    | 1.076   |
| – 14     | 0565    | 665               | 1250    | 736               | 0316    | 61   | 1.004    | 32                                    | 1.083   |
| – 13     | 0523    | 666               | 1237    | 737               | 0303    | 62   | 1.004    | 34                                    | 1.091   |
| – 12     | 0481    | 667               | 1224    | 738               | 0289    | 63   | 1.004    | 36                                    | 1.098   |
| – 11     | 0439    | 668               | 1211    | 739               | 0276    | 64   | 1.005    | 38                                    | 1.106   |
| – 10     | +0.0398 | 669               | –0.1197 | 740               | –0.0263 | 65   | 1.005    |                                       |         |
| – 9      | 0357    | 670               | 1184    | 741               | 0250    | 66   | 1.006    |                                       |         |
| – 8      | 0316    | 671               | 1171    | 742               | 0237    | 67   | 1.007    |                                       |         |
| – 7      | 0275    | 672               | 1158    | 743               | 0224    | 68   | 1.007    | $z'$ odl. zenit. pozorną              |         |
| – 6      | 0235    | 673               | 1145    | 744               | 0211    | 69   | 1.008    | $t$ temp. zewnętrzna                  |         |
| – 5      | +0.0195 | 674               | –0.1132 | 745               | –0.0197 | 70   | 1.009    | (w stopniach Celsjusza)               |         |
| – 4      | 0155    | 675               | 1118    | 746               | 0184    | 71   | 1.010    |                                       |         |
| – 3      | 0116    | 676               | 1105    | 747               | 0171    | 72   | 1.011    |                                       |         |
| – 2      | 0077    | 677               | 1092    | 748               | 0158    | 73   | 1.013    |                                       |         |
| – 1      | +0.0038 | 678               | 1079    | 749               | 0145    | 74   | 1.015    | $H$ ciśnienie atm.                    |         |
| 0        | 0.0000  | 679               | –0.1066 | 750               | –0.0132 | 75   | 1.017    | (w milimetrach Hg)                    |         |
| + 1      | –0.0038 | 680               | 1053    | 751               | 0118    | 76   | 1.020    |                                       |         |
| + 2      | 0076    | 681               | 1039    | 752               | 0105    | 77   | 1.023    |                                       |         |
| + 3      | 0114    | 682               | 1026    | 753               | 0092    | 78   | 1.026    |                                       |         |
| + 4      | 0151    | 683               | 1013    | 754               | 0079    | 79   | 1.031    | $A$ wsp. temp. $t$                    |         |
| + 5      | –0.0188 | 684               | –0.1000 | 755               | –0.0066 | 80   | 1.037    | $B$ wsp. ciśn. $H$                    |         |
| + 6      | 0225    | 685               | 0987    | 756               | 0053    | 81   | 1.045    | $\alpha, \beta, \gamma$ współczynniki |         |
| + 7      | 0261    | 686               | 0974    | 757               | 0039    | 82   | 1.055    |                                       |         |
| + 8      | 0298    | 687               | 0961    | 758               | 0026    | 83   | 1.069    |                                       |         |
| + 9      | 0334    | 688               | 0947    | 759               | –0.0013 | 84   | 1.087    |                                       |         |
| + 10     | –0.0369 | 689               | –0.0934 | 760               | 0.0000  | 85   | 1.114    | Dla $z' < 80^\circ$                   |         |
| + 11     | 0405    | 690               | 0921    | 761               | +0.0013 | 86   | 1.152    | $\gamma = 1.000$                      |         |
| + 12     | 0440    | 691               | 0908    | 762               | 0026    | 87   | 1.210    |                                       |         |
| + 13     | 0475    | 692               | 0895    | 763               | 0039    | 88   | 1.299    |                                       |         |
| + 14     | 0510    | 693               | 0882    | 764               | 0053    | 89   | 1.444    |                                       |         |
| + 15     | –0.0545 | 694               | –0.0868 | 765               | +0.0066 | 90   | 1.677    | Dla $z' < 45^\circ$                   |         |
| + 16     | 0579    | 695               | 0855    | 766               | 0079    |      |          | $\alpha = 1.000$                      |         |
| + 17     | 0613    | 696               | 0842    | 767               | 0092    |      |          | $\beta = 1.000$                       |         |
| + 18     | 0647    | 697               | 0829    | 768               | 0105    |      |          | $\gamma = 1.000$                      |         |
| + 19     | 0680    | 698               | 0816    | 769               | 0118    |      |          |                                       |         |
| + 20     | –0.0714 | 699               | –0.0803 | 770               | +0.0132 |      |          |                                       |         |
| + 21     | 0747    | 700               | 0789    | 771               | 0145    |      |          |                                       |         |
| + 22     | 0780    | 701               | 0776    | 772               | 0158    |      |          |                                       |         |
| + 23     | 0812    | 702               | 0763    | 773               | 0171    |      |          |                                       |         |
| + 24     | 0845    | 703               | 0750    | 774               | 0184    |      |          |                                       |         |
| + 25     | –0.0877 | 704               | –0.0737 | 775               | +0.0197 |      |          |                                       |         |
| + 26     | 0909    | 705               | 0724    | 776               | 0211    |      |          |                                       |         |
| + 27     | 0941    | 706               | 0711    | 777               | 0224    |      |          |                                       |         |
| + 28     | 0972    | 707               | 0697    | 778               | 0237    |      |          |                                       |         |
| + 29     | 1004    | 708               | 0684    | 779               | 0250    |      |          |                                       |         |
| + 30     | –0.1035 | 709               | –0.0671 | 780               | +0.0263 |      |          |                                       |         |
| + 31     | 1066    | 710               | 0658    | 781               | 0276    |      |          |                                       |         |
| + 32     | 1097    | 711               | 0645    | 782               | 0289    |      |          |                                       |         |
| + 33     | 1127    | 712               | 0632    | 783               | 0303    |      |          |                                       |         |
| + 34     | 1158    | 713               | 0618    | 784               | 0316    |      |          |                                       |         |
| + 35     | –0.1188 | 714               | –0.0605 | 785               | +0.0329 |      |          |                                       |         |
| + 36     | 1218    | 715               | 0592    | 786               | 0342    |      |          |                                       |         |
| + 37     | 1248    | 716               | 0579    | 787               | 0355    |      |          |                                       |         |
| + 38     | 1277    | 717               | 0566    | 788               | 0368    |      |          |                                       |         |
| + 39     | 1307    | 718               | 0553    | 789               | 0382    |      |          |                                       |         |
| + 40     | –0.1336 | 719               | –0.0539 | 790               | +0.0395 |      |          |                                       |         |

| $z'$ | $\gamma$              |
|------|-----------------------|
| 80°  | $1 - 0.00002 \cdot t$ |
| 81   | $1 - 0.00004 \cdot t$ |
| 82   | $1 - 0.00006 \cdot t$ |
| 83   | $1 - 0.00008 \cdot t$ |
| 84   | $1 - 0.00011 \cdot t$ |
| 85   | $1 - 0.00016 \cdot t$ |
| 86   | $1 - 0.00025 \cdot t$ |
| 87   | $1 - 0.00038 \cdot t$ |
| 88   | $1 - 0.00062 \cdot t$ |
| 89   | $1 - 0.00108 \cdot t$ |
| 90   | $1 - 0.00187 \cdot t$ |

# Zestawienie gwiazdozbiorów

| Nazwa łacińska<br>(z końcówką dopełniacza) | Skrót<br>nazwy<br>łac. | Nazwa polska      | Granice położenia<br>na sferze niebieskiej |                                | Liczba<br>gwiazd<br>jaśn.<br>od 6 |     |
|--------------------------------------------|------------------------|-------------------|--------------------------------------------|--------------------------------|-----------------------------------|-----|
|                                            |                        |                   | $\alpha$                                   | $\delta$                       |                                   |     |
| Andromed-a, -ae                            | And                    | Andromeda         | 22 <sup>h</sup> 56 <sup>m</sup>            | 2 <sup>h</sup> 36 <sup>m</sup> | +21.° +52.9                       | 100 |
| Antli-a, -ae                               | Ant                    | Pompa             | 9 25                                       | 11 03                          | −24.3 −40.1                       | 20  |
| Ap-us, -odis                               | Aps                    | Rajski Ptak       | 13 45                                      | 18 17                          | −67.5 −82.9                       | 20  |
| Aquar-ius, -ii                             | Aqr                    | Wodnik            | 20 36                                      | 23 54                          | +3.1 −25.3                        | 90  |
| Aquil-a, -ae                               | Aql                    | Orzeł             | 18 38                                      | 20 36                          | −11.9 +18.6                       | 70  |
| Ar-a, -ae                                  | Ara                    | Ołtarz            | 16 31                                      | 18 06                          | −45.5 −67.6                       | 30  |
| Arie-s, -tis                               | Ari                    | Baran             | 1 44                                       | 3 27                           | +10.2 +30.9                       | 50  |
| Aurig-a, -ae                               | Aur                    | Woźnica           | 4 35                                       | 7 27                           | +27.9 +56.1                       | 90  |
| Boot-es, -is                               | Boo                    | Wolarz            | 13 33                                      | 15 47                          | +7.6 +55.2                        | 90  |
| Cael-um, -i                                | Cae                    | Rylec             | 4 18                                       | 5 03                           | −27.1 −48.8                       | 10  |
| Camelopardal-is, -is                       | Cam                    | Żyrafa            | 3 11                                       | 14 25                          | +52.8 +85.1                       | 50  |
| Can-cer, -cri                              | Cnc                    | Rak               | 7 53                                       | 9 19                           | +6.8 +33.3                        | 60  |
| Can-es, -um Venatic-i, -orum               | CVn                    | Psy Gończe        | 12 04                                      | 14 05                          | +28.0 +52.7                       | 30  |
| Can-is, -is Maior, -is                     | CMa                    | Wielki Pies       | 6 09                                       | 7 26                           | −11.0 −33.2                       | 80  |
| Can-is, -is Minor, -is                     | CMi                    | Mały Pies         | 7 04                                       | 8 09                           | −0.1 +13.2                        | 20  |
| Capricorn-us, -i                           | Cap                    | Koziorożec        | 20 04                                      | 21 57                          | −8.7 −27.8                        | 50  |
| Carin-a, -ae                               | Car                    | Kil               | 6 02                                       | 11 18                          | −50.9 −75.2                       | 110 |
| Cassiopei-a, -ae                           | Cas                    | Kasjopea          | 22 56                                      | 3 36                           | +46.4 +77.5                       | 90  |
| Centaur-us, -i                             | Cen                    | Centaur           | 11 03                                      | 14 59                          | −29.9 −64.5                       | 150 |
| Cephe-us, -i                               | Cep                    | Cefeusz           | 20 01                                      | 8 30                           | +53.1 +88.5                       | 60  |
| Cet-us, -i                                 | Cet                    | Wieloryb          | 23 55                                      | 3 21                           | −25.2 +10.2                       | 100 |
| Chamaele-on, -onis                         | Cha                    | Kameleon          | 7 32                                       | 13 48                          | −75.2 −82.8                       | 20  |
| Circin-us, -i                              | Cir                    | Cyrkiel           | 13 35                                      | 15 26                          | −54.3 −70.4                       | 20  |
| Columb-a, -ae                              | Col                    | Gołąb             | 5 03                                       | 6 28                           | −27.2 −43.0                       | 40  |
| Com-a, -ae Berenices                       | Com                    | Warkocz Bereniki  | 11 57                                      | 13 33                          | +13.8 +33.7                       | 50  |
| Coron-a, -ae Australis                     | CrA                    | Korona Południowa | 17 55                                      | 19 15                          | −37.0 −45.6                       | 25  |
| Coron-a, -ae Borealis                      | CrB                    | Korona Północna   | 15 14                                      | 16 22                          | +25.8 +39.8                       | 20  |
| Corv-us, -i                                | Crv                    | Kruk              | 11 54                                      | 12 54                          | −11.3 −24.9                       | 15  |
| Crater, -is                                | Crt                    | Puchar            | 10 48                                      | 11 54                          | −6.5 −24.9                        | 20  |
| Cru-x, -cis                                | Cru                    | Krzyż             | 13 53                                      | 12 55                          | −55.5 −64.5                       | 30  |
| Cygn-us, -i                                | Cyg                    | Łabędź            | 19 07                                      | 22 01                          | +27.7 +61.2                       | 150 |
| Delphin-us, -i                             | Del                    | Delfin            | 20 13                                      | 21 06                          | +2.2 +20.8                        | 30  |
| Dorad-o, -us                               | Dor                    | Złota Ryba        | 3 52                                       | 6 36                           | −48.8 −70.1                       | 20  |
| Draco, -nis                                | Dra                    | Smok              | 9 18                                       | 21 00                          | +47.7 +86.0                       | 80  |
| Equule-us, -i                              | Equ                    | Żrebię            | 20 54                                      | 21 23                          | +2.2 +12.9                        | 10  |
| Eridan-us, -i                              | Eri                    | Erydan            | 1 22                                       | 5 09                           | +0.1 −58.1                        | 100 |
| Forn-ax, -acis                             | For                    | Piec              | 1 44                                       | 3 48                           | −24.0 −39.8                       | 35  |
| Gemin-i, -orum                             | Gem                    | Bliźnięta         | 5 57                                       | 8 06                           | +10.0 +35.4                       | 70  |
| Gru-s, -is                                 | Gru                    | Żuraw             | 21 25                                      | 23 25                          | −36.6 −56.6                       | 30  |
| Hercul-es, -is                             | Her                    | Herkules          | 15 47                                      | 18 56                          | +3.9 +51.3                        | 140 |
| Horolog-ium, -ii                           | Hor                    | Zegar             | 2 12                                       | 4 18                           | −39.8 −67.2                       | 20  |
| Hydr-a, -ae                                | Hya                    | Hydra             | 8 08                                       | 14 58                          | +6.8 −35.3                        | 130 |
| Hydr-us, -i                                | Hyi                    | Wąż Morski        | 0 02                                       | 4 33                           | −58.1 −82.1                       | 20  |
| Ind-us, -i                                 | Ind                    | Indianin          | 20 25                                      | 23 25                          | −45.4 −74.7                       | 20  |
| Lacert-a, -ae                              | Lac                    | Jaszczurka        | 21 55                                      | 22 56                          | +34.9 +56.8                       | 35  |
| Leo, -nis                                  | Leo                    | Lew               | 9 18                                       | 11 56                          | −6.4 +33.3                        | 70  |
| Leo, -nis Minor, -is                       | LMi                    | Mały Lew          | 9 19                                       | 11 04                          | +23.1 +41.7                       | 20  |
| Lep-us, -oris                              | Lep                    | Zajac             | 4 54                                       | 6 09                           | −11.0 −27.1                       | 40  |

## Zestawienie gwiazdozbiorów

| Nazwa łacińska<br>(z końcówką dopełniacza) | Skrót<br>nazwy<br>łac. | Nazwa polska                                | Granice położenia<br>na sferze niebieskiej                      |             | Liczba<br>gwiazd<br>jaśn.<br>od 6 |
|--------------------------------------------|------------------------|---------------------------------------------|-----------------------------------------------------------------|-------------|-----------------------------------|
|                                            |                        |                                             | $\alpha$                                                        | $\delta$    |                                   |
| Libr-a, -ae                                | Lib                    | Waga                                        | 14 <sup>h</sup> 18 <sup>m</sup> 15 <sup>h</sup> 59 <sup>m</sup> | −0.3 −29.9  | 50                                |
| Lup-us, -i                                 | Lup                    | Wilk                                        | 14 13 16 05                                                     | −29.8 −55.3 | 70                                |
| Lyn-x, -cis                                | Lyn                    | Ryś                                         | 6 13 9 40                                                       | +33.4 +62.0 | 60                                |
| Lyr-a, -ae                                 | Lyr                    | Lutnia                                      | 18 12 19 26                                                     | +25.6 +47.7 | 45                                |
| Mens-a, -ae                                | Men                    | Góra Stołowa                                | 3 20 7 37                                                       | −69.9 −85.0 | 15                                |
| Microscop-ium, -ii                         | Mic                    | Mikroskop                                   | 20 25 21 25                                                     | −27.7 −45.4 | 20                                |
| Monocer-os, -otis                          | Mon                    | Jednorożec                                  | 5 54 8 08                                                       | −11.0 +11.9 | 85                                |
| Musc-a, -ae                                | Mus                    | Mucha                                       | 11 17 13 46                                                     | −64.5 −75.2 | 30                                |
| Norm-a, -ae                                | Nor                    | Węgielnica                                  | 15 25 16 31                                                     | −42.2 −60.2 | 20                                |
| Octan-s, -tis                              | Oct                    | Oktant                                      | 0 00 24 00                                                      | −74.7 −90.0 | 35                                |
| Ophiuch-us, -i                             | Oph                    | Wężownik                                    | 15 58 18 42                                                     | +14.3 −30.1 | 100                               |
| Orion, -is                                 | Ori                    | Orion                                       | 4 41 6 23                                                       | −11.0 +23.0 | 120                               |
| Pavo, -nis                                 | Pav                    | Paw                                         | 17 37 21 30                                                     | −56.8 −75.0 | 45                                |
| Pegas-us, -i                               | Peg                    | Pegaz                                       | 21 06 0 13                                                      | +2.2 +36.3  | 100                               |
| Perse-us, -i                               | Per                    | Perseusz                                    | 1 26 4 46                                                       | +30.9 +58.9 | 90                                |
| Phoeni-x, -cis                             | Phe                    | Feniks                                      | 23 24 2 24                                                      | −39.8 −58.2 | 40                                |
| Pictor, -is                                | Pic                    | Malarz, właśc. Sztaluga                     | 4 32 6 51                                                       | −43.1 −64.1 | 30                                |
| Pisc-es, -ium                              | Psc                    | Ryby                                        | 22 49 2 04                                                      | −6.6 +33.4  | 75                                |
| Piscis Austrin-us, -i                      | PsA                    | Ryba Południowa                             | 21 25 23 04                                                     | −25.2 −36.7 | 25                                |
| Pupp-is, -is                               | Pup                    | Rufa                                        | 6 02 8 26                                                       | −11.0 −50.8 | 140                               |
| Pyx-is, -idis                              | Pyx                    | Kompas                                      | 8 26 9 26                                                       | −17.3 −37.0 | 25                                |
| Reticul-um, -i                             | Ret                    | Sieć, właśc. Siatka<br>Rombowa              | 3 14 4 35                                                       | −53.0 −67.3 | 15                                |
| Sagitt-a, -ae                              | Sge                    | Strzała                                     | 18 56 20 18                                                     | +16.0 +21.4 | 15                                |
| Sagittar-ius, -ii                          | Sgr                    | Strzelec                                    | 17 41 20 25                                                     | −11.8 −45.4 | 115                               |
| Scorp-ius, -ii                             | Sco                    | Skorpion                                    | 15 44 17 55                                                     | −8.1 −45.6  | 100                               |
| Sculptor, -is                              | Scl                    | Rzeźbiarz, właśc. War-<br>sztat Rzeźbiarski | 23 04 1 44                                                      | −25.2 −39.8 | 30                                |
| Scut-um, -i (Sobiescianum)                 | Sct                    | Tarcza (Sobieskiego)                        | 18 18 18 56                                                     | −4.0 −16.0  | 20                                |
| Serpen-s, -tis                             | Ser                    | Wąż                                         | 15 08 18 56                                                     | +25.7 −16.0 | 60                                |
| Sextan-s, -tis                             | Sex                    | Sekstans                                    | 9 39 10 49                                                      | +6.6 −11.3  | 25                                |
| Taur-us, -i                                | Tau                    | Byk                                         | 3 20 5 58                                                       | +0.1 +30.9  | 125                               |
| Telescop-ium, -ii                          | Tel                    | Teleskop                                    | 18 06 20 26                                                     | −45.4 −56.9 | 30                                |
| Triangul-um, -i                            | Tri                    | Trójkąt                                     | 1 29 2 48                                                       | +25.4 +37.0 | 15                                |
| Triangul-um, -i Austral-e, -is             | TrA                    | Trójkąt Południowy                          | 14 50 17 09                                                     | −60.3 −70.3 | 20                                |
| Tucan-a, -ae                               | Tuc                    | Tukan                                       | 22 05 1 22                                                      | −56.7 −75.7 | 25                                |
| Urs-a, -ae Maior, -is                      | UMa                    | Wielka Niedźwiedzica                        | 8 05 14 27                                                      | +28.8 +73.3 | 125                               |
| Urs-a, -ae Minor, -is                      | UMi                    | Mała Niedźwiedzica                          | 0 00 24 00                                                      | +65.6 +90.0 | 20                                |
| Vel-a, -orum                               | Vel                    | Żagle                                       | 8 02 11 24                                                      | −37.0 −57.0 | 110                               |
| Virg-o, -inis                              | Vir                    | Panna                                       | 11 35 15 08                                                     | +14.6 −22.2 | 95                                |
| Volan-s, -tis                              | Vol                    | Ryba Latająca                               | 6 35 9 02                                                       | −64.2 −75.0 | 20                                |
| Vulpecul-a, -ae                            | Vul                    | Lis                                         | 18 56 21 28                                                     | +19.5 +29.4 | 45                                |

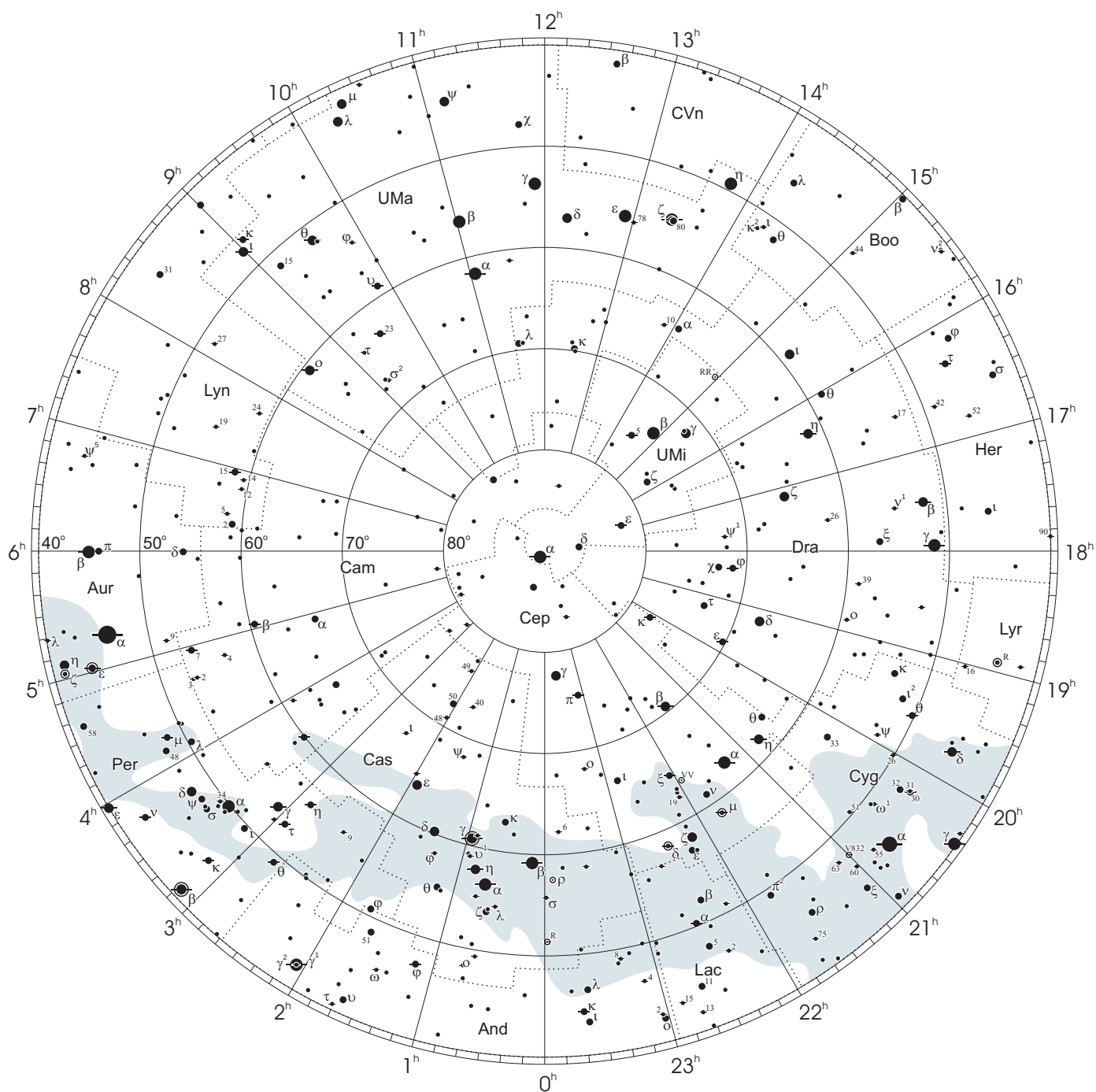
Gwiazdozbiory Carina, Puppis, Pyxis i Vela poprzednio tworzyły jeden gwiazdozbiór Argo navis (Okręt Argo).

Gwiazdozbiór Serpens bywa dzielony na: Serpens caput (Głowa Węża) i Serpens cauda (Ogon Węża). Numeracja gwiazd jest jednolita w łącznym gwiazdozbiore.

Wcześniejsze podziały na gwiazdozbiory były najpierw związane tylko z ugrupowaniami jaśniejszych gwiazd, następnie z obszarami nieba dość nieregularnymi bez wyraźnie sprecyzowanych granic.

# Mapa nieba

## otoczenie bieguna północnego sfery niebieskiej

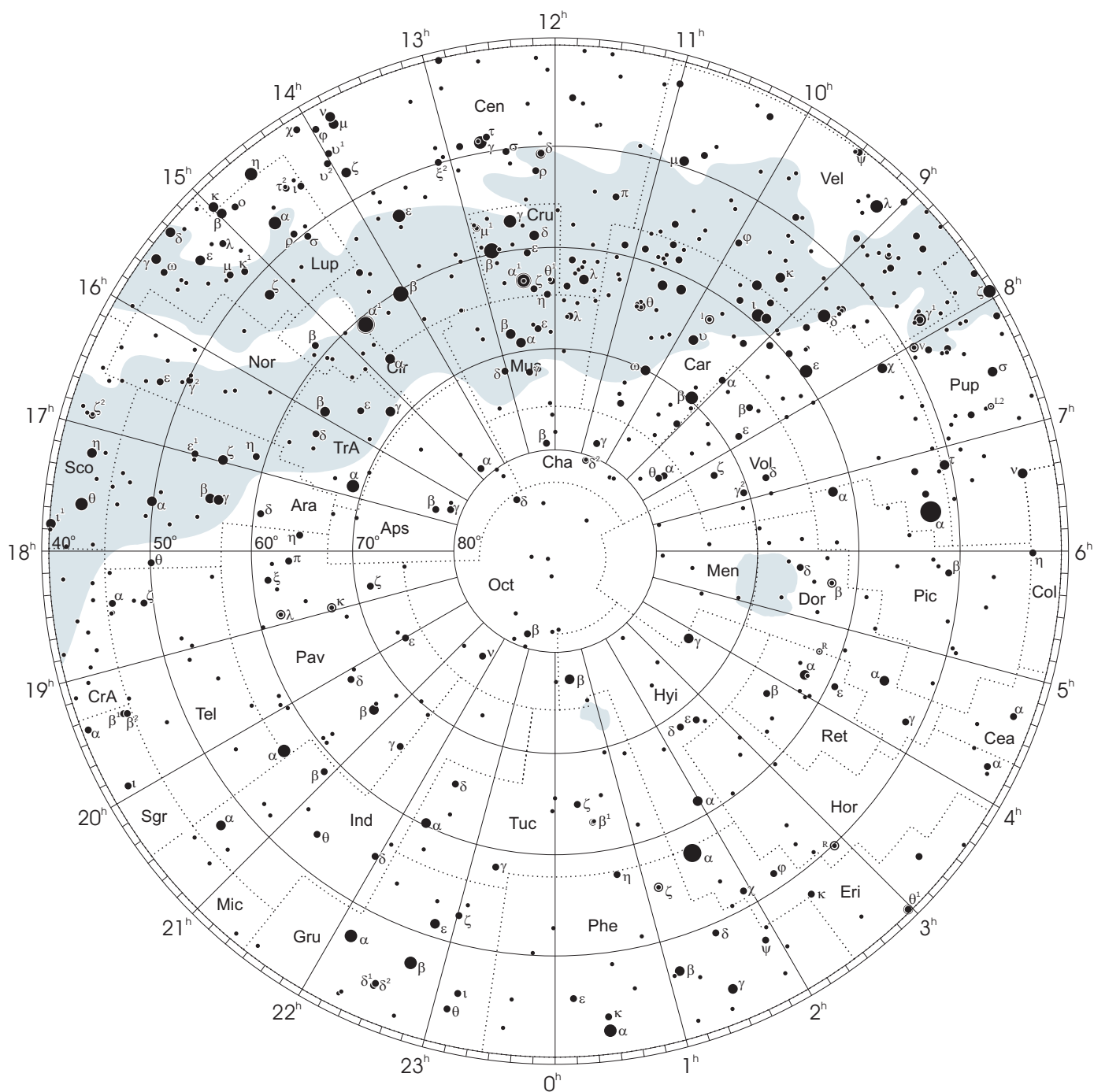


● 1 ● 2 ● 3 ● 4 ● 5

wielkości gwiazdowe

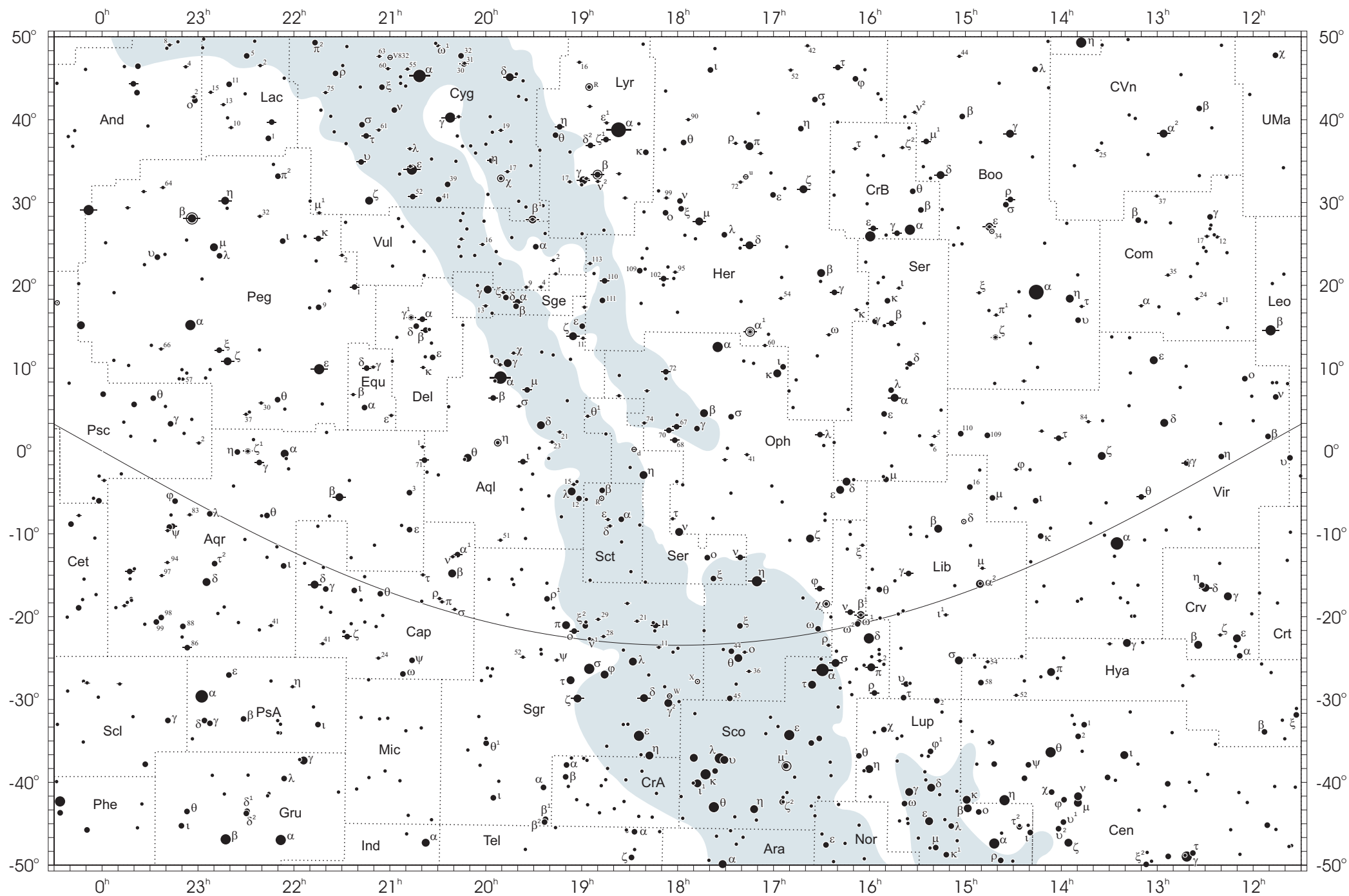
# Mapa nieba

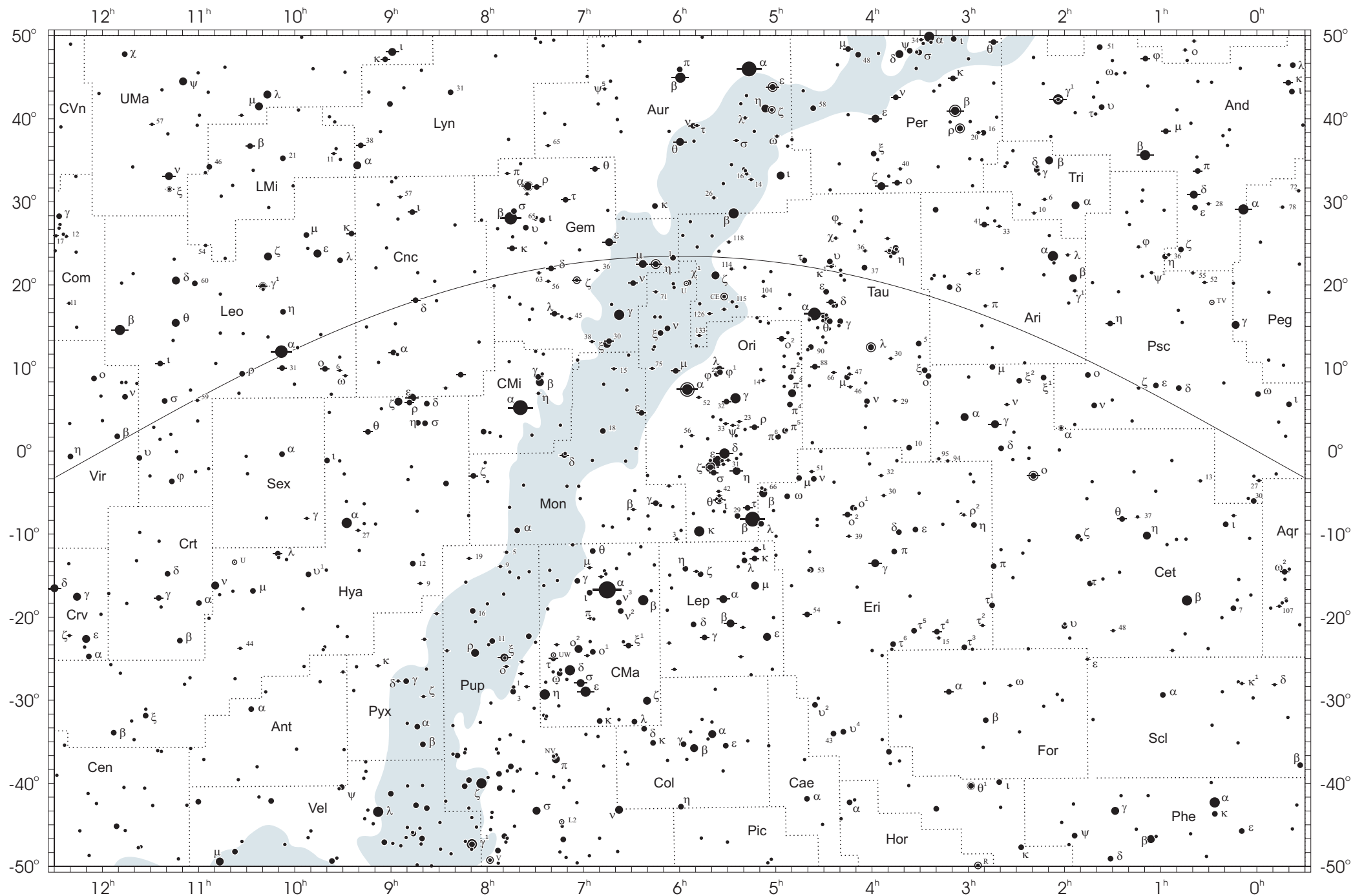
## otoczenie bieguna południowego sfery niebieskiej



● 1 ● 2 ● 3 ● 4 ● 5

wielkości gwiazdowe







## NIEKTÓRE STAŁE, DEFINICJE I WZORY ASTRONOMICZNE I GEODEZYJNE

System stałych astronomicznych i geodezyjnych oraz niektóre wzory podawane w kolejnych tomach Rocznika Astronomicznego (RA) oparte były na uchwałach podejmowanych przez Zgromadzenia Generalne (ZG) Międzynarodowej Unii Astronomicznej (IAU) i Międzynarodowej Unii Geodezji i Geofizyki (IUGG). Uchwały były zazwyczaj przygotowywane przez grupy robocze odpowiednich komisji tych unii, których zadaniem było opracowanie spójnego systemu stałych, najbardziej zbliżających teorię ruchu Ziemi i ciał niebieskich do wyników obserwacji astronomicznych. Rozwój metod i technik pozyskiwania danych wymuszał bowiem udoskonalanie teorii i rewizję poszczególnych stałych systemu. Wyrazem tego były stopniowo wprowadzane zmiany na mocy uchwał ZG IAU (Hamburg, 1964; Praga, 1967) oraz IUGG (Lucerna, 1967; Grenoble, 1975). Uchwałą XVI ZG IAU w Grenoble (1976) ustanowiono nowy, spójny i odpowiadający współcześnie używanym dokładnościom „System Stałych Astronomicznych IAU1976”. Kilka lat później, XVII ZG IUGG (Canberra, 1979) ustanowiło jako oficjalny „Geodezyjny System Odniesienia 1980” (GRS80). Na mocy kolejnych uchwał ZG IAU (Montreal, 1979; Patras, 1982) wprowadzono szereg poprawek i ustalono, że tak powstały system (stałe astronomiczne i model precesji IAU1976 oraz teoria nutacji IAU1980) ma obowiązywać w pracach astronomicznych począwszy od 1984 r.

W konfrontacji z osiągnięciami nowych technik obserwacyjnych system stałych astronomicznych IAU1976 wkrótce okazał się niedostatecznie dokładny i w 1991 roku ZG IAU w Buenos Aires ustanowiło nowy system, który na następnym ZG IAU (Haga, 1994) został zarekomendowany do powszechnego stosowania w obliczeniach astronomicznych<sup>1)</sup>. Na tym samym Zgromadzeniu Generalnym, stwierdzając potrzebę poprawienia stałych nutacji i precesji, polecono Międzynarodowej Służbie Ruchu Obrotowego Ziemi (IERS) opracowanie w trybie pilnym modelu nutacji i precesji na okres przejściowy, lepiej pasującego do obserwacji uzyskiwanych technikami VLBI i LLR.

Powołane na wspomnianych wyżej Zgromadzeniach Generalnych grupy robocze do spraw stałych fundamentalnych, układów odniesienia i ruchu obrotowego Ziemi, w tym działające również na płaszczyźnie międzyunijnej (IAU i IUGG), w porozumieniu z IERS i zgodne z zaleceniami XXIII ZG IAU (Kyoto, 1997), kontynuowały prace nad poprawieniem spójności systemu stałych astronomicznych, definicją jednostek, wartościami stałych podstawowych i stałych pochodnych oraz ujednoliceniem stosowanych algorytmów. Wyniki tych prac, ukierunkowane na:

- utrzymywanie w stanie aktualności Międzynarodowego Niebieskiego Systemu Odniesienia *ICRS* w powiązaniu z układem odniesienia katalogu *Hipparcos*, jako podstawowej realizacji *ICRS* dla astrometrii optycznej,
  - powiązanie układu odniesienia Systemu Słonecznego z systemem *ICRS*,
  - śledzenie stanu oceanu światowego i rozszerzenie badań nad atmosferą, tak aby ich wpływ na nieregularność obrotu Ziemi mógł być modelowany poprawnie niż obecnie,
  - śledzenie zmian położenia środka ciężkości Ziemi,
  - poprawienie spójności wewnętrznej parametrów orientacji Ziemi oraz układów odniesienia ziemskiego i niebieskiego,
- były przedmiotem obrad ZG IUGG (Birmingham, 1999) i IAU (Manchester, 2000). Na XXIII ZG IAU (Kyoto, 1997) przyjęto nową obowiązującą definicję Międzynarodowego Niebieskiego Układu Odniesienia (*ICRF*).

XXIV ZG IAU (Manchester, 2000) uściśliło definicje systemów odniesienia, Czasu Ziemskiego (*TT*), a także określenia wzajemnych relacji pomiędzy systemami. Zaleciło ono zastąpienie od 1 stycznia 2003 r. modelu precesji IAU1976 oraz teorii nutacji IAU1980 nowym modelem precesyjno–nutacyjnym IAU2000A<sup>2)</sup>. Ustalenia te zostały zaaprobowane przez XXIII ZG IUGG w Sapporo w 2003 r. Wprowadzenie nowego modelu precesyjno–nutacyjnego wiązało się z nowymi, spójnymi z nim, definicjami Pośredniego Bieguna Niebieskiego (*CIP*), który zastąpił Efemerydalny Biegun Niebieski (*CEP*) oraz definicjami Niebieskiego Efemerydalnego Punktu Początkowego (*CEO*) i Ziemskiego Efemerydalnego Punktu Początkowego (*TEO*) — przemianowanymi przez XXVI ZG IAU (Praga, 2006) odpowiednio na Niebieski Pośredni Punkt Początkowy (*CIO*) i Ziemski Pośredni Punkt Początkowy (*TIO*). Na tym samym zgromadzeniu przyjęto rezolucje ustalające orientacje osi *BCRS* i *GCRS*, uściślające definicję *TDB* oraz wprowadzające nowy model precesji P03, który od 1 stycznia 2009 r. zastąpił część precesyjną modelu precesyjno–nutacyjnego IAU2000. XXIV ZG IUGG (Perugia, 2007) zaaprobowало ustalenia ZG IAU z Pragi i dodatkowo wprowadziło Geocentryczny Ziemski System Odniesienia *GTRS*, który został zdefiniowany w zgodności z Rezolucją B1.3 ZG IAU w 2000 r. oraz uzupełniło definicję Międzynarodowego Ziemskiego Systemu Odniesienia *ITRS* jako szczególnego Geocentrycznego Ziemskiego Systemu Odniesienia *GTRS*, którego orientacja jest operacyjnie utrzymywana w ciągłości z poprzednimi uzgodnieniami międzynarodowymi (orientacja BIH). Na mocy Rezolucji B3 XXVII ZG IAU w Rio de Janeiro w 2009 r. druga realizacja Międzynarodowego Niebieskiego Układu Odniesienia *ICRF2* zastąpiła od 1 stycznia 2010 r. *ICRF* jako fundamentalna astrometryczna realizacja *ICRS*. To samo zgromadzenie w Rezolucji B2 określiło nowe stałe astronomiczne IAU2009 oraz strategię ich uaktualniania. W 2011 roku *ICRF2* został również przyjęty przez XXV ZG IUGG (Melbourne, Rezolucja 3). Na mocy Rezolucji B2 XXVIII ZG IAU (Pekin, 2012) wprowadzono nową definicję długości jednostki astronomicznej nadając jej oznaczenie *au*. Jednostkę astronomiczną uznano za pomocniczą stałą definiującą natomiast stałą grawitacyjną Gaussa *k* usunięto ze stałych astronomicznych.

<sup>1)</sup> Szczegółowy opis tego systemu, zmiany definicji oraz wartości numerycznych stałych astronomicznych zostały przedstawione na stronach 136 ÷ 144 Rocznika Astronomicznego na 1992 rok.

<sup>2)</sup> Dokładny opis ustaleń XXIV ZG IAU przedstawiono na stronach 214 ÷ 221 Rocznika Astronomicznego na 2004 rok.

## Zasadnicze różnice w definicjach systemów odniesienia

| Systemy używane do 1991 roku                                                                                                                                                                                                                                   | Systemy obowiązujące od 2003 roku                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Ogólne</b>                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                           |
| podstawy teoretyczne: <b>mechanika newtonowska</b> (z poprawkami relatywistycznymi)                                                                                                                                                                            | podstawy teoretyczne: <b>mechanika relatywistyczna</b>                                                                                                                                                                                                                    |
| zapewnienie dokładności na poziomie <b>milisekundy</b> łuku ( <i>mas</i> )                                                                                                                                                                                     | zapewnienie dokładności na poziomie <b>mikrosekundy</b> łuku ( <i>μas</i> )                                                                                                                                                                                               |
| <b>2. Systemy niebieskie</b>                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                           |
| system odniesienia: <b>FK5</b>                                                                                                                                                                                                                                 | system odniesienia: <b>ICRS</b> <ul style="list-style-type: none"> <li>– <b>BCRS</b> — dla Układu Słonecznego</li> <li>– <b>GCRS</b> — dla powiązania z ziemskim systemem odniesienia i monitorowania EOP</li> </ul>                                                      |
| <b>FK5</b> — <b>dynamiczny</b> układ odniesienia (określony na podstawie rozwiązania planetarnych równań ruchu i zdefiniowany poprzez pozycje jasnych gwiazd)                                                                                                  | <b>ICRF</b> — <b>kinematyczny</b> układ odniesienia (zdefiniowany poprzez pozycje obiektów pozagalaktycznych)                                                                                                                                                             |
| <b>FK5</b> — <b>nieustalone</b> położenie względem układu inercjalnego — określane na epokę katalogu.                                                                                                                                                          | <b>ICRF</b> — <b>kinematycznie ustalone</b> położenie względem układu inercjalnego (ruchy własne obiektów pozagalaktycznych — uznane za zaniedbywalnie małe)                                                                                                              |
| kierunki osi odniesione do określonych na epokę: <b>bieguna FK5</b> (definiującego płaszczyznę równika) i kierunku <b>równonocy wiosennej</b> (wyznaczonego przez przecięcie płaszczyzn równika i ekliptyki)                                                   | kierunki osi odniesione do ustalonych: <b>bieguna ICRF</b> (niemal pokrywający się z <b>CEP</b> FK5 na epokę J2000.0) i <b>początku liczenia rektascensji w ICRS</b> (niemal pokrywający się z kierunkiem równonocy wiosennej FK5 na epokę J2000.0)                       |
| <b>3. System pośredni</b>                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                           |
| kierunki osi pośredniego systemu niebieskiego odniesione do <b>CEP</b> (definiującego płaszczyznę <b>prawdziwego równika</b> ) i kierunku <b>równonocy wiosennej</b> (wyznaczonego przez przecięcie płaszczyzn <b>prawdziwego równika</b> i <b>ekliptyki</b> ) | kierunki osi pośredniego systemu niebieskiego określone przez <b>CIP</b> (niemal pokrywający się z <b>CEP</b> FK5 na epokę J2000.0) i <b>CIO</b> (niemal pokrywający się z kierunkiem równonocy wiosennej FK5 na epokę J2000.0) — w latach 2003–2006 pod nazwą <b>CEO</b> |
| kierunek osi <i>x</i> pośredniego systemu ziemskiego określony przez przecięcie płaszczyzny <b>chwilowego południka Greenwich</b> z <b>równikiem CEP</b>                                                                                                       | kierunek osi <i>x</i> pośredniego systemu ziemskiego określony przez <b>TIO</b> (przecięcie chwilowego południka zerowego <b>ITRS</b> z równikiem <b>CIP</b> ) — w latach 2003–2006 pod nazwą <b>TEO</b>                                                                  |
| relacja pomiędzy niebieskim i ziemskim pośrednim systemem odniesienia wyrażona w funkcji <b>prawdziwego czasu gwiazdowego Greenwich (GST)</b>                                                                                                                  | relacja pomiędzy niebieskim i ziemskim pośrednim systemem odniesienia wyrażona w funkcji <b>Kąta Obrotu Ziemi (ERA)</b>                                                                                                                                                   |
| <b>4. System ziemski</b>                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                           |
| kierunki osi systemu <b>CTS</b> określone przez <b>CIO*</b> i <b>zerowy południk BIH</b>                                                                                                                                                                       | kierunki osi systemu <b>ITRS</b> określone przez <b>biegun IERS ITRS</b> oraz <b>zerowy południk ITRS</b>                                                                                                                                                                 |

Ośrodki zrzeszone w uniach IAU i IUGG są także zachęcane do prowadzenia badań pionowych i poziomych ruchów skorupy ziemskiej, do prac nad łącznym opracowywaniem obserwacji uzyskiwanych za pomocą różnych technik pomiarowych i do ściślejszej współpracy z grupami roboczymi tych unii. Do upowszechniania przyjętych standardów (konwencji) zobowiązano IERS<sup>3)</sup>.

Stałe astronomiczne zamieszczone w niniejszym Roczniku zostały zaczerpnięte z uaktualnionej jesienią 2012 r. strony internetowej ([http://maia.usno.navy.mil/NSFA/NSFA\\_cbe.html](http://maia.usno.navy.mil/NSFA/NSFA_cbe.html)) Grupy Roboczej „Standardy Numeryczne Astronomii Fundamentalnej”. Są to wartości obowiązujące obecnie przy obliczeniach wymagających największej precyzji. Dodatkowo zamieszczono uzupełniającą listę stałych i wielkości pomocniczych — niektóre odniesione do poprzednio obowiązujących systemów. Mogą one być stosowane w obliczeniach nie wymagających najwyższych dokładności.

<sup>3)</sup> Dane szczegółowe na temat ewolucji systemu stałych astronomicznych można uzyskać m.in. na stronach internetowych IAU (<http://www.iau.org>) oraz IERS (<http://www.iers.org>).

## Jednostki astronomiczne

- Jednostkami długości, masy i czasu są jednostki międzynarodowego systemu jednostek (SI), mianowicie: metr ( $m$ ), kilogram ( $kg$ ) i sekunda ( $s$ ).
- Astronomiczną jednostką czasu jest doba ( $d$ ). Jest to interwał czasu wynoszący 86 400 sekund SI. Przez stulecie juliańskie ( $JC$  — Julian Century) jest rozumiany interwał czasu wynoszący 36 525 dób.
- Astronomiczną jednostką masy jest masa Słońca ( $M_S$ ).
- Astronomiczną jednostką długości, opartą na średniej odległości Ziemia—Słońce, jest długość ( $au$ ) wynosząca dokładnie 149 597 870 700  $m$ .

## System stałych astronomicznych IAU2009

### Stałe definiujące

#### Naturalne stałe definiujące

Prędkość światła w próżni  $c = 299\,792\,458\, m\,s^{-1}$

#### Pomocnicze stałe definiujące

|                                                   |                                                                                      |
|---------------------------------------------------|--------------------------------------------------------------------------------------|
| Współczynnik zmiany skali czasu od $TT$ do $TCG$  | $L_G = 6.969\,290\,134 \times 10^{-10}$                                              |
| Współczynnik zmiany skali czasu od $TCB$ do $TDB$ | $L_B = 1.550\,519\,768 \times 10^{-8}$                                               |
| Stała początkowa przy przejściu od $TCB$ do $TDB$ | $TDB_0 = -6.55 \times 10^{-5}\, s$                                                   |
| Astronomiczna jednostka długości                  | $au = 1.495\,978\,707\,00 \times 10^{11}\, m$                                        |
| Kąt Obrotu Ziemi w epoce J2000.0                  | $\theta_0 = 0.779\,057\,273\,264\,0 \times 2\pi\, rad$                               |
| Tempo zmian Kąta Obrotu Ziemi                     | $d\theta/dt = 1.002\,737\,811\,911\,354\,48 \times 2\pi\, rad \cdot doba_{UT1}^{-1}$ |

### Najlepsze współczesne oszacowania

#### Naturalne stałe mierzone

Stała grawitacyjna  $G = 6.674\,28 \times 10^{-11} \pm 6.7 \times 10^{-15}\, m^3\,kg^{-1}\,s^{-2}$

#### Inne stałe

Współczynnik zmiany skali czasu od  $TCG$  do  $TCB$   $L_C = 1.480\,826\,867\,41 \times 10^{-8} \pm 2 \times 10^{-17}$

#### Stałe ciała Systemu Słonecznego

##### Parametr masy Słońca

|                |                                                                                |
|----------------|--------------------------------------------------------------------------------|
| zgodny z $TCB$ | $GM_S = 1.327\,124\,420\,99 \times 10^{20} \pm 1 \times 10^{10}\, m^3\,s^{-2}$ |
| zgodny z $TDB$ | $GM_S = 1.327\,124\,400\,41 \times 10^{20} \pm 1 \times 10^{10}\, m^3\,s^{-2}$ |

Równikowy promień Ziemi<sup>4)</sup>  $a_E = 6.378\,136\,6 \times 10^6 \pm 1 \times 10^{-1}\, m$

Współczynnik dynamiczny figury Ziemi<sup>4)</sup>  $J_2 = 1.082\,635\,9 \times 10^{-3} \pm 1 \times 10^{-10}$

Zmiana wiekowa współczynnika  $J_2$   $dJ_2/dt = -3.0 \times 10^{-9} \pm 6 \times 10^{-10}\, stulecie^{-1}$

##### Geocentryczna stała grawitacyjna<sup>4)</sup>

|                |                                                                         |
|----------------|-------------------------------------------------------------------------|
| zgodna z $TCB$ | $GM_E = 3.986\,004\,418 \times 10^{14} \pm 8 \times 10^5\, m^3\,s^{-2}$ |
| zgodna z $TT$  | $GM_E = 3.986\,004\,415 \times 10^{14} \pm 8 \times 10^5\, m^3\,s^{-2}$ |
| zgodna z $TDB$ | $GM_E = 3.986\,004\,356 \times 10^{14} \pm 8 \times 10^5\, m^3\,s^{-2}$ |

Potencjał siły ciężkości na geoidzie<sup>4)</sup>  $W_0 = 6.263\,685\,60 \times 10^7 \pm 5 \times 10^{-1}\, m^2\,s^{-2}$

Prędkość kątowna Ziemi<sup>4)</sup>  $\omega = 7.292\,115 \times 10^{-5}\, rad\,s^{-1}$

Stosunek masy Księżyca do masy Ziemi  $M_M/M_E = 1.230\,003\,71 \times 10^{-2} \pm 4 \times 10^{-10}$

Stosunek masy Słońca do masy Merkurego  $M_S/M_{Me} = 6.023\,6 \times 10^6 \pm 3 \times 10^2$

Stosunek masy Słońca do masy Wenus  $M_S/M_V = 4.085\,237\,19 \times 10^5 \pm 8 \times 10^{-3}$

Stosunek masy Słońca do masy Marsa  $M_S/M_{Ma} = 3.098\,703\,59 \times 10^6 \pm 2 \times 10^{-2}$

Stosunek masy Słońca do masy Jowisza  $M_S/M_J = 1.047\,348\,644 \times 10^3 \pm 1.7 \times 10^{-5}$

Stosunek masy Słońca do masy Saturna  $M_S/M_{Sa} = 3.497\,901\,8 \times 10^3 \pm 1 \times 10^{-4}$

Stosunek masy Słońca do masy Urana  $M_S/M_U = 2.290\,298 \times 10^4 \pm 3 \times 10^{-2}$

Stosunek masy Słońca do masy Neptuna  $M_S/M_N = 1.941\,226 \times 10^4 \pm 3 \times 10^{-2}$

Stosunek masy Słońca do masy Plutona  $M_S/M_P = 1.365\,66 \times 10^8 \pm 2.8 \times 10^4$

Stosunek masy Słońca do masy Eris  $M_S/M_{Eris} = 1.191 \times 10^8 \pm 1.4 \times 10^6$

<sup>4)</sup> Por. z inną, przyjętą przez IUGG wartością wg GRS80.

|                                                 |                                                                |
|-------------------------------------------------|----------------------------------------------------------------|
| Stosunek masy Ceres do masy Słońca              | $M_{Ceres}/M_S = 4.72 \times 10^{-10} \pm 3 \times 10^{-12}$   |
| Stosunek masy Pallas do masy Słońca             | $M_{Pallas}/M_S = 1.03 \times 10^{-10} \pm 3 \times 10^{-12}$  |
| Stosunek masy Vesta do masy Słońca              | $M_{Vesta}/M_S = 1.35 \times 10^{-10} \pm 3 \times 10^{-12}$   |
| Nachylenie ekliptyki do równika w epoce J2000.0 | $\varepsilon = 8.438\,140\,6 \times 10^4 \pm 1 \times 10^{-3}$ |

### Wielkości uzupełniające i dodatkowe

|                                                                    |                                       |
|--------------------------------------------------------------------|---------------------------------------|
| Stała grawitacyjna Gaussa                                          | $k = 0.017\,202\,098\,95$             |
| Czas pokonywania przez światło astronomicznej jednostki długości   | $\tau_{au} = 499.004\,783\,806\,1\,s$ |
| Precesja ogólna w długości w epoce J2000.0 na stulecie juliańskie  | $p = 5028.796195$                     |
| Stała nutacji w epoce J2000.0                                      | $N = 9.2025$                          |
| Stała aberracji rocznej dla epoki J2000.0                          | $K = 20.49552$                        |
| Paralaksa Słońca ( $\pi_S = a_E/au$ )                              | $\pi_S = 8.794\,148$                  |
| Splaszczanie Ziemi <sup>4)</sup>                                   | $f = 1/298.256\,42$                   |
| Współczynnik dynamiczny Słońca                                     | $J_{2S} = 2 \times 10^{-7}$           |
| Masa Słońca ( $M_S = GM_S \cdot G^{-1}$ )                          | $M_S = 1.98842 \times 10^{30}\,kg$    |
| Stosunek masy Słońca do masy Ziemi ( $M_S/M_E = GM_S(GM_E)^{-1}$ ) | $M_S/M_E = 332\,946.04$               |
| Stosunek masy Słońca do masy układu Ziemia—Księżyc                 |                                       |
| $M_S/(M_E + M_M) = GM_S/(GM_E + M_M/M_E \cdot GM_E)$               | $M_S/(M_E + M_M) = 328\,901$          |

### Stałe Międzynarodowej Unii Geodezji i Geofizyki (IUGG) (dotyczące figury Ziemi GRS80)

#### Stałe definiujące (dokładnie)

|                                      |                                                   |
|--------------------------------------|---------------------------------------------------|
| Równikowy promień Ziemi              | $a_e = 6\,378\,137\,m$                            |
| Geocentryczna stała grawitacyjna     | $GM = 3.986\,005 \times 10^{14}\,m^3s^{-2}$       |
| Współczynnik dynamiczny figury Ziemi | $J_2 = 1.082\,63 \times 10^{-3}$                  |
| Prędkość kątowna obrotu Ziemi        | $\omega = 7.292\,115 \times 10^{-5}\,rad\,s^{-1}$ |

#### Stałe pochodne

|                                                                                                         |                                                 |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| Splaszczanie Ziemi                                                                                      | $f = 1/298.257\,222\,101$                       |
| Przyspieszenie normalne siły ciężkości na równiku                                                       | $\gamma_e = 9.780\,326\,771\,5\,ms^{-2}$        |
| Przyspieszenie normalne siły ciężkości na biegunie                                                      | $\gamma_p = 9.832\,186\,368\,5\,ms^{-2}$        |
| Normalny potencjał siły ciężkości na elipsoidzie<br>(potencjał siły ciężkości na geoidzie $W_0 = U_0$ ) | $U_0 = 6\,263\,686.085\,0 \times 10\,m^2s^{-2}$ |
| Geopotencjalny współczynnik skali ( $R_0 = GM/W_0$ )                                                    | $R_0 = 6\,363\,672.461\,m$                      |
| Współczynniki harmoniczne rozwinięcia potencjału siły ciężkości                                         | $J_4 = -2.370\,912\,22 \times 10^{-6}$          |
| Ziemi w szeregu funkcji kulistych                                                                       | $J_6 = 0.006\,083\,47 \times 10^{-6}$           |
|                                                                                                         | $J_8 = 0.000\,014\,27 \times 10^{-6}$           |

### Geodezyjne elipsoidy odniesienia

| Nazwa elipsoidy                        | $a\,[m]$       | $b\,[m]$       | $f^{-1}$        | $f$                  | $e^2$                |
|----------------------------------------|----------------|----------------|-----------------|----------------------|----------------------|
| Bessel (1841)                          | 6 377 397      | 6 356 079      | 299.15          | 0.003 342 8          | 0.006 674 4          |
| Clarke (1880)                          | 6 378 249      | 6 356 515      | 293.47          | 0.003 407 5          | 0.006 803 4          |
| Hayford (1909)<br>International (1924) | 6 378 388      | 6 356 912      | 297.0           | 0.003 367            | 0.006 723            |
| Krasovski (1940)                       | 6 378 245      | 6 356 863      | 298.3           | 0.003 352            | 0.006 693            |
| SAO III (1966)                         | 6 378 165      | 6 356 780      | 298.25          | 0.003 352 9          | 0.006 694 5          |
| GRS67                                  | 6 378 160.0    | 6 356 774.5    | 298.247         | 0.003 352 92         | 0.006 694 61         |
| WGS72                                  | 6 378 135      | 6 356 751      | 298.26          | 0.003 352 8          | 0.006 694 3          |
| IAU1976                                | 6 378 140.0    | 6 356 755.3    | 298.257         | 0.003 352 81         | 0.006 694 38         |
| GRS80                                  | 6 378 137.0000 | 6 356 752.3141 | 298.257 222 101 | 0.003 352 810 681 18 | 0.006 694 380 022 90 |
| WGS84                                  | 6 378 137.0000 | 6 356 752.3142 | 298.257 223 563 | 0.003 352 810 664 75 | 0.006 694 379 990 15 |

**Niektóre wzory modelu precesji IAU1976** ( $T$  liczone jest w stuleciach juliańskich od epoki J2000.0)

Precesja w rektascensji na stulecie juliańskie

$$m = 4\,612''.436\,2 + 2''.793\,12\,T - 0''.000\,278\,T^2 \quad (1)$$

Precesja w deklinacji na stulecie juliańskie

$$n = 2\,004''.310\,9 - 0''.853\,30\,T - 0''.000\,217\,T^2 \quad (2)$$

Średnie nachylenie ekliptyki

$$\varepsilon = 84\,381''.448 - 46''.8150\,T - 0''.00059\,T^2 + 0''.001813\,T^3 \quad (3)$$

Poprawka punktu równonocy przy przejściu z systemu FK4 do FK5<sup>5)</sup>

$$E = 0''.0775 + 0''.085\,T \quad (4)$$

**Niektóre wzory modelu precesyjno–nutacyjnego IAU2006** ( $T$  liczone jest w stuleciach juliańskich od epoki J2000.0)

Precesja — kąty Eulera

$$\zeta_A = -2\,306''.083\,227\,T - 0''.298\,849\,9\,T^2 - 0''.018\,018\,28\,T^3 + 0''.000\,005\,971\,T^4 + 0''.000\,000\,317\,3\,T^5 \quad (5)$$

$$\theta_A = 2\,004''.191\,903\,T - 0''.429\,493\,4\,T^2 - 0''.041\,822\,64\,T^3 - 0''.000\,007\,089\,T^4 - 0''.000\,000\,127\,4\,T^5 \quad (6)$$

$$z_A = -2\,306''.077\,181\,T - 1''.092\,734\,8\,T^2 - 0''.018\,268\,37\,T^3 + 0''.000\,028\,596\,T^4 + 0''.000\,000\,290\,4\,T^5 \quad (7)$$

Precesja w długości ( $\dot{p}_A \equiv p$ )

$$p_A = 5\,028''.796\,195\,T + 1''.105\,434\,8\,T^2 + 0''.000\,079\,64\,T^3 - 0''.000\,023\,857\,T^4 + 0''.000\,000\,038\,3\,T^5 \quad (8)$$

Precesja księżycowo–słoneczna ( $\dot{\psi}_A \equiv p_1$ )

$$\psi_A = 5\,038''.481\,507\,T - 1''.079\,006\,9\,T^2 - 0''.001\,140\,45\,T^3 + 0''.000\,132\,851\,T^4 - 0''.000\,000\,095\,1\,T^5 \quad (9)$$

Precesja planetarna ( $\dot{\chi}_A \equiv p_2$ )

$$\chi_A = 10''.556\,403\,T - 2''.381\,429\,2\,T^2 - 0''.001\,211\,97\,T^3 + 0''.000\,170\,663\,T^4 - 0''.000\,000\,056\,0\,T^5 \quad (10)$$

Precesja w rektascensji na stulecie juliańskie ( $m = \dot{\zeta}_A + \dot{z}_A$ )

$$m = 4\,612''.160\,408 + 2''.783\,169\,4\,T + 0''.108\,859\,950\,T^2 - 0''.000\,138\,268\,T^3 - 0''.000\,003\,038\,5\,T^4 \quad (11)$$

Precesja w deklinacji na stulecie juliańskie ( $n = \dot{\theta}_A$ )

$$n = 2\,004''.191\,903 - 0''.858\,986\,8\,T - 0''.125\,467\,92\,T^2 - 0''.000\,028\,356\,T^3 - 0''.000\,000\,637\,T^4 \quad (12)$$

Średnie nachylenie Ekliptyki

$$\varepsilon_A = 84\,381''.406 - 46''.836\,769\,t - 0''.000\,183\,1\,T^2 + 0''.002\,003\,40\,T^3 - 0''.000\,000\,576\,T^4 - 0''.000\,000\,043\,4\,T^5 \quad (13)$$

**Wzory na zamianę jednostek czasu gwiazdowego średniego i średniego czasu słonecznego**

$$\begin{aligned} \frac{\text{interwał czasu gwiazdowego średniego}}{\text{interwał czasu słonecznego średniego}} &= 1.002\,737\,909\,350\,795 + 5.9006 \times 10^{-11}\,T - 5.9 \times 10^{-15}\,T^2 \\ \frac{\text{interwał czasu słonecznego średniego}}{\text{interwał czasu gwiazdowego średniego}} &= 0.997\,269\,566\,329\,084 - 5.8684 \times 10^{-11}\,T + 5.9 \times 10^{-15}\,T^2 \end{aligned} \quad (14)$$

Do przeliczenia interwałów czasu wyrażonego w jednostkach czasu średniego słonecznego na interwały czasu wyrażonego w jednostkach czasu średniego gwiazdowego oraz do zamiany w stronę przeciwną wykorzystuje się w praktyce zależność, że liczba dób gwiazdowych w roku zwrotnikowym jest dokładnie o jedność większa od liczby dób słonecznych

$$\begin{aligned} \text{rok zwrotnikowy} &= 366.242\,198\,797 \text{ średnich dób gwiazdowych} \\ &= 365.242\,198\,797 \text{ średnich dób słonecznych} \end{aligned}$$

Relację pomiędzy jednostką czasu słonecznego i jednostką czasu gwiazdowego wyraża współczynnik proporcjonalności

$$1 + \mu = \frac{366.242\,198\,797}{365.242\,198\,797} = 1.002\,737\,909\,3 \quad (15)$$

stąd

$$[\text{interwał czasu}]_{\text{śr. cz. gw.}} = (1 + \mu) \times [\text{interwał czasu}]_{\text{śr. cz. sł.}} \quad (16)$$

Podobnie dla przejścia od jednostek czasu gwiazdowego do jednostek czasu słonecznego

$$[\text{interwał czasu}]_{\text{śr. cz. sł.}} = 1/(1 + \mu) \times [\text{interwał czasu}]_{\text{śr. cz. gw.}}$$

lub

$$[\text{interwał czasu}]_{\text{śr. cz. sł.}} = (1 - \mu') \times [\text{interwał czasu}]_{\text{śr. cz. gw.}} \quad (17)$$

gdzie  $\mu' = 0.002\,730\,433\,6$

<sup>5)</sup> Aby otrzymać rektascensję w systemie FK5, poprawkę należy dodać do rektascensji wyrażonej w systemie FK4.

# OBJAŚNIENIA

## CZĘŚĆ OGÓLNA

W ostatnich 35 latach zaszły ważne zmiany w poznaniu ruchu obrotowego Ziemi — nastąpił ogromny postęp w zakresie osiąganych precyzji i rozdzielczości czasowych obserwacji, jak również w strategiach i technologii ich opracowywania. Istotną zmianą jest także fakt, że począwszy od 1980 roku ruch bieguna jest monitorowany w sposób ciągły przy użyciu VLBI i dostarczane są aktualne pozycje bieguna w odniesieniu do układu niebieskiego. Używanie układu odniesienia opartego na równiku niebieskim (określonym przez średnią w sensie ruchów bieguna oś obrotu Ziemi) oraz punkcie początkowym zdefiniowanym położeniem ekliptyki (punkt średniej równonocy wiosennej) stawało się coraz trudniejsze, a nawet prowadziło do degradacji precyzji osiąganey w obserwacjach astronomicznych, szczególnie, że istniało kilka realizacji punktu równonocy: dynamiczne i katalogowe. Dodatkowo konstrukcja katalogów nie zapewniała całkowitej eliminacji obrotu definiowanych przez nie układów odniesienia. W ślad za postępem w dziedzinie obserwacji, w latach 1990–1999 nastąpiła również ogromna poprawa w modelowaniu teoretycznym, osiągającym dokładności na poziomie  $\mu as$ .

### 1. SYSTEMY ODNIESIENIA

XXI Zgromadzenie Generalne IAU (Buenos Aires, 1991) przyjęło w Rezolucji A4 pakiet 9 spójnych Rekomendacji specyfikujących nowe niebieskie systemy odniesienia w czterowymiarowej czasoprzestrzeni i związane z nimi skale czasu z uwzględnieniem ogólnej teorii względności. W Rekomendacji 1 zaleciło ono zdefiniowanie w ramach ogólnej teorii względności kilku układów współrzędnych ( $x^0 = ct, x^1, x^2, x^3$ ) w czasoprzestrzeni w taki sposób, aby w każdym układzie współrzędnych o początku w barycentrum dowolnego zbioru mas, kwadrat interwału  $ds$  między zdarzeniami, był wyrażony co najmniej ze stopniem przybliżenia podanym według wzoru:

$$ds^2 = -c^2 d\tau^2 = -(1 - 2U/c^2)(dx^0)^2 + (1 + 2U/c^2)[(dx^1)^2 + (dx^2)^2 + (dx^3)^2] \quad (18)$$

gdzie  $t$  jest współrzędną czasową (czasem współrzędnych<sup>6)</sup>),  $\tau$  jest czasem własnym (nazywanym również czasem prawdziwym) danego punktu w przestrzeni (czas pomiędzy dwoma zdarzeniami występującymi w tym samym punkcie przestrzeni), a  $U$  jest sumą potencjału grawitacyjnego tego układu mas oraz, generowanego przez ciała zewnętrzne względem układu, potencjału pływowego zanikającego w barycentrum. Interwał  $ds$  z formalnego punktu widzenia może być traktowany jako odległość dwóch punktów w abstrakcyjnej czterowymiarowej przestrzeni z wprowadzoną przez Minkowskiego geometrią pseudo-euklidesową. W Rekomendacji 2 zasygnalizowana została potrzeba zdefiniowania barycentrycznego systemu współrzędnych o początku w środku mas Układu Słonecznego z czasem współrzędnych barycentrycznych  $TCB$  (Rekom. 3) oraz geocentrycznego systemu odniesienia o początku w środku mas Ziemi z czasem współrzędnych geocentrycznych  $TCG$  (Rekom. 3). Jednocześnie zalecono aby te systemy nie podlegały obrotom względem zbioru odległych obiektów pozagalaktycznych, aby współrzędne czasowe tych systemów były wyprowadzone ze skali czasu realizowanej przez działające na Ziemi zegary atomowe oraz aby jednostkami fizycznymi w tych systemach były jednostki SI. Sformułowano również czterowymiarową transformację pomiędzy  $TCB$  i  $TCG$ . Za czas odniesienia dla pozornych, geocentrycznych efemeryd przyjęto czas ziemski  $TT$  oraz określono relację między  $TCG$  i  $TT$  (Rekom. 4). Dodatkowo w Rekomendacji 7 zalecono aby nowy, barycentryczny system odniesienia był możliwie bliski równikowi i punktowi równonocy wiosennej systemu FK5 odniesionym do epoki J2000.0, tj. aby podstawowa płaszczyzna tego systemu (płaszczyzna  $xy$  odpowiadająca płaszczyźnie równika niebieskiego w katalogowych systemach odniesienia) znalazła się możliwie blisko płaszczyzny średniego równika na epokę J2000.0, zaś punkt początkowy liczenia rektascensji  $CEO$  (odpowiednik punktu równonocy wiosennej w katalogowych układach odniesienia, czyli kierunek osi  $x$ ) znalazł się możliwie blisko dynamicznej równonocy wiosennej na epokę J2000.0. W tej samej rezolucji podkreślono, że utworzony system ma być dostępny dla astrometrii w zakresie fal radiowych i widma widzialnego.

<sup>6)</sup> Czas współrzędnych nie jest mierzalny.

**Międzynarodowy Niebieski System Odniesienia (ICRS)** zdefiniowany oraz przyjęty w Rezolucji B2 XXIII Zgromadzenia Generalnego IAU (Kyoto, 1997) („The extragalactic reference system of the International Earth Rotation Service (ICRS)”, Arias E.F. et al., A&A 303, 604 (1995)) jest od 1 stycznia 1998 roku obowiązującym niebieskim systemem odniesienia. Kinematyczną realizacją *ICRS* przeznaczoną do zastosowań praktycznych jest **Międzynarodowy Niebieski Układ Odniesienia (ICRF)**. Ta sama rezolucja zatwierdziła **katalog Hipparcos** jako podstawową realizację *ICRS* w zakresie widma optycznego. Uchwalona trzy lata później przez XXIV Zgromadzenie Generalne IAU Rezolucja B1.3 (Manchester, 2000) określa ponadto definicję *ICRS* dopasowaną do wyższych wymagań dokładnościowych oraz do współczesnego formalizmu ogólnej teorii względności, wprowadzając **Barycentryczny Niebieski System Odniesienia (BCRS)** oraz **Geocentryczny Niebieski System Odniesienia (GCRS)**, a także transformację między tymi systemami.

*ICRS* jest systemem kinematycznym, ponieważ jest zdefiniowany poprzez pozycje odległych obiektów pozagalaktycznych; dodatkowo ruchy własne tych obiektów są znacznie mniejsze aniżeli dokładność obserwacji tych obiektów. W systemie *ICRS*, kierunki do obiektów w odległych galaktykach nie podlegają globalnemu obrotowi względem tych obiektów. Zgodnie z definicją jest on czasoprzestrzennym systemem niezależnym od położenia osi obrotu Ziemi, a także od położenia osi ekliptyki. Czasoprzestrzeń w *ICRS* jest określona geometrycznie za pomocą tensora metrycznego (oddzielnie dla *BCRS* i dla *GCRS*) w ujęciu ogólnej teorii względności. Zgodnie z Rezolucją 2 XXVI Zgromadzenia Generalnego IAU (Praga, 2006) dla wszystkich praktycznych zastosowań przyjmuje się orientację *BCRS* zgodnie z orientacją osi *ICRS*. Orientacja *GCRS* jest wyznaczana z orientacji *BCRS* zorientowanej względem *ICRS*. Osie tych systemów spełniają kinematyczny warunek zerowego wzajemnego obrotu. Oba systemy mają też różne czasy współrzędnych: *TCB* i *TCG*. Odpowiadające sobie osie systemów *BCRS* i *GCRS* są wzajemnie powiązane współczynnikiem skali. Ponadto *BCRS* jest z założenia systemem kinematycznie ustalonym. Nie jest on odniesiony do epoki, która byłaby związana z pozycją osi systemu jak to ma miejsce w przypadku systemu katalogowego, np. FK5. Pozycje w systemie *ICRS* odgrywają rolę stosowanych dotychczas średnich pozycji katalogowych odniesionych do średniego równika i średniej równonocy wiosennej na standardową epokę, lecz w ich wypadku epoka we wspomnianym sensie nie ma zastosowania. Zmienność pozycji w systemie *ICRS* spowodowana jest wyłącznie ruchem własnym gwiazd z uwzględnieniem prędkości radialnej. Orientacja geocentrycznego systemu niebieskiego *GCRS* używanego do transformacji między systemami niebieskim i ziemskim, w stosunku do *BCRS* spełnia kinematyczny warunek braku globalnego obrotu geocentrycznych kierunków do obiektów realizujących *ICRS*. *GCRS* jest zatem nieobracaającym się systemem geocentrycznym przeznaczonym do monitorowania parametrów ruchu obrotowego Ziemi EOP. System ten nie podlega globalnej rotacji i nie zależy już od ruchu Ziemi, jak to miało miejsce w przypadku FK5.

*ICRF* został zdefiniowany z dokładnością około  $30 \mu\text{as}$  poprzez pozycje 212 definiujących radioźródeł, określone w oparciu o obserwacje VLBI. Umowny biegun *ICRS*, nazwany Konwencjonalnym Biegunem Odniesienia *CRP* (kierunek prostopadły do podstawowej płaszczyzny układu — płaszczyzny *xy*) choć jest bardzo zbliżony do średniego bieguna na epokę J2000.0 to jednak dokładnie się z nim nie pokrywa. Bieguny te są wzajemnie przesunięte o  $17.1 \text{ mas}$  w kierunku  $0^\circ$  i  $5.1 \text{ mas}$  w kierunku  $90^\circ$ . Podobna zgodność zachodzi pomiędzy umownym biegunem *ICRS* i biegunem katalogu FK5. Ocenia się ją na  $\pm 50 \text{ mas}$ . Punkt początkowy liczenia rektascensji w *ICRS*, który określa kierunek osi *x* tego systemu, jest przesunięty w stosunku do punktu równonocy katalogu FK5 o  $22.9 \pm 2.3 \text{ mas}$ .

Na mocy Rezolucji B3 XXVII Zgromadzenia Generalnego IAU w Rio de Janeiro w 2009 r. druga realizacja Międzynarodowego Niebieskiego Układu Odniesienia *ICRF2* zastąpiła od 1 stycznia 2010 r. *ICRF* jako fundamentalna astrometryczna realizacja *ICRS*. *ICRF2* jest zdefiniowany poprzez precyzyjnie wyznaczone pozycje 3414 zwartych astronomicznych radioźródeł. Jego poziom szumów nie przekracza  $40 \mu\text{as}$ , zaś stabilność jego osi kształtuje się na poziomie  $10 \mu\text{as}$ . Dopasowania *ICRF2* do *ICRS* dokonano przy użyciu 138 stabilnych radioźródeł, wspólnych dla *ICRF2* i *ICRF-Ext2*. *ICRF2* będzie utrzymywany przy wykorzystaniu 295 nowych definiujących radioźródeł wybranych w oparciu o kryterium stabilności oraz braku rozwiniętej wewnętrznej struktury źródła. Stabilność wspomnianych 295 definiujących radioźródeł oraz ich bardziej równomierny rozkład na sferze niebieskiej eliminują dwie najpoważniejsze słabości *ICRF*.

Ziemski system odniesienia jest systemem przestrzennym obracaającym się wraz z Ziemią. W systemie tym pozycje punktów związanych z powierzchnią Ziemi są określone przez współrzędne, które podlegają jedynie małym zmianom w czasie spowodowanym przez efekty geofizyczne (ruchy tektoniczne, deformacje pływowe). Realizacją ziemskiego systemu odniesienia jest ziemski układ odniesienia określony przez zbiór punktów o precyzyjnie wyznaczonych współrzędnych oraz ich zmianach w czasie, w ziemskim systemie odniesienia.

**Konwencjonalny Ziemi System Odniesienia** (*CTRS*) został zdefiniowany w Rezolucji 2 XX Zgromadzenia Generalnego IUGG (Wiedeń, 1991). Zgodnie z przyjętą rezolucją *CTRS* jest quasi-kartezjańskim systemem zdefiniowanym przez przestrzenny obrót względem nieobrcającego się systemu geocentrycznego (*GCRS* — zdefiniowany przez IAU). Czasem współrzędnych *CTRS* jest *TCG* — czas współrzędnych *GCRS*. Początkiem *CTRS* jest środek mas Ziemi określony z uwzględnieniem oceanów i atmosfery. *CTRS* jest systemem kinematycznym nie podlegającym globalnemu, residualnemu obrotowi względem ruchów poziomych na powierzchni Ziemi.

**Geocentryczny Ziemi System Odniesienia** (*GTRS*) stanowi uściślenie *CTRS*, a jednocześnie dopasowanie ziemskiego systemu odniesienia do jednolitego formalizmu użytego do zdefiniowania niebieskich systemów odniesienia. *GTRS* został zatwierdzony w Rezolucji 2 XXIV Zgromadzenia Generalnego IUGG (Perugia, 2007) jako system czasoprzestrzenny zdefiniowany w zgodności z Rezolucją B1.3 Zgromadzenia Generalnego IAU w 2000 r.

**Międzynarodowy Ziemi System Odniesienia** (*ITRS*) jest określony przez zbiór zaleceń i ustaleń wraz z opisem modeli niezbędnych do zdefiniowania początku, skali, orientacji i zmienności w czasie *CTRS* monitorowanego przez IERS. Jest to system geocentryczny, którego jednostką długości jest metr (SI). W myśl postanowień IUGG i IAU (1991) skala *ITRS* jest spójna z czasem współrzędnych geocentrycznych *TCG*. Orientacja *ITRS* została początkowo zdefiniowana przez orientację BIH 1984.0, zaś jej zmienność w czasie jest określona poprzez zastosowanie warunku, iż globalna suma poziomych ruchów tektonicznych nie zawiera składowych obrotu. Zgodnie z Rezolucją 2 Zgromadzenia Generalnego IUGG (Perugia, 2007) *ITRS* jest zdefiniowany jako szczególny Geocentryczny Ziemi System Odniesienia (*GTRS*), którego orientacja jest operacyjnie utrzymywana w ciągłości z poprzednimi uzgodnieniami międzynarodowymi (orientacja BIH) oraz przyjęty jako preferowany *GTRS* do zastosowań naukowych i praktycznych. Praktycznymi realizacjami *ITRS* są międzynarodowe ziemskie układy odniesienia *ITRF*. Poszczególne rozwiązania *ITRF* (*ITRF88*, *ITRF89*, ... *ITRF96*, *ITRF97*, *ITRF2000*, *ITRF2005* i *ITRF2008*) są opracowywane przez ośrodki obliczeniowe IERS w oparciu o obserwacje VLBI, LLR, SLR, GPS i DORIS. Każde kolejne rozwiązanie *ITRF* zawiera pozycje i prędkości stacji obserwacyjnych oraz pełną macierz kowariancji. Rozwój sieci *ITRF* w okresie ostatnich kilkunastu lat (5-krotny wzrost liczby stacji obserwacyjnych i poprawa ich przestrzennego rozkładu) oraz poprawa precyzji wyznaczenia pozycji i prędkości stacji dzięki zwiększaniu materiału obserwacyjnego i ulepszaniu strategii i metod opracowania obserwacji powodują znaczącą poprawę w kolejnych rozwiązaniach *ITRF*. Parametry transformacji pomiędzy układami *ITRF* są wyznaczone przez IERS i publikowane w IERS Conventions.

Transformacja pomiędzy ziemskim systemem odniesienia (do niego odnoszą się obserwacje) a niebieskim systemem odniesienia (system quasi-inercjalny, w którym podawane są pozycje gwiazd) tradycyjnie jest wykonywana w trzech zasadniczych etapach. W pierwszym etapie **system obserwacyjny** zdefiniowany przez „równik obserwacyjny” i „zerowy południk obserwacyjny” jest przeprowadzany przy pomocy parametrów opisujących ruch bieguna ziemskiego w **system pośredni** zdefiniowany przez „równik pośredni” i „zerowy południk pośredni”. Następnym krokiem jest **obróć** systemu pośredniego wokół osi „równika pośredniego” o kąt reprezentujący obrót Ziemi wokół własnej osi. Obrócony w ten sposób system pośredni staje się geocentrycznym systemem niebieskim, do którego odnoszą się tzw. miejsca pozorne. W ostatnim kroku system pośredni (a dokładnie utworzony w poprzednim kroku geocentryczny system niebieski) jest przeprowadzany w **system quasi-inercjalny** przy pomocy parametrów opisujących precesję i nutację. W transformacji są uwzględniane dodatkowo efekty aberracji i paralaksy, ruch własny gwiazd i efekty relatywistyczne.

Do 1980 roku rolę „równika obserwacyjnego” odgrywał równik tzw. międzynarodowego umownego średniego bieguna północnego Ziemi *CIO\** zdefiniowanego przez szerokości astronomiczne 5 obserwatoriów uczestniczących w Międzynarodowej Służbie Szerokości ILS, umieszczonych na równoleżniku  $39^{\circ}09'$ , zaś „zerowemu południkowi obserwacyjnemu” odpowiadał średni południk Greenwich zdefiniowany przez długości astronomiczne około 50 obserwatoriów uczestniczących w programie BIH. Tak zdefiniowany równik *CIO\** i „zerowy południk obserwacyjny” określały kierunki osi konwencjonalnego systemu ziemskiego *CTS* (od 1967 roku — *GRS67*). „Równikowi pośredniemu” odpowiadał równik chwilowy, którego oś stanowiła chwilowa oś obrotu Ziemi, zaś chwilowy południk Greenwich służył jako „zerowy południk pośredni”. Parametry ruchu bieguna wykorzystywane do przeprowadzenia bieguna *CIO\** w biegun chwilowy były dostarczane przez Międzynarodową Służbę Ruchu Bieguna IPMS (poprzedniczkę IERS). Obrót systemu pośredniego odbywał się wokół chwilowej osi obrotu Ziemi o kąt równy prawdziwemu czasowi gwiazdowemu Greenwich *GST* (lub *GAST*) będącemu nieliniową funkcją *UT1*. Przeprowadzał on system ziemski w system niebieski, w którym była wyrażona pozycja pozorna i, po usunięciu wpływu aberracji rocznej i paralaksy rocznej, tzw. pozycja prawdziwa (barycentryczna). Uwzględnienie następnie nutacji prowadziło do transformacji do systemu niebieskiego, w którym była wyrażona tzw. pozycja średnia na epokę obserwacji,



zaś uwzględnienie precesji wiązało się z kolejną transformacją systemu niebieskiego z epoki obserwacji do epoki katalogu fundamentalnego (FK4, a od 1984 r. FK5).

Opisana powyżej procedura transformacji systemu ziemskiego do niebieskiego uległa zasadniczym zmianom na skutek postępu w monitorowaniu ruchu obrotowego Ziemi oraz rozwoju teorii opisujących zjawiska precesji (model IAU1976) i nutacji (teoria nutacji IAU1980), odnoszących się do Niebieskiego Bieguna Efemerydalnego *CEP*. *CEP* został zdefiniowany jako biegun pośredniego systemu odniesienia (pomiędzy systemem ziemskim i niebieskim), który rozdziela ruch bieguna ziemskiego systemu odniesienia na dwie części. Część niebieska dotyczyła ruchu *CEP* względem niebieskiego systemu odniesienia z uwzględnieniem wszystkich wyrazów długookresowych (precesja/nutacja wymuszona) i zawierała wyrazy o okresach dłuższych od 2 dób (tj. o częstotliwościach pomiędzy  $-0.5$  i  $+0.5$  cykli na dobę gwiazdową). Część ziemską dotyczyła ruchu *CEP* względem ziemskiego systemu odniesienia z uwzględnieniem wszystkich wyrazów długookresowych (ruch bieguna) i zawierała wyrazy o okresach dłuższych od 2 dób (tj. o częstotliwościach pomiędzy  $-0.5$  i  $+0.5$  cykli na dobę gwiazdową). Podobnie jak poprzednio rolę „równika obserwacyjnego” oraz „zerowego południka obserwacyjnego” odgrywały odpowiednio równik *CIO\** i średni południk Greenwich BIH konwencjonalnego systemu ziemskiego. Miejsce chwilowego równika jako „równika pośredniego” zajął odpowiednio równik określony przez bliski chwilowemu biegunowi Ziemi *IRP* Niebieski Biegun Efemerydalny *CEP*, którego parametry położenia względem bieguna konwencjonalnego systemu ziemskiego początkowo były dostarczane przez IPMS, a następnie od 1988 roku przez IERS. Miejsce chwilowego południka Greenwich jako „zerowego południka pośredniego” zajął chwilowy południk określony poprzez uwzględnienie poprawki z tytułu ruchu bieguna do południka Greenwich BIH konwencjonalnego systemu ziemskiego GRS80. Obrót systemu pośredniego odbywał się wokół osi *CEP* albo o kąt równy *GST* w odniesieniu do punktu równonocy wiosennej, albo o kąt równy tzw. Kątowi Obrotu Ziemi *ERA* występującemu również pod nazwą kąta gwiazdowego (w odniesieniu do Niebieskiego Efemerydalnego Punktu Początkowego *CEO* — nieobracającego się punktu początkowego na równiku *CEP* — odpowiednika punktu równonocy wiosennej jako punktu początkowego, od którego liczona jest rektascensja). Obrót ten przeprowadzał pośredni system ziemski w system niebieski. Podobnie jak w procedurze sprzed 1980 roku, po usunięciu wpływu aberracji rocznej i paralaksy rocznej, uwzględnienie nutacji i precesji, według jednak nowych bardziej dokładnych teorii dopasowanych do definicji *CEP*, a także ruchu własnego i efektów relatywistycznych przeprowadzało kolejno system pośredni w system niebieski na epokę obserwacji, a następnie na epokę katalogu.

Kolejne zmiany w procedurze transformacji systemu ziemskiego do niebieskiego zaszły w wyniku dalszego wzrostu dokładności teorii do poziomu  $\mu as$ , jaki nastąpił w latach 1990–1999 oraz rosnących wymagań dokładnościowych. Definicja *CEP* przestała być spójna z precyzją i rozdzielczością przestrzenną współczesnych technik obserwacyjnych, a także z dokładnością teorii i częstotliwością włączonych w nie wyrazów. Pełniejsze wykorzystanie opracowanej przez Guinot koncepcji kinematycznie zdefiniowanego punktu nazwanego Nieobracającym się Punktem Początkowym *NRO* posłużyło do sformułowania bardziej rozwiniętej definicji *CEP* — Pośredniego Bieguna Niebieskiego *CIP* oraz *CEO*, a także zdefiniowania punktu początkowego dla długości w systemie ziemskim, któremu nadano nazwę Ziemskiego Efemerydalnego Punktu Początkowego *TEO*. Opracowano również spójną z tymi definicjami nową łączną teorię precesyjno-nutacyjną IAU2000, definicję *CIP* oraz definicję parametrów opisujących ruch bieguna. Parametry ruchu bieguna dają się obecnie wyznaczać z dokładnością lepszą od milisekundy łuku na podstawie kilkugodzinnych obserwacji GPS i VLBI. Jednocześnie wyrazy o okresach dobowych i sub-dobowych występujące zarówno w opisie nutacji jak i ruchu bieguna dają się wyznaczyć z dokładnością mikrosekund łuku. Aby sprostać wysokim wymaganiom dokładnościowym dotychczas stosowany w modelowaniu matematycznym rozdział zjawiskowy pomiędzy nutacją swobodną i wymuszoną został zastąpiony rozdziałem uwzględniającym charakterystykę częstotliwościową oddzielnych składowych tych efektów. Zgodnie z Rezolucją B1.7 IAU (Manchester, 2000) Pośredni Biegun Niebieski *CIP* rozdziela ruch bieguna ziemskiego systemu odniesienia w niebieskim systemie odniesienia na dwie części, z których jedna w postaci modelu matematycznego zawiera wyrazy precesyjne oraz część wyrazów nutacji wymuszonej, druga zaś wyrazy nutacji swobodnej, wyznaczone przez IERS jako parametry ruchu bieguna, efekty pływów oceanicznych oraz pozostałe wyrazy nutacji wymuszonej. Część zawierająca wszystkie wyrazy o okresach dłuższych od 2 dób (tj. o częstotliwościach pomiędzy  $-0.5$  i  $+0.5$  cykli na dobę gwiazdową) została określona jako precesja/nutacja, czyli ruch *CIP* względem systemu niebieskiego *GCRS*. Część zaś zawierająca wszystkie wyrazy ruchu wstecznego spoza pasma dobowego (tj. o częstotliwościach mniejszych od  $-1.5$  i większych od  $-0.5$  cykli na dobę gwiazdową) została określona jako ruch bieguna, czyli ruch *CIP* względem systemu ziemskiego *ITRS*.

Od 1 stycznia 2003 roku, na mocy Rezolucji B1.7 IAU (Manchester, 2000), obowiązuje nowa procedura transformacji systemu ziemskiego w system niebieski. Jako „równik obserwacyjny” przyjmuje się równik *ITRS*, zaś południk zerowy *ITRS* odgrywa rolę „zerowego południka obserwacyjnego”. Biegunem systemu pośredniego *IRS* jest Pośredni Biegun Niebieski

*CIP*, którego parametry położenia względem bieguna *ITRS* są obliczane w oparciu o dane dostarczane przez IERS. Transformacja *ITRS* do *IRS<sub>ZIEMSKI</sub>* określa położenie *TEO* (dokładna realizacja chwilowego zerowego południka pośredniego) na równiku *CIP* zgodnie z kinematyczną definicją *NRO* w *ITRS* gdy *CIP* porusza się względem *ITRS* pod wpływem ruchu bieguna. Obrót systemu pośredniego *IRS* odbywa się wokół osi *CIP* o kąt równy **Kątowi Obrotu Ziemi** (*ERA*) będącemu liniową funkcją *UT1* i przeprowadza system *IRS<sub>ZIEMSKI</sub>* w system *IRS<sub>NIEBIESKI</sub>*, w którym jest określane miejsce pozorne. Uwzględnienie precesji/nutacji według teorii IAU2000 przeprowadza ten system do Geocentrycznego Niebieskiego Systemu Odniesienia *GCRS*. Dodatkowo z *GCRS* do Barycentrycznego Niebieskiego Systemu Odniesienia *BCRS* przechodzi się przez zastosowanie post-newtonowskiej transformacji współrzędnych narzuconej przez formę odpowiednich tensorów metrycznych obu systemów (Rezolucja B1.3 IAU, 2000).

Na mocy Rezolucji 1 Zgromadzenia Generalnego IAU (Praga, 2006) dokonano kolejnej modyfikacji procedury transformacji systemu ziemskiego w system niebieski. Polega ona na zastąpieniu części precesyjnej modelu precesyjno-nutacyjnego IAU2000 teorią precesyjną P03. Zmodyfikowana procedura transformacji obowiązuje od 1 stycznia 2009 r. Z kolei, na mocy Rezolucji 2 IAU (Praga, 2006) terminy *CEO* i *TEO* zostały zastąpione odpowiednio przez *CIO* — Niebieski Pośredni Punkt Początkowy i *TIO* — Ziemski Pośredni Punkt Początkowy.

Zależność pomiędzy wektorem jednostkowym  $\mathbf{e}_{ITRS}$  w *ITRS* i jego obrazem  $\mathbf{e}_{GCRS}$  w *GCRS* wyraża się przez transformację

$$\mathbf{e}_{GCRS} = Q(t) R(t) W(t) \mathbf{e}_{ITRS} \quad (19)$$

gdzie  $W(t)$ ,  $R(t)$  i  $Q(t)$  są macierzami transformacji wyrażającymi odpowiednio ruch *CIP* względem systemu ziemskiego *ITRS*, obrót systemu pośredniego *IRS* wokół osi *CIP* oraz ruch *CIP* względem systemu niebieskiego *GCRS*. Parametr czasowy  $t$  jest zdefiniowany następująco:

$$t = (JD(TT) - 2000 \text{ styczeń } 1^d 12^h TT) \text{ dób} / 36\,525 \quad (20)$$

zgodnie z Rezolucją C7 IAU (Haga, 1994), która zaleciła aby epoka J2000.0 była zdefiniowana w środku mas Ziemi i aby 2000 styczeń 1.5  $TT = JD\,2\,451\,545.0\,TT$ .

Macierze transformacji pomiędzy systemami ziemskim i niebieskim dają się wyrazić w funkcji macierzy obrotowych  $R_1(\xi_1)$ ,  $R_2(\xi_2)$  i  $R_3(\xi_3)$  reprezentujących obroty odpowiednio wokół osi  $x$ ,  $y$  i  $z$  układu o kąty  $\xi_1$ ,  $\xi_2$ ,  $\xi_3$  dodatnie w kierunku przeciwnym do ruchu wskazówek zegara w przypadku stosowania układów prawoskrętnych. I tak

$$R_1(\xi_1) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos \xi_1 & \sin \xi_1 \\ 0 & -\sin \xi_1 & \cos \xi_1 \end{pmatrix} \quad R_2(\xi_2) = \begin{pmatrix} \cos \xi_2 & 0 & -\sin \xi_2 \\ 0 & 1 & 0 \\ \sin \xi_2 & 0 & \cos \xi_2 \end{pmatrix} \quad R_3(\xi_3) = \begin{pmatrix} \cos \xi_3 & \sin \xi_3 & 0 \\ -\sin \xi_3 & \cos \xi_3 & 0 \\ 0 & 0 & 1 \end{pmatrix} \quad (21)$$

Macierz  $W(t)$  ma postać

$$W(t) = R_3(-s') R_2(x_p) R_1(y_p) \quad (22)$$

gdzie  $x_p$  i  $y_p$  są współrzędnymi *CIP* w *ITRS* na epokę  $t$  i są zdefiniowane jako

$$(x_p, y_p) = (x_{IERS}, y_{IERS}) + (\Delta x, \Delta y)_{\text{tidal}} + (\Delta x, \Delta y)_{\text{nutation}} \quad (23)$$

przy czym  $(x_{IERS}, y_{IERS})$  są współrzędnymi bieguna dostarczanych przez IERS (dostępne w biuletynach IERS),  $(\Delta x, \Delta y)_{\text{tidal}}$  są składowymi pływowymi wynikającymi z pływów oceanicznych, zaś  $(\Delta x, \Delta y)_{\text{nutation}}$  są wyłączonymi z modelu precesyjno-nutacyjnego IAU2006 składowymi nutacji wymuszonej. Poprawki  $(\Delta x, \Delta y)_{\text{tidal}}$  z tytułu dobowych i sub-dobowych efektów ruchu bieguna wywołanych pływami oceanicznymi można obliczyć korzystając z procedury dostępnej na stronach internetowych IERS (<http://www.iers.org>). Wielkości  $(\Delta x, \Delta y)_{\text{nutation}}$  reprezentujące dobowe i sub-dobowe wyrazy nutacyjne w ruchu bieguna można obliczyć korzystając z parametrów podanych w tablicy 5.1 IERS Conventions 2003. Wielkość  $s'$  określa spowodowaną przez ruch *CIP* względem *ITRS* zmianę pozycji *TIO* na równiku *CIP* zgodnie z wyrażeniem

$$s'(t) = \frac{1}{2} \int_{t_0}^t (x_p \dot{y}_p - \dot{x}_p y_p) dt \quad (24)$$

Ponieważ wielkość  $s'$  jest bardzo mała (rzędu  $0.1 \text{ mas/stulecie}$ ) można ją wyznaczyć z przybliżonego wzoru

$$s'(t) = -0.0015 (a_c^2/1.2 + a_a^2) t \quad (25)$$

gdzie  $a_c$  i  $a_a$  są średnimi amplitudami (w sekundach łuku) odpowiednio ruchu Chandlera i rocznego w badanym okresie od  $t_0$  do  $t$ , przy czym  $t$  jest wyrażone w stuleciach juliańskich. Korzystając z aktualnych, średnich amplitud ruchów Chandlera i rocznego  $s' = -47 \mu as \times t$ .

Macierz  $R(t)$  ma postać

$$R(t) = R_3(-\theta) \quad (26)$$

gdzie  $\theta$  jest Kątem Obrotu Ziemi *ERA*, który oblicza się w oparciu o *UTC* (wyznaczone z *TT*) oraz dostarczanych przez IERS poprawek  $[UT1 - UTC]_{\text{IERS}}$  jako liniowa funkcja *UT1*

$$\theta(T_u) = 2\pi (0.779\,057\,273\,264\,0 + 1.002\,737\,811\,911\,354\,48\,T_u) \quad (27)$$

gdzie

$$T_u = JD(UT1) - 2\,451\,545.0 \quad (28)$$

oraz

$$UT1 = UTC + [UT1 - UTC]_{\text{IERS}} \quad (29)$$

Macierz  $Q(t)$  ma postać

$$Q(t) = R_3(-E)R_2(-d)R_3(E)R_3(s) \quad (30)$$

gdzie  $E$  i  $d$  są współrzędnymi sferycznymi *CIP* w *GCRS*. Składowe wektora jednostkowego *CIP* w *GCRS*, w układzie kartezjańskim mają postać

$$\begin{aligned} X &= \sin d \cos E \\ Y &= \sin d \sin E \\ Z &= \cos d \end{aligned} \quad (31)$$

Parametr  $s$  jest wielkością określającą zmianę w czasie położenia *CIO* na równiku *CIP* spowodowaną przez ruch *CIP* względem *GCRS*. Z zachowaniem dokładności na poziomie  $1 \mu as$  parametr ten wyraża się wzorem

$$s(t) = -\frac{1}{2}[X(t)Y(t) - X(t_0)Y(t_0)] + \int_{t_0}^t \dot{X}(t)Y(t)dt - ([\sigma_0 N_0] - [\Sigma_0 N_0]) \quad (32)$$

gdzie  $t_0 = \text{J2000.0}$

W celu zapewnienia ciągłości 1 stycznia 2003 roku z obliczeniami wykonywanymi w oparciu o poprzednie procedury precesyjno-nutacyjne, dla stałej  $s_0 = [\sigma_0 N_0] - [\Sigma_0 N_0]$  przyjmuje się wartość  $+94 \mu as$  ( $[\sigma_0 N_0]$  odpowiada kątowi pomiędzy  $\sigma_0$  — pozycją *CIO* na równiku *CIP* na epokę J2000.0 i  $N_0$  — węzłem wstępującym równika *CIP* w równik *GCRS* na epokę J2000.0, zaś  $[\Sigma_0 N_0]$  odpowiada kątowi pomiędzy  $\Sigma_0$  — kierunkiem osi  $x$ , czyli początkiem liczenia rektascensji na równiku *GCRS* i  $N_0$ ). Wartość stałej  $s_0$  nie ulega zmianie przy przejściu od modelu precesyjno-nutacyjnego IAU2000 do modelu IAU2006.

Macierz  $Q(t)$  można przedstawić w funkcji współrzędnych  $X, Y$  *CIP* w *GCRS* w postaci

$$Q(t) = \begin{pmatrix} 1 - aX^2 & -aXY & X \\ -aXY & 1 - aY^2 & Y \\ -X & -Y & 1 - a(X^2 + Y^2) \end{pmatrix} R_3(s) \quad (33)$$

gdzie  $a = 1/(1 + \cos d)$  lub z dokładnością  $1 \mu as$   $a = \frac{1}{2} + \frac{1}{8}(X^2 + Y^2)$ .

Współrzędne  $X, Y$  *CIP* w *GCRS* oparte na modelu precesyjno-nutacyjnym IAU2006 są obliczane ze wzorów:

$$\begin{aligned} X &= -0.016\,617 + 2004.191\,898\,t - 0.429\,782\,9\,t^2 - 0.198\,618\,34\,t^3 + 0.000\,007\,578\,t^4 + 0.000\,005\,928\,5\,t^5 \\ &+ \sum_{i,k} [(A_{ls})_{i,k} \sin(ARG) t^k + (A'_{ls})_{i,k} \cos(ARG) t^k] \\ &+ \sum_{i,k} [(A_{pl})_{i,k} \sin(ARG) t^k + (A'_{pl})_{i,k} \cos(ARG) t^k] \end{aligned} \quad (34)$$

$$\begin{aligned} Y &= -0.006\,951 - 0.025\,896\,t - 22.407\,274\,7\,t^2 + 0.001\,900\,59\,t^3 + 0.001\,112\,526\,t^4 + 0.000\,000\,135\,8\,t^5 \\ &+ \sum_{i,k} [(B_{ls})_{i,k} \sin(ARG) t^k + (B'_{ls})_{i,k} \cos(ARG) t^k] \\ &+ \sum_{i,k} [(B_{pl})_{i,k} \sin(ARG) t^k + (B'_{pl})_{i,k} \cos(ARG) t^k] \end{aligned} \quad (35)$$

gdzie parametr  $t$  jest określony wzorem (20), a  $ARG$  jest funkcją fundamentalnych argumentów teorii nutacji (argumenty Delauneya). Dla nutacji księżycowo-słonecznej ( $ls$ )  $ARG$  jest funkcją liniową 5 zmiennych: średniej anomalii Księżyca  $l$ , średniej anomalii Słońca  $l'$ , średniej długości Księżyca pomniejszonej o średnią długość węzła wstępującego Księżyca  $F$ , średniej elongacji Księżyca ze Słońca  $D$  i średniej długości węzła wstępującego Księżyca  $\Omega$ . Dla nutacji planetarnej ( $pl$ )  $ARG$  jest funkcją liniową 14 zmiennych, w skład których obok wyżej wymienionych wchodzi dodatkowo długości 8 planet: Merkurego, Wenus, Ziemi, Marsa, Jowisza, Saturna, Urana i Neptuna, a także całkowita precesja w długości. Współczynniki szeregów dla obliczenia współrzędnych  $X$  i  $Y$  są dostępne na stronie internetowej IERS Convention Centre na <ftp://maia.usno.navy.mil/conv2000/chapter5/>. Do dnia wydania Rocznika na stronach IERS były dostępne współczynniki rozwinąć tylko dla modelu precesyjno-nutacyjnego IAU2000.

Na podstawie porównań z obserwacjami VLBI, dokładność współrzędnych  $X$ ,  $Y$  otrzymywanych z modelu IAU2000 jest szacowana na około  $0.2 \text{ mas}$ . Międzynarodowa Służba Ruchu Obrotowego Ziemi i Systemów Odniesienia (IERS) publikuje więc na bieżąco, wynikające z obserwacji, poprawki  $\delta X$ ,  $\delta Y$  (dane EOP C04 dostępne na stronach internetowych IERS (<ftp://ftp.iers.org/products/eop/long-term/>)). Poprawki te zawierają m.in. nieuwzględniany w modelu precesyjno-nutacyjnym wpływ tzw. nutacji swobodnej jądra Ziemi. Do dnia wydania Rocznika publikowane przez IERS poprawki odnosiły się do modelu IAU2000A.

Położenie bieguna  $CIP$ , uwzględniające poprawki  $\delta X$ ,  $\delta Y$  wyraża się wzorami:

$$\tilde{X} = X + \delta X, \quad \tilde{Y} = Y + \delta Y \quad (36)$$

co jest równoważne zastąpieniu macierzy precesyjno-nutacyjnej  $Q$  przez macierz obrotu  $\tilde{Q}$

$$\tilde{Q} = \begin{pmatrix} 1 & 0 & \delta X \\ 0 & 1 & \delta Y \\ -\delta X & -\delta Y & 1 \end{pmatrix} Q \quad (37)$$

Przy dokładnych obliczeniach miejsc pozornych obiektów niebieskich należy uwzględniać poprawki relatywistyczne z tytułu opóźnienia propagacji światła w polu grawitacyjnym Słońca oraz z tytułu grawitacyjnego zakrzywienia światła. Oznaczając przez  $\mathbf{E}_B$ ,  $\mathbf{Q}_B$  i  $\mathbf{S}_B$  barycentryczne wektory wodzące ( $ICRS$ ), odpowiednio Ziemi ( $E$ ), obiektu niebieskiego ( $Q$ ) i Słońca ( $S$ ), heliocentryczne wektory wodzące Ziemi i obiektu  $Q$  można zapisać jako

$$\mathbf{E} = \mathbf{E}_B(t) - \mathbf{S}_B(t) \quad \mathbf{Q} = \mathbf{Q}_B(t - \Delta t_{lt}) - \mathbf{S}_B(t - \Delta t_{lt}) \quad (38)$$

zaś geocentryczny wektor wodzący obiektu  $Q$  ma postać

$$\mathbf{P} = \mathbf{Q}_B(t - \Delta t_{lt}) - \mathbf{E}_B(t) \quad (39)$$

gdzie  $\Delta t_{lt}$  jest poprawką do czasu z tytułu czasu propagacji światła (light time). Poprawkę tę oblicza się ze wzoru

$$\Delta t_{lt} = \frac{P}{c} + \frac{2GM_S}{c^3} \ln \frac{(E + P + Q)}{(E - P + Q)} \quad (40)$$

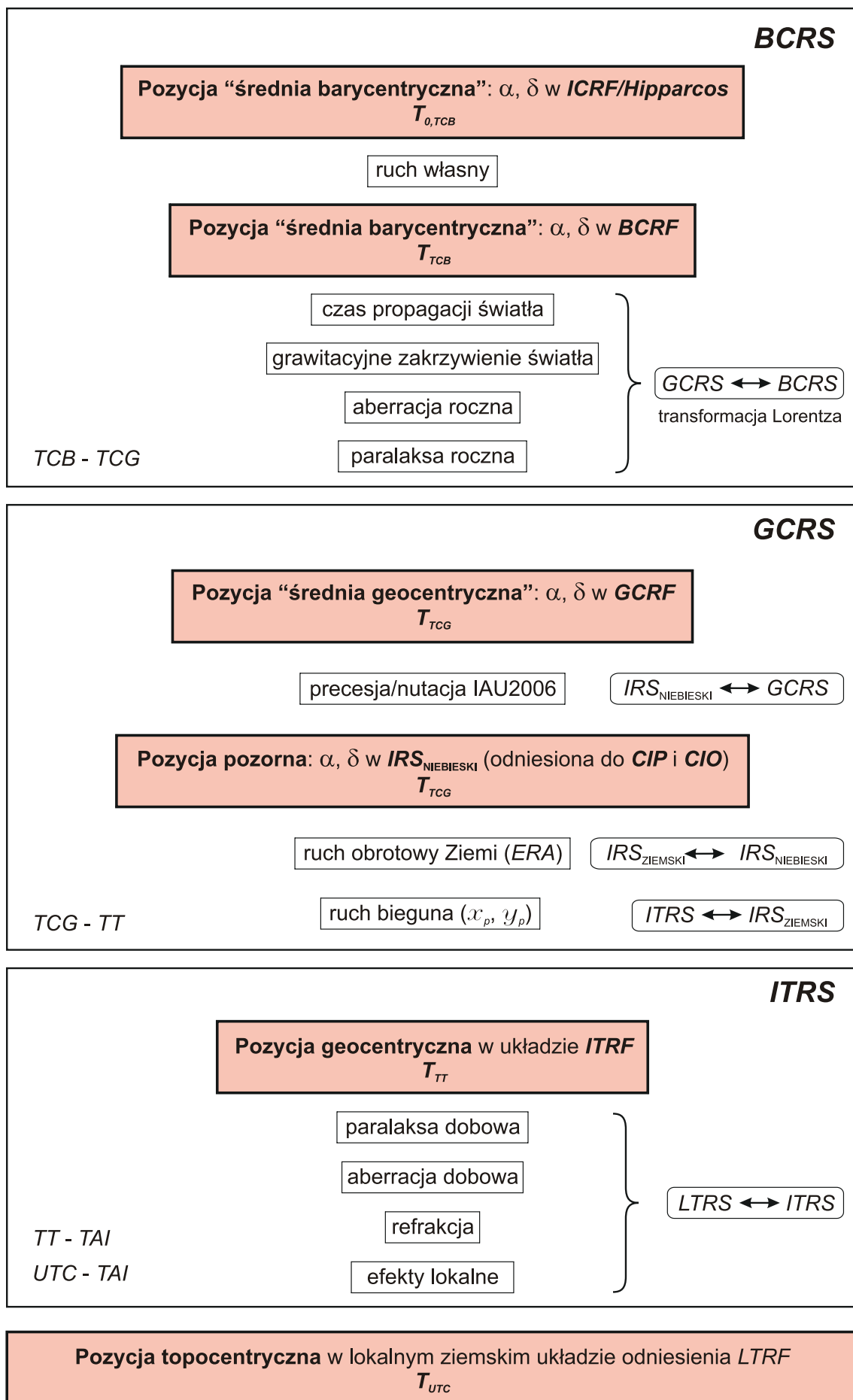
gdzie  $E = |\mathbf{E}|$ ,  $Q = |\mathbf{Q}|$  oraz  $P = |\mathbf{P}|$ ,  $c$  jest prędkością światła, a  $GM_S$  — heliocentryczną stałą grawitacyjną. Poprawkę tę można obliczyć z mniejszą dokładnością z uproszczonego wzoru

$$\Delta t_{lt} = \frac{R}{\pi c} \quad (41)$$

gdzie  $R$  — oznacza promień orbity Ziemi (przybliżenie  $P$ ), a  $\pi$  — paralaksę roczną obiektu  $Q$ .

Oznaczając przez  $\mathbf{e}^E$ ,  $\mathbf{e}^Q$  i  $\mathbf{e}^P$  odpowiednio wektory jednostkowe o kierunkach wektorów  $\mathbf{E}$ ,  $\mathbf{Q}$  i  $\mathbf{P}$ , tj.  $\mathbf{e}^E = \mathbf{E}/E$ ,  $\mathbf{e}^Q = \mathbf{Q}/Q$  i  $\mathbf{e}^P = \mathbf{P}/P$ , efekt grawitacyjnego zakrzywienia światła wyraża się w postaci poprawki  $\Delta \mathbf{e}^P$  do geocentrycznego wektora jednostkowego  $\mathbf{e}^P$  obiektu  $Q$  następująco:

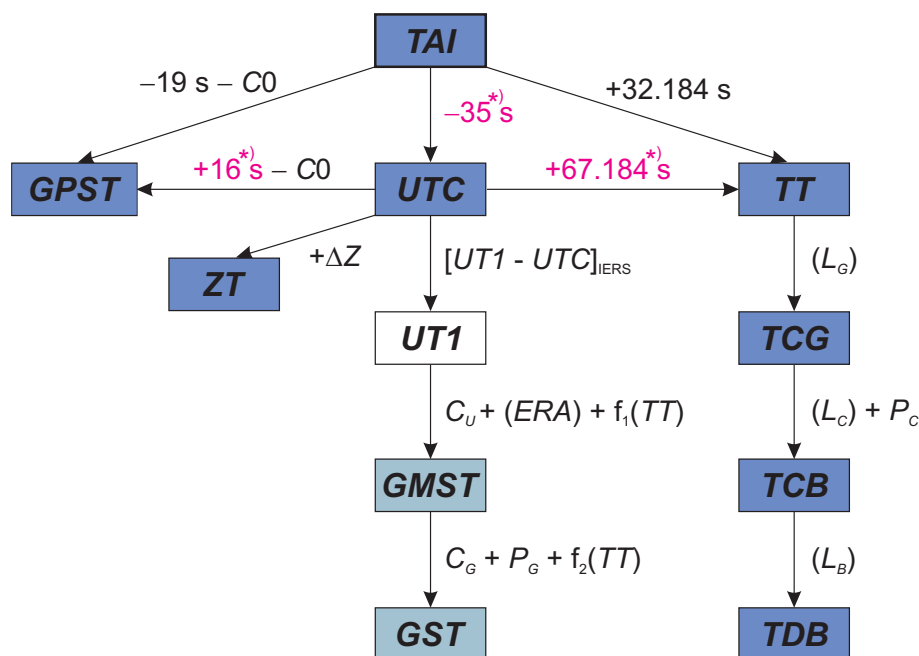
$$\Delta \mathbf{e}^P = \frac{2GM_S}{c^2 E} \cdot \frac{(\mathbf{e}^P \cdot \mathbf{e}^Q)\mathbf{e}^E - (\mathbf{e}^E \cdot \mathbf{e}^P)\mathbf{e}^Q}{1 + (\mathbf{e}^E \cdot \mathbf{e}^Q)} \quad (42)$$



Rys. 1 Schemat procesu transformacji od systemów niebieskich do ziemskich

## 2. SYSTEMY CZASU

Do praktycznego pomiaru czasu są wykorzystywane zjawiska przebiegające okresowo. Odstępy czasu są wyrażane liczbą zawartych w nich okresów przyjętego za wzorec czasu zjawiska. Do połowy XX wieku podstawą pomiaru czasu był ruch obrotowy Ziemi. Czas astronomiczny oparty o ruch obrotowy Ziemi nosi nazwę **czasu obrotowego**. Szczególnymi rodzajami czasu obrotowego są czas słoneczny, dla którego „zegarem” jest ruch obrotowy Ziemi względem Słońca, odmierzany kątem godzinnym Słońca oraz czas gwiazdowy, dla którego „zegarem” jest ruch obrotowy Ziemi względem punktu równonocy wiosennej, odmierzany kątem godzinnym punktu równonocy wiosennej. W zadanym momencie czas obrotowy w dwóch różnych punktach na powierzchni Ziemi jest różny — z wyjątkiem sytuacji gdy punkty te leżą na tym samym południku geograficznym<sup>7)</sup>. Różnica czasu obrotowego w dwóch punktach na Ziemi odpowiada różnicy długości geograficznej tych punktów. Za podstawową jednostkę czasu obrotowego przyjęto sekundę średniego czasu słonecznego, zdefiniowaną jako 1/86 400 część średniej doby słonecznej. Skala czasu obrotowego jest niejednostajna. W 1954 roku X Generalna Konferencja Wag i Miar (Conférence Générale des Poids et Mesures) zdefiniowała jako podstawę pomiaru czasu bardziej jednostajną astronomiczną skalę czasu — **czasu newtonowskiego** (czasu fizycznego) opartego na ruchu orbitalnym Ziemi wokół Słońca. Ruch orbitalny Ziemi został opisany w Tablicach Słońca Newcomba, które zawierają model matematyczny pozornego ruchu Słońca na epokę 1900.0, opracowany na podstawie obserwacji astronomicznych z XVIII i XIX wieku. Czas ten nazwano Czasem Efemeryd (*ET*) i za jego jednostkę wynikającą z długości okresu obiegu Ziemi wokół Słońca na epokę 1900.0 przyjęto tzw. sekundę efemerydalną. Definicja ta została ratyfikowana przez XI Generalną Konferencję Wag i Miar w 1960 roku.



Rys. 2 Współcześnie stosowane skale czasu i ich wzajemne relacje

\*) Wartości obowiązujące w okresie od 1 lipca 2012 do co najmniej 30 czerwca 2015.

Jednostka czasu oparta na wzorcu astronomicznym wkrótce przestała zadowalać rosnące potrzeby fizyki i techniki. Wzorcem doskonalszym od astronomicznego, pod względem jednostajności skali czasowej, okazał się wzorec atomowy. W 1971 roku za podstawę pomiaru czasu na Ziemi przyjęto zdefiniowaną na 59–ej sesji Międzynarodowego Komitetu Miar (1970) i zaaprobowaną przez XIV Generalną Konferencję Wag i Miar (1971) skalę Międzynarodowego Czasu Atomowego (*TAI*).

**Międzynarodowy Czas Atomowy** (*TAI* lub *IAT*) (*Temps Atomique International* lub *International Atomic Time*) jako najbardziej jednostajny stanowi podstawę współczesnych skal czasu. *TAI* jest czasem opartym na wzorcu atomowym (nie związanym z ruchem Ziemi) i jest odmierzany przez zsynchronizowane zegary atomowe rozmieszczone w laboratoriach na całym świecie. Skala czasu *TAI* jest wypadkową wskazań tych zegarów. Wzorce atomowe wykorzystują zjawisko przejść kwantowych między poziomami energetycznymi atomów lub cząsteczek. Uchwała XIII Generalnej Konferencji Wag i Miar z

<sup>7)</sup> Przez pojęcie południka geograficznego, długości oraz szerokości geograficznej rozumie się południk astronomiczny oraz odpowiednie współrzędne astronomiczne — w odróżnieniu od południka geodezyjnego oraz długości i szerokości geodezyjnej.

1967 roku zdefiniowała sekundę czasu atomowego i uznała ją za podstawową jednostkę czasu w międzynarodowym systemie jednostek SI. Na mocy definicji jest ona „trwaniem 9 192 631 770 okresów odpowiadających rezonansowej częstotliwości przejścia pomiędzy dwoma nadsubtelnymi ( $F=4$ ,  $M=0$ ) i ( $F=3$ ,  $M=0$ ) poziomami stanu podstawowego  $2S_{\frac{1}{2}}$  atomu cezu 133”. Interwał czasu odpowiadający tak zdefiniowanej sekundzie czasu atomowego jest równy sekundzie efemerydalnej. Czas atomowy został zatem wyskalowany do związanego z epoką 1900.0 czasu astronomicznego efemerydalnego.

Niezależne od *TAI* skale czasu atomowego są tworzone dla potrzeb systemów globalnej nawigacji satelitarnej. Wśród nich najpowszechniej używaną jest skala czasu GPS.

**Czas GPS (GPST) (GPS Time)** jest czasem atomowym używanym w systemie globalnej nawigacji satelitarnej GPS. Podstawą skali czasu GPS są atomowe zegary pokładowe umieszczone na satelitach GPS, zegary atomowe znajdujące się w ośrodkach sterowania systemem GPS oraz zegary atomowe US Naval Observatory. Skala czasu GPS jest bardzo zbliżona do skali czasu *TAI* i zsynchronizowana ze skalą *UTC* na epokę 1980 styczeń  $6^d 0^h$  *UTC*. Związek pomiędzy Międzynarodowym Czasem Atomowym a czasem GPS jest następujący:

$$TAI - GPST = 19^s + C0 \quad (43)$$

gdzie  $19^s$  jest stałą różnicą między *TAI* i *UTC* na epokę 1980 styczeń  $6^d 0^h$  *UTC*, a  $C0$  zmienną w czasie poprawką rzędu 10 ns wynikającą z korzystania w obu systemach z różnych zegarów atomowych.

Błędy realizowania skali czasu *TAI* wynikające z niedoskonałości zegarów atomowych nie zawsze są zanedbywalne. Uznano zatem za konieczne zdefiniowanie idealnej formy *TAI*, którą po uwzględnieniu przesunięcia 32.184 s realizuje tzw. Czas Ziemi (*TT*).

**Czas Ziemi (TT) (Terrestrial Time lub Temps Terrestre)** został zatwierdzony przez XXI Zgromadzenie Generalne IAU (Buenos Aires, 1991) (Rezolucja A4) jako skala czasu przeznaczona do praktycznego odmierzenia czasu na Ziemi, w szczególności jako czas odniesienia dla pozornych, geocentrycznych efemeryd (czas ziemski praktycznie wprowadzony był w 1976 roku jako Ziemi Czas Dynamiczny (*TDT*), który z dniem 1 stycznia 1977 roku zastąpił Czas Efemeryd (*ET*)). *TT* jest zdefiniowany jako skala czasu różniąca się od skali czasu współrzędnych geocentrycznych *TCG* o współczynnik  $L_G$  będący funkcją potencjału siły ciężkości na geoidzie. Z uwagi na niedostateczną dokładność wyznaczenia potencjału siły ciężkości na geoidzie oraz zmienność w czasie pola siły ciężkości Ziemi XXIV Zgromadzenie Generalne IAU (Manchester, 2000) (Rezolucja B1.9) przyjęło stałą wartość współczynnika  $L_G$ , określoną na podstawie ustalonej wartości potencjału siły ciężkości, i uznało ją za jedną ze stałych definiujących obowiązujące systemy astronomiczne i geodezyjne.

Związek pomiędzy Międzynarodowym Czasem Atomowym, a Czasem Ziemi jest następujący:

$$TT - TAI = 32^s.184 \quad (44)$$

zaś relację pomiędzy Czasem Ziemi, a czasem współrzędnych geocentrycznych wyraża wzór

$$TCG - TT = L_G \times (JD - 2\,443\,144.5) \times 86\,400 \quad (45)$$

gdzie

$$L_G = 6.969\,290\,134 \times 10^{-10} \quad (46)$$

Wzór (45) gwarantuje zgodność jednostki pomiaru *TT* z sekundą SI na bardzo bliskiej geoidzie powierzchni ustalonego potencjału siły ciężkości.

**Czas współrzędnych geocentrycznych (TCG) (Temps Coordonnée Géocentrique lub Geocentric Coordinate Time)**, wprowadzony przez XXI Zgromadzenie Generalne IAU (Buenos Aires, 1991) (Rezolucja A4), jest czasem w czterowymiarowej czasoprzestrzeni — Niebieskim Geocentrycznym Systemie Odniesienia (*GCRS*) (*Geocentric Celestial Reference System*), który porusza się w przestrzeni wraz z ruchem orbitalnym Ziemi wokół barycentrum Układu Słonecznego, przy czym kierunek osi tego systemu pozostaje niezmienny w odniesieniu do systemu inercjalnego (praktycznie *BCRS*). Czas ten należy do zdefiniowanej w Rezolucji B1.5 XXIV Zgromadzenia Generalnego IAU (Manchester, 2000) metryki relatywistycznej *GCRS*. W tej samej rezolucji znajduje się definicja Niebieskiego Barycentrycznego Systemu Odniesienia (*BCRS*) oraz związanego z nim czasu współrzędnych barycentrycznych.

**Czas współrzędnych barycentrycznych (TCB)** (*Temps Coordonnée Barycentrique* lub *Barycentric Coordinate Time*) jest czasem współrzędnych czterowymiarowego Niebieskiego Barycentrycznego Systemu Odniesienia (BCRS) (*Barycentric Celestial Reference System*), który jest traktowany jako system quasi-inercjalny. Czas ten należy do metryki relatywistycznej niebieskiego systemu barycentrycznego. Zależność pomiędzy TCB i TCG jest wyrażona za pomocą pełnej 4-wymiarowej transformacji Lorentza (Rezolucja B1.5). W przybliżeniu (z dokładnością  $10^{-14}$ ) można używać wyrażenia

$$TCB - TCG = L_C \times (JD - 2\,443\,144.5) \times 86\,400 + c^{-2} \mathbf{v}_e(\mathbf{x} - \mathbf{x}_e) + P \quad (47)$$

gdzie

$$L_C = 1.480\,826\,867\,41 \times 10^{-8} \pm 2 \times 10^{-17} \quad (48)$$

zaś  $\mathbf{x}_e$  i  $\mathbf{v}_e$  oznaczają wektory barycentrycznej pozycji i prędkości środka mas Ziemi,  $\mathbf{x}$  jest wektorem barycentrycznej pozycji obserwatora, a  $P$  przedstawia wyrazy okresowe, których łączna amplituda nie przekracza  $1.6\,ms$  (Rezolucja B1.6).

XVI Zgromadzenie Generalne IAU (Grenoble, 1976) wprowadziło, obok skali Ziemskiego Czasu Dynamicznego TDT również skalę czasu dynamicznego odniesionego do barycentrum Układu Słonecznego. Czas ten nazwano Barycentrycznym Czasem Dynamicznym.

**Barycentryczny Czas Dynamiczny (TDB)** (*Temps Dynamique Barycentrique* lub *Barycentric Dynamical Time*) jest czasem atomowym używanym od 1984 roku jako argument efemeryd, np. Księżyca, planet, odniesionych do barycentrum Układu Słonecznego, a także jako argument precesji. TDB może być określony jako argument w algorytmach efemerydalnych DE405/LE405 opracowanych przez JPL (efemerydy planetarne zazwyczaj są wyrażane w funkcji czasu  $T_{eph}$ , który jest bardzo zbliżony do TDB). TDB różni się od TDT o wyrazy okresowe spowodowane ruchem orbitalnym Ziemi w polu grawitacyjnym Słońca, Księżyca i planet. Różnica ta, zawierająca efekty relatywistyczne, nie przekracza  $2\,ms$ .

Uznając potrzebę zachowania spójności ze skalą czasu  $T_{eph}$ , XXVI Zgromadzenie Generalne IAU (Praga, 2006) (Rezolucja 3) wprowadziło nową definicję TDB opartą na TCB

$$TDB = TCB - L_B \times (JD_{TCB} - T_0) \times 86\,400 + TDB_0 \quad (49)$$

gdzie

$$L_B = 1.550\,519\,768 \times 10^{-8} \quad T_0 = 2\,443\,144.500\,372\,5 \quad TDB_0 = -6.55 \times 10^{-5} \quad (50)$$

są stałymi definiującymi<sup>8)</sup>.

Wzorce atomowe nie dostarczają żadnych charakterystycznych momentów, jakie dawałyby możliwość stworzenia naturalnej skali czasu atomowego. Początek skali czasu atomowego musi być obrany umownie przez nawiązanie do skali o trwałej ciągłości. Aspekt chronologiczny metrologii czasu wymaga zegara wzorcowego, który gwarantowałby pomiary bardzo wielkich interwałów czasu i zapewniał skalę dla zdarzeń bardzo odległych w przeszłości i w przyszłości. Naturalnymi skalami czasu są skale czasu astronomicznego. W szczególności, naturalną skalą czasu jest skala czasu obrotowego słonecznego, do której odnoszą się pojęcia dnia i nocy i z którą wiąże się cykl biologiczny żywych organizmów na Ziemi. W skali czasu słonecznego są wyrażane nie wymagające wysokiej precyzji efemerydy ciał niebieskich.

**Czas słoneczny (Solar Time)** jest definiowany jako tzw. czas słoneczny prawdziwy lub czas słoneczny średni. Czas słoneczny prawdziwy odmierza się geocentrycznym kątem godzinnym środka tarczy słonecznej, zwiększonym o 12 godzin (modulo  $24^h$ ). Czas słoneczny średni mierzy się kątem godzinnym tzw. Słońca średniego, tj. punktu na równiku o rekta-scensji równej średniej długości ekliptycznej Słońca prawdziwego, również zwiększonym o 12 godzin (modulo  $24^h$ ). Czas słoneczny, jako czas obrotowy, może być czasem miejscowym lub tzw. czasem Greenwich<sup>9)</sup>. Pierwszy jest odmierzany kątem godzinnym odniesionym do południka miejscowego, drugi, odniesionym do południka londyńskiego obserwatorium w Greenwich. Czas słoneczny Greenwich różni się od czasu słonecznego miejscowego o długość geograficzną  $\lambda$  południka miejscowego, która na wschód od Greenwich przybiera wartości dodatnie<sup>10)</sup>

$$\text{czas słoneczny miejscowy} = \text{czas słoneczny Greenwich} + \lambda \quad (51)$$

<sup>8)</sup> W Rezolucji B2 ZG IAU 2009 wielkość  $T_0$  nie została zaliczona do stałych definiujących.

<sup>9)</sup> Na Konferencji Międzynarodowej w Washington D.C. w 1884 roku południk przechodzący przez obserwatorium w Greenwich został przyjęty jako południk zerowy dla odliczania długości geograficznej, a także dla odliczania czasu.

<sup>10)</sup> Wg uchwały IAU (Patras, 1982), Rezolucja C4.



Czas słoneczny prawdziwy jest to czas jaki daje się bezpośrednio wyznaczyć z obserwacji Słońca. Czas słoneczny średni, jako bardziej zbliżony do jednostajnego, jest stosowany w obliczeniach astronomicznych. Znajduje on również zastosowanie w nawigacji i geodezji.

Zależność między rodzajami czasu słonecznego wyraża się za pomocą tzw. równania czasu

$$\text{czas słoneczny prawdziwy} - \text{czas słoneczny średni} = E \quad (52)$$

gdzie  $E$  jest nazywane równaniem czasu<sup>11)</sup>.

Poczynając od 1 stycznia 1925 roku średni czas słoneczny Greenwich (*Greenwich Mean Time* — *GMT* o początku doby w południe), używany w obliczeniach astronomicznych został zastąpiony tzw. czasem uniwersalnym.

**Czas uniwersalny** (*UT* lub *TU*) (*Universal Time* lub *Temps Universel*) to średni czas słoneczny (odniesiony do ruchu dobowego Słońca średniego) południka geograficznego Greenwich.

W dalszej części objaśnień na stronie 180 zostały przedstawione historyczne odmiany czasu uniwersalnego *UT0*, *UT1* i *UT2*, z których obecnie stosuje się jedynie skalę czasu *UT1*.

Definicję *UT1*, obowiązującą od 2003 roku, przyjęto na mocy Rezolucji B1.8 XXIV Zgromadzenia Generalnego IAU (Manchester, 2000). Zgodnie z tą rezolucją, i po uwzględnieniu zmian terminologicznych wprowadzonych na mocy Rezolucji 2 XXVI Zgromadzenia Generalnego IAU (Praga, 2006), *UT1* jest zdefiniowany jako funkcja liniowa Kąta Obrotu Ziemi (*ERA*, oznaczanego także grecką literą  $\theta$ ), który jest kątem w płaszczyźnie równika *CIP* pomiędzy wektorami jednostkowymi skierowanymi od osi *CIP* do Niebieskiego Pośredniego Punktu Początkowego (*CIO*) i Ziemskiego Pośredniego Punktu Początkowego (*TIO*)

$$\theta(T_u) = 2\pi (0.779\,057\,273\,264\,0 + 1.002\,737\,811\,911\,354\,48\,T_u) \quad (53)$$

gdzie  $T_u$  w funkcji *UT1* dane jest wzorem (28), zaś *UT1* jest otrzymywane, zgodnie ze wzorem (29), poprzez dodanie do *UTC* wyznaczanej przez IERS poprawki  $[UT1 - UTC]_{\text{IERS}}$ .

Definicja *UT1* (wzór (53)) zapewnia ciągłość tej skali czasu. Zawarta w niej liniowa zależność *UT1* od Kąta Obrotu Ziemi (*ERA*) świadczy o tym, że *UT1* można interpretować jako miarę rzeczywistego ruchu obrotowego Ziemi wokół *CIP* (nie jak w poprzednio stosowanej definicji wokół chwilowego bieguna lub bieguna *CEP*) względem średniego Słońca. Pochodna *UT1* względem czasu jest proporcjonalna do prędkości kątowej obrotu Ziemi  $\omega$ .

Utrzymywanie skal dokładnego czasu i udostępnianie ich użytkownikom leży w gestii powołanej w tym celu służby czasu. Służba czasu polegała na wyznaczaniu czasu w oparciu o obserwacje gwiazd oraz na kontroli poprawek i niejednostajności wzorców czasu. Odpowiednią do tego celu skalą czasu jest astronomiczna skala gwiazdowego czasu obrotowego. Czas gwiazdowy służył również do określania relacji pomiędzy ziemskim układem odniesienia i niebieskim układem odniesienia.

**Czas gwiazdowy** (*Sidereal Time*) może być prawdziwy ( $s_v$ ), quasi-prawdziwy ( $s_q$ ), lub średni ( $s$ ), podobnie jak punkt równonocy wiosennej, którego ruch go definiuje. Odpowiednio więc prawdziwy punkt równonocy wiosennej jest to punkt przecięcia się na sferze niebieskiej ekliptyki z prawdziwym równikiem, tj. z równikiem, którego położenie zależy od precesji i nutacji (w długości). Stosowane do 2003 roku modele nutacji pozwalały wyróżniać nutację długo- ( $\Delta\Psi$ ) i krótkookresową ( $d\Psi$ ) w długości. Istniało zatem pojęcie quasi-prawdziwego punktu równonocy wiosennej. Był to punkt przecięcia na sferze niebieskiej ekliptyki z tzw. quasi-prawdziwym równikiem, którego położenie zależało od precesji i nutacji długookresowej (nie zależało od nutacji krótkookresowej). Średni punkt równonocy wiosennej jest to punkt przecięcia na sferze niebieskiej ekliptyki z tzw. średnim równikiem, tj. równikiem, którego położenie w przestrzeni podlega zmianom tylko pod wpływem precesji księżycowo-słonecznej. Czas gwiazdowy prawdziwy jest to czas jaki daje się bezpośrednio wyznaczyć z obserwacji gwiazd. Czas gwiazdowy średni, jako bardziej zbliżony do jednostajnego, jest stosowany w obliczeniach astronomicznych.

Zależności między rodzajami czasu gwiazdowego były przedstawiane za pomocą następujących wzorów:

$$\begin{aligned} s_q &= s + \Delta\Psi \cos \varepsilon \\ s_v &= s + (\Delta\Psi + d\Psi) \cos \varepsilon \end{aligned} \quad (54)$$

gdzie  $\varepsilon$  oznacza nachylenie ekliptyki do równika, a  $\Delta\Psi \cos \varepsilon$  i  $d\Psi \cos \varepsilon$  przedstawiają długo- i krótkookresową nutację punktu równonocy wiosennej na równiku (w rektascensji).

<sup>11)</sup> Równanie czasu jest funkcją o wartościach oscylujących w okresie roku pomiędzy  $-15$  a  $+17$  minut.

Podobnie jak w przypadku czasu słonecznego czas gwiazdowy Greenwich różni się od czasu gwiazdowego miejscowego o długość geograficzną  $\lambda$  południka miejscowego, która na wschód od Greenwich przybiera wartości dodatnie

$$\text{czas gwiazdowy miejscowy} = \text{czas gwiazdowy Greenwich} + \lambda \quad (55)$$

Do 2003 roku średni czas gwiazdowy Greenwich był formalnie zdefiniowany jako nieliniowa funkcja  $UT1$ . Funkcja ta była oparta na wyrażeniu podanym przez Newcomba dla rektascensji średniego Słońca, określającym relację pomiędzy  $UT1$  a średnim czasem gwiazdowym Greenwich ( $GMST$ ) o  $0^h UT1$ . Od 2003 roku średni czas uniwersalny  $UT1$  jest odniesiony do osi obrotu Ziemi określonej przez Pośredni Biegun Niebieski  $CIP^{12)}$ . Czas  $UT1$  można więc uważać za kątową miarę rzeczywistego obrotu Ziemi wokół osi  $CIP$ .

Spójna z nową definicją  $UT1$  (wzór (53)) jest nowa definicja średniego czasu gwiazdowego Greenwich  $GMST$ , która w zgodzie z najnowszym, obowiązującym od 1 stycznia 2009 r. modelem precesji P03, przyjmuje postać

$$GMST = 0''.014\,506 + \theta + 4612''.156\,534\,t + 1''.391\,581\,7\,t^2 - 0''.000\,000\,44\,t^3 - 0''.000\,029\,956\,t^4 - 0''.000\,000\,036\,8\,t^5 \quad (56)$$

gdzie  $t$  jest dane wzorem (20).

Przyjęty przez IAU, do stosowania od 2003 roku, model precesyjno–nutacyjny IAU2000 nie wyróżnia już nutacji długo– i krótkookresowej. Związek pomiędzy prawdziwym ( $GST$ ) oraz średnim ( $GMST$ ) czasem gwiazdowym Greenwich wyraża się wzorem

$$GST = GMST + Eq \quad (57)$$

przy czym  $Eq$  jest to równanie równonocy.

Po wprowadzeniu modelu precesyjno–nutacyjnego IAU2000 równanie równonocy opisywane było wzorem

$$Eq = \Delta\psi \cos \varepsilon_A + \sum_k [(C'_{s,0})_k \sin \alpha_k + (C'_{c,0})_k \cos \alpha_k] - 0''.000\,000\,87\,t \sin \Omega \quad (58)$$

gdzie  $\varepsilon_A$  jest nachyleniem ekliptyki poprawionym o zmiany precesyjne zdefiniowane w modelu IAU2000;  $\Delta\psi$  to „całkowita” (bez podziału na składowe długo– i krótkookresową) nutacja w długości odniesiona do ekliptyki zadanej epoki, skąd  $\Delta\psi \cos \varepsilon_A$  jest „klasycznym równaniem równonocy”. Pozostałe dwa człony po prawej stronie (58) stanowią uzupełnienie „równania równonocy”, zapewniające ciągłość prawdziwego czasu gwiazdowego Greenwich po przejściu na nową jego definicję oraz spójność z pozostałymi wielkościami systemu IAU2000. Parametry  $\alpha_k$  i  $\Omega$  oraz wartości współczynników  $(C'_{s,0})_k$  i  $(C'_{c,0})_k$  są podane w IERS Technical Note 32 „*IERS Conventions (2003)*”, a także w wersji elektronicznej wraz z pełną numeryczną reprezentacją  $GST$  na stronie internetowej <http://maia.usno.navy.mil/ch5tables.html>.

Po zastąpieniu modelu IAU2000 nowym modelem precesyjno–nutacyjnym IAU2006 wartość równania równonocy wyznacza się jako różnicę czasu gwiazdowego prawdziwego oraz czasu gwiazdowego średniego

$$Eq = GST - GMST \quad (59)$$

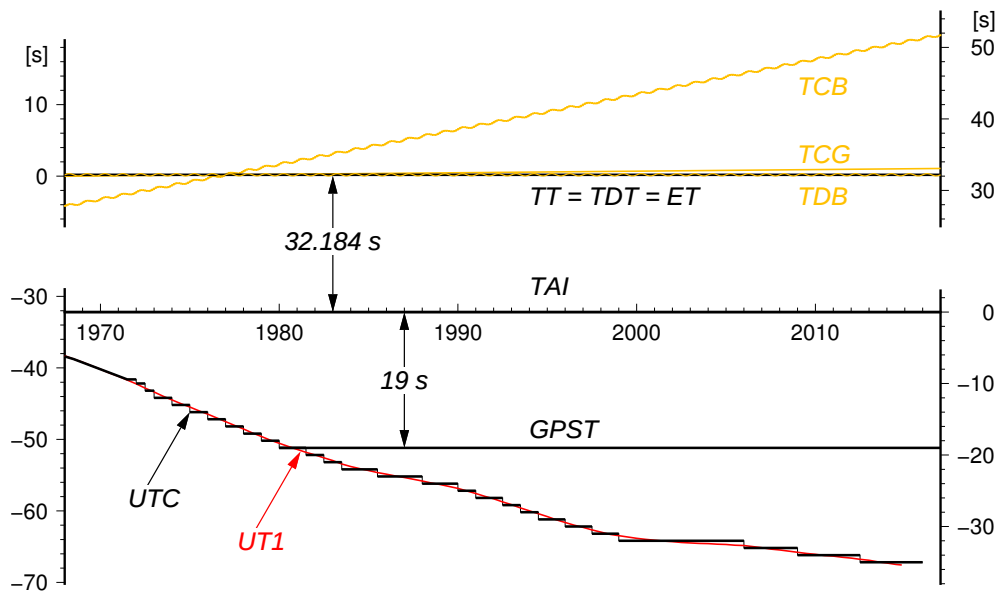
przy czym czas gwiazdowy prawdziwy jest obliczony bezpośrednio, wychodząc od pełnej macierzy precesyjno–nutacyjnej IAU2006 oraz tzw. równania początków (*equation of origins*). Podejście to jest równoważne poprzednio stosowanemu podejściu z użyciem modelu IAU2000.

Rolę jaką odgrywał czas gwiazdowy w transformacji pomiędzy układami ziemskim i niebieskim przejął Kąt Obrotu Ziemi ( $ERA$ ), który nie jest obarczony wpływem precesji i nutacji. W nowym wyrażeniu na  $GST$  w funkcji czasu kąt  $\theta$  ( $ERA$ ) jest wyrażony w funkcji  $UT1$ , zaś pozostałe człony reprezentujące efekt precesji i nutacji w rektascensji są odniesione do skali czasu  $TDB$  (praktycznie do  $TT$ ). Zgodnie z nową definicją  $GMST$  nie jest już kątem godzinnym średniej równonocy wiosennej na południku Greenwich. Należy zauważyć, że wprowadzanie w przyszłości nowych poprawionych modeli precesyjno–nutacyjnych spowoduje konieczność formułowania nowych wyrażeń dla  $GMST$ . Także „równanie równonocy” nie prowadzi do prawdziwej rektascensji średniej równonocy. Obecna rola czasu gwiazdowego ogranicza się do umożliwienia zachowania ciągłości w obliczeniach astronomicznych. W szczególności  $\theta(J2000.0) = GMST(J2000.0)$ , zaś różnica  $GST - \theta$  określa rektascensję  $CIO$ , a tym samym położenie punktu równonocy wiosennej na równiku  $CIP$ .

<sup>12)</sup> Biegun  $CIP$  znajduje się bardzo blisko bieguna chwilowej osi obrotu Ziemi.

**Dynamiczny Czas Gwiazdowy (SDT)** (*Sidereal Dynamical Time*) jest odpowiednikiem  $TT$  w grupie skal czasu gwiazdowego. Definiuje się go dokładnie tak samo jak średni czas gwiazdowy Greenwich ( $GMST$ ) tyle, że w odniesieniu do skali Czasu Ziemi, tj. we wzorze (56) kąt  $\theta$  powinien być obliczony zgodnie z (53), przy czym argument  $T_u = JD(TT) - 2451545.0$ . Otrzymany w ten sposób  $SDT$  jest czasem średnim. Dynamiczny czas gwiazdowy prawdziwy otrzymuje się poprzez dodanie nutacji w rektascensji  $\Delta\psi \cos \varepsilon_A$  do dynamicznego czasu gwiazdowego średniego.

Używana w służbie czasu skala czasu astronomicznego obrotowego jest nie tylko niejednostajna ale z uwagi na spowalnianie prędkości obrotowej Ziemi (rok słoneczny ulega skracaniu w tempie 0.2–1.2 sekundy na rok), spowodowanej efektami pływowymi, wykazuje dodatkowo nieliniowy trend w stosunku do jednostajnej skali czasu atomowego. Wprowadzona w 1964 roku skala Czasu Uniwersalnego Koordynowanego jest bliską aproksymacją niejednostajnego czasu obrotowego uniwersalnego  $UT1$  skalą czasu atomowego.



Rys. 3 Zależności pomiędzy niektórymi stosowanymi skalami czasu

**Czas Uniwersalny Koordynowany (UTC lub TUC)** (potocznie — *Universal Time Coordinated*, poprawnie — *Coordinated Universal Time* lub *Temps Universel Coordonné*), jako najbardziej zbliżony do czasu słonecznego średniego na południku Greenwich, czas przedziałami jednostajny, stanowi od 1964 roku podstawę czasu cywilnego utrzymywanego początkowo przez BIH a następnie od 1988 roku przez Sekcję Czasu BIPM w Paryżu (do 1964 roku czas cywilny opierał się na skali czasu słonecznego średniego Greenwich  $GMT$  zwanej również czasem uniwersalnym  $UT$ ). Lokalne realizacje  $UTC$  są prowadzone przez narodowe laboratoria czasu. Pierwotnie utrzymywano skalę czasu koordynowanego w pobliżu aktualnej przeciętnej wartości skali czasu uniwersalnego średniego  $UT1$  (dopuszczalne odchylenie  $5 \times 10^{-9}$ ), zachowując różnicę obu czasów — w granicach 0.1 sekundy. Zmiany wprowadzano skokami z zastosowaniem zmiennej częstotliwości  $UTC$ . Od stycznia 1972 roku zaniechano jednak zmian częstotliwości  $UTC$  i zwiększono tolerancję różnic  $UT1 - UTC$ . Wskazania Czasu Uniwersalnego Koordynowanego mogą teraz odbiegać o mniej niż 1 sekundę od  $UT1$  i różnić się od jednoczesnych wskazań Międzynarodowego Czasu Atomowego ( $TAI$ ) tylko o całkowitą liczbę sekund. Zmiany mające zapobiec większemu niż 1 sekunda oddaleniu czasu koordynowanego od czasu uniwersalnego są dokonywane poprzez dodanie tzw. sekundy przestępnej (leap second) 31 grudnia lub 30 czerwca. Od 1 lipca 2012 roku różnica ta wynosi<sup>13)</sup>:

$$TAI - UTC = 35^s \quad (60)$$

Różnice  $[UT1 - UTC]$ , a także  $[UT1 - TAI]$ , określające relacje pomiędzy skalą czasu astronomicznego obrotowego i skalami czasu atomowego są regularnie wyznaczane przez IERS na podstawie obserwacji VLBI, GPS, SLR i DORIS, a następnie publikowane w biuletynach IERS (<http://www.iers.org>).

<sup>13)</sup> Wprowadzenie sekundy przestępnej jest każdorazowo ogłaszane w wydawanym przez IERS biuletynie C; (<ftp://hpiers.obspm.fr/eop-pc/bul/bulc/>).

### Zestawienie okresów, w których obowiązywał w Polsce czas letni

|                |                |     |               |                |     |                |                |     |               |                |     |
|----------------|----------------|-----|---------------|----------------|-----|----------------|----------------|-----|---------------|----------------|-----|
| od 1946.IV.14  | 0 <sup>h</sup> | CSE | do 1946.X.07  | 2 <sup>h</sup> | CSE | od 1991.III.31 | 2 <sup>h</sup> | CSE | do 1991.IX.29 | 2 <sup>h</sup> | CSE |
| od 1947.V.04   | 2 <sup>h</sup> | CSE | do 1947.X.05  | 2 <sup>h</sup> | CSE | od 1992.III.29 | 2 <sup>h</sup> | CSE | do 1992.IX.27 | 2 <sup>h</sup> | CSE |
| od 1948.IV.18  | 2 <sup>h</sup> | CSE | do 1948.X.03  | 2 <sup>h</sup> | CSE | od 1993.III.28 | 2 <sup>h</sup> | CSE | do 1993.IX.26 | 2 <sup>h</sup> | CSE |
| od 1949.IV.10  | 2 <sup>h</sup> | CSE | do 1949.X.02  | 2 <sup>h</sup> | CSE | od 1994.III.27 | 2 <sup>h</sup> | CSE | do 1994.IX.25 | 2 <sup>h</sup> | CSE |
| od 1957.VI.02  | 1 <sup>h</sup> | CSE | do 1957.IX.29 | 1 <sup>h</sup> | CSE | od 1995.III.26 | 2 <sup>h</sup> | CSE | do 1995.IX.24 | 2 <sup>h</sup> | CSE |
| od 1958.III.30 | 1 <sup>h</sup> | CSE | do 1958.IX.28 | 1 <sup>h</sup> | CSE | od 1996.III.31 | 2 <sup>h</sup> | CSE | do 1996.X.27  | 2 <sup>h</sup> | CSE |
| od 1959.V.31   | 1 <sup>h</sup> | CSE | do 1959.X.04  | 1 <sup>h</sup> | CSE | od 1997.III.30 | 2 <sup>h</sup> | CSE | do 1997.X.26  | 2 <sup>h</sup> | CSE |
| od 1960.IV.03  | 1 <sup>h</sup> | CSE | do 1960.X.02  | 1 <sup>h</sup> | CSE | od 1998.III.29 | 2 <sup>h</sup> | CSE | do 1998.X.25  | 2 <sup>h</sup> | CSE |
| od 1961.V.28   | 1 <sup>h</sup> | CSE | do 1961.X.01  | 1 <sup>h</sup> | CSE | od 1999.III.28 | 2 <sup>h</sup> | CSE | do 1999.X.31  | 2 <sup>h</sup> | CSE |
| od 1962.V.27   | 1 <sup>h</sup> | CSE | do 1962.IX.30 | 1 <sup>h</sup> | CSE | od 2000.III.26 | 2 <sup>h</sup> | CSE | do 2000.X.29  | 2 <sup>h</sup> | CSE |
| od 1963.V.26   | 1 <sup>h</sup> | CSE | do 1963.IX.29 | 1 <sup>h</sup> | CSE | od 2001.III.25 | 2 <sup>h</sup> | CSE | do 2001.X.28  | 2 <sup>h</sup> | CSE |
| od 1964.V.31   | 1 <sup>h</sup> | CSE | do 1964.IX.27 | 1 <sup>h</sup> | CSE | od 2002.III.31 | 2 <sup>h</sup> | CSE | do 2002.X.27  | 2 <sup>h</sup> | CSE |
| od 1977.IV.03  | 1 <sup>h</sup> | CSE | do 1977.IX.25 | 1 <sup>h</sup> | CSE | od 2003.III.30 | 2 <sup>h</sup> | CSE | do 2003.X.26  | 2 <sup>h</sup> | CSE |
| od 1978.IV.02  | 1 <sup>h</sup> | CSE | do 1978.X.01  | 1 <sup>h</sup> | CSE | od 2004.III.28 | 2 <sup>h</sup> | CSE | do 2004.X.31  | 2 <sup>h</sup> | CSE |
| od 1979.IV.01  | 1 <sup>h</sup> | CSE | do 1979.IX.30 | 1 <sup>h</sup> | CSE | od 2005.III.27 | 2 <sup>h</sup> | CSE | do 2005.X.30  | 2 <sup>h</sup> | CSE |
| od 1980.IV.06  | 1 <sup>h</sup> | CSE | do 1980.IX.28 | 1 <sup>h</sup> | CSE | od 2006.III.26 | 2 <sup>h</sup> | CSE | do 2006.X.29  | 2 <sup>h</sup> | CSE |
| od 1981.III.29 | 1 <sup>h</sup> | CSE | do 1981.IX.27 | 1 <sup>h</sup> | CSE | od 2007.III.25 | 2 <sup>h</sup> | CSE | do 2007.X.28  | 2 <sup>h</sup> | CSE |
| od 1982.III.28 | 1 <sup>h</sup> | CSE | do 1982.IX.26 | 1 <sup>h</sup> | CSE | od 2008.III.30 | 2 <sup>h</sup> | CSE | do 2008.X.26  | 2 <sup>h</sup> | CSE |
| od 1983.III.27 | 1 <sup>h</sup> | CSE | do 1983.IX.25 | 1 <sup>h</sup> | CSE | od 2009.III.29 | 2 <sup>h</sup> | CSE | do 2009.X.25  | 2 <sup>h</sup> | CSE |
| od 1984.III.25 | 1 <sup>h</sup> | CSE | do 1984.IX.30 | 1 <sup>h</sup> | CSE | od 2010.III.28 | 2 <sup>h</sup> | CSE | do 2010.X.31  | 2 <sup>h</sup> | CSE |
| od 1985.III.31 | 1 <sup>h</sup> | CSE | do 1985.IX.30 | 1 <sup>h</sup> | CSE | od 2011.III.27 | 2 <sup>h</sup> | CSE | do 2011.X.30  | 2 <sup>h</sup> | CSE |
| od 1986.III.30 | 1 <sup>h</sup> | CSE | do 1986.IX.28 | 1 <sup>h</sup> | CSE | od 2012.III.25 | 2 <sup>h</sup> | CSE | do 2012.X.28  | 2 <sup>h</sup> | CSE |
| od 1987.III.29 | 1 <sup>h</sup> | CSE | do 1987.IX.27 | 1 <sup>h</sup> | CSE | od 2013.III.31 | 2 <sup>h</sup> | CSE | do 2013.X.27  | 2 <sup>h</sup> | CSE |
| od 1988.III.27 | 1 <sup>h</sup> | CSE | do 1988.IX.25 | 1 <sup>h</sup> | CSE | od 2014.III.30 | 2 <sup>h</sup> | CSE | do 2014.X.26  | 2 <sup>h</sup> | CSE |
| od 1989.III.26 | 1 <sup>h</sup> | CSE | do 1989.IX.24 | 1 <sup>h</sup> | CSE | od 2015.III.29 | 2 <sup>h</sup> | CSE | do 2015.X.25  | 2 <sup>h</sup> | CSE |
| od 1990.III.25 | 2 <sup>h</sup> | CSE | do 1990.IX.30 | 2 <sup>h</sup> | CSE |                |                |     |               |                |     |

Kierując się względami praktycznymi, związanymi z posługiwaniem się czasem w życiu codziennym, na Konferencji Międzynarodowej w Washington D.C. w 1884 roku wprowadzono czas strefowy. Dokonano w tym celu podziału Ziemi na 24 południkowe strefy godzinne, każda o szerokości 15°. Granice stref dostosowano do wygody i życzenia mieszkańców poszczególnych regionów (w USA określono je dopiero w 1918 roku). Wewnątrz strefy obowiązuje jednolity czas strefowy. Południki strefowe przebiegające przez środek stref czasowych: 0°, 15°, 30°, ..., w kierunku na wschód od Greenwich ponumerowano odpowiednio liczbami całkowitymi: 0, 1, 2, ..., przypisując każdemu południkowi strefowemu odpowiednią liczbę  $\Delta Z$ .

**Czas strefowy (ZT) (Zonal Time)** jest to czas koordynowany (atomowy) południków strefowych. ZT jest przesunięty względem UTC (do 1964 roku względem czasu astronomicznego obrotowego GMT lub UT) o całkowitą (w większości wypadków) liczbę  $\Delta Z$  godzin, tj.:

$$ZT = UTC + \Delta Z \quad (61)$$

Poszczególne kraje opierają rachubę swego czasu urzędowego przeważnie na najbliższym południku strefowym. W Polsce podstawowym czasem urzędowym jest czas środkowoeuropejski (CSE), czyli czas południka oddalonego o 15° na wschód od Greenwich (jest to w przybliżeniu południk Zgorzelca). W innych państwach ustalony czas urzędowy obowiązuje nierzadko na obszarze kilku stref czasowych lub bywa przesunięty od odpowiedniego czasu strefowego o 30 lub 15 minut. W niektórych krajach w okresie letnim jest wprowadzany tzw. czas letni. Przy przechodzeniu z czasu zimowego na letni wskazówki zegarów są przesuwane o 1 godzinę do przodu, a przy powrocie na czas zimowy są o 1 godzinę cofane. W Polsce czas letni (czyli czas wschodnioeuropejski — czas południka 30°E) obowiązywał od wiosny do jesieni w latach 1946–1949 i 1957–1964, a począwszy od 1977 roku jest wprowadzany corocznie<sup>14)</sup>. Relacja między letnim i zimowym czasem urzędowym w Polsce a Czasem Uniwersalnym Koordynowanym przedstawia się następująco:

<sup>14)</sup> Dane na rok bieżący: Rozp. Prezesa Rady Ministrów z 5 stycznia 2012 r. w sprawie wprowadzenia i odwołania czasu letniego środkowoeuropejskiego w latach 2012–2016, Dz. U. z dnia 12 stycznia 2012 r., poz. 33.

$$\text{czas letni} = \text{czas wschodnioeuropejski} = UTC + 2^h$$

$$\text{czas zimowy} = \text{czas środkowoeuropejski (CSE)} = UTC + 1^h$$

W zagadnieniach, w których nie jest wymagana lepsza od 1 sekundy dokładność rejestracji czasu, czas środkowoeuropejski koordynowany można utożsamiać ze średnim słonecznym czasem środkowoeuropejskim. W przypadkach jednak, w których są wyższe wymagania dokładności rejestracji czasu, np. przy precyzyjnych wyznaczeniach astronomicznych azymutu, należy rozróżnić skalę czasu koordynowanego (atomowego) od skali czasu obrotowego.

W przeszłości istotną rolę odgrywały także inne, niestosowane obecnie, skale czasów. Do końca lat 30-tych XX wieku czas uniwersalny *UT* był uważany za jednostajną skalę czasu. Nieregularności *UT* dostrzeżono dopiero dzięki zastosowaniu zegarów kwarcowych, a później zegarów atomowych. Na podstawie analizy źródeł tych nieregularności, w miejsce czasu *UT* wprowadzono trzy jego reprezentacje, przy czym pojęcie czasu *UT* pozostawało nadal w użyciu przy określaniu czasu uniwersalnego gdy nie była wymagana wysoka dokładność:

*UT0* (lub *TU0*) — czas uniwersalny prawdziwy — wyznaczany bezpośrednio (po uwzględnieniu równania czasu) z obserwacji astronomicznych średni czas słoneczny średniego południka Greenwich, od którego były odmierzane długości geograficzne. Płaszczyzna średniego południka Greenwich była określona przez dwa kierunki: kierunek linii pionu w Greenwich oraz kierunek równoległy do średniej osi obrotu Ziemi<sup>15)</sup>, która łączy średnie bieguny geograficzne. Prawdziwy czas uniwersalny można było uważać za kątową miarę rzeczywistego obrotu Ziemi wokół średniej osi obrotu.

*UT1* (lub *TU1*) — czas uniwersalny średni — średni czas słoneczny chwilowego południka Greenwich, odniesionego do chwilowej osi obrotu Ziemi<sup>16)</sup> (czas uniwersalny średni, w którym zostały uwzględnione okresowe zmiany wywołane strefową składową pływów oznaczano przez *UT1R* — okresowości 5 – 35 dób, *UT1S* — okresowości 5 dób – 18.6 lat oraz *UT1D* — okresowości dobowe i krótsze: IERS Technical Note 21, 1996). Średni czas uniwersalny można było uważać za kątową miarę rzeczywistego obrotu Ziemi wokół chwilowej osi obrotu, która łączy chwilowe bieguny geograficzne.

*UT2* (lub *TU2*) — czas uniwersalny quasi-jednostajny — średni czas słoneczny chwilowego południka Greenwich uwolniony od sezonowych nieregularności ruchu obrotowego Ziemi. Quasi-jednostajny czas uniwersalny można było uważać za kątową miarę „uśrednionego” obrotu Ziemi wokół chwilowej osi obrotu<sup>17)</sup>.

Podane definicje reprezentacji systemów czasu uniwersalnego obowiązywały do 2003 roku. Zależności między zdefiniowanymi powyżej systemami czasu uniwersalnego można przedstawić za pomocą następujących wzorów:

$$UT1 = UT0 + \Delta\lambda \quad (62)$$

$$UT2 = UT0 + \Delta\lambda + \Delta T_s = UT1 + \Delta T_s \quad (63)$$

Znaczenie poprawek  $\Delta\lambda$  i  $\Delta T_s$ , które reprezentują odpowiednio efekt ruchu bieguna oraz sezonowe nieregularności ruchu obrotowego Ziemi zdefiniowano w części szczegółowej objaśnień RA (patrz wzory (75) i (76)).

Czasem astronomicznym bardziej jednostajnym od czasu obrotowego był Czas Efemeryd.

**Czas Efemeryd** (*ET* lub *TE*) (*Ephemeris Time* lub *Temps des Ephémérides*) zwany również czasem efemerydalnym, wprowadzony w 1954 roku, był czasem słonecznym lecz nie związanym z ruchem obrotowym Ziemi, a z jej ruchem orbitalnym wokół Słońca. Nieco później definicję *ET* związano również z ruchem orbitalnym Księżyca wokół Ziemi. Nie istnieje wzorzec podstawowy reprodukujący dobę *ET*. Miarą Czasu Efemeryd jest pozycja Słońca, a dokładnie jego długość ekliptyczna. Sekundę Czasu Efemeryd, która do 1967 roku była podstawową jednostką czasu, określa się jako  $1/31\,556\,925.974\,7$  część roku zwrotnikowego<sup>18)</sup> epoki 1900 styczeń 0<sup>d</sup> 12<sup>h</sup> Czasu Efemeryd.

<sup>15)</sup> W latach 1967–1988 średnia oś obrotu Ziemi była określona przez międzynarodowy umowny średni biegun północny Ziemi *CIO\**. Obecnie jest ona określona przez biegun *ITRS*.

<sup>16)</sup> W latach 1988–2002 oś chwilowa była utożsamiana z osią bieguna *CEP*, od roku 2003 — z osią bieguna *CIP*.

<sup>17)</sup> W latach 1988–2002 oś chwilowa była utożsamiana z osią bieguna *CEP*, od roku 2003 — z osią bieguna *CIP*.

<sup>18)</sup> Rok zwrotnikowy jest to odstęp czasu pomiędzy dwoma kolejnymi przejściami środka masy Ziemi przez płaszczyznę, którą tworzy środek Słońca, punkt równonocy wiosennej i kierunek bieguna ekliptyki (w ciągu roku zwrotnikowego długość ekliptyczna Słońca zmienia się o 360°).

Niestalość jednostek czasów słonecznego i gwiazdowego związanych z ruchem obrotowym Ziemi wynika nie tylko ze zmian sezonowych  $\Delta T_s$  w prędkości kątowej ruchu obrotowego Ziemi ale także z powodu zmian wiekowych i okresowych  $\Delta T$  tego ruchu. Zależność między Czasem Efemeryd a czasem uniwersalnym jest następująca:

$$ET = UT2 + \Delta T \quad (64)$$

gdzie  $\Delta T$  jest poprawką, której dokładną wartość można było otrzymać *ex post*, i to ze znacznym opóźnieniem wynikającym z konieczności opracowania pewnego okresu obserwacji długości ekliptycznej Księżyca i porównaniu z efemerydą. Poprawkę tę otrzymuje się na mocy wzorów:

$$\begin{aligned} \Delta T &= 24^s.349 + 72^s.318T + 29^s.950T^2 + 1^s.82144B''/1'' \\ B'' &= \lambda_{obs} - [\lambda_{Br.} + 4''.65 + 12''.96T + 5''.22T^2 - 10''.71 \sin(240^\circ.7 + 140^\circ.0T)] \end{aligned} \quad (65)$$

We wzorach (65)  $T$  oznacza liczbę stuleci juliańskich liczonych od momentu 1900 styczeń  $0^d 12^h UT1$ , zaś  $B''$  jest to tzw. fluktuacja, która przedstawia różnicę: zaobserwowana długość ekliptyczna Księżyca ( $\lambda_{obs}$ ) pomniejszona o jej wartość wziętą z tablic Browna ( $\lambda_{Br.}$ ), poprawiona o stałą i uzupełniona wiekowymi i okresowymi przyspieszeniami ruchu Księżyca. Dodać należy, że niejednostajność czasu słonecznego zaznacza się również w ruchu planet wewnętrznych. Ułożone przez Newcomba tablice Słońca z argumentem „czas uniwersalny” pozostają w mocy ze zmianą jedynie nazwy argumentu „czas uniwersalny” na „Czas Efemeryd”.

W roku 2015, zgodnie z przewidywaniami zawartymi w biuletynach IERS, można przyjmować następującą przybliżoną relację między Czasem Efemeryd a czasem uniwersalnym:

$$ET = UT1 + 67^s \quad (66)$$

Wadą Czasu Efemeryd jest jego zależność od podlegającej udoskonaleniom teorii ruchu Księżyca, a także nieuwzględnienie w nim efektów wynikających z ogólnej teorii względności.  $ET$  był używany jako argument równań ruchu ciał niebieskich układu słonecznego do 1984 roku, kiedy to został zastąpiony zdefiniowanym przez XVI Zgromadzenie Generalne IAU (Grenoble, 1976) (Rezolucja 5) Ziemijskim Czasem Dynamicznym.

**Ziemijski Czas Dynamiczny** ( $TDT$ ) (*Temps Dynamique Terrestre* lub *Terrestrial Dynamical Time*) był czasem atomowym odniesionym do środka mas Ziemi i zdefiniowanym następująco:

$$TDT = TAI + 32^s.184 \quad (67)$$

$TDT$  był używany jako argument efemeryd dla obserwacji z powierzchni Ziemi. Przesunięcie skali czasu  $TDT$  w stosunku do  $TAI$  o 32.184 s, odpowiadające różnicy między  $ET$  i  $TAI$  1977 styczeń  $1^d 0^h$ , zostało wprowadzone w celu zachowania ciągłości liczenia czasu przy przejściu od  $ET$  do  $TDT$ . Tablice Słońca Newcomba pozostały zatem nadal w mocy ze zmianą nazwy argumentu „Czas Efemeryd” na „Ziemijski Czas Dynamiczny”. Tak jak w przypadku  $ET$ , w roku 2015 można przyjmować przybliżoną relację między Ziemijskim Czasem Dynamicznym a czasem uniwersalnym:

$$TDT = UT1 + 67^s \quad (68)$$

Na mocy Rezolucji 4 XXI Zgromadzenia Generalnego IAU (Buenos Aires, 1991) Ziemijski Czas Dynamiczny został zastąpiony równoważnym mu Czasem Ziemijskim ( $TT$ ), tj.:

$$TT \equiv TDT \quad (69)$$

Astronomiczna rachuba czasu stosowana do długich jego odstępów (lat, stuleci) wiąże się z ruchem orbitalnym Ziemi. Okres pomiędzy dwoma kolejnymi przejściami środka Ziemi przez płaszczyznę utworzoną przez środek Słońca, punkt równonocy wiosennej oraz kierunek bieguna ekliptyki jest nazwany rokiem zwrotnikowym. Zawiera on  $365.242\,198\,79 - 0.000\,006\,14 \times t$  dób, gdzie  $t$  oznacza liczbę stuleci juliańskich od epoki 1900 styczeń  $0^d 12^h$  Czasu Efemeryd czyli od południa 31 grudnia 1899 r. Interwał czasu odpowiadający  $1/31\,556\,925.974\,7$  części roku zwrotnikowego na tę epokę został przyjęty jako sekunda Czasu Efemeryd, a następnie został uznany jako podstawowa jednostka czasu atomowego i miara sekundy SI.

**Data juliańska** ( $JD$ ) (*Julian Date*) jest ciągłą rachubą dni wprowadzoną w XVI wieku. Za początek tzw. okresu juliańskiego, od którego liczy się dni juliańskie, przyjęto moment  $-4712$  styczeń  $1^d 12^h$  czyli południe 1 stycznia 4713 p.n.e. Pierwotnie data juliańska była odniesiona do skali średniego czasu słonecznego, a do niedawna, do 1997 roku do  $UT1$ . Niekiedy specyfikowano daty juliańskie w odniesieniu do Czasu Efemeryd  $ET$  i wówczas oznaczano je jako  $JED$  (*Julian Ephemeris Date*). Doba juliańska zawsze rozpoczyna się o  $12^h 00^m 00^s$ , a jej długość odpowiada 24 godzinom lub 1440 minutom lub 86 400 sekundom skali czasu, do której została odniesiona. I tak, na przykład doba juliańska odniesiona do skali  $UT1$  odpowiada 86 400 sekundom  $UT1$ , czyli średniego czasu słonecznego, zaś doba juliańska odniesiona do  $ET$  odpowiada 86 400 sekundom efemerydalnym. Moment 1900 styczeń  $1^d 12^h UT1$  odpowiada  $JD(UT1) 2\,415\,021.0$ , zaś epoka J2000.0 (2000 styczeń  $1^d 12^h UT1$ ) odpowiada  $JD(UT1) 2\,451\,545.0$ .

XXIII Zgromadzenie Generalne IAU (Kyoto, 1997) na mocy Rezolucji B1 zaleciło aby data juliańska była wyrażana w skali Czasu Ziemskiego  $TT$ . W przypadku odniesienia daty juliańskiej do innej niż  $TT$  skali czasu, np.  $UT1$ , należy więc w myśl tej rezolucji stosować oznaczenie  $JD(UT1)$ .

Dla skrócenia zapisu i uproszczenia obliczeń, w końcu lat 1950, wprowadzono tzw. zmodyfikowaną datę juliańską ( $MJD$ ) (*Modified Julian Date*). Zazwyczaj korzysta się z następującej definicji  $MJD$ :

$$MJD = JD - 2\,400\,000.5 \quad (70)$$

Początek  $MJD$  pokrywa się z początkiem doby, tj.  $0^h$  odpowiedniej skali czasu. Rok juliański odpowiada 365.25 dobowi juliańskim, zaś stulecie juliańskie odpowiada 36 525 dobowi juliańskim.

**Juliańska data gwiazdowa** ( $JSD$ ) (*Julian Sidereal Date*) zwana również Datą Gwiazdową Greenwich ( $GSD$ ) (*Greenwich Sidereal Date*) jest odpowiednikiem daty juliańskiej, odniesionej do skali czasu gwiazdowego.  $JSD$  jest definiowany jako interwał czasu liczony w dobach gwiazdowych, określonych przez punkt równonocy na daną epokę, jaki upłynął na południku Greenwich od początku doby gwiazdowej, w której wypada moment  $JD 0.0$ . Przykładowo  $JSD 2\,421\,633.0$  odpowiada momentowi 1899 grudzień  $31^d 17^h 21^m 07.2^s UT1$  ( $JD 2\,415\,020.223$ ). Przybliżone zależności pomiędzy rachubami  $JD$  i  $JSD$  wyglądają następująco:

$$JSD = +0.671 + 1.002\,737\,909\,3 \times JD$$

$$JD = -0.669 + 0.997\,269\,566\,4 \times JSD$$

## CZĘŚĆ SZCZEGÓŁOWA

### Czas gwiazdowy Greenwich i Kąt Obrotu Ziemi (str. 8÷11)

Średni czas gwiazdowy Greenwich  $GMST$  o zerowej godzinie czasu uniwersalnego średniego  $UT1$  obliczono w odstępach dobowych według wzoru (56) zatwierdzonego uchwałą Międzynarodowej Unii Astronomicznej (Manchester, 2000) (Rezolucja B1.8). Wzór ten uwzględnia poprawkę związaną z obowiązującym od 2003 roku przejściem od punktu równonocy wiosennej (ekwinokcjum) systemu FK5 do  $CEO$  (obecnie  $CIO$ ) w  $IRS$  oraz przejściem od modelu precesyjno-nutacyjnego IAU2000 do modelu IAU2006 i zapewnia ciągłość w  $UT1$ , wyznaczanym z obserwacji astronomicznych i satelitarnych

$$GMST \text{ o } 0^h UT1 = 2\pi(0.779\,057\,273\,264\,0 + 1.002\,737\,811\,911\,354\,48T_u) + \\ + 0.014\,506 + 4612.156\,534\,t + 1.391\,581\,7\,t^2 - 0.000\,000\,44\,t^3 - 0.000\,029\,956\,t^4 - 0.000\,000\,036\,8\,t^5 \quad (71)$$

gdzie  $T_u$  jest wyrażony w dobach juliańskich<sup>19)</sup> odniesionych do skali czasu  $UT1$

$$T_u = JD(UT1) - 2\,451\,545.0 \quad (72)$$

zaś parametr  $t$  jest wyrażony w stuleciach juliańskich odniesionych do skali czasu  $TT$

$$t = (JD(TT) - 2000 \text{ styczeń } 1^d 12^h TT) / 36\,525 \quad (73)$$

Argumenty  $UT1$  i  $TT$  we wzorach (72) i (73) wyznacza się w oparciu o  $UTC$  z następujących zależności:

$$UT1 = UTC + [UT1 - UTC]_{\text{IERS}} \\ TT = UTC + 67^s.184$$

gdzie różnica  $[UT1 - UTC]_{\text{IERS}}$  jest wyznaczanym przez IERS parametrem ruchu obrotowego Ziemi<sup>20)</sup>.

Przy obliczaniu prawdziwego czasu gwiazdowego Greenwich  $GST$  stosowano wzory zatwierdzonej uchwałą IAU (Praha, 2006) teorii precesyjno-nutacyjnej IAU2006 (Rezolucja 1).

Wartości równania równonocy  $Eq$  otrzymuje się jako różnicę prawdziwego czasu gwiazdowego  $GST$  i średniego czasu gwiazdowego Greenwich  $GMST$ , zgodnie z zależnością (59).

Kąt Obrotu Ziemi ( $ERA$ )  $\theta$  zgodnie z Rezolucją B1.8 IAU (Manchester, 2000) jest obliczany wg wzoru (27).

#### Przykłady

- 1) Wyrazić moment 2015 sierpień  $26^d 8^h 48^m 30^s.0000$  czasu wschodnioeuropejskiego w średnim i prawdziwym czasie gwiazdowym południka Borowej Góry; rachunek należy prowadzić do  $0^s.0001$ .

|                                            |                      |                            |
|--------------------------------------------|----------------------|----------------------------|
| Czas wschodnioeuropejski                   | $8^h 48^m 30^s.0000$ |                            |
| minus redukcja strefowa $\Delta Z$         | $- 2\,00\,00.0000$   |                            |
| $UTC$                                      | $6\,48\,30.0000$     |                            |
| plus poprawka $[UT1 - UTC]_{\text{IERS}}$  | $- 0.6800$           | ze str. 41 (interpolowane) |
| $UT1$                                      | $6\,48\,29.3200$     |                            |
| plus redukcja $UT1$ na śr. czas gw.        | $+ 1\,07.1043$       | <sup>a)</sup>              |
| $\Delta s$ interwał cz. śr. gw. odp. $UT1$ | $6\,49\,36.4243$     |                            |
| $GMST$ o $0^h UT1$                         | $+22\,15\,42.7541$   | ze str. 10                 |
| $GMST$ w zadanym momencie                  | $5\,05\,19.1784$     |                            |
| plus długość geogr. BG                     | $+ 1\,24\,08.9140$   | <sup>b)</sup>              |
| śr. czas gwiazdowy BG                      | $6\,29\,28.0924$     |                            |
| plus równanie równonocy $Eq$               | $+ 0.1047$           | <sup>c)</sup>              |
| prawdziwy czas gwiazdowy BG                | $6\,29\,28.1971$     |                            |

<sup>a)</sup>  $6^h 48^m 29.3200 = 24\,509.3200$ ;  $24\,509.3200 \times 0.002\,737\,909\,3 = 67.1043$  (patrz wzór na str. 164).

<sup>19)</sup> Data juliańska na  $0^h TT$  każdego dnia roku 2015 jest podana w trzeciej kolumnie w tablicach pozycji Słońca na str. 12÷19.

<sup>20)</sup> Poprawki do czasu uniwersalnego są podane w tablicach na str. 40÷41.



- b) Wg uchwały IAU (Patras, 1982) (Rezolucja C4), długości geograficzne na wschód od Greenwich przybierają znak dodatni. Długość geograficzna BG wynosi  $1^h 24^m 08^s.9140$  (str. 7).
- c) Ze str. 10 wypisujemy podane na  $0^h$  czasu  $UT1$  na okalające daty wartości równania równonocy  $Eq$ , a następnie tworzymy różnice

|                                                |         |         |
|------------------------------------------------|---------|---------|
| 25                                             | +0.1009 |         |
| 2015.VIII.26 <sup>d</sup> 0 <sup>h</sup> $UT1$ | +0.1039 | +0.0030 |
| 27                                             | +0.1063 | +0.0024 |
| 28                                             | +0.1069 | +0.0006 |
|                                                |         | -0.0006 |
|                                                |         | -0.0018 |

Posłużymy się wzorem interpolacyjnym Bessela

$$u = u_0 + n\Delta_{1/2}^I + \frac{n(n-1)}{4} (\Delta_0^{II} + \Delta_1^{II}) + \dots$$

w którym pomijamy wyrazy zawierające trzecie i dalsze różnice, ponieważ nie mają one tu znaczenia praktycznego. Otrzymujemy

|                                              |                                                    |             |
|----------------------------------------------|----------------------------------------------------|-------------|
|                                              | $u_0$                                              | $= +0.1039$ |
| $n = \frac{6^h 48^m 29^s.3}{24^h} = +0.2837$ | $n\Delta_{1/2}^I$                                  | $= +0.0007$ |
| $\frac{n(n-1)}{4} = -0.0508$                 | $\frac{n(n-1)}{4} (\Delta_0^{II} + \Delta_1^{II})$ | $= +0.0001$ |
|                                              | $u$                                                | $= +0.1047$ |

Jeżeli rachunek zamiany czasów prowadzimy do  $0.001$ , to równanie równonocy wystarczy interpolować liniowo, a redukcję czasu średniego słonecznego do czasu średniego gwiazdowego można wykonać korzystając ze wzoru (16).

- 2) Wyrazić moment 2015 sierpień 26<sup>d</sup> 6<sup>h</sup> 29<sup>m</sup> 28<sup>s</sup>.1971 prawdziwego czasu gwiazdowego południka Borowej Góry w czasie środkowoeuropejskim i w czasie wschodnioeuropejskim; rachunek należy prowadzić do  $0.0001$ .

|                                                           |                                                      |                            |
|-----------------------------------------------------------|------------------------------------------------------|----------------------------|
| Prawdziwy czas gw. BG                                     | 6 <sup>h</sup> 29 <sup>m</sup> 28 <sup>s</sup> .1971 |                            |
| minus długość geogr. BG                                   | - 1 24 08.9140                                       | ze str. 7                  |
| $GST$                                                     | 5 05 19.2831                                         |                            |
| minus równanie równonocy $Eq$                             | - 0.1047 <sup>a)</sup>                               |                            |
| $GMST$ w zadanym momencie                                 | 5 05 19.1784                                         |                            |
| minus $GMST$ o 0 <sup>h</sup> $UT1$                       | -22 15 42.7541                                       | ze str. 10                 |
| $\Delta s$ – interwał cz. śr. gw. od 0 <sup>h</sup> $UT1$ | 6 49 36.4243                                         |                            |
| minus red. int. $\Delta s$ na odp. int. $UT1$             | - 1 07.1043 <sup>b)</sup>                            |                            |
| $UT1$                                                     | 6 48 29.3200                                         |                            |
| minus poprawka $[UT1 - UTC]_{IERS}$                       | + 0.6800                                             | ze str. 41 (interpolowane) |
| $UTC$                                                     | 6 48 30.0000                                         |                            |
| plus redukcja strefowa $\Delta Z$                         | + 1 00 00.0000                                       |                            |
| czas środkowoeuropejski                                   | 7 48 30.0000                                         |                            |
| plus redukcja strefowa $\Delta Z$                         | + 1 00 00.0000                                       |                            |
| czas wschodnioeuropejski                                  | 8 48 30.0000                                         |                            |

- a) Równanie równonocy interpolujemy jak w przykładzie poprzednim. Do obliczenia współczynnika  $n$  potrzebna jest znajomość a priori  $UT1$  w zadanym momencie. Jednakże niedokładność rzędu  $0.1^m$  nie stanowi przeszkody, toteż potrzebną wartość czasu  $UT1$  można obliczyć w następujący sposób:

|                                                         |                                                |           |
|---------------------------------------------------------|------------------------------------------------|-----------|
| czas gwiazdowy Greenwich                                | 5 <sup>h</sup> 05 <sup>m</sup> 32 <sup>s</sup> |           |
| minus czas gwiazdowy Gr. o 0 <sup>h</sup> $UT1$         | -22 15.71                                      |           |
| $\Delta s$ – interwał czasu gw. od 0 <sup>h</sup> $UT1$ | 6 49.61                                        |           |
| minus red. int. $\Delta s$ na odp. int. $UT1$           | - 1.12                                         | wzór (17) |
| $UT1$                                                   | 6 48.49                                        |           |

Następnie obliczamy współczynnik interpolacyjny:  $n = \frac{6^h 48.49^m}{24^h} = +0.2837$

Dalej postępujemy jak w przykładzie poprzednim.

- b)  $6^h 49^m 36.4243^s = 24 576.4243$ ;  $24 576.4243 \times 0.002 730 433 6 = 67.1043$  (patrz wzór (17)).

Jeżeli obliczenia zamiany czasów są prowadzone do  $0.001$ , to równanie równonocy  $Eq$  wystarczy interpolować liniowo, przy czym do obliczenia współczynnika interpolacyjnego  $n$  zadowalająca jest znajomość czasu uniwersalnego do  $0.1^h$ , a zamianę średniego czasu gwiazdowego na średni czas słoneczny można wykonać korzystając ze wzoru (14).

- 3) Obliczyć wartość Kąta Obrotu Ziemi na moment 2015 sierpień 26<sup>d</sup> 8<sup>h</sup> 48<sup>m</sup> 30.0000 czasu środkowoeuropejskiego; rachunek prowadzić do 0.0001.

|                                           |                                        |            |
|-------------------------------------------|----------------------------------------|------------|
| <i>CSE</i>                                | 8 <sup>h</sup> 48 <sup>m</sup> 30.0000 |            |
| minus redukcja strefowa $\Delta Z$        | -1 00 00.0000                          |            |
| <i>UTC</i>                                | 7 48 30.0000                           |            |
| plus poprawka $[UT1 - UTC]_{\text{IERS}}$ | - 0.6800                               | ze str. 41 |
| <i>UT1</i>                                | 7 48 29.3200                           |            |

Wartość Kąta Obrotu Ziemi można teraz obliczyć korzystając bezpośrednio ze wzoru (27) na str. 170, przyjmując  $T_u = JD(UT1) - J2000.0 = 2\,457\,260.5 + \frac{7\,48\,29.3200}{24^h} - 2\,451\,545.0 = 5\,715.825\,339\,352$  oraz biorąc wartość Kąta Obrotu Ziemi  $\theta$  modulo  $2\pi$  i wyrażając ją w jednostkach czasu

$$\theta = 6^h 04^m 40.9143^s$$

lub za pomocą liniowej interpolacji wartości  $\theta$ , podanych w czwartej kolumnie tablicy na str. 10 Rocznika

$$\theta = \theta_0 + n\Delta_0^I, \quad \text{gdzie } n = \frac{7^h 48^m 29.3200^s}{24^h} = +0.325\,339\,352$$

|                                                  | $\theta$                                                | $\Delta_0^I$                                          |
|--------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------|
| 2015 sierpień 26 <sup>d</sup> 0 <sup>h</sup> UT1 | 22 <sup>h</sup> 14 <sup>m</sup> 54 <sup>s</sup> .6362   | 24 <sup>h</sup> 03 <sup>m</sup> 56 <sup>s</sup> .5470 |
| 27                                               | 24 <sup>h</sup> + 22 18 51.1832                         |                                                       |
| $\theta_0$                                       | = 22 <sup>h</sup> 14 <sup>m</sup> 54 <sup>s</sup> .6362 |                                                       |
| $n\Delta_0^I$                                    | = + 7 49 46.2781                                        |                                                       |
| $\theta$                                         | = 6 04 40.9143                                          |                                                       |

### Słońce (str. 12÷19)

Początkiem okresu juliańskiego, od którego liczy się daty juliańskie ( $JD$ ), jest moment  $-4712$  styczeń 1<sup>d</sup> 12<sup>h</sup>  $TT$  czyli południe  $TT$  1 stycznia 4713 r. p.n.e.

Pozorne współrzędne równikowe ( $CIP$ ) Słońca: rektascensja ( $\alpha_{app}^{CIO}$ ) odniesiona do  $CIO$ , rektascensja ( $\alpha_{app}^\gamma$ ) odniesiona do punktu równonocy wiosennej i deklinacja ( $\delta_{app}$ ), obliczone w odstępach dobowych w skali czasu  $TT$ . Zawierają one wpływ aberracji rocznej. Zgodnie z zaleceniem IAU,  $CIO$  (poprzednio określany jako  $CEO$ ) zastąpił punkt równonocy wiosennej jako punkt początkowy liczenia rektascensji. Wynikająca stąd różnica w rektascensji Słońca wynosi średnio w roku 2015:  $\alpha_{app}^{CIO} - \alpha_{app}^\gamma \approx -48^s.2$ . Wartość deklinacji nie ulega zmianie.

W kolejnych kolumnach tablic zawarto:

- $V_\delta/1^h$ , przemianę deklinacji pozornej Słońca na jedną godzinę;
- $R$ , widomy kątowy promień tarczy słonecznej, obliczony przy założeniu, że liniowa średnica tarczy słonecznej  $D_\odot = 1.392 \times 10^9 \text{ m}$ ;
- $\pi$ , horyzontalną paralaksę równikową Słońca;
- $E$ , równanie czasu — jest to różnica pomiędzy rektascensją Słońca średniego i rektascensją środka tarczy Słońca prawdziwego. Jest to także różnica pomiędzy kątem godzinnym środka Słońca prawdziwego i kątem godzinnym Słońca średniego. Uwaga: w tablicach podano równanie czasu  $E$  zwiększone o 12<sup>h</sup>;
- $V_E/1^h$ , przemianę równania czasu na jedną godzinę.

Wschody i zachody Słońca odnoszą się do momentów wschodu i zachodu górnego brzegu tarczy słonecznej w Warszawie (Obserwatorium Politechniki) w czasie środkowoeuropejskim ( $UTC + 1^h$ ). W obliczeniach uwzględniono refrakcję średnią i paralaksę Słońca. Chcąc wyrazić wschody i zachody w czasie wschodnioeuropejskim, który w Polsce jest czasem letnim, należy do momentów podanych w Roczniku dodać jedną godzinę.

Przykład obliczenia pozornych współrzędnych równikowych Słońca

- 4) Obliczyć pozorne współrzędne równikowe Słońca w Niebieskim Pośrednim Systemie Odniesienia  $IRS_{\text{NIEBIESKI}}$  na moment 2015 sierpień 26<sup>d</sup> 8<sup>h</sup> 48<sup>m</sup> 30<sup>s</sup> czasu wschodnioeuropejskiego za pomocą wzoru interpolacyjnego Stirlinga

$$u = u_0 + n\Delta_0^I + \frac{n^2}{2}\Delta_0^{II} + \dots$$

Ze str. 17 Rocznika wypisujemy, podane na 0<sup>h</sup> czasu  $TT$ , wartości  $\alpha_{app}^{CIO}$  oraz  $\delta_{app}$  na okalające daty i tworzymy różnice

|                                               | $\alpha_{app}^{CIO}$                                 | $\delta_{app}$ |
|-----------------------------------------------|------------------------------------------------------|----------------|
| 25                                            | 10 <sup>h</sup> 13 <sup>m</sup> 16 <sup>s</sup> .439 | +10°56'21".66  |
|                                               | +220 <sup>s</sup> .004                               | −1240".62      |
| 2015.VIII.26 <sup>d</sup> 0 <sup>h</sup> $TT$ | 10 16 56.443                                         | +10 35 41.04   |
|                                               | −0 <sup>s</sup> .417                                 | −10".00        |
|                                               | +219.587                                             | −1250.62       |
| 27                                            | 10 20 36.030                                         | +10 14 50.42   |

Zadany moment podany jest w czasie wschodnioeuropejskim. Argumentem w tablicach Słońca jest natomiast Czas Ziemi  $TT$ , toteż w tymże czasie należy wyrazić zadany moment jeszcze przed rozpoczęciem rachunku interpolacyjnego. Przeliczenie to wykonuje się w sposób następujący:

|                                    |                                                     |           |
|------------------------------------|-----------------------------------------------------|-----------|
| czas wschodnioeuropejski           | 8 <sup>h</sup> 48 <sup>m</sup> 30 <sup>s</sup> .000 |           |
| minus redukcja strefowa $\Delta Z$ | −2 00 00.000                                        |           |
| $UTC$                              | 6 48 30.000                                         |           |
| plus ( $TAI - UTC$ )               | + 35.000                                            | wzór (60) |
| $TAI$                              | 6 49 05.000                                         |           |
| plus ( $TT - TAI$ )                | + 32.184                                            | wzór (44) |
| $TT$                               | 6 49 37.184                                         |           |

Teraz można obliczyć współczynnik interpolacyjny

$$n = \frac{6^h 49^m 37^s.184}{24^h} = +0.284\,458$$

skąd

$$\frac{n^2}{2} = +0.0405$$

Obliczenie współrzędnych przebiega następująco:

|                              | $\alpha_{app}^{CIO}$                                 | $\delta_{app}$ |
|------------------------------|------------------------------------------------------|----------------|
| $u_0$                        | 10 <sup>h</sup> 16 <sup>m</sup> 56 <sup>s</sup> .443 | +10°35'41".04  |
| $n\Delta_0^I$                | + 1 02.5226                                          | − 5 54.327     |
| $\frac{n^2}{2}\Delta_0^{II}$ | − 0.0169                                             | − 0.405        |
| $u$                          | 10 <sup>h</sup> 17 <sup>m</sup> 58 <sup>s</sup> .949 | +10°29'46".31  |

Deklinację pozorną można także obliczyć posługując się przemianami zamieszczonymi w następnej za deklinacją kolumnie, na mocy wzoru

$$u = u_0 + np \left[ V_0 + \frac{n}{2}\Delta_0^I(V_0) + \dots \right]$$

Tym razem, poszukując deklinacji na ten sam moment co poprzednio, wypisujemy ze str. 17, oprócz wartości  $\delta_{app}$ , także jej przemiany na jedną godzinę,  $V_\delta/1^h$  na okalające daty, a następnie tworzymy różnice przemian

|                                               |          |         |
|-----------------------------------------------|----------|---------|
| 25                                            | −51".477 | −0".424 |
| 2015.VIII.26 <sup>d</sup> 0 <sup>h</sup> $TT$ | −51.901  | −0.410  |
| 27                                            | −52.311  |         |

Współczynnik interpolacyjny pozostaje taki sam jak poprzednio, tj.  $n = +0.284\,458$ .

Współczynnik  $p$ , który przedstawia stosunek interwału funkcji  $u$ , do interwału jej przemiany  $V$ , równa się

$$p = \frac{24^h}{1^h} = 24$$

Dalszy rachunek przebiega następująco:

|               |           |                              |            |            |                 |
|---------------|-----------|------------------------------|------------|------------|-----------------|
| $\frac{n}{2}$ | = +0.1422 | $V_0$                        | = −51".901 | $\delta_0$ | = +10°35'41".04 |
| $np$          | = +6.8270 | $\frac{n}{2}\Delta_0^I(V_0)$ | = − 0.059  | $npV$      | = − 5 54.731    |
|               |           | $V$                          | = −51".960 | $\delta$   | = +10°29'46".31 |

Przykłady przeliczenia kąta godzinnego Słońca prawdziwego (obserwowany)

- 5) Znaleźć kąt godzinny Słońca prawdziwego względem południka Borowej Góry na moment 2015 sierpień 26<sup>d</sup> 8<sup>h</sup>48<sup>m</sup>30<sup>s</sup> czasu wschodnioeuropejskiego.

Kąt godzinny Słońca prawdziwego oblicza się ze wzoru  $t = T + E - \mu\Delta T'$ , gdzie  $T$  jest czasem średnim słonecznym odniesionym do południka lokalnego,  $E$  efemerydalnym równaniem czasu, a  $\mu\Delta T'$  poprawką związaną z przejściem pomiędzy czasem  $TT$ , w którym jest wyrażone równanie czasu, a czasem  $UT1$ . Wielkość  $\mu = 0.002\,737\,909\,350\,795$  (por. wzór ze str. 164), zaś  $\Delta T'$  jest zdefiniowana za pomocą wzoru

$$\Delta T' = TT - UT1$$

Przy przeliczaniu kąta godzinnego Słońca prawdziwego w 2015 roku z dokładnością 0.005 wystarczy przyjąć  $\Delta T' = 67^s$ , skąd  $\mu\Delta T' = 0^s.183$ .

|                                                         |                                                     |                            |
|---------------------------------------------------------|-----------------------------------------------------|----------------------------|
| Czas wschodnioeuropejski                                | 8 <sup>h</sup> 48 <sup>m</sup> 30 <sup>s</sup> .000 |                            |
| minus redukcja strefowa $\Delta Z$                      | – 2 00 00.000                                       |                            |
| $UTC$                                                   | 6 48 30.000                                         |                            |
| plus $[UT1 - UTC]_{IERS}$                               | – 0.680                                             | ze str. 41 (interpolowane) |
| $UT1$                                                   | 6 48 29.320                                         |                            |
| plus długość geograficzna BG                            | + 1 24 08.914                                       | ze str. 7                  |
| średni czas słoneczny BG                                | 8 12 38.234                                         |                            |
| minus $\mu\Delta T'$                                    | – 0.183                                             |                            |
| kąt godz. Sł. śr. wzgl. połud. BG minus 12 <sup>h</sup> | 8 12 38.051                                         |                            |
| plus równanie czasu plus 12 <sup>h</sup>                | 11 58 02.976 <sup>a)</sup>                          |                            |
| kąt godzinny Słońca prawdziw. wzgl. południka BG        | 20 10 41.027                                        |                            |

<sup>a)</sup> Wyrażamy, zadany w czasie wschodnioeuropejskim moment, w  $TT$

|                                    |                                                     |           |
|------------------------------------|-----------------------------------------------------|-----------|
| Czas wschodnioeuropejski           | 8 <sup>h</sup> 48 <sup>m</sup> 30 <sup>s</sup> .000 |           |
| minus redukcja strefowa $\Delta Z$ | – 2 00 00.000                                       |           |
| $UTC$                              | 6 48 30.000                                         |           |
| plus $(TAI - UTC)$                 | + 35.000                                            | wzór (60) |
| $TAI$                              | 6 49 05.000                                         |           |
| plus $(TT - TAI)$                  | + 32.184                                            | wzór (44) |
| $TT$                               | 6 49 37.184                                         |           |

Ze str. 17 Rocznika wypisujemy na najbliższą północ  $TT$  zwiększone o 12 godzin równanie czasu oraz przemiany równania czasu na okalające daty, a następnie obliczamy pierwsze różnice przemian

|                                               |         |         |
|-----------------------------------------------|---------|---------|
| 25                                            | +0.6804 | +0.0177 |
| 2015.VIII.26 <sup>d</sup> 0 <sup>h</sup> $TT$ | +0.6981 | +0.0171 |
| 27                                            | +0.7152 |         |

liczymy współczynniki

$$n = \frac{6\,49\,37.184}{24^h} = +0.284\,458, \quad \frac{n}{2} = +0.1422, \quad p = \frac{24^h}{1^h} = 24, \quad np = +6.8270$$

i obliczamy interpolowaną wartość równania czasu

$$E + 12^h = 11\,57\,58.193 + 6.8270(0.6981 + 0.1422 \times 0.0174) = 11\,58\,02.976$$

- 6) Wyrazić w czasie uniwersalnym średnim  $UT1$  moment, w którym w dniu 26 sierpnia 2015 roku kąt godzinny Słońca prawdziwego względem południka Borowej Góry wynosi 20<sup>h</sup>10<sup>m</sup>41<sup>s</sup>.027.

|                                                              |                                                      |                         |
|--------------------------------------------------------------|------------------------------------------------------|-------------------------|
| Kąt godz. Słońca prawdziw. wzgl. południka BG                | 20 <sup>h</sup> 10 <sup>m</sup> 41 <sup>s</sup> .027 |                         |
| minus długość geogr. Borowej Góry                            | – 1 24 08.914                                        | ze str. 7               |
| kąt godz. Słońca prawdziw. wzgl. poł. Greenwich              | 18 46 32.113                                         |                         |
| minus $(E + 12^h)$                                           | – 11 58 02.976 <sup>a)</sup>                         |                         |
| kąt godz. Sł. śr. wzgl. poł. Greenwich minus 12 <sup>h</sup> | 6 48 29.137                                          |                         |
| plus $\mu\Delta T'$                                          | + 0.183                                              | zob. przykład poprzedni |
| $UT1$                                                        | 6 48 29.320                                          |                         |

- a) Do obliczenia równania czasu potrzeba znać a priori czas  $TT$  w zadanym momencie, ale niedokładność paru sekund nie ma znaczenia. Przybliżoną w tych granicach wartość czasu  $TT$  obliczamy w sposób następujący:

|                                                     |                     |                            |
|-----------------------------------------------------|---------------------|----------------------------|
| kąt godz. Słońca prawd. wzgl. poł. Greenwich        | $18^h 46^m 32^s.11$ |                            |
| minus $(E + 12^h)$                                  | $-11 58 02.95$      | <sup>b)</sup>              |
| kąt godz. Sł. śr. wzgl. poł. Greenwich minus $12^h$ | $6 48 29.16$        |                            |
| plus $\mu\Delta T'$                                 | $+ 0.18$            | zob. przykład poprzedni    |
| $UT1$                                               | $6 48 29.34$        |                            |
| minus $[UT1 - UTC]_{\text{IERS}}$                   | $+ 0.68$            | ze str. 41 (interpolowane) |
| $UTC$                                               | $6 48 30.02$        |                            |
| plus $(TAI - UTC)$                                  | $+ 35.00$           | wzór (60)                  |
| $TAI$                                               | $6 49 05.02$        |                            |
| plus $(TT - TAI)$                                   | $+ 32.18$           | wzór (44)                  |
| $TT$                                                | $6 49 37.20$        |                            |

- b) Do obliczenia przybliżonej wartości równania czasu współczynnik interpolacyjny  $np$  określamy na podstawie wartości kąta godzinowego Słońca względem południka Greenwich zmniejszonej o  $12^h$ , czyli przybliżonej (błędnej głównie o wartość równania czasu minus  $\Delta T'$ ) wartości czasu  $TT$ . Możemy tak zrobić, ponieważ przemiany równania czasu są podane na  $0^h TT$ , a zatem  $n = TT/24^h$ , przy czym są to przemiany godzinowe, zatem  $p = 24^h/1^h$ . Tak więc

$$np \simeq \frac{\text{czas sł. pr. Greenwich}}{1^h} = \frac{18^h 47^m - 12^h}{1^h} = 6.8$$

Przybliżoną wartość równania czasu (zwiększoną o  $12^h$ ) interpolujemy liniowo, korzystając z danych ze str. 17, podobnie jak w przykładzie poprzednim

$$E + 12^h = 11^h 57^m 58.19 + 6.8 \times 0.70 = 11^h 58^m 02.95$$

Z tą prowizoryczną wartością równania czasu kończymy rachunek przybliżonej wartości czasu  $TT$ . Następnie liczymy dokładnie współczynniki interpolacyjne

$$n = \frac{6^h 49^m 37.20}{24^h} = +0.284\,458, \quad \frac{n}{2} = +0.1422, \quad np = +6.8270$$

a wreszcie ostateczną wartość równania czasu, z którą kończymy obliczenia zasadnicze. Tu również korzystamy z danych ze str. 17, użytych w przykładzie poprzednim

$$E + 12^h = 11^h 57^m 58.193 + 6.8270 (0.6981 + 0.1422 \times 0.0174) = 11^h 58^m 02.976$$

Pozorne współrzędne równikowe Słońca w układzie równikowym związanym z punktem równonocy wiosennej oblicza się według tego samego schematu z wykorzystaniem wielkości  $\alpha_{app}^\gamma$  w miejsce  $\alpha_{app}^{CIO}$ .

### Księżyc (str. 20÷27)

Pozorne współrzędne równikowe ( $CIP$ ) Księżyca: rektascensja ( $\alpha_{app}^{CIO}$ ) odniesiona do  $CIO$ , rektascensja ( $\alpha_{app}^\gamma$ ) odniesiona do punktu równonocy wiosennej i deklinacja ( $\delta_{app}$ ), obliczone w odstępach dobowych w skali czasu  $TT$ .

W kolejnych kolumnach tablic zawarto:

- $V_\delta/1^h$ , przemianę deklinacji pozornej Księżyca na jedną godzinę;
- $R$ , pozorny promień tarczy Księżyca;
- $\pi$ , horyzontalną paralaksę równikową Księżyca;
- Wiek Księżyca, interwał czasu liczony w dobach od nowiu.

Wschody i zachody Księżyca odnoszą się do momentów wschodu i zachodu górnego brzegu tarczy Księżyca w Warszawie (Obserwatorium Politechniki) w czasie środkowoeuropejskim ( $UTC + 1^h$ ). W obliczeniach uwzględniono refrakcję średnią i paralaksę Księżyca na dany moment. Chcąc wyrazić wschody, górowania i zachody w czasie wschodnioeuropejskim, który w Polsce jest czasem letnim, należy momenty podane w Roczniku zwiększyć o jedną godzinę. Godzina 24 otrzymana z dodawania byłaby wtedy godziną 0 dnia następnego.

### Pozorne położenie Słońca (str. 28)

Momentary wstępowania Słońca w poszczególne znaki Zodiaku podano w czasie  $TT$ , który w tym wypadku można utożsamiać z czasem uniwersalnym.

## Planety (str. 28÷29)

Pozorne współrzędne równikowe: rektascensja ( $\alpha_{app}^{CIO}$ ) i deklinacja ( $\delta_{app}$ ) planet: Merkurego, Wenus, Marsa obliczone w odstępach 10 dniowych zaś Jowisza, Saturna, Urana i Neptuna w odstępach 20 dniowych, w skali czasu  $TT$ . Są one odniesione do równika  $CIP$  oraz do  $CIO$ .

W kolejnych kolumnach tablic zawarto:

- $\pi$ , horyzontalną paralaksę równikową planety;
- $R$ , pozorny promień tarczy planety.

## Fazy Księżyca, perigeum, apogeum (str. 29)

Momenty osiągnięcia faz są podane do 1 minuty, momenty przejścia Księżyca przez perigeum i apogeum do 1 godziny.

Lunacja to cykl faz Księżyca pomiędzy dwoma kolejnymi nowiami. Czas trwania lunacji nosi nazwę miesiąca synodycznego i zwykle oba te pojęcia są utożsamiane. Zgodnie z propozycją Browna lunacje są numerowane kolejno od 17 stycznia 1923 roku (w nawiasach podano numery kolejnych lunacji).

Paralaksa Księżyca w perigeum i apogeum przyjmuje wartości ekstremalne.

## Tablice do obliczania czasu wschodu i zachodu Słońca i Księżyca poza Warszawą (str. 30÷31)

Momenty wschodu i zachodu Słońca oraz Księżyca w Warszawie, wyrażone w czasie środkowoeuropejskim, podano w tablicach na str. 12÷27. Czas wschodu i zachodu Słońca w innych miejscowościach Polski można obliczyć korzystając z danych zawartych w tablicy ze str. 30, a czas wschodu i zachodu Księżyca korzystając z danych z tablicy ze str. 31. Tablice te zawierają poprawki, jakie należy dodać (algebraicznie) do czasu wschodu i zachodu tych ciał niebieskich w Warszawie (z uwzględnieniem uwag zamieszczonych u dołu str. 30 i 31), aby otrzymać momenty wschodu i zachodu w  $CSE$  w innych miejscowościach.

*Przykład obliczenia momentów wschodów i zachodów poza Warszawą*

- 7) Obliczyć w czasie środkowoeuropejskim momenty wschodu i zachodu Słońca oraz Księżyca w dniu 10 marca 2015 roku w Kaliszu.

Ze str. 13 Rocznika dla Słońca i str. 21 dla Księżyca dostajemy

|        | Słońce    |            | Księżyc    |           |           |
|--------|-----------|------------|------------|-----------|-----------|
|        | wschód    | zachód     | wschód     | górow.    | zachód    |
| III.10 | $6^h03^m$ | $17^h31^m$ | $22^h37^m$ | $2^h46^m$ | $7^h50^m$ |
| III.11 |           |            |            | $3^h32^m$ |           |

Obliczamy dla Księżyca odstęp czasu  $\tau$ , przy czym  $\tau_E$  jest to odstęp czasu między wschodem a następującym po nim górowaniem, zaś  $\tau_W$  przedstawia odstęp czasu między poprzedzającym dany zachód górowaniem a momentem zachodu

$$\tau_E = 3^h32^m - 22^h37^m = 4^h55^m, \quad \tau_W = 7^h50^m - 2^h46^m = 5^h04^m$$

Do obliczeń przyjmujemy współrzędne geograficzne Kalisza

$$\varphi = +51^\circ 46' \quad \lambda = 18^\circ 06' = +1^h12^m.4$$

Najpierw interpolujemy dla szerokości geograficznej Kalisza dane ze str. 30 i 31, i układamy dla nich tabelki poprawek. Dla Słońca interpolujemy w wierszach okalających dat, a dla wschodu Księżyca w wierszach najbliższych  $\tau$  (dla zachodu Księżyca przyjmujemy tę samą wyinterpolowaną wartość z przeciwnym znakiem). Obliczamy także różnicę długości geograficznych Kalisz—Warszawa. Długość geograficzną Warszawy przyjmujemy przy tym równą  $+1^h24^m.0$ , tj. równą długości Obserwatorium Politechniki Warszawskiej (str. 7), do którego odnoszą się momenty wschodów i zachodów Słońca i Księżyca w Warszawie.

|        | Słońce   |          | Księżyc   |          | długość geogr.   |             |
|--------|----------|----------|-----------|----------|------------------|-------------|
|        | wsch.    | zach.    | $\tau$    | wsch.    | Kalisz           | $1^h12^m.4$ |
| III.02 | $-0^m.6$ | $+0^m.6$ | $4^h50^m$ | $-1^m.4$ | W-wa Obs. PW     | 1 24.0      |
| III.12 | $-0^m.2$ | $+0^m.2$ | $5^h00^m$ | $-1^m.2$ | $-\Delta\lambda$ | +11.6       |
|        |          |          | $5^h10^m$ | $-1^m.0$ |                  |             |

Poprawki na zadaną datę i dla odstępów czasu  $\tau$  interpolujemy liniowo. Wyinterpolowane poprawki dodajemy algebraicznie wraz z różnicą długości (długość Warszawy minus długość Kalisza) do danych dla Warszawy. Wyniki otrzymujemy w czasie środkowoeuropejskim.

|        |                       | Słońce    |            | Księżyc    |           |
|--------|-----------------------|-----------|------------|------------|-----------|
|        |                       | wschód    | zachód     | wschód     | zachód    |
| III.10 | Warszawa cz. śr. eur. | $6^h03^m$ | $17^h31^m$ | $22^h37^m$ | $7^h50^m$ |
|        | poprawka w szerokości | -0.3      | +0.3       | -1.4       | +1.0      |
|        | poprawka w długości   | +11.6     | +11.6      | +11.6      | +11.6     |
| III.10 | Kalisz cz. śr. eur.   | $6^h14^m$ | $17^h43^m$ | $22^h47^m$ | $8^h03^m$ |

### Poprawki do obliczeń momentów początku brzasku i końca zmierzchu cywilnego w Warszawie (str. 31)

Podano poprawki dla Warszawy 3 razy w miesiącu. Na inne dni wystarczy interpolować liniowo. Błąd wyniku końcowego nie przekracza 2 minut.

Odległość zenitalną środka Słońca w momentach początku brzasku i końca zmierzchu cywilnego przyjęto równą  $96^\circ30'$ .

### Wschód i zachód Słońca w niektórych miastach Polski (str. 32÷33)

Podano w czasie środkowoeuropejskim momenty wschodu i zachodu górnego brzegu tarczy słonecznej we wszystkie niedziele dla następujących miast polskich: Białegostoku, Bydgoszczy, Gdańska, Katowic, Kielc, Koszalina, Krakowa, Lublina, Łodzi, Olsztyna, Opola, Poznania, Rzeszowa, Szczecina, Wrocławia i Zielonej Góry.

### Wschód i zachód Słońca w niektórych stolicach europejskich (str. 34)

Podano w czasie środkowoeuropejskim momenty wschodu i zachodu górnego brzegu tarczy słonecznej dwa razy w miesiącu dla następujących stolic europejskich: Aten, Belgradu, Berlina, Budapesztu, Bukaresztu, Helsinek, Lizbony, Londynu, Madrytu, Moskwy, Paryża, Pragi, Rzymu, Sofii, Sztokholmu i Wiednia.

### Kalendarz Astronomiczny (str. 35)

Kalendarz Astronomiczny umożliwia odczytanie momentów wschodu i zachodu w Warszawie w czasie środkowoeuropejskim: Słońca, Merkurego, Wenus, Marsa, Jowisza i Saturna, a także początku brzasku cywilnego i astronomicznego oraz końca zmierzchu cywilnego i astronomicznego.

### Konfiguracje planet (str. 37)

Tablica konfiguracji planet zawiera momenty koniunkcji planet Układu Słonecznego ze Słońcem, Księżycem oraz koniunkcji wzajemnych, a także momenty elongacji planet wewnętrznych i opozycji planet zewnętrznych.

Koniunkcja oznacza moment, w którym odległość kątowa na sferze niebieskiej danych dwóch ciał jest minimalna.

Elongacja i opozycja oznaczają z kolei największą, względną, kątową odległość planety i Słońca na sferze niebieskiej.

Dwie ostatnie kolumny tablicy przedstawiają, odpowiednio, odległość kątową i położenie danej planety w stosunku do drugiego, wymienionego ciała Układu Słonecznego w momencie koniunkcji gdzie: N — oznacza, że wartość deklinacji planety jest większa niż wartość deklinacji drugiego ciała, S — przeciwnie.

### Zaćmienia Słońca i Księżycy (str. 38÷39)

Podano ogólne informacje o zaćmieniach Słońca i Księżycy. Dane liczbowe dotyczące zaćmień Słońca i Księżycy zaczerpnięto ze stron internetowych NASA (F. Espenak, J. Anderson, <http://eclipse.gsfc.nasa.gov/eclipse.html>).

## Współrzędne bieguna *CIP* („chwilowego” bieguna północnego Ziemi) oraz poprawka do czasu uniwersalnego (str. 40÷41)

Współrzędne  $x_{\text{IERS}}$ ,  $y_{\text{IERS}}$  Niebieskiego Bieguna Pośredniego *CIP* („chwilowego” bieguna północnego Ziemi) na lata 2013–2014 podano w pięciodniowych interwałach wraz z datą oraz zmodyfikowaną datą juliańską (*MJD*). Są one wyrażone w układzie płaskich współrzędnych prostokątnych o początku w *IRP* (IERS Reference Pole) w systemie *ITRS*. Do roku 1987 początkiem tego układu był *CIO\** (Conventional International Origin) w systemie *BTS* (BIH Terrestrial System).

Współrzędne te (nie wyrównywane) zostały obliczone na podstawie wykonanych różnymi technikami obserwacji, których wyniki są przekazywane do IERS i sprowadzone do wspólnego układu za pomocą odpowiednich, systematycznych, właściwych dla danej techniki poprawek. Oś  $x$  tego układu jest styczna do południka zerowego *ITRS* (*IRM* — IERS Reference Meridian) ze zwrotem w kierunku Greenwich, a oś  $y$  jest skierowana na zachód. Relacje pomiędzy  $\lambda_0$ ,  $\varphi_0$  i  $A_0$ , oznaczającymi odpowiednio długość, szerokość i azymut, odniesione do *IRP* oraz  $\lambda_{\text{CIP}}$ ,  $\varphi_{\text{CIP}}$  i  $A_{\text{CIP}}$ , oznaczającymi chwilowe współrzędne i azymut odniesione do *CIP* (bardzo bliskiego chwilowemu biegunowi Ziemi), wyrażają następujące wzory:

$$\begin{aligned}\lambda_0 &= \lambda_{\text{CIP}} - \frac{1}{15} (x'' \sin \lambda_0 + y'' \cos \lambda_0) \tan \varphi_0 \\ \varphi_0 &= \varphi_{\text{CIP}} - (x'' \cos \lambda_0 - y'' \sin \lambda_0) \\ A_0 &= A_{\text{CIP}} - (x'' \sin \lambda_0 + y'' \cos \lambda_0) \sec \varphi_0\end{aligned}\tag{74}$$

We wzorach (74) długości geograficzne punktów leżących na wschód od Greenwich mają wartości dodatnie, a azymuty liczy się od północy zgodnie z ruchem wskazówek zegara. Wielkości  $x''$  i  $y''$  odpowiadają współrzędnym płaskim  $x_{\text{IERS}}$ ,  $y_{\text{IERS}}$  bieguna *CIP* wyrażonym w sekundach łuku.

Poprawkę  $\Delta\lambda = UT1 - UT0$ , która służy do przejścia od czasu uniwersalnego południka *TIO* w *IRS* do czasu uniwersalnego południka zerowego *ITRS* Greenwich, można odnaleźć w pierwszym ze wzorów (74). Mamy mianowicie

$$\Delta\lambda = UT1 - UT0 = -\frac{1}{15} (x'' \sin \lambda_0 + y'' \cos \lambda_0) \tan \varphi_0\tag{75}$$

Oprócz współrzędnych bieguna *CIP* tablica zawiera także różnice  $UT1 - UTC$ . Pozwalają one na przejście od Czasu Uniwersalnego Koordynowanego *UTC* do średniego czasu uniwersalnego  $UT1$ .

Wielkości  $\Delta T_s = UT2 - UT1$ , które przedstawiają sezonowe nieregularności ruchu obrotowego Ziemi, są przedstawiane od szeregu lat za pomocą wzoru

$$\Delta T_s = +0^s.022 \sin 2\pi\tau - 0^s.012 \cos 2\pi\tau - 0^s.006 \sin 4\pi\tau + 0^s.007 \cos 4\pi\tau\tag{76}$$

We wzorze (76)  $\tau$  oznacza część roku, jaka upłynęła od jego początku do zadanego momentu.

Współrzędne bieguna *CIP* są odniesione do układu o początku w *IRP*, przy czym do opracowania końcowych wyników  $UT1 - UTC$  są przyjmowane wyrównane współrzędne w systemie *ITRS*.

Dane dotyczące bieguna *CIP* oraz różnice  $UT1 - UTC$  na koniec roku 2013 i większą część roku 2014 zamieszczono na str. 40. Dane stanowią wynik obliczeń prowadzonych na bieżąco przez IERS, aktualizowanych dwa razy w tygodniu i publikowanych jako tzw. rozwiązanie C04<sup>21)</sup> oraz w wydawanych co miesiąc przez IERS biuletynach B<sup>22)</sup>. Tablica zawiera dane dostępne w chwili wydawania Rocznika.

Przybliżone, przewidywane, dostępne w chwili wydawania Rocznika, współrzędne bieguna *CIP* oraz różnice  $UT1 - UTC$  na koniec roku 2014 i znaczną część roku 2015 zostały przedstawione w tablicy na str. 41. Dane te zaczerpnięto z biuletynu A<sup>23)</sup>, wydawanego przez IERS Rapid Service/Prediction Center w US Naval Observatory i podano z dokładnością do dwóch cyfr znaczących.

<sup>21)</sup> Dane te są dostępne pod adresem internetowym: <ftp://ftp.iers.org/products/eop/long-term/>.

<sup>22)</sup> Biuletyny B są dostępne pod adresem internetowym: <ftp://hpiers.obspm.fr/eop-pc/bul/bulc/>.

<sup>23)</sup> Biuletyny A są dostępne pod adresem internetowym: <ftp://maia.usno.navy.mil/ser7/ser7.dat>.



Podano aktualne informacje o wybranych, europejskich i światowych radiostacjach nadających całodobowo sygnały czasu. Dane te zostały zaczerpnięte z *BIPM Annual Report on Time Activities, Vol. 8, 2013*, wydawanego corocznie przez Bureau International des Poids et Mesures, w Sèvres oraz stron internetowych wybranych stacji nadawczych.

Poprawki do momentów emisji sygnałów względem Czasu Uniwersalnego Koordynowanego *UTC* są z reguły zaniebdywalne w porównaniu do błędów znajomości czasu propagacji fal radiowych.

W Polsce sygnały czasu są nadawane przez rozgłośnie Polskiego Radia z Głównego Urzędu Miar, który wysyła sygnały złożone z sześciu krótkich znaków fonicznych, następujących po sobie w odstępach sekundowych. Początek ostatniego znaku oznacza równą godzinę z dokładnością większą niż 1 ms.

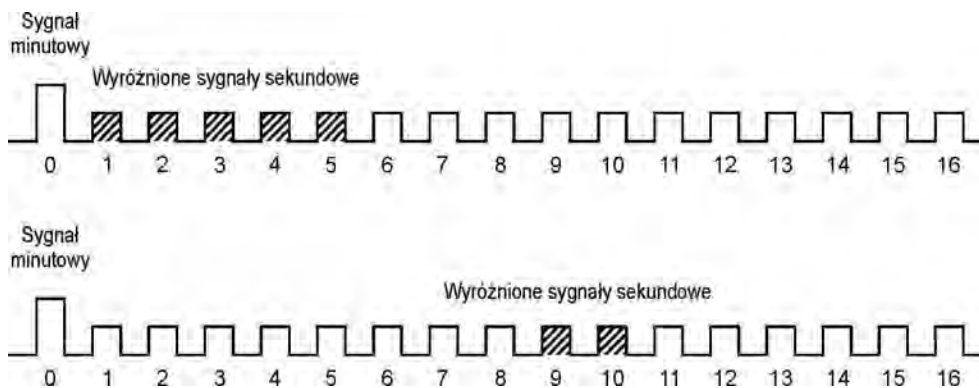
Z sygnałów Polskiego Radia można korzystać przy wyznaczeniach azymutu astronomicznego metodą kąta godzinowego Polaris. Poprawki tych sygnałów względem czasu koordynowanego, a także poprawki propagacyjne na obszarze Polski, są przy tym zaniebdywalne. Do momentu emisji należy jedynie wprowadzać wartości  $DUT1^{24)}$  i przy przejściach do czasu południka Greenwich pamiętać o różnicy między czasem uniwersalnym a czasem urzędowym

$$DUT1 = UT1 - UTC \quad (77)$$

Większość emitowanych sygnałów dokładnego czasu zawiera w sobie informację o wartości poprawki  $DUT1$ , wyrażonej w  $0^s.1^{25)}$ . Dodatnia wartość  $DUT1$  jest wskazywana przez wyróżnienie następujących po sobie  $n$  sygnałów sekundowych po sygnale oznaczającym pełną minutę. Ujemna wartość  $DUT1$  jest wskazywana przez  $n$  następujących po sobie, wyróżnionych sygnałów sekundowych, począwszy od dziewiątej sekundy po impulsie oznaczającym pełną minutę

$$DUT1 = n \times 0^s.1 \quad (78)$$

Impulsy sekundowe sygnalizujące wartość poprawki  $DUT1$  są wyróżniane np.: przez przedłużenie sygnału, podwojenie, lub zmianę jego tonu. Na rys. 4 przedstawiono kodowanie poprawek  $DUT1 = 0^s.5$  oraz  $DUT1 = -0^s.2$ .



Rys. 4 Kodowanie poprawek  $DUT1$

## Mapa deklinacji magnetycznej (str. 43)

Z mapy deklinacji magnetycznej na epokę 2015.5 można wyinterpolować przybliżoną wartość deklinacji magnetycznej dla dowolnego punktu na obszarze Polski. Aby otrzymać wartość deklinacji na inną epokę, należy ekstrapolować liniowo z uwzględnieniem podanej zmiany rocznej. Epoka, na którą dokonuje się ekstrapolacji nie powinna odbiegać bardziej niż 5 lat od epoki mapy deklinacji.

<sup>24)</sup> Informacje o wartościach poprawek  $DUT1$  są publikowane w biuletynie D IERS (<ftp://hpiers.obspm.fr/eop-pc/bul/buld/>).

<sup>25)</sup> Niektóre stacje jak np. RWM i RBU kodują w sygnałach czasu dodatkową informację ( $dUT1$ ), pozwalającą na określenie różnicy czasu  $UT1 - UTC$  z dokładnością do  $0^s.02$ .

## Miejsca średnie gwiazd (str. 44÷62)

Miejsca średnie ( $\alpha_{2015.5}$ ,  $\delta_{2015.5}$ ) gwiazd wybranych z katalogu FK5 (*Fifth Fundamental Catalogue*), ich przemiany roczne  $VA_\alpha$ ,  $VA_\delta$  oraz roczne ruchy własne  $\mu_\alpha$ ,  $\mu_\delta$ , obliczono zgodnie z uchwałą IAU (Grenoble, 1976) (patrz str. 160 niniejszego RA), to znaczy w systemie stałych IAU1976, wychodząc z pozycji katalogowych FK5, odniesionych do epoki J2000.0 i ekwinokcjum FK5. Miejsca średnie gwiazd są podane na epokę 2015.5. Wybór zawiera 475 gwiazd północnej półkuli niebieskiej, w tym 460 gwiazd o deklinacji nie większej niż  $81^\circ$  i 15 gwiazd bliskobiegunowych, których deklinacje przekraczają  $81^\circ$  oraz 474 gwiazdy południowej półkuli niebieskiej, z których 5 leży blisko bieguna południowego.

Jasności gwiazd o deklinacjach zawartych w granicach od  $-81^\circ$  do  $+81^\circ$  nie przekraczają  $5.68^m$ . Oznaczenia *pr*, *sq*, *cg*, umieszczone przy numerach gwiazd (wg FK5), odnoszą się do gwiazd podwójnych i oznaczają odpowiednio: *praecedens* — poprzedzająca, *sequens* — następująca, *centrum gravitatis* — środek mas. Znak \* przy numerze gwiazdy (wg FK5) oznacza, że w Roczniku są podane również jej pozycje pozorne. W kolumnie jasności gwiazdowych (magnitudo) literą *v* oznaczono gwiazdy zmienne — jasności gwiazd pochodzą z katalogu FK4. Tablice zawierają ponadto typy widmowe (Sp) gwiazd oraz ich paralaksy ( $\pi$ ) zaczerpnięte z katalogu FK5.

## Barycentryczne pozycje gwiazd w systemie ICRS (BCRS) (str. 63÷81)

Tablice barycentrycznych pozycji gwiazd, zgodnie z Rezolucją B2 XXIII Zgromadzenia Generalnego IAU (Kyoto, 1997), zostały opracowane na podstawie katalogu Hipparcos uznanego za podstawową realizację ICRS w zakresie widma optycznego. Tablice zawierają te same gwiazdy, których miejsca średnie na epokę J2015.5 zamieszczono w tablicach na str. 44÷62. Zamieszczone w niniejszym Roczniku Astronomicznym barycentryczne pozycje ICRF gwiazd na epokę J2000.0 obliczono korzystając z ich pozycji podanych w katalogu Hipparcos (odniesionego do epoki J1991.25), w oparciu o tzw. „standardowy model ruchu gwiazd” (zakładający ich prostoliniowy ruch w trójwymiarowej przestrzeni), z uwzględnieniem ruchów własnych w rektascensji i deklinacji (Hipparcos) oraz prędkości radialnych. Katalog Hipparcos nie zawiera danych o prędkościach radialnych gwiazd. Prędkości radialne  $V_R$  większości gwiazd pochodzą więc z katalogu FK6, a w wypadku gwiazd, których on nie obejmuje, z katalogu FK5.

W tablicach barycentrycznych pozycji gwiazd dla każdej gwiazdy podano jej numer katalogowy według katalogu Hipparcos (HIP) oraz według katalogu FK5, jasność gwiazdy (magnitudo), jej pozycję barycentryczną  $\alpha_{ICRF}$  i  $\delta_{ICRF}$  oraz ruchy własne  $\mu_\alpha$  i  $\mu_\delta$ , przeliczone na epokę J2000.0, a także paralaksę roczną  $\pi$  oraz typ widmowy (Sp). Wszystkie powyższe dane zaczerpnięte zostały z katalogu Hipparcos.

Oznaczenia *pr*, *sq*, *cg* umieszczone przy numerach gwiazd (HIP) odnoszą się do gwiazd podwójnych i oznaczają, podobnie jak w tablicach miejsc średnich, odpowiednio: *praecedens* — poprzedzająca, *sequens* — następująca, *centrum gravitatis* — środek mas. Znak \* przy numerze gwiazdy (HIP) oznacza, że w Roczniku są podane również jej pozycje pozorne. W kolumnie jasności gwiazdowych (magnitudo) literą *v* oznaczono gwiazdy zmienne.

W przypadku gwiazd podwójnych o wyróżniającej się jasności, np. Syriusz lub Biegunowa, ich pozycje barycentryczne odnoszą się do środka mas układu podwójnego.

## Wielkości redukcyjne (str. 82÷ 89)<sup>26)</sup>

Wielkości redukcyjne podano w odstępach dobowych na  $0^h$  Dynamicznego Czasu Gwiazdowego *SDT*. Służą one do obliczania miejsc pozornych  $\alpha_{app}^\gamma$ ,  $\delta_{app}$ .

Współrzędne pozorne gwiazdy oblicza się następująco:

$$\begin{aligned}\alpha_{app}^\gamma &= \alpha_0 + (A + A')a + (B + B')b + Cc + Dd + E + \mu_\alpha \tau + I_\alpha \tan^2 \delta_0 \\ \delta_{app} &= \delta_0 + (A + A')a' + (B + B')b' + Cc' + Dd' + \mu_\delta \tau + I_\delta \tan \delta_0\end{aligned}\quad (79)$$

gdzie  $\alpha_0$ ,  $\delta_0$  to miejsca średnie na środek roku, a wielkości redukcyjne  $A$ ,  $A'$ ,  $B$ ,  $B'$  odnoszą się do precesji i nutacji

$$\begin{aligned}A + A' &= n\tau + (\Delta\Psi + d\Psi) \sin \varepsilon & A' &= d\Psi \sin \varepsilon \\ B + B' &= -(\Delta\varepsilon + d\varepsilon) & B' &= -d\varepsilon\end{aligned}\quad (80)$$

<sup>26)</sup> W świetle uchwały IAU (Montreal, 1979), metoda tu opisywana nie może być stosowana w obliczeniach wymagających wysokiej precyzji (patrz str. 160 niniejszego RA).

$C$  i  $D$  są to wielkości redukcyjne uwzględniające aberrację roczną

$$\begin{aligned} C &= 1191''.286\,16\,\dot{Y} \\ D &= -1191''.286\,16\,\dot{X} \end{aligned} \quad (81)$$

przy czym  $\dot{X}, \dot{Y}$  to składowe barycentrycznego wektora prędkości Ziemi w jednostkach astronomicznych na dobę, a  $n$  oznacza precesję roczną w deklinacji (str. 7) wyrażoną w sekundach łuku. Ułamek  $\tau$  przedstawia część roku zwrotnikowego od środka roku do danego momentu. W pierwszej połowie roku jest on ujemny, a w drugiej dodatni.

Współczynniki  $a, b, c, d$  i  $a', b', c', d'$  są obliczane ze wzorów

$$\begin{aligned} a &= \frac{1}{15} \left( \frac{m}{n} + \tan \delta \sin \alpha \right) & a' &= \cos \alpha \\ b &= \frac{1}{15} \tan \delta \cos \alpha & b' &= -\sin \alpha \\ c &= \frac{1}{15} \sec \delta \cos \alpha & c' &= \tan \varepsilon \cos \delta - \sin \delta \sin \alpha \\ d &= \frac{1}{15} \sec \delta \sin \alpha & d' &= \sin \delta \cos \alpha \end{aligned} \quad (82)$$

gdzie  $m$  oznacza precesję roczną w rektascensji (str. 7) wyrażoną w sekundach łuku.

Ruch własny gwiazdy  $\mu_\alpha$  w rektascensji i  $\mu_\delta$  w deklinacji jest podany w tablicach miejsc średnich.

Wielkość redukcyjną  $E$  oblicza się ze wzoru

$$E = \frac{p_2}{p_1} (\Delta\Psi + d\Psi) \quad (83)$$

gdzie  $p_1$  oznacza roczną precesję równika, a  $p_2$  roczną precesję ekliptyki (str. 7).

Miejsca pozorne gwiazd, których paralaksa roczna jest nie mniejsza niż  $0''.010$ , oblicza się z uwzględnieniem wpływu tej ostatniej, w myśl następujących zależności:

$$\begin{aligned} c_\pi - c &= +0.05318\pi'' d & c'_\pi - c' &= +0.05318\pi'' d' \\ d_\pi - d &= -0.04476\pi'' c & d'_\pi - d' &= -0.04476\pi'' c' \end{aligned} \quad (84)$$

Wartości paralaks zamieszczone w tablicach na str. 44÷62 wzięto z *General Catalogue of Trigonometric Stellar Parallaxes* (Yale University Observatory, New Haven, Conn., 1952).

Przy obliczaniu miejsc pozornych gwiazd znacznie oddalonych od równika uwzględnia się wyrazy drugiego rzędu  $I_\alpha \tan^2 \delta_0$  oraz  $I_\delta \tan \delta_0$ . Dla gwiazd o deklinacjach  $\delta \approx 70^\circ$  wyrazy te mogą osiągać wartość około  $0''.01$ , a dla  $\delta \approx 80^\circ$  wartość około  $0''.02$ .

Występujące tu współczynniki  $I_\alpha$  i  $I_\delta$  oblicza się ze wzorów

$$I_\alpha = \frac{1}{15} PQ \sin 1'', \quad I_\delta = -\frac{1}{2} P^2 \sin 1'' \quad (85)$$

przy czym wielkości  $P$  i  $Q$  dane są wzorami

$$P = (A \pm D) \sin \alpha + (B \pm C) \cos \alpha, \quad Q = (A \pm D) \cos \alpha - (B \pm C) \sin \alpha \quad (86)$$

(dla gwiazd o  $\delta > 0^\circ$  należy brać znaki górne).

Nutację w długości  $\Delta\Psi$ ,  $d\Psi$  i nutację w nachyleniu  $\Delta\varepsilon$ ,  $d\varepsilon$ , a następnie wielkości redukcyjne  $A, A', B, B', C, D$  i  $E$  oraz czas gwiazdowy prawdziwy obliczono w systemie IAU1976 i w odniesieniu do standardowej epoki J2000.0.

W pierwszej części tablic podano w odstępach co 10 dób gwiazdowych miejsca pozorne  $\alpha_{app}^\gamma$  i  $\delta_{app}$  w momencie górowania w południku Greenwich 48 gwiazd nieba północnego i 8 gwiazd nieba południowego z katalogu FK5. Zostały one wybrane spośród gwiazd, których pozycje średnie na epokę 2015.5 zawarto w tablicach na stronach 44÷62. Przy nazwach gwiazd zamieszczono dodatkowo ich wielkości gwiazdowe i typy widmowe. U dołu kolumny każdej gwiazdy zamieszczono: miejsca średnie na środek roku, współczynniki  $\sec \delta$  i  $\tan \delta$  pomocne przy redukcji obserwacji przejść gwiazd przez południk, dzień, w którym przypada dwukrotne górowanie w południku Greenwich oraz wartości stałych redukcyjnych  $a, a', b, b'$ , służące do dodatkowego uwzględnienia krótkookresowej części nutacji, pominiętej w efemerydach tych gwiazd, według wzorów

$$\begin{aligned}\Delta\alpha_{app}^\gamma &= A'a + B'b \\ \Delta\delta_{app} &= A'a + B'b'\end{aligned}\quad (87)$$

W drugiej części, w odstępach dobowych zamieszczono efemerydy miejsc pozornych  $\alpha_{app}^\gamma$  i  $\delta_{app}$  Polaris i czterech innych gwiazd bliskobiegunowych: 1H Dra,  $\epsilon$  UMi,  $\delta$  UMi, 36H Cep. Efemerydy gwiazd okołobiegunowych zawierają już krótkookresową część nutacji. U dołu stronic podano daty dwukrotnego górowania<sup>28)</sup> oraz dołowania, miejsca średnie na środek roku, a także współczynniki  $\sec \delta$  i  $\tan \delta$  w odstępach co 10'' wartości deklinacji.

#### Przykłady obliczenia miejsc pozornych

- 8) Obliczyć przy użyciu wzoru interpolacyjnego Stirlinga, na podstawie tablic miejsc pozornych gwiazd, współrzędne pozorne gwiazdy  $\alpha$  Cygni (FK5 777) na moment 2015 październik 21<sup>d</sup>16<sup>h</sup>00<sup>m</sup>00<sup>s</sup> UT1.

Ze str. 101 Rocznika wypisujemy  $\alpha_{app}^\gamma$  i  $\delta_{app}$  na okalające daty oraz obliczamy pierwsze i drugie różnice

|                          | $\alpha_{app}^\gamma$                                | $\delta_{app}$ |
|--------------------------|------------------------------------------------------|----------------|
| 2015.X.06 <sup>d</sup> 8 | 20 <sup>h</sup> 41 <sup>m</sup> 59 <sup>s</sup> .304 | +45°20'38".44  |
|                          | −0.265                                               | +1.01          |
| 16.7                     | 59.039                                               | −0.008         |
|                          | −0.273                                               | +0.51          |
| 26.7                     | 58.766                                               | 39.96          |

Z dołu tej samej strony wypisujemy ponadto stałe redukcyjne, potrzebne do obliczenia wpływu krótkookresowej części nutacji

$$a = +0.102 \quad b = +0.044 \quad a' = +0.649 \quad b' = +0.761$$

Wielkości redukcyjne  $A'$  i  $B'$ , potrzebne do tego samego celu, bierzemy ze str. 88

|                            | $A'$    | $B'$    |
|----------------------------|---------|---------|
| 2015.X.20 <sup>d</sup> 919 | +0".038 | +0".042 |
|                            | +0.014  | −0.035  |
| 21.917                     | +0.052  | −0.015  |
|                            | −0.001  | −0.039  |
| 22.914                     | +0.051  | −0.032  |

Należy najpierw wyrazić zadany moment w średnim czasie gwiazdowym Greenwich

|                                            |                                 |
|--------------------------------------------|---------------------------------|
| UT1                                        | 16 <sup>h</sup> 00 <sup>m</sup> |
| plus redukcja UT1 na śr. czas gw.          | + 3                             |
| $\Delta s$ interwał czasu śr. gw. odp. UT1 | 16 03                           |
| GMST o 0 <sup>h</sup> UT1                  | + 1 56                          |
| GMST w zadanym momencie                    | 17 59                           |

ze str. 11

<sup>27)</sup> Porównanie wartości miejsc pozornych (odniesionych zarówno do CIO jak i punktu równonocy) opartych na danych katalogowych FK5 oraz Hipparcos wykazuje w wypadku niektórych gwiazd duże rozbieżności. Rozbieżności te mają swe źródło w systematycznych błędach pozycji zawartych w katalogu FK5 i osiągają niekiedy wartość nawet kilkuset mas. Dokonana w trakcie przygotowania Rocznika wstępna analiza danych prezentowanych w niniejszych tablicach wskazuje, że wspomniane rozbieżności dotyczą w szczególności gwiazd o numerach katalogowych FK5: 257 ( $\alpha$  CMa), 335 ( $\iota$  UMi), 417 ( $\zeta$  UMi) i 893 ( $\gamma$  Cep). Pozycje pozorne tych gwiazd wyznaczone w oparciu o katalog FK5 należy traktować ze szczególną ostrożnością.

<sup>28)</sup> Niezgodność tej daty z wynikającą z momentów górowania z pierwszej kolumny jest pozorna i wynika z zaokrąglenia tych ostatnich do jednego miejsca po przecinku.

Współczynnik interpolacji obliczamy jako podzieloną przez  $10^d$  (interwał z jakim tablicowane są w Roczniku miejsca pozorne) różnicę pomiędzy wyrażonym w czasie gwiazdowym momentem zadany (data oraz czas gwiazdowy) a najbliższym momentem, dla którego została podana w Roczniku pozycja pozorna gwiazdy, tj. datą oraz czasem  $UT1$  (ułamek doby) wyrażonym w skali czasu gwiazdowego. Ponieważ pozycje pozorne są podawane na moment górowania gwiazdy, moment czasu gwiazdowego efemerydy jest równy rektascensji gwiazdy.

|                                                                   |                                           |
|-------------------------------------------------------------------|-------------------------------------------|
| Czas gwiazdowy Greenwich w zadany momencie                        | 2015.X.21 17 <sup>h</sup> 59 <sup>m</sup> |
| epoka efemerydy (cz. gw. Gr. w momencie górowania = rektascensja) | 2015.X.17 20 42                           |
|                                                                   | +4 21 17                                  |

$$\text{współczynnik interpolacyjny } n = \frac{+4^d 21^h 17^m}{10^d} = +0.48868$$

Współczynnik do interpolowania wielkości redukcyjnych obliczamy w sposób następujący: od zadanego momentu, określonego liczbą dni miesiąca oraz ułamkiem doby, odpowiadającym czasowi uniwersalnemu średniemu  $UT1$ , odejmujemy najbliższą datę (złożoną z liczby dni miesiąca i ułamka doby, odpowiadającego czasowi uniwersalnemu średniemu  $UT1$ ), na którą są podane w Roczniku wielkości redukcyjne, a w końcu, aby prowadzić interpolację w dziedzinie czasu gwiazdowego, otrzymaną różnicę dzielimy przez współczynnik 0.998 wzór (14).

|                 |                                                                      |
|-----------------|----------------------------------------------------------------------|
| Zadany moment   | 21 <sup>d</sup> 16 <sup>h</sup> 00 <sup>m</sup> $UT1 = 21.667$ $UT1$ |
| epoka efemerydy | 21.917 $UT1$                                                         |
| różnica         | -0.250 cz. śr. sł.                                                   |

$$\text{współczynnik interpolacyjny } n = \frac{-0.250}{0.998} = -0.251$$

A oto rachunek interpolacyjny za pomocą wzoru Stirlinga

$$\begin{aligned}\alpha_{app}^{\gamma} &= 20^h 41^m 58.907 + 0.4887 (-0.5 \times 0.538 - 0.5 \times 0.4887 \times 0.008) = 20^h 41^m 58.907 \\ \delta_{app} &= +45^\circ 20' 39.76 + 0.4887 (0.5 \times 1.52 - 0.5 \times 0.4887 \times 0.50) = +45^\circ 20' 39.76 \\ A' &= +0.052 - 0.251 (0.5 \times 0.013 + 0.5 \times 0.251 \times 0.015) = +0.050 \\ B' &= +0.007 - 0.251 (-0.5 \times 0.074 + 0.5 \times 0.251 \times 0.004) = +0.016\end{aligned}$$

W ostatniej części rachunku uwzględniamy w myśl wzorów (87) wpływ krótkookresowej części nutacji, którego nie obejmują współrzędne pozorne publikowane w Roczniku

|                                      |                                        |                             |              |
|--------------------------------------|----------------------------------------|-----------------------------|--------------|
| $\alpha_{app}^{\gamma}$ bez kr. nut. | 20 <sup>h</sup> 41 <sup>m</sup> 58.907 | $\delta_{app}$ bez kr. nut. | +45°20'39.76 |
| $A'a$                                | + 0.0051                               | $A'a'$                      | + 0.032      |
| $B'b$                                | + 0.0007                               | $B'b'$                      | + 0.012      |
| $\alpha_{app}^{\gamma}$              | 20 <sup>h</sup> 41 <sup>m</sup> 58.913 | $\delta_{app}$              | +45°20'39.80 |

- 9) Obliczyć współrzędne równikowe pozorne  $\alpha_{app}^{\gamma}$  i  $\delta_{app}$  gwiazdy  $\alpha$  *Cygni* (FK5 777) na moment 2015 październik 21<sup>d</sup>16<sup>h</sup>00<sup>m</sup>00<sup>s</sup>  $UT1$ , wychodząc z miejsc średnich na środek roku.

Najpierw, ze str. 59 Rocznika (gwiazda nr FK5 777), wypisujemy współrzędne równikowe średnie i ruchy własne na epokę 2015.5 oraz paralaksę

|                                      |                                         |
|--------------------------------------|-----------------------------------------|
| $\alpha_{2015.5} = 20^h 41^m 57.648$ | $\delta_{2015.5} = +45^\circ 20' 10.79$ |
| $\mu_{\alpha} = +0.0003$             | $\mu_{\delta} = +0.002$                 |
| $\pi = 0.000$                        |                                         |

Dalej ze str. 88 wypisujemy wielkości redukcyjne oraz obliczamy pierwsze i drugie różnice. Na zadany moment interpolujemy za pomocą wzoru Stirlinga

| $UT1$                 | $\tau$  | $A + A'$ | $B + B'$   | $C$        | $D$        | $E$        |
|-----------------------|---------|----------|------------|------------|------------|------------|
| X.20 <sup>d</sup> 919 | +0.3013 | +5.514   | +8.995     | +16.658    | +9.705     | -0.0002    |
|                       |         | +53      | -19        | -153       | +313       |            |
| 21.917                | +0.3040 | +5.567   | -16 +8.976 | -3 +16.505 | -5 +10.018 | -3 -0.0002 |
|                       |         | +37      | -22        | -158       | +310       |            |
| 22.914                | +0.3067 | +5.604   | +8.954     | +16.347    | +10.328    | -0.0002    |

Wielkości redukcyjne są podane w Roczniku dla każdej doby na  $0^h$  Dynamicznego Czasu Gwiazdowego ale w pierwszej kolumnie tablic podano także *UT1* odpowiadający momentowi  $0^h$  Dynamicznego Czasu Gwiazdowego. Dzięki temu można obliczyć współczynnik interpolacyjny na moment wyrażony w czasie uniwersalnym bez potrzeby przeliczania go na czas gwiazdowy Greenwich. Wystarczy *UT1* momentu zadanego zamienić na ułamek doby i odjąć od niego *UT1* z pierwszej kolumny, najbliższy zadanemu momentowi, a różnicę podzielić przez interwał argumentu

$$\begin{array}{rcl} \text{moment zadany} & 2015.X.21^d 667 & UT1 \\ \text{epoka efemerydy} & 2015.X.21.917 & UT1 \\ \hline \text{różnica} & -0.250 & \text{cz. śr. sł.} \\ \\ \text{współczynnik interpolacyjny} & n = \frac{-0.250}{0.998} & = -0.251 \end{array}$$

Wyniki interpolacji za pomocą wzoru Stirlinga są następujące:

$$\begin{aligned} \tau &= +0.3033 \\ A + A' &= +5.555 \\ B + B' &= +8.981 \\ C &= +16.544 \\ D &= +9.940 \\ E &= -0.0002 \end{aligned}$$

Korzystając ze wzorów (82) i (84) obliczamy stałe redukcyjne

$$\begin{array}{ll} a = +0.10214 & a' = +0.6493 \\ b = +0.04380 & b' = +0.7605 \\ c_\pi = +0.06160 & c'_\pi = +0.8456 \\ d_\pi = -0.07215 & d'_\pi = +0.4618 \end{array}$$

Końcowe obliczenia wykonujemy wg wzorów (79), przy czym wyrazy drugiego rzędu są zaniedbywalne

$$\begin{array}{rclcl} \alpha_0 & 20^h 41^m 57.648 & \delta_0 & +45^\circ 20' 10.79 \\ (A + A')a & + 0.5674 & (A + A')a' & + 3.607 \\ (B + B')b & + 0.3934 & (B + B')b' & + 6.830 \\ Cc_\pi & + 1.0191 & Cc'_\pi & + 13.990 \\ Dd_\pi & - 0.7171 & Dd'_\pi & + 4.590 \\ E & - 0.0002 & & \\ \mu_\alpha \tau & + 0.0001 & \mu_\delta \tau & + 0.001 \\ \hline \alpha_{app}^\gamma & 20^h 41^m 58.911 & \delta_{app} & +45^\circ 20' 39.81 \end{array}$$

### Barycentryczna pozycja i prędkość oraz heliocentryczna pozycja Ziemi (str. 114÷121)

W tablicach podano, obliczone w oparciu o zalecane do stosowania przez IAU efemerydy JPL DE405, barycentryczne współrzędne kartezjańskie  $X_B^E, Y_B^E, Z_B^E$  środka mas Ziemi wyrażone w jednostkach astronomicznych, składowe prędkości orbitalnej Ziemi  $\dot{X}_B^E, \dot{Y}_B^E, \dot{Z}_B^E$  wyrażone w jednostkach astronomicznych na dobę oraz heliocentryczne współrzędne kartezjańskie  $X_H^E, Y_H^E, Z_H^E$  środka mas Ziemi wyrażone w jednostkach astronomicznych. Dane podano w odstępach dobowych odniesionych do *TCB*.

### Współrzędne bieguna niebieskiego *CIP* IAU2006 (str. 122÷123)

Tablice zawierają współrzędne  $X, Y$  bieguna niebieskiego *CIP* (IAU2006) w odniesieniu do bieguna *GCRS* na 2015 rok wyrażone w radianach, w odstępach dobowych, w czasie *TT*. Współrzędne bieguna niebieskiego *CIP* wraz z podaną na końcu tablic średnią wartością parametru  $s$  na 2015 rok mogą służyć do konstrukcji precesyjno-nutacyjnej macierzy obrotu, zgodnie z wzorem:

$$Q = \begin{pmatrix} Q_{11} & Q_{12} & Q_{13} \\ Q_{21} & Q_{22} & Q_{23} \\ Q_{31} & Q_{23} & Q_{33} \end{pmatrix} = \begin{pmatrix} 1 - aX^2 + saXY & s(1 - aX^2) - aXY & X \\ -s(1 - aY^2) - aXY & 1 - aY^2 - saXY & Y \\ -X + sY & -Y - sX & 1 - a(X^2 + Y^2) \end{pmatrix} \quad (88)$$

zgodnie z oznaczeniami wzoru (33).

Macierz  $Q$  jest macierzą obrotową przeprowadzającą wektor gwiazdy wyrażony w systemie  $IRS_{\text{niebieski}}$  do systemu *GCRS*. Chcąc dokonać przejścia odwrotnego, jak to ma miejsce np. przy obliczaniu miejsc pozornych, należy posługiwać się macierzą transponowaną  $Q^T$ .

W pierwszej części podano w odstępach co 7 dób na moment  $0^h$  UT1 miejsca pozorne  $\alpha_{app}^{CIO}$  i  $\delta_{app}$  48 gwiazd nieba północnego i 8 gwiazd nieba południowego, z zaznaczeniem przy nazwach gwiazd ich wielkości gwiazdowych i typów widmowych. Są to te same gwiazdy, dla których podano pozycje pozorne odniesione do punktu równonocy systemu FK5 na str. 90÷113. W przypadku gwiazd podwójnych (Syriusz, Biegunowa) pozycje pozorne zostały obliczone dla środków mas układów, a następnie zredukowane do środka optycznego tych układów. Dokładność wyznaczenia miejsc pozornych ( $IRS_{\text{NIEBESKI}}$ ) dla Syriusza i Biegunowej odbiega od dokładności pozycji pozostałych gwiazd z tabeli i jest na poziomie 0".10.

Zgodnie z zaleceniami IAU proces obliczenia miejsca pozornego gwiazdy w  $IRS_{\text{NIEBESKI}}$  ze znanej barycentrycznej pozycji gwiazdy w  $ICRF$ /Hipparcos składa się z trzech zasadniczych etapów: 1) poprawienie barycentrycznych współrzędnych gwiazdy w  $BCRF$  o ruch własny, z uwzględnieniem prędkości radialnej, 2) wykonanie transformacji Lorentza, przeprowadzającej współrzędne barycentryczne gwiazdy do współrzędnych geocentrycznych i jednocześnie  $TCB$  w  $TCG$ , 3) przejście do  $IRS_{\text{NIEBESKI}}$  poprzez uwzględnienie precesji i nutacji, zgodnie z modelem precesyjno–nutacyjnym IAU2006. Dla uproszczenia, z zachowaniem dokładności RA, proces ten może być wykonywany w następujących etapach: 1) przeliczenie czasów, 2) przejście z  $ICRF$ /Hipparcos do  $BCRF$  poprzez uwzględnienie ruchu własnego gwiazdy (łącznie z uwzględnieniem prędkości radialnej), 3) przejście z  $BCRF$  do  $GCRF$  poprzez uwzględnienie paralaksy rocznej gwiazdy, 4) poprawienie pozycji w  $GCRF$  o wpływ grawitacyjnego ugięcia światła, 5) poprawienie pozycji w  $GCRF$  o wpływ aberracji rocznej, 6) przejście do  $IRS_{\text{NIEBESKI}}$  poprzez uwzględnienie efektu precesyjno–nutacyjnego.

1. Czas  $TCG$  można obliczyć z czasu  $TCB$  na podstawie zależności (patrz też wzór (47))

$$TCB - TCG = L_C \times (JD - 2\,443\,144.5) \times 86\,400 + c^{-2} \mathbf{v}_e(\mathbf{x} - \mathbf{x}_e) + P$$

wykorzystując składowe barycentrycznych wektorów pozycji i prędkości Ziemi podane w tablicach RA na str. 114÷121. Pierwszy wyraz w tym wzorze jest dominujący i na połowę 2015 roku wynosi 18.0 s. Ostatni człon  $P$  odnoszący się do wyrazów okresowych nie przekracza 0.0016 s. Człon środkowy, zależny od barycentrycznego położenia i prędkości Ziemi i obserwatora, przybiera wartości poniżej 1  $\mu$ s.

Mając  $TCG$  można obliczyć  $TT$  ze wzoru (45). Na połowę roku 2015 różnica między  $TCG$  i  $TT$  wynosi 0.847 s.

2. Przejście od  $ICRF$ /Hipparcos do  $BCRF$  poprzez uwzględnienie ruchu własnego gwiazdy. Jednostkowy wektor barycentryczny  $\mathbf{p}_{ICRF}$  gwiazdy jest tworzony na podstawie barycentrycznej pozycji gwiazdy  $(\alpha_{ICRF}, \delta_{ICRF}) \equiv (\alpha, \delta)$  z katalogu Hipparcos (barycentryczne pozycje gwiazd podane w niniejszym Roczniku Astronomicznym w tablicach na str. 63÷81 odpowiadają pozycji barycentrycznej w  $ICRF$  na epokę J2000.0)

$$\mathbf{p}_{ICRF} = \begin{pmatrix} \cos \delta \cos \alpha \\ \cos \delta \sin \alpha \\ \sin \delta \end{pmatrix} \quad (89)$$

Barycentryczny wektor  $\mathbf{m}$  ruchu własnego gwiazdy ma postać

$$\mathbf{m}_{ICRF} = \begin{pmatrix} -\mu_{\alpha 0} \cos \delta \sin \alpha - \mu_{\delta 0} \sin \delta \cos \alpha + V_R \pi \cos \delta \cos \alpha \\ \mu_{\alpha 0} \cos \delta \cos \alpha - \mu_{\delta 0} \sin \delta \sin \alpha + V_R \pi \cos \delta \sin \alpha \\ \mu_{\delta 0} \cos \delta + V_R \pi \sin \delta \end{pmatrix} \quad (90)$$

gdzie  $\mu_{\alpha 0}$  i  $\mu_{\delta 0}$  oznaczają ruchy własne gwiazdy na stulecie juliańskie, prędkość radialna  $V_R$  jest wyrażona w jednostkach astronomicznych na stulecie juliańskie zaś paralaksa roczna  $\pi$  jest wyrażona w radianach.

Wektor pozycji barycentrycznej  $\mathbf{p}_{BCRF}$  gwiazdy w  $BCRF$  otrzymuje się z zależności

$$\mathbf{p}_{BCRF} = \mathbf{p}_{ICRF} + t \mathbf{m}_{ICRF} \quad (91)$$

<sup>29)</sup> Dokładność współczesnych modeli układu słonecznego oraz modelu precesyjno–nutacyjnego powoduje, że prezentacja danych o pozycjach pozornych gwiazd, w tradycyjnej formie: tabel z kilkudniowym interwałem, nie jest możliwa bez utraty dokładności pozycji pozornych — zwłaszcza wartości interpolowanych. Zapewnienie odpowiedniej dokładności danych musiałoby się wiązać z koniecznością znacznego skrócenia kroku tablicowania, a tym samym ze znacznym wzrostem objętości Rocznika. Miejsca pozorne gwiazd w Pośrednim Systemie Odniesienia, można obliczyć na dowolny zadany moment korzystając z Rocznika Astronomicznego „on-line”, dostępnego na stronach internetowych Centrum Geodezji i Geodynamiki IGIK, pod adresem: <http://www.igik.edu.pl>.

gdzie  $t = (JD(TCB) - 2\,451\,545.0)/36\,525$ .

3. Przejście od  $BCRF$  do  $GCRF$  dokonuje się poprzez uwzględnienie paralaksy rocznej

$$\mathbf{p}_{GCRF} = \mathbf{p}_{BCRF} - \pi \mathbf{E}_B \quad (92)$$

gdzie  $\mathbf{E}_B$  jest barycentrycznym wektorem pozycji Ziemi, którego współrzędne  $X_B^E, Y_B^E, Z_B^E$  z krokiem dobowym w skali czasu  $TCB$  są podane w tablicach na str. 114÷121 niniejszego RA.

4. Poprawienie pozycji gwiazdy w  $GCRF$  o wpływ grawitacyjnego zakrzywienia światła uzyskuje się dodając poprawkę  $\Delta \mathbf{p}_{graw}$  (uproszczony wzór (42))

$$\Delta \mathbf{p}_{graw} = \frac{2GM_\odot}{c^2 E_H} \frac{\mathbf{e}_H^E - (\mathbf{e}_{GCRF}^p \mathbf{e}_H^E) \mathbf{e}_{GCRF}^p}{1 + (\mathbf{e}_{GCRF}^p \mathbf{e}_H^E)} \quad (93)$$

gdzie  $\mathbf{e}_{GCRF}^p$  i  $\mathbf{e}_H^E$  są znormalizowanymi wektorami  $\mathbf{p}_{GCRF}$  i  $\mathbf{E}_H$ :  $\mathbf{e}_{GCRF}^p = \mathbf{p}_{GCRF}/|\mathbf{p}_{GCRF}|$ , a  $\mathbf{e}_H^E = \mathbf{E}_H/|\mathbf{E}_H|$ . Wektor  $\mathbf{E}_H$  jest heliocentrycznym wektorem wodzącym środka mas Ziemi, którego współrzędne  $X_H^E, Y_H^E, Z_H^E$  z krokiem dobowym w skali czasu  $TCB$  są podane w tablicach na str. 114÷121 niniejszego RA

$$\mathbf{p}'_{GCRF} = \mathbf{e}_{GCRF}^p + \Delta \mathbf{p}_{graw} \quad (94)$$

5. Poprawienie pozycji w  $GCRF$  o wpływ aberracji rocznej prowadzi do wyznaczenia właściwej pozycji  $\mathbf{p}''_{GCRF}$  gwiazdy w układzie geocentrycznym poruszającym się z prędkością  $\mathbf{V}$  w  $BCRS$ . Pozycję tę oblicza się ze wzoru

$$\mathbf{p}''_{GCRF} = \left( \beta^{-1} \mathbf{p}'_{GCRF} + \mathbf{V} + \frac{(\mathbf{p}'_{GCRF} \mathbf{V}) \mathbf{V}}{(1 + \beta^{-1})} \right) / (1 + \mathbf{p}'_{GCRF} \mathbf{V}) \quad (95)$$

gdzie  $\beta = 1/\sqrt{1 - V^2}$ , przy czym  $V = |\mathbf{V}|$ ; wektor  $\mathbf{V}$  jest liniową funkcją wektora  $\dot{\mathbf{E}}_B$  — prędkości środka mas Ziemi względem barycentrum Układu Słonecznego, którego współrzędne  $\dot{X}_B^E, \dot{Y}_B^E, \dot{Z}_B^E$  z krokiem dobowym w skali czasu  $TCB$  są podane w tablicach na str. 114÷121 niniejszego RA

$$\mathbf{V} = \dot{\mathbf{E}}_B/c = 0.005\,775\,5 \dot{\mathbf{E}}_B \quad (96)$$

$c$  jest prędkością światła wyrażoną w au/dobę.

6. Przejście od  $GCRF$  do  $IRS_{\text{NIEBESKI}}$ , w którym jest określona pozycja pozorna gwiazdy odbywa się poprzez uwzględnienie efektu precesyjno-nutacyjnego

$$\mathbf{p}_{IRS} = Q^T \mathbf{p}''_{GCRF} \quad (97)$$

gdzie  $Q$  jest macierzą precesyjno-nutacyjną (88), której elementy  $Q_{ij}$  z krokiem dobowym w skali czasu  $TCB$  są podane w tablicach na str. 122÷123 niniejszego RA<sup>30)</sup>.

Pozycję pozorną  $\alpha_{app}^{CIO}, \delta_{app}$  gwiazdy w  $IRS_{\text{NIEBESKI}}$  otrzymuje się ostatecznie ze współrzędnych kartezjańskich wektora  $\mathbf{p}_{IRS} = (x_{IRS}, y_{IRS}, z_{IRS})^T$

$$\begin{aligned} \alpha_{app}^{CIO} &= \arctan(y_{IRS}/x_{IRS}) \\ \delta_{app} &= \arcsin(z_{IRS}/\sqrt{x_{IRS}^2 + y_{IRS}^2 + z_{IRS}^2}) \end{aligned} \quad (98)$$

*Przykład obliczenia miejsc pozornych*

- 10) Obliczyć współrzędne równikowe pozorne  $\alpha_{app}^{CIO}$  i  $\delta_{app}$  gwiazdy  $\alpha$  *Cygni* (HIP 102098) w systemie  $IRS_{\text{NIEBESKI}}$  na moment 2015 październik 21<sup>d</sup>16<sup>h</sup>00<sup>m</sup>00<sup>s</sup> czasu  $UT1$ , wychodząc z jej pozycji w  $ICRS$  na epokę J2000.0.

<sup>30)</sup> Poprawki  $\delta X$  i  $\delta Y$  współrzędnych bieguna  $CIP$  (wzory (36) i (37)) nie przekraczają 0.2 *mas* i nie są uwzględniane w obliczeniach miejsc pozornych w Roczniku.



Dokonujemy zamiany czasu  $UT1$  na  $TT$ ,  $TCG$  i  $TCB$ <sup>31)</sup>

|                                   |                                    |                            |
|-----------------------------------|------------------------------------|----------------------------|
| $UT1$                             | $16^h 00^m 00^s.0000$              |                            |
| minus $[UT1 - UTC]_{\text{IERS}}$ | $-\frac{0.7300}{16\ 00\ 00.7300}$  | ze str. 41 (interpolowane) |
| $UTC$                             |                                    |                            |
| plus $(TAI - UTC)$                | $+\frac{35.0000}{16\ 00\ 35.7300}$ | wzór (60)                  |
| $TAI$                             |                                    |                            |
| plus $(TT - TAI)$                 | $+\frac{32.1840}{16\ 01\ 07.9140}$ | wzór (44)                  |
| $TT$                              |                                    |                            |
| plus $(TCG - TT)$                 | $+\frac{0.8534}{16\ 01\ 08.7674}$  | wzór (45)                  |
| $TCG$                             |                                    |                            |
| plus $(TCB - TCG)$                | $+\frac{18.1330}{16\ 01\ 26.9004}$ | wzór (47)                  |
| $TCB$                             |                                    |                            |

Z tablicy na str. 78 Rocznika wypisujemy podane na epokę J2000.0 barycentryczne współrzędne  $\alpha_{ICRF}$  i  $\delta_{ICRF}$  oraz ruchy własne  $\mu_{\alpha 0}$  i  $\mu_{\delta 0}$ , prędkość radialną  $V_R$  i paralaksę  $\pi$

$$\begin{aligned}\alpha_{ICRF} &= 20^h 41^m 25^s.9147 \\ \delta_{ICRF} &= +45^\circ 16' 49''.217 \\ \pi &= 1.010\ mas = 0.000\ 000\ 005\ rad \\ \mu_{\alpha 0} &= +0.1478\ ms/rok = +0.000\ 001\ 075\ rad/stulecie \\ \mu_{\delta 0} &= +1.5500\ mas/rok = +0.000\ 000\ 752\ rad/stulecie \\ V_R &= -4.5\ km/s = -94.927\ 275\ au/stulecie \quad (1\ km/s = 21.094\ 95\ au/stulecie)\end{aligned}$$

Zgodnie ze wzorem (89) tworzymy jednostkowy wektor barycentryczny  $\mathbf{p}_{ICRF}$  gwiazdy

$$\mathbf{p}_{ICRF} = \begin{pmatrix} 0.455\ 649\ 043 \\ -0.536\ 182\ 064 \\ 0.710\ 558\ 051 \end{pmatrix}$$

oraz, wykorzystując wzór (90) barycentryczny wektor  $\mathbf{m}_{ICRF}$  ruchu własnego gwiazdy

$$\mathbf{m}_{ICRF} = \begin{pmatrix} 0.000\ 000\ 019 \\ 0.000\ 001\ 146 \\ 0.000\ 000\ 199 \end{pmatrix}$$

Wyznaczamy parametr czasu  $t$

$$t = (JD(TCB) - 2\ 451\ 545.0)/36\ 525 = (2\ 457\ 317.167\ 7 - 2\ 451\ 545.000\ 0)/36\ 525 = 0.158\ 033\ 338$$

i korzystając ze wzoru (91) obliczamy wektor pozycji barycentrycznej  $\mathbf{p}_{BCRF}$  gwiazdy w  $BCRF$

$$\mathbf{p}_{BCRF} = \begin{pmatrix} 0.455\ 649\ 046 \\ -0.536\ 181\ 883 \\ 0.710\ 558\ 083 \end{pmatrix}$$

Z tablicy na str. 120 Rocznika wypisujemy współrzędne  $X_B^E$ ,  $Y_B^E$ ,  $Z_B^E$  barycentrycznego wektora pozycji Ziemi na okalające daty i dokonujemy interpolacji na moment  $TCB$

obliczamy pierwsze i drugie różnice

|      | $X_B^E$     |          | $Y_B^E$     |          | $Z_B^E$     |
|------|-------------|----------|-------------|----------|-------------|
| X.21 | 890 336 031 |          | 416 464 035 |          | 180 361 413 |
|      | -8 242 537  |          | 13 937 210  |          | 6 042 369   |
| 22   | 882 093 494 | -262 399 | 430 401 245 | -130 085 | 186 403 782 |
|      | -8 504 936  |          | 13 807 125  |          | 5 986 107   |
| 23   | 873 588 558 |          | 444 208 370 |          | 192 389 889 |

<sup>31)</sup> Przedstawiona zamiana czasów ma na celu zwrócenie uwagi na fakt, że poszczególne dane, wykorzystywane w obliczeniach są tablicowane w dziedzinie różnych skal czasowych. W praktyce, różnice wynikające z rozróżnienia tych skal nie mają jednak wpływu na wyniki końcowe. We wszystkich obliczeniach w tym przykładzie można więc posługiwać się wyłącznie czasem  $UTC$ .

a następnie obliczamy współczynnik interpolacyjny  $n$

|                     |                        |                                                       |
|---------------------|------------------------|-------------------------------------------------------|
| zadany moment $TCB$ | 2015.X.21 <sup>d</sup> | 16 <sup>h</sup> 01 <sup>m</sup> 26 <sup>s</sup> .9004 |
| epoka efemerydy     | 2015.X.22              | 0 00 00.0000                                          |
| różnica             |                        | – 7 58 33.0996                                        |

wsp. interpolacyjny  $n = \text{różnica}/24^h = -0.332\,327\,542$

i za pomocą wzoru interpolacyjnego Stirlinga liczymy interpolowane na moment  $TCB$  współrzędne wektora  $\mathbf{E}_B$

$$\begin{aligned} X_B^E &= [882\,093\,494 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (-8\,242\,537 - 8\,504\,936 + 262\,399 \cdot 0.332\,327\,542)] \times 10^{-9} \\ Y_B^E &= [430\,401\,245 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (13\,937\,210 + 13\,807\,125 + 130\,085 \cdot 0.332\,327\,542)] \times 10^{-9} \\ Z_B^E &= [186\,403\,782 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (6\,042\,369 + 5\,986\,107 + 56\,262 \cdot 0.332\,327\,542)] \times 10^{-9} \end{aligned}$$

$$\mathbf{E}_B = \begin{pmatrix} 0.884\,861\,827 \\ 0.425\,783\,958 \\ 0.184\,401\,978 \end{pmatrix}$$

Przejście od  $BCRF$  do  $GCRF$  dokonuje się przy użyciu wzoru (92), po zastosowaniu którego uzyskujemy

$$\mathbf{p}_{GCRF} = \begin{pmatrix} 0.455\,649\,042 \\ -0.536\,181\,885 \\ 0.710\,558\,082 \end{pmatrix}$$

Z tablicy na str. 120 Rocznika wypisujemy współrzędne  $X_H^E$ ,  $Y_H^E$ ,  $Z_H^E$  heliocentrycznego wektora pozycji Ziemi na okalające daty i dokonujemy interpolacji na moment  $TCB$  odpowiadający momentowi  $UT1$  przykładu obliczamy pierwsze i drugie różnice

|      | $X_H^E$     |          | $Y_H^E$     |          | $Z_H^E$     |
|------|-------------|----------|-------------|----------|-------------|
| X.21 | 886 686 461 |          | 415 560 793 |          | 180 142 641 |
|      | –8 244 095  |          | 13 931 136  |          | 6 039 786   |
| 22   | 878 442 366 | –262 390 | 429 491 929 | –130 090 | 186 182 427 |
|      | –8 506 485  |          | 13 801 046  |          | 5 983 522   |
| 23   | 869 935 881 |          | 443 292 975 |          | 192 165 949 |

i za pomocą wzoru interpolacyjnego Stirlinga, stosując wyznaczony uprzednio współczynnik interpolacyjny  $n$  liczymy interpolowane na moment  $TCB$  współrzędne wektora  $\mathbf{E}_H$

$$\begin{aligned} X_H^E &= [878\,442\,366 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (-8\,244\,095 - 8\,506\,485 + 262\,390 \cdot 0.332\,327\,542)] \times 10^{-9} \\ Y_H^E &= [429\,491\,929 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (13\,931\,136 + 13\,801\,046 + 130\,090 \cdot 0.332\,327\,542)] \times 10^{-9} \\ Z_H^E &= [186\,182\,427 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (6\,039\,786 + 5\,983\,522 + 56\,264 \cdot 0.332\,327\,542)] \times 10^{-9} \end{aligned}$$

$$\mathbf{E}_H = \begin{pmatrix} 0.881\,211\,216 \\ 0.424\,876\,661 \\ 0.184\,181\,482 \end{pmatrix}$$

Obliczamy długość  $E_H$  wektora  $\mathbf{E}_H$  ( $E_H = |\mathbf{E}_H|$ ) i wektory jednostkowe  $\mathbf{e}_{GCRF}^p = \mathbf{p}_{GCRF}/|\mathbf{p}_{GCRF}|$  i  $\mathbf{e}_H^E = \mathbf{E}_H/|\mathbf{E}_H|$

$$E_H = 0.995\,477\,877$$

$$\mathbf{e}_{GCRF}^p = \begin{pmatrix} 0.455\,649\,076 \\ -0.536\,181\,925 \\ 0.710\,558\,135 \end{pmatrix} \quad \mathbf{e}_H^E = \begin{pmatrix} 0.885\,214\,264 \\ 0.426\,806\,734 \\ 0.185\,018\,157 \end{pmatrix}$$

Przyjmując  $c = 299\,792\,458 \text{ ms}^{-1}$  i  $GM_S = 1.327\,124\,4 \times 10^{20} \text{ m}^3\text{s}^{-2}$  (patrz stałe astronomiczne str. 162) (przy czym  $GM_S/c^2 = 9.870\,63 \times 10^{-9} \text{ au}$ ) i korzystając ze wzoru (93) otrzymujemy poprawkę o wpływ grawitacyjnego ugięcia światła

$$\Delta \mathbf{p}_{graw} = \begin{pmatrix} 0.000\,000\,011 \\ 0.000\,000\,009 \\ -0.000\,000\,001 \end{pmatrix}$$

a następnie dodając ją do wektora  $\mathbf{e}_{GCRF}^p$  (zgodnie ze wzorem (94)) otrzymujemy poprawioną pozycję gwiazdy w  $GCRF$

$$\mathbf{p}'_{GCRF} = \begin{pmatrix} 0.455\,649\,087 \\ -0.536\,181\,916 \\ 0.710\,558\,134 \end{pmatrix}$$

Z tablicy na str. 120 Rocznika wypisujemy współrzędne  $\dot{X}_B^E, \dot{Y}_B^E, \dot{Z}_B^E$  barycentrycznego wektora prędkości Ziemi na okalające daty i dokonujemy interpolacji na moment  $TCB$  odpowiadający momentowi  $UT1$  przykładu

obliczamy pierwsze i drugie różnice

|      | $\dot{X}_B^E$ |       | $\dot{Y}_B^E$ |        | $\dot{Z}_B^E$ |
|------|---------------|-------|---------------|--------|---------------|
| X.21 | -8 110 465    |       | 14 000 898    |        | 6 069 906     |
|      | -263 711      |       | -128 058      |        | -55 372       |
| 22   | -8 374 176    | 2 632 | 13 872 840    | -4 034 | 6 014 534     |
|      | -261 079      |       | -132 092      |        | -57 146       |
| 23   | -8 635 255    |       | 13 740 748    |        | 5 957 388     |

i za pomocą wzoru interpolacyjnego Stirlinga, stosując wyznaczony uprzednio współczynnik interpolacyjny  $n$  liczymy interpolowane na moment  $TCB$  współrzędne wektora  $\dot{\mathbf{E}}_B$

$$\dot{X}_H^E = [-8\,374\,176 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (-263\,711 - 261\,079 - 2\,632 \cdot 0.332\,327\,542)] \times 10^{-9}$$

$$\dot{Y}_H^E = [13\,872\,840 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (-128\,058 - 132\,092 + 4\,034 \cdot 0.332\,327\,542)] \times 10^{-9}$$

$$\dot{Z}_H^E = [6\,014\,534 - \frac{1}{2} \cdot 0.332\,327\,542 \cdot (-55\,372 - 57\,146 + 1\,774 \cdot 0.332\,327\,542)] \times 10^{-9}$$

$$\dot{\mathbf{E}}_B = \begin{pmatrix} -0.008\,286\,830 \\ 0.013\,915\,845 \\ 0.006\,033\,133 \end{pmatrix}$$

W dalszej kolejności posługując się wzorem (96) obliczamy wektor  $\mathbf{V}$  i jego długość  $V$

$$\mathbf{V} = \begin{pmatrix} -0.000\,047\,861 \\ 0.000\,080\,371 \\ 0.000\,034\,844 \end{pmatrix}$$

$$V = 0.000\,099\,821$$

oraz  $\beta = 1/\sqrt{1-V^2}$ ,  $\beta = 1.000\,000\,005$ , które po wstawieniu do wzoru (95) prowadzą do wyznaczenia właściwej pozycji  $\mathbf{p}''_{GCRF}$  gwiazdy w układzie geocentrycznym

$$\mathbf{p}''_{GCRF} = \begin{pmatrix} 0.455\,619\,515 \\ -0.536\,123\,065 \\ 0.710\,621\,500 \end{pmatrix}$$

Z tablicy na str. 123 Rocznika wypisujemy współrzędne  $X$  i  $Y$  Niebieskiego Bieguna Pośredniego w  $GCRS$  na okalające daty i dokonujemy interpolacji na moment  $TT$  odpowiadający momentowi  $UT1$  przykładu

Obliczamy pierwsze i drugie różnice

|      | $X$       | $Y$     |
|------|-----------|---------|
| X.21 | 1 532 521 | -46 365 |
|      | 251       | 93      |
| 22   | 1 532 772 | -46 272 |
|      | 176       | 106     |
| 23   | 1 532 948 | -46 166 |

a następnie obliczamy współczynnik interpolacyjny  $n$

|                    |                        |                                                      |
|--------------------|------------------------|------------------------------------------------------|
| zadany moment $TT$ | 2015.X.21 <sup>d</sup> | 16 <sup>h</sup> 01 <sup>m</sup> 07.9140 <sup>s</sup> |
| epoka efemerydy    | 2015.X.22              | 0 00 00.0000                                         |
| różnica            |                        | -7 58 52.0860                                        |

wsp. interpolacyjny  $n = \frac{-7^h 58^m 52.0860^s}{24^h} = -0.332\,547\,292$  i za pomocą wzoru interpolacyjnego Stirlinga liczymy interpolowane na moment  $TT$  wartości  $X$  oraz  $Y$  składowych wektora jednostkowego  $CIP$

$$X = [1\,532\,772 - \frac{1}{2} \cdot 0.332\,547\,292 \cdot (251 + 176 + 75 \cdot 0.332\,547\,292)] \times 10^{-9}$$

$$Y = [-46\,272 - \frac{1}{2} \cdot 0.332\,547\,292 \cdot (93 + 106 - 13 \cdot 0.332\,547\,292)] \times 10^{-9}$$

Korzystając z wrorów (33) lub (88) oraz przyjmując średnią wartość parametru  $s$  dla roku 2015 podaną na str. 123 obliczamy wartości współczynników macierzy precesyjno-nutacyjnej  $Q$  (w obliczeniach wymagających dokładności nie lepszej niż 10 *mas* wpływ parametru  $s$  można zaniedbać przyjmując  $s = 0$ ).

$$\begin{aligned}
X^2 &= 0.000\,002\,349, \quad XY = -0.000\,000\,071, \quad Y^2 = 0.000\,000\,002, \quad a = 0.500\,000\,294, \quad s = 0.000\,000\,039 \\
1 - aX^2 &= 0.999\,998\,825, \quad aXY = -0.000\,000\,035, \quad 1 - aY^2 = 0.999\,999\,999, \quad 1 - a(X^2 + Y^2) = 0.999\,998\,824 \\
sX &= sY = s aXY = 0.000\,000\,000, \quad s(1 - aX^2) = 0.000\,000\,039, \quad s(1 - aY^2) = 0.000\,000\,039
\end{aligned}$$

$$Q = \begin{pmatrix} 0.999\,998\,825 & 0.000\,000\,074 & 0.001\,532\,697 \\ -0.000\,000\,003 & 0.999\,999\,999 & -0.000\,046\,305 \\ -0.001\,532\,697 & 0.000\,046\,305 & 0.999\,998\,824 \end{pmatrix}$$

Stosując wzór (97) obliczamy pozycję gwiazdy w  $IRS_{\text{NIEBESKI}}$

$$\mathbf{p}_{IRS} = \begin{pmatrix} 0.454\,529\,814 \\ -0.536\,090\,125 \\ 0.711\,343\,817 \end{pmatrix}$$

a następnie korzystając z (98) otrzymujemy pozycję pozorną  $\alpha_{app}^{CIO}$ ,  $\delta_{app}$  gwiazdy

$$\begin{aligned}
\alpha_{app}^{CIO} &= 20^h 41^m 10^s.393 \\
\delta_{app} &= +45^\circ 20' 39''.69
\end{aligned}$$

Miejsca pozorne odniesione do równika *CIP* oraz do *CIO* różnią się od miejsc pozornych odniesionych do równika FK5 i punktu równonocy wiosennej. Jeśli jednak dokona się transformacji wyrażonej obrotem wokół *CIP* o kąt odpowiadający różnicy między prawdziwym czasem gwiazdowym *GST* i Kątem Obrotu Ziemi (*ERA*), to rozbieżność w miejscach pozornych zostanie zredukowana do nieznaczącej zaledwie wielkości, która wynika z użycia, różnych w obu wypadkach, miejsc średnich i ruchów własnych gwiazd oraz różnych modeli precesyjno-nutacyjnych (do obliczenia pozycji pozornych odniesionych do równika *CIP* oraz do *CIO* są stosowane dane z katalogu Hipparcos oraz model precesyjno-nutacyjny IAU2006, zaś do obliczenia pozycji pozornych odniesionych do równika FK5 i punktu równonocy wiosennej są używane dane z katalogu FK5 oraz model IAU1976/IAU1980).

### Przybliżony azymut Biegunowej (str. 148)<sup>32)</sup>

Tablica zawiera przybliżone wartości azymutu Biegunowej, zestawione według dwóch argumentów: kąta godzinnego  $t$  Biegunowej i szerokości geograficznej  $\varphi$ .

Dla wartości kąta godzinnego  $t$  odczytanych z kolumny po lewej stronie, wartości w tablicy wyznaczają azymut liczony w kierunku przeciwnym do ruchu wskazówek zegara od kierunku północy (rzeczywisty azymut jest więc dopełnieniem podanych wartości do  $360^\circ$ ); dla wartości  $t$  odczytanych z kolumny po prawej stronie tablicy, azymut jest liczony zgodnie z ruchem wskazówek zegara (tablica zawiera rzeczywiste wartości azymutu).

### Przybliżona odległość zenitalna Biegunowej (str. 149)

Tablice służą do obliczania wartości pozornej odległości zenitalnej Polaris z dokładnością jednej minuty łuku według wzoru

$$z' = (90^\circ - \varphi) + \Delta z \quad (99)$$

Argumentem tablic jest kąt godzinny  $t$  Biegunowej. Odstępy argumentu są dobrane tak, aby następującym po sobie interwałom kąta godzinnego odpowiadały kolejne, zmieniające się skokami co 1 minutę łuku wielkości  $\Delta z$ . Tak więc znając kąt  $t$  wystarczy odszukać w tablicach interwał, w którym on się mieści i odczytać poprawkę  $\Delta z$  odpowiadającą temu interwałowi.

W poprawkach  $\Delta z$  uwzględniono refrakcję normalną dla  $\varphi = 52^\circ$ .

Odległość zenitalną Biegunowej można obliczać przy pomocy omawianych tabel z dokładnością jednej minuty łuku w co najmniej dwudziestostopniowym pasie ( $\varphi = 40^\circ \div 60^\circ$ ). Należy korzystać z tabeli, w której nagłówku znajduje się wartość deklinacji najbliższa deklinacji pozornej Polaris w zadanym momencie.

<sup>32)</sup> Obliczony wg wzoru:  $\tan A = \frac{-\cos \delta \sin t}{\sin \delta \cos \varphi - \cos \delta \sin \varphi \cos t}$ .

## Szerokość geograficzna z wysokości Biegunowej (str. 150)

Podstawą tablic odnoszących się do wyznaczania szerokości geograficznej  $\varphi$  z pomiaru wysokości  $h = 90^\circ - z$  Biegunowej, jest wzór

$$\varphi = h - p \cos t + \frac{1}{2} p^2 \sin^2 t \tan h \sin 1'' - \dots \quad (100)$$

w którym  $p = 90^\circ - \delta$  oznacza odległość biegunową a  $t$  kąt godzinny Biegunowej. Wzór ten można przedstawić w następującej postaci:

$$\varphi = h + V_I + V_{II}$$

$$V_I = -p \cos t + \frac{1}{2} p^2 \sin^2 t \sin 1'', \quad V_{II} = \frac{1}{2} p^2 \sin^2 t (\tan h - 1) \sin 1'' \quad (101)$$

Wartości wyrazu  $V_I$ , w zależności od argumentów  $p$  oraz  $t$ , zawiera tablica główna, zaś wartości wyrazu  $V_{II}$  (oddzielnie dla  $h < 40^\circ$  i  $h > 40^\circ$ ), w zależności od  $h$  i  $t$ , zawierają tablice pomocnicze.

## Współczynniki do wzorów interpolacyjnych (str. 151)

Tablice zawierają wartości współczynników do wzorów interpolacyjnych Stirlinga, Bessela i Newtona. Odnośne wzory zostały umieszczone u dołu strony. Przy interpolowaniu do środka ( $n = 0.5$ ) szczególnie korzystne jest stosowanie wzoru Bessela.

## Refrakcja (str. 152÷153)

Tablica na str. 152 zawiera wartości refrakcji normalnej  $R_0$  według *Radau* oraz ekstynkcji  $E_0$ , w zależności od pozornej odległości zenitalnej  $z'$  gwiazd, w odstępach  $1^\circ$  dla  $z'$  od  $0^\circ$  do  $50^\circ$  i w odstępach  $20'$  dla  $z'$  od  $50^\circ$  do  $91^\circ$ .

Na str. 153 podane są wartości współczynników:

$A$  zależny od temperatury  $t$  w  $^\circ C$ ,

$B$  zależny od ciśnienia  $H$  w  $mm\ Hg$ ,

$\alpha$  zależny od pozornej odległości zenitalnej  $z'$ ,

$\beta$  zależny od  $R_1$ ,

$\gamma$  zależny od odległości zenitalnej  $z'$  i temperatury  $t$ .

W celu wyznaczenia refrakcji całkowitej stosuje się następujące wzory:

$$R_1 = R_0(1 + A\alpha\gamma) \quad (102)$$

$$R = R_1(1 + B\beta) \quad (103)$$

*Przykład obliczenia wpływu refrakcji atmosferycznej*

- 11) Dane: zaobserwowane odległości zenitalne  $z'$ , temperatura zewnętrzna  $t$  oraz ciśnienie atmosferyczne  $H$  (wskazanie barometru). Obliczyć wpływ refrakcji atmosferycznej  $R$  i znaleźć rzeczywistą odległość zenitalną  $z = z' + R$ .

| $z'$                        | $t\ [^\circ C]$ | $H\ [mm]$ | $A$     | $\alpha$ | $\gamma$ | $(1 + A\alpha\gamma)$ | $R_0$              |
|-----------------------------|-----------------|-----------|---------|----------|----------|-----------------------|--------------------|
| $44^\circ 09' 18'' = 44.16$ | +19.8           | 763.2     | -0.0707 | 1.000    | 1.00000  | 0.92930               | $0' 58.3'' = 58.3$ |
| $73\ 45\ 42 = 73.76$        | -4.2            | 748.5     | +0.0163 | 1.015    | 1.00000  | 1.01654               | $3\ 23.8 = 203.8$  |
| $81\ 12\ 38 = 81.21$        | +10.9           | 752.5     | -0.0401 | 1.047    | 0.99952  | 0.95804               | $6\ 12.8 = 372.8$  |

| $R_1$           | $B$     | $\beta$ | $(1 + B\beta)$ | $R$      | $z$                 |
|-----------------|---------|---------|----------------|----------|---------------------|
| $54.2'' = 0.90$ | +0.0042 | 1.000   | 1.00420        | $54.4''$ | $44^\circ 10' 12''$ |
| $207.2 = 3.45$  | -0.0152 | 1.002   | 0.98477        | 204.0    | 73 49 06            |
| $357.2 = 5.95$  | -0.0098 | 1.004   | 0.99016        | 353.7    | 81 18 32            |

## Zestawienie gwiazdozbiorów (str. 154÷155)

Zestawienie gwiazdozbiorów podano w oparciu o Atlas Nieba Gwiazdzistego (J. Dobrzycki, A. Dobrzycki, PWN 1989).

### Mapa nieba gwiazdzistego (str. 156÷159)

Mapę sporządzono na podstawie *Bright Star Catalogue, 5th Revised Edition*. Mapa obejmuje gwiazdy jaśniejsze od 5 wielkości gwiazdowej. Współrzędne gwiazd odnoszą się do epoki J2000.0. Gwiazdy zmienne zaznaczono kółkami, zaś gwiazdy podwójne kreską. Oznaczenia literowe oraz liczbowe gwiazd podano dla gwiazd jaśniejszych od 4 wielkości gwiazdowej oraz wszystkich gwiazd zmiennych i podwójnych. Granice gwiazdozbiorów podano na podstawie *Catalogue of Constellation Boundary Data*, (A.C. Davenhall i S.K. Leggett, 1990), będącego przeliczoną na epokę J2000.0 wersją *Delimitation Scientifique des Constellations*, (E. Delporte, 1930).

### Niektóre stałe, definicje, wzory astronomiczne i geodezyjne (str. 160÷164)

Dane zamieszczone w tym dziale zaczerpnięto z IERS Technical Note 21 (lipiec 1996) i Journal of Geodesy, Vol. 74, No 1 (2000), a także z IERS Technical Note 32 „*IERS Conventions 2003*”, IAU Bulletin 88 „*Resolutions of the XXIVth General Assembly*” oraz z Rezolucji XXVI ZG IAU (Praga, 2006), a także Rezolucji XXVII ZG IAU (Rio de Janeiro, 2009).



PEGASUS.

Andromeda.

Delphinus.

Vulpecula.

Aquarius.

Aquarius.

Aquarius.

Columba.

Aequinoctiorum.

Aequinoctiorum.

Aequinoctiorum.