Journal for Occultation Astronomy

FORMERLY OCCULTATION NEWSLETTER

XXIX ESOP 2010

By Alex Pratt

York, England 20th to 24th August 2010

29th European Symposium on Occultation Projects

Symposium Abstracts

Saturday 21st August – XXIX ESOP 2010

Dr Marek Zawilski – Four occultation phenomena from the past observed in northern England.

Each country can name its extraordinary celestial phenomena observed in the past. In northern England, there were many unusual occultation phenomena observed in the previous centuries, but four of them will be reviewed in detail.

Occultation of Jupiter by the eclipsed Moon on November 23, 755

In the medieval chronicle written by Simeon of Durham in the 12th century, we can find an account borrowed from another, lost source, devoted to a lunar eclipse and a bright star that first was seen on the left side of the Moon, crossed it, and then was seen on right side. The phenomenon was said to have been on November 24, 756. As we can calculate today, the situation took place one year earlier and in the evening of November 23. The mistake of the date can be attributed to a simple writing error concerning the year and day. The bright star can be easily identified as the planet Jupiter. Although the original description is not precise, in general the circumstances were correctly described. It seems to be an account about the occultation of the planet by the eclipsed Moon. If so, it was the only such event definitely observed on the Earth in the past!

However, taking the results of modern calculations into consideration, one can determine the details: in fact, the Moon occulted Jupiter as seen from northern England but the disappearance took place at the illuminated limb of the Moon slowly emerging from the shadow of Earth. The reappearance also occurred at the bright limb when the partial eclipse

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Dear reader,

as most of you are aware, there have been some problems regarding the production and distribution of Occultation Newsletter during the last couple of years. Just like every member, John Graves produced ON in what spare time he had voluntarily without compensation. Due to familiar reasons, he is no longer able to produce ON. Thank you very much, John, for editing/assembling ON for so many years. During the past few months, we have had some communications with members of IOTA's European Section and a solution has been found. Three members of IOTA/ES will produce ON, from now on called Journal of Occultation Astronomy (JOA) with the assistance of country- / state-coordinators. Hans-J. Bode and Brigitte Thome are members of an editorial staff of a German magazine being published every month whereas Michael Busse is the owner of a small marketing company experienced also with the layout of a magazine. These three persons will work together to produce JOA four times a year – whenever the necessary amount of articles have been obtained. We encourage contributions from all readers. For receiving articles, we have established the following procedures: Every European country will have a coordinator who will collect occultation-related (or of general interest) articles and transfer them to our JOA-ftp-server. Pawel Maksym, Alfons Gabel (Europe) and David Dunham (USA and rest of the world, with help from one or two other IOTA members) will keep in touch with these coordinators and supervise all activities.

Hans-J. Bode David Dunham

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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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had already ended. One can assume that none of the two phenomena could be discerned in detail by a naked eye and only the conjunction of both celestial bodies can be easily seen. Therefore, it was not the real occultation by the totally eclipsed Moon; the phenomenon was described for the first time by J. Meeus et al. in 1977.

Total solar eclipse on May 3, 1715

This eclipse was total in England after a pause of almost 600 years! Therefore, it was carefully observed, especially thanks to the work of Sir Edmond Halley who prepared the ephemeris and coordinated observations. Some of them are of particular interest because they were made at the limits of the path of totality. For us especially, the observation made by Theophilus Shelton in Darrington is of great interest. During the maximum phase, he noted a remaining part of the Sun like a reddish particle resembling Mars; therefore he concluded he was exactly at the limit of totality. At the same time, the eclipse was total as observed from two places situated at the distance of three miles to the south.

The observation together with some others made both at the northern and southern limits of the path of totality made it possible to precisely determine the diameter of the Sun. Most of the authors who have analysed the value of the diameter are of the opinion that it has not changed since 1715.

Annular solar eclipse on May 15, 1836

An annular eclipse occurred in Ireland and northern England. Francis Baily at Inch Bonney near Jedburg, Roxburgshire, saw "a row of lucid points, like a string of bright beads" on the Moon's rim (Baily`s beads). The darkness during annularity was "not greater than that caused by a temporary cloud passing over the Sun (but) of a peculiar character…like that produced by the Sun shining through a morning mist." The name "Baily's beads" has been accepted worldwide although the most famous Baily's observation of the phenomenon was made in 1842 in Pavia, Italy during a total solar eclipse.

Total solar eclipse on June 29, 1927

On that day, shortly after sunrise, the path of totality crossed Wales and northern England. Unfortunately, the observing conditions were not favourable because of the short duration of totality (only 24 seconds) and the low altitude of the Sun. Moreover, the weather conditions were very bad. In Wales it was raining all the time and the eclipse was not visible at all. In northern England it was a little bit better. The official expedition to Giggleswick in North Yorkshire led by Sir Frank W. Dyson, the Astronomer Royal, with the presence of Charles D.P.Davies,, a famous mirror-maker, and W.H. Steavenson, the president of the BAA and many other observers, were amongst the few to catch sight of totality from the grounds of the local school.

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Photos: Otto Farago, IOTA/ES

The local paper next reported that at Giggleswick that the eclipse was perfectly seen. The crowds were struck dumb by the sight of the corona glowing like a volcano, and cheered when the Sun reappeared. Virginia Woolf was among the observers, too. She viewed the eclipse from Bardon Fell in Yorkshire and described it in her diary: "it became darker and darker as at the beginning of a violent storm; the light sank and sank… suddenly the light went out. We were bitterly cold … then it was over until 1999".

Some newspapers organized aerial observations, too. They used chartered aircraft and one balloon.

Andrew Elliott – (130) Elektra – a UK first! (presented by Alex Pratt.)

On the evening of 20th February 2010 asteroid (130) Elektra occulted a star in Monoceros. The shadow track passed over the UK and several observers in England recorded the event. Their results allowed a profile of the asteroid to be estimated. This is perhaps a 'first' for UK astronomers.

Sven Andersson – ZC822, a successful grazing expedition.

On 22nd March 2010 the group of amateur observers at Archenhold-Observatory made an expedition to observe the grazing occultation of ZC822 by the Moon. Five people made video observations, and three more people just watched the event, because it was the first grazing occultation they had seen. Altogether 75 contacts were observed by the stations that recorded the event on video. The events, which fitted the Kaguya data almost exactly, have been reported to Mr. Soma.

In the prediction ZC822 is mentioned as a close binary and effects caused by diffraction were observed by the stations recording the event on video.

Jan Manek – 2009 total occultation statistics for Europe.

For the first time we have statistics of a complete year as obtained by IOTA with its new observation collecting procedure. A view of how Europe observed with some statistics from different points of view will be presented.

Václav Pribán – PHEMU 09 mutual events of Galilean satellites.

Mutual events, it means occultations and eclipses, repeat every six years for the Galilean moons of the planet Jupiter. IMCCE, Paris and other institutions organise international observation campaigns called PHEMU. I have participated in PHEMU 97, PHEMU 03.

This contribution describes the technical equipment and software that was used for these observations in PHEMU 09. Accelerated videorecords are projected during the lecture. Obtained light curves are shown at the end.

Vagelis Tsamis – Lunar and asteroidal occultations observed from Greece in 2009 and 2010.

Dr Wolfgang Beisker – Using MIDAS to produce lightcurves from occultation events.

Dr Ricard Casas[a,b] and Carles Schnabel[a] – The occultation of 45 Capricorni by Jupiter (presented by Ricard Casas).

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[b] Institut de Ciències de l'Espai (CSIC/IEEC)

In August 3rd, 2009 Jupiter occulted the 6th magnitude star 45 Cap. Six observatories, coordinated by Carles Schnabel, observed the event using photometric devices. Some of them used specific photometric filters centred in methane absorption lines to reduce the planet brightness and to increase the contrast of the star.

Two observations were carried out from the Observatorio del Teide (Tenerife, Canary Islands), with telescopes of 1.5 and 0.8 m. The first one with CAIN, an infrared camera provided with a Ks band filter, and the second one with a conventional CCD and U band filter. From Observatoris de l'AAS in the Montsec (Catalonia), one team used an 890 nm filter in the 0.5 m telescope of the association and the second one used a red filter in a 0.21 m telescope. In Pinsoro (Aragon), a red filter W25 was used with a telescope of 0.18 m. In these three sites Mintron TV cameras were used as detectors and KIWI time inserters. In the Observatori de Sabadell (Catalonia) a methane filter centred in 890 nm in front of a CCD camera was used with the 0.5 m telescope.

In ESOP XXVIII 2009, held in Niepolomice (Poland), Carles Schnabel presented a first, and quick, analysis of the data. One year later, we have made a new reduction of the raw images and a more detailed analysis of the data. The use of a mask, generated with the same images, allows to remove the planet brightness and to obtain a best signal to noise ratio in the photometry.

The first step in the analysis consists to fit an isothermal model of the atmosphere and the second one is an inversion method to obtain the temperature profile.

Dr Wolfgang Beisker – The atmospheric structure of the Jovian atmosphere as derived from the 2009 observations.

Wolfgang Rothe – A possibility to avoid star image saturation for video observations of bright star occultations.

Some tests are presented in order to demonstrate that a defocused star image is a very simple method to prevent nonlinearity due to saturation. The method allows an easy fine adjustment also under field conditions. Scintillation effects depending on used aperture are additionally shown. A combination of unsharp star image, reduced aperture and filters may be required for large instruments.

2010 July 8th occultation of δ Oph by (472) Roma.

Included contributions by Wolfgang Rothe (calibrating and analysing Roma observations), Oliver Klös (the distribution of Roma observers across Europe) and Dr Marek Zawilski (Mieczyslaw Borkowski's report on a partial occultation of Roma recorded at Lodz observatory.)

Sunday 22nd August - XXIX ESOP 2010 Day 2

Dr Eberhard Bredner – La Lunette d'Arago, my Watec 120N+ and LiMovie – the tale of an observation.

Our electronics for occultation work has been developed during the last 15 years in great steps, now our equipment (camera, time inserter) is very sensitive. The minor planet (80) Sappho would occult a star June 6, 2010 and the shadow path would cross Paris Observatory. The main instrument there (in the very heart of Paris) was a refractor from 1855. I accepted the challenge to try the observation there, something difficult – but in the end I got a positive result.

Dr Wolfgang Beisker – How to get the GPS timing from a serial receiver as system time into Windows XP...Hardware and software.

Thomas Flatrès – Using GPS Garmin 18 LVC for video timing.

Because of an internal battery the satellite almanac is stored in a GPS receiver, but it can be quite old. Information is presented about problems using a GPS receiver when it is restarted after a long time without use.

Tim Haymes – Poster presentation – Three positive asteroidal occultation observations in 2010.

Experiences of three positive observations in 2010 – (130) Elektra, (532) Herculina and (80) Sappho.

Thomas Flatrès – Improve video timing using diffraction fringes.

The flux of a star, on a picture, is the result of a 40ms time exposure. That value involves also the effect of diffraction, the star diameter, the spectral response of the camera and the radial speed of approach of the two bodies. The lower time inserted in a picture is the start of the exposure time. Using all these features our challenge is knowing the time when the star centre is crossing the limb of the Moon or the asteroid.

Henk de Groot – Some extraordinary asteroidal occultations.

In the last 2 years I observed 3 extraordinary occultations of asteroids. The first one, (9) Metis, has a magnitude drop of 0.11, and during the observation the seeing is bad. Still it is possible to get a good timing.

The second one, (4925) 1981 XH2 appears to have a shift of about 200 km to the south. Also, there is a diffraction pattern visible at disappearance and reappearance. I will explain how I come to a correct timing.

The third one, (539) Pamina, occults a double star. The magnitude drop is much smaller than predicted.

Dr Wolfgang Beisker – Preliminary data of the occultation of a 15th mag star by Pluto on the 4th of July 2010 containing observations in Namibia, South Africa and Southern USA.

Eamonn Ansbro – Dual high speed photometer for detecting Edgeworth-Kuiper Belt objects by occultation.

We present the design of a high speed dual photometer to detect Edgeworth Kuiper Belt Objects. The current limitation in occultation surveys is course time resolution and poor sensitivity. We need high precision, high reliability photometry. High time resolution photometry is the only way to search for small scale variability within a star and this provides orders of magnitude more resolution than even the NGST. This time resolution allows us to be sensitive to detecting the unexplored sub-kilometer regime of EKBOs. Discovering and constraining the size distribution of EKBOs is crucial to understand solar system formation.

Dr Richard Miles – Occultation, photometric and direct imaging studies of Pluto and their relevance to the study of Trans-Neptunian Objects.

A review will be given of physical studies of the 'once planet' Pluto, comparing the results obtained over the years from occultation studies with those obtained from photometric studies and direct imaging with HST. Preliminary results of an observing campaign conducted in 2009 by the Asteroids and Remote Planets Section of the British Astronomical Association will be presented. The scope for further study of the dwarf planet and 'other' TNOs before the fly-by of the New Horizons space probe (due to reach Pluto in 2015) will also be discussed.

Dr Eberhard Riedel – Kaguya measurements versus Earthbound lunar limb observation – a statistical comparison.

If the topographic measurements of the Kaguya-mission are accepted to yield the best lunar limb data presently available these can be referenced to Earthbound observations of limb details by means of grazing occultations. Thus Kaguya limb heights are compared to ACLPPP and MOONLIMB data where available and the quality of Earthbound measurements can be statistically calculated.

Dr Eberhard Riedel - GRAZPREP, IOTA/ES-software for the preparation of grazing occultation observations.

'GRAZPREP' was designed as a simple tool to easily access the grazing occultation prediction data supplied each year to interested observers. The software assists in finding and listing individually favourable occultation events and figuring out the best observing site in advance or under way by graphically showing the expected apparent stellar path through the lunar limb terrain. Through the use of the Kaguya topographic data the approximate number of dis- and reappearances can be predicted for any site coordinates and elevation.

Professor Costantino Sigismondi, Konrad Guhl, Andreas Tegtmeier – Baily's beads, eclipses and the diameter of the Sun (presented by Konrad Guhl and Andreas Tegtmeier.)

The solar diameter changes or not? Whatever will be the answer the methods used for its measurements are more and more challenging, and facing new astrophysical and optical problems since the required space resolution is of astrometric quality. A quick overview on different

methods is here presented, as well as the problem of the solar limb definition, emerging after the flash spectrum during eclipses.

Konrad Guhl – Invitation to attend ESOP XXX in Berlin.

Invitation from the members of the Archenhold observatory to attend ESOP XXX in Berlin – 2011 August 26th to August 30th.

The ESOP XXX website www.astw.de/ESOP will be available from January 2011.

Discussion session – JOA

The conclusions:

Each country will have a coordinator who will collect all principal articles of interest. These articles will be sent to the European Coordinators: Pawel Maksym and Alfons Gabel. Both will contact the "country-coordinators" (in case of missing articles) or the Layouter (Michael Busse) and send him their articles.

Whenever Michael receives the necessary amount of articles for the next issue he will produce the next JOA as PDF for being placed in the Internet. The actual issue will be given only to members – older ones (> 6 months) can be offered to everybody.

All articles can be used for local issues.

IOTA should install an equivalent system: 2 American coordinators (in case 1 is ill …), country-coordinators (states?), coordinators for other countries (Australia, …?) All these articles should be sent to Michael. The first/next issue will include abstracts of ESOP XXIX. ■

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CCD Photometry of the occultation of star 2UCAC 33233154 by asteroid (511) Davida on May 7th 2010

By Vagelis Tsamis & Kyriaki Tigani

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Abstract

We present a positive CCD observation and data reduction results of the occultation of star 2UCAC 33233154 (Vmag = 13.2) by asteroid (511) Davida (Vmag = 11.5) on May 7th 2010, which we made at Ellinogermaniki Agogi Observatory, near Athens, Greece.

Figure 1 caption: CCD image of the asteroid and the star 20 minutes before the predicted time of the occultation. The asteroid is brighter than the star.

1. Introduction

In observing asteroidal occultations, the most convenient situation for the observer is that both the target star magnitude and the magnitude drop during the occultation are large enough, so that the event can be easily captured on video using sensitive low-light video cameras. In this way, GPS time inserting devices can also be used for recording the precise UT times of disappearance and reappearance of the star. In cases where the target star is faint or when the magnitude drop is small, the observer needs either a large aperture telescope (which is often not available) or another method of observation, in order to capture the event successfully. The most suitable method for capturing these faint targets – low magnitude drop events is the CCD observation. Precise photometry can then be carried out in order to reveal the parameters of the occultation event. The case of the observation of the May 7th 2010 Davida occultation, which is presented here, is such a case.

2. The Davida Event - Scientific Prediction

The prediction data we used for the observation had been published by Steve Preston on April 29th 2010 at: http://www.asteroidoccultations.com/2010_05/0507_511_23201.htm. On 2010 May 07 UT, the 326 km diameter asteroid (511) Davida was expected to occult 2UCAC 33233154, a 13.2 mag star in the constellation Virgo, for observers along a path across S Europe and SW Asia. A large part of Greece was well inside the predicted path. During the occultation the combined light of the asteroid and the star would drop by only 0.21 mag; from 11.29 to 11.5 mag (the magnitude of the asteroid). The predicted maximum duration of the occultation was 21.9 seconds, depending on the impact parameter of each observing site with respect to the asteroid's centre of figure.

3. Location and Equipment

The observation of the Davida event was made at the Ellinogermaniki Agogi School Observatory (EAO), which is located in Pallini, 15 km east of the city of Athens, with a 40 cm f/10 Meade LX200-R Schmidt Cassegrain telescope. The geographical coordinates of the EAO are: LAT 37° 59′ 52.3″ North, LON 23° 33′ 56.0″ East, ALT 162 m (from Google Earth). For CCD imaging we used an ATIK 16-HR camera, which has the following technical specifications:

Chip: Sony Chip ICX-285 AL
Resolution: 1390 x 1040 pixels (1.445.600 pixels)
Chip size:10.2mm x 8.3mm / diagonal 13.15mm
Pixel size: 6.45 x 6.45 um
Digitization: 16 BIT
Computer Port: USB 1.1, Download time max. 15 s
Cooling: Peltier cooling, (25 °C below ambient temp.)
Preview function: Only approx. 1 second download time
Protective glass: Optical glass ñ BK-7

4. Timing

Since accurate timing is very important in capturing occultation events, we synchronized our laptop computer clock with an Oregon Scientific RMB 899P DCF77 radio clock a few minutes before the predicted time for the event.

5. Method of Observation

Our purpose was to acquire enough photometric points in order to produce a well defined light curve of the occultation event. It was thus important that both the exposure time and the CCD download (read-out) time were kept as short as possible. The maximum pixel value of the target (star & asteroid) and all reference stars (Fig. 2) should lie in the linear region of the CCD detector for the differential aperture photometry measurements that would follow the observation; in our case: between 20,000 and 30,000 ADU for our 16-bit camera. In order to achieve this, we started observation one hour before the event, acquiring many CCD images for testing.

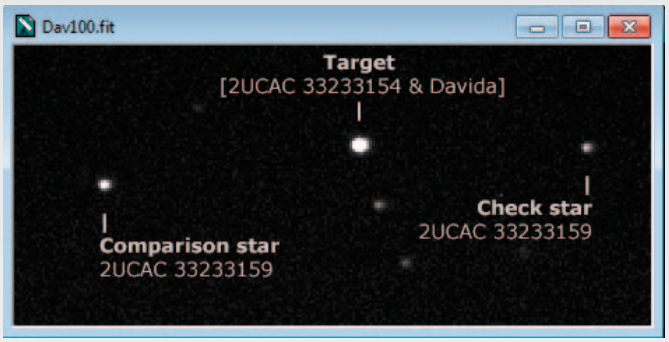


Figure 2: Choice of reference stars

Finally, we chose a high-binning mode (4x4) and used sub-framing, which proved to be an ideal solution. We took a series of 3 sec exposures, with a rate of 1 exposure every 4 seconds; read-out time was 1 second. During the actual observation we acquired 161 images. UT time of first exposure was 23:12:56 and UT time of last exposure was 23:23:53. Immediately after the observation we took dark frames. Throughout the night, atmospheric transparency and star image stability were very good. Almost no wind was blowing, temperature was about 16 ∞C.

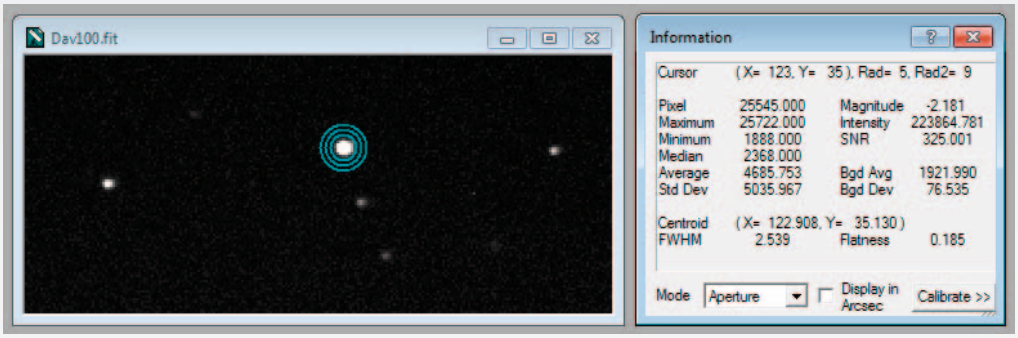


Figure 4: Some technical information about the star image and sky quality

6. Data reduction: Processing of photometric points with MaximDL, AIP4WIN and IDL software.

The images were photometrically reduced using standard techniques (Henden & Kaitchuck 1990; Howell 2006; Warner 2006). We calibrated all the images using the dark frames. Then we proceeded with photometric measurements using MaximDL software (Fig. 3). Signal to noise

Figure3: Differential aperture photometry targets

ratio of the target (star & asteroid) was above 300. Maximum pixel value of the target prior to and after the occultation was about 25,000. FWHM value was 2.6 arc seconds (Fig. 4).

For the differential aperture photometry we used two nearby stars in the field as reference stars: 2UCAC 33233159 was the comparison star and 2UCAC 33233148 was the check star. In the MaximDL aperture photometry window we set the star aperture radius to 6 pixels, the sky annulus inner radius to 8 pixels and the sky annulus outer radius to 10 pixels.

The photometry processing clearly showed that in three of the images there is a relatively small but well defined flux drop of the target, in accordance with the prediction and during the expected time of the event. Namely, these image files were: Dav104.fit, Dav105.fit and Dav106.fit (to be discussed later). This was also obvious at the light curve plot which was produced (Fig. 5 A). In order to double check these results we did another run at the observation data using slightly smaller photometric aperture radii: 5,6 & 8 pixels respectively, a method first proposed by Howell (Howell, 1953), who suggests using the minimum aperture radii possible. The results were the same. Finally, in order to verify the consistency of the results with other processing tools, we made photometric measurements with AIP4WIN software (Astronomical Image Processing for Windows, Version 2.1.10, Berry & Burnell, 2006). Again, the results were the same, indicating that in these three images the actual occultation of the star by asteroid Davida was captured.

Apostolos Christou independently processed the CCD images with Interactive Data Language (IDL) software at Armagh Observatory. The photometric light curve which was produced (Fig. 5 B) is in full accordance with the ones we produced by using MaximDL and AIP software.

7. Results

From the time stamp in the headers of the FIT files, we examined the UT times in relation to the event, as follows:

Dav103.fit - Time UT = 23:19:55 [start of exposure, no flux drop]

Dav103.fit - Time UT = 23:19:58 [end of exposure, no flux drop]

Dav104.fit - Time UT = 23:19:59 [start of exposure, flux drop]

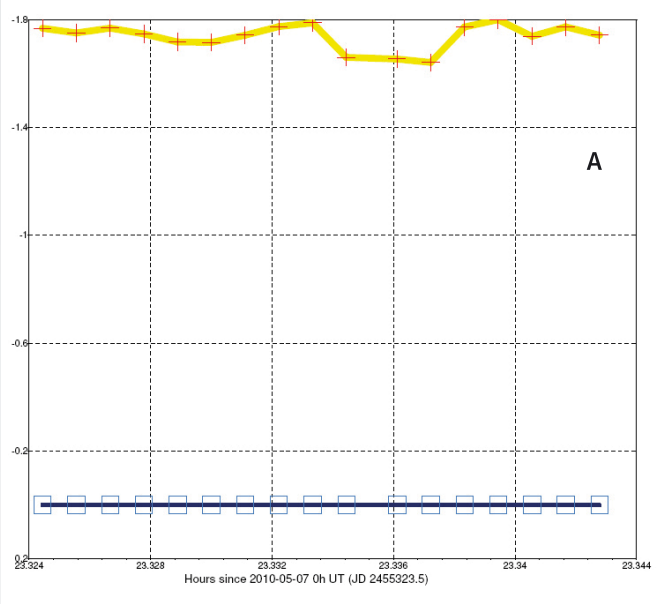
Dav105.fit - Time UT = 23:20:03 [start of exposure, flux drop]

Dav106.fit - Time UT = 23:20:08 [start of exposure, flux drop]

Dav106.fit - Time UT = 23:20:11 [end of exposure, flux drop]

Dav107.fit - Time UT = 23:20:12 [start of exposure, no flux drop]

From these times and taking into account that the CCD read-out time was 1 second, we estimate that:



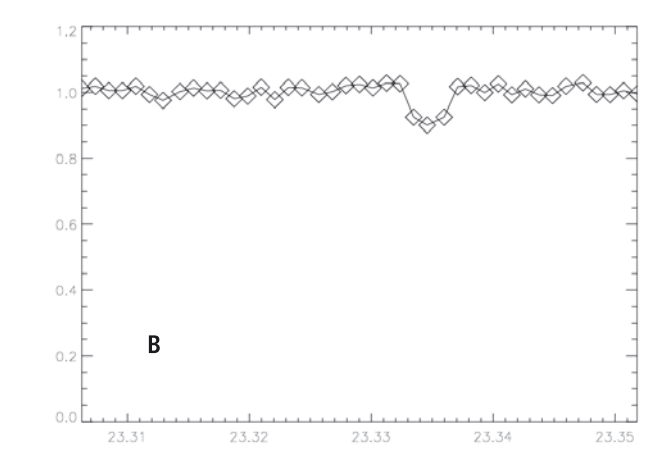


Figure 5: Light curves of the occultation event with MaximDL (A) and IDL (B). In both plots, which were independently acquired, the same set of three images shows a considerable flux drop.

■ Disappearance was at UT 23:19:58.5 +/- 0.5 seconds

■ Reappearance was at UT 23:20:11.5 +/- 0.5 seconds

■ The duration of the event was 13 seconds +/- 1 second

■ The time of mid-event was at: UT 23:20:05 +/- 0.5 seconds

Acknowledgment

We would like to thank Apostolos Christou for his valuable advice in using this observation method and for his independent reduction and analysis of the data.

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Pope Silvester II's Astronomical Observatory in Bukowiec – new occultation station in Poland

By Pawel Maksym

Pope Silvester II's Astronomical Observatory in Bukowiec – new occultation station in Poland

The Astronomical Observatory in Bukowiec came into being thanks to the idea of the creators of an Astronomy Education Programme called Become Young Copernicus.

Enthusiasts of astronomy found two great partners in Brójce Community Office and Mikolaj Kopernik Primary School in Bukowiec.

Content-related works were coordinated by The Foundation of Development and Promotion of Natural Science Galileo, established by Pawel Maksym is one of the founders of the observatory. The building is managed by Brójce Commune.

Thanks to our joint efforts, we managed to start building the observatory in 2009 – The International Year of Astronomy. The building was finished in December 2009. Completion of these works enabled telescope installation to begin late in the spring of 2010. At the opening ceremony on the 21st of May 2010 the observatory was given the name of Pope Sylvester the Second.

For the time being the observatory is equipped with two main telescopes a 10" f/4.7 Newtonian and a 10" f/10 SCT. Choice of telescope depends on the needs and application for each observer. Both telescopes are installed/assembled with the use of EQ-6 Pro SynScan German Equatorial mounts. They are placed under the SCOPEDOME dome which is compatible with the ScopeDome automatic and LAN driver USB Card. Moreover, the observatory has video CCD cameras to observe occultations. Other CCDs (from ATIK 16IC and 314) are used for photometric and astrometric observations and for general astrophotography.

Smaller telescopes, binoculars and a large amount of additional equipment is also at observers' disposal.

The Astronomical Observatory in Bukowiec is active in two main areas.

The first one is to popularize astronomy. As the originators decided, the priority is to broaden the fellowship of people who are interested in natural sciences and astronomy in particular. Not only children but also adults are taught in astronomy classes in our Observatory. Popularization is based on depicting the sky as a common element of the enviroment which should be protected from contaminations pollutions in the same way as we protect the air and water. The sky, as the element of nature, is friendly to human beings and difficulties in moving in it (the sky) are only myths.

In the observatory everyone can find out what is hidden in the mysterious shapes made by the stars on the celestial sphere. Furthermore, we show the sky has a timeless and superior value which is universal for everyone, regardless of the place we are in. In this regard, the sky remains almost the same (of course on the same hemisphere).

We always begin from the basics and concentrate on observations, thus a child and an adult will learn about how to find successive constellations. We will explain which objects on the sky are worthy to be observed with the use of binoculars and which with the telescopes. We will advise you on buying the right telescope and we will tell you what it can be used for besides observing the sky.

Now we move to the second area, which is connected with the prior question: „What can the telescope be used for besides admiring the beauty of the sky?" The answer is simple: You can use it to gain knowledge of the objects and phenomena which occur in the distant parts of the Universe. That is why the observatory has its own observational programme concentrated on observing occultations and astrometry. Photometric researches on small objects of the Solar System are also planned to be carried out. The Observatory is open to proposals and ideas of amateur astronomers, astronomy and physics students (or other related majors), and astronomers as well as everyone who would like to use our equipment to scientific aims.

Another vital area of the future which would like to be put into effect by the observatory is so-called Historical Astronomy. We care about the memory of the achievements, discoveries and their originators. We do not want them to be forgotten, but to be cultivated and studied.

The first step was to give our observatory the name of Pope Sylvester the Second – a forgotten scientist whose researches, philosophical considerations and achievements towards the United Nations were crucial and timeless. We hope that our actions will restore the memory of people who are glorious but forgotten. We would like to present the real lives of many people such as Galileo Galilei and Nicolaus Copernicus whose icons are covered with various legends which are frequently untrue and false. Historical astronomy also includes researches into earlier astronomical phenomena.

Our work is supported by Honour Scientific Committee:

Prof. Costantino Sigismondi – astronomer from Sapienza University of Rome, famous researcher of Pope Silvester II live and works and Solar Diamiter.

Dr. Michal Drahus – researcher working with Prof. David Jewitt on comets and other small Solar-System bodies on Department of Earth and Space Sciences of University of California at Los Angeles.

Janusz Wiland MSc – most famous Polish amateur astronomer, outhor of planetarium software called Astrojawil, President of Warsaw Division of Polish Association of Amateur Astronomers, member of board of Polish Association of Amateur Astronomers.

Dr. Richard Miles – Director of Asteroids and Remote Planets Section of British Astronomical Association. Keen on limiting the spread of light pollution in the UK and on encouraging observers young and old, both visual and CCD.

Our observatory is a member of International Occultation Timing Association European Section, European Asteroidal Occultation Network and EuroPlaNet – NA1/MATRIX

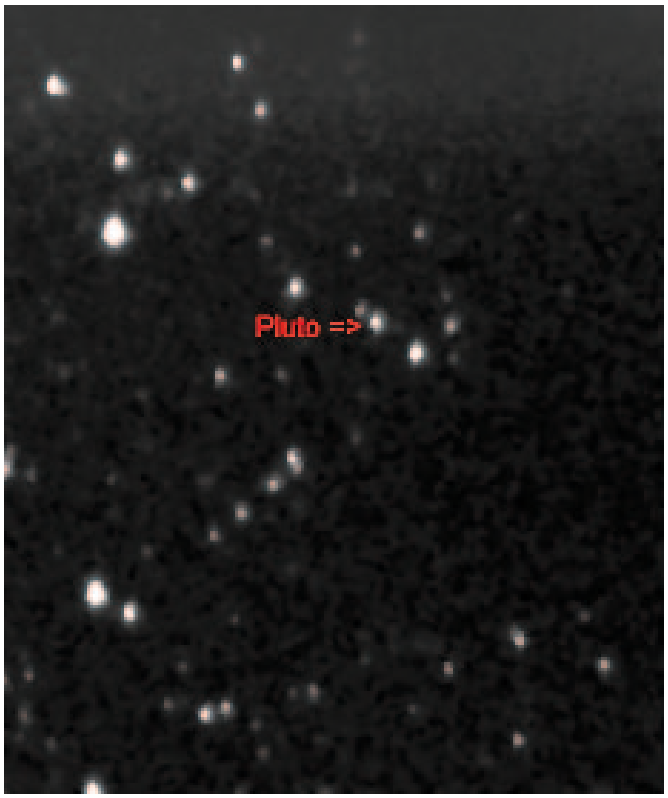
We want to invite all of us to cooperation in each fields of our interests: occultations, astrometry, popularization and other.

Pope Silvester II's Astronomical Observatory in Bukowiec

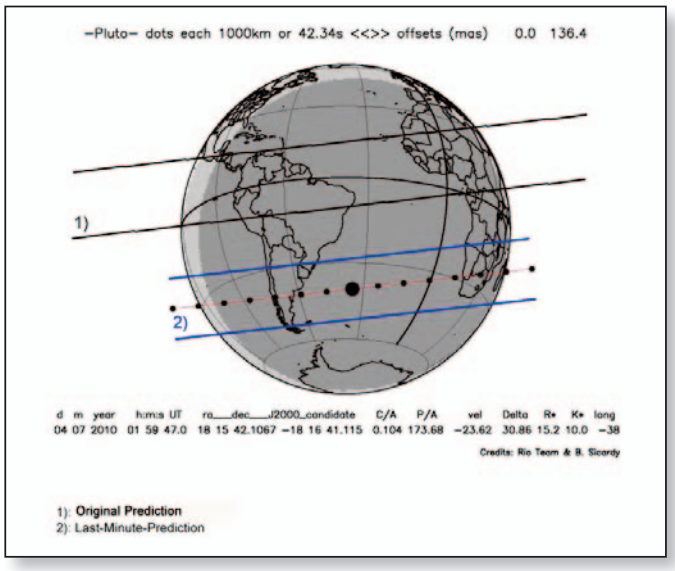
Journal for Occultation Astronomy

Pluto occults UCAC 24915755

By Hans-Joachim Bode

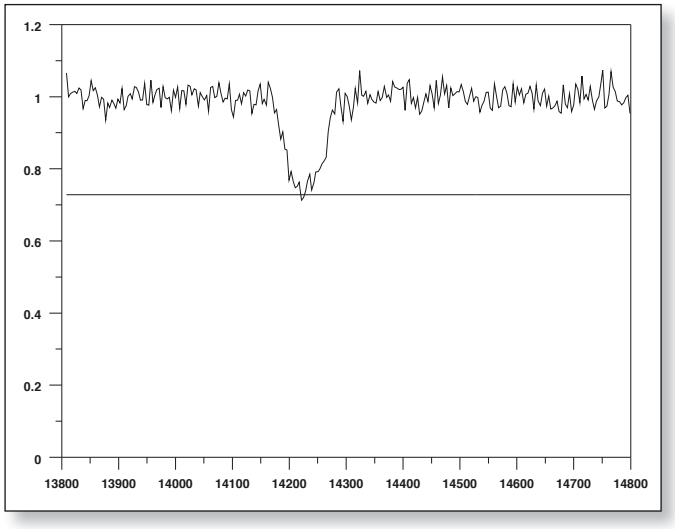


Stellar occultations by dwarf planet Pluto are of much interest throughout the next decades as Pluto on its strongly elliptical orbit increases its distance to the sun since his perihelion in 1989. Until 2030 it will be some 24 % more distant from the sun than at perihelion, resulting in only 65 % of the solar radiation on its surface compared to 1989. By means of observing stellar occultations we will be able to witness a considerable "climate experiment". Hopefully not before 2015 when the US 'New Horizons'-mission passes by Pluto, but in foreseeable time its atmosphere will probably freeze out. It mostly consists of nitrogen and some 0.5 % of methane. The pressure on Pluto's surface is in the range of 1.5 Pa and temperatures are between 40 and 45 K.



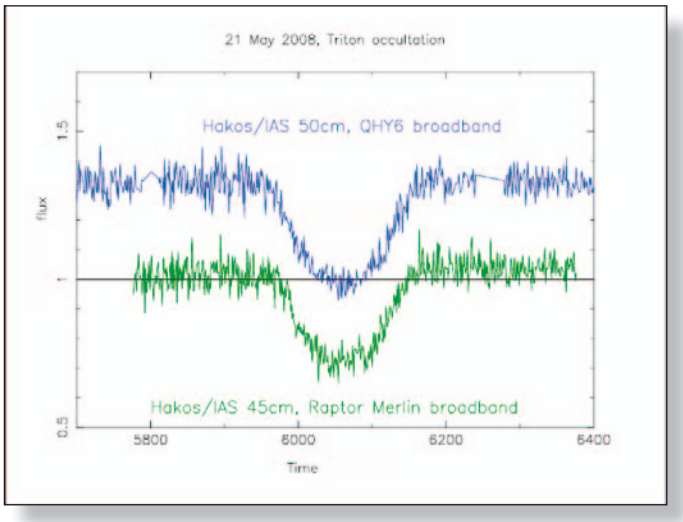
In the early morning of July 4th this year at 1h55m UT Pluto was scheduled to occult the 15th magnitude star UCAC 24915755 for about 100 seconds at most. The determination of the occultation zone a long time before the event proved to still be rather difficult. It was first predicted for Northern Africa shifting into southern Africa after some high precision measurements. Since many years there exists a co-operation between the Observatoire de Paris/Meudon and IOTA-ES forming a kind of a 'European Occultation Team'. Also for this event an observation campaign of the professional astronomers in Paris and IOTA-ES was started to organize as many observing sites as possible. The final calculations of French and Brazilian colleagues yielded a zone covering Namibia and South Africa over to Argentina, Brazil, and Chile. American astronomers calculated a zone some 1000 km further to the north.

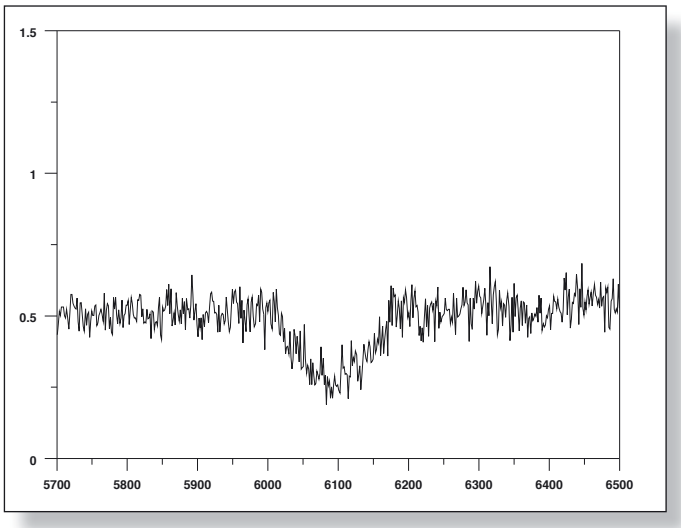
The same observing sites as in the year before were addressed and successfully asked for observing time. Thus the measurements could

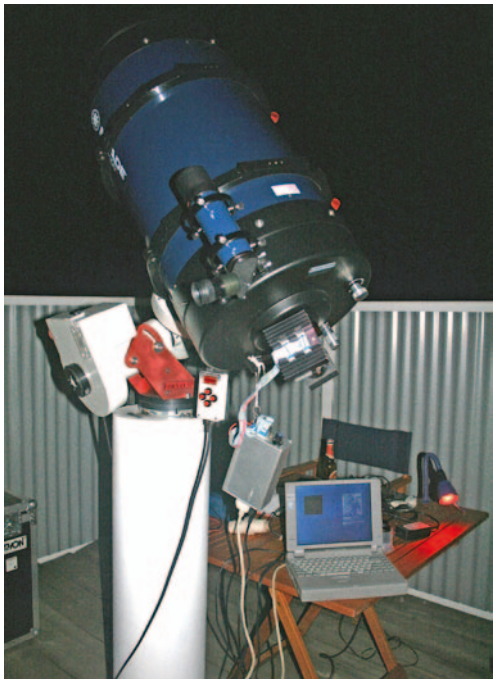


be made at the IAS at Hakos, on the Tivoli Farm, at the place of Sonja Itting-Enke in Namibia and at Springbok and Cederberg, both north of Cape Town in South Africa. Corresponding observations were supposed to take place in Brazil, Argentina, and Chile. Excluding Tivoli and Springbok all African stations were successful. In contrast to that most professional astronomers had no luck: The Brazilian observatories were just outside the occultation zone, on La Silla too much wind made the opening of the domes impossible, and in Argentina only one observer with a smaller instrument was successful.

As a first result of this joint observation it can be stated that the predictions of the French and Brazilian astronomers were more or less correct and that Pluto's atmosphere still exists. But it is yet too early to give a more precise idea about its density.







Additional remarks: Triton 2008-05-21

Hans-J. Bode

In ON Vol. 14 No. 1 January 2009 some pictures were not shown that has been done now:

Two light curves being recorded at Hakos Observatory

The light curve that has been received at Tivoli Observatory

One of Tivolis Instruments (14" Meade RC) with the IOC recording device.

Journal for Occultation Astronomy

Solar Eclipse Baily's Beads Timings Using LiMovie

By Richard Nugent

Introduction

IOTA's solar eclipse research is dependant on the successful observation and accurate reduction of Baily's Beads timings during both total and annular solar eclipses. The methods to use Baily's Beads to measure the diameter of the Sun goes back to the 1970's when Drs. David and Joan Dunham devised the technique. The technique involves stationing observers at both the north and south eclipse umbral limits. Observers at the umbral limits video record through a solar filter the portion of the Sun experiencing Baily's beads along with time information (WWV or GPS Time Insertion).

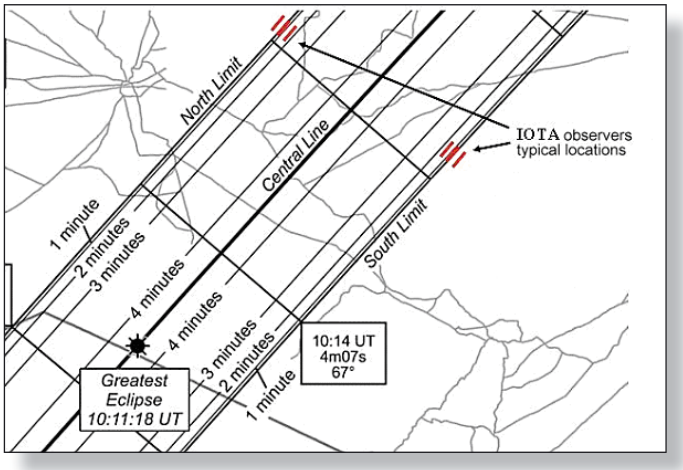


Figure 1. Baily's Beads observers will be stationed at both the north and south eclipse limits. Locations of IOTA observers not to scale.

Baily's Beads observations during an eclipse is analogous to a grazing occultation of a star by the Moon. In order to use the data in the solution for the solar radius, accurate timings of both the appearance and disappearance ("A" and "D") of beads is needed. With these accurate timings, this information is combined with the lunar limb profile to determine the exact position of the edge of the Moon's shadow on Earth (or anti-shadow with an annular eclipse). With the width of the Moon's shadow on Earth accurately known, this is used in a solution for the diameter of the Sun. The geometry of this technique is shown in Figure 2.

Early Timing Methods

Dunham's method has observers stationed at the north and south eclipse limits perpendicular to the Moon's motion as shown in Figure 1. As the Moon moves across the solar disk the lunar mountains and valleys along the limb will gradually allow beads of sunlight to shine through. If an observer sees only Baily's Beads and no totality, he would be slightly outside the Moon's umbral shadow. An observer that sees totality and some Baily's Beads would be inside the Moon's shadow in the grazing zone. From the analysis of the appearance, duration and disappearance of the beads using WWV or GPS time inserters an accurate point on the ground of the Moon's north and south shadow limits can be derived. A line of observers can establish the geographical location of the edge of the Moon's shadow to within 100 meters. This uncertainty corresponds to an error in the Sun's diameter of 0.05 arc-seconds. Early results using this technique showed a precision of better than 0.1 arc-second and although this is quite an impressive figure it was not enough to detect any changes in the Solar diameter over short time periods of under 50 years. A comparison of a historical eclipse observed in the year 1715

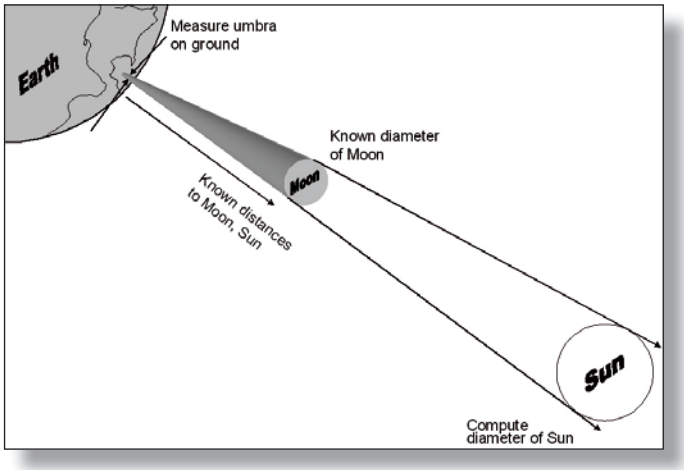


Figure 2. Geometry of the solar eclipse method to determine the Sun's radius. During an eclipse all quantities are k own in the shadow cone except the Sun's diameter, which is computed following the determination of the umbral shadow limits on the ground. Diagram not to scale.

and timed by Sir Edmund Halley (Dunham, et. al. 1980) with eclipses through the year 1979 have shown the measured change in the Sun's size to be -0.34 ± 0.2 arc-second. Dunham's colleagues Wayne Warren, Jr. Alan Fiala, Paul Maley, Richard Nugent, Hal Povenmire, (United States), Dave Herald (Australia), Patricia Rosenzweig (Venezuela), Hans Bode (Europe) and other IOTA colleagues have painstakingly traveled to some of the most remote places on Earth to collect data along the eclipse umbral shadow limits. High resolution video and improved reduction methods have improved the precision of the solar radius to 0.04 arc-second as measured at the eclipse of 29 March 2006 through Egypt and Turkey (Sigismondi 2008).

Early timing methods included the use of a movie camera to film the projection of the Sun. In the late 1970's early 1980's when 1st generation video cameras became available, the projection of the Sun was recorded along with WWV time signals. As video cameras became more advanced, they were attached directly to the telescope using solar filters.

The timing of the "A" and "D" of beads is not a simple matter. These events are gradual so the precise determination of their times is difficult. A bead will gradually appear then brighten reaching a maximum brightness then fade slowly before disappearing. Unlike the instantaneous "D" and "R" of a stellar/grazing occultation, a bead's "A" and "D' can take 20-30 seconds. Until recently, timing was done by examining the tapes visually in conjunction with the Occult program (Herald 2008). Event timings were good to 0.1 sec as determined by Sigismondi 2008.

LiMovie

With the advent of the LiMovie program released by Kazuhisa Miyashita of Japan (Miyashita 2006) to analyze occultations, it was used to test the feasibility of Baily's Bead timings.

Limovie is sensitive enough to pick up stellar magnitude changes on the order of 0.02m. This is why LiMovie light curves of asteroid and lunar occultations show significant amounts of noise and scatter. The signal LiMovie analyzes is the star's light over and above the background noise. This noise is due to the sum of the noise level of the video camera and that of the Earth's fluctuating atmosphere on the stars light. Even under steady atmospheric conditions and with high signal to noise cameras, there is still scatter in the light curve (Nugent 2007, Figure 8.13a).

The video recording of the Baily's Beads during a solar eclipse has some advantages in the signal/noise problem. The solar filter only allows the Sun's light through - leaving the remaining background atmosphere black. The beads will still fluctuate with atmospheric seeing effects, however the background area analyzed by LiMovie's aperture circles will remain at the zero light level. This allows easier identification of the light produced by Baily's Beads.

An example of this effect compared to that of a stellar occultation is shown in Figure 3. Figure 3a shows a video frame from an asteroid occultation. LiMovie's sensitivity picks up noise effects quite easily. Figure 3b shows a video frame from the recent annular eclipse of January 15, 2020. With the use of a solar filter on the telescope, the background noise level is zero.

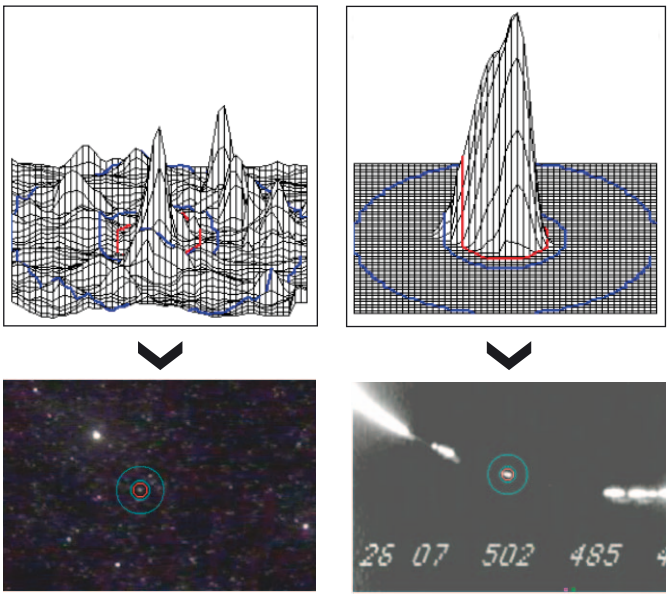


Figure 3. Limovie contour plots and their corresponding video frames. a) Asteroid occultation with image intensifier, b) Baily's Beads from annular eclipse of Jan 15, 2010. Note the corresponding area of the aperture circles from the contour plots and the video frame.

By utilizing the contour plots in a frame by frame analysis, the time of "A" and "D" of a bead can be determined to within 1 or 2 video frames.

In Figure 4a Baily's Beads are identified from the August 1, 2008 solar eclipse. Figure 4b shows the contour plots from 4 consecutive video frames along with their corresponding times in seconds taken straight off the video.

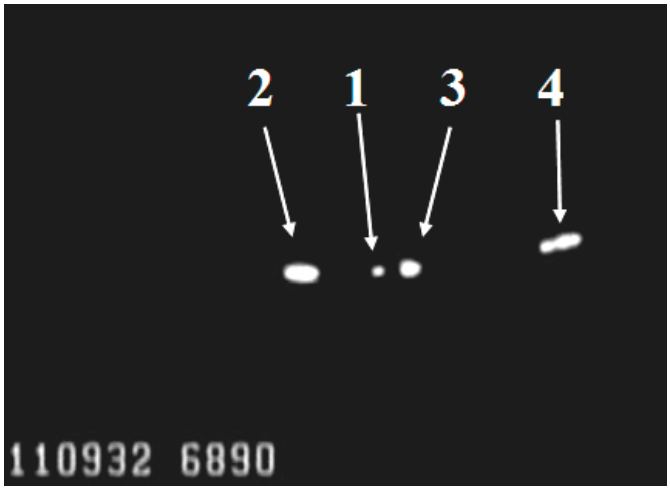


Figure 4a. Bead identification from Aug 1, 2008 eclipse. GPS time is in lower left corner.

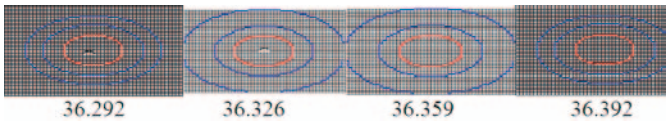


Figure 4b. Contour plots of Bead #2. Each plot is from consecutive video frames. Numbers below represent the time in seconds of the frame, incrementing by 0.033 sec.

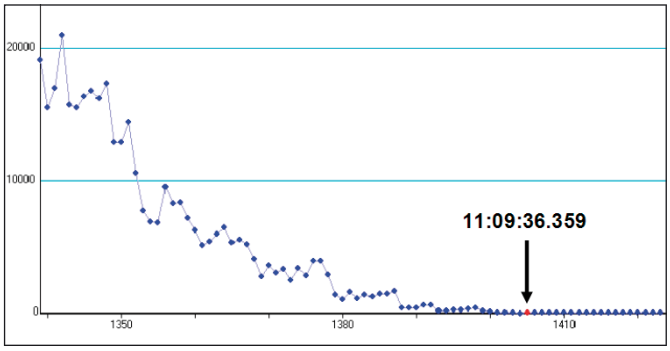


Figure 4c. Graph of light level produced by Bead #2 created by LiMovie. The peaks from Figure 4b are gradually shrinking. By the 3rd contour plot (time = 36.359 sec), the peak has disappeared and the 4th contour plot confirms this.

Figure 4c is the LiMovie graph of brightness (y-axis) vs. video frame (x-axis). As bead #2 shrinks, its brightness level drops and by frame #1405 its has vanished and the light level is zero. The remaining data points are also all at zero light level confirming the disappearance of the bead. The data point corresponding to the disappearance of Bead

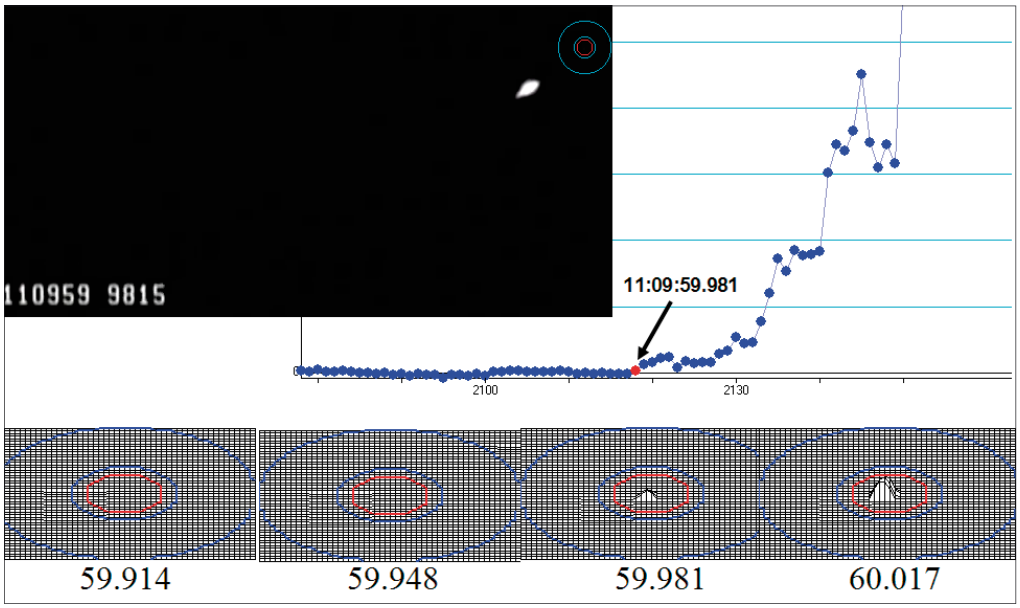


Figure 5. Appearance of a bead just after totality from the eclipse of Aug 1, 2008.

#2 is identified by the arrow and the UT time is 11h 09m 36.359sec UT read directly off the GPS time inserted video.

LiMovie's unique frame by frame playback feature allows simultaneously viewing of the video frame, the contour diagram and the point on the graph. With the "Star image (3D)" option chosen (below the data window) and the graph displayed, simply clicking on a data point from the graph turns the point red and displays the corresponding video frame and contour diagram. Continuous clicking on the "1Fr+" button advances the video and contour plot frame by frame allowing the user to watch the peak in the contour plot gradually disappear (or reappear) against a zero background level.

The appearance of a bead is analyzed in the same manner. Figure 5 illustrates the appearance of a bead just after totality from the eclipse of August 1, 2008.

As before the frames are advanced one at a time until the zero background level on the contour plot shows a peak. This represents the first appearance of a Baily's Bead. This occurred on the 3rd contour plot in Figure 5, time reading 59.981sec. The corresponding data point is shown in red and from the video the time of the event is 11h 09m 59.981sec UT. The graph in Figure 5 shows zero brightness until frame #2118 when the data points have a non-zero brightness value.

LiMovie allows investigators to determine to the nearest frame (0.03sec) the times of appearance and disappearance of Baily's Beads quite simply. Compared to earlier manual reduction methods that relied on the observer to watch over and over again a video to determine the "A' and "D" of beads, it is a three-fold improvement.

This new method has demonstrated higher systematic accuracy in Baily's Beads timings measurements during solar eclipses (Sigismondi et. al., 2009). It is being used to analyze then eclipse of 2008 and the recent eclipse of January 15, 2010.

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Journal for Occultation Astronomy

Highlights and Minutes of the 27th IOTA Annual Meeting

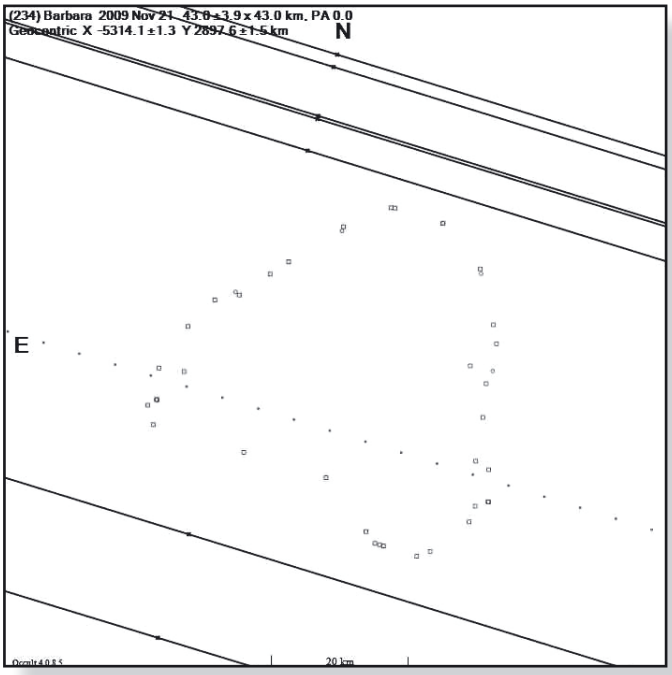
November 20-22, 2009
Orlando Science Center, University of Central Florida, Orlando Florida

by Richard Nugent, Executive Secretary

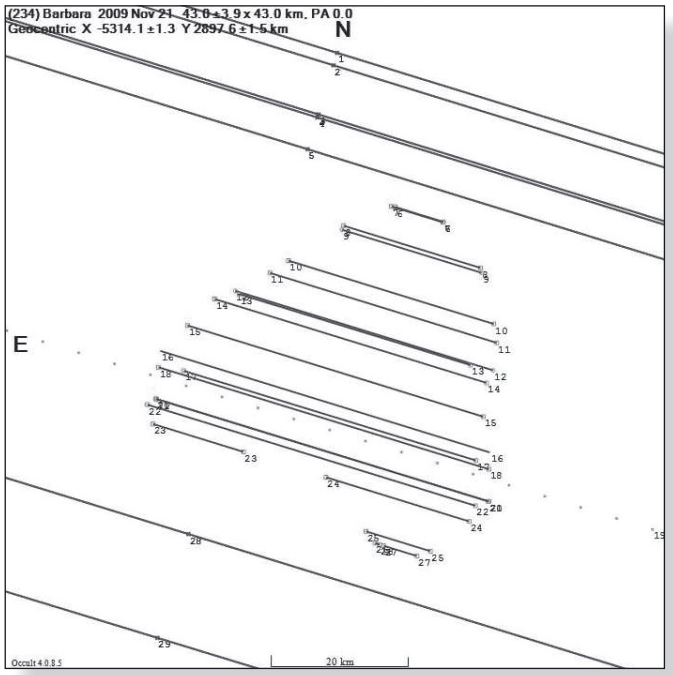
The 27th annual meeting of the International Occultation Timing Association was held Saturday-Sunday November 21-22, 2009 at the Orlando Science Center and the University of Central Florida in Orlando, Florida. This location was chosen to coincide with the asteroid occultation 234 Barbara Friday evening November 20. The Barbara event was a favorable event for North America in 2009 as it occurred at 10:38 PM EST on November 20th (3:38 UT Sep 21). Numerous positive chords were obtained and the results are posted at the asteroid occultation results page:

http://www.asteroidoccultation.com/observations/results/

234 Barbara is suspected of having a binary nature. The profile for 234 Barbara obtained taken from Brad Timerson's Results page are shown:



"D" and "R" points only



Chords only

The meeting location was kindly hosted by the Orlando Science Center on Saturday and the University of Central Florida on Sunday. A planning meeting for the 234 Barbara event was held at the University of Central Florida on Friday September 20 from 2-5 PM. The final meeting schedule, and most of the presentation files, are located as a link from Brad Timerson's North American Observations web site:

http://www.asteroidoccultation.com/observations/NA/Meeting/Presentations.htm

A total of 34 persons participated in the meeting:

President Dr. David Dunham from Maryland,
Vice-President Paul Maley from Texas,
Executive Secretary Richard Nugent from Texas,
Dr. Terrence Redding from Florida,
Scott Degenhardt from Tennessee,
Chuck Herold from Texas,
Dr. Ken Coles, from Pennsylvania,

Dr. Barbara Harris from Florida,
Dr. Roger Venable and Anna Venable from Georgia,
Hal Povenmire from Florida.
Tom and Marsha Campbell from Florida.
Mike Hoskinson from Canada,
Ernie Iverson from Texas.

Video Internet Conference Attendees: Peter Eachman, IOTA webmaster Rob Robinson, Jan Manek, Hans Heynan, Bob Sandy, Pedro Sada, Gerhard Dangl, Steve Conrad, Dave Herald, John Grismore, Dave Gault, Brad Timerson, Aart Olsen, Frank Suits, Sander Pool, Derek Breit, Chad Ellington, (IOTA Secretary/Treasurer), Dave Clark, Steve Messner and Randy Peterson.

Technical Session – Saturday morning

President Dr. David Dunham opened the meeting at 9:30 AM and welcomed everyone. Dunham then asked the attendees to introduce themselves. He thanked the Orlando Science Center and the University of Central Florida for allowing us to host the meeting at their facilities (even though no one from these organizations showed up). A few minutes was spent by the Florida attendees summarizing results from their 234 Barbara stations. Among those with multiple stations were Scotty Degenhardt – 8 stations, Paul Maley – 5 stations, Roger Venable – 4 stations, David Dunham – 4 stations, Terry Redding – 3 stations, Richard Nugent – 3 stations, Tom Campbell – 2 stations.

Vice President Paul Maley described his international outreach efforts involving bright star asteroid occultation events in foreign countries. Maley has traveled to different countries where these events occur pursuing IOTA's objectives – to recruit, inform, educate and expand occultation knowledge with hands on experience to amateur astronomers. He showed photos and described two recent expeditions. Maley traveled to Herce Govina in Bosnia for the 1041 Asta occultation on June 6, 2008. He showed photos of the Sarajevo Observatory's 8-meter dome which originally housed a 40-cm Cassegrain reflector. These were destroyed the recent war conflict. They have since replaced it with a 10" Meade LX-200. For the Asta event 3 sites were set up with Physics teachers and some of their students. There was a 100% forecast for thunderstorms, and luckily the sky cleared, but due to the high humidity, the cameras at all 3 stations failed.

The 2nd event was 96 Aegle across Europe on September 8, 2009 again with 3 teams of observers set up. Unfortunately overcast skies foiled the event. Maley then described IOTA's upcoming effort for the annular solar eclipse on January 15, 2010 in Uganda, Africa. As part of IOTA's long term study to measure possible solar radius variations, plans call to have 2 stations set up at the north eclipse limit collaborating with IOTA-ES with 2 stations at the southern limit.

The next total solar eclipse occurs on July 11, 2010, however the entire path crosses the southern Pacific Ocean with no landfall at either north or south eclipse limits. Maley's planned expedition is to Tahiti to observe near the center line. In 2011 there are 4 partial solar eclipses, thus no IOTA research can be done with these. The next favorable annular eclipse occurs on May 20, 2012 with the path going over China, Japan, the Pacific Ocean and ending up over the western and central United States.

Dave Herald mentioned that the Japanese satellite Kaguya's high resolution topographic data of the Moon was recently released and has been incorporated into the Occult program. This ten-fold improvement over the outdated Watts data will allow refinement of the existing lunar limb profile dataset for IOTA's solar eclipse research and will be used for future eclipses.

The Kaguya-Selene satellite was launched by the Japanese Aerospace Exploration Agency (JAXA) on September 14, 2007 from Japan's Tanegashima Space Center. Among it various instruments on board was a laser altimeter to measure the topography of the Moon from a 100 km circular 90° inclined orbit. Two other sub-satellites of Kaguya were at highly elliptical orbits; the Relay satellite at 100 x 2400 km orbit and the VRAD satellite at 100 x 800 km orbit.

Maley described plans for the bright star asteroid event for 148 Gallia over the Philippines on September 30, 2010. The target star is ε Hya, m = 3.1. At event time, the altitude of the star will be 29° and it occurs in the early morning hours allowing plenty of time to set up remote video stations. Maley is working with the Philippine Astronomical Society in preparation for this event. Dave Herald mentioned that there are slightly different positions for this star from the Tycho and Hipparcos catalogues due to different proper motions used. And this will be true of many bright stars compared from these two catalogues.

A problem with bright star occultation events is the position of the star determined from the Hipparcos and Tycho catalogues. Very bright stars saturated the satellite's scanning sensors making it difficult to determine the centroid of the star for determining an accurate positional solution. This was also the case back in the era when photographic glass plates were used for astrometry. Large overexposed images caused problems in locating the centroid of the image on the plate's emulsion. It was mentioned that new images of the star and asteroid might be obtained with the United States Naval Observatory's (USNO) 61-inch astrometric reflector within a month prior to the event.

Maley next discussed funding issues with IOTA. This has been a long standing problem for IOTA and its research. Although IOTA Officers and members have requested funding from numerous sources over the years only rarely in IOTA's history has there been funding for any expeditions and/or equipment. He is currently communicating with Bill Merline of the Southwest Research Institute (SWRI) in Colorado. Merline is currently researching asteroid satellites and understands that multiple remote stations seem to be one of the best methods of catching an asteroid satellite. This could lead to possible funding of IOTA's asteroid occultation events through SWRI. This promising potential funding source was largely due to Scotty Degenhardt's revolution in multiple "Mighty-Mini" stations and success with the 135 Hertha event on December 11, 2008. Merline also recognized the spectacular occultation observation of an asteroidal satellite made by Japanese observers on November 7, 2007 of the M-Class main belt asteroid 22 Kalliope. This result was published in Sky and Telescope magazine in the February 2007 issue. Degenhardt's success with 135 Hertha was on December 11, 2008 in which he obtained 14 of the 23 chords. This asteroid profile was published in Sky and Telescope in the November 2009 issue.

Maley proposes that IOTA identify high probability asteroidal satellite targets over the USA only. If funded, IOTA's status would be as an

independent contractor meaning money would only be dished out per event. We would need good path coverage and RESULTS ! Plain and simple: No results = no more funding. He suggested IOTA pick 3 events for SWRI that we can produce good results. Possible 2010 candidate events are: 96 Aegle October 29 (target star m = 9.7) and 375 Ursula December 4 (target star m = 10.0). As mentioned previously 148 Gallia is outside the USA, but is certainly a bright star event that cannot be ignored even if not funded.

Dunham mentioned that funding was available in the 1970's for the University of Arizona and Lowell Observatory. They used Celestron 14's and other large telescopes plus expensive photometric equipment. There was a lack of results and hence a lack of interest with funding.

Next, Paul Maley presented an overview of the tax benefits of occultation expeditions for United States observers. This presentation was to inform USA observers of new tax reporting requirements associated with work done for non profit 501c corporations such as IOTA. As an example, if one makes an international trip for a solar eclipse to do IOTA research and stays for 1 week, the entire week's expenses cannot be deducted. Only those expenses related to the eclipse research are allowed. Sightseeing expenses on other days is not allowed to be deducted. Airfare, taxi and travel costs surrounding the eclipse event which means hotel and meals the day before and the day of the eclipse only would be allowed because these are vital for making the observations.

There are expenses in the "maybe" category which are possibly allowed deductions. Examples would be equipment costs as long as it was vital to the observations being made, batteries, cables video camera, phone (for collaborating with other team members), internet access (for checking weather) and copies (charts, maps, etc.).

A new IRS record keeping rule went into effect August 17, 2006 regarding contributions to non profit organizations. It requires the donor to obtain and keep a bank record or a written communication from the recipient as a record of the contribution. Written records prepared by the donor (such as check registers or personal notations) are no longer sufficient to support charitable contributions.

Also for donations of $250 or more to IOTA, the donor must have proof (cancelled check, money order, wire transfer, etc. or appraisal for equipment donations greater than $5,000) and the recipient must send acknowledgement to you. For claimed non-cash contributions over $5,000, generally a qualified appraisal prepared by a qualified appraiser must be obtained. For appraisals prepared in connection with returns or submissions filed after August 17, 2006, see IRS Notice 2006-96.

It is important that persons take note that IOTA is not in the business of providing legal or other professional advice in regard to tax expenses applied to occultation activities. When in doubt about allowed expenses consult a competent accountant or CPA. Each person is responsible for their tax reporting and its accuracy. The IOTA Manual Section 2.2.1 (page 25) has a brief summary of expenses involved with occultation activities.

Maley's presentation (along with the others at the meeting) is on Brad Timerson's IOTA 2009 Presentation website link stated above. If you are planning to make a contribution to IOTA North America, contact one of IOTA's Officers and they will assist you.

Dave Herald then called for a panel discussion in reference to publication of results. Although IOTA and it's sister organizations maintain webpages with up to date results, the information about occultation activities and discoveries does not seem to reach the community of professional astronomers such as the USNO. In regard to double star results, such as new discoveries, or confirmation of suspected double stars, Herald suggested that we publish the results quickly. Currently IOTA has a poor record for delivery of double star information and discovery. A recent publication was a paper co-authored by Dave Herald and Bob Sandy in the October 2009 issue in the Journal for Double Star Observations (JDSO). In this paper Sandy and Herald reported the discovery of a new double star made and confirmed by video. Such double star papers will obviously require light curves to prove the discovery as visual observations don't carry much weight these days. Another recent publication example is Brad Timerson's paper in the Minor Planet Bulletin (MPB) in from the July-August 2009 issue along with 15 co-authors of 3 important recent asteroid profiles from occultations. MPB would like to see consolidated results of occultation observations with 5-6 or more chords. These two papers create a template (agreed format) for future papers.

Scott Degenhardt presented his method of broadcasting occultation observations from his laptop from his car. Degenhardt uses a Supercircuits camera mounted in his car to monitor his activities prior to the occultation event. This include the assembly of Mighty Mini's and other components for setting up a station. The transmission is done via a broadband connection through his laptop which is also mounted in his front seat. During the 234 Barbara occultation he had a viewer from Athens, Greece. The maximum # of viewers he has had is 70. This important method advertises IOTA and its real time activities worldwide for free.

Lunch break 12 - 1 PM

Business Meeting 1 PM

IOTA Secretary/Treasurer Chad Ellington presented the income and expense report. A summary of the year's bank balances are:

Starting Balance:	$6,648.48	2008, August 19
Ending Balance:	$6,753.66	2009, November 20
Net Increase in Balance:		$105.18

The net increase in balance is due to the lack of publishing the Occultation Newsletter (ON) which accounts for the bulk of printing costs. In the past few years the publication rate of ON is way behind, sometimes only 1 issue is published per year. This represents an embarrassment for IOTA, as some Library subscribers has asked where are the 4 issues/year that they pay for. The question is does IOTA really need to continue with ON ? Most of IOTA information including articles, discussions (IOTA listserver) and results are now on the Internet. Dunham raised the fact that ON has IOTA's history. It was agreed that ON needs to continue, possibly with a new format. The other issue is that if ON had a steady stream of articles it would be in competition with MPB which has a larger readership and has 50-100 pages per issue. All members need to consider contributing articles on any aspect of occultation science as the ON Editor has a lack of material for publishing.

Ellington went on to explain that he Occult program was used for the first time this year for graze predictions. Dave Herald has now incorporated the Kaguya data into Occult's limb profile database.

This year's presentation of the annual Homer F. Daboll Award was made by the Award Committee Chair Dr. Terrence Redding. The Homer Daboll award is given annually to an individual in recognition of significant contributions to Occultation Science. "Occultation Science" is limited to actual IOTA research: total and grazing occultations, asteroid occultations and solar eclipses.

Homer F. DaBoll had a long history with IOTA until his death on March 10, 1990. DaBoll was born on May 22, 1920. He led numerous grazing occultation expeditions in the Chicago area spanning 3 decades, from the 1960's to 1990. He was the first ever editor of Occultation Newsletter for 16 years from its first issue in 1974 thru early 1990 when health reasons forced him to pass on the Editorial duties to Joan Dunham. DaBoll was the person who came up with the acronym IOTA, International Occultation Timing Association. Members of IOTA have always held Homer DaBoll in the highest regard for his numerous contributions to occultation observations, expeditions, ON, and his many other volunteer efforts.

This year's committee received nominations from nine persons for the award, six of the nominations were the same person. The Committee's main objective in selecting an award recipient was to reach a consensus and not choosing someone by a majority vote. The rules allow any person to be considered for the award except for current IOTA Officers and Committee members.

The 2009 Homer F. Daboll award recipient was Steve Preston from Seattle, Washington for his dedicated contributions in the prediction of asteroid occultations worldwide. Preston's webpage, www.asteroidoccultation.com is the standard source for prediction of asteroid occultations used by nearly all occultation observers worldwide. Dunham called Steve on his cell phone at the time of the announcement and Steve offered a hearty "Thanks You" for the award.

2010 Elections – Dunham mentioned that in regard to next year's elections, IOTA could use some new blood, and possibly a Board of Directors that can oversee a variety of IOTA activities. Terry Redding mentioned that we could amend IOTA's by-laws to create a Board of Directors. The only problem is finding the by-laws. Paul Maley said he thinks he has a copy but it's been since 1983 when IOTA was incorporated in Texas that he last saw them. Roger Venable mentioned that IOTA officers could rotate their respective positions as does the Association of Lunar and Planetary Observers (ALPO).

With no further business Executive Secretary Richard Nugent Motioned that he business meeting be closed. Terry Redding seconded the Motion, and the Business Meeting ended at 3 PM.

Technical Session – Saturday afternoon

Several double star discoveries were made during asteroid occultation observations. Recent ones mentioned were 336 Lacadiera and 790 Pretoria. Dr. Roger Venable believes the Pretoria results might indicate a double-double (quadruple) star system. Scotty Degenhardt suggested that any double star discovery should be reviewed by a 3rd party prior to any type of publication. This review would include review of the video(s) and the light curves. This would be in addition to the regular referee process journals use.

David Dunham presented a brief review of remote station observing. The first ever successful remote video station event was that of 9 Metis on September 7, 2001. Twenty-six (26) additional remote video station asteroid events were done through February 10, 2008, most of these involving just 2-4 stations set up by a single observer. Several IOTA members have improved on and polished the technique including Dr. Roger Venable, David Dunham, Dave Gault, Steve Preston and Scotty Degenhardt. Scotty Degenhardt showed a graph of observed remote stations from the years 2000-2009.

Following a short break David Dunham listed some favorable remaining grazes and asteroid events for the year 2009. They are:

Graze Events 2009

December 7, 2009, 14 Leo, m = +3.5, 69% Moon

December 31, 2009 – during this total lunar eclipse – there are no grazes

Asteroid Events 2009

706 Hirundo	11-30-09, m = +11.2
120 Elektra	12- 1-09, m = +9.4, 182 km path width over Canada
423 Diotima	12- 6-09, m = +11.4
234 Barbara	12-14-09, m = +11.7
216 Kleopatra	12-24-09, m = +11.7 (m = +10.2 red light)
324 Bamberga	12-24-09, m = +11.9
81 Terpsichore	12-25-09, m = +8.5

From the Royal Astronomical Society of Canada's Handbook a few notable events occur in 2010:

Antares - graze is on January 11 by the 13% early morning crescent Moon. Graze line is northern Canada and Greenland. This is the last graze of Antares in the current series. The next graze of Antares will be in 2023.

Merope – March 21, 2010. This is the last graze of this Pleiades star until 2023.

Dr. Terrence Redding presented a talk on "How Amateur Astronomers Learn". This was a study Dr. Redding did based on a survey of 213 amateur astronomers. In deciding why to do such a survey, Dr. Redding knew that amateur astronomers have unique characteristics not associated with any other group of unpaid scientists:

1. They are members of the oldest science
2. As a group they demonstrate high persistent learning across a lifetime

3. As amateurs, they love learning, are not paid for their learning efforts

4. As a group they are recognized for their ability to contribute new knowledge, skills, and discoveries in their field of study

He mentioned that most astronomers got started from some unique event they either experienced first hand or heard about, such as first view through a telescope, first solar/ lunar eclipse, first visit to a planetarium, etc. He showed charts from his survey showing various statistics of amateur astronomers:

1. Ethnic background: 91.8% were Caucasian, the remaining 8.2% were Black, Hispanic and Asian

2. Males (91.6%) outnumber the females (8.4%)

3. Highest level of education: 60% had 4-year college degrees including 22.8% with graduate degrees and 12.9% with Ph.D's. Only 3.5% never attended or didn't finish high school.

4. 89.4% were self learners compared to 11.6% learned in a group

5. Encouragement to study astronomy: 83.1% through oneself and 40.2% through magazines. Other sources of encouragement were; 25.4% - family, 22.8% - clubs, 18% - libraries, 12.7% school and 7.4% - Museums

6. Place where you engage in the hobby: Outdoors 47.9%, Personal observatory 28.7%, home office 17.6%, family room and kitchen 2.1% and garage 1.6%

The numbers clearly show that amateur astronomers are largely a self taught group of highly educated individuals. Redding gave two examples of famous self taught scientists. Sir William Gilbert was born in 1544. He studied magnetism and his research and findings stood for 200 years. He devised the modern scientific method and the textbook. Galileo Galilie was born in 1564. His father was a musician and Galileo was home schooled. He studied to be a priest and failed to graduate. He became a professor of mathematics by age 26. He struggled with money and saw the telescope as a way to gain financial success. His discoveries were tempered by the Church. Galileo was a highly self-directed individual.

Scotty Degenhardt demonstrated his method of using programmable remotes for his unattended video stations. One of the main problems with multi station setup for an event is the amount of tape (or capacity on SD memory cards) available to record on a particular digital video recorder (DVR). For example, with 2-hours of recording time (even with a 5-hour battery) you are limited to starting the tape just under 2 hours prior to the event time. So the question is how many additional stations can you set up during this 2-hour window prior to the event? Station setup can be complicated - setting up the tripod and video camera, pre-pointing to the target area of the sky, GPS time stamping the video, etc.

Scotty solves the problem of DVR's limited recording capacity by using the "Sony Integrated Remote Commander RM-AV3000" programmable remote. He uses one remote per video station. These remotes are connected to the DVR. These units are programmed to signal the start time and the end time to the DVR. Thus only 5-10 minutes of tape are used. With a 5-hour battery, many more remote stations can be setup by a single observer increasing coverage. Scotty also recommended the use of an exercise mat when setting up stations. Since much time is spent on your knees setting up the tripod, video camera, DVR, GPS time stamping etc., increased comfort allows you to move quickly at each station.

Frank Suits presented the talk, "USB Video Cameras" in which he promoted the use of current USB cameras for occultation timings. By USB camera, he meant any digital camera that records directly to a personal computer. In order it to be video it must autonomously generate a series of frames at a steady pace driven by its own clock – i.e. no handshaking with or waiting on the receiving device. This is crucial for occultation timings.

The emergence of low cost USB cameras on the market provides a means of recording video directly into a computer's hard disk. This has the advantages of digital readout, control over exposure/gain, arbitrary frame rates, binning, cropping, more than 8-bit output and no analog transmission or raster conversion. A few problems exist with them for occultation timings: They are harder to timestamp and the recordings can sometimes suffer from dropped frames depending on the PC/hard drive speed. Suits has devised a method to time stamp video with a small device that projects an LED illuminated spot onto the camera. The spot follows a ramped triangle wave pattern precisely synchronized to the GPS 1 pulse-per-second (1pps) signal using a microcontroller circuit Suits designed and built himself with materials costing less than $60.

Another issue with the ramped LED spot is identifying, "Which second is it ?" The video capture software records the PC time for each video frame, giving the nearest second, which is then combined with the light spot signal to give the full time at the millisecond level. He suggested also manually blinking the light at the 59 second marker to identify the minute. Simpler approaches to optical time stamping are possible just by placing a flashing LED at the front of the telescope, but that illuminates the entire camera field. Suits's presentation is located on Brad Timerson's website.

The meeting adjourned at 5:00 PM and several attendees met for dinner later that evening at a local restaurant.

Sunday, November 22, 9:50 AM. Technical Sessions continue

Dave Herald discussed recent developments in the lunar occultation database and reporting. In 2008 IOTA took over the task of collecting lunar occultation observations from Japan's ILOC (after 27 years of service to the occultation community) which closed due to lack of funding. This conversion has gone fairly smoothly, as there are now 7 Regional Coordinators (see the IOTA Manual Appendix F.1). The meeting attendees held the regional coordinators and others who made this smooth transition possible in the highest regards or their hardworking and dedicated efforts. He reported there are now some 3190 grazing occultation observations in the database and these will be submitted to the Astrophysical Data System (ADS) when the format revision is complete. This will place the 45+ years of grazing occultation data online with all other astronomy databases.

Herald then re-emphasized the situation with regard to double stars. Discovery claims by occultation persons rarely reaches the professional double star community. He stressed the need for the occultation com-

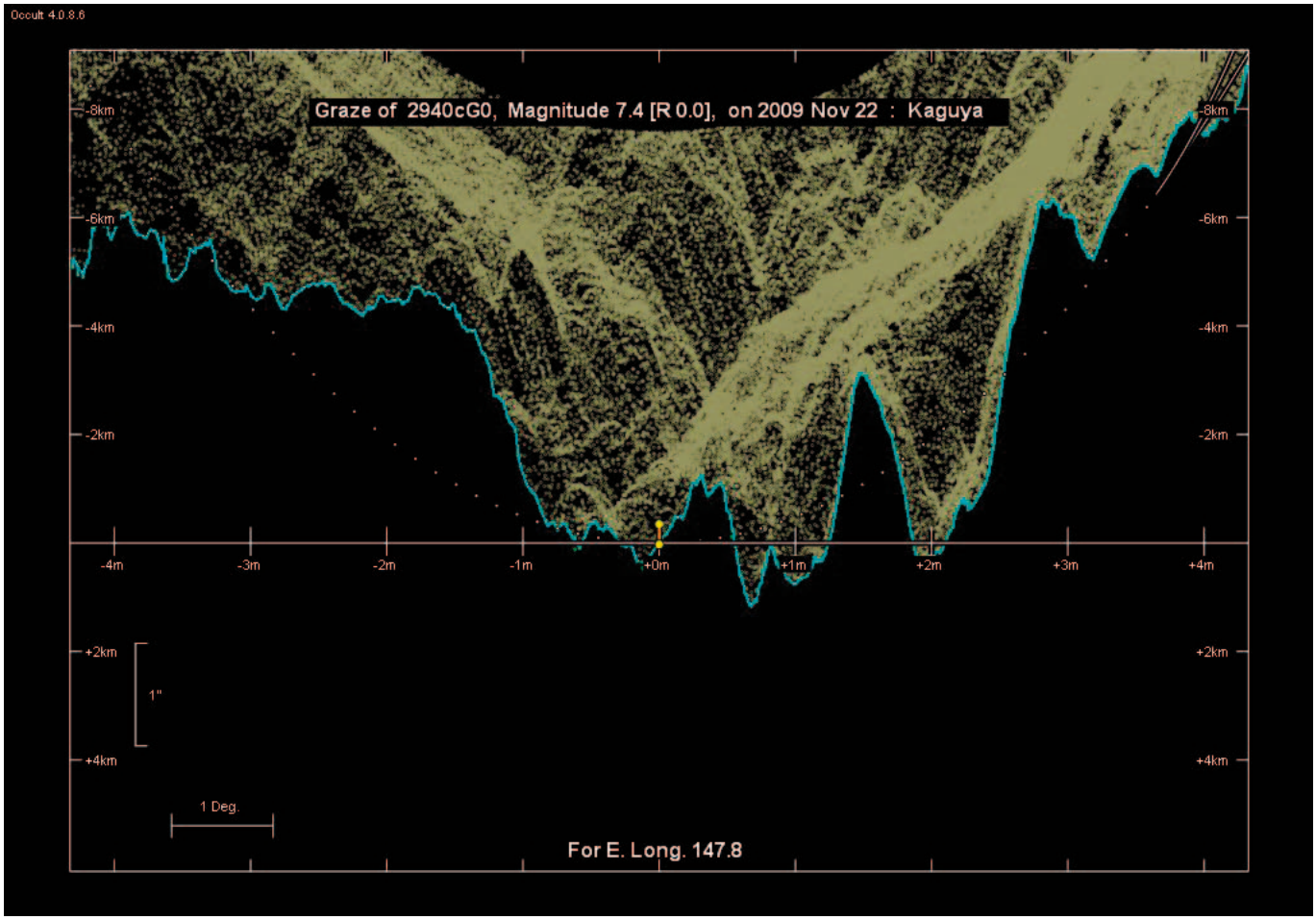
munity to publish results rapidly. The double star report cycle is as follows:

From asteroid discoveries:	to your regional coordinator
From Lunar occultations:	to Brian Loader (New Zealand)
Publish papers:	to the JDSO with authorship
USNO:	picks up information from the JDSO
Occult program:	data is periodically updated from USNO

The two recent papers published in 2009 by Brad Timerson in MPB (three recent asteroid occultations) and by Bob Sandy and Dave Herald in JDSO (confirmation of an existing double star using video) as mentioned earlier set the templates for future publications. He again stated that publication of results is crucial while the "irons are hot" and not to delay. Double star papers need to have the light curves published for credibility.

Herald has also updated the Occult program to include an alert message for double stars with separations < 2". And it will include double star details in graze predictions.

Herald has taken the Kaguya's lunar altimeter data and converted it into limb profiles in the Occult program's database. This high accuracy data now supercedes the older outdated Watts data. Its fit with past grazes is excellent, only occasionally do the grazes have inconsistencies. He showed an example of a recent graze plotted with the Kaguya data. The graze was on March 22, 2009 with lunar libration angles of l=-2.87° , b = +1.19°. The graze observations were in excellent agreement with the Kaguya data as shown on the Occult profile plot:



Lunar limb profile using new Kaguya laser altimeter data

Roger Venable asked if the Kaguya data would help with the solar eclipse reductions, Dunham answered that it probably will, the Europeans are now working with this data with their eclipse observations.

One of the principle investigators (PI) for the Kaguya mission was Dr. Mitsuro Soma of Japan. This allowed IOTA access of the catalog of laser altimeter measurements prior to their being released. The Kaguya satellite was in a 90° inclined polar orbit around the Moon thus there are numerous more passes at the lunar poles that at the equatorial regions. This provided coverage not only of altitudes of lunar mountains and terrain but also along their slopes. This huge dataset is visible in the Occult programs plots showing the 3-dimensionsal profile of the lunar limb.

David Dunham briefly discussed the current status of IOTA's solar eclipse research. A research grant he had obtained a few years ago jointly with Drs. Sabatino Sofia (Yale University) and Wayne Warren was extended. Dunham and Sofia had recruited high school students to assist with the Baily's Beads data reduction. The data reduction of Baily's Beads timings is difficult to do visually since the "D and "R" of the Beads are not instantaneous as in stellar occultations, rather they are gradual. In 2008, Richard Nugent proposed and demonstrated a new method to reduce the Bead timings using LiMovie. The appearance and disappearance of a bead can now be determined to within 1 or 2 video frames allowing for high precision timings. Dunham remarked that a paper was published this year in the journal Solar Physics on the August 1, 2008 eclipse over China summarizing the Baily's Beads effort by IOTA and IOTA-ES observing teams. The paper had 27 authors in Europe and the USA, including IOTA's North American astronomers D. Dunham, R. Nugent, C. Herold, W. Warren, M. Patel and D. Schwartz. In that paper, 598 data points were obtained by 23 observers at 28 stations at both the north and south eclipse umbral limits. Dunham is currently working on analyzing the recent 2006-2008 eclipses and hopes to have a summary paper on the results published shortly.

David Dunham showed a power point presentation given by Detlef Kochny of the European Space Agency's (ESA) Solar System Mission Division. The original presentation was made at ESA's Malta Symposium on Hazardous Near Earth Asteroids October 12-16, 2009. The presentation was on the relevance of asteroid occultation measurements and their possible use for the study of NEO's (Near Earth Objects) and KBO's (Kuiper Belt Objects). The presentation covered many of the facts and aspects already known to IOTA about the prediction, observation and data reduction of asteroid occultations. A main point in the presentation was that successful occultations can produce astrometric position of asteroids accuracies of 0.001" - 0.002" relative to the target star. With the upcoming launch of ESA'a Gaia astrometry mission (currently scheduled for 2011), stellar positions are expected to be improved down to the 20 μas (20 micro-arc seconds, 0.000020") range for some 1 billion objects. This represents approximately 1% of the Milky Way's population.

At 12:20, a 1 hour lunch break was taken.

Dr. Ken Coles/Dave Gault authored a presentation updating the status of archiving and extracting data from older graze reports from the 1960's and 1970's. They volunteered to scan these older reports and to place the data into a useable format for Occult and other programs. One such report examined by Dave Gault was a graze done using the USNO's 12" refractor. In plotting the graze observations it showed poor correlation with the Watts Data. In an email to Dave Gault, Dunham had mentioned that the 12" telescope was moved since 1964 when the original observation was made. In researching the position of the telescope, and then re-plotting the graze data using the new Kaguya limb profile showed excellent agreement. There are still many missing older graze reports from the 1960's and 1970's. Gault and Dave Herald had made a request recently on the IOTA listserver requesting that observers check the current graze database for the inclusion of their reports. If any occultation observer has a record of an observation that is not in the database, they are requested to forward the reports to Dr. Ken Coles and Dave Gault.

David Dunham presented some history of IOTA members that have made valuable contributions to Occultation Science over the years that passed away in 2009.

Dr. Tom Van Flandern 1940-2009 worked at the USNO for 21 years and was Chief of the Celestial Mechanics Branch of the Nautical Almanac Office. He published several dozen papers in the fields of analyzing graze data, improving the lunar ephemeris using occultation observations, celestial mechanics and edge observation from solar eclipses. He obtained his PhD in 1969 from Yale University, with a dissertation involving lunar occultation of stars by the Moon. Van Flandern helped establish the basic infrastructure of IOTA, he helped with predictions, and solar eclipse edge observations. His last eclipse was December 4, 2002. Van Flandern had started the controversial Meta Research organization in the 1980's. He had some drastic new ideas (some have called these ideas radical) about the nature of gravity, light bending, the origin of the Moon, planets, planetary satellites, comets and a host of other celestial phenomena. He published many of his ideas the 1993 book "Dark Matter, Missing Planets & New Comets, Paradoxes Resolved, Origins Illuminated", when Van Flandern introduced me after we were married to Joan Bixby in 1970.

Emil Volcheck 1930-2009. Dr. Volcheck earned his PhD in Organic Chemistry from the University of California at Berkeley in 1955. He actively pursued astronomy and computers as hobbies. His interest in astronomy began in high school when he made his first telescope. He was active in the Delaware Astronomical Society (DAS) starting in 1958 and served in several Offices including its President. It was at a DAS star party that he met and married his wife Diana. While he was in the Richmond, VA area in the late 1970's and early 1980's he led several grazing occultation expeditions in the DC area. He was the director of Mt. Cuba Observatory in Delaware, and helped arranged the IOTA meeting which was held there in September 2006.

Clifford Bader 1934-2009. Cliff helped organize graze expeditions in the Philadelphia area and was a graze computor for the Mid-Atlantic region. Cliff attended the IOTA meeting at Mt. Cuba Observatory in 2006.

Dunham next listed some of the important asteroid occultation events over the USA for 2010:

139 Juewa	Jan 8, 2010	m = 10.0
1248 Jugurtha	Feb 3, 2010	m = 5.9
88 Thisbee	Mar 2, 2010	m = 9.6
598 Octavia	Mar 9, 2010	m = 9.3
824 Anastasia	Apr 6, 2010	m = 2.5

(Southern California – British Columbia)

995 Sternberga	Apr 11, 2010	m = 6.1
16 Psyche	Aug 21, 2010	m = 8.3
1736 Floriac	Nov 26, 2010	m = 6.1

The event of 824 Anastasia involves the m = 2.5 star Zeta (13) Oph. This is the brightest asteroid event in the USA/Canada in many years. Although not specifically mentioned by Dunham at the meeting, this star

is a spectral type O9.5 main sequence star with an estimated diameter of 24 $R_\odot$ thus diffraction effects plus the star's diameter could lead to gradual "D" and "R" observations.

Dr. Roger Venable presented a talk "Calibrating a Video File". Occultation events made with smaller aperture telescopes and faint stars will lead to low signal to noise ratios (S/N). He started off with an example of an asteroid occultation observation that would normally not be detectable by the unaided eye. The event chosen was 360 Carlova that occurred on June 3, 2009. Venable recorded this occultation. This event had a m = 13.7 star, m = 13.7 asteroid, a magnitude drop m = 0.7, max. duration was 8.8 sec and star altitude = 37°. Watching the tape on a video monitor visually he could not detect an event. After using a 7 frame stack with the program Registax, he was able to see the event. After taking a dark frame, he then plotted the video and noticed a 1-sec periodicity in the data. Venable's analysis of this 1-sec effect seems to indicate it's caused by a combination of dark field read noise and dark current. He also mentioned that many false events are caused by dust particles and pollen grains and other artifacts on the acrylic cover of the CCD chip.

For the occultation of 1258 Sicilia on January 14, 2008, Venable had 3 stations set up and recorded 2 positive events. He analyzed the videos with LiMovie (confirmed by Dave Herald) and it shows the discovery of a new double star.

Venable has determined from his findings in regards to false positives is that they are caused by a number of factors:

1) Dirty optics
2) Low S/N
3) Faint star
4) Low magnitude drop m
5) Noisy, high gain video camera
6) Small telescope
7) Twilight
8) Light pollution

By utilizing a dark frame subtraction in the data, Venable can reduce the unavoidable random noise level in a video. This reduces the incident of false positives. He listed several freeware programs to aid in this: Virtual Dub 1.6, AVI Synth 2.5, Registax 4.0 and LiMovie 9.20.

Tom Campbell demonstrated his home made "Cool Vest" that he uses when observing during the hot humid summer months in Florida. This vest is worn by the observer along with a back pack. The net patterned vest has plastic tubing wrapped uniformly around it that carries cold water circulated via a battery powered pump stored in the backpack. The water is chilled with ice which is also stored in a small ice chest in the backpack. A pair of polypropylene non leak quick disconnect hose couplers are connected on the front of the vest start the cold water circulating. The backpack and vest weigh in at 25 lbs. Richard Nugent tried the vest on and immediately felt the cold effect of the water circulating through the tubing. Campbell designed and made the vest with $100 in materials. Compare this to commercial cooling vests that run $400 or more. His design is the result of a year's worth of experimenting with two different designs and swears it keeps him cooler during long observing sessions. He also finds it very useful when mowing his lawn. Campbell has detailed plans on constructing the vest with photos posted on the website: http://www.poyntsource.com/New/Cool_Vest.htm

Richard Nugent presented a talk "A Non-Motorized 10' Domed Observatory". This talk had nothing to do with occultations hence it was saved for the end of the meeting when extra time allowed its presentation. Nugent built a personal observatory in Ft. Davis, Texas, just 8 miles down the road from McDonald Observatory. The observatory is situated in the Davis Mountains at an altitude of 5,200 ft. The all metal construction consists of a 10' dome, and 3 foot hallway connecting a 10' x 10' control room. This design was utilized to allow the domed portion to have circular walls eliminating water leaks which are problematic with square observatory buildings. After installing the dome, he found that the supplied motors would not rotate the dome nor open/close the shutter. The dome was one of only two made by a company that eventually went out of business. After spending over $1,000 and experimenting with various motors and hardware, Nugent finally decided to use the theory of Occam's Razor, that is use the simplest method for the dome's rotation and shutter opening. He then purchased two $25 winches and 50 feet of garage door cable and now the dome and shutter open up easily by turning the cranks on the winches. The observatory houses a Meade 14" LX-200. Nugent plans to do asteroid astrometry with this observatory as soon as a CCD camera is acquired.

The meeting attendees then summarized their efforts for the 234 Barbara occultation which held a record for the most remote stations attempted.

Dunham	4 stations
Maley	5 stations
Scotty D.	8 stations
Nugent	3 stations (one remote station was stolen before he retrieved it)
Redding	3 stations
Povenmire	1 station
B. Harris	1 station
Campbell	2 stations
Venable	4 stations
Iverson	1 station (two videos on two telescopes)
Coles	1 station

The meeting adjourned at 5:07 PM as several attendees had to catch flights back home. Informal discussions continued afterwards.

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.

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Occultation Newsletter – Impressum

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

IOTA Member Site:
http://groups.google.com/group/iota_us

This site contains information about the organization known as IOTA and provides information about joining IOTA and IOTA/ES, topics related to the Journal of Occulation Astronomy, and information about the membership – including the membership directory.

IOTA Lunar Occultations, Eclipses, and Asteroidal and Planetary Occultations Site:
http://asteroidoccultation.com/iota/

This site contains information on lunar occultations, eclipses, and asteroidal and planetary occultations and the latest information on upcoming events. It also includes information explaining what occultations are and how to report them.

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