IOTA occultation predictions for 2026
using Occult 4 to compute your own

Ever since IOTA was founded, providing predictions, usually on an annual basis, was a right of membership. That was important in the early days, when predictions could only be generated on large mainframe computers, and several volunteers who had access to those machines did the work of generating and distributing the predictions, printed and sent by "snail mail". But now, all predictions that a member needs can be generated with the PC software Occult 4 that can be downloaded and set up for free at http://www.lunar-occultations.com/iota/occult4.htm . Most members already have this program on their computers. If so, it's better for you to generate the annual predictions yourself (the specific steps to do so are given below) so that you can tailor the results to what you really want. For example, for lunar occultations, you can click on each event in the list of total occultations that Occult generates for your site and obtain a view of the Moon showing where the star will be relative to lunar features at the event time, especially important for reappearances. And if you move, you don't need to ask us for predictions and wait for us to generate and deliver them to you; instead, you can generate them yourself immediately. That's also useful if you plan to travel to a distant place, perhaps with less light pollution or clouds than where you live; you can generate predictions for that place for just the dates you'll be there. We assume that all observers who use OccultWatcher, another free software package (http://www.hristopavlov.net/OccultWatcher/publish.htm that interfaces with Occult 4, also have, or can download and use, Occult 4. We will assume that you can generate your own predictions with Occult 4 and the instructions given below. If you have any trouble with generating your own predictions, let me know and either I or another IOTA observer will help you. We will generate the predictions upon request, if you can't generate your own predictions, for example, if you don't have good access to the Windows environment (or a suitable emulation of it) that Occult 4 needs. The predictions format for 2026 is the same as those for 2019-2025, with the description of the predictions at http://www.lunar-occultations.com/iota/obs20119.txt. The information below tells you how to generate the predictions for 2026 described in that file.

Link for occultations of stars by asteroids, and by major planets and their satellites

You can generate a list of occultations of stars by asteroids, and by major planets and their satellites, for 2026 for your location (and for a specified radius around your location) using Occult 4. To do that, you need an Occult 4 input file of the data for all of these events. You can obtain that file at **http://www.lunar-occultations.com/iota/All2026.xml** [sorry, it was necessary to remove the hyperlink because MS Word insists on adding a "/" for the link generated for an .xml file and that destroys the link; so just copy the link as given here in bold type and paste it into your browser, to obtain the needed file]. I find when I do that with Chrome, at least, it gives a statement, "This XML file does not appear to have any style information associated with it. The document tree is shown below." and after several seconds, the correct data lines for the .xml file appear.

Information about Occult 4 installation

If you currently don't have Occult 4 installed on your PC, or windows emulation on a Mac, you can obtain the software at http://www.lunar-occultations.com/iota/occult4.htm , as noted above. Follow the instructions for installation given there. As noted there, you first should create a directory where you want to install the program; they suggest calling it "Occult 4" but I prefer names without blanks, so on my computer, it is the directory c:\Occult4\. When you first run the program, you will be prompted to download several data files, including star catalogs, planetary ephemerides, lunar limb data, and a number of others needed for the predictions. You don't need to do your own searches for occultations by major and minor planets; instead, you can just use the dataset with link given above. You don't need to download the very large Gaia14 catalog (download #40), but you may want it if you want Occult to generate 2-deg. star charts for asteroidal occultations. The much smaller Gaia11 catalog (#41) is optional but recommended. You should download all of the other star catalogs and recommended files. For planetary ephemerides, you need #34, JPL planetary ephemeris. Unless you plan to work with historical observations made before the 19th century, you do not need the large #35, JPL 6000-year planetary ephemeris. First-time users need to first run "Maintenance" at the bottom left of the main page menu; on its page, click on the "User settings" button in the upper left, primarily for item 1, to specify your home location. I prefer to always set Time Zone to 0, that is, always provide predictions and work in Universal Time. In Item 3, specify your telescope aperture and travel distance for lunar grazes (use 0 if you only observe from a fixed observatory); you may want to adjust the correction to limiting magnitude later, based on your experience (if you need more predictions, set it to 1.0 or greater; if you want fewer, specify a negative number). For item 4, I didn't specify my SMTP email server name, but I recommend giving it, if you know it. Check item 6 if you have GoogleEarth; I just leave the line width defaults there (1.0 and 2.0, respectively). For the other items, leave the defaults, with some other remarks: Item 11, include the defaults, but you may want to check "Double star info" and "Add SAO #'s to Pre-point stars". For Item 12, I suggest that you include values for asteroid maps #1, with the values in degrees with west longitudes negative. For Item 13, I recommend 0.10 and 10.0 arcsec for double stars; set the graze travel distances for the brighter stars. For the graze path settings, I suggest selecting a start longitude 5 deg. west of your site (round to the nearest degree) and end longitude 5 deg. east, remembering that longitudes are negative west of Greenwich. For step interval, I recommend 0.250, and for Nominal altitude, generally you should use the altitude (above sea level) of your home. When you are done, be sure to click "Save and Exit" at the top of the page, before exiting. Then, on the Maintenance main page, click on the "Check Installation" button on the bottom left. At the top of each of the Occult main menu pages is a Help (blue with white question mark) button, the second from the right; click it to access Occult's extensive documentation for using the program. It will give a menu where the documentation for the current page is selected. At the top of the list of prediction/menu items is "First time user – examples" under which are step-by-step instructions for each of the main jobs for which you want to use Occult. Besides generating predictions, Occult can also be used to report your observations. Don't hesitate to contact us if you have any questions or problems.

Accurate coordinates for your location(s) for an Occult 4 site file

You need coordinates (longitude, latitude, and height above sea level) of your observing location. You should have already entered at least "low-precision" values for your home location, but it's

best to have rather precise values, suitable for reporting observations, that are accurate to at least the nearest second of arc, 0.01 arc minute, or 0.0001 deg. in long. and lat., and to 30m in height above sea level. There are three easy ways that accurate coordinates can be found:

GPS Test smart phone app: This free app gives accurate coordinates, if your location has a reasonable view of the sky, but it works even inside most frame houses. If you have an observatory with a metal dome, it will probably work if you open the slit and place the phone near it; the left of the five small menu displays at the bottom should say "3D Fix" (if not, move until it does). If you can't get that inside your dome, stand outside right next to it, that will be good enough. Once the 3-D fix is obtained, press the world map button on the bottom right to obtain the longitude and latitude of the site. Then press the button to its right, with a large "0" (that's your velocity, so 0 if you're not moving); it gives your altitude above sea level in meters. GPS Test is for Androids; GPS Diagnostic is similar for iPhones.

Google Earth: For most regions of the world, you can obtain accurate-enough coordinates from Google Earth by zooming in on your location and placing the cursor there, but be careful, if you do that and then move the cursor off of the display to access Occult or another app on your computer, the coordinates displayed at the bottom of the Google Earth display will be for a place where the cursor left the edge of the display, not for your location. To avoid that problem, I leave the cursor right at the location whose position I want, then obtain a screen view (PrtScr button on most PC's) and paste that into any image program such as Paint; then you can read the coordinates at the bottom of that display. Google Earth has the advantage that you don't need to physically be at the location to obtain coordinates, but if you are observing, you're there, anyway (unless you observe remotely). Google Maps and some other mapping software can also be used to find coordinates, but I prefer Google Earth.

GPS-based Video Time Inserter: The coordinates obtained with GPS-based (using 1PPS) time inserters, such as the IOTA-VTI, Kiwi, and the GPSBOXSPRITE2 by Blackboxcamera (http://www.blackboxcamera.com/pic-osd/sprite.htm) can also be used. They should be operating at the location for 15 minutes or more, to be sure the latest GPS satellite ephemerides and time corrections have been obtained. The same is true for the GPS system used by the QHY 174M GPS camera.

It's always a good idea to use two of these methods at a site, for verification. Once you have accurate coordinates, it's best to enter them as a station in one of the site files provided with Occult. You can do that from the Occult Maintenance page, click the "Edit SITE files" button on the upper right, then select the site file (upper right of the Site Editor page) you want to use, generally the one for your continent (but the USA Short one can be used for those in the USA), and click the "Open site file" below it. Then, all of the sites in the file will be displayed in a large box to the left; click on the button "Add new site" below it. Enter the site name, coordinates, and other information; for the coordinates, you can enter either deg., min., & sec. of arc; or deg. min. & decimals of min. of arc; or degrees and decimals; if you have the coordinates to a precision of 0.1 arc second, 0.001 arc minute, or 0.00001 deg. (that's to about 3m), enter all of those numbers, even though the accuracy may be a little greater. Once you are done, click on the "Accept" button at the bottom left, and then (this is important), you must click the "Save" button below the "Open site file" button on the upper right. If you prefer, you can save the edited site file with a new name using the "Save as" button instead.

Using Occult 4 for computing 2026 predictions by major and minor planets

First, you need the prediction dataset All2026.xml noted above. It should be placed in the /Asteroid subdirectory of Occult (note, there is also an /Asteroids subdirectory; be sure to select the "singular" one). Once the file is in the /Asteroid subdirectory, from the main Occult menu, select the "Asteroid predictions" menu. On the middle right of that page, click on the "List & Display occultations" button. Click on "File" in the upper left and select "Open" which lists all of the input files in the /Asteroid subdirectory. Select the All2026.xml file. At the top of the page are several "Selection filters" that you need to select, as desired. Check the box just to the left of "Visible from:" in the yellow box, then enter your coordinates, or click on the "Select site" button to obtain your station from the appropriate site file. You will probably want to check the box for "Local altitude" with 5 deg., but you can select a higher or lower value, with 1 deg. being the lowest possible. In the orange box, leave the "Magnitude drop" unchecked (for most major planets, the "mag. drop" is likely to be near 0, but one of the contacts might be observable against the dark side of the planet), check a Star mag. limit appropriate for your telescope. I have already removed events with solar elongation <15 deg. so you don't need to check the "Solar elongation >" box. I recommend leaving the last three boxes all unchecked (no filtration). Then, click on the "List events" button just below "File" in the upper right. Click the button under it, "Save listed events". If you want to save all of the selected events to your own Occelmnt file, for future use. While in Occult, if you click on any line, a map of the event will be displayed; the first time you do that, I suggest, at the top of the map, click on "Redraw" and change the setting there from "1" to "2" or even "4". With "1", a full-world view is given with only the coastlines drawn. With "2", you have a more zoomed-in (centered on your location) view that now includes country boundaries, and for the USA, Canada, and Australia, the state or provincial boundaries; "4" and higher numbers zoom in more, but with no more map information given. If you click on "with this Event", there are many things you can do, including saving the map by clicking on "Save" at the bottom.

The star mag. should be checked and set to a value appropriate for your telescope and camera; with the Runcam astro camera with integration, you should be able to reach at least mag. 12 with a 20cm telescope, 13 with a 25cm telescope, and 15 with a 40cm telescope, but you should experiment with your equipment; local light pollution might force you to set brighter limits. I would leave max. duration and diameter unchecked.

The "All2026.xml" file for 2026, generated in late 2025, included all of Steve Preston's events to mag. 10.3 and brighter, filtered to eliminate occultations with 1-sigma path errors greater than 0.4 path-widths or high RUWE (>1.4, so some events with RUWE = 1.4 may have large path errors or solar elongation less than 15°), and occultations of stars by the major planets and their satellites with mag. limits appropriate for them. In early 2024, the "Horizons" ephemeris team at JPL improved the orbital elements for about 150,000 asteroids with accurate astrometric observations from Gaia's third data release (DR3), permitting a huge increase in the number of predictions of occultations by thousands of asteroids much smaller than we were able to consider before then. Consequently, the number of predicted occultations for 2026 on Preston's predictions page at www.asteroidoccultation.com is much greater than what we had for 2024 at the beginning of that year. As explained on that page, the predictions are in large monthly files that can be extracted from the .zip files posted. There are now way too many occultations with accurate path data to create a file for the whole year, it would far exceed the 30,000 limit that can be handled by Occult4.

To make a manageable file of asteroidal occultations covering all of 2025 for the whole world, I had to make smaller monthly files by including only those events brighter than mag. 10.3, and also rejecting events as described abive. I then used command prompt to add the resulting smaller monthly files to form one for the whole year, and edited that with Notepad to remove 11 of the monthly separators. That resulted in a file, 2026MBtoMag10p3.xml, with 26,725 occultations. For fainter events, you can either do your own Occult calculations for your region using Preston's monthly files, or just use OccultWatcher (usually abbreviated below as OW; for information (including download files) about OW, see https://occultations.org/observing/software/ow/) that only works 60 days into the future. For the monthly files filtering, I used Steve Preston's "OccFilter" utility to eliminate many occultations that had 1-sigma path errors greater than 0.4 (at that value, an observer on the central line has more than a 55% chance for an occultation), as well as those with likely poor Gaia solutions (and bad path predictions) when the Gaia "RUWE" is greater than 1.4 or less than 0.1 (some Gaia stars have 0 RUWE, indicating that no proper motions could be computed, usually the case for very bright stars). for stars fainter than mag. 6.0 (brighter stars often do not have Gaia data and use instead data from UBSC (U.S. Naval Observatory Bright Star Catalog) or HIP2 (HIPPARCOS-2) which, although they are generally less accurate than Gaia, they aren't affected by the Gaia-specific RUWE issue). You can tell the source of the stellar data by what's given in the lower left corner of the Occult header for the Occult map for the event; if it says "Reliable x.x", then the source is Gaia (specifically, Gaia EDR3) and "x.x" is the RUWE value. Occult further warns "(beware)" if x.x is 1.4 or greater.

I added to 2026MBtoMag10p3.xml, another "**2026PlanetsAndSatsDMGT0p2.xml**" file of 1506 worldwide occultations of stars by major planets, by the dwarf planet Pluto, and by their larger and medium-sized moons to form **All2026.xml** with 28,231 occultations. For 2026, the first major planets/satellites file is **2026PlanetsAndSats.xml** with 1849 occultations, but it includes almost 350 occultations by the Galilean satellites of stars fainter than them that produce mag. drops less tha 0.2, so those were eliminated in the version that we used to form All2026.xml. On rare occasions, a Galilean moon is in the shadow of (eclipsed by) Jupiter; in that case, the satellite is fainter than 15th mag., allowing observation of occultations of much fainter stars than when the moon is not eclipsed. To allow others to check for this possibility, we provide the first file noted above.
I did not use OccFilter on the 2026 planetary predictions since the ephemerides of many of the satellites are given error values that are larger than is available from Lucky Star or other alternative sources, so many of them can be refined enough to enable observation campaigns. Also, occultations by major planets and by the larger planetary moons are not affected significantly by RUWE problems.

For coverage for North America, I created a smaller version of the all2026 file noted above filtered for those visible from populated parts of North America called **nam26all.xml** that contains 2671 occultations. Later, I will create files for only North American events from my filtered worldwide versions of Preston's large monthly events to create a new version of the file down to Preston's limit of mag. 12.0 and add to that, **nam26PlanetsAndSats.xml** (a North American subset of the worldwide 2026PlanetsAndSats.xml file). All of these files will be posted in a new page for 2026 events that will be called https://occultations.org/publications/rasc/2026/nam26MBoccs.htm .

An IMPORTANT CAUTION: The All2026.xml and nam26all.xml files are only for approximate calculations and long-range planning. Starting with 2024, all events listed on the main page of

www.asteroidoccultation.com are provided only for long-range planning since the paths will NOT be updated during the year, as was done before 2024. You MUST use that Web site for occultations of stars by asteroids fainter than 10.3; the predictions in all2026.xml for occultations by major planets and their moons include fainter stars, when appropriate (observable) for the occulting object. At www.asteroidoccultation.com, you need to click on "2026 Events" at the top for 2026 events. At the bottom of the 2026 events page are links to .zip files that include Occult input ("occelmnt") files in monthly groups for many more events (many thousands; Occult4 has a limit of 30,000 for the number of events it can use in an input file) for each month. Now, you must use OccultWatcher (OW), or its Web version OW Cloud, to get an updated prediction with the latest orbit, either from JPL or from the Lucy Star project. OW only includes events during the next 60 days. The best predictions for occultations by the Trojan asteroids that are targets of NASA's Lucy mission are at http://lucy.swri.edu/occultations.html while those for other Trojan asteroids and more distant objects are usually obtained from the Lucky Star prediction Web site at https://lesia.obspm.fr/lucky-star/predictions.php. The RECON site now also has extensive predictions for occultations by many Trojan asteroids, not for just the Lucy targets. The events in All2026.xml do not have final updates (i.e., less accurate asteroid ephemerides, although mainly they are now obtained from the JPL Horizons system, which is quite accurate using Gaia DR3 observations of about 150,000 of the brightest asteroids, but Horizons makes some updates during the year using less accurate ground-based astrometry. Many more events will be added later, especially in the various regional feeds available with OW, so for your detailed planning for asteroidal events during the next 60 days, you should rely instead on OccultWatcher and on the regional OW feed Web sites, rather than on the long-range predictions generated with the **All2026.xml** or **nam26all.xml** files. To get the latest prediction for any event you find with our file or the above Web sites, use OccultWatcher; If you don't see an event of interest in your regular OccultWatcher, you can always find the event, as long it's there at all, at https://cloud.occultwatcher.net/events. With that, you need to specify the asteroid's number and a date specified by clicking on the calendar symbol and selecting the date on it; you can't just type the date.

In spite of efforts to prevent duplicates, there may be some in both of the "all" files. These mainly involve (617) Patroclus and its large moon, Menoetius, and some other asteroids with satellites that have their orbits determined. Three lines are usually given for these objects, such as Patroclus, Patroclus #1, and Menoetius #1. It's best to ignore the one for Patroclus since it uses a diameter of 141, the equivalent diameter as if both Patroclus and Menoetius were combined as one body. There are similar issues with other asteroids with known moons, including (216) Kleopatra. The ones with "#1" appended give the correct diameters for the separate objects. The paths for Patroclus and Patroclus #1 are the same (except for a small difference in the path widths) and Menoetius #1 has the correct path for the moon. However, for Patroclus especially, and for the other Lucy target asteroids, the best predictions, improved with proprietary past SwRI occultation campaigns, are available on the SwRI predictions Web site at https://lucy.swri.edu/occ/predictions/ . If an occultation of a Lucy target you want to try to observe is not on the SwRI predictions page, you should ask SwRI's Brian Keeney, bkeeney@gmail.com, to add the event on their prediction page.

Using Occult 4 for computing 2026 predictions of lunar total occultations

In several past years, Rob Robinson provided an overview of the brightest lunar occultations worldwide during the year at http://www.lunar-occultations.com/iota/iotandx.htm . But starting in 2026, only a few of these, including occultations of first-mag. stars and of major planets under good conditions visible from North America will be posted. Besides the small world maps and long lists of occultations of major planets and the brighter stars, in the upper right is a "2026 Predictions" section that includes this document, as well as .zip files with total occultation predictions for the year for 40 North American Cities, including two in Hawaii. Also there is information about, and a download link, for Occult 4. It's best to use it to generate comprehensive predictions for your location, as described below.

From the Occult main menu page, click on the "Lunar predictions" icon to get the "Lunar Occultation predictions" menu page. On it, click on the "Predictions for single sites" button to obtain the prediction menu page. For item 1 at the top, select your .site file, and your station within that .site file. For 2, select "XZ" at the top. For 3, check Stars, Planets, and Asteroids. For 4, select the Start as 2026 Jan 01 and End as 2026 Dec 31; under "Starting at", select "0 hrs" if you are in Asia east of long. 120 E, Australia, and the Pacific Ocean west of long. 130 W; for the rest of the Americas, select -6 hrs; for Europe and Africa, select +12hrs; and for Asia west of long. 120 E, select +6 hrs. The predictions will be filtered with a variable magnitude limit based on your telescope size (and lunar phase, twilight, etc.) for a visual observer; using a sensitive camera like the Runcam, Watec, or PC164C-EX2, you may want to select "1" or even "2" from the "Mag limit adjustment" at the top, to add to the calculated mag. limit. Then press the "Occultations" button under item 5 and your predictions will be generated. Once that's done, you can click on "with Prediction" at the top left to save the prediction list to a plain text file. A plain text file for the whole year is useful mainly for long-range planning. For actually observing occultations tonight (i.e., sometime during the next few to 18h or so in the future), it's useful to generate the predictions for just that night with Occult, then with the list in Occult, you can click on a line to select an occultation, then right-click on it for a menu of further options, the most useful of which is "Moon map". That generates a view of the Moon showing the maria and many craters, and where on the Moon's limb the event will occur. If that's done for the first event of the night, you can right-click anywhere on the Moon map to plot more events. The Moon map is a little counter-intuitive in that the darker shaded area is sunlit, while the lighter-shaded area is dark (illuminated by Earthshine).

Using Occult 4 for computing 2026 predictions of lunar grazing occultations

This starts with the same "Lunar Occultation predictions" menu page as for total lunar occultations in the section above. But Occult won't let you predict grazes for a single site for multiple dates, as you can do for total occultations; you can only do that for one date at a time. So for grazing occultation predictions for a year, you need to click on "Predictions of Multiple objects for Multiple sites" at the upper right. Then under Item 1, select your site file, and then check the box under it for your station; at the bottom, it should then say "1 sites selected". Then under Item 2, you should select the 3rd option, "XZ < mag 9" (or even the 4th option, "XZ < mag 7" if you have only a small portable telescope) as almost nobody these days is interested in observing grazing occultations of very faint stars. The cusp angles for grazing occultations are usually quite small, much smaller than

for most total occultations, making them generally more difficult to observe, due to glare from the (closer) sunlit part of the Moon. Since there is now less scientific value in observing grazing occultations than there used to be, perhaps a main attraction of them is their spectacular nature that can be useful for publicity and education; see, for example, the video of the spectacular 2017 March Aldebaran grazing occultation at https://vimeo.com/209854850 . You may want to check the "XZ < mag 4" button, to get predictions for only the most spectacular grazes, but these are quite rare; a small telescope can give a very good view of a crescent-Moon graze of a star of mag. 7 or less. For Item 3, Options for grazes, under "Set output files", check all of the items "for individuals" and only "No spaces in filenames" under "for web sites". Under "Profile options", the GIF format gives the smallest file sizes, and under "Plot", select "Medium" (good enough) and B&W (the color option, with its black background, is very printer-unfriendly). Under "Kaguya/LOLA profile data", select LOLA and check "HiRes" and "Number of events indictor". Leave "Observed data" at None; that was useful in the old days with the inaccurate Watts profiles, but just adds clutter with the detailed LOLA profiles we have now. Item 4 has no settings for grazes, while Item 5 is like for total occultations, select 2026 Jan 1 for the first date and 2026 Dec 31 for the last date. Then just click on the "Compute Grazes" box on the middle right side. It may take a few hours to generate the predictions for all of 2026, if you have a travel radius larger than 150 km; the calculation of the detailed profiles is computer-intensive. You can follow the progress of the calculations as the date of the current calculation is given under the date range; when it reaches the end date, the calculations are done. Then, using File Explorer, display the "AutoGenerated Grazes" Occult folder; it should show 4 folders, named "_Predictions", "tmp", "GoogleMap files", and "[name of your station]". The last two of these should be empty and can be deleted. The "tmp" folder should contain 2 files that are duplicated in the last folder, so it should also be deleted. The folder "_Predictions" should contain one .zip file that will unzip to give all of the prediction files. Before clicking on the .zip file with File Explorer to unzip it, I suggest that you first create a folder with a short name such as YourCity2026 and then unzip the files to that folder, rather than to the default folder, which will have a very long name as a subdirectory of the _Predictions folder and hence will be less easy to access. Once the file is unzipped to the YourCity2026 (or whatever you name it) folder, you can delete the .zip file. The .zip file is like the graze .zip files distributed to IOTA members in previous years, including a small map and summary list of the grazes, and for each graze, a .txt file with the graze path information, the predicted profile, a Google Map .htm file that you can use with your browser to plot the path with offsets determined from the profile to show the graze zone (Google Maps now requires that you have an .api license, making it hard for individual users, but they can work on Web sites whose owner has a license), and a .kmz file (if you select that option) that can be used to plot the graze limit line with Google Earth. Good luck with predicting AND OBSERVING occultations during 2026; let us know if you need any help.

David Dunham, iotadunham@yahoo.com and dunham@starpower.net, 2025 December 31