

## Occultations by Major Planets and their Satellites

The text from the Handbook is repeated below. Following that is the Occult program input file with instructions for using the program to generate your own local predictions for many more occultations, for wherever you are in the world. This Web page concentrates on occultations by the major planets and their satellites, while other pages give similar information, and Occult input files, for occultations by main-belt asteroids, and by other classes of asteroids, including Near-Earth Asteroids (NEA's), Jupiter Trojan asteroids, and more distant objects, the Centaur asteroids and Kuiper-Belt Objects (KBO's) or Trans-Neptunian Objects (TNO's).

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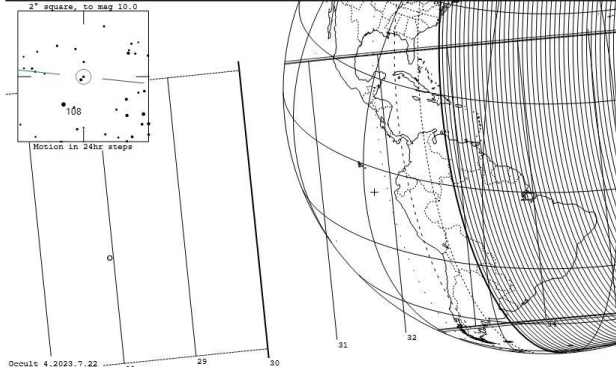
### Handbook Text

As major, dwarf, and minor planets, and their moons, move across the sky, they occasionally pass directly between an observer and a distant star, producing an *occultation*. Astronomers have learned much about solar system bodies by carefully monitoring the changing apparent brightness of stars during the immersion and emersion phases of occultations. If the occulting body does not have an atmosphere, the occultation is virtually instantaneous; if there is an atmosphere, it causes the star's disappearance and reappearance to occur gradually. If a planet has rings or other debris in its environs, the extent and degree of transparency of this material can be precisely mapped. The rings of Uranus, the ring arcs of Neptune, and the atmosphere of Pluto were all discovered by occultation observations. If an occultation is observed at several distributed sites, the size and shape of the occulting body can be determined more accurately than by other Earth-based techniques.

### 2024 Occultations by Major Planets

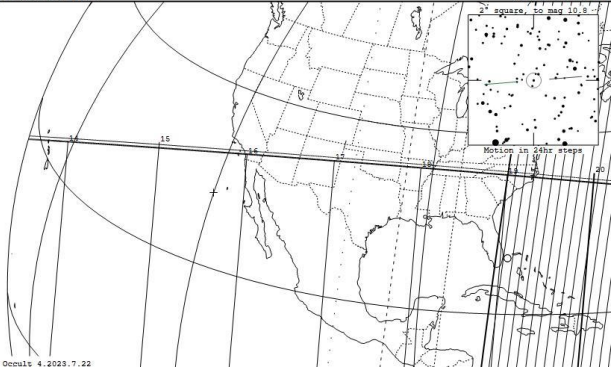
Occultations by the major planets are difficult to observe due to the brightness of the occulting body; events involving stars bright enough to observe next to a dazzling planet are rare. In 2024, the brightest star occulted by a major planet in North America is 8.8-mag. TYC 1846-00598-1 by Mars on August 19<sup>th</sup> around 10:32 UT, visible from southern Mexico to Chile, with the northern limit passing just south of Tampa and Orlando but in strong morning twilight, best will be Sun alt.  $-8^\circ$  at Key West. But Mars is much brighter than the star, so high magnification with a large telescope will be needed to see it. The Occult map for the event is on the top of the next page. The map for occultations by special main-belt asteroids shows the northern limits for this and another Mars event on October Oct. 7<sup>th</sup>; it is on p. 249 of the *Observer's Handbook 2024* and is on the page for the special Main Belt occultations with link given near the end of this document. Better will be an occultation of 11.4-mag. UCAC4 440-126076 by Neptune on Oct. 9, after 0h UT, visible from eastern and central North America, as well as South America, Europe, and Africa, but again, the occultation magnitude drop is only 0.04. Effective observations of the event by Neptune's atmosphere could be made with large telescopes and methane-band filters that darken the methane-rich planet. R. French and D. Souami published a paper on occultations by the outer planets, and by Titan and Triton, through 2050 available at <https://arxiv.org/abs/2307.13530>.

**P4M00 Mars occults TYC 1846-00598-1 on 2024 Aug 19 from 10h 29m to 10h 40m UT**  
 Star: (Dia = 0.1 mas) Durations: Max = 233.0 secs Asteroid: (Dia = 0.8) Mag = 7.8  
 Hv 8.9; Mb 2.1; Mc 1.3 RA = 15 54 8.709 (astrometric) RA = 15 54 8.709 (astrometric) RA = 15 54 8.709 (astrometric) RA = 15 54 8.709 (astrometric)  
 Dec = 22 48 23.050 Sun Dist = 61° Mag Drop = 0.00 (04)v Dec = 22 48 23.050 Sun Dist = 61° Mag Drop = 0.00 (04)v  
 (of Date: 2023 Jul 29.2) Moon: Dist = 117° illum = 100% Hourly dRA = 6.825 (of Date: 2023 Jul 29.2) Moon: Dist = 117° illum = 100% Hourly dRA = 6.825  
 Prediction of 2023 Jul 29.2 Error: ±10.0 x 10.0 mas in PA 90° Hourly dDec = 6.257 (of Date: 2023 Jul 29.2) Moon: Dist = 117° illum = 100% Hourly dRA = 6.825  
 Reliable 1.0 (good). Error: ±10.0 x 10.0 mas in PA 90° Hourly dDec = 6.257 (of Date: 2023 Jul 29.2) Moon: Dist = 117° illum = 100% Hourly dRA = 6.825  
 DE440, Star+Assumed



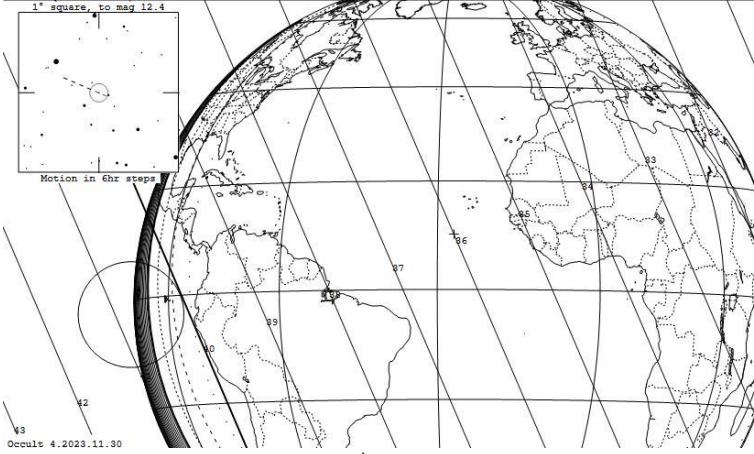
Occult map for the 2024 August 19<sup>th</sup> occultation by Mars

**P4M00 Mars occults TYC 1909-00533-1 on 2024 Oct 7 from 11h 11m to 11h 28m UT**  
 Star: (Dia = 0.1 mas) Durations: Max = 376.6 secs Asteroid: (Dia = 0.4) Mag = 7.8  
 Hv 8.8; Mb 10.6; Mc 9.3 RA = 17 36.383 (astrometric) RA = 17 36.383 (astrometric) RA = 17 36.383 (astrometric) RA = 17 36.383 (astrometric)  
 Dec = 22 58 56.393 Sun Dist = 51° Mag Drop = 0.00 (04)v Dec = 22 58 56.393 Sun Dist = 51° Mag Drop = 0.00 (04)v  
 (of Date: 2023 Jul 29.2) Moon: Dist = 138° illum = 19% Hourly dRA = 6.394 (of Date: 2023 Jul 29.2) Moon: Dist = 138° illum = 19% Hourly dRA = 6.394  
 Prediction of 2023 Jul 29.2 Error: ±10.0 x 10.0 mas in PA 90° Hourly dDec = -6.207 (of Date: 2023 Jul 29.2) Moon: Dist = 138° illum = 19% Hourly dRA = 6.394  
 Reliable 1.2 (good). Error: ±10.0 x 10.0 mas in PA 90° Hourly dDec = -6.207 (of Date: 2023 Jul 29.2) Moon: Dist = 138° illum = 19% Hourly dRA = 6.394  
 DE440, Star+Assumed



Occult map for the 2024 October 7<sup>th</sup> occultation by Mars

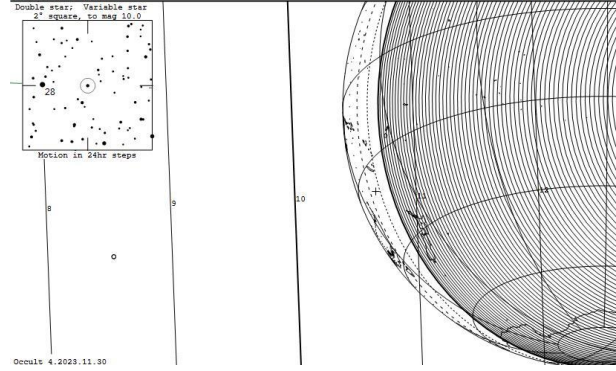
**P8M00 Neptune occults UCAC4 440-126076 on 2024 Oct 9 from 0h 15m to 0h 58m UT**  
 Star: (Dia < 0.1 mas) Durations: Max = 2182.5 secs Asteroid: (Dia = 7.8) Mag = 7.8  
 Hv 11.4; Mb 12.0; Mr 11.4 RA = 23 53 34.8063 (astrometric) RA = 23 53 34.8063 (astrometric) RA = 23 53 34.8063 (astrometric) RA = 23 53 34.8063 (astrometric)  
 Dec = -2 8 27.134 Sun Dist = 162° Mag Drop = 0.04 (4)v, 0.03 (3)v Dec = -2 8 27.134 Sun Dist = 162° Mag Drop = 0.04 (4)v, 0.03 (3)v  
 (of Date: 2023 Jul 29.2) Moon: Dist = 93° illum = 32% Hourly dRA = 0.304 (of Date: 2023 Jul 29.2) Moon: Dist = 93° illum = 32% Hourly dRA = 0.304  
 Prediction of 2023 Jul 29.2 Error: ±150.0 x 80.0 mas in PA 90° Hourly dDec = -1.53 (of Date: 2023 Jul 29.2) Moon: Dist = 93° illum = 32% Hourly dRA = 0.304  
 Reliable 1.5 (Beware). Error: ±150.0 x 80.0 mas in PA 90° Hourly dDec = -1.53 (of Date: 2023 Jul 29.2) Moon: Dist = 93° illum = 32% Hourly dRA = 0.304  
 DE440, Star+Assumed



Occult map for Oct. 9<sup>th</sup> occultation by Neptune

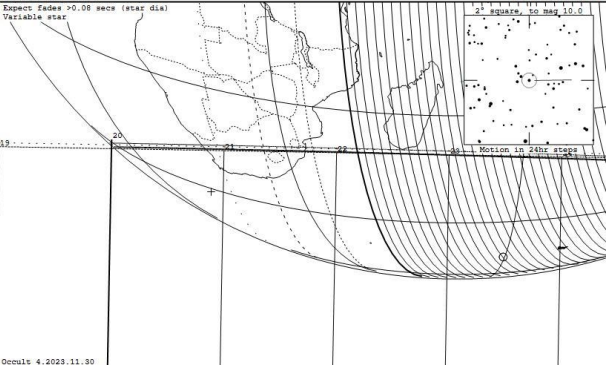
The brightest star occulted by any planet in the world over land in 2024 will be 7.7-mag. ZC 2716 = SAO 187185 = HIP 91826, spec. type B3 by Venus on Jan. 31 from east Australia, and also an 8.0-mmag. star by Mars on Sep. 17; see the Occult maps below.

**P2M00 Venus occults HIP 91826 on 2024 Jan 31 from 18h 8m to 18h 17m UT**  
 Star: (Dia = 0.1 mas) Durations: Max = 241.1 secs Asteroid: (Dia = 2.9) Mag = 2.9  
 Hv 7.7; Mb 7.8; Mc 7.7 RA = 18 43 20.514 (astrometric) RA = 18 43 20.514 (astrometric) RA = 18 43 20.514 (astrometric) RA = 18 43 20.514 (astrometric)  
 Dec = 22 58 56.393 Sun Dist = 71° Mag Drop = 0.00 (04)v Dec = 22 58 56.393 Sun Dist = 71° Mag Drop = 0.00 (04)v  
 (of Date: 2023 Jul 29.2) Moon: Dist = 84° illum = 71% Hourly dRA = 6.443 (of Date: 2023 Jul 29.2) Moon: Dist = 84° illum = 71% Hourly dRA = 6.443  
 Prediction of 2023 Jul 29.2 Error: ±150.0 x 80.0 mas in PA 90° Hourly dDec = 6.257 (of Date: 2023 Jul 29.2) Moon: Dist = 84° illum = 71% Hourly dRA = 6.443  
 Reliable 0.8 (good). Error: ±150.0 x 80.0 mas in PA 90° Hourly dDec = 6.257 (of Date: 2023 Jul 29.2) Moon: Dist = 84° illum = 71% Hourly dRA = 6.443  
 DE440, Star+Assumed



Occult map for the 2024 January 31<sup>st</sup> occultation by Venus

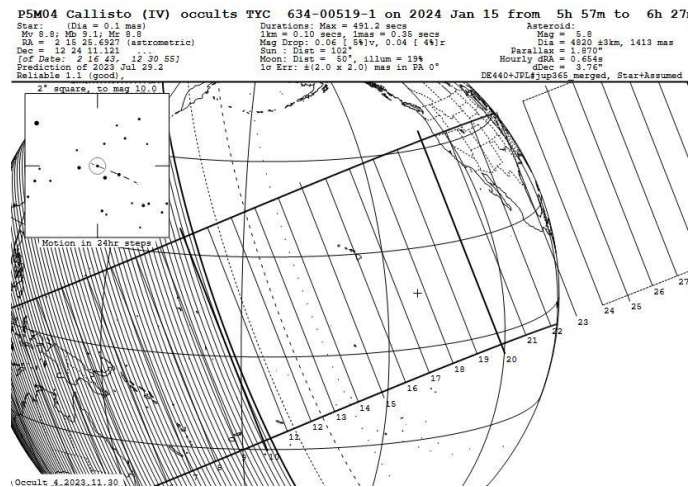
**P4M00 Mars occults TYC 1879-00828-1 on 2024 Sep 17 from 3h 19m to 3h 27m UT**  
 Star: (Dia = 1.9 mas) Durations: Max = 295.3 secs Asteroid: (Dia = 0.6) Mag = 0.6  
 Hv 8.0; Mb 9.9; Mc 8.0 RA = 6 30 6.893 (astrometric) RA = 6 30 6.893 (astrometric) RA = 6 30 6.893 (astrometric) RA = 6 30 6.893 (astrometric)  
 Dec = 23 58 47.7 Sun Dist = 71° Mag Drop = 0.00 (04)v Dec = 23 58 47.7 Sun Dist = 71° Mag Drop = 0.00 (04)v  
 (of Date: 2023 Jul 29.2) Moon: Dist = 116° illum = 99% Hourly dRA = 6.225 (of Date: 2023 Jul 29.2) Moon: Dist = 116° illum = 99% Hourly dRA = 6.225  
 Prediction of 2023 Jul 29.2 Error: ±150.0 x 80.0 mas in PA 90° Hourly dDec = -1.25 (of Date: 2023 Jul 29.2) Moon: Dist = 116° illum = 99% Hourly dRA = 6.225  
 Reliable 0.9 (good). Error: ±150.0 x 80.0 mas in PA 90° Hourly dDec = -1.25 (of Date: 2023 Jul 29.2) Moon: Dist = 116° illum = 99% Hourly dRA = 6.225  
 DE440, Star+Assumed



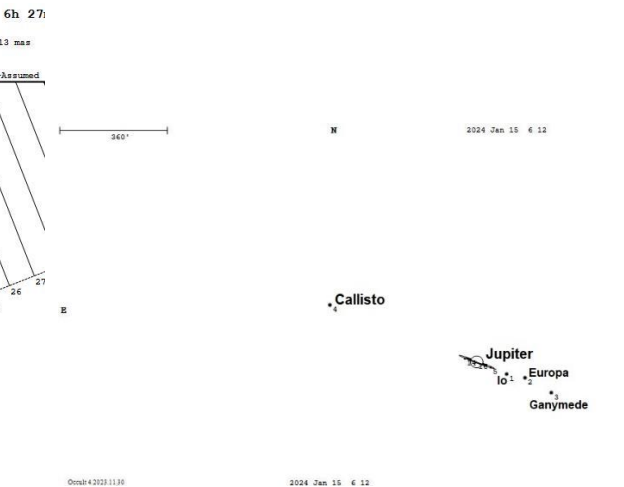
Occult map for the 2024 September 17<sup>th</sup> occultation by Mars

## 2024 Occultations by Satellites of Major Planets

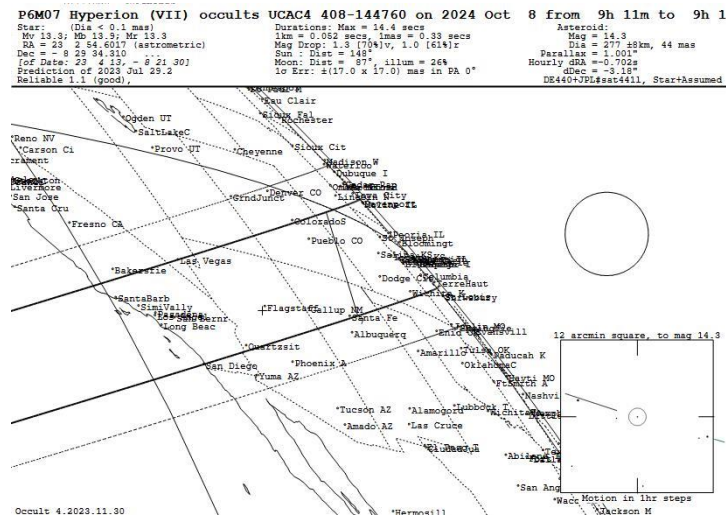
Easier to observe are occultations by moons of the planets, but they are not common. We have one on Jan. 15<sup>th</sup> by Callisto, the outer (4<sup>th</sup>) Galilean satellite of Jupiter; see the occult map for it below as well as the view of the Jupiter system showing that Callisto will be near maximum eastern elongation, far from the glare of the bright planet. The best during 2024 may be an occultation of 9.8-mag. TYC 634-00519-1 by Mars' small moon Deimos on October 7<sup>th</sup> around 11:15 UT with path from Calif. to Illinois, shown on the special main-belt occultations map on p. 247. Mars also occults that star visible from North America south of the northern limit extending from San Diego to Oklahoma City. The *Handbook* p. 249 map also shows the paths for two other occultations by Phobos and Deimos, as well as the northern limits of two occultations by Mars. Occultations by the irregular outer moons of Jupiter are predicted by astronomers working for the Lucky Star project, but usually only a few weeks in advance, based on special astrometric updates; IOTA's Occult program found no observable events by the larger moons in N. America during 2024. More on occultations by planets can be found at <https://occultations.org/publications/rasc/2024/nam24Planetoccs.htm>.



2024 January 15<sup>th</sup> Occult Map



2024 January 15<sup>th</sup> Jupiter and Galilean Sats. Config.



Occult map for Oct. 8<sup>th</sup> Hyperion occ'n

Occultations by the irregular outer moons of Jupiter are predicted by astronomers working for the Lucky Star project, but usually only a few weeks in advance, based on special astrometric updates; IOTA's Occult program found no such events by the larger ones during 2024.

The maps given at the end of this document, and on previous pages, were produced with IOTA's free Occult software; see <http://www.lunar-occultations.com/iota/occult4.htm> . The orbital elements are all from the NASA JPL Horizons Web site at <https://ssd.jpl.nasa.gov/horizons.cgi> and the stellar data are from the Early third release (EDR3) of the European Space Agency's Gaia mission, as implemented with UCAC4, Tycho, and Hipparcos catalog identifiers with *Occult*.

Note that the times are for the geocentric time of closest approach; for any specific location in North America, the event time can be several minutes earlier or later.

You can download and use IOTA's free Occult program and use it to compute your own local lists and information about these and many other occultations. The information for doing this is at <http://www.lunar-occultations.com/iota/2024iotapredictions.pdf> . This describes a prediction input file for planetary and asteroidal files called **All2024.xml**. Besides the occultations by major planets and their main moons, it also includes all of the occultations, generally down to about 12<sup>th</sup> magnitude, found by Edwin Goffin and Steve Preston, and some other IOTA members working with them. You can use that file to generate local predictions, but you can replace it with the other files listed below and on the pages for other types of occultations:

**Planets2024.xml** – This is the input for 341 occultations of stars by the major planets, including Pluto, and by Jupiter's Galilean Satellites, and by the major satellites of Saturn and Uranus. Included are several unobservable occultations of very faint stars, especially by the Galilean satellites; a few of those can be observed if the satellite is in total eclipse by Jupiter's shadow; in that case, Occult detects that fact, and replaces the magnitude of the satellite with 16.0, to calculate a more realistic magnitude drop for the situation. Several of the shadows for these events narrowly miss the Earth, or are visible only from oceans. Also included, as has been the case for some previous years, are some occultations by the Martian satellites Phobos and Deimos, but not by the satellites of Neptune and Pluto; predictions for them are given by Occult Watcher, if you select its feed for occultations by planetary satellites. A list of all of these events is at <https://occultations.org/publications/rasc/2024/Planets2024.txt> .

For worldwide occultations for the whole year, use the **All2002.xml** file noted above, but even more occultations can be found with Occult Watcher (it is also limited to the next two months); links to it are given above.

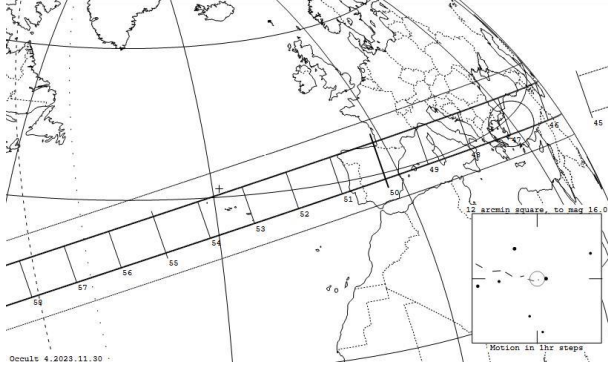
### Links to other 2024 RASC asteroidal occultation pages

First versions of the below pages will be posted later this week, except for the distant objects, which will follow a week or two later (in the meantime, for them, consult the Lucky Star prediction page at

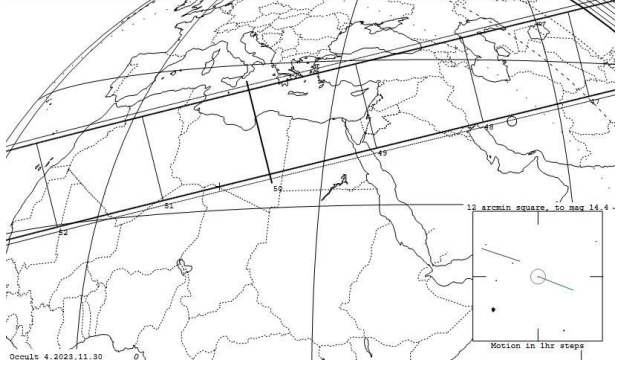
<https://occultations.org/publications/rasc/2024/nam24NEAoccs.htm> - Occultations by Near-Earth Asteroids (NEA's)  
<https://occultations.org/publications/rasc/2024/nam24MBspecialoccs.htm> - Occultations by some special main-belt objects  
<https://occultations.org/publications/rasc/2024/nam24Trojanoccs.htm> - Occultations by Trojan asteroids  
<https://occultations.org/publications/rasc/2024/nam24distantoccs.htm> - Occultations by more distant objects  
<https://occultations.org/publications/rasc/2024/OccultWatcher.htm> - Occult Watcher information

At the top of the next (last) page are Occult maps for some occultations outside of North America, including one on Jan. 20<sup>th</sup> by Miranda, the inner and fainter of the five main moons of Uranus (visible from s. Europe; Lucky Star is organizing a campaign for this event as described in a .pdf document at <https://occultations.org/publications/rasc/2024/20240120MirandaCampaign.pdf> .) Also of note will be an occultation of a 13.4-mag. star by Pluto on August 4<sup>th</sup>, visible from Indonesia and southern Africa.

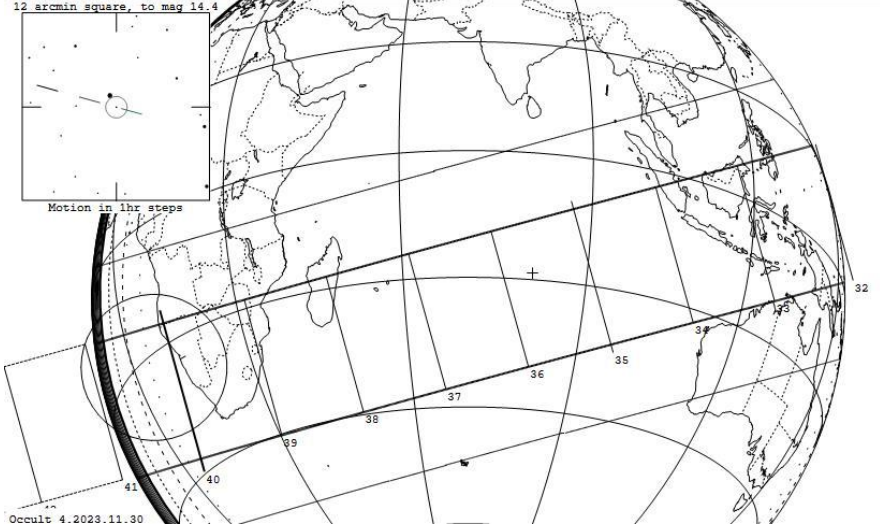
**P7M05 Miranda (V) occults UCAC4 536-005401 on 2024 Jan 20 from 21h 46m to 22h 9m**  
 Star: (Dia < 0.1 mas) Durations: Max = 51.1 secs Asteroid:  
 MV 15.6; Mb 16.0; Mr 15.6 1km = 0.11 secs, lmas = 1.5 secs Mag = 16.5  
 RA = 7 09.6616 (astrometric) Mag Drop: 2.3 [73%], 1.3 [50%] Parallax = 0.445"  
 Dec = 17 20.945 19:12.49 Sun : Dist = 109° Hourly dRA = -0.165"  
 [of Date: 2 6 27, - 6 25.00] Moon: Dist = 164°, illum = 78% Hourly dDec = -0.31"  
 Prediction of 2023 Jul 29.2 1σ Err: ±(20.0 x 20.0) mas in PA 0° dDec/dRA/dRA/dRA, StarAssumed  
 Reliable 1.0 (good), DE440/JPLstar4411, StarAssumed



**P6M03 Tethys (III) occults UCAC4 418-154279 on 2024 Jul 30 from 23h 46m to 23h 54m**  
 Star: (Dia < 0.1 mas) Durations: Max = 41.2 secs Asteroid:  
 MV 13.4; Mb 13.3; Mr 13.4 1km = 0.045 secs, lmas = 0.33 secs Mag = 10.1  
 RA = 21 20 17.8179 (astrometric) Mag Drop: 5.04 [81%], 0.04 [4%] Dia = 1042 silm, 165 mas Parallax = 0.350"  
 Dec = - 6 33 39.487 Sun : Dist = 140° Hourly dRA = -0.152"  
 [of Date: 23 42 39, - 6 25.00] Moon: Dist = 84°, illum = 20% Hourly dDec = -0.118"  
 Prediction of 2023 Jul 29.2 1σ Err: ±(9.0 x 9.0) mas in PA 0° dDec = -2.14"  
 Reliable 1.0 (good), DE440/JPLstar4411, StarAssumed



**P9M00 Pluto occults UCAC4 334-210940 on 2024 Aug 4 from 18h 31m to 18h 42m UT**  
 Star: (Dia < 0.1 mas) Durations: Max = 100.1 secs Asteroid:  
 MV 13.4; Mb 13.9; Mr 13.4 1km = 0.042 secs, lmas = 1.0 secs Mag = 14.4  
 RA = 20 12 40.6425 (astrometric) Mag Drop: 1.4 [71%]v, 1.1 [62%]r Dia = 2376 ±2km, 96 mas  
 Dec = -23 15 51.432 Sun : Dist = 167° Parallax = 0.258"  
 [of Date: 20 14 9, -23 11 24] Moon: Dist = 164°, illum = 0% Hourly dRA = -0.241s  
 Prediction of 2023 Jul 29.2 1σ Err: ±(50.0 x 50.0) mas in PA 90° dDec = -0.93"  
 Reliable 0.9 (good), DE440, StarAssumed



**P6M02 Enceladus (II) occults UCAC4 417-149038 on 2024 Aug 6 from 15h 11m to 15h 2**  
 Star: (Dia < 0.1 mas) Durations: Max = 20.1 secs Asteroid:  
 MV 9.2; Mb 9.1; Mr 9.2 1km = 0.040 secs, lmas = 0.25 secs Mag = 11.8  
 RA = 21 18 58.4797 (astrometric) Mag Drop: 2.7 [54%]v, 4.3 [88%]r Dia = 504 ±0km, 75 mas Parallax = 0.998"  
 Dec = - 6 43 1.479 Sun : Dist = 140° Hourly dRA = -0.901s  
 [of Date: 23 20 17, - 6 34.51] Moon: Dist = 171°, illum = 54 Hourly dDec = -3.07"  
 Prediction of 2023 Jul 29.2 1σ Err: ±(4.0 x 4.0) mas in PA 0° dDec/dRA/dRA/dRA, StarAssumed  
 Reliable 0.2 (be wary), DE440/JPLstar4411, StarAssumed

