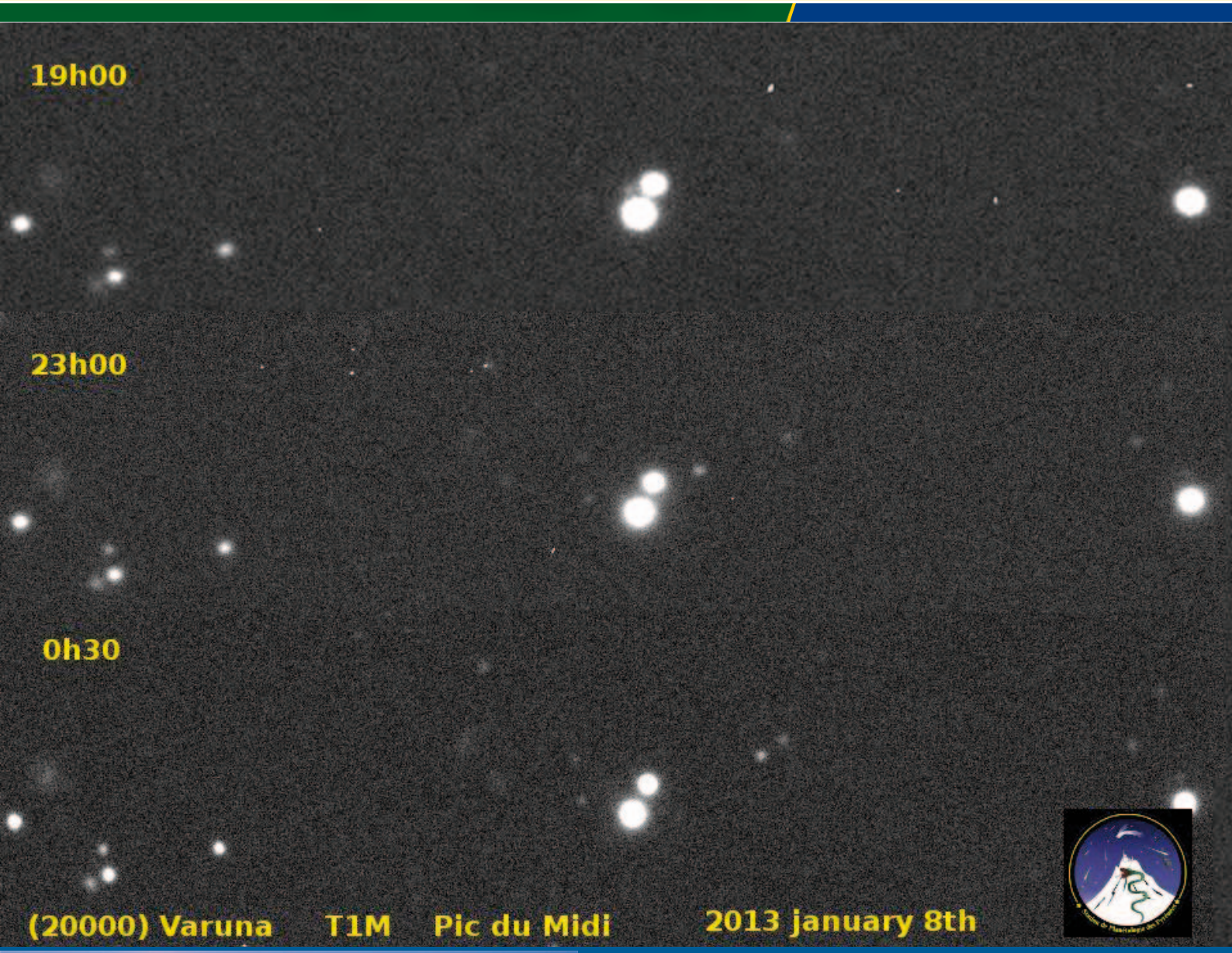
Journal for
Occultation Astronomy

INTERNATIONAL OCCULTATION TIMING ASSOCIATION

2013–01

FORMERLY OCCULTATION NEWSLETTER



The Varuna event

Images taken from Pic du Midi
by Francois Colas during the Varuna appulse.
Camera: ANDOR IKON-L camera CCD E2V 2K 2K
Filter: Sloan DSS r'
Exposure: 180 s
Telescope: T1M Pic du Midi F/12

Journal for
Occultation Astronomy

Dear reader,

for December 24th an occultation of a 10th magnitude star by Ceres was predicted for Central Europe, but – was clouded out, so no results could be presented.

Again another spectacular event had been calculated for Europe: The Trans-Neptunian-Object Varuna was supposed to occult a 16th magnitude star on January 8th, the result: clouds…

Unfortunately occultation-chasers have no chance for a rollback like other observers who can repeat their deep-sky pictures the next night with suitable weather.

As a young boy I remember I often went to my school's observatory to look at the moon and the stars especially during wintertime. At extremely low temperatures it was a hard job to open the dome for a long night of star gazing with the telescope .

But things seem to have changed. Now in the winter it is foggy or it is raining with temperatures well above zero degrees centigrade.

Similar things were reported to me by Sonja Itting-Enke living in Namibia since the nineteenfifties. Back then you were able to rely on the rainy season always hitting the same yearly period – but this has changed too.

The conclusion is: We cannot change the climate (although we are doing it with carbon dioxide) but we could change our observing site to some desert-areas of the world in case an occultation can be recorded there!

Hans-Joachim Bode

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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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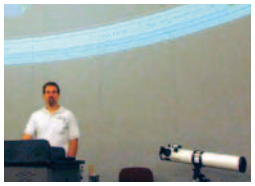
Journal for Occultation Astronomy

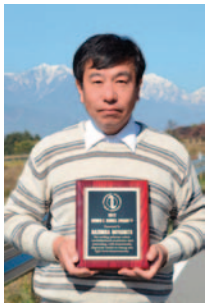
The International Occultation Timing Association's 30th Annual Meeting

College of Southern Nevada, North Las Vegas, Nevada, October 19-21, 2012
by Richard Nugent, Executive Secretary




From left to right: IOTA Middle East Section Presentation
Walt Morgan discusses the IOTA-VTI
Homer F. Daboll Award to Kazuhisa Miyashita
Dr. David Dunham and Dr. Terry Redding
Paul Maley summary of IOTA Officers Meeting
Richard Nugent May 20th Annular eclipse summary
Dr. Marc Buie, Steve Conard, Walt Morgan, Ernie Iverson, Steve Preston
David Dunham's Dr. Niels Wieth-Knudsen Award
Dave Gault's GPS-ABC unit



The minutes of all IOTA annual meetings are at:

http://www.poyntsource.com/Richard/IOTA_Annual_Meetings.htm

Kazuhisa Miyashita,
2012 Homer F. Daboll Recipient

Meeting attendees

The 30th annual meeting of the International Occultation Timing Association was held Friday, Saturday and Sunday October 19-21, 2012 at the College of Southern Nevada Cheyenne Campus in North Las Vegas, Nevada. This location was chosen to coincide with the occultation of the asteroid 521 Brixia covering a 122-km wide projected path west and north of Las Vegas early on October 22, 2012.

Nine (9) positive chords were obtained and the results are posted at the asteroid occultation results page (a 10th chord by T. Redding, north of the others, is still being processed):

http://www.asteroidoccultation.com/observations/results/Data2012/2012Oct22_Brixia_Profile.gif

The meeting location was kindly hosted by the Planetarium staff of the Cheyenne Campus. The final meeting schedule, and most of the presentation files, are located as links from Brad Timerson's North American Observations web site:

http://www.asteroidoccultation.com/observations/NA/2012Meeting/

http://www.asteroidoccultation.com/observations/NA/2012Meeting/Presentations/

Fifty-five persons participating in the meeting in person/from the EVO internet conference:

President Dr. David Dunham and Dr. Joan Dunham from Maryland, Vice President Paul Maley and Chuck Herold from Texas, Executive Secretary Richard Nugent from Texas, Steve Preston from Washington,

Walt Morgan, Danny Falla, Sandy Bumgarner from California,

Other on-site attendees included Ernie Iverson, Ted Blank, Steve Conard, Lampert Levy, Dr. Terry Redding and Dr. Marc Buie.

Video Internet Conference (EVO) Attendees: Steve Messner, Brad Timerson, Scott Deganhardt, IOTA Treasurer Chad Ellington, Aart Olsen, Jan Manek, Dave Herald, Rob Robinson, Hristo Pavlov, John Talbot, Rafael Chavez-Rangel, Dr. Mitsuru Sôma, Kazuhisa Miyashita, Dr. Ken Coles, Bert Stevens, Dr. Ted Swift, John Brooks, Tony George, Brendo Sacchin, Lawrence Flemming.

10:23AM – Meeting start – Introductions

President Dr. David Dunham opened the meeting and welcomed everyone following a problem with the EVO system. He then asked the

attendees to introduce themselves. All present at the Cheyenne campus walked in front of the webcam and introduced themselves.

Business meeting:

This year's presentation of the annual Homer F. DaBoll Award was made by the Award Committee Chair Dr. Terry Redding. The Homer F. 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.

Previous Homer F. Daboll awardees: 2007: Dave Herald (Australia), 2008: Edwin Goffin (Europe), 2009: Steve Preston (USA), 2010: Hristo Pavlov (Australia) and 2011: Scotty Degenhardt (USA).

This year's Award Committee consisted of all past recipients (above) plus Colin Haig, (Ontario, Canada), Robert Buchheim, (California) and Dr. Terry Redding (Florida – chairman).

This year 10 nominations were received from 9 nominators. The Committee's main objective in selecting an award recipient was to reach a consensus and not choosing someone by a majority vote. Eligibility for the award is for anyone who has made significant contribution to occultation science or for the work of IOTA and its goals. Persons not eligible are current IOTA Officers & the award committee. IOTA membership is not required.

The 2012 Homer F. DaBoll award recipient was Kazuhisa Miyashita from Japan, for writing the highly acclaimed LiMovie software program. LiMovie has revolutionized occultation data processing, with dramatically improved results in timing and light level measurements.

Kazuhisa, through EVO, offered his sincere thanks to IOTA for the award. After the meeting on October 24, 2012, he sent Richard Nugent the following email of what he said over the EVO system:

My sincere thanks for granting me the Homer DaBoll award. I am very honored to receive this award.

I will tell a short history of Limovie. In 2000, when I report a result of grazing occultation, Dr. Soma asked me to make a rough estimation of the light change with seeing the video monitor. The purpose was detection of double star. However, the change of star's brightness is slow and complicated. So, I tried to obtain more detail of light change. I captured several hundred images from each video frames, and I measured them with ordinary light measurement software. I had to spend very much time to complete the analysis, and I came to desire a new software which can measure the occultation light change directly from video. In 2005, I made a solution for my own task. Limovie, which was mere small program at that time, has been gown up to a software being able to analyze several kind of occultation. I greatly appreciate support and discussion of IOTA members on producing Limovie program.

I would like to continue improvement of Limovie and analysis of various occultations.

I say my thanks again to IOTA, in Japanese: "Arigato gozaimashita."

Best regards, Kazuhisa Miyashita

A spin-off benefit of the LiMovie software not immediately known by the occultation community was its use to measure the position angle and separation of double stars. This method was developed by Richard Nugent and Ernie Iverson, and was presented at the 2010 IOTA annual meeting in Boston, Massachusetts.

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

Starting Balance	$ 6,305.00	2011, Jul 11
Ending Balance	$ 5,997.29	2012, Oct19
Net Decrease in Balance	$ 308.17	
The breakdown of this past year's budget is		
Membership Income	$ 3,607.37	
Interest	$ 6.98	
IOTA-VTI Royalties	$ 786.00	
PayPal Balance	$ 510.64	
Expenses		
Printing/Mailing	$ 2,617.18	
JOA	$ 1,973.88	
Web Service: Donated		
by Art Lucas Awards:	$ Not determined	
Fees:	$ 55.10	(PayPal)

Chad mentioned that except for the current issue the Journal of Occultation Astronomy (JOA) is more or less on schedule. Online subscribers will see the JOA issues uploaded well before the print issues are delivered. JOA is IOTA's largest expense and the March 2012 issue costs were as follows:

Layout/design:	$ 305.99
90 copies printed:	$ 232.56
Envelopes/labels/printable postage sheets:	$ 124.30 (purchased every 2-3 issues)
Postage:	$ 332.56

The net cost for this issue was ~ $ 912.55 with 87 issues mailed thus each issue cost $ 10.49. The price paid per issue by members depends on several factors such as location (USA/overseas) and delivery options but averages ~ $ 10.29.

IOTA's current membership status is print subscribers: 67 – USA, 20 – outside USA, 45 – online only.

Executive Secretary Richard Nugent presented a summary of the 2011 annual meeting minutes. Those minutes were published in the first 11 pages of JOA Vol. 1, No. 5 (the first issue of 2012) so they are not repeated here. Just after the 2011 meeting, 56 observers obtained 35 positive chords to determine the profile of 90 Antiope. This asteroid occultation profile ranks as one of IOTA's best. 90 Antiope is a binary asteroid consisting components A & B separated by about 90 km that are gravitationally bound. The asteroid profile of 90 Antiope appeared in the January 2012 issue of Sky and Telescope page 51. A formal scientific paper on this occultation is currently being written.

David Dunham discussed the proposed location for the 2013 meeting. Since 1998, IOTA meetings have been in the proximity of spectacular occultation events. The occultation by 617 Patroclus of a m = +9 star on October 21, 2013 crosses the USA from North Carolina through Las Vegas and California, and although it is a good event, it is also visible over a wide area. Therefore, rather than dilute local efforts, it was decided not to have the IOTA meeting in one place (like Las Vegas again), that is, not to put "all our eggs in one basket". Las Vegas has perhaps the highest probability for clear skies along the path at that time of year, so observers going there might want to hold a "mini" IOTA meeting. The 2012 meeting was originally planned for New Brunswick, Canada under invitation from Guy Nason. The 2013 meeting can be held in Canada as it's not a requirement to have an occultation event associated with the meeting. A location at or near one of the more accessible large Canadian cities was recommended.

Dunham then motioned to end the Business meeting, Richard Nugent seconded the Motion and the Business meeting was closed.

Technical Sessions

Walt Morgan/Sandy Bumgarner described the status, sales, technical issues and proprietary rights to the IOTA-VTI unit. It's manufactured by Video Timers and IOTA receives royalties for each unit sold. Video Timers is a sole proprietorship with Walt Morgan as proprietor and Sandy Bumgarner as Engineer.

The unit was first introduced in 2011 and has enjoyed sales in 14 countries. A new board version (2.5) is in the final stages of being implemented, it will include minor cosmetic changes and a spare fuse. Thus far the only problem issues with units were minor; a soldering mistake, memory failure, 1 unit was unresponsive and a failed crystal. These were all resolved.

Walt mentioned that the unit could take up to 12.5 minutes to acquire an almanac, however the typical time is under 5 minutes. The IOTA-VTI unit is now sold in three versions: The "IOTA-VTI Basic" which has an internal GPS ($ 249), the "IOTA-VTI EX" which has an external GPS receiver ($ 300) and the "IOTA-VTI Dual" which has the internal and external GPS receiver ($ 350). With Dual unit, time is derived from the external GPS whenever it is connected, but when the external GPS is disconnected, internal circuitry automatically switches to use the internal GPS. A new version of the LiMovie program now captures the IOTA-VTI time stamps simplifying analysis of occultation videos.

The basic unit costs $ 249 USD plus $ 12 shipping to a USA destination with 2-3 day delivery. Overseas shipping costs can go as high a 33% due to certain Customs regulations (worst case) in some countries. Shipping times for overseas orders can range from 1-4 weeks for USPS Priority Mail ($ 18) or 3-5 days for USPS Express Mail ($ 41).

Brad Timerson presented the status of IOTA publications from the Minor Planet Bulletin in which he was co-author with numerous other authors. Papers mentioned were:

"A Trio of Well-Observed Asteroidal Occultations in 2008", MPB 36-3, July-Sept. 2009

"Occultations by 81 Terpsichore and 694 Ekard in 2009 at Different Rotational Phase

Angles", MPB 37-4, Oct.-Dec. 2010

"Several Well-Observed Asteroidal Occultations in 2010", MPB 38-4, Oct. – Dec. 2011

Papers he is still working on include:

"Binary Asteroid (90) Antiope: A High Resolution Profile Using Occultation Data", Brad said he awaiting reference information from J. Berthier (Icarus) regarding crater modeling as well as information from Bill Merline regarding Keck images.

"Occultation Evidence for a Satellite of (911) Agamemnon", he is waiting for F. Marchis to be co-author and to supply more detailed information on images of Agamemnon with adaptive optics telescope. IOTA attendees recall that this event from January 19, 2012 where Steve Conard's video recorded a secondary event after the main occultation. This secondary event is wholly consistent with the existence of an asteroid satellite.

Brad closed his talk asking for assistance in gathering reference material for future papers. He showed a list of asteroid event candidates for future MPB articles:

2011 Dec 26	Xanthippe
2011 Nov 25	Ausonia
2011 Oct 22	Thia
2011 Oct 19	Ariadne
2011 Aug 15	Carlova
2011 Jul 4	Europa
2011 Apr 22	Thetis
2011 Jan 26	Parthenope

Scotty Deganhardt presented his continuing research of Jovian extinction events (JEE) and how he is able to model the Jovian dust field, moon atmospheres, flux tubes and Io's Torus. This exciting new research begun when Scotty saw evidence for an atmosphere for Io and Europa during an eclipse/occultation event August 9, 2007. The result after many follow up observations was a paper published for The Society of Astronomical Science: Proceedings for the 29th Symposium on Telescope Science, "Io and Europa Atmosphere Detection through Jovian Mutual Events" in 2010. Co-authors were S. Aguirre, M. Hoskinson, A. Scheck, B. Timerson, D. Clark, T. Redding, and J. Talbot.

The result was that Europa seems to show a 20-radii extinction to with an 0.18 to 0.25 magnitude drop as evidence. For Io they found a ~ 8 Io radii extinction detection with an 0.18 magnitude drop. He showed slides illustrating how the extinction event is viewed from Earth to detect Io's torus. At the SAS conference in May 2012, he realized that there were very well placed conjunction events for July/August 2012 so he got the word out through AAVSO, MPML and IOTA. The observations made during this campaign have helped confirm Io's atmosphere which extends to 6x its radius.

Scotty showed numerous light curves from extinction videos. The precision of the magnitude data showed standard deviations of 0.009-0.019 with S/N ratios ranging from 8.7-12.2, hence the detection of the "wings" on the light curves was quite simplified. Light curve fits to JPL data was very good.

Steve Conard asked Scotty if any of the data was not video. Scotty said some observers are using CCD imaging to record these events. Since the durations of these events can take hours, CCD exposures of 40-seconds spaced at predetermined intervals are typically used and combined to construct a light curve.

Richard Nugent presented the results of the May 20, 2012 annular eclipse over the USA. This was IOTA's (USA) first attempt to standardize the equipment and filters used to capture the Baily's beads effect for deriving the solar radius. In the past, IOTA has been criticized for using different telescopes and different solar filters to derive the solar diameter from eclipse edge expeditions. Nugent created a web site 3 months before the eclipse to specify the standardized equipment required: Telescope aperture (3"-5"), Baader solar filters, narrow band filters: Kodak Wratten #23a or #56 filter, plus a host of observing and set up tips from his 9 previous Baily's beads expeditions.

Nugent called for the use of the Baader solar filter which was ordered in sheets and distributed by Walt Morgan. Five-inch (5") square sheets were sold to observers for $10. The use of a 5" square sheet Baader solar filter required a telescope with an aperture of 3"-5" which was idea for recording Baily's beads. Nugent decided that each observer would use either a Kodak Wratten #23a or #56 filter placed in front of the video chip to match to 535nm or 607nm Picard satellite wavelengths for future calibration of all previous existing ground based beads observation – telescope or visual. The plan was to have observers at two stations (path lines) at north limit with and 0.5km separation and the same at the south limit. Each of the path lines would host an observer with each of the #23a and #56 narrow band filter, thus a minimum of 8 observers would be needed.

Observers for the North limit were Tony George, Steve Preston, Dr. David Dunham, Dr. Terry Redding, Lawrence Flemming and Ernie Iverson. Due to cloud and some equipment problems, the north limit teams were largely clouded out. Dr. Terry Redding obtained a video with passing clouds that did show Baily's beads briefly, however it was not useful for analysis.

Southern limit observers were: Derek Breit, Sandy Bumgarner, Chuck Herold, Dr. Chris Kitting, Walt Morgan, Dr. Richard Nolthenius, Richard Nugent, Andreas Tegtmeier from Germany, Dr. Ted Swift and Dr. Roger Venable. Nugent showed video frames from Chris Kitting's and Dr. Ted Swift's video from the southern limit.

Nugent showed path maps for eclipses for the next 5 years leading up the total eclipse that crossed the continental USA in August 2017. This 2017 eclipse will be the next good chance to coordinate Baily's beads observations on a large scale. Paul Maley and David Dunham mentioned that after this Aug 2017 eclipse, a comparison of IOTA's solar radius method can be compared to that of the Picard satellite. At that time, it can be decided if IOTA's ground based method of measuring the solar radius should continue.

Lunch Break

2:00 PM Technical sessions continue…

David Dunham presented a summary of his 50 years history of grazing occultations observations and experience. This talk was first presented on August 25, 2012 in Pescara, Italy at the 31st annual ESOP meeting (European Symposium on Occultation Projects). Dunham is currently working at the Moscow Institute of Electronics and Mathematics (MIEM) for part of the year and was asked to say a few words in late June during their 50th anniversary. Dunham thought that 1962 was the first year he first got serious about grazing occultations, making the first computer predictions and mobile expeditions to observe them, and reaching out to observers around the world to encourage them to observe these spectacular events. He recalled the time on October 29, 1957 when he observed the total occultation of b1 Capricorni from La Cañada, California, from his backyard with a 60mm refractor. Many other occultations occurred during these early years expanding Dunham's thirst for these events and how to calculate and observe them.

For the Alderbaran graze of March 12, 1962 Dunham had completed a course in solid geometry at the Univ. of Calif. at Berkeley shortly before this event, realized he could work out the equations and compute it. The hand calculations using trig function tables and a clunky Marchant calculator were harder than expected, in fact less than 2h before the event, he had calculated 6 graze point positions from Arizona to near Santa Cruz, and convinced a grad student to drive him there. They didn't make it to the limit but while crossing the Bay on the Dumbarton Bridge, using binoculars, he saw the star had disappeared. At Palo Alto, he quickly set up a 60mm refractor and saw Aldebaran reappear on the bright side, coming out like a drop from a faucet. Dunham realized that was close enough to the limit to see the star's angular diameter! The chase for grazes was on!

Dunham showed slides of a few notable grazes from the early 1960's including:

- 1962 April 10th expedition to Concord, Calif., for a graze of 5.1-mag. 64 Orionis,
- Leo Kalish's 1962 Sept. 18th expedition to Castaic Junction, for a bright-limb graze.
- His 1st prediction (no map) published in the March 1963 Sky and Telescope, of the Zeta Geminorum graze of 1963 March 4/5,
- His first observed graze, north of Roseville, California, 1963 Mar. 31, 6.3-mag. ZC 881

■ 1963 April 2, he saw the graze of 5.4-mag. 85 Geminorum over Freemont, CA,
■ First successful dark limb graze where the observers travelled to their sites – 1963 Sept. 8 Graze of 6.1-mag. ZC 464, Davis, CA,
■ His 1st graze map published in Sky and Telescope, for the 1963 Oct. 8 graze of 3.0-mag. zeta Tauri,
■ Graze of 6.4-mag. ZC 398 observed 1964 February 19, again near Davis, CA,

Dunham even showed a slide on his wedding day July 10, 1970 with him and Joan Dunham, Tom Van Flandern, Ronald Abileah, Homer DaBoll and Edward Halbach all posed on a cable trailer that laid cable used to time grazes!!!

International Occultation Timing Association (IOTA) had been formally established as a dues-paying organization in July 1975, primarily to promote the observation and analysis of lunar grazing occultations. IOTA formerly incorporated in 1983 as a Texas corporation. Dunham continued occultation history by telling the audience about the 1981 May 9-10 graze of Delta Cancri in which Alan Fiala of the USNO, obtained the first video recording of multiple events during a graze, with 7 D's and 7 R's. The first well-observed graze with unattended video stations occurred on Dec 20, 2001 when 4.0-mag. t2 Aqr was observed by 8 stations near Kitty Hawk, NC, 4 of which were unattended video stations. Six observers also timed this graze from Georgia.

Unattended video station advances were made by Scotty Deganhardt in 2008 who developed the Mighty Mini and Mighty Midi systems. Scotty's techniques and methods have revolutionized asteroid occultation observations, and Dunham has had a couple of successes applying them to grazes of relatively bright stars on the dark side of crescent moons.

Dunham closed his talk with a quick comparison of the Kaguya and LRO lunar profiles. Most profiles between the two sets of satellite data is a close match but the LRO with more orbits and data points than Kaguya, seems to be more accurate for some profile parts. Dunham talked about his recruiting of others to observe asteroidal occultations from multiple stations – lessons learned from the May 11th Occultation by (28) Bellona near Khabarovsk, Russia. Dunham talked about the first ever asteroid event observed by an unattended station, the 9 Metis event in California on September 7, 2001. His unattended video camera was prepointed and recording where the target star was to be during occultation time. Before the battery died, it recorded the event. This now famous profile was published in Sky and Telescope in March 2002 issue. He continued with Scotty Deganhardt's Mighty Mini revolution starting in 2008 and showed the well known profile from December 11, 2008 of 135 Hertha in which 21 chords were made to create the profile, 14 of them Scotty's !! He then showed the 2010 July 8th occultation deployment of stations for the m = +2.5 event of Yed Prior by 472 Roma in S.W. Iberia. He recruited and held a training session for observers Joao Cruz, Rui Conclaves and Luis Santo to set up Mighty Minis to observe this event. The light curves of this occultation were shown. This and the other events mentioned below occurred only a couple of hours after sunset, not providing enough dark time for a significant deployment of pre-pointed minis or midis. So Dunham tried to teach other amateur astronomers to use the small video systems and spread out to record the occultation from more stations across the path than he could deploy himself.

The next occultation he recruited observers for in Russia was the event by 2 Pallas on November 23, 2011. He held a training session with M. Turchenko the day before the event with Mighty Midis he brought. This was the first successful asteroid event from the Moscow area; 3 chords were obtained. The observers were Dunham, D. Denisenko, V. Savvicheva and M. Turchenko. The next event he prepared for in Russia was the m = + 6.5 occultation of 28 Bellona by HIP 78870 in the Khabarovsk area, on the evening of May 11, 2012. A training session was held the day before, but clouds that evening prevented a "live" sky training. The next night was clear and we deployed 6 stations across the path, but the actual path shifted half a path-width south of the predicted path, and only one of the three observers in the actual path successfully recorded the occultation.

Ted Blank gave the North East Astronomy Forum (NEAF) report. NEAF was held April 28-29, 2012 at Rockland Community College, Suffern, NY, USA. Representing IOTA's booth was Ted Blank, Bruce Holenstein, Bruce Berger, Dr. Ken Coles, Steve Conard and Al Carcich. The event had some 4,000 astronomy enthusiasts. Three IOTA-VTI's were sold (IOTA offered a $15 discount). One of the purchasers, Oliver Thizy, now markets the VTI in Europe and to date has sold 15 units. To demonstrate the unit, a real time LiMovie graph of a red flashing light was shown. An IOTA poster was displayed which was paid for out of IOTA's funds. This is a one time expense.

Dave Herald summarized occultations from around the world. For the time period Jan 2011 – June 2012 lunar events by region were:

	Lunar Occultations	Grazes
N. America	35	2
Australia	1201	10
Japan	928	12
Europe	2082	10
Middle East	88	2
Double Star observations cataloged by Brian Loader from New Zealand:		
# positive measures	94	
Definite doubles	30	
Definite "net doubles"	58	
# wide doubles	22	
Approximately one in 100 occultations a double is discovered.		
For asteroid occultations during the period Jan 2011-June 2012, successful events by region:		
Europe	51 + 29 (2011 and 2012 positives)	
Australia	51 + 31	
Japan	25 + 21	
US	76 + 27	

Double star discoveries have separations in the range of 0.01 – 0.001 . He noted that seven (7) double stars were discovered. The occultation by 90 Antiope in July 2011 over California indicated a large diameter star. Sixty-one light curves were analyzed with a preliminary result of the stars angular diameter of 2.14 ± 0.03 mas.

Herald then showed the asteroid profiles of widely observed asteroids:

212 Medea	2011 Jan 8	Japan
144 Vibilia	2011 Jan 25	Europe
11 Parthenope	2011 Jan 26	USA
554 Peraga	2011 Mar 8	Europe
360 Carlova	2011 Aug 15	USA
156 Xanthippe	2011 Dec 26	Europe + USA
329 Svea	2011 Dec 28	Japan
654 Zelinda	2012 Jan 6	Japan
266 Aline	2012 Jan 17	Japan
57 Mnemosyne	2012 Mar 11	USA
128 Nemesis	2012 Mar 30	Australia
1038 Vija	2012	Canada + US

Dave Herald then gave his next talk on "Determining the Characteristics of Video Cameras". The early occultations were visual and this led to the estimating of one's personal equation. Personal equations (PE) had the disadvantage that they were different for all observers plus an observer's PE changed from one observation to the next. Along came video in which observations could be replayed and the measurements were strictly "D and "R", not the amplitude of any brightness changes. By also examining the photometry of a video, we can now open up new research areas – double stars, Jovian mutual events and diameters of stars.

Herald then posed a question: How accurate (or reliable) are our analog video cameras? He then discussed properties of typical CCD cameras. With care, magnitude can be estimated to ±0.002 mag. An example video made by Derek Breit showed an artificial satellite changing brightness in a constant manner – it was tumbling. Thus flat fielding would be necessary.

Using LiMovie as an example, a star whose visual magnitude was 7.9 had a 2,070 pixel brightness value. He showed another star with the same magnitude and a different LiMovie brightness value. It was clear that video brightness is not equal to star brightness largely due to the camera chip's spectral sensitivity. He recommended that if you were going to use video for photometry, flat fielding would be necessary. As with standard photometric reduction procedures, video camera users need to account for star colors and the altitude of the star (sec z).

Hristo Pavlov then presented a study for the occultation community: Video Camera sensitivity issues. The co-investigators in this study were Tony Barry and Dave Gault. Different cameras have different spectral sensitivity and the stars brightness depends on the stars spectral type + the chip sensitivity.

Hristo used NGC 6716 in the study and created an H-R diagram using a Meade LX-200ACF, Watec 120N, PC-164CEX-2, Watec 90hH cameras and f3.3 focal reducer. An early proposed test was to observe an occultation with the different cameras to determine if the magnitude drop was the same. Hristo derived color coefficients to convert standard camera magnitudes to published star magnitudes for observers to better know the actual apparent brightness your camera provides of the target star.

Hristo then presented the new Astronomical Digital Video System (ADVS) which was developed with Tony Barry and Dave Gault. ADVS is a new a digital video recording system designed for astronomical purposes and observing asteroidal occultations in particular. A prime feature of ADVS is direct digital recording to a personal computer. Other advantages are: all digital system (which increases S/N), 12-bit progressive scans which improves photometry, uses the open source ADV file format and no codecs to deal with. An open source and free application to convert ADV files to FITS called ADV2FITS has been developed and works on Windows, Mac, Linux and Unix operating systems. The incoming version 2 of Tangra will support working with ADV files natively on Windows. Video frames time-stamped with GPS technology with an accuracy = +/- 0.001 seconds. It has remote or scripted control of all camera functions thus observing while you sleep is a real possibility. Later on a 60 frame/sec recording rate is possible.

ADVS currently only supports the Point Grey Research Flea3 model FL3-FW-03S3 cameras. A website is available which describes the system in detail http://www.astrodigitalvideo.com.au/. Extensive frame timing tests of consecutive frames exposed in the range from 30fps to 1spf and confirm that: 1)the SEXTA (optical) based timings correlate with the ADVS (electronic) based timings of the ADVS system as well as that displayed by Tangra and 2) There is little or no Dead-Time between exposures.

Steve Conard discussed the status of the proposed Astronomical League's (AL) Occultation Observing program. It was first proposed in 2010 and he sent requirements of the program to Aaron Clevenson in Houston). As with other AL observing programs, the occultation program would require a website and a pin design. The proposed program would include that observers would attempt at least 7 asteroid events (with one positive), 15 lunar events including 3 reappearances and one double star event. With the AL's response being very slow to this program, Steve asked if we should continue pushing for it and the general consensus of the meeting attendees was yes – give it another year.

Dave Gault gave a talk on the GPS-ABC, jointly developed by Tony Barry. It's a portable GPS based precision timepiece designed for use by visual observers. A paper about it is in JOA issue #3 of 2012, pp. 10-11.

This unit uses GPS satellites to provide a digital readout of UT plus a series of beeps/tones to alert the visual observer of various times during the minute. A long beep starts the beginning of the minute, then short beeps = 10th, 20th, 30th, 40th and 50th seconds, a brief beep = 55th, 56th, 57th and 58th second. The 59th second is silent to attenuate the beep for the top of the next minute. The unit runs on a 9V battery and runs independently. Dave offers various ways to acquire a unit from plans to build it yourself or Dave will build you a ready to go (RTG) unit. Pricing information is found here: http://www.kuriwaobservatory.com/pdf_files/GPS-ABC_Costings.pdf

Saturday October 21

Marjan Zakerin from the IOTA Middle East section (www.iota-me.com) presented the status and update on the first 2 years since the creation of the IOTA-ME section. She gave a brief outline of IOTA-ME's activities: their monthly newsletter, location of their primary office in the south-west part of Iran and how they got started. IOTA-ME members are classified into 4 working groups: 1) occultations and trans-Neptunion objects, 2) exoplanets, 3) eclipsing variable stars and 4) development of astronomical tools.

The IOTA-ME newsletter is published monthly and to date (November 2012) has published 23 issues. The newsletter typically has 15-20 pages and is published in two languages, English and Persian. It is sent out by some 1,200 emails and it is downloaded from their website approximately 300 times/month. Some notable achievements by the organization include the publication of the book "Occultation" co-authored by Atila Pero and Paul Maley.

IOTA-ME has had a number of workshops and conferences recently:

- Eclipsing Variable stars workshop in Esfahan with 115 participants,
- Occultation workshop in Tabriz, 35 participants,
- Occultation workshop in Gonbad e kavos,
- Occultation workshop in Shiraz,
- National Occultation workshop in Tehran, with 52 participants,
- National Occultation workshop in Damghan.
- International Occultation workshop in Dezful, 346 participants,
- Third International Occultation workshop in Tehran November 1-3, 2012

For the recent transit of Venus, Atila Pero working with John Talbot from RANZ, IOTA-ME recruited more than 400 people comprising 128 teams. Booklets and other information were distributed to educate people on how to time the contacts. The event was a success- 77 standard reports were collected, two articles summarizing the event and observations were published in the IOTA-ME newsletter and the Iranian Astronomical Journal, and a 1 day workshop was held discussing the results.

David Dunham presented a summary of the 31st European Section Conference on Occultation projects (ESOP). ESOP 31 was held in August in Pescara, Italy and is described (including several pictures) in the 4th 2012 issue of JOA, on pages 14-19. The conference hosted 34 participants from 12 countries. There were key discussions from observers from France, Germany and Spain on observation planning for the November 13, 2012 total solar eclipse in the continuing study to detect possible solar radius variations.

Dunham and Konrad Guhl discussed the situation with the ground based solar radius experiment which currently is in doubt. Prior observations from eclipses results have been suffered from various problems – equipment failure, non standardization of filters, cameras, recording equipment and telescope aperture, bad weather and a shortage of observers to travel to remote places on Earth to make the observations. The number one problem is the attainable accuracy of the method in detecting variations in the solar radius. The radius changes sought (if any) are for the most part buried in the errors of the observations. As Richard Nugent mentioned in his May 20, 2012 eclipse summary earlier in the meeting, the last "great hope" of recruiting a large number of observers for a widely visible eclipse is the August 17, 2017 total eclipse that crosses the USA.

At the meeting Dunham presented his "50 year History of Occultation Observations" and "Observing Asteroid Observations from Multiple Stations". For his five decades of pioneering occultation work the 2012 Dr. Neils Wieth-Knudsen award went to David Dunham.

David Dunham next presented a summary of important occultation events from July 2011 to the present. The most widely observed event was the July 19, 2011 occultation of the double asteroid 90 Antiope by LQ Aquarii over northern California. Dunham's light curve obtained near Tracy, CA showed a gradual disappearance and reappearance lasting several tenths of a second. This was caused by the large angular size of the giant star.

Other events discussed:

- 8.9-mag. SAO 95144 by (360) Carlova in the Carolinas August 15, 2011. Seven Positive chords were made by Dunham, Scotty Deganhardt and Bill Keel, and Deganhardt had seven misses also from remote stations. The sky plane plot matched the asteroid light curve 3-D model quite well.

- 613 Ginerva by m = +11.8 TYC 1806-01411-1 on September 27, 2011 over south east Texas. Observers were Dunham, Ernie Iverson, Paul Maley, Doug Rask, Brian Cudnik and Art Lucas. A large north-east shift (from Steve Preston's path computed by "standard" methods largely with FASTT data) of the path predicted from astrometry obtained with large astrometric telescopes at USNO-Flagstaff, Table Mtn. Observatory in California, and in Brazil ("last-second" CCD astrometry) the 2 nights before the event was confirmed with Dunham's and Lucas' positive results; Steve Preston computed the update with the new data only 12 hours before the event.

- 407 Arachne by m = +8.4 HIP 54719 over Huntsville, Texas. Observers were Dunham, Paul Maley, R. Dietz, Ernie Iverson (clouds) and Richard Nugent (clouds). Dunham's station #2 near Huntsville, TX showed a graze like light curve with 3 D's and 3 R's !!

- SAO 60804, m = +8.0, by the Trojan Asteroid 911 Agamemnon, January 19, 2012. Steve Conard's video had a disappearance from the asteroid and a few seconds later he recorded a 2nd disappearance. This 2nd disappearance was likely the result of a satellite of Agamemnon and its likely size was in the neighborhood of 4-8 km.

- March 11, 2012, BN Orionis occulted by 57 Melpomene, over the mid- Atlantic USA. Eight positive chords were obtained.

Brad Timerson presented "Inversion Model Priority List". These are asteroid events in which 3-D light curve models exist. A number of asteroids with inversion models are listed in the Minor Planet Bulletin. The DAMIT (Database of Asteroid Models for Inversion Technique) has some 211 models for which light curve models exist and ISAM (Interactive Service for Asteroid Models) has 107 models (as of September 24, 2012).

A list was created from the merger of these two databases for potential asteroid events for 2013 involving stars brighter than m = +10.5.

Twenty–eight events were identified. Brad showed the DAMIT and ISAM models for the upcoming occultation by 88 Thisbe on Dec 23, 2012 over Florida.

Brad next presented a Summary of late 2011, early 2012 Asteroidal Occultations through September 30, 2012. He identified some of the best observed events:

4 July 2011	Europa 4 chords
19 July 2011	Antiope 46 chords, binary asteroid
15 August 2011	Carlova 8 chords
19 October 2011	Ariadne 4 chords
22 October 2011	Thia 4 chords
19 January 2012	Agamemnon 5 chords, probablynew satellite
11 March 2012	Mnemosyne 8 chords, new double star discovered

Brad showed a comparison of the light curve model of the August 15, 2011 360 Carlova event overlaid on the occultation chords. There was an excellent agreement.

Chuck Herald, one of IOTA's original incorporators in 1983, gave a talk about optimizing a company's output using ISO 9000 methods, visions, statements and policies. Even non-profit corporations such as IOTA could possibly benefit from utilizing streamlining methods and procedures. It's unclear whether the ISO methods designed originally for very large corporations could be applied to IOTA and its procedures. Herald will continue to study this.

Lunch Break

Brad Timerson started to present on behalf of Breno Loureiro Giacchini the status and history of occultation astronomy from Brazil. The first occultation in IOTA's archive from Brazil was in 1954. Breno was able to present most of his talk himself via EVO.

In the year 1500 the Portuguese arrived in Brazil. Other European countries followed and occupied parts of Brazil. The Dutch occupation began in the 1600's and the ruling governer at the time was John Maurice of Nassau. Nassau was enthusiastic about science. Artists and scientists were brought to Brazil during his government in order to better study and represent the "New World".

George Marcgrave came to Brazil in 1638 and built the first observatory in 1639 at Nassau's house. According to reliable sources this was the first observatory of the Americas and the most modern at the time. From this observatory Marcgrave observed lunar occultations of planets (including Mercury in 1639) and in Leiden he also recorded lunar occultations (including stellar occultations).

Louis Cruls (1848-1908) was an observer of occultations at the Imperial Observatory in 1874 when he started working there. In 1886 Cruls published a series of articles on "Revista do Observatório" on a new method to calculate the times for occultations. He made some predictions, but the observations didn't happen apparently due to bad weather.

José Brazilício de Souza (1854-1910) was an avid astronomer. He made made observations of eclipses, variable and double stars, comets, planets, asteroids, meteors, conjunctions, sunspots, and occultations. He made the first (known) reports of stellar occultations in Brazil. Among his writings there are references of 4 planetary and 6 stellar occultations, between 1883 and 1898. Unfortunately there are huge uncertainties in his timings.

In more recent times the first occultation observation made in Brazil, according to IOTA's archive was in 1954 (with 18 events observed from Rio de Janeiro). The first asteroid occultation observed from Brazil was in 1982. In 2012 More than 43 lunar occultation events were observed, by 6 observers. Two positive asteroid occultations (and 1 miss) for 52 Europa were made in which there was a double star discovery.

The REA Occultation Section was estalished in 2009 to promote occultation activities in Brazil. Their website is www.rea-brasil.org/ocultacoes and is maintained by Breno Loureiro Giacchini who can be reached at bgiacchini@yahoo.com.br.

Tony George presented the status of the program Occular originally released in 2007 and its possible successor program, "BinOCCULAR". Occular was designed to find simple square wave occultation signals in noisy data and has been a very useful program in extracting D and R times from occultation videos. Occular worked with variety of input formats, including Tangra, LiMovie or any data in Excel CSV format. It analyzed data quickly and provided output graphs and reports that determined D and R times with error bars and other statistical quantities.

Yet Occular had some cons also – it will always find a signal, even if one does not exist. User judgment was always a factor in evaluating results D and R error bars were based on Monte Carlo simulations – multiple runs made with simulated noise equal to the noise in the original data. The D and R error bars were not statistically valid, they were more of an estimate than a scientific measurement. Discrimination between suspected real signals and false signals was based on 'Occular Confidence Level' – a semi-statistical parameter that was based on the Monte Carlo simulations.

Bob Anderson pursued basic research on applying Bayesian Inference (BI) statistical techniques to the analysis of occultations. With the BI advantage, if input data is normally distributed, then output results will also be normally distributed – thus error bars will be statistically valid and D error bars can be independent of R error bars.

The BI upgrades to Occular would require programming changes. Hristo Pavlov was contacted, since he had previously had an interest in incorporating Occular into Tangra. Hristo also agreed to take over the writing of the computer code. Hristo suggested splitting the project in two phases: 1) Occultation Timing Extractor and 2) Light Curve Signal Analyzer. Tony showed a few slides explaining the mathematical process that will used for the BI analysis and how it will be applied to videos. The project would consist of: Hristo Pavlov – program designer and code programmer, Bob Anderson – Bayesian Inference methods and implementation consultant and Tony George – OTE beta tester. The timeline would include programming start-up after Tangra2 is released (about 6 months) and testing would follow lasting approximately 6 months.

An advisory panel has been formed to help with this project: David Dunham, Dave Herald, Steve Preston, Tony George, Brad Timerson and a few others.

Tony George presented a report of new double star discoveries published in the Journal of Double Star Observations (JDSO) and some in press. In April 2009, JDSO Vol 8, No. 4, (October 2011) was the report of the discovery of a 4th component of the star 3UC197-115376 from the occultation by 336) Lacadiera. The derived separation of the ABAB pair was 7.5 ± 0.9mas and position angle 124.9 ± 6.3 deg. A report of the occultation on 2010 August 31 by 695 Bella of the star TYC 2322-01054-1 was abandoned due to the unobservable secondary occultation. PC-164CEX-2 cameras were used. The PC164CEX-2 camera uses on-chip integration method and it smears star images across multiple pixels when the target star is drifting across the field of view. The variation in brightness due to the PC164CEX-2 on-chip integration is approximately 20%. Tony reported if this variation occurs during an occultation step transition, it can mimic a brief step event. Since all the data from observers was obtained with PC164CEX-2 cameras, no clear unambiguous step event could be evaluated. A report was prepared but not submitted. However, Dunham protested that a 20% variation can't produce the type of step shown in his videos of the Bella occultation R, an 80% variation would be needed for that. The "drift" variation measured on the video during the unocculted part was only 20%. Since there's some controversy left, we decided to publish this in a future issue of JOA rather than in JDSO.

For the star BN Orionis (TYC 126-0781-1) duplicity was discovered from the occultation by 57 Mnemosyne on 11 Mar 2012. The light curves of two chords made with larger telescopes showed clear step events, while a third chord showed a partial occultation of only one of the two components – essentially a graze event with only one component occulted. This may be a first for IOTA observers.

The star TYC 6223-00442-1 had a new component discovered from occultation by 52 Europa on 12 August 2012 by Brazilian observer Breno Loureiro Giacchini . This was a single chord observation with an approximate 600 video frame secondary occulation. With only a single chord observation there are at least two potential solutions for any ellipsoid assumption – thus four total combinations of position angle are possible.

Dr. Terry Redding discussed the excitement and how to share these moments of an occultation observation and other astronomy space related type experiences. In 1991, NASA had the SAREX and ARRL programs. Here, 3,000 students from 21 schools in seven cities listened as 6 students talked live via radio contact to the Space Shuttle astronauts.

These outreach programs were expanded in 2012 . With the ARISS and ARRL programs, 80,000 students entered an essay contest. 100,000 will watch the event live from their classrooms while 11 students and two teachers from the Palm Beach County School District, Florida will talk live to the International Space Station (ISS). Experiences like this in which students are participating in a live broadcast with astronauts can set off the science spark that can lead to a career in science/astronomy. Terry suggested why not try such an outreach event with an occultation or graze?

By planning high probability events for students, IOTA could promotes world wide occultations and grazes for educational enterprises. The events would be announced more than a year in advance to allow planning. IOTA could provide lesson plans and resources designed to guide teachers through the process of a successful event. The data obtained and learning shared with all students. He mentioned the possibility of tying in the Astronomical League. Such a "First moment" observation can make lasting excitement by creating/fostering the "ah-ha" moments.

Steve Conard suggested that one such event for this project was the occultation of Regulus by 163 Erigone on March 20, 2014. This event will be visible along a path about 40 miles wide from New York City to Oswego in the United States, and extending approximately northwest into Canada on a track that includes Belleville and North Bay, Ontario.

Dunham mentioned a previous outreach event in which there were 5,000+ observers (mostly in China) from the occultation of the m = +1.9 star Gamma Geminorium by the asteroid 381 Myrra on January 13, 1991. The successful Japanese observations (about 21 chords) was organized by Isao Sato of Japan. Dunham heard that 4 positive observations were obtained in China, but details of them have not been reported.

Vice President Paul Maley presented a summary of funding possibilities in collaboration with the Southwest Research Institute (SWRI). SWRI's goals are 1) To obtain the maximum number of video chords spread across the entire asteroid and beyond with the expenditure of fewest amount of dollars. 2) only video station chords would be funded, 3) continuing collaboration from 2011 (90 Antiope), they seek to fund additional efforts to acquire high quality occultation data, 4) to investigate further progress made on methodology to prioritize fundable events.

When an asteroid event is selected for funding, the likely expenses covered would be transportation (car, train or air), lodging, (no meals) and possible shipping of equipment. SWRI's decisions on support will be made 2 months before on domestic travel, 3 months for foreign travel.

SWRI will decide which observer(s) gets funded. The logic is if fewer dollars are available than observers, they will make the final determination of who gets funded. IOTA officers would then notify prospective observers of who is chosen. Observer(s) need to make a commitment once notified. If the contacted observer refuses or is unavailable, the next observer in sequence will be notified. Paul mentioned the known risks to the funding allocations, items such as the weather and/or unexpected factors could cause event cancellation. Expenses may not be reimbursed if observer makes unreasonable decisions or is not set up in proper time. For a funded event, observers would use own funds initially with reimbursement after the event.

Just because an event would be selected for funding common sense would have to be applied by observers and prudent decisions on whether to start travel prior to the event. If weather probabilities for success are deemed low, travel should be aborted. If the observer fails to exercise good judgment this may result in no reimbursement. In this event the observer must agree and realize that he/she would have to cover their own expenses.

The SWRI selection process for asteroid events would include those in which shape models have already been developed, adding those which have known satellites plus filtering for those which have existing light curves, adaptive optics and/or prior occultation data. Paul showed a list of 78 events for 2012 and 2013 being considered. Paul showed a table of 15 observers (as of October 2012) that had multi-station capabilities. He then showed a filtered list of 2013 candidate events along with some world maps.

Steve Preston mentioned that integrating cameras could be used for long duration faint star events since their time resolution would have less impact on timing precision than for short events.

Paul Maley then presented the results of the IOTA Officers meeting held earlier in the day. IOTA's Officers are David Dunham, Paul Maley, Richard Nugent and Chad Ellington. Issues discussed included the possibility of a 2nd IOTA award. This award would be aimed at those individuals whose expertise, contributions to occultation science occurred more than 15 years ago. This opened up the door to recognize dozens of people who have made outstanding contributions to occultation science during a time period in which no award existed.

Provisionally named the David E. Laird Award, it will be similar to the Homer DaBoll award, but is meant to honor those individuals whose major contribution to IOTA or to occultation science is more than 15 years old. It is named for David E. Laird, a physics teacher at the Cincinnati Country Day School who made important contributions to occultation science in the early days of lunar grazing occultation expeditions in the mid 1960's. Unfortunately, he suffered from leukemia and died when he was only 37 years old, in 1968 or 1969 according to Dunham. He already has an award named after him, the computer science award given by the Cincinnati Country Day School.

The Baily's Beads science experiment continuation was discussed. The situation is that the measured changes in the solar radius are only slightly larger that the estimated errors of measurement. This is analogous to the case of a signal to noise (S/N) ratio of 10/9. In this scenario 90% of the signal is noise making the measured signal barely reliable. The launch of the Picard satellite in June 2011 will now be the standard in which the solar radius will be measured. IOTA's next opportunity for a widespread coverage of observers would be the August 2017 total eclipse over the continental USA. After this eclipse, IOTA's ground based measures of the solar radius could be calibrated with accuracy to the Picard satellite data.

There was a discussion of funding for future hardware needs. Paul showed a website that offers organizations (non profit or for profit) that advertises their funding request. Users click on their link and are taken to another web page where the organization describes what the money if for, tax deductible or not, benefits of contributing, etc. Once such possibility mentioned for asteroid event funding is to have the size/shape profile sent to donor's cell phone as a text message. The donor could then brag to friends/colleagues that they participated in that particular event thus increasing advertising for IOTA. Perfecting hardware for IOTA would a necessary milestone prior to soliciting funding.

Another key issue discussed was the stepping down of the current Officers to allow for a new (younger) Officers. The current Officers (President and VP) have been in their respective positions since IOTA was founded in 1975. They would transition to a Board of Directors and remain active in the organization. This would allow newer persons with fresh ideas to continue running IOTA.

Also discussed was a move to combine IOTA's myriad of web sites to make a single site. This single site (for example www.occultations.org) would have links to all the various IOTA related web pages (annual meetings, asteroid events, occultation tutorial pages, equipment and method pages, IOTA business etc.). Many such astronomy organizations have a single main web page with a long column of links to their other pages. Such a move by IOTA to combine web resources can make us look more professional and easier to navigate.

Dr. Marc Buie of the Southwest Research Institute (SWRI) discussed his RECON program

(Research and Education Cooperative Occultation Network). Marc has been involved in research into Kuiper Belt Objects (KBO's) and he has been involved in occultations since 1983.

The larger KBO's that have occultation data are Eris, Pluto/Charon, Makemake, Haumea, Quaoar and Orcus. Marc explained that KBO occultations are fairly rare so rather than have a mad dash of mobile observers race to the occultation path (which covers 500-2,000 km wide, with an even wider uncertainty), he proposed setting up an occultation fence along the eastern California/Oregon/Washington State borders. He has identified 10 pilot program sites (high schools) located in Tulelake, CA, Alturas, CA, Burney, CA, Susanville, CA, Quincy, CA, Reno, NV, Yerington, NV, Hawthorne, NV, Bishop, CA, and Tonopah, NV.

The proposed stations would be high school science departments. Teachers/students would be trained to make observations of these events. Each of the proposed stations would take responsibility for an 11-inch telescope and video camera system over duration of the project. Initially they would send one representative to 4-5 day weekend training session currently set for Reno, NV in March, 2013. The observers would participate in coordinated observations: 4 observations between April-September 2013 and 6 observations between October 2013 – August 2014. Occultation data would be sent to SWRI for analysis and the results would be sent back to the participating pilot sites for local recognition. The current cost is approximately $5,400 per station. Marc and astronomer Jack Keller will visit target communities to provide support and public outreach. Each community team receives $700 to facilitate their involvement.

Marc mentioned that the expected TNO rate would be on the order of 4-6 events per year, limiting star magnitude would be m = +13, main-belt asteroids would be chosen during the pilot project to ensure some positive results and the predictions and observations would be coordinated with Occult Watcher.

Opportunities for IOTA exist also for these events. Nearly all of these TNO events will be very uncertain. They of course would not be practical for mighty-mini or other types of portable deployments. An 11-inch will likely be a minimum aperture due to the faint limit of the target stars involved. IOTA observers can observe from their backyard or other easy to reach locations.

The proposed project schedule included site visits in October 2012 (already done) followed by:

Nov.-Dec. 2012 – team selection
Nov. 2012 – Jan. 2012 – hardware procurement
Mar. 2013 – participant workshop
Apr. 2013 – Network functional
Nov. 2013 – NSF proposal due
Aug. 2014 – End of pilot project
Sep. 2014 – Start implementation of full network

Marc visited 3 schools in October: Yerington, NV, Hawthorne, NV and Tonopah, NV. He said the teachers were very excited about the project !

David Dunham presented a summary of the asteroid occultation 2013 event summary for 2013. This is from a list he jointly prepares with Jim Stamm, Derek Breit and Steve Preston for the RASC Handbook. Some of the more important bright star events are:

Jan 2	1637 Swings	HIP 15241	m = +5.5	Texas to Quebec
Jan 21	679 Pax	HIP 51046	m = +7.9	Yukon to New York
Feb 14	79 Eurynome	HIP 8655	m = +8.3	Canada
Mar 7	329 Svea	HIP 71779	m = +8.4	Florida to Quebec
Apr 18	702 Kalahari	HIP 26964	m = +6.2	NW USA
Jun 12	332 Siri	HIP 84478	m = +6.4	Mexico, Texas
Jul 1	1481 Tubingia	HIP 104665	m = +8.0	Mexico, Florida
Sep 7	1005 Arago	HIP 116629	m = +7.7	Mexico, Texas, Florida
Oct 11	2085 Henan	HIP 154	m = +4.4	Mexico, South USA
Oct 21	617 Patroclus	TYC 00646-0730,	m = +9.6	Central USA
Dec 26	733 Mocia	HIP 17548	m = +7.2	Baja Mexico to Newfoundland

Brad Timerson presented a summary of late 2011 through September 30 2012 asteroid occultation statistics. The number of positive occultations was down from 2011 and the number of occultations by chords was down also. He showed profiles of the more prominent events for the time period including the double asteroid 90 Antiope (35 chords), 360 Carlova (8 chords that matched the light curve model), 911 Agamemnon (5 chords with a possible satellite discovered by Steve Conard), 57 Mnemosyne (8 chords and a new double star discovery).

Steve Conard presented a comparison of cameras and a study of signal level and signal to noise ratios (SNR). The hardware used for the tests included Celestron-14 on a CGE mount, a focal reducer used to set f/number to about 4.0. The video data was collected using an IOTA-VTI to Canon ZR-65 recorder with data through firewire to desktop PC.

Cameras used were the popular ones used by most occultation observers: Stellacam EX 1 & 2, Watec 902 Ultimate, PC164CEX-2, firewire camera and a Flea 3 FL3-FW-03S3M-C.

The test conditions were as follows:

- Same star field for each camera,
- Eplison Lyra ("Double Double") selected for easy reference. It was high in the sky
- Reference camera used before and after to look for changes
- Tried to pick nights with good transparency and no visible clouds
- Tangra used for data analysis
- Used auto aperture selection
- Picked up to 6 stars for comparison

He showed graphs illustrating for each camera the signal level, signal to noise and sample images of the field of view of the test stars. The results suggested that the PC164CEX-2 gave the best combination of SNR and signal level. The PC164CEX-2 was significantly better than the other cameras for all except the brightest targets. He mentioned it may have other issues that weren't investigated. The Watec 902 Ultimate and Stellacam EX's gave similar results. Steve noted that the Watec can produce almost as much signal as the PC164CEX-2 when the gain is set very high.

In comparing the Stellacam to the Flea, the Stellacam has much larger signal level

This may not be true with Flea at 12-bits. It has roughly the same SNR for fainter targets, Stellacam showing saturation on brighter targets.

With this presentation the formal meeting ended at 5:30PM.

Sunday October 21

Ernie Iverson presented his 120mm refractor setup for remote station observing. With these 10 pound (22 kg) short tube refractors, there usually is a balance problem when aiming for targets near the zenith using a tripod. Ernie solved this problem by attaching a counterweight near to the tube's objective which maintained balance. The counterweight's position could be adjusted allowing for different zenith distances and cameras.

Other members showed some of their equipment setups and all attendees made plans for positioning their stations for the Brixia occultation to occur later that night.

IOTA's Annual Meetings

The International Occultation Timing Association is the primary scientific organization that predicts, observes and analyses lunar and asteroid occultations and solar eclipses. IOTA astronomers have organized teams of observers worldwide to travel to observe grazing occultations of stars by the Moon, eclipses of stars by asteroids and solar eclipses since 1962.

Journal for
Occultation Astronomy

The Seventh Trans-Tasman Symposium on Occultations

Graham Blow & Murray Forbes · RASNZ Occultation Section

The Occultation Section of the Royal Astronomical Society of New Zealand (RASNZ) is pleased to announce that the Seventh Trans-Tasman Symposium on Occultations (TTSO7) will be held in Invercargill, New Zealand, over Monday May 27 and Tuesday May 28, 2013. The meeting will immediately follow the Annual Conference of the RASNZ.

The venue is the Ascot Park Hotel, the premier conference facility in Invercargill. Further information about TTSO7 is available on the Occultation Section website (http://www.occultations.org.nz) and about the RASNZ Conference on the RASNZ website (http://www.rasnz.org.nz/) .

TTSO meetings are alternately held in New Zealand and Australia and attract a wide variety of participants from novices to advanced observers. Their common goal is to advance the observation of all types of occultations. Included will be sessions catering for new observers – e.g. how to select and set up an occultation observing programme – while there will also be sessions on data reduction, the latest observing techniques, reviews of successes from the preceding year and expected highlights of the upcoming year.

A feature of TTSO7 will be the new Astronomical Digital Video System (ADVS) developed by Tony Barry, Dave Gault and Hristo Pavlov to overcome many of the problems inherent in current video occultation systems. Tony and Dave will be in attendance and will have a full working model with them so that participants will be able to get some "hands on" experience. More information about the ADVS is available at: http://www.astrodigitalvideo.com.au/

Request for Presentations

The organisers now invite other potential speakers at TTSO7 to advise us of their intent to submit a presentation. Presentations can include both full talks and poster papers. Please send your expression of interest, including a title, brief abstract and requested duration in the case of oral presentations, to the TTSO7 convenor, Murray Forbes (Murray_Forbes@xtra.co.nz) with a copy to Graham Blow (Director@occultations.org.nz).

The cut-off date for presentations will be advertised on the TTSO7 web page in due course. At the meeting digital copies of all presentations will be required in a form suitable for inclusion on the Symposium CD.

If you are considering attending simply as a participant we would also like to hear from you now so we can judge approximate numbers attending. Overseas guests will be particularly welcome. If you are coming for the TTSO meeting we strongly recommend that you enrol for the preceding RASNZ Conference, as that meeting is expected to feature some occultation-related papers which will not appear in the TTSO7 meeting.

Tourism Opportunities

New Zealand is particularly known for its diverse and stunning landscapes, and wide variety of tourist activities. These range from semi-tropical beaches and volcanoes in the north to majestic mountains, glacier-fed lakes, fjords, rainforest and more in the south. Many people will have seen some of these locations through director Peter Jackson's "Lord of the Rings" film trilogy based on the books of J.R.R. Tolkien, and in his recent release of the first in "The Hobbit" trilogy. Some of New Zealand's stunning scenery featured in these movies can be viewed here:

http://www.newzealand.com/int/

Within 2-3 hours drive of Invercargill lie many locations used in either "The Lord of the Rings" or "The Hobbit", plus additional scenery for which New Zealand is well-known. In addition to the beautiful southern lakes, there is easy access to the fjords around Milford Sound, majestic snow-covered peaks of the Southern Alps, the semi-arid desert-like areas of Central Otago and some of the best walking tracks in the world. Two hours drive from Invercargill is Queenstown, acknowledged as the adventure capital of the Southern Hemisphere, with hundreds of activities as diverse as bungy jumping, jetboating, and back-country safaris. While the TTSO7 meeting occurs at the end of autumn making temperatures cooler, this opens up new possibilities for those wishing to participate in winter sports. Alternatively, visitors are advised that

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ties as diverse as bungy jumping, jetboating, and back-country safaris. While the TTSO7 meeting occurs at the end of autumn making temperatures cooler, this opens up new possibilities for those wishing to participate in winter sports. Alternatively, visitors are advised that arriving earlier in May may allow you to still see some of the golden autumn colours for which the region is famous.

To get to Invercargill international visitors can fly into the city of Christchurch, and from there travel by plane, or by rental car via the inland Southern Scenic Route to Invercargill. If following the inland route you will pass through the Mackenzie Country, the world's newest – and largest - Dark-Sky Reserve (as declared by the International Dark Sky Association), which includes some 4300 square kilometres of the darkest skies on Earth. Near the centre of this region lies Lake Tekapo, home to Mt John Observatory with its 1.0 and 1.8 metre telescopes, the latter being home to the MOA (Microlensing Observations in Astrophysics) project hunting for exo-planets.

New Zealand has much to offer members of both the astronomical and environmental communities, and the organisers of TTSO7 will be delighted to assist visitors from overseas in making the most of their visit here.

For more information please visit the following websites:

TTSO7: http://occsec.wellington.net.nz/meetings/TTSO7/index.htm

RASNZ Conference: http://www.rasnz.org.nz/Conference/

A list of links related to New Zealand astronomy, dark skies and tourism is available on the TTSO7 home page.

Hi Jean,

Long time since we had contact. How are you ? Did you get married ?

Just received your observations. You mention a probably new double of Sep 8th in your letter but as I can see from the sheets it concerns most likely Oct 22nd observation.

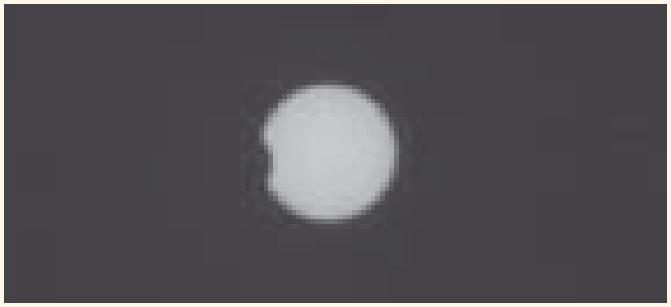
My astronomical interest has shrunken to observations of occultation by asteroids and grazing occultations.

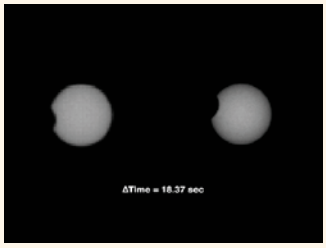
For your information I'm no longer collecting new double star observations. I will send a copy of this mail together with your observations to Dave Herald for him to process them and a copy to David Dunham as well. The reason for quitting the job is that my last publication about new doubles of Sep 29 2007 was never published. Last year after several reminders, especially from Japanese observers, Eberhard Bredner bluntly refused to publish it and any future publications of me. After some discussions in which David Dunham and Dave Herald played a positive role, I agreed to send updated information. I did send original mail reports to Dave Herald and David Dunham but got no reaction from them sofar nor have I seen any publication. I have lost interest since and I'm really to busy with other things.

I'm advicing people and businesses about a fast transition to green and renewable energy. I started a foundation to do this. Some 4 years ago I placed PV solar panels on my house and did a lot more in energy saving resulting in a negative energy bill (-9 euro per month in 2012). The government wants to ruin my living space by placing a few hundred mega (5 MW) wind turbines (198 m high) in my backyard. Since these plans were introduced I'm an advocate for a fast transition to real green energy without mega wind turbines ruining the landscape and the health of people.

Best regards, Henk & Jessica
Chairman "Stichting Duurzame Energieprovincie"
website http://energieprovincie.nl/

Phobos in Transit





Mars has two small, asteroid-sized moons named Phobos and Deimos. From the point of view of the rover, located near the equator of Mars, these moons occasionally pass in front of, or "transit," the disk of the sun. These transit events are the Martian equivalent of partial solar eclipses on Earth because the outline of the moons does not completely cover the sun (in contrast, Earth's moon does block the entire sun during a total solar eclipse). These eclipses, like those on Earth, occur in predictable "seasons" a few times each Mars year.

As part of a multi-mission campaign, NASA's Curiosity rover is observing these transits, the first of which involved the moon Phobos grazing the sun's disk. The event was observed on Martian day, or sol, 37 (September 13, 2012) using Curiosity's Mast Camera, or Mastcam, equipped with special filters for directly observing the sun. In a series of high-resolution video frames acquired at about three frames per second for about two minutes, the outline of part of Phobos blocked about five percent of the sun.

This animation shows the transit as viewed by the Mastcam 100-millimiter camera (M-100) in nine frames. Another version of the animation is available, consisting of 20 frames taken by the Mastcam 34-millimeter camera (M-34), which has about one-third the resolution of the M-100. In total, 256 frames were taken by the M-100 and 384 frames for the M-34.

Mastcam-34 animation:
http://www.nasa.gov/mission_pages/msl/multimedia/pia16151.html

Image credit: NASA/JPL-Caltech/MSSS

IOTA-ES Business meeting

2013

Location: Hannover, Germany
Am Lindener Berg
Public Observatory Geschwister Herschel
Date and Time: April 20th, 9:30 UT
Topics will be given later.
Please feel free to send us your meeting-proposals.

IOTA-ES
(Board of Directors)

Journal for Occultation Astronomy

The Uranian System Occults a 9th mag Star in May 2013. A Preview

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International Occultation Timing Association - European Section

Abstract and introduction

Since the detection of the Uranian ring system by occultation astronomy in 1977, seven occultations of stars by Uranus have been observed in the years up to 1983. This large number of occultations was possible because of the passage of Uranus through the galactic plane. In these years, an increase of the isothermal temperature increase from 100K in 1977 to about 179K in 1983 has been evaluated for an atmospheric pressure range from 0.1 to 10 Pa (Baron et. al. [1]). The occultations observed were all before Uranus' summer solstice in 1985. Later the number of occultations decreased, and after 1985 the Voyager UVS occultation from 1986 and an occultation on the 6th of Nov. 1998 were rare events.

The results from the 1998 occultation as published by Young et. al. [2] showed a reversed temperature development resulting in isothermal temperatures of around 120 K.

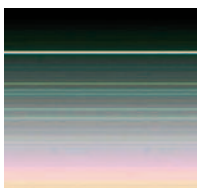
15 years later as 1998, on the 23rd of May 2013 an occultation will take place with the bright star 3UC 188-002199 having a visual magnitude of 9m2. The star is only about 3m6 fainter than Uranus in the V-Band. By observing in the methane absorption band of 890nm with a width of around 50nm the intensity difference can be brought down to nearly equal intensities for Uranus and the star. Therefore this occultation is ideal for continuing to follow the temperature development of the Uranian atmosphere.

Another aspect of the upcoming occultation is the analysis of the Uranian rings. Two aspects are important from a scientific point of view

The determination of the orbital parameters of the rings (radius variation etc.)

The optical depth of the different rings

For post event astrometry of the occultation, stations spread out as much as possible should be prepared to record the occultation. With only a single station, a correct localization of the track with respect to Uranus can not be achieved.



The 9 main rings of Uranus are visible here as horizontal lines. The somewhat fainter, pastel lines seen between the rings are artifacts of computer enhancement. Six narrow-angle images were used to extract color information from the extremely dark and faint rings. The final image was made from three color averages and represents an enhanced, false-color view. The image shows that the brightest, or epsilon ring at top is neutral in color, with the fainter 8 remaining rings showing slight color differences between them.

The star

The star has the following designations:

PPM: 143783; Tycho: 14-653-1; UCAC2: 2UC 32982944; UCAC3: 3UC 188-002199.

The star has the position from the UCAC3 catalog as follows: 00h 42min 01.613sec in RA and +03d 46' 57.76" in DEC for J2000. Spectral Type F5

Table 1:

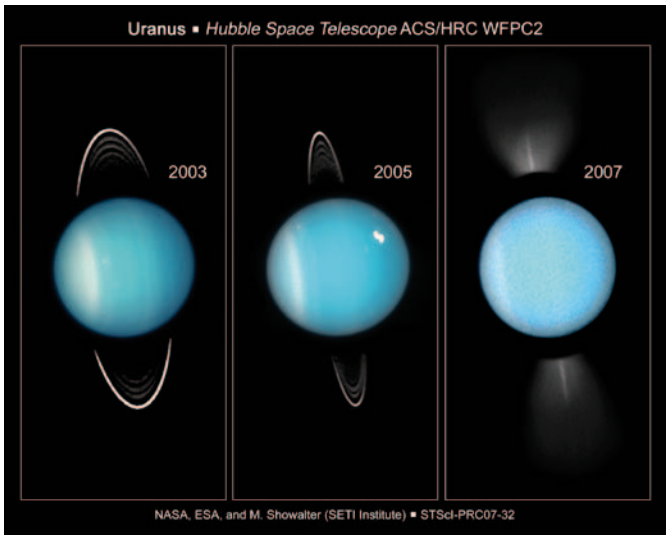
The stellar magnitudes of 3UC 188-002199 for different bands taken from different catalogs, as well as the magnitudes of Uranus taken from Schmude [3].

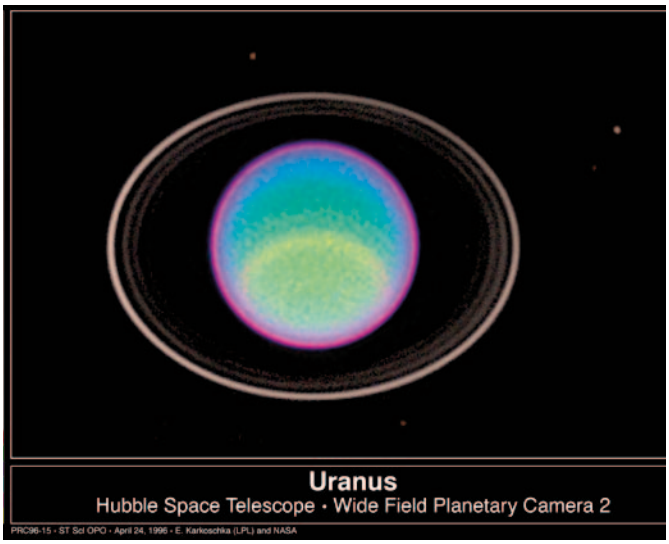
Band	Stellar mag	Catalog	Uranus mag
K-Band (2.2 µm)	8.026	2MASS	12.2 [6]
H-Band (1.6 µm)	8.098	2MASS	
J-Band (1.2 µm)	8.336	2MASS	
I-Band	6.64 [3]		
R-Band (600-750 nm)	8.930	USNO-B1	5.73 [3]
V-Band	9.273	Tycho	5.54 [3]
B-Band (400-500 nm)	9.784	Tycho	6.14 [3]

Using a prediction algorithm for stellar diameter developed by van Belle [4], from V - K = 1.247 and B - K = 1.758 a stellar diameter of about 0.104 mas can be determined. In the distance of Uranus (20.7 AU in May), this corresponds to a linear diameter of about 1.6 km. The error of this determination is according to van Belle [4] in the range of a few percent.

The planet Uranus and hints for observations

In different broad wavelength bands, the UBVRI system, Schmude R.W. [3] has determined the brightness of Uranus in the UBVRI Bands for a standard distance of 1 AU. Converted to the distance of Uranus in May 2013, the data are given in the last column of table 1. To calculate the actual contrast of the occultation, it has to be considered, that Uranus has a broad methane absorption band around 890 nm. Because of the low temperature the bands are much broader than for Jupiter and Saturn. Karkoschka [5] has presented a spectrum in this wavelength range, where he showed, that the albedo is very low for a wavelength range from about 850 nm to 930 nm. Even at longer wavelengths, the albedo does not considerably increase again, besides a little peak around 950nm. To preview, what has to be expected for the upcoming occultation, separate images of the star and Uranus have been taken





with a 27 cm diameter telescope (SCT type) instrument with a focal length of 2700 mm. Using a RAPTOR (c) EMCCD camera with the TC247 chip (Texas Instruments) , images, darks and flats have been taken. As filter selections setups with

- a) no filter at all,
- b) a long path filter for wavelengths longer than 850 nm (RG 850, 3 mm thick, Schott, Mainz, Germany), and
- c) a methane band pass filter with 17nm FWHM and about 85% maximum transmission at 890 nm (Dr. Hugo Anders, Gesellschaft für dünne Schichten, Nabburg, Germany)

have been used. The elevation above horizon for all images were similar, about 35 degree. Resulting FITS Files have been reduced using MIDAS software system.

The estimated occultation depth, normalized to the sum of Uranus and the star is presented in Table 2.

Table 2

Uranus/(Uranus + star)		
no filter	850 nm LP	890nm BP
0.94	0.61	0.50

Therefore, without filter the light is dimmed at full occultation by only 6 %, using a 850 LP filter by 38 % and using the 890 BP filter by 50 %. However, the exposure times are very different for the filters. Whereas without filter and a gain setting of 50% of the RAPTOR (c) camera, exposure times of 50 msec (no filter) and 500 msec (RG 850) have been used, for the images with the 890 BP filter the gain has to be increased to 60 % and the exposure time as well to 2000 msec. Concerning all these data, the best recommendation for the moment would be to use a RG 850 filter as a good compromise between light loss and increasing contrast.

Using the RG 850 filter, the amount of electrons, the star delivers in the CCD, is around 7 % of the intensity without any filter. This factor is dependent on the actual sensitivity curve of the used chip, in general, it will be a little better even for EXVIEW (c) CCDs as for the TC 247 in the RAPTOR (c) because of its higher sensitivity in the near infrared. For Uranus this value is less than 0.7 %, reflecting the low albedo in the near infrared..

Using the RG 850 filter, the possibility for observation will be dramatically increased and allows the use of instruments with less than 0.3 m diameter. Filters, which were used for Jupiter and Saturn occultations in the past at many stations (so called methane band filters) with a bandwidth of around 17 nm can be used too, but the absolute amount of photons transmitted per time is rather small, due its small bandwidth. It can however be used with larger telescopes or longer exposure times.

IF higher contrast is required, the use of cameras for the K-Band would be the method of choice. As has been shown by Nicholson and Jones [6], Uranus has a magnitude of only 12m2 in the K-Band, whereas the star is around 8th magnitude. This would give very brilliant results, Uranus would be more or less black at these wavelengths.

The relative movement of Uranus with respect to the star as seen from earth will be around 5.33" per hour in RA and 2.33" per hour in DEC (data taken from WINOCCULT). This corresponds to an overall movement of 5.81" per hour. Using the stellar diameter above, it will take about 65 msec to pass one stellar diameter.

The occultation

A general overview of the occultation using the WINOCCULT program is presented in fig. 1.

The view of the Uranus system including the rings with respect to the star at the time of occultation has been determined using the Uranus Viewer Tool from the PDS ring node (fig. 2). The red line gives the relative movement of the star versus Uranus during the occultation. The occultation will be near grazing for Uranus itself. This allows a very detailed analysis of the atmosphere, because the angle is very flat, and therefore a very good resolution with respect to the height above surface is possible. It is very likely, that the star can be seen during the full time of occultation behind the planet, with a lot of flickering and dimming. The only problem may be the relatively large diameter of the star, about 1.6 km in the distance of Uranus. This reduces the spatial resolution.

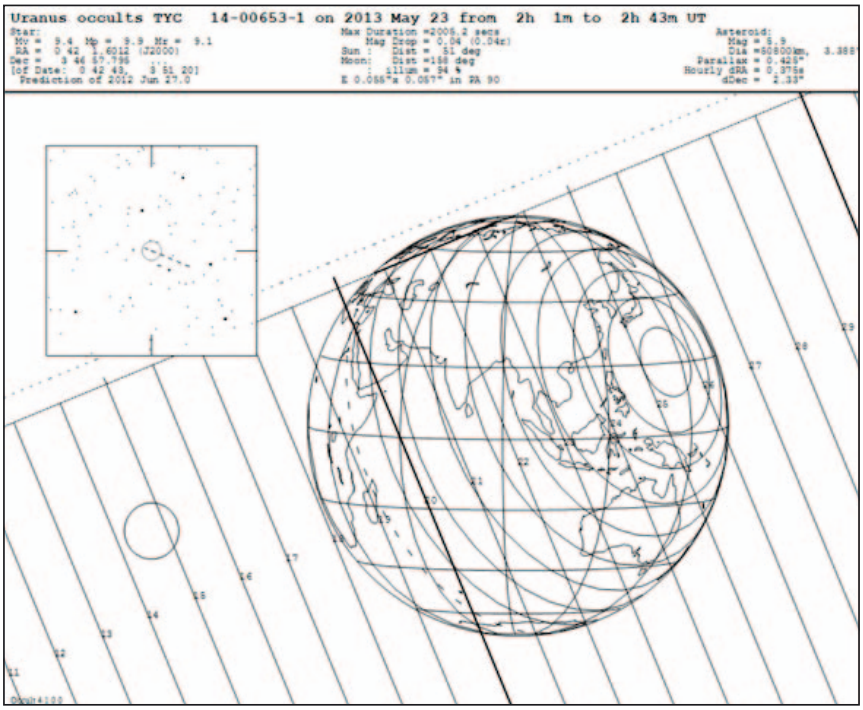


Fig. 1 Global view of the occultation by Uranus on 23rd of May 2013 as calculated by WINOCCULT software

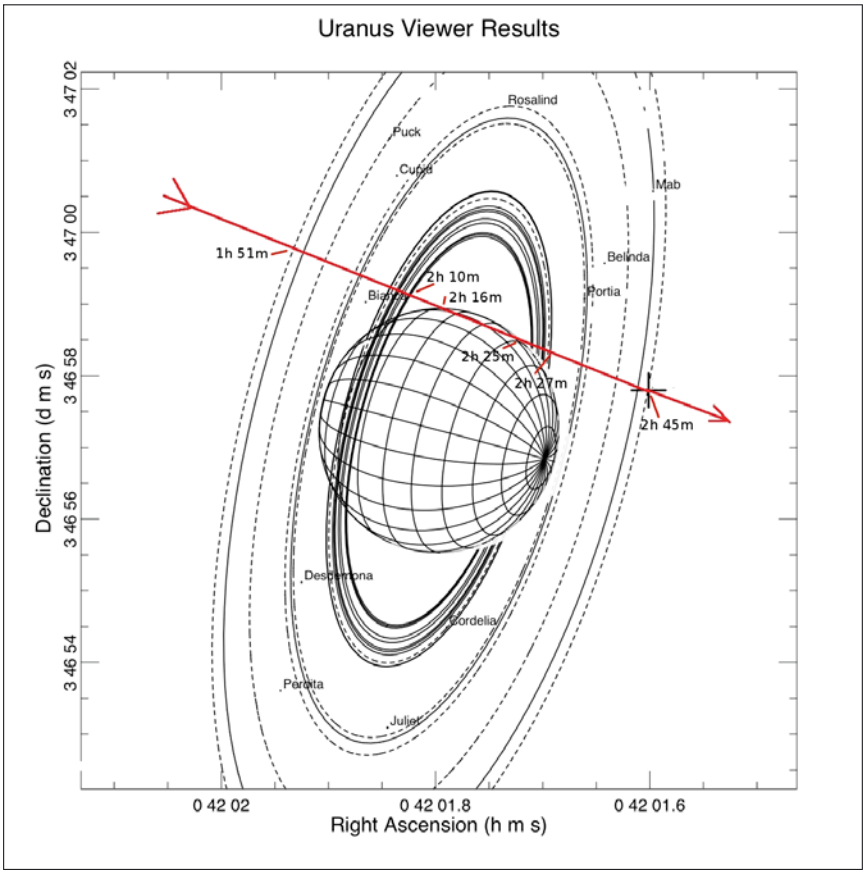


Fig. 2 View of the relative movement of the star with respect to the Uranus system, including satellites and ring structure. Calculated using the Uranus Viewer Tool from the PDS ring node. The timing are approximate timings only.

From where to observe?

The area of good observability is rather small, as you can even guess from the UTC time of the occultation. Two main areas are important, one in the eastern Mediterranean and the other in southern Africa, but on the east side (not Namibia!). On fig. 3 and fig. 4 both graphs show the areas as plotted from WINOCCULT program. At the black line, the sun is -0 deg below the horizon, at the blue line its -10 deg and sunset is, where the red line is plotted. Yellow lines mean solar elevations of 10°, 20° and 30° above horizon. The view is from Uranus in direction of the earth, in order to see the elevations of Uranus. Optimal conditions are on Crete, mainland of Greece, perhaps central Bulgaria or western Romania. It is okay to observe from western Turkey and from Egypt. Excellent conditions would be around Aswan. Excellent conditions (astronomical) would be in eastern Somalia, followed by Kenya and the African east coast down to the Republic of South Africa. For Reunion and even more for Mauritius the sun may be too low, but otherwise it would be a good choice, because there are also telescopes available. In South Africa the Boyden Observatory near Bloemfontain with its instruments of up to 1.5 m are interesting.

It has to be emphasized, that observations from two distant sites are urgently requested, because otherwise a clear astrometric analysis of the position of the star relative to the ring system and Uranus itself is not possible. If the data of the occultation should be used to define orbital parameters of the rings and a for detailed analysis of Uranus' atmosphere, this is absolutely important.

Conclusion

The occultation of a 9th mag star by Uranus on the 23rd of May 2013 will be a unique possibility to measure the Uranian ring geometry, its optical depth and properties of the Uranian atmosphere.

Using proper filtering in the near infrared, even with small telescopes a sufficient depth of the occultation near 30% can be achieved. Areas of visibility are in the eastern Mediterranean and southern Africa as well. More details for this occultation will be published on the website http://www.iota-es.de/uranus2013/ .

Literature

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[5] Karkoschka, E.: Spectrophotometry of the Jovian Planets and Titan at 300- to 1000 nm wavelength: The Methane spectrum. Icarus 111, 174-192 (1994)

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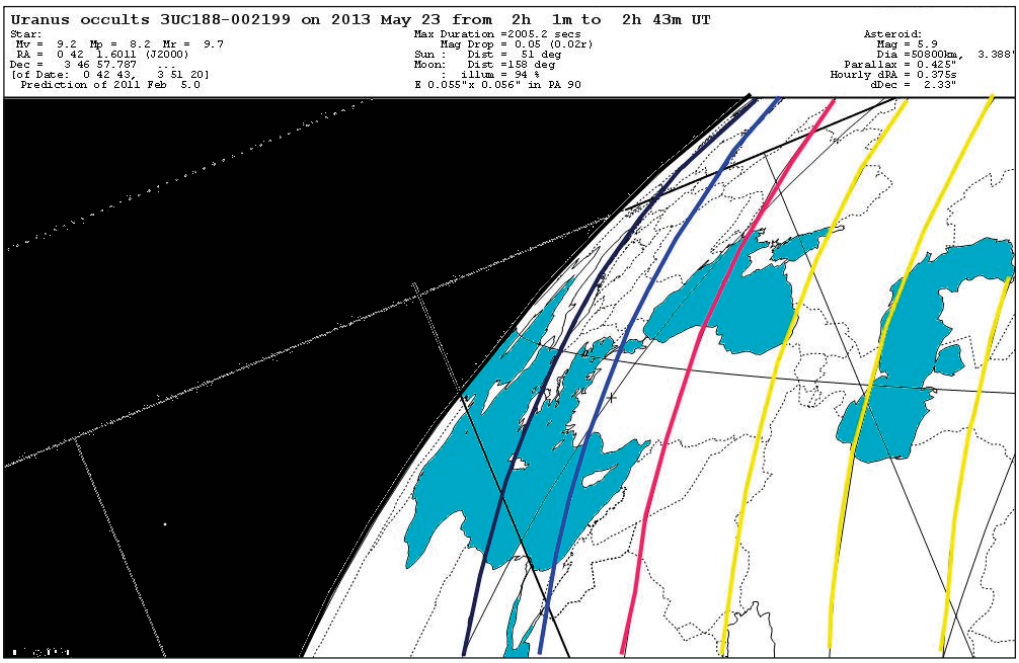

Fig. 3 Northern part of the occultation situation as viewed from Uranus. The map is calculated using WINOCCULT. The black line drawn are the sun elevation of -20 deg, the blue is -10 deg and the red is 0 deg elevation. Following yellow lines are 10 deg, 20 deg and 30 deg above the horizon. Calculated for the center time of occultation.

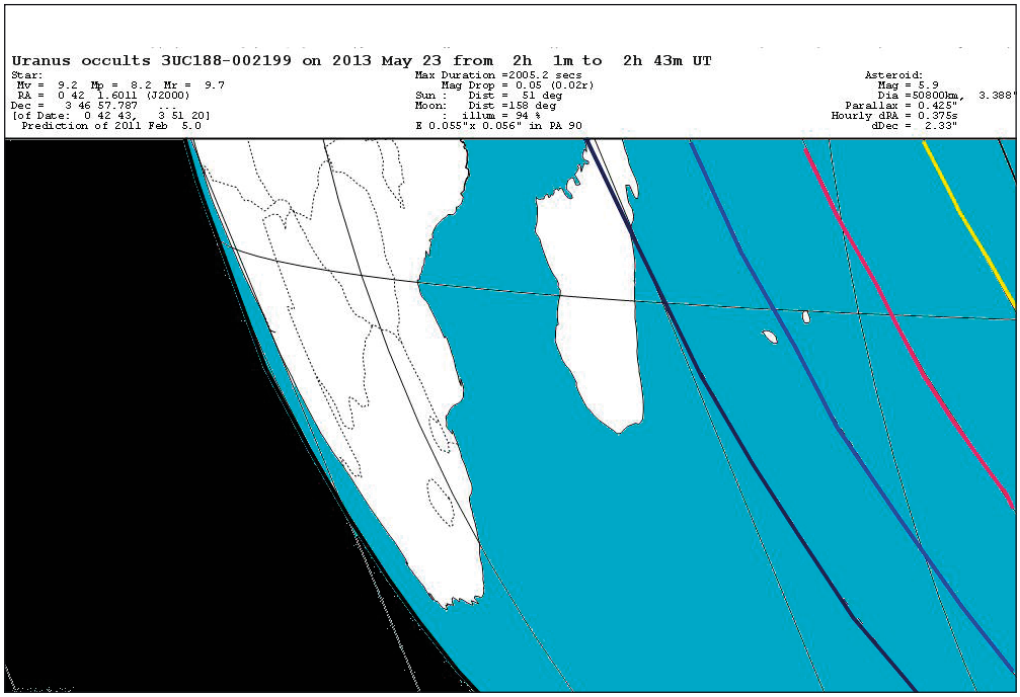

Fig. 4 Southern part of the occultation situation as viewed from Uranus. The map is calculated using WINOCCULT. The black line drawn are the sun elevation of -20 deg, the blue is -10 deg and the red is 0 deg elevation. Following yellow lines are 10 deg, 20 deg and 30 deg above the horizon. Calculated for the center time of occultation.

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IOTA's Mission

The International Occultation Timing Association, Inc. was established to encourage and facilitate the observation of occultations and eclipses. It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made.

The Offices and Officers of IOTA

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http://www.occultations.org
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This site contains information about the organization known as IOTA and provides information about joining

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