Journal for Occultation Astronomy

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2018-03

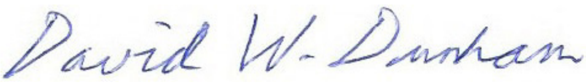
SOLAR Eclipse
2017. 8. 21

Dear reader,

Over a year ago, IOTA/Middle East's Atila Poro proposed an "Occultation Day", similar to "Astronomy Day" that's observed in many countries. But if so, when? Rather than a fixed date, we wanted to select an important or bright occultation that most of North America might focus on. You can read what we did in the last article. The other IOTA sections are encouraged to similarly select Occultation Days for their regions.

The first article, by Thomas Weiland about his successful observation of the last good grazing occultation in Europe during last year's series of lunar occultations of Regulus, brought back memories, as a month later, North America had its turn, with a similar event in North Dakota; most other places along that path were clouded out. Sadly, that event was ignored; I was too ill at the time to travel. Also unfortunately, Mr. Weiland didn't video record the September occultation, so that others could see that spectacle. Although with Kaguya, LRO-LOLA, and Gaia DR2, the value of grazes is much less than they used to be, they are still interesting events, of some value for resolving close double stars, and recordings of them can be shown during presentations to recruit new occultation observers among the younger generation that needs such shows to excite them. Mainly for that reason, I plan to travel for the last graze of another series, the long one of Aldebaran, on July 10th, as described at the end of the last article. Other articles of note are about OccultWatcher, and Guhl and Tegtmeier's article about how the Europeans did better than the Americans at recording the "ultimate graze" at the edges of totality of last August's Great American Eclipse.

Clear skies,



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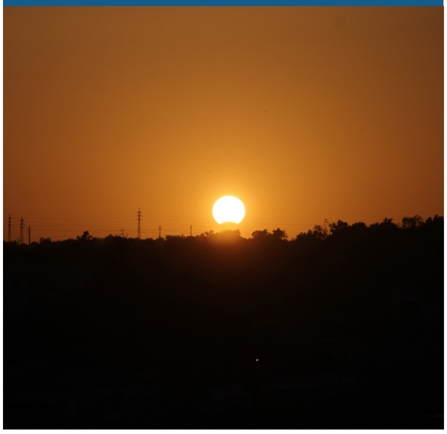
In this Issue:

COVER



Canon EOS 700D
Optics: 125 mm f/7.1
21/08/2017, 19:05 UTC
Copyright:
W. Beisker, IOTA/ES

This is an image from the great solar eclipse in 2017, but observed not from the US, but from the "Pte. dos Descobrimentos" bridge across the Gilao river in Tavira, Algarve, Portugal. I saw not too many observations from Europe of that eclipse!

Copyright Transfer

Rules for Authors

In order to optimize the publishing process, certain rules for authors have been set up how to write an article for JOA. They can be found in "How to Write an Article for JOA" published in this JOA issue (2018-3) on page 13. They also can be found on our webpage at http://www.iota-es.de/howtowrite.html .

Journal for
Occultation Astronomy

The Spectacular Regulus Graze of September 18, 2017, Observed in Greece

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ABSTRACT: Regulus (α Leo; ZC 1487) currently saw an occultation series by the Moon, running from December 18, 2016 until April 24, 2018. On September 18, 2017 a northern dark limb graze far from any sunlit lunar features occurred over south-eastern Europe which was observed visually in Central Greece. It proved to be a spectacular event, yielding ten contact times. Results are presented and discussed, together with the corresponding limb profiles.

Introduction

Lunar occultations of first and second magnitude stars are astronomical events always worth pursuing, especially if the Moon is less than 50 % sunlit and the Earthshine is visible. Of all bright stars which the Moon can occult, only α Tau (Aldebaran) yields frequent events for mid-northern latitudes from time to time. The remaining – α Leo (Regulus), α Vir (Spica), α Sco (Antares) and σ Sgr (Nunki) – usually see no more than one occultation per series at their best, and β Tau (El Nath) can never be occulted at 48°N (the latitude of Vienna, Austria). In order to compensate for this I have travelled around recently and was successful with α Sco in south-eastern Austria (2005), β Tau in Egypt (2006), σ Sgr in India (2008) and α Vir in Iran (2013), all of them total nighttime events involving a crescent Moon. Only Regulus (ZC 1487) was I still missing, the brilliant bluish star representing the "heart" of the Lion (magnitude +1.3; spectrum B7), lying close to the ecliptic (β = +0°28').

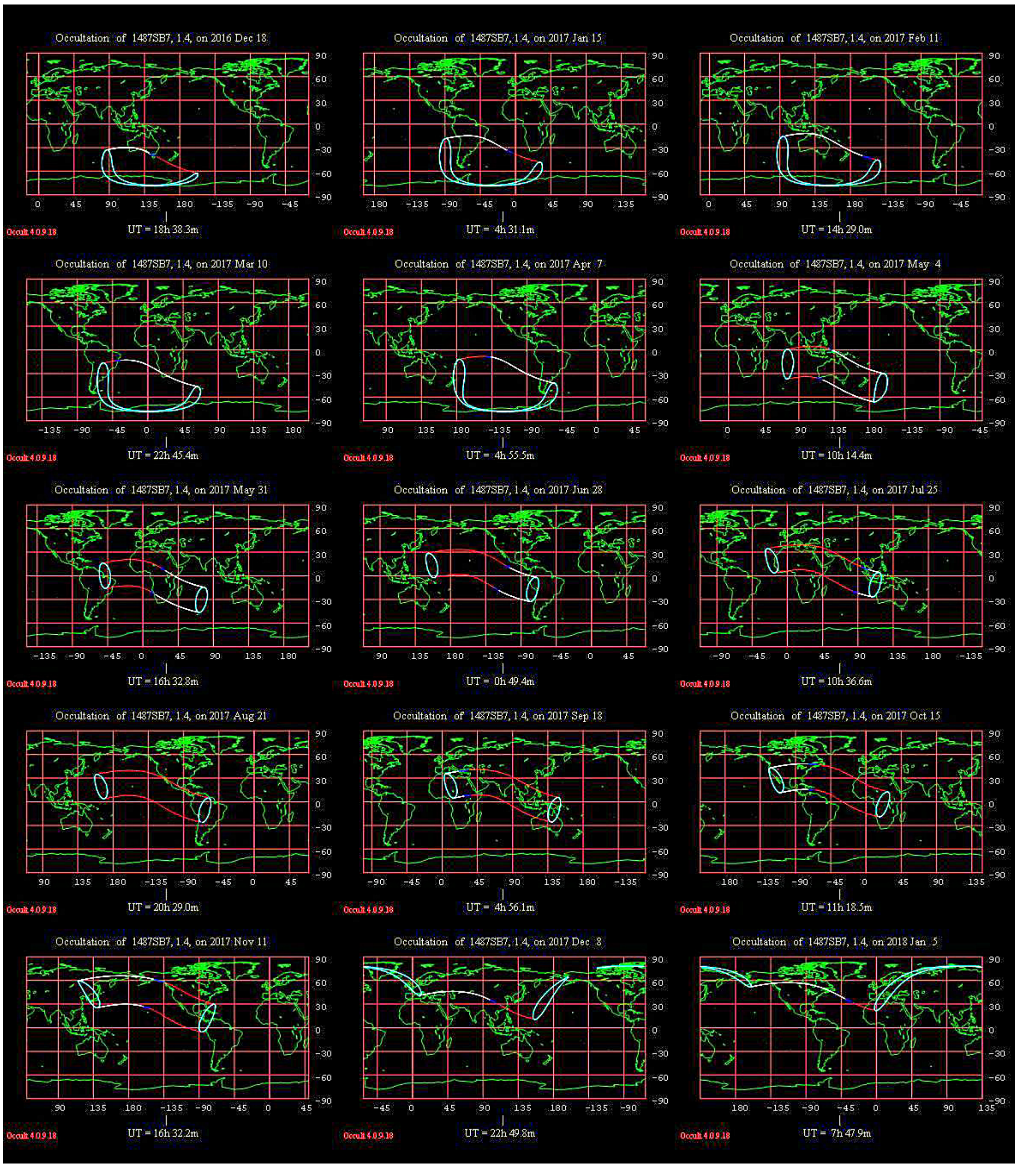

Figure 1: Visibility areas of Regulus occultations 2016 12 18 to 2018 01 05 (Occult 4.0.9.18).

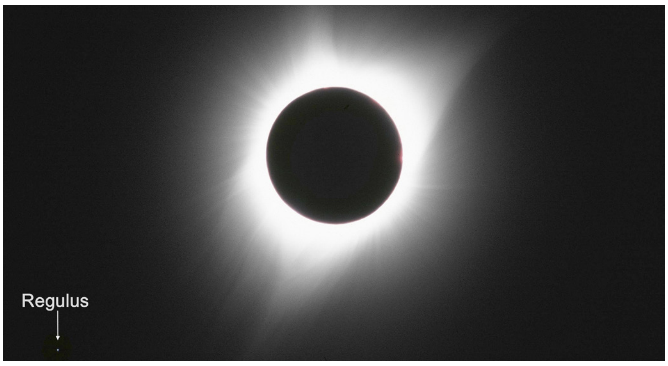

Figure 2: Total solar eclipse 2017 08 21, showing the corona and Regulus (arrow). Picture taken at John Day, Oregon, USA (118°58'02.0"W, 44°24'39.5"N, 1120 m; GPS/WGS84). Nikon FM2 with Nikkor 1:8/500 mm lens on a Manfrotto 055 Pro tripod with 410 Junior Geared Head; Fujichrome Provia 100 F Professional Film (ISO 100/21°), exposure time ½ second. Photo: Thomas Weiland.

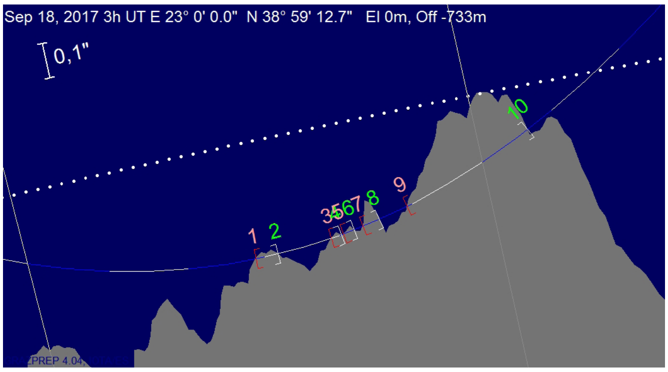

Figure 4: Graze prediction for 23°E on the northern limb respectively graze line (GRAZPREP 4.04). Courtesy Eberhard Riedel.

2017 – "Year of Regulus"

The current series of Regulus occultations started on December 18, 2016 in the southern hemisphere and continued until April 24, 2018, ending in the north. It included 19 events of which 13 occurred in 2017 (Figure 1). As a bonus, during the total solar eclipse of August 21, 2017 the star was located within the outer corona, 1.2° east of the Sun – a beautiful arrangement which for the last time happened more than 100 years ago (August 21, 1914) and which will not be due until August 23, 2044 (Figure 2). For completeness, one should mention that the New Moon occulted the star shortly after the eclipse, albeit barely visible with amateur means. Thus, from the occultation observer's view, I would call 2017 the "Year of Regulus".

The Event of September 18, 2017

Close inspection of the series' occultations revealed that the event of September 18, 2017 was most favourable in terms of the lunar phase (-5% illuminated) and its accessibility from Vienna. The area of night-time visibility comprised parts of Sicily, Greece, Turkey and north-eastern Africa (Figure 3). In Sicily the Moon was too low at the horizon (altitude < 10°), in Turkey the sky already too bright (Sun altitude > -6°), and north-eastern Africa was still suffering from political instability. Consequently, Greece seemed the place to go, boosted by an approx. 70% probability of clear skies in mid-September. Additionally, in JOA 2017-1

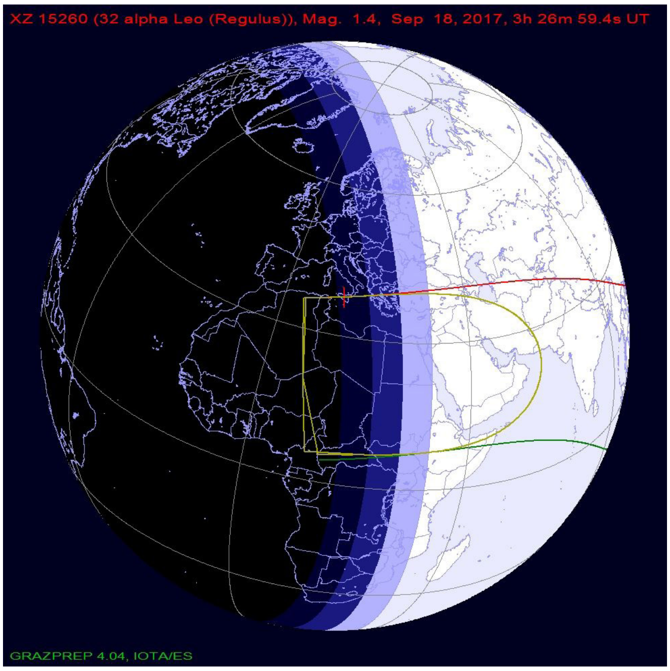

Figure 3: Visibility area of the Regulus occultation 2017 09 18 (GRAZPREP 4.04). Courtesy Eberhard Riedel.

Eberhard Riedel had pointed out that multiple contacts far from any sunlit lunar features were possible south of the northern graze line [4]. This led me to planning such an expedition. Eberhard Riedel further performed detailed predictions with his software GRAZPREP 4.04 for different longitudes (22°-24°E) including an offset of approx. -730 m at mean sea level in order to obtain the maximum number of possible contacts. It turned out that the area around 23°00'00"E / 38°59'13"N looked most promising (Moon altitude 15°; Sun altitude -9°), where ten contacts were to be expected (cusp angle 8.8°N) (Figure 4).

Observation

Starting from Athens I drove via Lamía (some 150 km northwest of the capital; about 215 km by car) to the chosen region between Glífa and Achíllio and arrived there on the evening of September 17. Searching for an undisturbed place I finally found one at the position 22°58'00.0"E / 38°58'55.5"N, 85 m above sea level (GPS/WGS84), amidst a rural area dominated by olive trees (Figures 5-7). As I went up in the early morning of September 18, weather satellite data did not show any clouds all over Greece (Figure 8). After setting up my lightweight telescope, a 75/524 mm (30x magnification) refractor azimuthally mounted on a photo tripod with a geared head (Figures 9-10), I tried to synchronize my stopwatch with a time signal. Unfortunately, I could not get any with my shortwave receiver, thus I had to synchronize the stopwatch via the Web (http://www.time.gov/ie corrected for the path delay of the timestamp through the Internet). This method bears some uncertainties, but repeated synchronization usually then delivers a stable time source. As the time of the graze drew near, the Moon together with Venus a few degrees apart became a conspicuous sight and the tension grew. At 03:29:25.20 UTC the star vanished behind the dark limb, 4.35 seconds later, at 03:29:29.55 UTC, it popped into view again. Then, at 03:29:36.05 UTC, a rapid succession of disappearances and reap-

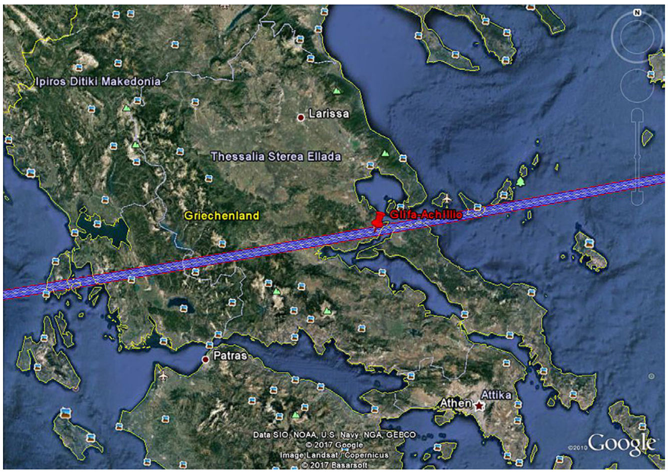

Figure 5: Map of Central Greece with the graze line and the observation site (Google Earth).

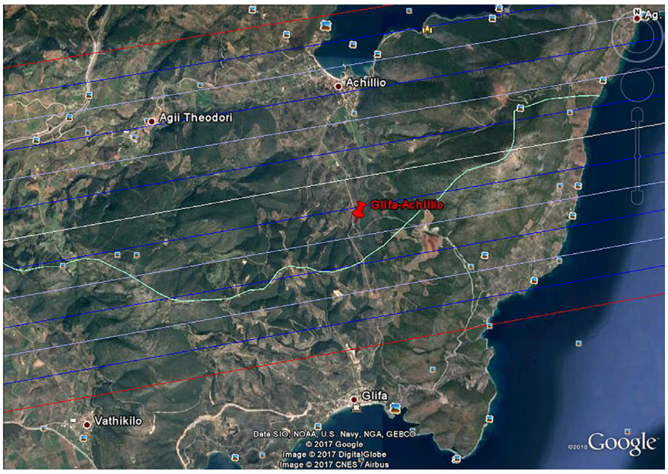

Figure 6: Map of the area between Glifa and Achíllio, showing the graze line and the observation site (Google Earth). Blue and red lines represent 500-m-offsets parallel to the graze line (white).

Figure 7: Map of the observation site (Google Earth).

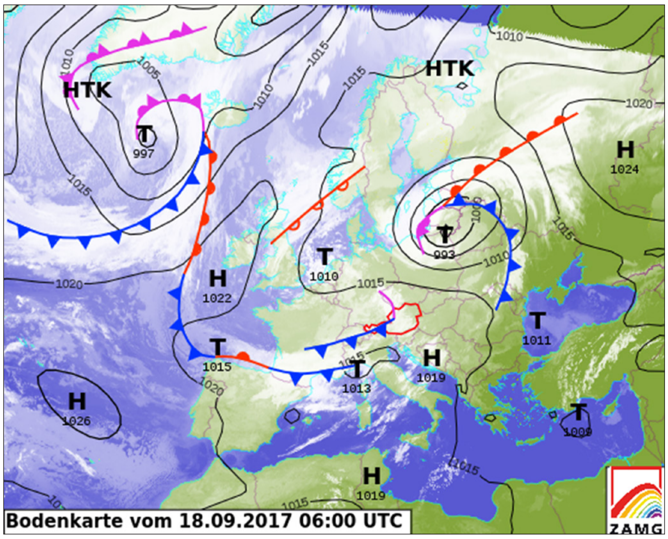

Figure 8: Ground pressure map 2017 09 18, 06:00 UTC (© ZAMG).

Figure 9: 75/524 mm refractor (30x magnification), mounted on a Manfrotto 055 Pro tripod with 410 Junior Geared Head, the latter offering precise geared movement in three directions. Moon and Venus are seen on the upper right.

Figure 10: 75/524 mm refractor, mounted on a Manfrotto 055 Pro tripod with 410 Junior Geared Head.

pearances followed, yielding six contact times within 6.25 seconds. At 03:29:48.00 UTC Regulus disappeared for the last time, staying invisible until 03:30:02.95 UTC. Only when I checked the lap times of my stopwatch (Figure 11), I realized that the graze had lasted 37.75

Figure 11: Casio digital stopwatch showing the first lap time (of ten).

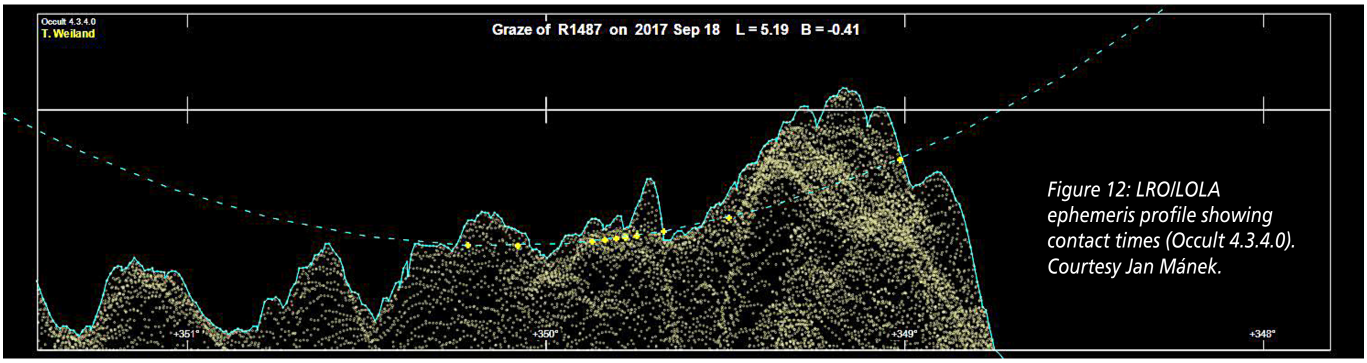

Figure 12: LRO/LOLA ephemeris profile showing contact times (Occult 4.3.4.0). Courtesy Jan Mánek.

seconds, resulting in ten contact times. At this point, it should be mentioned that during the short occultations between contacts 3 and 8 I had the impression as if the star would produce a fan-like shimmer from behind the limb.

Results

Times are given to 0.05 second (personal equation subtracted), corresponding to an estimated accuracy of 0.1 second. Coordinates delivered by GPS are estimated to be accurate to 0.5″ which corresponds to 10 m in longitude and 15 m in latitude respectively. Altitude is less precise, matching 10-20 m at its best. Coordinates (including altitude) were determined with three measurements and the average used.
The residuals given by Jan Mánek, IOTA regional collector for Europe, were derived from the LRO/LOLA ephemeris and are within the range -0.01″ to -0.06″ (average -0.037″ ± 0.014″). The corresponding profile is seen in (Figure 12) (Table 1).

Ephemeris: DE435 (1550/2650), DE422 (-2999/3000) Limb basis: LRO Lunar Orbiter Laser Altimeter [LOLA] O-C basis: limb correction applied		
Phase	UTC	O-C
Disappearance 1:	03 29 25.20	-0.05
Reappearance 1:	03 29 29.55	-0.03
Disappearance 2:	03 29 36.05	-0.05
Reappearance 2:	03 29 37.15	-0.03
Disappearance 3:	03 29 38.15	-0.05
Reappearance 3:	03 29 38.95	-0.02
Disappearance 4:	03 29 39.95	-0.06
Reappearance 4:	03 29 42.30	-0.01
Disappearance 5:	03 29 48.00	-0.05
Reappearance 5:	03 30 02.95	-0.03

Table1: Residuals by Jan Mánek

The residuals delivered by Mitsuru Sôma, National Astronomical Observatory of Japan and IOTA graze coordinator, are based on the Kaguya/LALT ephemeris and ranging from +0.004″ to +0.049″ (average +0.023″ ± 0.007″). The corresponding profile based on the LRO/LOLA ephemeris is seen in (Figure 13), (Table 2).

Ephemeris: DE423 Corrections to the Moon's Long. +0.00″ Lat. +0.00″ at mean distance Radius of the Moon 1738.091 km				
Phase	UTC	Height	Kaguya	O-C
Disappearance 1:	03 29 25.20	-0.239	-0.244	+0.006
Reappearance 1:	03 29 29.55	-0.239	-0.249	+0.010
Disappearance 2:	03 29 36.05	-0.228	-0.268	+0.040
Reappearance 2:	03 29 37.15	-0.225	-0.251	+0.025
Disappearance 3:	03 29 38.15	-0.222	-0.233	+0.010
Reappearance 3:	03 29 38.95	-0.220	-0.252	+0.032
Disappearance 4:	03 29 39.95	-0.216	-0.220	+0.004
Reappearance 4:	03 29 42.30	-0.207	-0.255	+0.048
Disappearance 5:	03 29 48.00	-0.177	-0.181	+0.004
Reappearance 5:	03 30 02.95	-0.055	-0.104	+0.049

Table 2: Residuals by Mitsuru Sôma

Height: Height of the star above lunar mean limb at the contact time
Kaguya: Lunar limb height from Kaguya
O-C: Difference between "Height" and "Kaguya"

Conclusions

Residuals derived from the Kaguya/LALT and LRO/LOLA ephemeris are well within the currently demanded accuracy of -0.10″ to +0.10″, the latter yielding slightly higher errors, whereas the corresponding profile delivered by Jan Mánek shows small systematic shifts in height against the predicted limb (Figure 12). As timing is not so critical for grazes, such shifts may be caused by site coordinates and, to a lesser extent, the profile itself (Jan Mánek; personal communication [5]). Another fact to be considered is the lower positional accuracy of very bright stars compared to those of fainter ones [1]. At this point it should be mentioned that the GPS measurement yielded an altitude of 85 m, while Google Earth indicates 68 m, though according to Mitsuru Sôma (personal communication [6]) this explains only -0.005″ in the heights of the reduction profile. However, an additional correction of 0.01° in axis angle (corresponding to -0.3 seconds in time) carried out by him results in an almost perfect fit (Figure 13). Since at the moment it is not clear which factor is mainly responsible for the shifts separation of errors could only be done in comparison with other observations (Mitsuru Sôma; personal communication [6]). Likewise, it seems doubt-

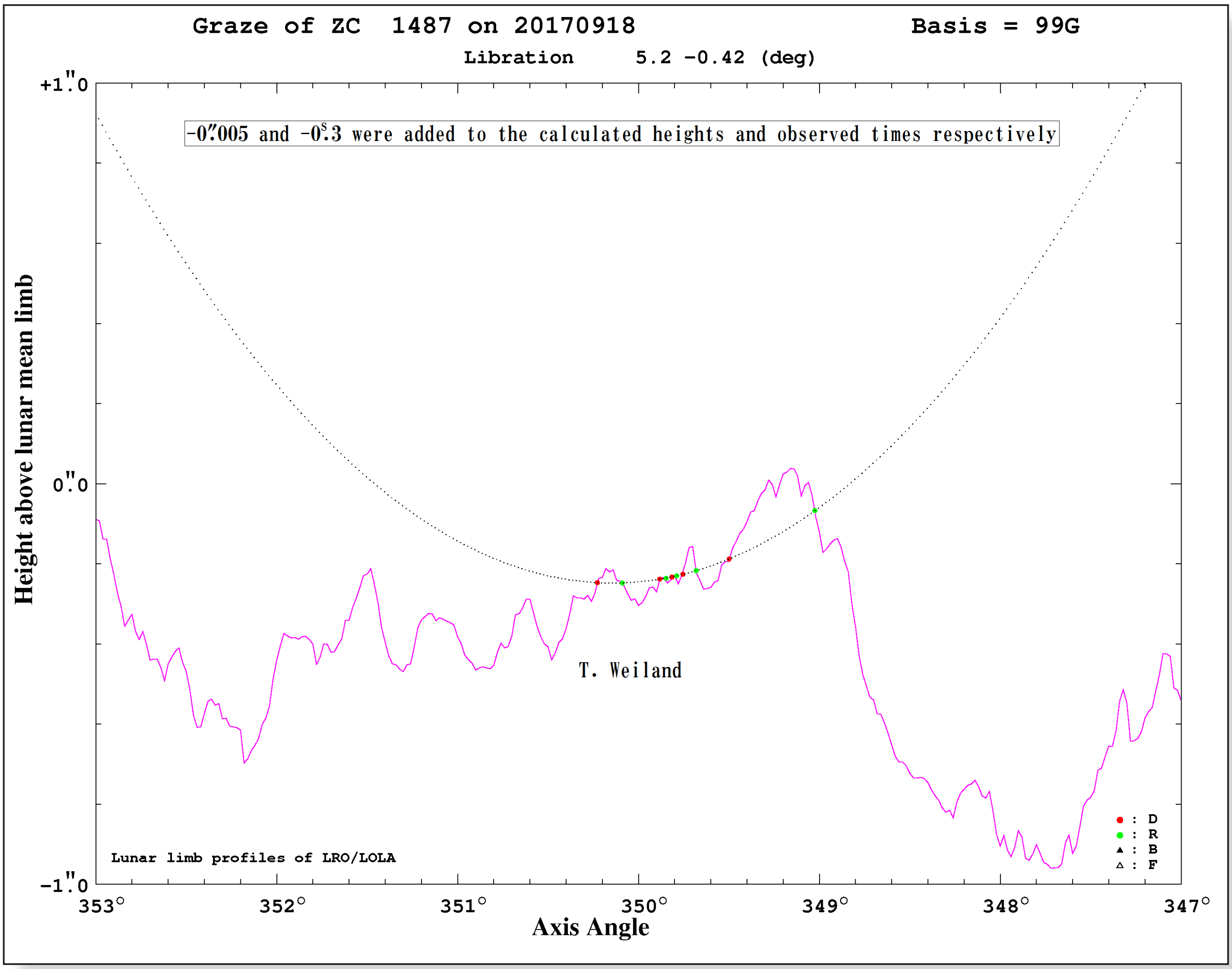

Figure 13: LRO/LOLA ephemeris profile showing disappearances (red dots) and reappearances (green dots). Courtesy Mitsuru Sôma.

ful whatever generated the fan-like shimmer at the dark limb between contacts 3 and 8; from the perspective of the author diffraction phenomena are the likely explanation, because Regulus is neither a giant star nor accompanied by a close, intrinsic bright binary. Anyway, the results shown above demonstrate that visual observations of grazes, even performed with modest equipment, still have a scientific value. Furthermore, occultations of very bright stars by a crescent Moon are thrilling. The combination of both ranks among the ultimate experience for occultation observers [2, 3]. Never in my 40 years of visual observing had I seen a nighttime occultation of a first magnitude star by a 5 % sunlit Moon, let alone combined with a spectacular graze yielding ten contact times and topped by perfect weather. Great!

Acknowledgements

I am deeply grateful to Eberhard Riedel for his efforts and help in planning the expedition, using his software GRAZPREP to predict the event at different longitudes. Furthermore, I would like to thank both Jan Mánek and Mitsuru Sôma for data reduction and useful explanations.

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[5] Jan Mánek, e-mail, 2017 October 14

[6] Mitsuru Sôma, e-mail, 2017 October 16

Becoming an Expert OccultWatcher User – Part 2

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ABSTRACT: While OccultWatcher (OW) has been designed to be easy to use, throughout the years I have received questions from various users asking how to accomplish something specific as well as questions about OW's internal workings and why it does or does not work in a particular way. This paper covers some of those topics and also discusses in more detail the rarely used but useful functions of the program, with the intention to help the reader to use OW more effectively. Each topic or function is discussed in its own section.
In the second part of this paper we will review the following topics: Warning Thresholds, Instrumental Magnitudes, Fixed Observatory Local Horizon, Tangra-AOTA-Occult Watcher Integration, Near Earth Asteroids and Lunar Occultations.

Warning Thresholds

There are a number of factors that are important to determine whether an event is easily doable, difficult or not doable at all. For example the star needs to be high enough above the horizon to be visible from a particular location. For fork-mounted telescopes it may also be important how far away the star is from the zenith. If too close, then the observer may be forced to use a diagonal mirror or may not be able to observe at all if the detector doesn't swing under or if it touches part of the mount. If the Moon is too close or the Sun is not sufficiently below the horizon the limiting magnitude will change and the star may not be detectable any more for the given instrument. Most users that have used OccultWatcher for a while would have noticed that it displays some of the parameters for the events in a different colour or on a different background. For example in Figure 1 the Star magnitude is displayed in red because it is fainter than the configured warning threshold, which is 11.5 by default. Also the Sun altitude is in orange because it is only 5 degrees below the horizon and therefore the event happens at dusk or dawn. In the last example the warning is in yellow on a black background and means that the Sun is above the horizon.

The warning styles are indeed not very consistent but this is how they have been historically introduced in OccultWatcher. The logic behind the yellow font for the Sun altitude is that the sky colour is yellowish when the Sun is above the horizon and it is orange when the Sun is not too far below the horizon. The same alert colours are however also used for the Star altitude (see Local Horizon below). All other warnings such as magnitudes or the Moon being too close are displayed with a red font. The thresholds themselves can be configured from the Configuration -> Other options -> Advanced -> Warning Thresholds tab. Their purpose is mostly to alert the user of potential observing challenges. Probably the parameter that would vary the most from observer to observer is the "Star is fainter than" threshold which default has been chosen for small mobile telescopes and non-integrating cameras. With many people using larger telescopes and integrating cameras quite likely the default value of 11.5 will not be good for many of the observers. To take full advantage of the alerting system users should change this value to better fit their situation.

A screenshot of all thresholds that can be set is displayed in Figure 2.

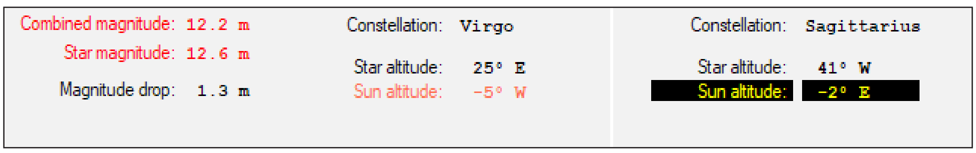

Figure 1. Various colour alerts based on the configured Warning Thresholds.

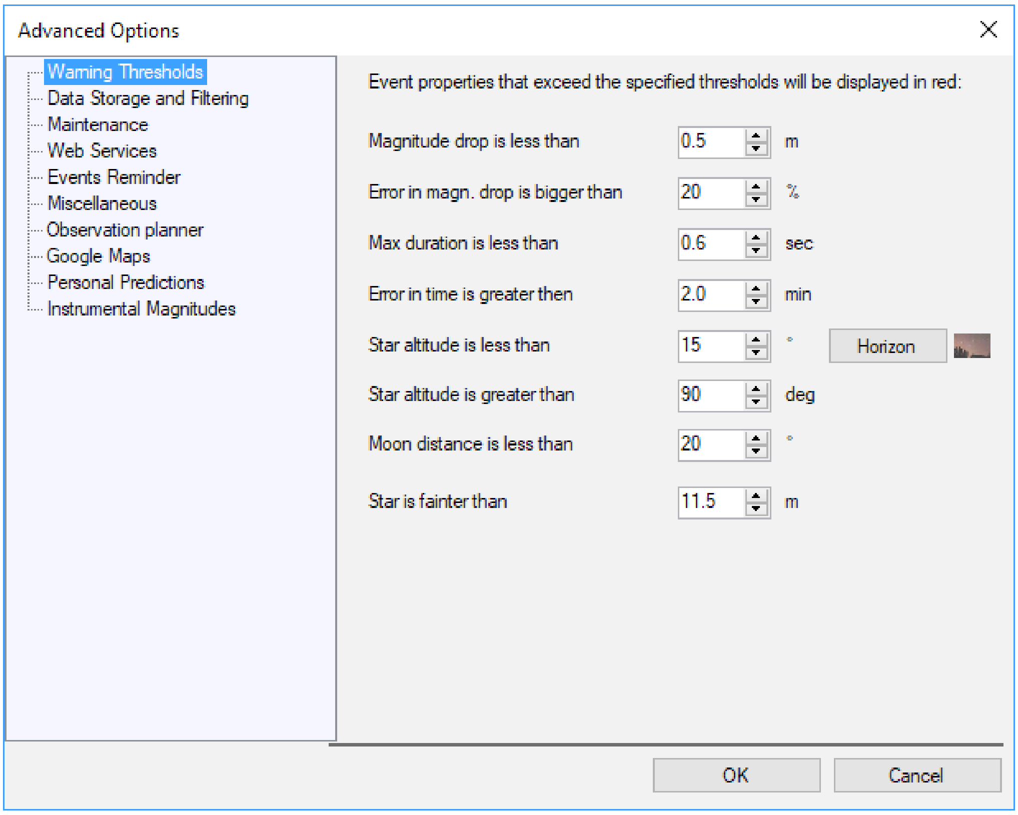

Figure 2. The advanced configuration tab for editing the warning thresholds used by OccultWatcher to alert for potentially difficult conditions.

Local Horizon

On the thresholds page discussed above there is a button titled "Horizon" which is used to configure the obstructions on the local horizon of a fixed observatory. This functionality is particularly useful if you have for example a single tall tree close to your observatory and you really need to know if the star is going to be close to the tree or perhaps behind it. OccultWatcher will use the local horizon configuration file to work out how close will the star be to the configured obstructions during the mid-event time and will display a warning for the 'Star altitude' if the star is close or obstructed (Figure 3).

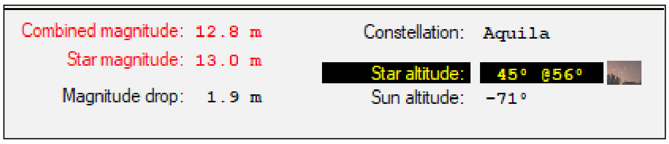

Figure 3. If the star is obstructed, based on the local horizon configuration, the Star altitude will be displayed in yellow on a black background and a little icon will be also displayed next to it to indicate that this warning is related to the local horizon. If the star is close to the edge but is not obstructed then the warning will be orange on a black background.

The local horizon is defined in a text file and its format is explained in detail and appears as a commented out section when you click the ''Horizon" button to open up the UserHorizon.txt file. As the local horizon definition is tied to an observing site name, in order to use this functionality the user will need to define a site name from Configuration -> General -> Sites -> Edit saved sites. Once a site is defined its name can be used in the UserHorizon.txt file. For example the lines below correspond to the definition of a local horizon for a site called Sydney:

```
Name = Sydney
# Add one horizon point per line below starting
with azimuth 0 and finishing with azimuth 360
0, 0
90, 0
90, 40
110, 40
110, 0
360, 0
```

If the specified site in the UserHorizon.txt doesn't exist in OccultWatcher the user will be presented with an error message when OW starts. It is possible to define the horizon for more than one site if the user uses predictions for different locations in the same OW installation.

Instrumental Magnitudes and Rotation Variations

Another factor in determining how difficult or easy an event could be is the spectral response of the video camera. Whilst OccultWatcher shows the magnitude of the star and the combined magnitude of the star and asteroid, different video cameras will have slightly different spectral responses and as a result stars may appear fainter or brighter than what the observer might expect. A typical scenario could be a very blue star that is appearing too faint and may not be detectable with a useful integration for a given expected occultation duration or the occultation being too shallow.

In this case, OccultWatcher can help by calculating instrumental magnitudes for the supported cameras, which at this point are: WAT-910HX (same as WAT-910BD), WAT-120N, PC-164EX2 and Point Grey Flea3. OccultWatcher can calculate an instrumental magnitude for the camera based on experimentally derived formulae for these cameras. This functionality can be enabled from Configuration -> Other options -> Advanced -> Instrumental magnitudes (Figure 4).

Some asteroids also have large magnitude variations because of their rotation. OccultWatcher will use the rotational data for the asteroid (if available) and can also provide an expected range for the combined magnitude and/or magnitude drop based on the maximum amplitude variations from the rotation for the asteroid.

Once the Instrumental Magnitudes are enabled OW will display in purple the 'Combined magnitude', 'Star magnitude' and 'Magnitude drop' calculated for the selected camera (Figure 5).

The Magnitudes tab of the Additional Event Details form will contain more detailed information about the calculated magnitudes. If OW is unable to get colour data for the star the Instrumental Magnitudes will

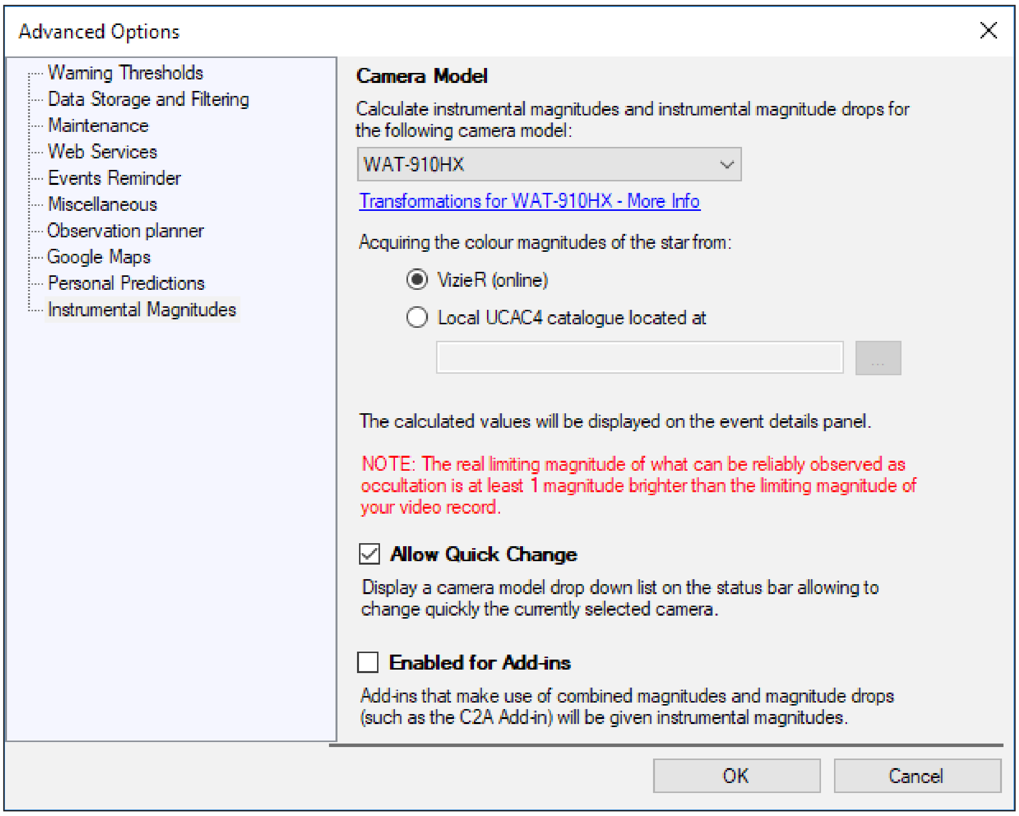

Figure 4. Enabling instrumental magnitudes

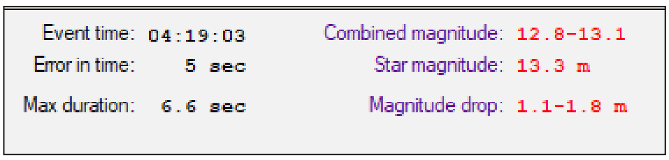

Figure 5. An expected range for the Combined magnitude and Magnitude drop of an event resulting from corrections for spectral response of the camera and taking into account the amplitude variation of the brightness of the asteroid as a result of its rotation.

not be calculated. This will be indicated by the standard black (rather than purple) font for the three displayed magnitudes. If colour data for the star is missing no rotational magnitude variations will be shown either.

Tangra-AOTA-Occult Watcher Integration

This functionality is available out of the box in both Tangra and OccultWatcher and its purpose is to make it easier for users to report observed events by automatically populating the start/stop observing times and the D and R times in a case of an occultation, which have been provided by an AOTA analysis called from within Tangra. The pre-population of the report in OccultWatcher only works for the Excel report forms which are currently used in Australia and the US. The workflow of this interaction is described next.

We are starting from a light curve (.lc) file opened in Tangra. This could be your own observation that has been just reduced by Tangra or it could be an .lc file that another observer has sent you. From the Light Curve form in Tangra then you choose **Add-ins -> Asteroidal Occultation Analysis with AOTA.**

Next follow the prompts from AOTA to complete the analysis. Depending on whether there was an occultation event or not, you exit AOTA with or without results. If you have OccultWatcher installed on the same computer, upon exit Tangra will notify you that the results have been saved for OW to use. If you don't want all AOTA results to be automatically made available to OW and you want to choose which Tangra-AOTA results to be sent to OW and which not, in Tangra you can modify the **Settings -> Add-ins -> Occult Watcher Reporting Integration** (at the bottom). Now in order to use the report data from AOTA into the Excel report form you go through the standard **right click -> Report Observation** in OW. Now clicking "Pre-fill Report File" will display a form with all currently available reports in OW that haven't been used yet (Figure 6).

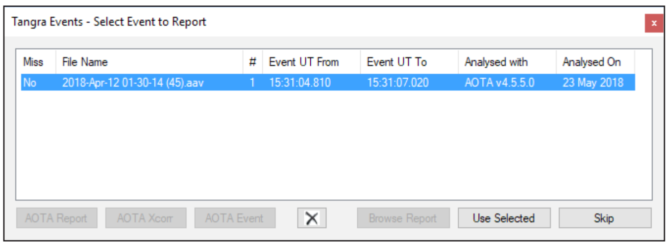

Figure 6. Unused AOTA reports displayed in OW when pre-filling an Excel report form.

After an AOTA report has been selected OccultWatcher will populate the 'Timing Source', 'Timing Method', 'Camera Model' and 'Video Format' fields in the report form. It will also populate the 'Started Observing' and 'Stopped Observing' values for both a miss and a detection event. These values will correspond to the timestamps of the first and the last frames of the loaded video. Even when the analysed part of the video is a smaller chunk it is assumed that the target has been recorded for the duration of the entire video and therefore the start and stop observing times are reported as the start and the end of the video recording. The remaining parts of the report form such as asteroid and star name and observer details will be also prefilled as normal.

Near Earth Asteroids

The functionality of OccultWatcher can be extended by add-ins, some of which have to be downloaded and installed manually. The currently available add-ins are listed on
http://www.occultwatcher.net/MoreAddins.html
and to 'install' any of them the user simply needs to download it and unzip the contents into the OccultWatcher directory. In the next two sections we will review two prediction add-ins – the Near Earth Asteroids and Lunar Occultations.

The Near Earth Asteroids add-in provides a list of events appropriate for video astrometry of Near Earth Asteroids (NEAs). The add-in monitors the list of close approaches published by NASA on
https://cneos.jpl.nasa.gov/ca/.
At the time of the synchronisation the add-in computes the ephemeris of the object for the configured home site in Occult Watcher using the MPC online tool and finally checks if the object will be bright enough and visible from the location before finally adding it to the list of events (Figure 7).

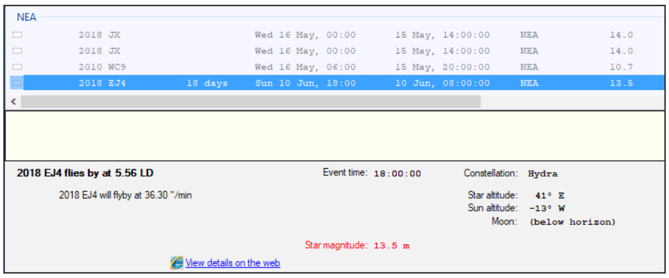

Figure 7. The information presented when a listed NEA flyby is selected. The 'View details on the web' link will open up the MPC ephemeris page for the object for the current OW site and a few days around the closest approach.

There is some caution to the listed events though - new NEAs are often discovered days before the closest approach and sometimes even after it. Because OccultWatcher's synchronisation typically runs only a few times a day (at max) it is possible to miss the closest approach of NEA flyby events that have been published hours before the closest approach and when the observer doesn't check the feed every day. This is however part of the nature of this add-in and observing NEAs in general and this is something of which the user should be well aware. Having said that, many events will be listed more than a week before the closest approach and will allow for better planning.

If you are new to video astrometry I should also note that there is a bit of a learning curve but typical occultation equipment is very well suited for it and software such as Tangra provides a significant aid in the reduction of the observations. More importantly reporting video astrometry to the MPC has a huge scientific value and is a great way to get more deeply involved in making scientific contributions as an amateur in addition to the occultation observations. The Near Earth Asteroids add-in in OccultWatcher will provide you with what you need to get started. Remember that at times there will be a couple of events within the same month, while sometimes there will be a couple of months without observable events so don't be put off if you don't see events for a while and be prepared to act quickly on new discoveries. A very useful guide to Video Astrometry using Tangra by Alex Pratt is available online at *https://minorplanetcenter.net/iau/info/AGuidetoVideoAstrometry.pdf*

Lunar Occultations

OccultWatcher also allows you to get Lunar Occultation predictions. This is made possible thanks to Brian Loader in Australia and New Zealand, Brad Timerson in the US and Oliver Klös and Jan Mánek in Europe. They carefully select events of interest for their respective regions which at this point are typically lunar occultations of close double stars.

For the Lunar Occultations feed to work you also need to have Occult4 installed on the same computer. OccultWatcher will ask Occult to calculate the event details for the configured Home location in OW at the time of the synchronisation. This means that if you change your site in OccultWatcher after synchronising the Lunar Occultations feed the event details are not going to be recalculated. In fact the event details will contain the site name for which they have been calculated (Figure 8).

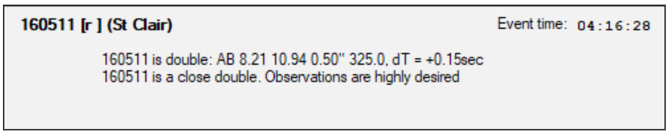

Figure 8. Details of a Lunar Occultation event contains the name of the OW site for which it has been calculated at synchronisation time, in this case St. Clair. If the user hasn't defined any sites then this will read 'Home'.

After the feed is configured the user will need to enable it from Configuration -> Prediction feeds and will also need to restart Occult Watcher.

This is the end of the second part of this paper.

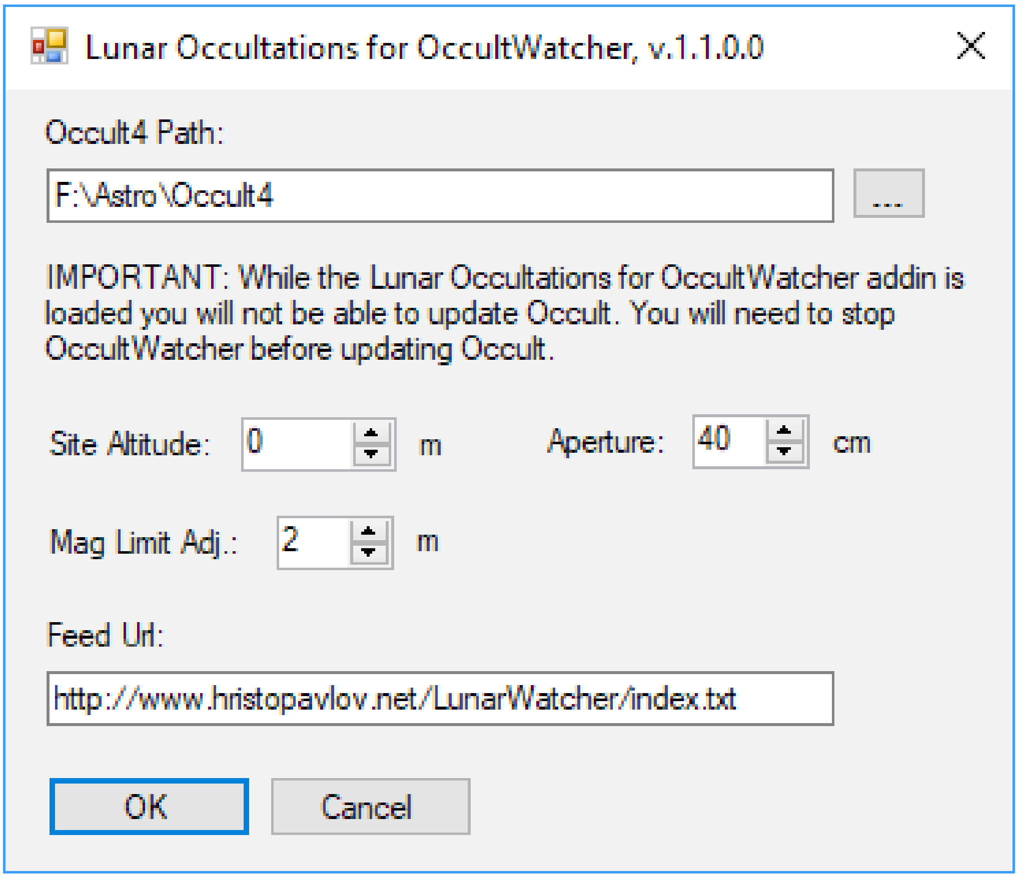

Figure 9. Lunar Occultations require the file path to where Occult4 is installed and the feed URL, which can be obtained for your region from http://www.occultwatcher.net/MoreAddins.html#lunar

How to Write an Article for JOA

In order to make the Journal for Occultation Astronomy (JOA) a more professional publication we have decided to adopt slightly stricter rules for writing articles for the journal. This will reduce the workload of the editors and the layout artist when they prepare an issue for publication.

The Process for Submitting Articles Is as Follows

Send your manuscript by e-mail or postal mail to a member of the Editorial Board (listed in JOA). We can only accept an article by postal mail if it is on a CD or DVD. Your article is then reviewed either by a member of the Editorial Board or an external referee who is a specialist in the subject matter of your contribution. If, for certain reasons, you do not want your article to be refereed by a specific person, please notify us in an accompanying letter. We will then decide if your request can be granted or not. If we cannot fulfill your wishes we will notify you.

After your article has been reviewed we will contact you if there are any questions about its content or to discuss any recommended changes. After this assessment process has been completed the reviewer sends the latest version of the article (including any changes) and their comments to the Editorial Board. The reviewer can give 1 of 4 recommendations:

- Publish without any changes
- Publish with minor revisions within the next 3 weeks
- Major revisions are necessary within the next 6 weeks
- Not acceptable for publication in JOA

You will be informed of the Editorial Board's decision based on the reviewer's recommendations. The Board might contact you or the reviewer again, and they reserve the right to overrule the decision of the reviewer and to decide whether an article is published or not. They will do their best to ensure that articles accepted for publication appear in a timely manner.

When you submit an article we require the following documents:

- An e-mail or postal mail to a member(s) of the Editorial Board with a short description of your article and any other comments supporting your work. If your subject is perhaps outside the scope of JOA you may add an explanationwhy it should appear in the Journal.
- The manuscript in the following format: **.doc** or **.docx** or **.rtf** or **.pdf** or **.txt**
- The figures with a minimum resolution of 1024 pixels x 768 pixels either as .jpg or .tiff
- The legends to the figures can either be included in the manuscript or written as a separate file in one of the acceptable formats given above

This is to make the publishing process easier and more effective. Your manuscript layout should be written according to the following guidelines:

Title

The title of the article has to be as informative as possible. Please avoid titles like you sometimes see in the press, where some information is hidden with the only reason to "force" the reader to read the complete article. To give an example: 'The big occultation of... read more'.

The main title has to be short; we will not accept titles of more than 150 characters, including spaces. You may use subtitles, such as:

The Triton Occultation of 2017:
Instrumentation and Observing Stations

Affiliation

List your name, association affiliation(s) and e-mail address, e.g.:
Bernhard Deckung – IOTA/ES – b.deckung@iota-es.de

Abstract

Every article must have an abstract. It is limited to 1000 characters, including spaces. Please describe the content of your paper as informatively as possible. Do not cite figures or references in the abstract, because the abstract may appear somewhere else without the full paper, such as the SAO/NASA ADS.

The Article Itself

The article may have the following section headings

- Introduction
- Material and Methods
- Observations
- Results
- Discussion
- Summary
- Acknowledgements
- References

You can use your own section headings, but in any case a Summary is strongly advised. This facilitates the reading.

In all paragraphs, references to journal articles, communications, websites, books etc. should be given in square brackets [ ], as follows:

It took a further 10 years until another stellar occultation by Triton has been successfully recorded in May 2008 [3]. Unfortunately the geometry of the chords (two almost grazing chords at the southern limb) limited the derived astrometry and therefore, within a 3-sigma confidence level, no significant value of the atmospheric pressure (and possible changes since 1997) could be derived [4]. All predictions have been carried out with the "OCCULT" program [2, 7, 13]

Figures have to be included as separate files, either in .jpg or .tiff formats. The minimum size is 1024 x 768 pixels. The names of the figures have to be included in the text in their desired positions. For example: <figure1.jpg>. The final placement in the article will be the decision of the JOA layout artist. The figures have to appear in the text with consecutive numbers, such as:

We have taken a picture of the surface of the nearest exoplanet. One of the craters including the IOTA/ES rover is shown in figure 1 <crater_exoplanet.jpg>. A full map of the surface of the exoplanet can be seen in figure 2 <map_exoplanetl.tiff>.

Make it very clear in your article where the figures have to be inserted. Each figure has to have a legend. Do not write legends directly into the figures or pictures. The legend has to begin with text, such as "Figure 1". The legends can either be included in your manuscript after the References or in a separate file in the same format as the main article.

References

The following are examples of references as they should be formatted when writing for JOA:

[1] Sicardy, B. et al., Large changes in Pluto's atmosphere as revealed by recent stellar occultations, Nature 424, 168-170 (2003).

[2] Elliot, J.L. et al., Global warming on Triton. Nature 393, 765-767 (25 June 1998).

[3] Sicardy, B. et al., The Triton stellar occultation of 21 May 2008, EPSC 2008 abstracts (2008).

[4] Sicardy, Bruno, Personal communication (July 2017).

[5] http://lesia.obspm.fr/lucky-star/predictions

[6] http://astro.kretlow.de/?Solar-System---Occultations

[7] https://occultations.org/ and http://www.asteroidoccultation.com/observations/NA/

[8] http://www.iota-es.de

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ESOP 37

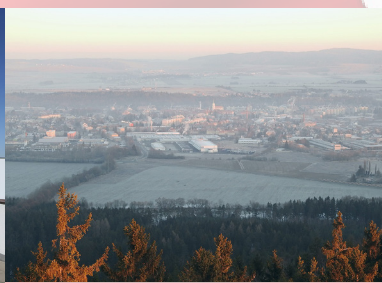
http://esop37.cz/

It is a great pleasure to invite all interested parties to Rokycany, Czech Republic for the 37th European Symposium on Occultation Projects on August 24th-29th, 2018.

IOTA/ES's annual conference will include talks and lectures, as well as interesting excursions. Host town is Rokycany, a town in the Plzen region, about 17 km east from Plzen. The town of Rokycany lies in a hollow, at the confluence of a small river called Klabava and the Holoubkovský and Rakovský streams. The town is surrounded by the forest hills of Čilina, Kotel, Žď'ár and Vršíček. Rokycany was first mentioned in 1110 and the main-belt minor planet (15925) Rokycany is named after this town.

Getting to Rokycany: The nearest Václav Havel Airport (PRG) is in Prague. The train from Prague (Praha) takes to Rokycany about 1.5 hrs. Highway from Prague to Rokycany is D5, exit 62. Highway from Germany's Autobahn A6 to Rokycany is D5, exit 62.

Symposium is organized by Rokycany & Plzeň Observatory with co-organization by Town Rokycany, Pilsen Region and Occultation & Astrometry Section of Czech Astronomical Society.



Beyond Jupiter

The World of Distant Minor Planets

Since the downgrading of Pluto in 2006 by the IAU, the planet Neptune marks the end of the zone of planets. Beyond Neptune, the world of icy large and small bodies, with and without an atmosphere (called Trans Neptunian Objects or TNOs) starts. The zone between Jupiter and Neptune is also host to mysterious objects, namely the Centaurs and the Neptune Trojans. All of these groups are summarized as "distant minor planets". Occultation observers investigate these members of our solar system, without ever using a spacecraft. The sheer number of these minor planets is huge. As of June 2018, the Minor Planet Center listed 768 Centaurs and 1934 TNOs.

In the coming years, JOA wants to portray a member of this world in every issue; needless to say not all of them will get an article here (KG).

In this Issue:

(54598) BIENOR

Konrad Guhl, IOTA/ES

Marwitz/Germany

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ABSTRACT: Since 2016, JOA regularly publishes portraits of objects beyond Jupiter's orbit. This short communication on the centaur Bienor tells the story of its discovery, the meaning behind its name and its orbit. Size and physical properties follow data published until 2017. Two single chord occultations have been announced and an outlook for coming stellar occultations is given.

The Discovery

The discovery of Bienor was a result of the "Deep Ecliptic Survey" (DES), a project of the University of Arizona. The object was discovered on August 27, 2000 with the 4m Victor M. Blanco telescope at Cerro Tololo Inter-American Observatory (CTIO) by Jim Elliot. It got the preliminary name 2000 QC_{243}. Pre-discovery images were found as observations from Siding Spring Observatory dating back to 1975. The orbit is beyond Jupiter and inside Neptune's orbit, placing Bienor among the Centaurs dynamical class (Figure 1).

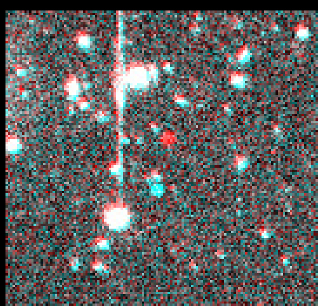


Figure 1: The pair of red/cyan objects are the discovery images of 2000 QC_{243} which moved about 12 arcsec in the sky in the 1.7 hours between the two exposures. The subframe image was provided by L. Wasserman, Lowell Observatory.

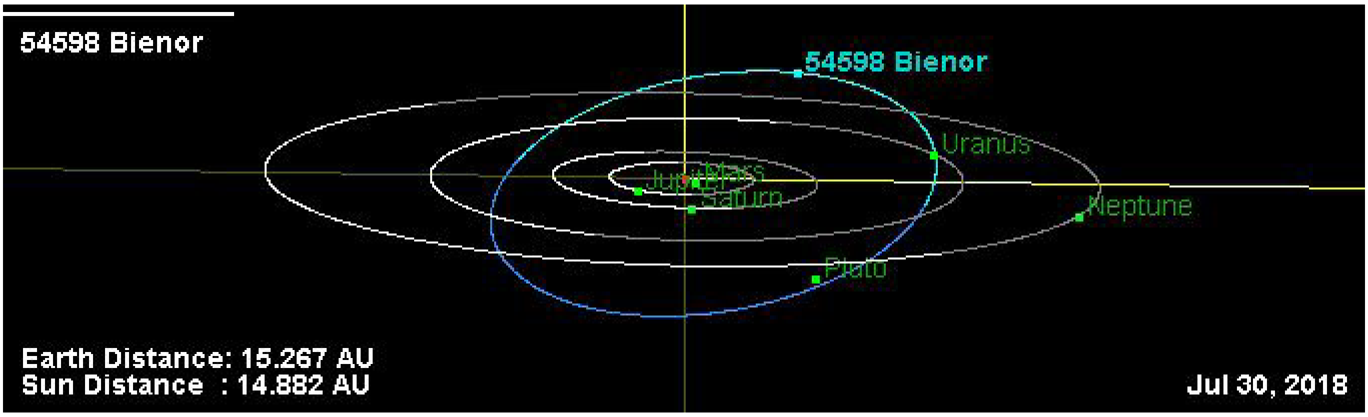


Figure 3. Orbit diagram and position of Bienor for Jul 30th , 2018, source JPL

Figure 2: A.-L. Barye, Theseus Combatting the Centaur Bianor; Dahesh Museum of Art, New York. 1995.110

The Name Bienor = Bianor (Greek Βιάωρ)

As has been said, the object was identified as a member of the sky object family called Centaurs. So Elaine K. Elliot, Jim Elliot's wife, suggested the name "Bienor", one of the centaurs mentioned by the Greek poet Ovid in his epic Metamorphoses. During the wedding party of Peirithoos and Hippodameia, the centaurs attempted to carry off the bride and all female guests. This initiated a tough battle between the Lapiths and the centaurs. The battle was decided when Theseus, ruler of Athens, helped the king of the Lapiths by violently slaying the centaur Bianor. This subject inspired Antoine-Louise Barye (1795-1875) to the plaster "Theseus Combatting the Centaur Bianor", shown in figure 2.

The Orbit

The orbit is slightly eccentric (0.199) and inclined to the ecliptic by 20.74°. The perihelion and aphelion are 13.15 and 19.73 AU, respectively. The semi-major axis of the orbit is 16.43 AU and the orbital period is 66.64 years.

Figure 3 shows Bienor's orbit and the orbits of the outer planets. In summer 2018, Bienor will have a distance to the sun of 14.8 AU and stands close to the northern point of the orbit.

The Size and Physics

Bienor is a member of the Centaurs' group and the fourth biggest Centaur discovered (after 2002 GZ_{32}, Chariklo and Chiron, according Herschel Space Observatory derived diameters). The absolute magnitude is found to be 7.5. Based on light curve observations, Ortiz and his group found a rotational period of 0.190416 days with a light curve amplitude of 0.75 mag [1], remarking "…a large amplitude period is found at 4.57 h ± 0.05 h, which likely corresponds to half the rotation period of the body" in 2002. The group from Stansbearry measures a rotation period of 0.382230 days with a peak-to-peak amplitude of 0.34 mag [2] in 2005. More than 10 years after the discovery and first observation of Bienor, the group of E. Fernandez-Valenzuela from the Instituto de Astrofísica de Andalucía (IAA-CSIC) in Granada (Spain) published new data on Bienor [6]. They obtain a rotational period of 9.1713 ± 0.0011 h (0,38213 days). This result is consistent, within the error bars, with the periods determined by Rabinowitz, Schaefer & Tourtellotte (2007) [2] and Ortiz et al. (2002) [1]. In the paper, the team around E. Fernandez-Valenzuela found a decline in the amplitude of the rotational light curve. The reason for this decline is the change in angle between the observation direction (line of sight) and the rotation axis during the last years. Based on rotational light-curves, the team found models for the body and a possible ring similar to the rings of Chariklo and Chiron. Figure 4 shows the first light curve from 2002 and the new observation of Nov/Dec 2014.

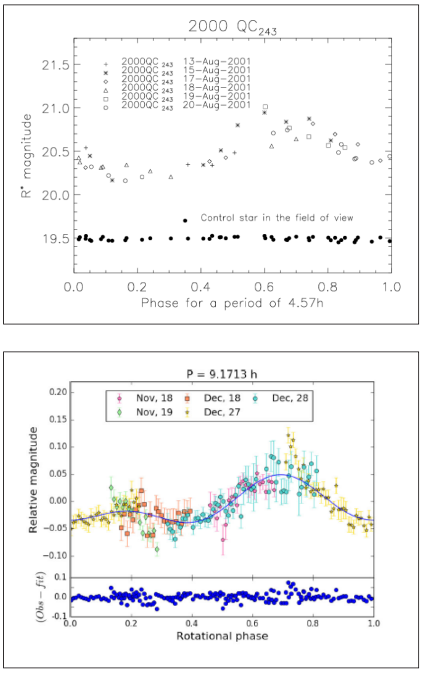


Fig 4: Rotational light curve of Bienor

2002 [1]

and 2014 [6]

Based on IR spectroscopic observation, the albedo of Bienor was found to be around 3.4 %. The thus-calculated first photometric diameter is approximately 210 km [3]. Considering the strong amplitude in the rotation light curve, the object cannot be spherical – a more elongated body is expected- Dotto et.al. found via near infrared spectroscopy on the VLT indicators for water ice on the surface of Bienor [4]. These observations are confirmed with the Keck I telescope in [5]. New results about Bienor were obtained from observations with the ESA Herschel Space Observatory [7]: The team observed the thermal emission of Bienor with the Photodetector Array Camera and Spectrometer (PACS) at wavelengths of 70, 100 and 160 µm (the so-called blue, green and red channels of the PACS instrument). Figure 5 shows a couple of images of Bienor from this thermal emission campaign framed within the Herschel key project called "TNOs are Cool: a survey of the trans-neptunian region"

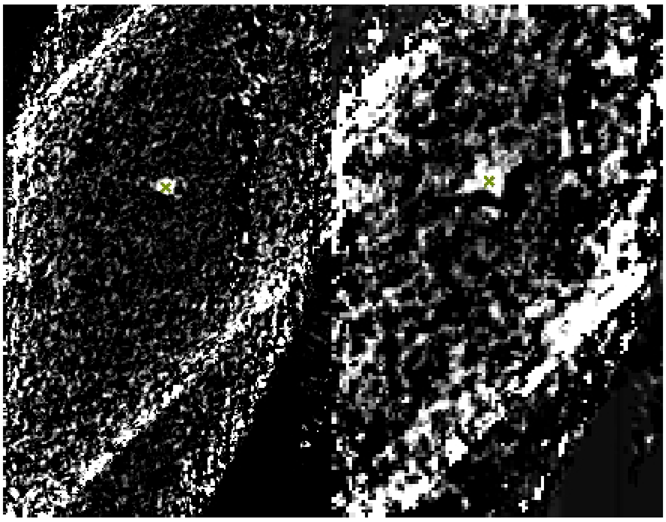


Fig 5: 2 Herschel-PACS images of Bienor processed by Pablo Santos Sanz, left at blue band (70 microns) and right at red band (160 microns). Thanks to P. Santos-Sanz, Instituto de Astrofísica de Andalucía - CSIC, Glorieta de la Astronomía s/n, 18008 Granada, Spain.

that observed around 130 TNOs/Centaurs with Herschel/PACS in order to obtain their sizes, albedos and thermal properties.

From the measured fluxes at these wavelengths, the team obtains a diameter of 198 + 6 / –7 km and an albedo of 4.3 +1.6 / –1.2 %. That renders Bienor the fourth largest Centaur known today.

Stellar Occultations

In the past, some occultations by Bienor were predicted and occultation observers across North America and Europe attempted to observe them. Up to today, we do have one chord occultation of a currently unpublished observation from Dec 29th, 2017 and another one-chord observation from Apr 2, 2018 with two negative and one positive report. Josselin Desmars, of Bruno Sicardy's Paris team (with help of the IAA-Granada team and the Rio team), calculated more possible stellar occultation by Bienor for 2018. The predictions sorted by date, and/or star magnitude and/or area can be found at http://lesia.obspm.fr/lucky-star/predictions/. Planning an observation shall be done by just-in-time predictions because precise stellar occultation predictions by Solar System distant minor bodies (like TNOs and Centaurs) can only be refined by using very accurate astrometry close to the occultation date.

Special consideration should be placed on the predictions for August 5th (North America), November 26th (Middle America) and December 12th (South America).

References

[1] J.L. Ortiz, S. Baumont, P.J. Gutierrez, M. Roos-Serote: Lightcurves of Centaurs 2000 QC243and 2001 PT13, Astronomy and Astrophysics 388, 661–666.

[2] David L. Rabinowitz, Bradley E. Schaefer, and Suzanne W. Tourtellotte: The diverse solar phase curves of distant ice bodies. I. Photometric observation of 18 Trans-Neptunian Objects, 7 Centaurs and Neireid, The Astronomical Journal, 133, 2007 January

[3] J. Stansberry et. All: Physical Properties of Kuiper Belt and Centaur Objects:Constraints from Spitzer Space Telescope, to Appear in: The Solar System beyond Neptune (M.A. Barucci et al., Eds.) U. Arizona Press, 2007

[4] E. Dotto, M.A. Barucci, H. Boehnhardt, J.Romon, A. Doressoundiram, N. Peixinho, C. de Bergh, M.Lazzarin: Searching for water ice on 47171 1999 TC36, 1998 SG35, and 2000 QC243: ESO large program on TNOs and centaurs*, Icarus, Volume 162, Issue 2, p. 408-414. (Icarus Homepage)

[5] Barkume, K. M., Brown, M. E., Schaller, E. L.: Near-Infrared Spectra of Centaurs and Kuiper BeltObjects. Astronomical Journal 135, p55-67.

[6] E. Fernandez-Valenzuela, J. L. Ortiz, R. Duffard, N. Morales and P. Santos-Sanz: Physical properties of centaur (54598) Bienor from photometry, MNRAS 466, 4147–4158 (2017)

[7] R. Duffard et al.: "TNOs are Cool": A survey of the trans-Neptunian region XI. A-Herschel-PACS view of 16 Centaurs. Astronomy & Astrophysics 564, A92 (2014).

Useful Links

About the Deep Ecliptic Survey:

https://web.archive.org/web/20040829233039/

http://www.lowell.edu:80/Research/DES/index.html

About objects like TNO and Centaurs:

http://ssd.jpl.nasa.gov/sbdb.cgi

http://spacewatch.lpl.arizona.edu

http://www.minorplanetcenter.org/

Journal for
Occultation Astronomy

Baily's Beads Observations during the Total Solar Eclipse 2017 August 21

Konrad Guhl (IOTA/ES, Archenhold-Sternwarte), Andreas Tegtmeier (IOTA/ES)

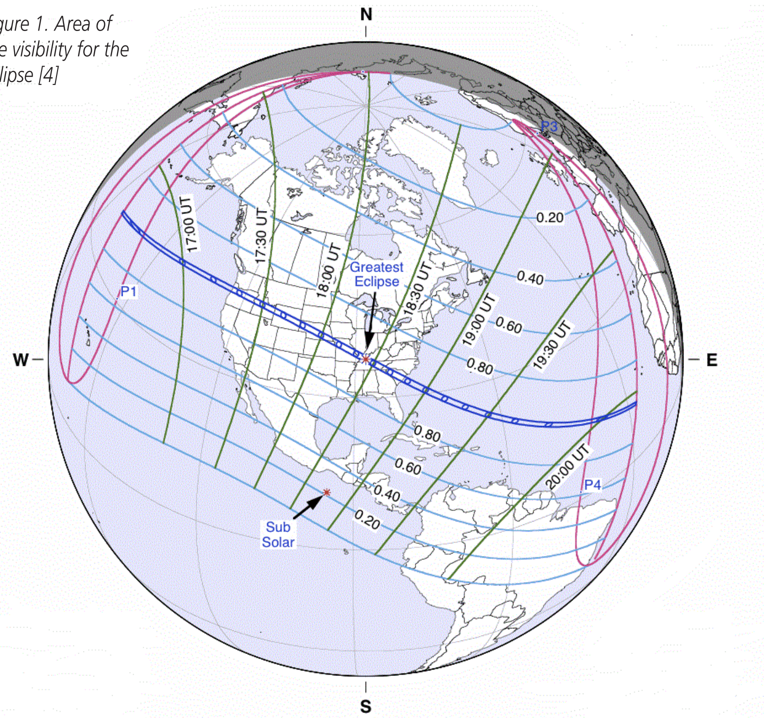


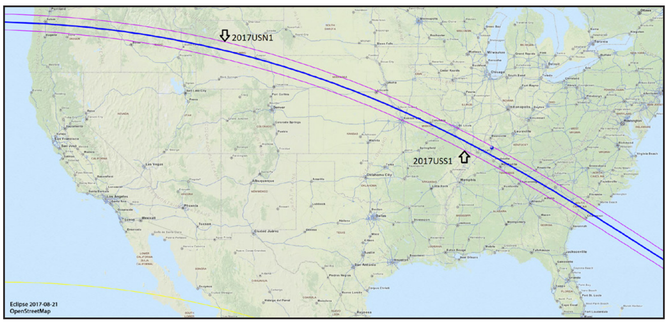
Figure 1. Area of the visibility for the eclipse [4]

ABSTRACT: Measuring the angular solar diameter and calculating the real diameter, taking into account the Earth-Sun distance, has been a fundamental challenge for astronomers for more than two thousand years. After micrometer, heliometer or transit measurements, astronomers found one of the best ground-based methods for finding the solar diameter: The observation of the disappearance and reappearance of the remaining sunlight in the valleys on the lunar limb during total or annular solar eclipses. Due to the fact that Francis Baily (1774-1844) was one of the first who described the tiny points of light on the lunar edge during a total eclipse, the technique was named Baily's Beads observation. Such observations have been a focus of activity of IOTA and IOTA/ES for many years. The aim was a measurement of the solar diameter and detection of possible variations. Following the agreement at the ESOP XXXI (held 2012 in Pescara, Italy) the measurement program will end in 2017 due to the better precision of spacecraft observations since 2012. This ensures some overlap in the data sequences from bead observation and spacecraft-borne observations, for 5 years after the start of the PICARD-spacecraft mission.
In 2017, IOTA/ES organized an expedition to the edges of a total solar eclipse (TSE) on August 21, where bead observation is possible. Additionally, some US observers (IOTA) observed this event; a separate report is expected.

Eclipse Circumstances

The TSE 21082017 eclipse path ran over the US from Oregon to South Carolina and was called the "Great American Eclipse" (Figure 1).

From the western part of Europe, the end of the eclipse was possible to observe during sunset (see front page). The planned observation points for the northern and southern edges are marked in figure 2.



Instruments and Reduction Method

Like former TSE and ASE observations, the equipment used follows the IOTA/ES recommendation. It is based on a 100/1000 mm Maksutov-optic, a non-automatic camera, a 535 nm filter and the IOTA/ES filter [1]. The video signal was paired with an additional GPS time signal and recorded as a video file. The video files have been visually analyzed by the authors. The inspection was done twice on different machines and days. Following the station code created in [1], the stations were called 2017USN1 and 2017USS1. All observations were simulated with the software tool "Baily Bead Analysis" of the software [2]. The version V 4.5.3.0 includes LOLA and Kaguya data. This was the only analysis performed. All other simulation/calculation tools e.g. SUNBEADS that used the old Watts data and were not considered.

The simulation shows the distance of the lunar limb (based on Kaguya data) and the calculated solar radius in arc-seconds. The offset from

Figure 2. Map of US with path of totality and the observation points

the standard solar radius is given as output data. Only easily-identified beads are included in the table of results. After clear identification of disappearing/reappearing beads, the axis angle of each is the output by the eclipse simulation software [2]. Following [3], the limb darkening function of the video observation is analyzed on a video frame during the partial phase (Figures 3, 4). The limb darkening effect is clear to see in the brightness profile to guarantee that no overexposure/saturation influences the measurement. Following the data table format of [1], the observations are listed in Table 1.

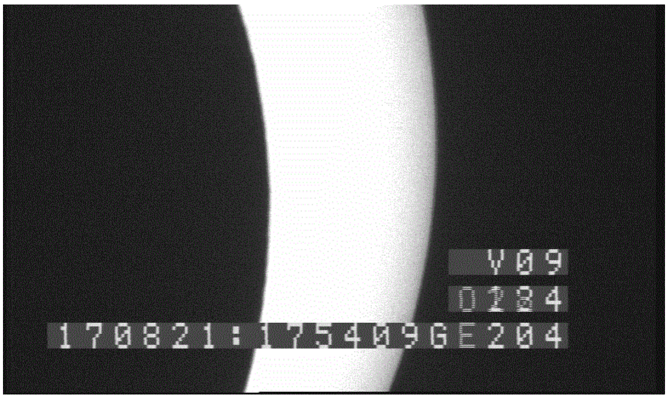


Figure 3. Video frame during partial phase

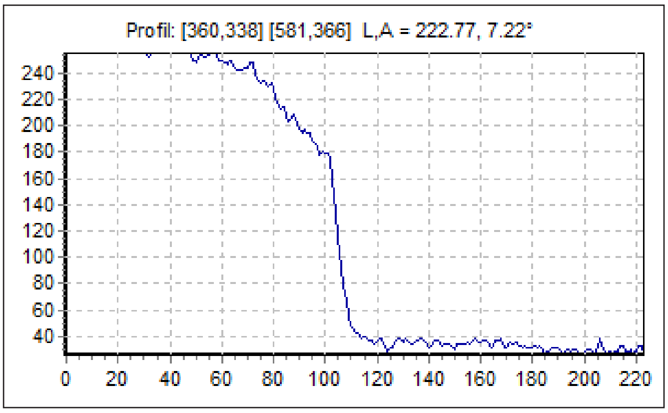


Figure 4. Brightness profile station 2017USN1

Northern Station 2017USN1 (Elke and Konrad Guhl)

The northern station was located in the RV park "Fountain of Youth RV" on the northern edge of the small town Thermopolis in Wyoming. The weather conditions were perfect from first till last contact. The infrastructure of the RV park guaranteed easy and convenient observation circumstances. The observation point (Latitude 43°40'23.5"N; Longitude 108°12'18.4"W; h=1320 m (WGS84)) was 700m inside the totality zone and the predicted duration of totality was 16 s.

All data points, following the method described above, are presented in table 1:

Table 1 Data-points, D = Disappearance; R = Reappearance

2017USN1			
time UTC	Axis Angle	type	Variation solar radius Δr_S
17:39:59.9	35.1°	D	0.03"
17:40:03.4	32.0°	D	0.07"
17:40:09.2	18.4°	D	0.14"
17:40:10.2	11.7°	D	0.11"
17:40:10.5	0.7°	D	– 0.03"
17:40:12.6	0.8°	D	– 0.04"
17:40:12.7	8.8°	D	-0.02"
17:40:32.5	348.1°	R	0.08"
17:40:35.4	352.3°	R	0.07"
17:40:35.6	346.2°	R	0.05"
17:40:36.0	356.5°	R	0.13"
17:40:37.6	348°	R	0.13"
17:40:37.7	330.6°	R	– 0.02"
17:40:40.9	343°	R	– 0.04"
17:40:42.9	325.6°	R	– 0.10"
17:40:42.9	325.4°	R	– 0.10"

Southern Station 2017USS1 (Carmen and Andreas Tegtmeier)

For the southern station, a place about 15 km southwest of Cape Giradeau in Missouri was chosen. In a field next to the country road MO 245, which branches off halfway from the MO 25 between the towns of "Delta" and "Dutchtown", there was a good place with optimal panoramic views without obstructing trees, etc. The observation point had the coordinates Latitude 37° 13' 6.20" N, Longitude 89° 40' 49.26" W, h= 106.0 m (WGS84) and was approx. 1100 m outside the totality-zone. The weather conditions were very good for the whole time of totality, clouds were only on the horizon.

The successful video recordings showed disappearing and reappearing beads. However, the evaluation of the video by the authors according to the procedure described above resulted in unusual values for the correction values from the standard radius of the Sun. The radius-correction was more than 0.2". Analyzing the video tape and brightness profile over the limb, it was found that the video observation was overexposed.

Table 2 Data-points, D = Disappearance; R = Reappearance

2017USS1			
time UTC	Axis Angle	type	Variation solar radius Δ r_S
18:20:13.9	121.3°	D	0.29″
18:20:16.7	127.0°	D	0.27″
18:20:18.1	184.4°	R	0.22″
18:20:28.9	139.3°	D	0.28″
18:20:31.5	141.3°	D	0.31″
18:20:36.0	145.6°	D	0.33″
18:20:55.7	163.1°	D	0,23″
18:21:04.0	195.3°	R	0.26″
18:21:12.5	205.6°	R	0.19″
18:21:19.5	171.6°	D	0.19″
18:21:21.2	211.4°	R	0.26″
18:22:14.4	181.4°	D	0.17″

Conclusion

The average value for Δ r_S station 2017USN1 is 0.029″. The average value for Δ r_S on station 2017USS1 (higher sensitive exposition – over-exposed) is 0.25″.
So using the measurement of station 2017USN1 only, the radius is found to 959.63 + 0.03 = 959.66″.

Using the average of both stations, we have to add a value of 0.255 to the standard radius and find 959.63 + 0.25 = 959.88″.

Figure 5. 2017USN1 on RV park

In [5], the average of measured solar radius from eclipse observation from 2010, 2012, 2013, and 2015 is given as 959.99 +/- 0.06″. In [6] the observed solar radius for September 2016 was 959.59.
The official value, used for calculation based on [7] is 959.63″. So the value found by the expedition is close to the official value, the difference is within the field of tolerances.

The overexposed video on the southern station shows the limits of the method with the 8bit video signal. A signal resolution of 12 or 16bit would be a success towards accurate measurements.

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Further Reading

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2018 IOTA Occultation Campaigns

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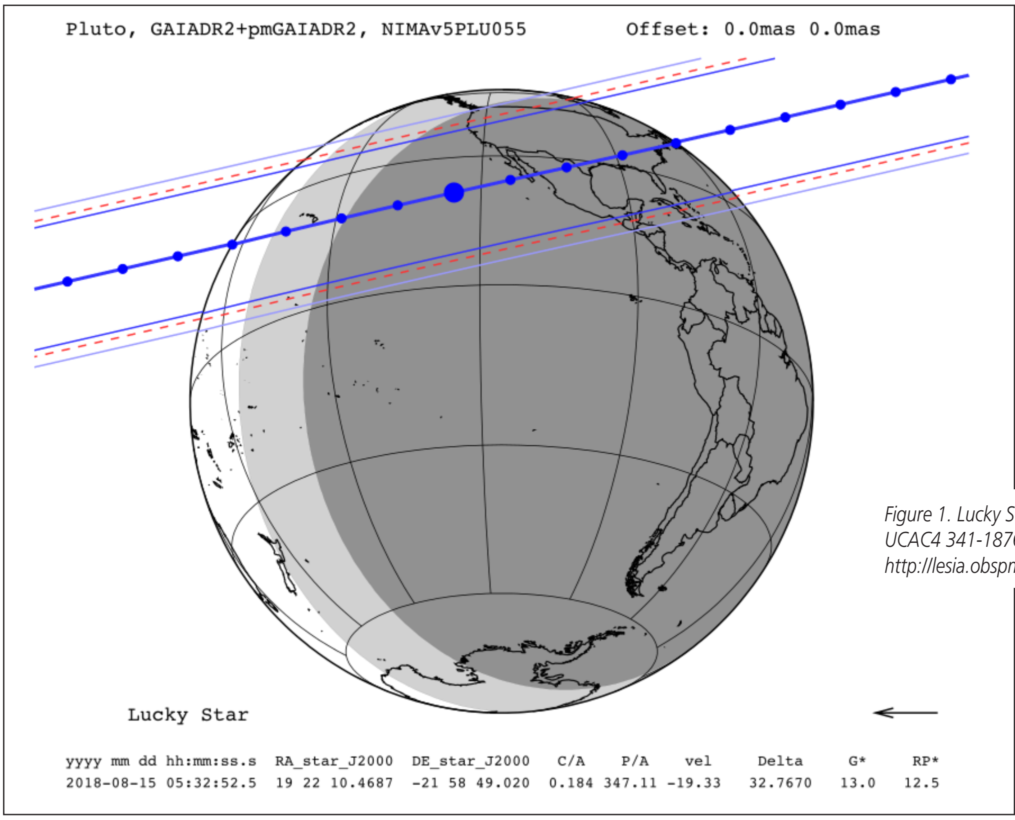

Figure 1. Lucky Star prediction for the occultation of 12.9-mag. UCAC4 341-187633 by Pluto on 2018 August 15, from http://lesia.obspm.fr/lucky-star/predictions/single.php?p=8348.

ABSTRACT: Occultation observers in North America are encouraged to use Occult Watcher and Occult 4 to keep track of upcoming occultations that might occur in their region, but especially they should mark two dates on their calendar, the nights of Aug. 14/15 and Sept. 16/17, for two of the best occultations in the continent during 2018. How did we select these dates? What is the "best" occultation? We decided to have two campaigns, one for the most valuable occultation, and the other for the most observable, that might be observed by many with small portable systems that could even be transported by airplane.
We have set up a special "Campaigns" tab at IOTA's web site, with the direct link to it being http://occultations.org/campaigns/

August 15 – Occultation by Pluto

The most valuable was easy to select; it's the occultation of a 12.9-mag. star by Pluto that will occur on 2018 August 15, around 5.5h UT, a Tuesday night, visible from most of the USA. This is relatively faint, relative to the occultations that we normally observe, but this is the brightest star to be occulted by Pluto since the 2015 June event in New Zealand and Tasmania. The region of visibility is shown in Figure 1, between the two thin dark blue lines, marking the occultation limits, the location where the star's intensity is predicted to fade by 50% in Pluto's refracting atmosphere, until the star starts to brighten again. The red dashed lines show the outer 1-sigma locations of the limits. The light blue lines outside these limits mark the places where the fading will be by only 1%, the smallest drop that might be detected with large telescopes under good conditions with sensitive detectors. The current prediction was recently updated with a refinement of the ephemeris of Pluto using an analysis of past occultations with Gaia DR2 data for the stars (Figure 1).

The occultation can best be recorded with large telescopes at fixed observatories, of which there are many in the predicted path. If you have occultation recording equipment but not a large-enough telescope, find an observatory at a college near you and offer to use your equipment there. Those with large portable telescopes might want to

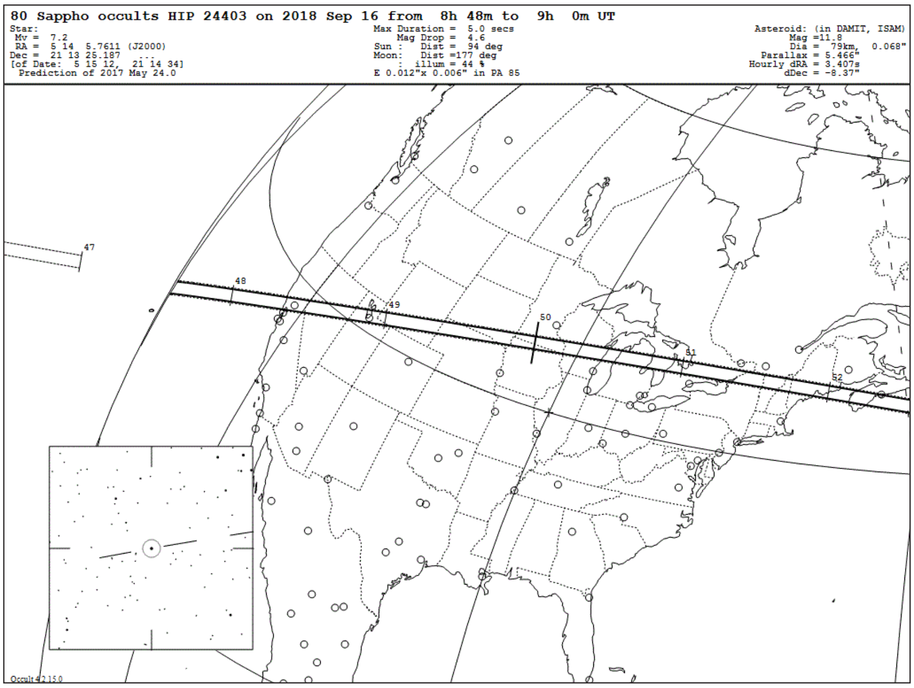

Figure 2. IOTA (Steve Preston) prediction for the occultation of ZC 782 by (80) Sappho on 2018 September 16.

travel to the central line, where a central flash will occur that probes the deeper parts of Pluto's atmosphere; it is shown by the heaviest dark blue line in Figure1, with dots marking the time at 1-minute intervals from the central time (largest dot) at 5:32:52.5 UT; the motion is from right (earlier) to left (later). A good example of a central flash observation is shown in an account of last October's Triton occultation at http://www.skyandtelescope.com/astronomy-news/surprising-results-from-octobers-triton-occultation/ The central occultation duration will be 123 seconds.

September 16 – Occultation by (80) Sappho

For the most observable, we've selected the rank 100 occultation of 7.2-mag. ZC 782 = SAO 77043 = HIP 24403 (spectral type A2, in Taurus) by the 79-km asteroid (80) Sappho that will occur around 8.8h UT of Sunday, September 16, in the path shown in Figure 2. Being in the middle of the weekend will facilitate travel, and there will be many hours of dark time before the event, for those wanting to pre-point one or more remote stations. Finder charts of different scales and other event details are at http://www.asteroidoccultation.com/2018_09/0916_80_56486.htm More information to help coordination for the event, including pre-point charts, will be posted during the weeks before the occultation (Figure 2).

July 10 – The Last Lunar Occultation of Aldebaran

This is not an official IOTA campaign, but it is a rare event worth noting. Although they are of less value these days, some IOTA observers may want to try the best lunar grazing occultation of the year in North America, the July 10th occultation of Aldebaran by the 11% sunlit Moon. It is the last of the current series visible from the main road network of the "lower 48" States and southern Canada, see Figure 3. There won't be another one until the next Aldebaran series starts in 2033. The southern limit of the July 10th event starts at moonrise in Iowa, is perhaps best at Mackinaw City, Michigan (where I hope to observe it, weather permitting), and crosses rural country in Ontario, and then Quebec before the Sun rises. More information about it is in slides 9-13 of http://occultations.org/community/meetingsconferences/na/2018-iota-annual-meeting/presentations-during-the-2018-iota-annual-meeting/Grazes.ppt (Figure 3).

Local Occultation Campaigns?

Another possibility for the campaigns page is to add links to campaign pages for different parts of North America; there are much more frequent expeditions for rather local events than the events of national and continent-wide interest that we want to promote on the IOTA campaigns page. There are several regional pages with occultation predictions, but not ones currently that specified for which events, actual expeditions are planned. I expect to add something in this direction soon to the Mid-Atlantic occultations page that I currently maintain. Campaign information is effectively included by observer declarations with Occult Watcher, but it's sometimes useful to know this information farther in advance than the 6-8 weeks typically covered by that tool. And many observers don't use it, especially those only casually interested in occultations, or with computers that make it difficult to install and/or use Occult Watcher.

Figure 3. The two dark gray lines mark the 2018 July 10th Aldebaran graze zone; Moonrise is in Iowa. Details are at http://iota.jhuapl.edu/20180710Aldebaran.htm

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IOTA's Mission

The International Occultation Timing Association, Inc was established to encourage and facilitate the observation of occultations and eclipses It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made.
The Journal for Occultation Astronomy (JOA) is published on behalf of the IOTA sections and for the worldwide occultation astronomy community.

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http://www.occultations.org
http://www.iota-es.de

These sites contain information about the organisation known as IOTA and provide information about joining.

The main page of occultations.org provides links to IOTA's major technical sites, as well as to the major IOTA sections, including those in Europe, Middle East, Australia/New Zealand, and South America.

The technical sites hold definitions and information about all issues of occultation methods. It contains also results for all different phenomena. Occultations by the moon, by planets, asteroids and TNOs are presented. Solar eclipses as a special kind of occultation can be found there as well results of other timely phenomena such as mutual events of satellites and lunar meteor impact flashes.

IOTA and IOTA/ES have an on-line archive of all issues of Occultation Newsletter, IOTA'S predecessor to JOA.

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