Journal for Occultation Astronomy

2013–04 FORMERLY OCCULTATION NEWSLETTER

Eclipse Over New York

2013 November 3

A sunrise over New York City rarely looks like this. Yesterday, however, the Sun rose partly eclipsed by the Moon as seen from much of the eastern North American and northern South America. Simultaneously, much of Africa, already well into daytime, saw the eclipse from beginning to end. The eclipse was unusual in that it was a hybrid – parts of the Earth saw the Moon as too angularly small to cover the whole Sun, and so at maximum coverage left the Sun surrounded by a ring a fire, while other parts of the Earth saw the Moon as large enough to cover the entire Sun, and so at maximum coverage witnessed a total solar eclipse. Slight changes in the angular size of the Moon as seen from the Earth's surface are caused by the non-flatness of the Earth and the ellipticity of the Moon's orbit. Pictured above, the famous Empire State Building in New York City is seen to the left of the partially eclipsed Sun, adorned with scenic clouds. The next solar eclipse visible from New York City – a very slight eclipse – will occur during the sunset of 2014 October 23. Image Credit & Copyright: Chris Cook

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Dear reader,

Since 32 years the European Symposium on Occultations Projects (ESOP) provides a forum for participants interested in occultation work or contributing their ideas, knowledge and results. This yearly meeting in countries all over Europe should continue to maintain plentiful personal contacts between observers, calculators, theorists, technicians, and any interested persons.

Time, efforts, changing travel conditions etc. sometimes limit the ability to join these meetings personally. Modern communication platforms may help to overcome such limitations. But due to varying conditions and network capacities experiences (e.g. Skype) were not generally satisfying.

Recently Tony George offers a new software of which he gained good experiences. That is why he proposed to the potential site moderators to use this system for at least two weeks of advanced practice. Familiar with the system, he recommends that all potential users should log into a practice session prior to the actual conference session.

Nothing can substitute personal communication. But I hope that In future all international meetings will be presented via internet to offer remote participation additionally – first time in Prague 2014.

Hans-J. Bode
(Editor in chief)

JOA 2013-4 · $ 5.00 · $ 6.25 OTHER · (ISSN 0737-6766)

In this issue:

Writing articles for JOA:

The rules below should be regarded while writing an article; using them will greatly facilitate the production and layout of ON!

If your article does not conform to these rules, please correct it.

There are 3 different possibilities for submitting articles:

- pdf-articles (must be editable – these can be converted)
- unformatted Word *.doc-files containing pictures/graphs or their names (marked red: <figure_01>) at the desired position(s)
- *.txt-files must contain at the desired position the name of each graph/picture

The simplest way to write an article is just use Word as usual and after you have finished writing it, delete all your format-commands by selecting within the push-down-list "STYLE" (in general it's to the left of FONT & FONTSIZE) the command "CLEAR FORMATTING". After having done this you can insert your pictures/graphs or mark the positions of them (marked red: <figure_01>) within the text.

txt-files: Details, that should be regarded

- Format-commands are forbidden
- In case of pictures, mark them within the text like <picture001> where they should be positioned

Name of the author should be written in the 2nd line of the article, right after the title of the article; a contact e-mail address (even if just of the national coordinator) should be given after the author's name.

IMPORTANT:Use only the end-of-line command (press ENTER) if it's really necessary (new paragraph, etc.) and not when you see it's the end of the line!

Sending articles to JOA:

Each country / state has a coordinator who will translate your article to English – if necessary.

In case there is no one (new country) please send a mail to the editorial staff at: **info@occultations.info**

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Australia / NZ	Graham Blow	Graham.Blow@actrix.gen.nz
Europe:	Wolfgang Beisker. . .	wbeisker@iota-es.de
England:	Alex Pratt	alexander.pratt@btinternet.com
Finland:	Matti Suhonen.	suhonen@ursa.fi
Germany:	Wolfgang Beisker. . .	wbeisker@iota-es.de
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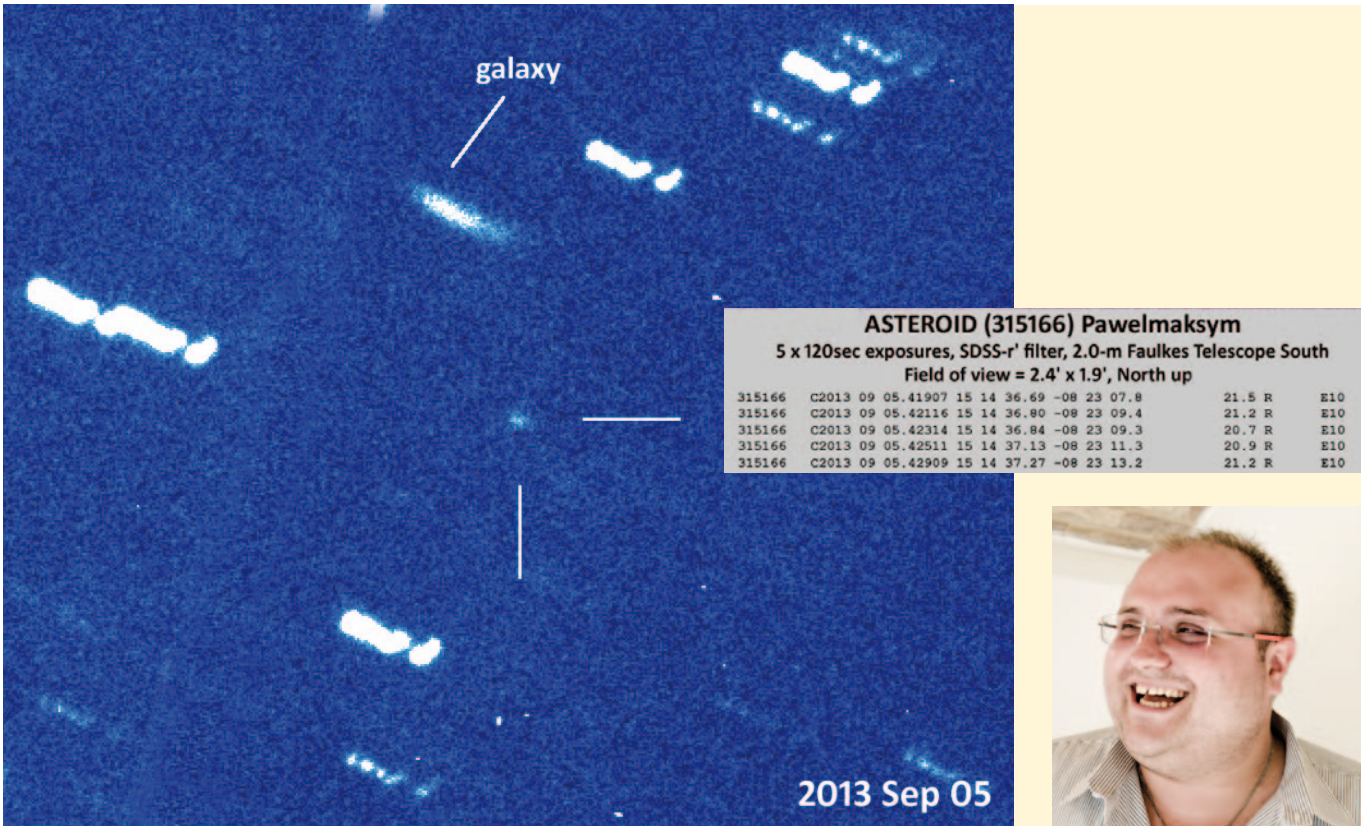

An asteroid for Paweł Maksym

Alex Pratt & Richard Miles · Asteroids & Remote Planets Section · British Astronomical Association

Paweł Maksym was a 29-year-old amateur astronomer from Poland who was very active within the International Occultation Timing Association, European Section (IOTA-ES) and an enthusiastic participant at the annual European Symposium on Occultation Projects (ESOP) conferences, presenting a talk each year and taking part in lively discussions in the lecture theatre, on trips, and in the bar. He organised the excellent ESOP XXVIII in Niepolomice, Poland, in 2009 and played a key role in the creation of the Journal for Occultation Astronomy.

Paweł was a star of the next generation of occultation observers and was expected to progress the work of IOTA-ES far into the 21st Century. Tragically however, he passed away on 2013 February 13 following complications after surgery.

Asteroid (315166) Pawelmaksym, discovered on 2007 April 6 at Charleston Observatory, South Carolina and originally designated 2007 GA_4, was recently named in honour of Paweł and his role as an astronomy populariser in Poland. According to the citation "he was an expert in asteroid occultations, an active member of IOTA and co-founder of the Pope Silvester II Astronomical Observatory in Bukowiec. Name suggested by Barbara Dluzewska, from the Czacki High School in Poland."

A tribute to Paweł Maksym's life and work, written by Costantino Sigismondi, can be found in the Journal for Occultation Astronomy (2013-02) and at:

http://arxiv.org/abs/1302.6910.

The adjacent image of Pawel's asteroid was captured by Richard Miles on 2013 Sept 5 using the remotely-operated Faulkes Telescope South in Australia. We hope it will be a source of some satisfaction for his family and friends. ESOP conferences will not be the same without him!

Original article published in the Journal of the British Astronomical Association, 123(5), 303 (2013)

http://www.britastro.org/journal/

Caption for image:

Image of main-belt asteroid (315166) far from opposition taken using the Faulkes Telescope South located in Siding Spring, Australia. Five 2-min exposures were tracked and stacked using Astrometrica to produce the composite image. The object is 2-4 km across and at the time of the observations, it was located at a distance of 485,621,000 km from Earth. Having a V magnitude brightness of 21.5, it was more than 1 million times fainter than a 6th magnitude star. (R. Miles)

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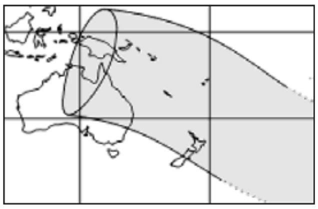
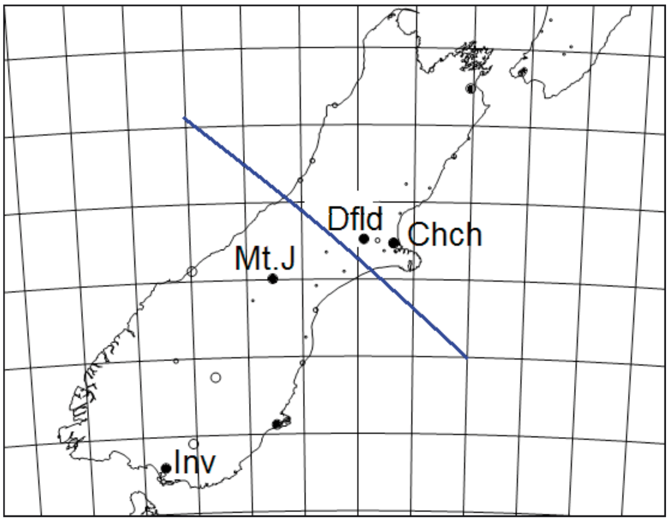
A Grazing Occultation of SAO 138754

Brian Loader, RASNZ Occultation Section · Email: brian.loader@clear.net.nz

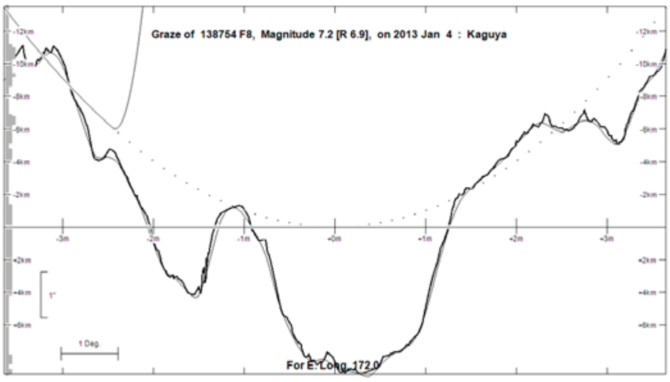
The star SAO 138574, magnitude 7.2, was occulted by the 58% lit waning moon on the night of 2013 January 4. The occultation was visible from northern and eastern parts of Australia and New Guinea soon after moon-rise, and then from the North Island and northern parts of the South Island of New Zealand.



A southern limit grazing occultation was visible from South Australia and New South Wales before crossing the centre of the South Island of New Zealand



In New Zealand the graze took place at about 15:16 UT (4.16 am NZDT) at a 3.9° S cusp angle and position angle 207.6°. The altitude of the moon was 38°, its azimuth 56°.



The profile of the edge of the moon near where the graze of SAO 138754 took place shows some prominent features. The vertical scale is exaggerated by a factor of about 14 compared to the horizontal. Graze type events were expected to be visible from positions up to 8 km, 5 miles, either side of the predicted path, although at 8km north of the path the initial disappearance would have taken place against the lit cusp of the moon.

The author observed the occultation at Darfield, a small town about 40 km, 25 miles, inland and to the west of the city of Christchurch. Darfield is 27 km, 17 miles, northeast of the predicted graze line (Dfld on figure 2). So a total occultation was expected there.

At Darfield there was an interval of about 10 minutes between the disappearance of the star behind the moon and its reappearance. The disappearance took place at the lit limb so was not observable. While the reappearance of the star at the unlit limb was expected to be a single event, I was aware of the slight possibility of graze type events. As it happened a series of such events took place over a time period of about 10 seconds.

The observation was made using a 10-inch Meade Schmidt-Cassegrain telescope fitted with a focal reducer giving an effective F-ratio of about 3. The event was recorded on video using a P164C PAL camera at 25 frames, 50 fields, per second. Times were inserted on each field to millisecond accuracy using Kiwi OSD. The output was captured as an .avi file on a lap top computer. Subsequently Limovie software was used to analysis the light intensity of the star and produce a light curve.

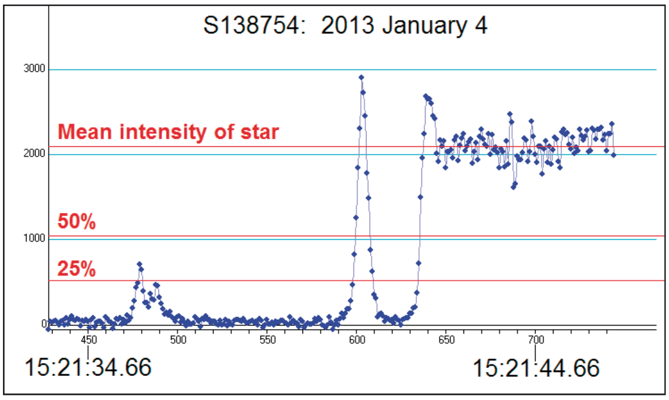


Figure 4 shows an extract from the light curve spanning a little over 10 seconds in the minute of 15:21 UT (4.21 am NZDT) during which events occurred. The horizontal axis can be taken as representing time while the vertical axis shows the light intensity of the star image as measured

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by Limovie. Points are plotted at 0.04 second intervals, 25 per second. Clearly, there was more than one event, with three appearances of the star easily visible on the screen in real time, the first two being rapidly followed by a disappearance of the star.

Also shown on the light curve are lines representing 25%, 50% and 100% of the mean light level for the star.

All events occurred during the minute of 15:21UT. The first partial reappearance was brightest at 35.82 seconds with a secondary brightening at 36.20 seconds. The highest peak was 4.5 seconds later, the final peak occurring 1.5 seconds later again.

There are at least two notable features to this light curve. For a lunar occultation, even a grazing occultation, the reappearances and disappearances are very slow. The first complete reappearance took over half a second to fully brighten and a similar time to fade. The second reappearance is only slightly faster. A second feature is that the two peak light intensities are significantly higher than the final light level. Both these features are suggestive of Fresnel diffraction of the star light at the edge of the moon.

Diffraction occurs when a point source of light like a star is seen at a sharp edge. In this case the moon acts as the sharp edge. Briefly the effect is that as the star appears from behind the moon the light starts to increase before the star geometrically emerges. At the instant the star is 50% exposed, the light intensity is only 25% of full. The star image peaks in brightness just after it is fully exposed, when the light intensity reaches about 36% above its normal value.

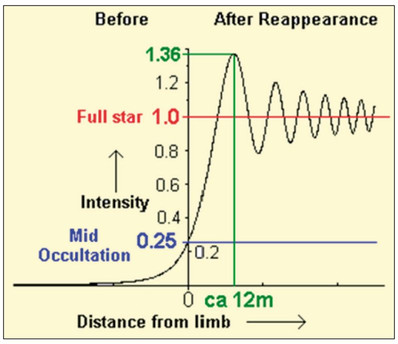
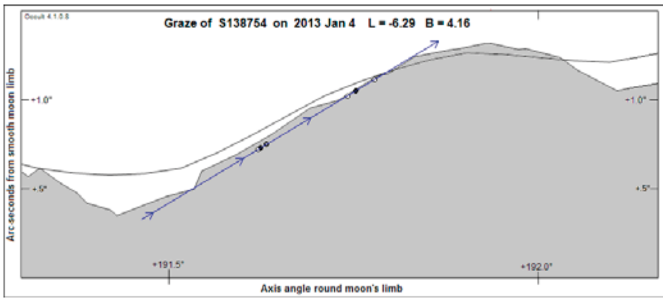


Figure 5 shows the theoretical diffraction light curve for monochromatic light. The vertical axis line represents the position of the moon's limb. The wavelength of the oscillations after reappearance is a function of the wavelength of light. As a result in white light the spread of wavelengths results in the oscillations being blurred out after the first peak.

The times used for reporting were for when the light intensities were 25% of the full, that is when the star was half exposed to view, resulting in the times shown below measured to 2 decimal places of a second.

Star No.	Date (y m d)	Time UT (h m ss.ss)	Event
S 138754	2013 1 4	15 21 35.77	Part reappearance
S 138754	2013 1 4	15 21 35.89	Near disappearance
S 138754	2013 1 4	15 21 36.20	Faint flash
S 138754	2013 1 4	15 21 40.59	Full reappearance
S 138754	2013 1 4	15 21 41.03	Full disappearance
S 138754	2013 1 4	15 21 42.04	Final reappearance



These events can be plotted against a lunar profile derived from measures made by the Japanese Kaguya satellite. In this small section of profile the mean lunar limb has been kept horizontal with the moon's body towards the bottom of the chart. The open circles are the points at which the star partly or fully appeared, the solid circles where it disappeared again. The heavier circle represents the brief brightening after the first partial reappearance.

The arrowed line through the points gives an idea of the apparent direction of movement of the star relative to the moon. As can be seen, its path was nearly parallel to the slope of the feature, hence the slowness of the various events. The true slopes of the line and the rising limb profile are about 8.3°. As seen from the Earth the mountain subtends an angle of about 1 arc-second, which translates to an apparent height of about 1.9 km. On the horizontal scale, half a degree of axis angle is about 15 km.

The fit of the timed events is very close to the Kaguya profile but perhaps suggesting finer detail. The discrepancies may indicate slight errors in the profile, or a very slight error in the predicted position of the moon.

With a fit this close one may ask if there is anything much to be learned from observing a graze or occultation? While the fit is close at this part of the moon's limb, there are other points where the Kaguya based profile is unrealistic. This is no criticism of the Kaguya survey, it merely reflects the finite number of separate measures made of the altitude of the moon at discreet points. Occultation observations may be able to help resolve the remaining issues.

Grazing occultations can often be visually interesting to watch and capture to video. For me this one was no exception, both due to the distance I was from the predicted graze path and the clear display of Fresnel diffraction, the clearest I have seen in over 30 years of occultation observing.

Acknowledgements.

Maps, profiles, predictions and reductions were all produced using Occul4t written by Dave Herald.

Analysis of the video was carried out and the light curve produced using Limovie written by Kazuhisa Miyashita.

GPS derived times were inserted on the video using Kiwi OSD developed by Geoff Hitchcox.

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Recent successful asteroidal occultations in our region in the past year

Paper presented to Seventh Trans-Tasman Occultation Symposium TTS07 Invercargill, NZ, May 2013.

John Talbot (NZ) · RASNZ Occultation Section · john.talbot@xtra.co.nz

Abstract:

A selection of interesting minor planet occultation results observed from Australia and New Zealand during 2012 is presented.

Background:

This is the fourth in a series, highlighting the more interesting results from the previous year. Previous papers covering 2008to 2011 were presented at TTSO4 [1], TTSO5 [2,] and TTSO6 [3], copies can be made available if required.

Some Statistics:

Since 2006 the number of events with positive observations for the region has run

2006 – 23, 2007 – 31, 2008 – 47, 2009 – 46, 2010 – 50, 2011 – 51, 2012 - 51. Our region recorded 17.8% of all events in the IOTA global database for 2011 (11% in 2010 and 2011).

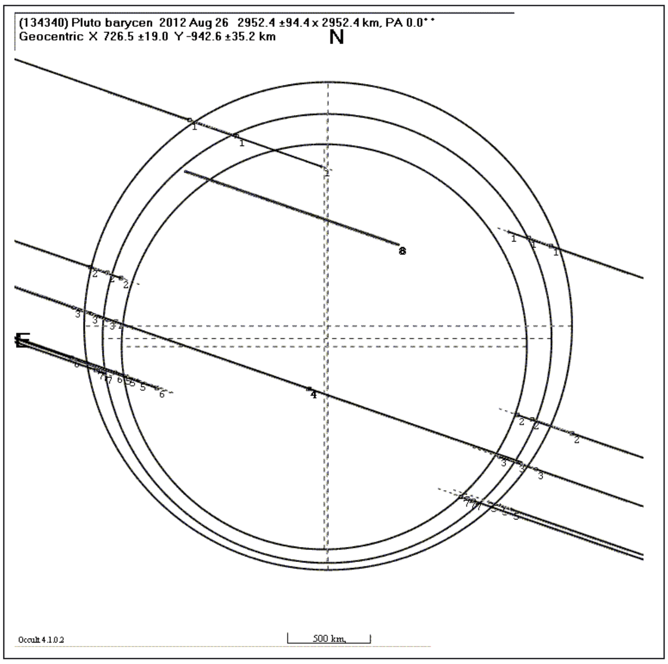
The big jump in success in our region can be attributed in part to increased number of observers and more using integrating cameras that allow fainter events to be attempted.

May to July was were the best months for observing with 5 or 6 positive events and up to 33 misses each. December was the worst with just 1 positive and February had only 3 positive and 5 misses.

Year	Reports	Observers	Positive observations	Negative observations
2008	280	26	66	214
2009	320	29	75	245
2010	343	29	74	269
2011	289	28	70	218
2012	383	34	77	315 + 9 ?

Our total number of observers and positive events seems to be fairly stable but the number of reports has increased by about 50% this year compared to last year. The 9 doubtful events are not included in the archive but are on our web site.

Our top observers (positive and negatives) were B. Loader with 80, J. Broughton with 54, C. Chad 37, J. Bradshaw with 26, D. Watson 21. The RASNZ Occultation Section website (http://occultations.org.nz/) now has over 700Mb of disk space used, most for predictions and results, and is growing at over 50 Mb per year.



Best Positive Results:

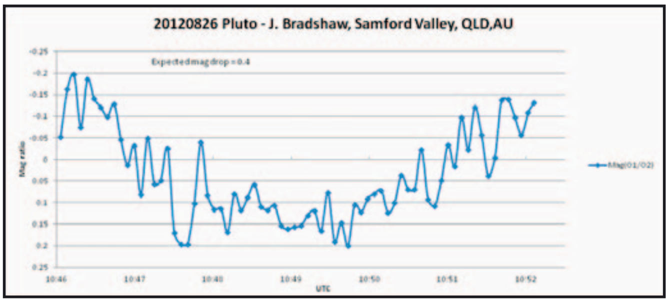
2012 August 26 Occultation of UCAC3 141-0302444 by 134340 Pluto

Five well spaced complete chords and one R only were recorded.

One observer was in the path but had technical problems.

Observers:

1 W Hanna,Alice Springs, NT,AU
2 J Bradshaw,Samford Valley, Qld, AU
3 I Curtis,Adelaide, SA, AU
4 (C) C Chad,Gunnedah, NSW, AU
5 T Barry et al, Penrith Obs, NSW,AU
6 H Pavlov,St Clair, NSW, Australia
7 T Dobosz,Bankstown, NSW,AU
8 (P) Prediction, Occult, 13 Aug



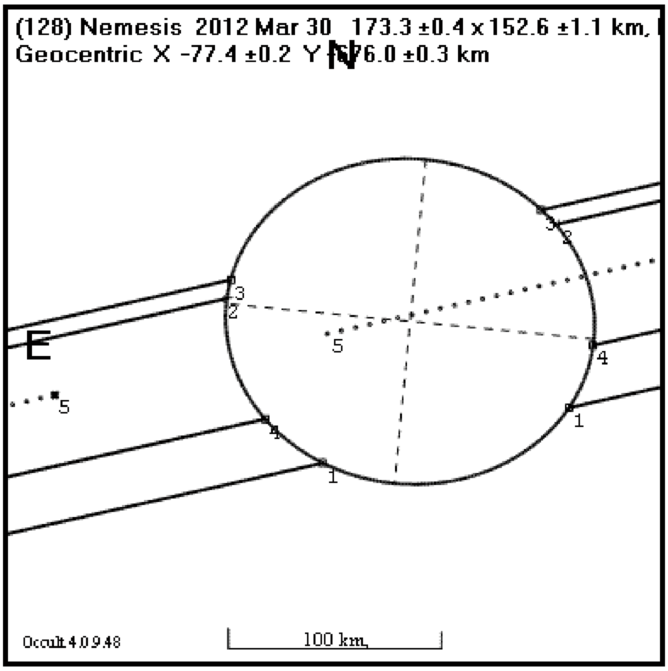
I have chosen Jonathan's light curve as his was most central and illustrates some characteristics of Pluto data.

The D and R are very slow (about 2 minutes) due to Pluto's atmospheric extinction.

The magnitude drop is quite small at about 0.4

The plot above has tried to show the times where this extinction zone is. The outer one is 2952 km diameter, the Mid one is 2717 km, and the Inner one is 2452 km, compared to the expected diameter of Pluto of 2306 km.

In summary this was a successful team effort of a difficult target. Well done all.



Interesting events with 4 Chords:

2012 March 30 Occultation of UCAC2 23177086 by 128 Nemesis

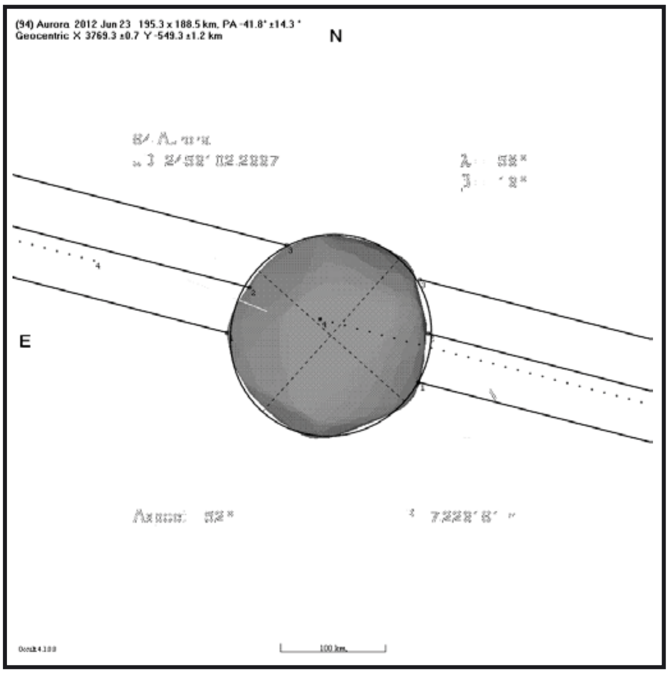
Observers:

1 J Broughton,Pottsville, NSW, AU
2 P Anderson,THE GAP,Brisbane,QLD,AU
3 J Bradshaw,Samford Valley,QLD,AU
4 J Broughton,Reedy Creek, QLD, AU
5 (P) Prediction 24 Feb

The ellipse above is plotted at the best fit to the observed data. Peter's visual observation data (chord 2) has had 1 sec subtracted from the times and as you can see is a very good fit to the rest.

This results in an area about 36% greater than the predicted circle of 139 km. This suggests that the albedo estimate may be too high and that Nemesis is darker than predicted.

With 4 chords we can be confident of the path of Nemesis and that it was very close to the predicted line but about 18 seconds late.

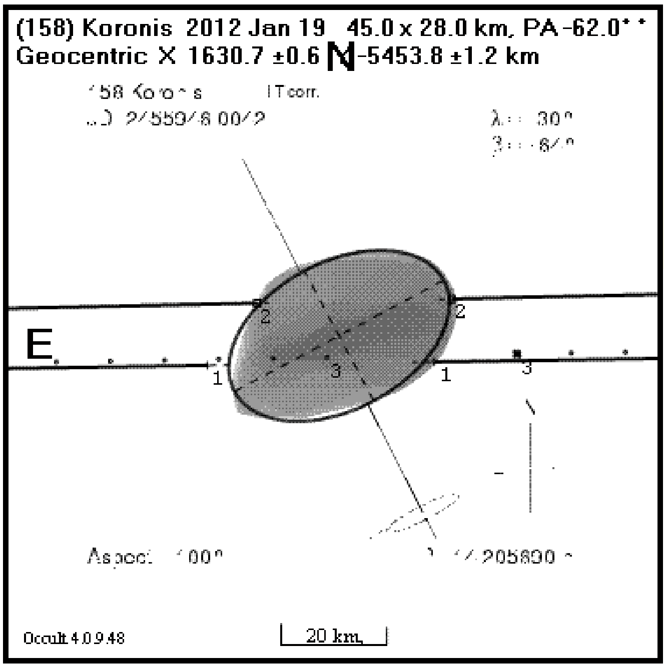


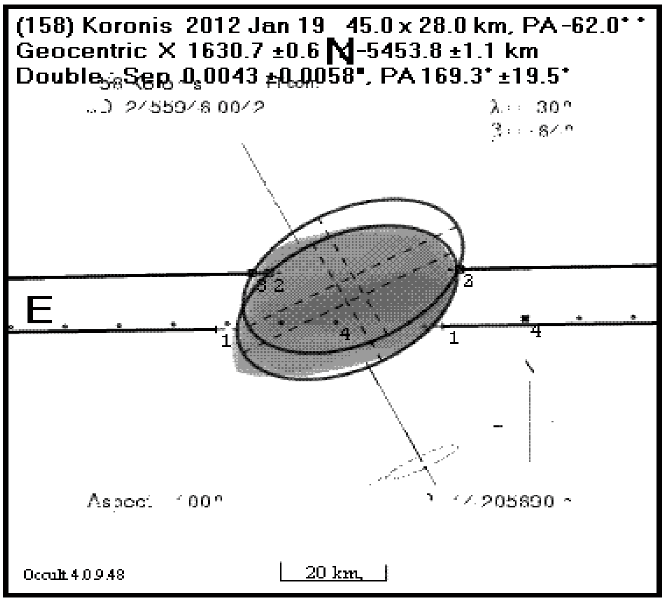
2012 June 23 Occultation OF TYC 7430-00743-1 by 94 Aurora

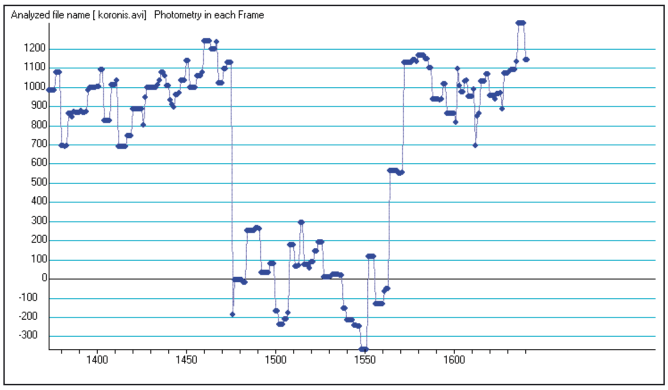
Observers:

1 C Chad,Gunnedah, NSW
2 J Broughton,Brunswick Heads, NSW, AU
3 J Broughton,Reedy Creek, QLD, AU
4(P) Prediction, 6 June

The ellipse above is very nearly circular at 191km x 188 km compared to the expected the expected 218 km diameter of Aurora. The ISAM 3D model has been overlaid on the circle and shows good fit. With 3 chords we can be confident of the path of Aurora and that it was south of the predicted line.







Interesting events with 2 Chords:

2012 January 19 Occultation of TYC 1879-00902-1 by 158 Koronis (Double star?)

Observers:

1 D Watson, Thornton near Whakatane, NZ
2 P Purcell, Chapman, ACT, AU
3(P) Prediction, Jan 15

The ellipse above is plotted at the same area as the predicted circle of 35 km. With two independent chords we can be confident of the path of Koronis and that it was just north of the predicted line. The ISAM 3D model has been overlaid on the measured ellipse and shows a good fit. Diana had said her visual timing may have been a bit slow so when I first saw the times I thought that might explain the offset between the chords. When I looked more closely and got the ISAM 3D model overlaid it became clear that the offset is mainly real due to the shape of the rock and the longer than expected times are due to the orientation.

Patrick Purcell's Limovie lightcurve opposite shows an interesting step during the R at about 50% light intensity which lasts for 2 integration periods. Normally we would ask for 3 periods at the intermediate level to indicate a new double star or steps on both D and R.

If we assume that it is a double star then the following plot shows the fit to 2 stars.

This gives a separation of 4.3 milli arcseconds and PA of 169 degrees.

We can see that the no step D may be a result of the two shadows co-inciding at that time and Diana Watson's report of slow visual changes can also be understood by this solution.

On balance the evidence for a double while tantalising, is probably not good enough to make a formal claim however it is worth flagging this star as a "Possible Close Double".

Acknowledgements:

1. Dave Herald for the provision of Occult4 software for prediction and analysis of occultations.
2. Kazuhisa Miyashita for provision of Limovie software for analysis of video recordings and production of light curves.
3. Hristo Pavlov for provision of Tangra and Occult Watcher software for planning and analysis of video recordings and production of light curves.
4. Bob Anderson and Tony George for the provision of Occular software for analysis of lightcurve data using statistical methods to discover the event times.
5. Josef Durech from Prague, Czech Republic, for providing DAMIT models at http://astro.troja.mff.cuni.cz/projects/asteroids3D/web.php
6. Przemysław Bartczak from Poznan, Poland for providing the ISAM service at http://isam.astro.amu.edu.pl/
7. And all observers who have attempted observations and contributed to the success of this valuable observing program.

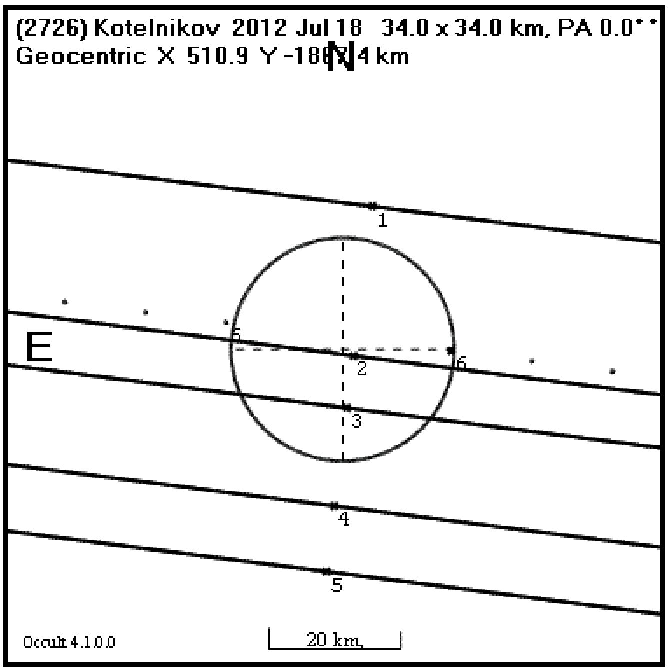
References:

Predictions and results on the RASNZ Occultation Section site http://occultations.org.nz

Recent successful asteroidal occultations in our region in the past 2 years.
Presented at TSSO4 Canberra, April 2010.

Successful asteroidal occultations in our region in the past year.
Presented by proxy at TTSO5, Napier May 2011.

Successful asteroidal occultations in our region in the past year.
Presented remotely at TTSO6, Brisbane May 2012.



Even with a lot of observers you may still not get a result:

2012 July 18 Occultation of HIP 95967 by 2726 Kotelnikov

Observers:

1 (M) J Talbot, Waikanae Beach, NZ
2 (M) G Hudson, Porirua, New Zealand
3 (M) M Forbes, Lower Hutt, NZ
4 (M) P Graham, Martinborough, New Zealand
5 (M) G McKay, Blenheim, NZ
6 (P) Prediction, OZNZ, 1 Jul

The circle above is plotted at the expected 34 km diameter of Kotelnikov. With no positive chords we cannot say where the actual path was, so the circle has been plotted on the predicted path. A good turn out with a bright (m7.6) star and nicely spaced sites but no prizes.

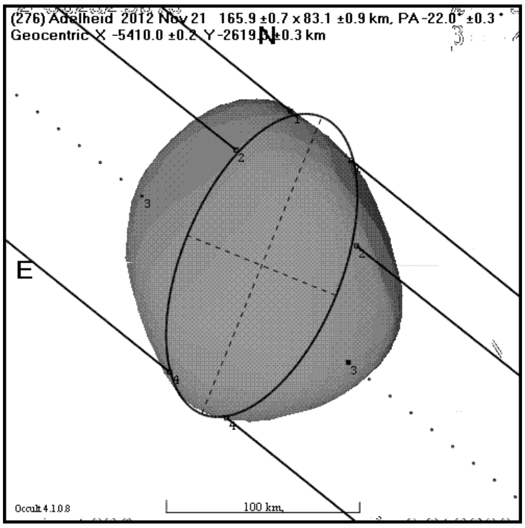
A Trans Pacific success

2012 November 21 Occultation of TYC 0100-01306-1 by 276 Adelheid

Observers:

1 S Kerr, Rockhampton, Australia
2 R Jones, Running Springs, CA, USA
3 S Messner, Northfield, MN,USA
4(P) Predicted Centerline

The ellipse above is plotted at the best fit axis ratio as determined by Occult. With 3 chords we can be confident of the path of Adelheid and that it was close to the predicted line. The ISAM 3D model has been overlaid on the measured ellipse and shows good fits for the outer chords but the inner one is much shorter than the 3D model. It is well



known that the current 3D inversion process always results in convex shapes, so it is possible that the centre chord is indicating deep craters on each side. We have also considered the possible change in projected shape between the USA and AU observers as Adelheid spins, but there is only a small change in the approximately 12 minutes that it takes the shadow to cross the Pacific Ocean.

Conclusion:

Minor planet occultation observing is alive and well in Australasia. We have shown in the past that for some events we can muster 20 or more stations but we could always do with a few more reports and a few more regular observers for the less exciting and smaller object events.

How about setting a goal of trying to observe any event within the 2 sigma zone from your home site, and which has a combined magnitude within the reach of your equipment, on clear nights.

Always remember that a result with more than one chord measured is much more valuable than those with only one. Check in OW and join a team event!

But also remember that it may take you a while to find your target so start setting up early or better still find your target the previous night at about the predicted time so you become familiar with asterisms you may use for prepoint or star hopping. I find that my first attempt at finding a prepoint target takes me anywhere between 20 mins and an hour but the next night I can usually get there in under 20 mins. In particular I find it useful to note the RA and declination setting circle readings on my mount on the test night so that I can get back there and already be close to the track.

The RASNZ Occultation Section Circular

I wish to give a special thank you to Murray Forbes who has been working on catching up on the backlog of all observations reported in our region in a Journal format. The 2007, 2008, and 2009 events have now been completed. I hope he can further close the gap this year.

I would also like to thank Murray for his work in putting together the program for TTS07

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Prepointing for Occultations

Presented at TTSO7 at Invercargill May 2013
John Talbot · John.talbot@xtra.co.nz · Occultation Section RASNZ

Abstract:

Prepoint verb. - to point telescope at a point in the sky where an event is predicted to occur at some time in the future. A technique that is particularly suited to observing with mounts that are not perfectly aligned or do not have accurate pointing ability (eg Dobsonian, mobile observation). It helps to have driven RA axis.

Introduction.

In order to observe an Occultation you need to know:

The Right Ascension and Declination of the objects where the event is predicted to happen and The Time the event is predicted to occur. For NZ & AU Occultation Predictions use http://occultations.org.nz/

Your Location – Latitude, Longitude, Altitude

It is also useful to know:

The predicted duration of the event and time error. This will affect how long you observe /record for.

How long it takes for a star to drift across your field of view (FOV). Do you need to be able track the star once it is in the frame?

Basic Method

The basic idea is to point at a star that is at the same Declination as your target at some time before the event and then stop tracking until the target is in the frame. If the predicted duration of the event is longer than the drift time across about half your FOV then you should aim to have the star at the centre of the FOV at the earliest expected time of an event: (Predicted centre time - [2 x Prediction time error]) and then restart tracking and start observing/recording.

Prepointing… Option 1

Use Occult … Asteroid Predictions to display a list of stars and time or offset.

Below is the Occult output for a typical event. Note The times start at the bottom and work up.

Occultation of 2UCAC 14430598 by 10199 Chariklo on 2011 Jun 29

Three lines stand out:

The first at 09:51:25 is for a bright Mag 3.2 star that you should be able to locate in your spotter scope. BUT it is less than 10 minutes before the event and we need to adjust the declination by 16.8 arc mins so possibly not a good starting point.

Prediction of 2011 Jun 29.0				
Point Time h m s	Star mag	J2000 RA h m o '	Dec	Dec Offset ArcMin
10 2 0	12.1	15 32.0	-40 56	Target star
9 51 25	**3.2**	**15 21.4**	**-40 39**	**-16.8**
9 50 49	**7.8**	**15 20.8**	**-40 54**	**-1.8**
9 48 59	5.6	15 18.9	-40 47	-8.4
9 46 7	5.2	15 16.1	-41 29	33.9
9 38 16	5.8	15 8.2	-40 35	-20.5
9 35 24	5.1	15 5.3	-41 4	8.6
9 34 47	6.3	15 4.7	-40 52	-3.8
9 22 4	7.9	14 52.0	-40 48	-7.0
9 18 16	7.7	14 48.2	-41 1	5.8
9 13 29	8.0	14 43.4	-41 1	6.2
9 10 25	**6.7**	**14 40.3**	**-40 51**	**-4.7**

The second at 09:50:49 is too dim to start on via spotter scope but is very close to the right declination so may be a good way point check.

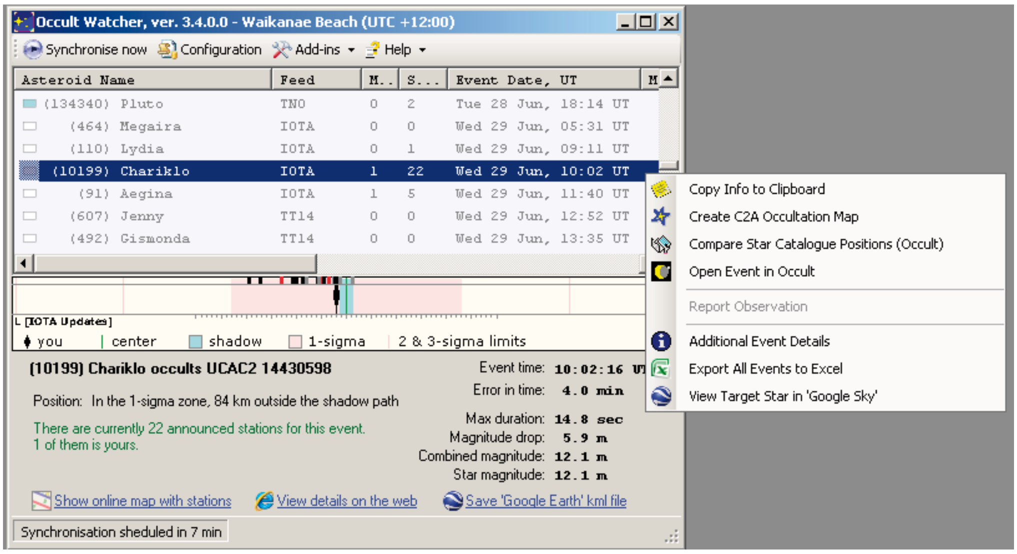
The bottom line looks like a good place to start. It is near enough to the right declination that only a small adjustment will be required and bright enough that you should be able to find it.

Acknowledgements:

1. Dave Herald for the provision of Occult4 software for prediction and analysis of occultations.
http://www.lunar-occultations.com/iota/occult4.htm

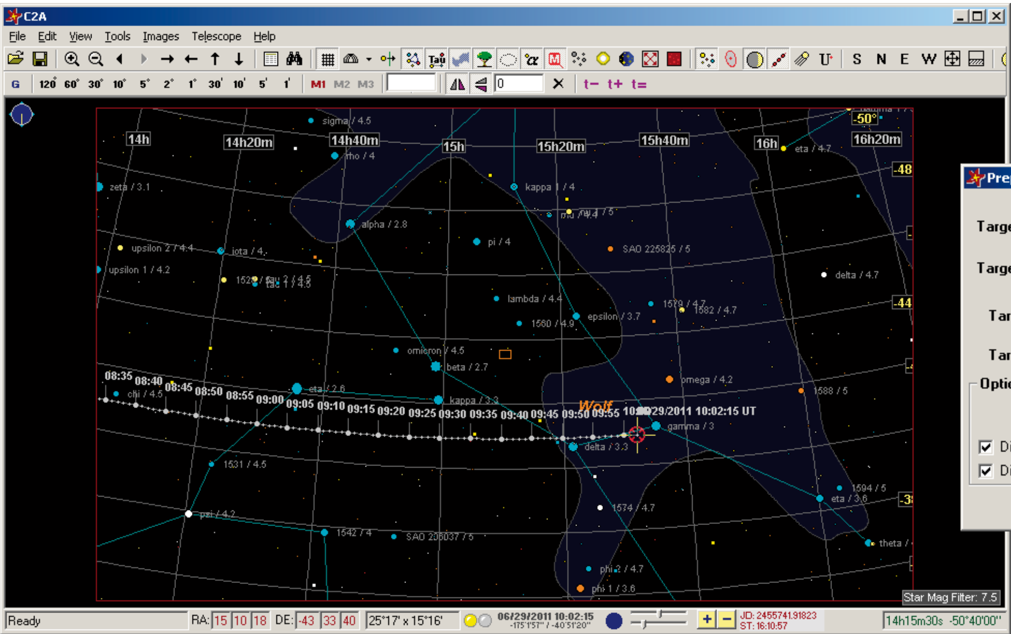
2.Hristo Pavlov for provision of Occult Watcher software for planning and analysis of video recordings and production of light curves.
http://www.hristopavlov.net/OccultWatcher/OccultWatcher.html

3. Philippe Deverchère for the provision of C2A software
http://www.astrosurf.com/c2a/english



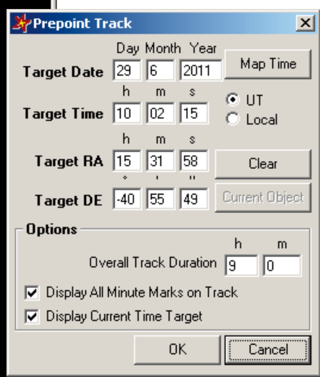
Prepointing… Option 2

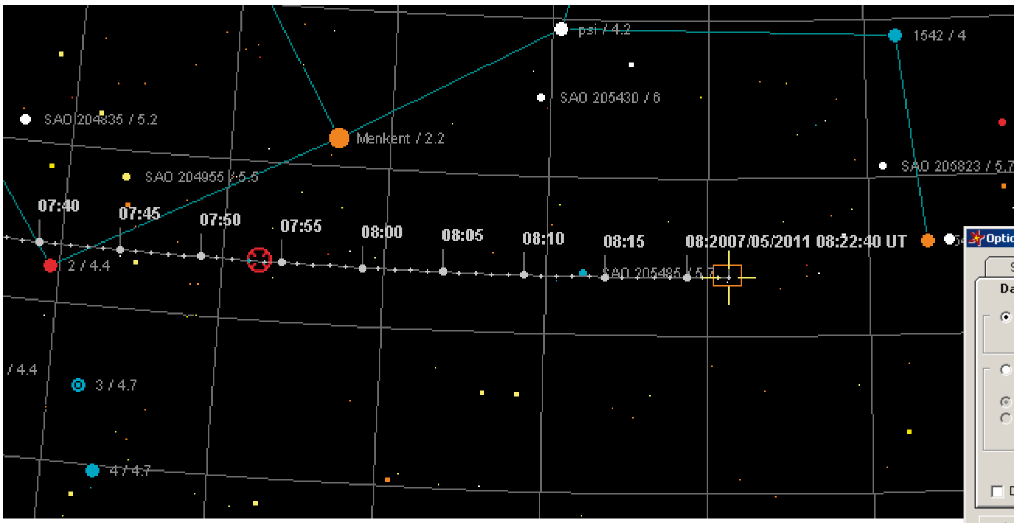
Use Occult Watcher and C2A linkage.



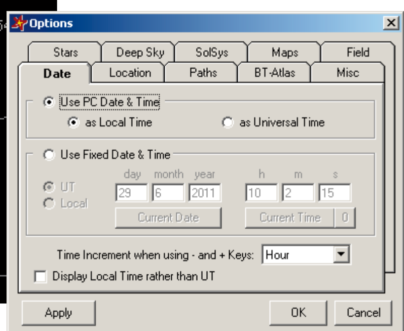
Right click on event in Occult Watcher and select

Create C2A Occultation Map





For this method I have C2A and Occult Watcher on my notebook PC next to video monitor. The round red target is time "now" if you set the Date option to display PC Date & Time.



We start by finding a bright star near track that is easy to point to.

Have it in frame before the due time and start RA tracking.

Adjust Declination until you are on the target track. This is easy if you have a well calibrated Dec setting circle or display. Otherwise you just star hop till you are on track.

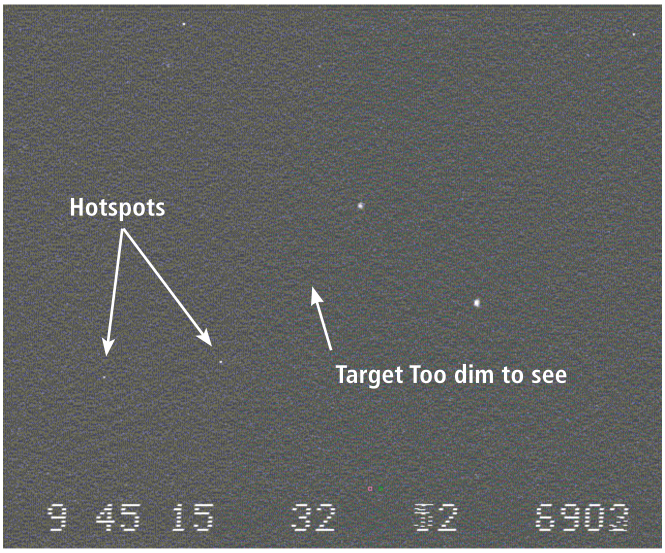
Keep tracking until (x) minutes (x is approx <Predicted centre time> - 2 x Prediction time error> easiest to choose whole minutes) before due time for the field you have in view.

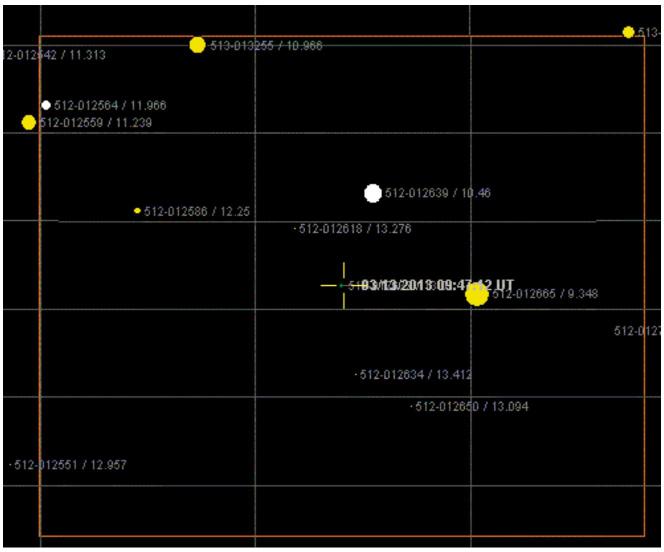
Then stop tracking. I just stop my RA drive. This maybe a problem with a computer driven GOTO scope (but you probably don't need to prepoint with those.

Check that fields really match the predicted view as they drift past.

Watch actual versus Predicted view.

If camera not lined up EW may have to rotate field frame in C2A.





I like to track early (~4mins in this example)

Video C2A

If a short event expected then plan for target to be in centre at due time and don't restart tracking.

You can even set your recorder to record for the expected drift time across screen.

I try to record from – 2x to + 2x seconds where x is the "Error in Time" displayed by Occult Watcher – more if there are Satellites you may be able to catch..

Remember to hit your VTI Reset button and record date and location data before you stop recording.

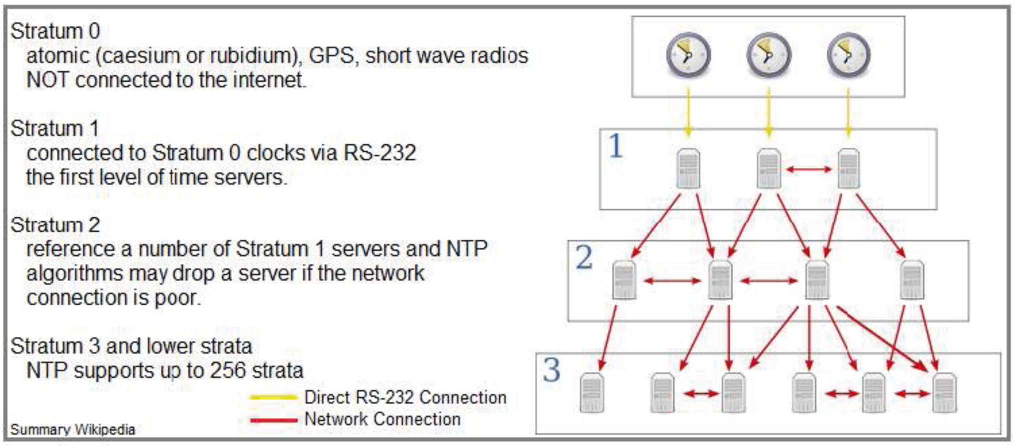
Journal for Occultation Astronomy

Network Time Protocol (NTP)

How accurate is it? Is it good enough for Occultation Observations?

by Dave Gault

NTP is of course the acronym for Network Time Protocol and is a method of synchronisation of clocks that have access to the internet. The computers and clock software sends synchronisation requests to timeservers maintained by various organisations around the world, and in response to the request, the time server sends packets of information that enable the clock to correct it's time display.



NTP Clock Strata (levels)

It is important to realise that NTP is a hierarchical, semilayered system of levels of clocks.

What can affect the accuracy of time synchronzied by NTP?

There are many factors that can have a detrimental effect upon the quality of time displayed;

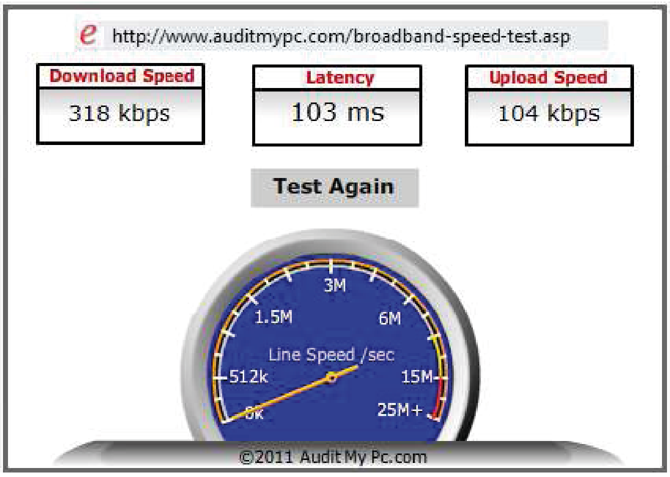
– Speed (latency) of the internet connection
– Strata of the time server(s) chosen for synchronization.
– Signal distance from the servers (including to and from orbiting satellites).
– The quality and complexity of the software algorithm used.
  – Does it use more than one server?
  – Does it compute the roundtrip delay?
  – Does it compensate for systematic bias?
  – Does it report on the accuracy of the synchronization?

All these factors can affect the quality of the synchronized time you receive, many of which are beyond your control, however some are within your control.

Speed of your internet connection

The speed of an internet connection can easily be measured and the effect of traffic load from other computers on the network can be seen, so that when synchronisation is required, steps can be taken to ensure the computer has the best chance to display good time. There are many tools that will measure internet speed. Simply load the URL and run the test. By having other computers that share the connection actively working (or not) you can see their effect.

http://www.auditmypc.com/broadbandspeedtest.asp



Strata of the time server

Try to choose a time server that is operated by a government institution.

Signal Distance

If you can, choose servers that are physically close to your synchronisation site. This will lessen the chance that the signal is not routed up to a geostationary satellite. Here is a list of public time servers;

– Global; http://www.pool.ntp.org/zone/@
– Asia; http://www.pool.ntp.org/zone/asia
– Iran; http://www.pool.ntp.org/zone/ir

– Typically, the URL will be something like;
  – x.asia.pool.ntp.org
  – where x = 0,1,2 or 3

Quality of the software and time algorithms

The following programs were used to test the accuracy of the time displayed and the synchronisation achived was compared to 1ppsGPS time supplied by either IOTAVTI or KIWIPC.

1) Windows Control Panel Date and Time This program will synchronise the PC's system clock. This is not an easy task to do accurately, and you have little choice of the time server which is used. An indication that complex algorithms are not used is the speed the operation takes to complete, which on the author's machine is about 2 seconds. Here the program is shown to be 0.4442 seconds slow. This is NOT good enough for any astronomical occultation observations.

2) WebPage (.html) specifically http://www.asteroidoccultation.com/observations/NA/

Shown here is the recently synchronised webclock that is displaying time that is;

0.090 seconds slow.

As stated in my article in IOTAME Newsletter No. 1,

"Universal Time For Occultation Observations"

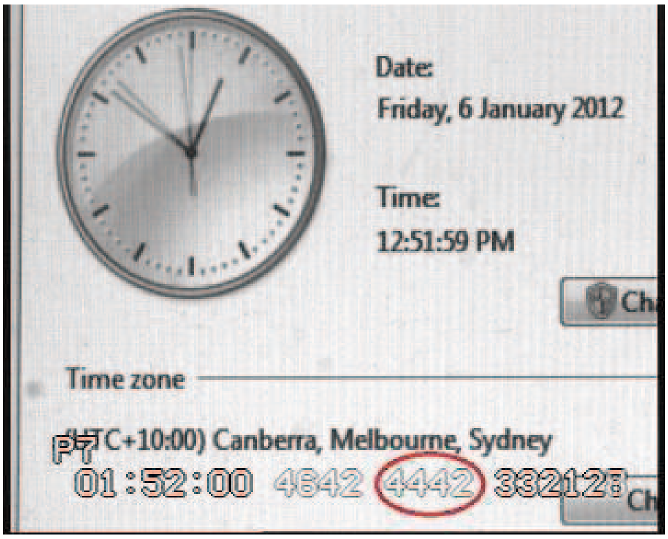
the timebase used for an occultation observation has to be 10 times more accurate than the observation itself, therefore if the accuracy of the timebase, as shown here is +/0.09 seconds, then the accuracy of the observation itself is +/0.9 seconds or simply round the accuracy to +/1 second.

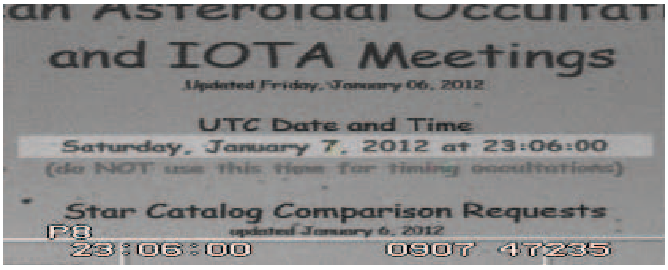
3) Program:Dimension4 http://www.thinkman.com/dimension4/

Dimension4 has a good reputation for synchronising to Universal Time, but at the time of writing, the author has failed to get it running on his PC (Win7/32 Core i7) so the author can only say that he believes Dimension4 is worth considering.

4) Program:BeeperSync http://www.hristopavlov.net/BeeperSync/

BeeperSync is a program designed specifically to synchronise a device called a BeeperBox and it does this by emitting an electronic signal,





sent via the Parallel or Serial ports of the computer. The author is Hristo Pavlov of Sydney, Australia.

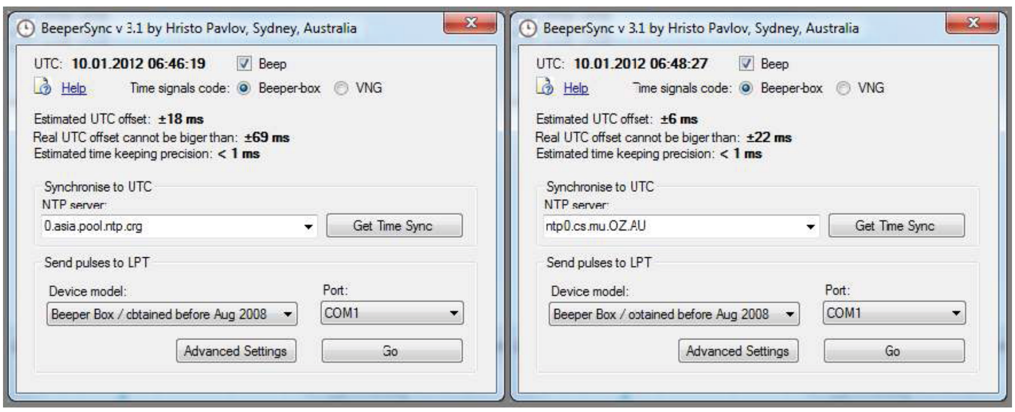
Once installed and given a URL for a nearby timeserver, BeeperSync will measure the latency of the internet connection and will compensate for the delay and it will present the user with accuracy estimates. Shown here are two screenshots of BeeperSync where the screenshot on the left is using a timeserver a long way away from the author's home (near Sydney) and the screenshot on the right is using a nearby timeserver.

Note:

the left (distant) Estimated UTC accuracy = +/18 milliseconds
the right (nearby) Estimated UTC accuracy = +/6 milliseconds
So the effect of timeserver distance can be readily seen.

I have tested the claimed accuracy of BeeperSync while performing the task it was designed for, namely synchronisation of BeeperBoxes, and found that the stated accuracy values were correct. However Hristo does not guarantee the On Screen Display time (OSDtime) or the sound of beeps made by the PC's speaker, so I decided to test the accuracy of both;

1) The OSDtime which could be used to set a stopwatch.



2) The audio beeps which could be used as a timebase for the observation directly.

Sadly the test of the accuracy of the OSDtime was spoilt by the nature of the program – the tick at the beginning of the minute was delayed due to the program resyncing with the timeserver and this made it impossible to set a stopwatch accurately.

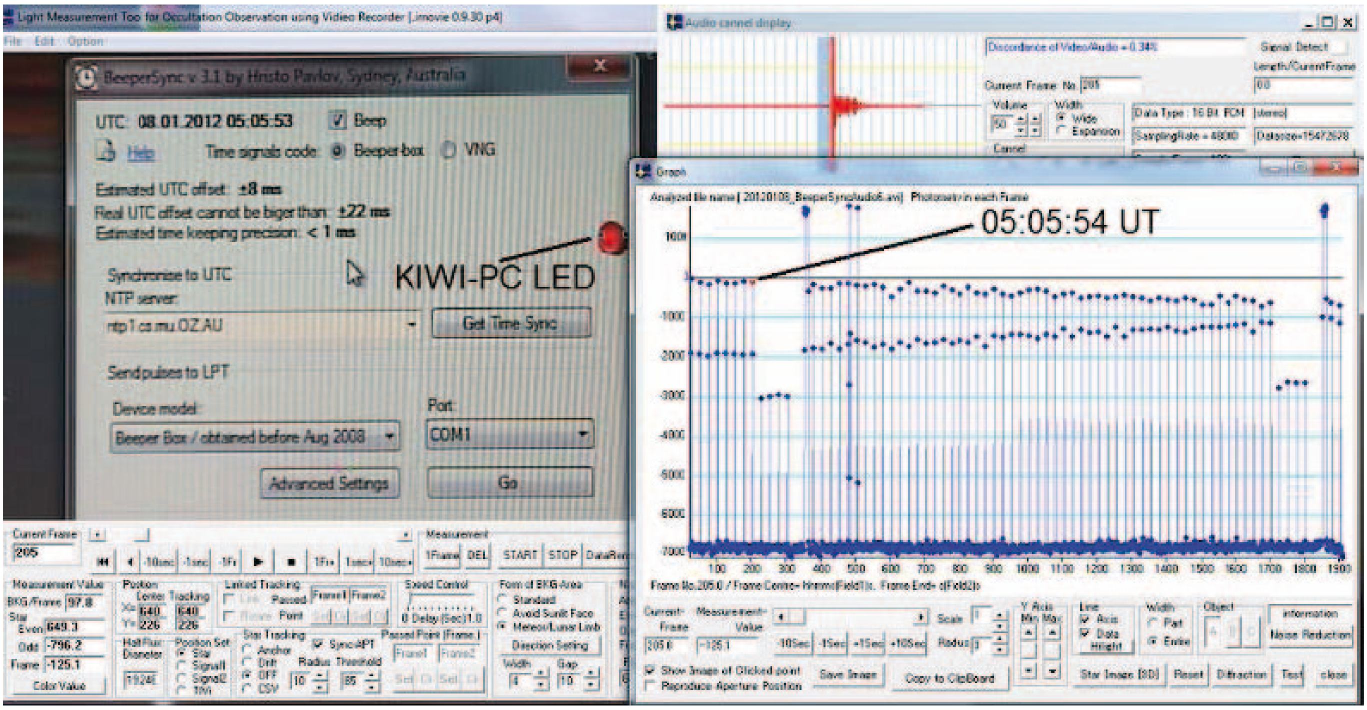
However the audio beeps emitted by the PC's speaker were found to be consistently delayed by 40 milliseconds. The photo below is of a LiMovie analysis of a Video.avi file with a sound track.

– The blue dots at the top of the plot is when the KIWIPC LED flashes, indicating precise (Stratum 0) UT.

– The light blue vertical line represents the LED flash frame in the sound plot.

– The red vertical line is a visual indication of the audio beep.

The beep is exactly and consistently 40 milliseconds behind Universal time.



Summary

If a Webpage timebase is used the accuracy should be reported as +/1 second.

However, provided the observer;

1) Uses the audio beeps of BeeperSync as a timebase.

2) Notes that the timebase was supplied by BeeperSync and gives the Estimated UTC Offset value as part of their observation.

3) The Estimated UTC Offset value is 0.010 seconds or less.

4) Maintains constant internet connection so that BeeperSync will compensate for time drift

5) Adds a value of 40 milliseconds to their value of PE and notes that this was added to the PE value reported.

6) The observation was analysed as detailed in the article

"Analysis of Occultation Events using Audio Techniques"

A visual accuracy of +/0.1 seconds is achievable for an occultation observation.

1ppsGPS time

I wish to point out that 1ppsGPS time is Stratum 0 (the most accurate) and is the preferred timebase if available.

Regards
Dave Gault, Australia

Journal for
Occultation Astronomy

TimeTheSat Measuring Time Accuracy

by Dave Gault

Preamble:

The application TimeTheSat[1] runs on an Android Smartphone. It uses a NTP and has a list of time servers from which to choose for synchronisation. It's almost always best to choose a time server close to the user's location It uses the Smartphone's built in GPS for Geolocation data The operator presses the phone's return button (or the volume button) to trigger a timestamp record, and a beep is sounded. Provision is given to save and share the time record, which is uploaded to the SatFlare[2] website

Equipment, Time References and software:

For these test a Samsung S3 phone was used. I'm located near Sydney, Australia so the NTP time server used was Australia NTP Pool Project[3]. This server gave TAcc<0.1 sec Reference device was GPSABC[4]. This device provided audible beeps synchronised to UTC to +/0.001 sec. Audible record was recorded on a ViewSonic laptop computer using Ubuntu 12.04 Operating System. Audacity[5] Software to make and analyse the recording.

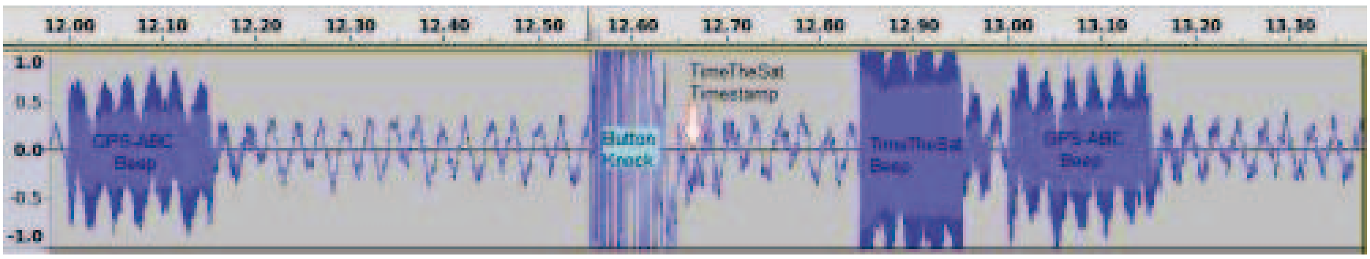
Testing schema

In use TimeTheSat timestamps the instant the return button is pressed. In reality, this is a touch screen function and as such there are no electrical contacts to make or break. A beep is sounded to confirm that a timestamp has been made.

An arrangement was devised so that the laptop body was knocked at the same instant as the Phone's Return button was activated. This was achieved by using two fingers of the one hand and a piece of wood was used to lift the deck of the phone level with the deck of the laptop. This was the operator's input.

Analysis using Audacity would determine;

1. the time of the GPSABC beeps these should start at the integer second.
2. the time of the tap laptop's body and hence activation the phone's Return button
3. the time of TimeTheSat beep.

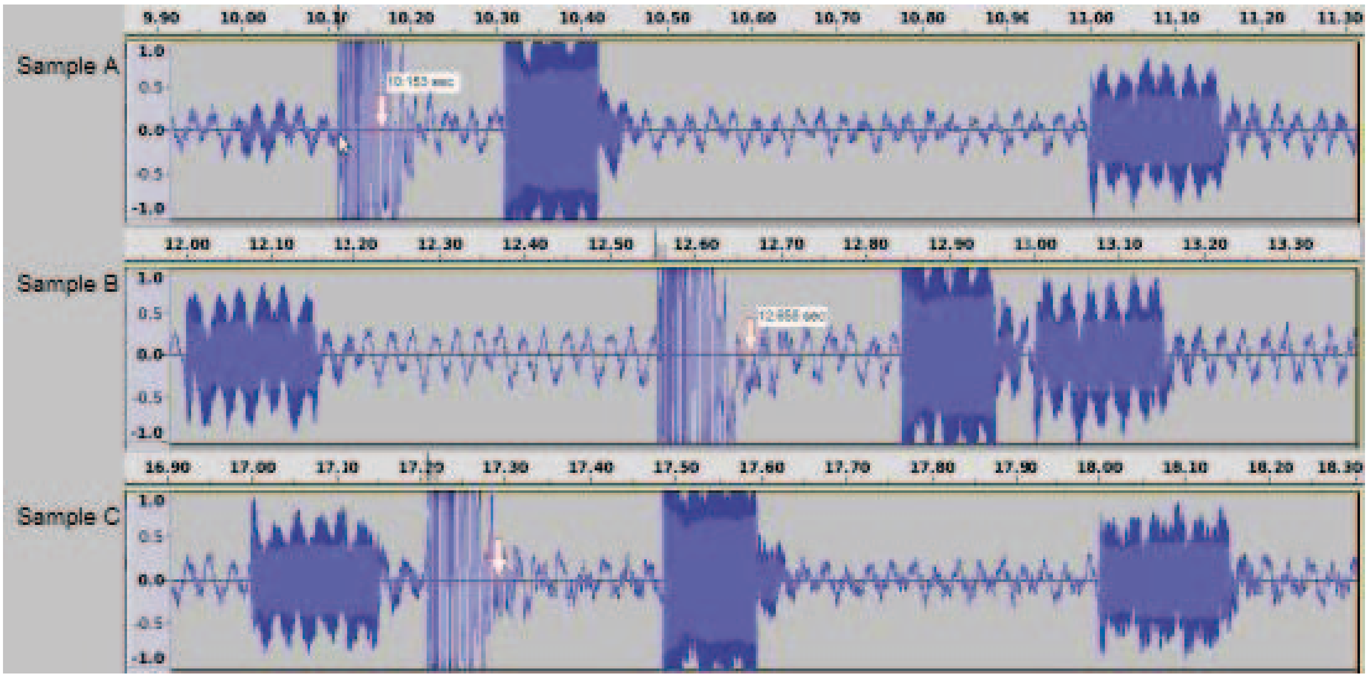


These time could then be compared to the TimeTheSat Timestamp and the delay if any could be calculated.

Testing Method:

- start GPSABC and wait for the AOK LED to light
- start the laptop
- start Audacity and ensure the recording microphone levels are OK
- start TimeTheSat and obtain a NTP Sync
- start a recording and make a number of samples
- analyse the samples

Samples:



Analysis:

Sample	GPSABC[1] (sec)	Knock (sec)	Timestamp (sec)	Delay (sec)	TimeTheSat beep (sec)	Delay (sec)	GPSABC[2] (sec)
A	10.000	10.12	10.153	0.033	10.31	0.190	11.000
B	12.000	12.55	12.658	0.108	12.84	0.290	13.000
C	17.000	17.21	17.290	0.080	17.48	0.270	18.000
				0.074		**0.250**	

- ■ an average delay of 0.074 seconds was observed from the activation of the timing input to the recording of the TimeTheSat timestamp.
- ● an average delay of 0.250 seconds was observed from the activation of the timing input to the sounding of the TimeTheSat beep.

Conclusion:

Visual observations using TimeTheSat as the TimeBase are possible, provided a good NTP Sync is obtained from a nearby server and the TAcc is 0.100 sec or less In addition;

- An observer would have to make allowance for the TimeTheSat timestamp delay. This would be added to their own Personal Equation (PE).
- Reported Observation Accuracy should be 10x the TAcc value.
  - A TAcc of 0.075 sec means the Observation Accuracy should be reported as +/0.75 sec.
- The audible beep of TimeTheSat is of little use as a timing function. It's primary use however is to simply confirm that a timestamp function did occur.
- TimeTheSat is NOT suitable to time events using Video methods.

Comment:

A careful observer should perform their own testing to verify the TimeBase to their own satisfaction.

Notes

https://play.google.com/store/apps/details?id=com.satflare.timesat&hl=en
http://www.satflare.com
http://www.pool.ntp.org/zone/au NTP Server URL= au.pool.ntp.org
http://www.kuriwaobservatory.com/GPSABC.html
http://audacity.sourceforge.net/

The Eighth Trans-Tasman Symposium on Occultations

Dave Gault, Graham Blow & Stephen Russell · RASNZ Occultation Section

The Eighth Trans-Tasman Symposium on Occultations (TTSO8) will be held over Easter 2014, in conjunction with the 26th National Australian Convention of Amateur Astronomers (NACAA).

TTSO8 will feature reviews of recent occultation activity and results, data reduction methods and techniques, updated information on equipment, and sessions devoted to the practical needs of both new and more advanced observers.

TTSO8 is expected to draw wide attendance from occultation observers throughout Australia and New Zealand. The organisers also welcome the attendance and participation of observers from Asia, Europe and the Americas.

NACAA XXVI will be held in Melbourne, Australia, and hosted by the Astronomical Society of Victoria. TTSO8 attendees are encouraged to also attend some or all of the NACAA events. More information on the NACAA meeting is available on its website: http://www.nacaa.org.au/

TTSO8's technical sessions will be split across the weekend. At this stage, the TTSO8 schedule is not finalised. The bulk of the presentations will occur on Sunday and Monday April 20-21, with a workshop on Friday April 18.

Information on the TTSO8 meeting will be posted to the RASNZ Occultation Section website: http://occultations.org.nz/ Registrations will be done via the NACAA website.

The organisers would now like to invite presentations for both the TTSO8 and NACAA meetings. Proposals for TTSO8 should include a title, brief abstract and requested duration and be sent to the TTSO8 organiser, Dave Gault: ttso8@nacaa.org.au

Presentations for the main NACAA meeting should be submitted via the NACAA website: http://www.nacaa.org.au/2014/submission

The RASNZ Occultation Section is looking forward to welcoming participants to the Eighth Trs-Tasman Symposium on Occultations.

Journal for
Occultation Astronomy

European Symposium on Occultation Projects – Barcelona 2013

Carles Schnabel & Hans-J. Bode · IOTA/ES

ESOP XXXII, the European Symposium on Occultation Projects in 2013, took place in Barcelona / Spain. As in the preceeding meeting last year in Pescara / Italy many professional and amateur astronomers came together to present, exchange and discuss experiences, results, and projects.

The authors of the following abstracts are kindly requested to provide their full presentations for publication. Participants and readers may meet again at next year's ESOP in Prague / Czech Republic.

The occultation of the bright star 45 Cap by Jupiter in 2009: Observations, scientific results and future prospects

■ Apostolos Christou, Armagh Observatory

Photometric monitoring of stellar occultations is an established method of determining the structure and variability of planetary and satellite atmospheres.

A campaign was organised in 2009 to observe the occultation of the bright star 45 Capricornii (V=5.5) by Jupiter during the night of 3/4 August 2009. Its occurrence during the summer months encouraged the participation of a large number of both amateur and professional observers as a "stress test" for a pro-am collaboration.

The occultation was recorded by both fixed and mobile stations in Europe, Africa and South America using CCD cameras of various types and telescopes ranging in aperture from 0.4m to 2.2m. Observations took advantage of deep absorption bands in Jupiter's spectrum due to methane in order to minimise the contribution of its atmosphere to the observed flux. The cadence used was in the range 0.4-10 sec.

The light curves were fitted to Baum-Code isothermal models in order to extract the time of half-light and the effective scale height of the atmosphere. The latter was found to be in the region 20-30 km, in agreement with previous works. The Star-Jupiter-Observer geometry was reproduced in each case using kernels and subroutines from JPL's SPICE package. It was found that the atmospheric heights relative to the 1-bar level were systematically higher at ingress than those at egress. This is probably due to the uncertainty in the star's position with respect to Jupiter. The light curves were numerically inverted to produce temperature and pressure profiles of the Jovian atmosphere. These showed the presence of layers which correspond to similar features identified during a previous occultation in 1999.

Future opportunities for scientifically useful occultation work at Jupiter in the next 10 yrs include the events at 12th April 2016 and at 2nd April 2021. These will be described in more detail at the meeting.

Updates on solar diameter issues

■ Costantino Sigismondi, ICRANet Pescara and Observatorio Nacional, Rio de Janeiro

The solar diameter measured using the transit of Venus of 2012, observed in Huairou, China, and the observational campaign of the Heliometer in Rio de Janeiro are briefly presented.

Historical solar eclipses collection updated and supplemented

■ Marek Zawilski, IOTA/ES and Polish Association of Amateur Astronomer

Prepared for the first time in 1992, "The Catalogue of the Historical Observations of Solar Eclipses for Europe and the Near East" as well as "The Collection of the Texts of Historical Observations of Solar Eclipses for Europe and the Near East" was presented during ESOP in Castel Gandolfo, Italy. Initially, the main aim of this work was collecting old observations of solar eclipses for calibrating astronomical software and especially determining the "delta-T" curve. It turned out over time that there is a lot of interesting data on solar eclipses observed in many countries, even if the entries are not particularly precise as written down by non professional sky-watchers.

Beginning from about 2004, the author was able to find first valuable data on the Internet where more and more digitized sources were accessible. This replaced the time consuming method of visiting the public scientific libraries including those situated abroad. Moreover, the web searching revealed some texts probably unknown till now but containing important observations. There is a paradox that often important observational descriptions are found in historical texts of little general importance.

At present (June 2013) 1051 original entries have been collected for the period from the year -1222 (hypothetically) to 1905; next several interesting observations have been gathered till 1927, either. However, for the period after 1724, the searching was not complete and professional observations were collected mainly.

Inter alia, the oldest description recently found concerns Spain – it comes from Valencia and says about the big partial eclipse from September 13, 1178. Also, next information concerns Spanish observations – two of June 7, 1415 from Navarra and Basque Country (chronologically the first impressions on this event in Europe), two of July 29, 1478 from Valencia and Sevilla, and one of March 16, 1485 from Salamanca. The last date of the solar eclipse is very fruitful because many unknown texts have been found, for instance those from Germany and Switzerland including one original manuscript from St.Gallen. In northern Europe some new data come even from Iceland as well as from Scotland (for instance completely unknown observations of the eclipse from March 7, 1598). The "triada" of the 17th century Spanish eclipses of 1600, 1605 and 1614 again was found in the Valencian sources.

First of all, however, the best observed European solar eclipse occurred on May 12, 1706 and was observed from Spain to northern Russia. Until now, from Spain some data from Barcelona have been found only; but now we know the first not anonymous man who observed the total eclipse on this day – he was Juan Bautista Corachán in Valencia; and the totality was remarked near Ampurdan, too. Next new entries have also been found for some places in France (Requsita, Peypin-d'Aigues, Entrecasteaux, Agen, Gévaudan), Switzerland (Zürich, Neuchatel, St.Gallen, Weiach, Basel, Geneve), Austria (Reutte, Hall), Germany (more than 20), Czechia (Časlav, Řídeč) and Poland (Szprotawa, Międzychód). In total, 96 entries for this extraordinary event have been found.

Less known but interesting professional observations were collected for the annular eclipses of 1737, 1764, 1793, 1820 and 1836.

So far, 48% of known observations have been made by professional observers; however this results from the later period - since 17th century and rare professional observations come from the Middle Ages. No new data were found for ancient and early medieval period; this is obvious – so far no new historical sources were discovered.

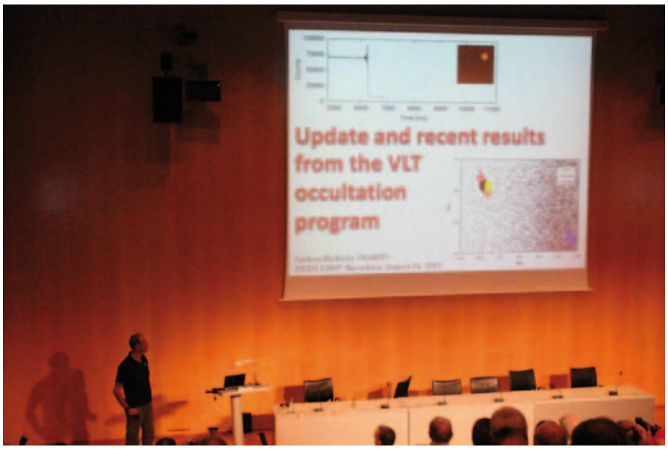
The search for new observations is not finished although there are more and more difficulties to find anything new. On the other hand, maybe 20% of all written sources have been transformed into accessible web form, so the number of undiscovered data can still be large.

Finding grazing occultation "sweet spots" using Kaguya profiles

■ **David Dunham, IOTA (USA)**

The accuracy of high resolution profiles generated from the Kaguya laser ranging observations (and more recently, also from NASA's LRO mission) has been confirmed by analysis of past grazing occultation observations. Now the predicted profiles are much more detailed than those up to a few years ago, when we depended on Watts' charts to generate grazing occultation profiles. Two successes during 2012 will be recounted, one involving 80 mm "mighty midi" systems. I will describe recent efforts to observe multiple events at the tops of narrow plateaus for northern-limit grazes in Maryland on May 12 and in southern Russia on June 2.

Update and recent results from the VLT occultation program



■ **Andrea Richichi, National Astronomical Research Institute of Thailand (NARIT)**

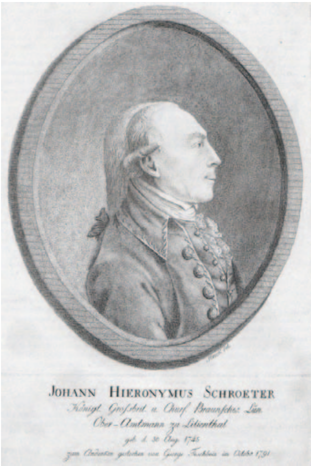
I will provide an update on the lunar occultations program carried out in the past few years at the ESO VLT.

The program, based mainly on a filler strategy which makes use of small slots not claimed by other observers, has resulted in over 1,200 events recorded. The quality of the resulting light curves is arguably the best ever obtained with the occultation technique. I will highlight some of the most recent results in the area of binary stars, angular diameters and infrared sources with complex circumstellar emission. A catalogue of unresolved sources with upper limits on the angular size has also been produced.

18th century occultation observation by J. H. Schroeter - early usage of astronomy's Swiss knifelemented

■ **Konrad Guhl, IOTA/ES**

The observation of occultation allows the measurement of a multitude of parameters of celestial bodies - hence they are known as "Astronomer's Swiss Knife".



Johann H. Schroeter (1745-1816) was one of the first to make use of occultation observations in order to prove scientific hypotheses. Between 1793 and 1798, he observed occultation of stars, Mars, Jupiter and Saturn at the observatory Liliental (Germany). Thus, he wanted to find a proof for a lunar atmosphere. His observations, along with his own comments, were published in 1802. This contribution showcases the use of astronomy's Swiss Knife and analyses some of his observations from a modern point of view.

UCAC2 42913552 a Double Star Discovered

During an Asteroidal Occultation, Antoni Selva

The occultation of the star UCAC2 42913552 by the asteroid 388 Charybdis on December 3rd, 2012 showed the duplicity of the star. Six observations carried out from Catalonia, Spain enabled the determination of the parameters of this double star. A separation of 28.6 ± 0.6 milliarcseconds (mas) and a position angle (PA) of 110.2 ± 3.6 degrees were deduced from the timings. From the steps in the light curve the estimated magnitudes without filter are 11.7 and 12.0. We suggest that this pair has to be included in the WDS catalogue.

Agrupació Astronòmica de Sabadell (AAS) European Total occultations 2010-2012

■ Jan Manek, IOTA/ES

An overview of Total occultations (occultations of stars by the Moon) statistics during the period 2010-2012 will be given together with some comments, recommendations and info on double stars reporting.

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Discovery of a binary star: 2UCAC 46691743

■ Harrie Rutten, IOTA/ES

On January 27th 2013 Henk de Groot, secretary of the Dutch Occultation Association, observed the occultation of 2UCAC 46691743 by (536) Merapi. During the analysis of this observation he noticed a two stage disappearance and two stage reappearance from Nijmegen in the Netherlands. Donatas Tamonis observed from Kaunas in Lithuania a single disappearance and a single reappearance. So, is 2UCA 4661743 a binary star or not?

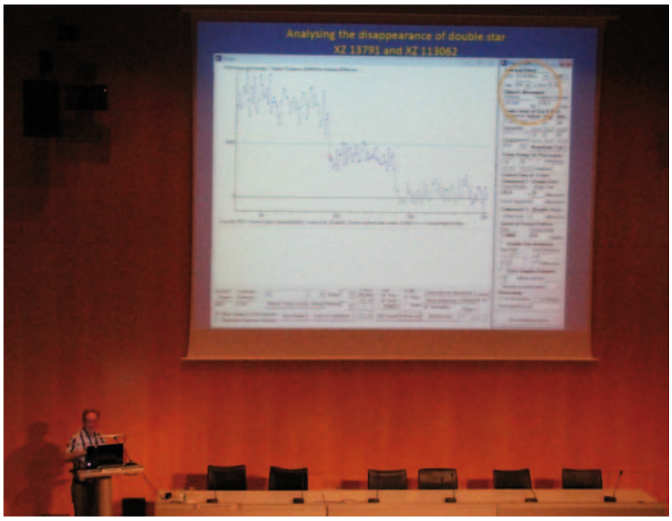
Unfortunately Tim Haymes and Alex Pratt in the UK had a miss. A small presentation of the observations will show the results to open a discussion.

Personal feeds for Occultation Watcher

■ Carlos Perelló / Joan López, AAS

Sometimes, considering your specific equipment, location or time availability you would be able to follow events not included in the usual sources. Personal predictions can help us.

Video recording and analysing lunar occultations of double stars



■ Alexander Pratt, IOTA/ES

Examples of occultations of double stars are discussed, including the use of LiMovie to estimate the step height and duration of the event. Provisional results of PA and separation – derived by Occult – are presented.

Computing Asteroidal Occultations and Eclipse visibility using GIS techniques

■ José Gómez Castaño, IOTA/ES

Traditionally, asteroidal occultation visibility is computed using baseline elements and then obtaining the shadow path over the earth. To determine if the event will be visible from a certain location, this can be projected over the fundamental plane. Also, it is possible to draw the shadow path over some kind of digital maps like Google Maps or Open Street Map, and compare it to the observer location.

In this project a new methodology is presented using Geographic Information System techniques. The shadow predicted coordinates, computed using OCCULT or other occultation software, are stored into a spatial database, PostGIS in this case, as a geospatial object. Observer's position is compared to the shadow as a spatial object using a geospatial process, and a visibility condition is resolved as a point into the polygon described by the shadow. A percentage of observability can be assigned. (A range of vision can be assigned)

With this methodology an observer may know directly which events are more accessible from his location without the need to consult each prediction map. It is also possible to know the visible events into a travel radius. A special application of the methodology allows to compute historical visibility over long periods of time. It is an easy way to know, for a given place, which eclipse was visible for each epoch. This is a very useful tool for historical investigations.

The algorithm has been implemented in an application using Java, PHP, and a PostGIS database.

Keywords: Asteroidal Occultation, Solar Eclipse, GIS, History.

Driftscan with the WINSCAN utility

Ramon Naves, ASTER

How to use the WINSCAN utility in order to record stellar occultations by minor planets.

On the search for an occultation camera

Dr. Wolfgang Beisker, IOTA/ES

Abstract: Starting from the old IOTA Occultation Camera (IOC) in the 90ies a number of attempts have been made, to provide the observers with a versatile CCD camera for the recording of occultation events. Since some years, the focus turned from the high speed recording of lunar events to the lower speed of asteroidal events down to occultations by Trans Neptunion Objects (TNOs). However, the sensitivity of the cameras remains to be a main point as well as the cost per unit. One of the most important issues is the readout noise of the camera, which is the noise generated when the charge of a particular pixel is transferred to the analogue digital converter. The readout noises ranges from less than 1 electron in case of an EMCCD camera or less than 2 e- for some new CMOS cameras up to 30 e- in case of the old IOC. EMCCD and scientific CMOS cameras have an extremely high price per unit, starting at about 8000 Euro. This is far beyond the scope, what a typical occultation observer can spend. The upcoming comissioning of our transportable 50cm instrument also kept the search for a new camera system on. Some units of a chinese manufactured CCD camera have been purchased, but the line had some problems and is discontinued. The work of our Australian friends has put the focus on a CCD camera from a Canadian company (PointGrey), which provides a full series of CCD cameras with various speeds and different CCD chips. For testing purposes, one of the cheaper units have been purchased and tested. The company provides an excellent interface for programmers, even for LINUX. The API they developed can control nearly all of their cameras. Because of the low cost of some of their systems (the tested one has a price tag of less than 500 Euro) observatories can easily be equipped with such a system. The tested product, a Chameleon 1/3 inch CCD camera with USB2 connection can record up to 30 frames per second (full field!!!) with 680 by 480 resolution in 12 Bit. The readout noise has been determined to be lower than 8 e- and the fan controlled air cooling provides sufficient temperatures only about 8 degrees C above ambient temperature.

Tutorial: Analysis of light curves with diffraction patterns

Andrea Richichi, NARIT

Amateur observers have been traditionally mostly interested in the timing of lunar occultations (e.g., for determining the limb profile). However, modern detectors allow to sample the occultation light curves at rates close to the millisecond level, and this is becoming possible also with amateur instrumentation thanks to techniques such as drift-scanning or subframe readouts.

In this case, the light curves show characteristic diffraction patterns that can be analyzed to measure very close binaries or angular diameters. This requires in turn specialized software.

I will give a hands-on tutorial on the analysis of occultation light curves with both model-dependent and model-independent algorithms, using my own software. Attendants are welcome to bring also their own light curves for analysis, if desired.

Mult iple station deployments for asteroidal occultations

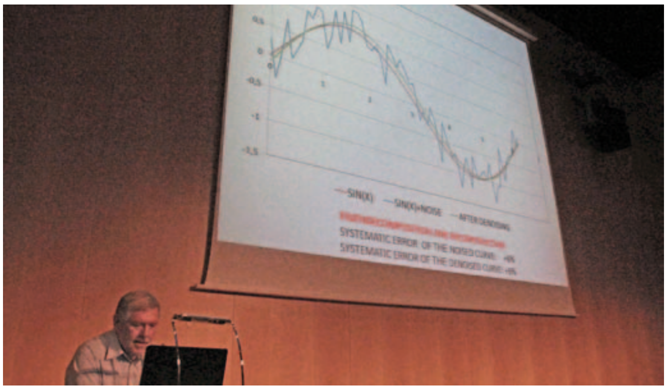
David Dunham, IOTA (USA)

I will describe the first efforts to video record occultations of stars by asteroids from more than one station, starting with the occultation by (9) Metis on 2001 September 7. Scotty Degenhardt's invention of the "mighty mini" allowed a significant expansion of multiple station deployments starting in 2008. The successful efforts depend on having several hours of darkness before an occultation to allow time to pre-point several mighty mini's or other small telescopes. A good example was the occultation of 6th-mag. LQ Aquarii by the binary asteroid (90) Antiope in the western USA in July 2011. But often there are occultations that occur rather early in the evening, with only enough dark time to pre-point maybe just one other system. In these cases, it is better to try to train others to use mighty mini's to deploy across a predicted occultation path.

I will describe how this was partly done for the occultation of delta Ophiuchi by the asteroid Roma in Iberia in July 2010. Then I'll describe lessons learned during an attempt to record another early evening occultation, of a 6th-mag. star by the asteroid (28) Bellona in May 2012, with observers from Khabarovsk, Russia.

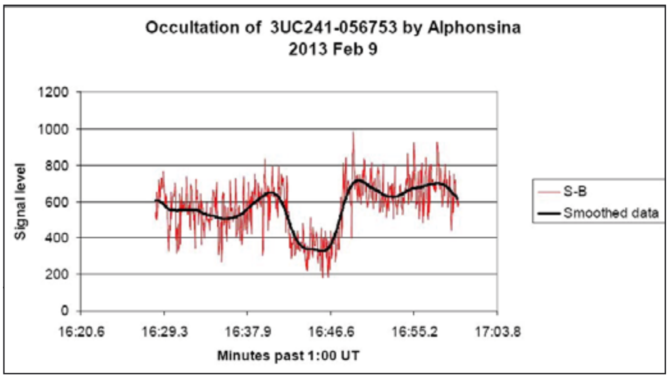
Besides the 50mm "mighty mini" systems, which can record stars to about mag. 9th, we often use 80 mm "mighty midi's" that can reach just below mag. 11. In the past, I have deployed a few 120 mm "mighty maxi" systems, but they were difficult to use without mounts that are too expensive for multiple-station use. Earlier this year, Scotty Degenhardt and Ted Blank developed an inexpensive system, made from an inexpensive lawn sprinkler mount, that makes use of "mighty maxi's" much easier. This should allow deployment of multiple stations for the much more common events down to about 12th mag.

Denoising of photometric light curves



Marek Zawilski, IOTA/ES and Polish Association of Amateur Astronomers

Recording of measured photometric light curves for occultation phenomena represents an essential progress in elaboration of final observation results. However, usually obtained in unstable terrestrial conditions, such light curves are subject to a random noise due to thermal and density turbulence of the Earth's atmosphere as well as a noise generated by the electronics. If the resulted signal to noise (S/N) ratio is low, there is a significant difficulty to determine the occultation time and other parameters properly.



Original measured light curve (signal-background) and its smoothed run according to the Eigen decomposition and reconstruction denoising algorithm.

Curve v.5.01 software. Several denoising algorithms have been tested and their results can be compared. In the graphics below one example of signal denoising is presented.

How a "miss" turns into "positive"

Harrie Rutten, IOTA/ES

Mostly an occultation of a star by a minor planet is very clear: the star disappears and after a few seconds or more the star reappears. But when the minor planet is nearly the same brightness or even brighter as the star, it can be very difficult, especially when you have a bad seeing or even passing clouds. In this lecture some examples will be given where an occultation was found after processing recent and older observations.

Once, an occultation was found after 1.5 years!

Invitation to Prague ESOP 2014

Vaclav Priban, IOTA/ES

It introduces the place where ESOP 33 will take place and with its planned excursions.

The treasurer of IOTA-ES met Einstein & Darwin in Barcelona.

Journal for Occultation Astronomy

Astronomy in Namibia

by Hans-Joachim Bode · IOTA/ES

In 1986 I have been in Namibia for the first time and whenever I returned I always met a perfect sky! This time I had planned to record 4 TNO-occultations in July within a fortnight – but looks like I did not succeed at all and the only data to inspect in detail are still the ones of the occultation of Quaoar's moon…

Sonja Itting-Enke is a long-time member of IOTA-ES & the Wissenschaftliche Gesellschaft (Scientific Society) and I could use her C14 and assistance whenever I was in Namibia for recording occultations. During my stay I was invited by Sonja to get again in contact with the Wissenschaftliche Gesellschaft and to come to their 2nd meeting (see below). So I consented while thinking of popularizing occultation astronomy in Namibia.

Gazing at the beautiful night sky…

On the 13th June 2013 an inception meeting took place at the Namibia Scientific Society. Those in attendance were people well-known amongst star friends andmembers of the Namibia Scientific Society, e.g. Eberhard von Grumbkow, Dr. Michael Bakkes, Sonja Itting-Enke, Rob Johnstone, Toni Hanke, SiegfriedStraube, Burghardt Voigts, Annegret Enengl. The reason for this meeting was torevive the Astronomy work group of the Namibia Scientific Society. A subsequent gathering was held on the 10th of July 2013, where members ofthe general public were invited to attend. This evening was well attended andsome foreign professional astronomers were present, e.g. Dr.s Hopfer and Bode. Mr Rob Johnstone from Space Observation Learning Namibia was unanimously appointed as the coordinator and chairman of this work group. The astronomy work group aims at fostering the interest for astronomy, stargazing and information relating to the Namibian night sky in all people, irrespective of their age or background. It also intends to educate interested parties on this subject. The group will have regular excursions where the participants have the opportunity to observe the magnificent Namibian night sky through telescopes. The first excursion takes place on the evening of Friday, 9th August, at Gocheganas. To enable all in attendance to receive ample time to gaze at theheavens, only thirty participants can attend. Star viewing will be facilitated by Rob Johnstone. Demand is far larger than expected and thus another star gazing evening will be organized. Such events will not only be of educational value, but also provide the opportunity to meet like-minded people. Don't forget toput on warm clothes as Namibian evenings can be quite chilly.

A very interesting presentation will be held by Rob Johnstone on Wednesday,August 21st at 19h00 at the Namibia Scientific Society (Robert Mugabe 110 –opposite the National Theatre). Everyone is welcome to attend. If you are interested in joining the Astronomy group or in sharing the amazing events, like the one on Friday and others to come, please contact nwg@iway.na. What are you waiting for? Expand your horizons and join the Astronomy group today!

Journal for
Occultation
Astronomy

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 Offices and Officers of IOTA

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(IOTA maintains the following web site for your information and rapid notification of events.)

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

This site contains information about the organization known as IOTA and provides information about joining

IOTA and IOTA/ES, including topics related to the Journal of Occulation Astronomy (JOA), and also has an on-line archive of all issues of Occultation Newsletter, IOTA's predecessor to JOA. On the right side of the main page of this site are included links to IOTA's major technical sites, as well as to the major IOTA sections, including those in Europe, Asia, Australia/New Zealand, and South America. The technical sites include definitions and information about observing and reporting, and results of, lunar, planetary, and asteroidal occultations, and of eclipses and other timely phenomena, including outer planet satellite mutual events and lunar meteor impact flashes.

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