Journal for Occultation Astronomy

2011-03

FORMERLY OCCULTATION NEWSLETTER

Measurement region of Limovie for occultation by Earth-lit Lunar limb

August 10, 2009 ■ Kazuhisa Miyashita* ■ k_miyash@js5.so-net.ne.jp

*Japanese regional coordinator for Lunar Occultation observation)

1. Introduction

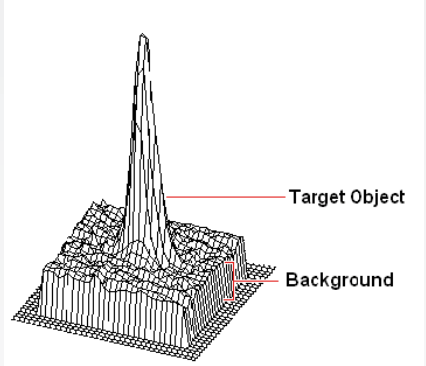

Figure 1 3D graph of video image

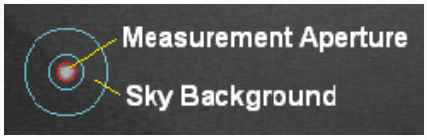

Figure 2: Measurement region of Limovie

Limovie measures the luminous intensity of the target object with a measurement region which consists of a measurement aperture (called aperture in Limovie) and background region (called background). The sum of the pixel values in the measurement aperture contains CCD noise, light of neighbouring stellar objects and haze in addition to the target star. The light sources other than the target star are called background-light in this paper. It is impossible to directly measure the background-light in the measurement aperture. Instead, the background-light is estimated from the neighbouring sky background area using the background aperture. The measurement value is obtained by subtracting the estimated background-light from the value of measurement aperture. Therefore the background region should be positioned on an area which represents the backgroundlight of measurement aperture. In an asteroidal occultation, the video image usually has a uniform sky background. On the other hand, in a lunar-occultation the target star comes into contact with the earth-lit dark limb of moon. In that case, measurement aperture includes both sky background and earth-lit lunar surface. As a result, it is difficult to estimate the background-light by using standard annular background region because no information about the area and brightness of lunar surface in the measurement aperture can be obtained. In this paper, I describe a study about the form of background region which most accurately estimates the background-light.

2. Photometric measurement region of Limovie, and earth-lit lunar limb

Figure 3, which is derived from the 3D graph of Limovie, shows the distribution of pixel values around a star. The sky-background looks like a coastal plain, the moon's surface is a plateau, and the lunar limb is a linear precipice. The figures at the right side show three different location of measurement region. In (a), the measurement aperture is placed on the sky background. However, the annular background region includes a part of lunar surface. As a result, the background-light value derived from background region is higher than the real background-light of the measurement aperture. In (c), the measurement region lies on the moon's surface. In this case, the background-light value is lower than its real value because the background region includes sky background, and the calculated luminous intensity of star becomes higher than its real value. Therefore, at a disappearance event the luminous intensity which is derived from Limovie analysis gradually increases according to movement of moon. The situation is shown in Figure 4. It is the value of an empty (that is, not including any star) measurement-aperture as the moon limb passes through the aperture. If there is a star in the measurement aperture, the light change will consist of the change caused by the occultationtogether with the influence of moon surface. And it can become difficult to detection the event time. Additionally, in the case of a faint double star, any estimate of component's magnitude will be inaccurate.

Journal for
Occultation Astronomy

Dear reader,

a long-term astronomical friend, Ingo Reiman, , passed away a few weeks ago. He was very experienced in grazing occultations and a brilliant observer as well as a teacher of astronomy.

Looking around many of my old friends have grown old – just like me: But where are the young ones?

Is astronomy no longer of interest to younger people? As a 13 year old boy I kept in touch with astronomy.At school an astronomy class was held and many students were active within this group until they left school for university studies.

When studying at Hannover University some friends and I still were active at our former school but had to discover that the astronomical interest of younger people was slowly vanishing. We checked some more schools with astronomy classes and talked to their teaching leaders: The situation we discovered was similar everywhere. It must be a result of modern technologies: TV, internet, play stations, etc.

What are our conclusions for the future?

I think it is necessary to publish our ideas, plans, efforts, and results using the internet and additionally the classical print media!

Everybody who is doing astronomical work ought to also present and publish what he/she does whereever possible!

Hans-J. Bode (editor in chief)

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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:

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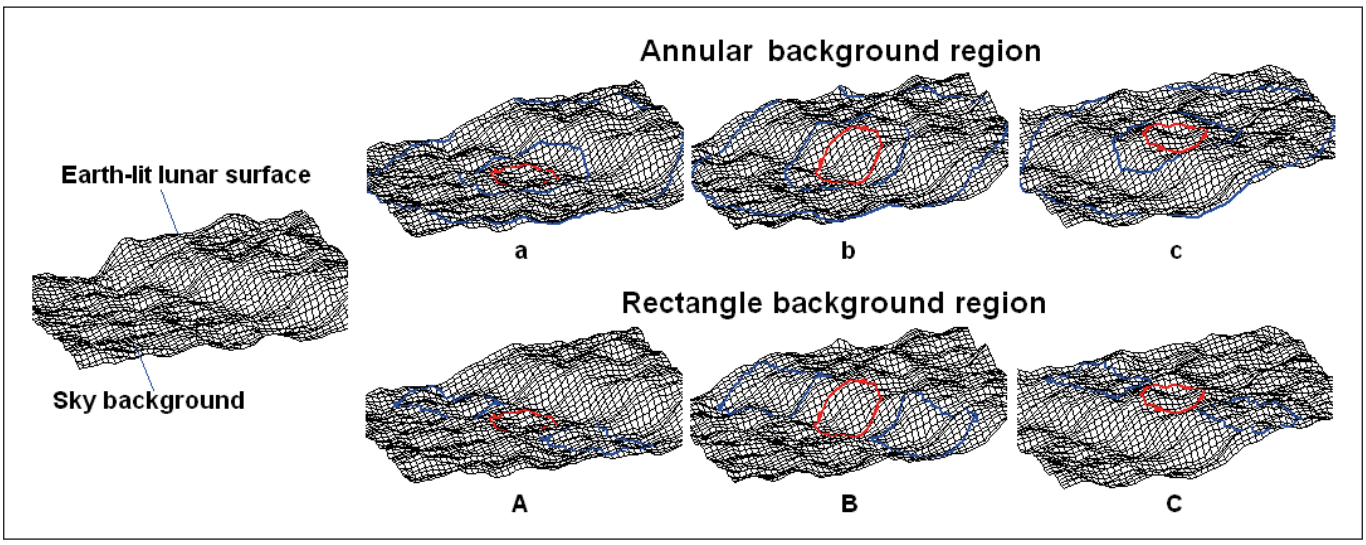


Figure 3: 3D view of lunar limb and measurement region of Limovie

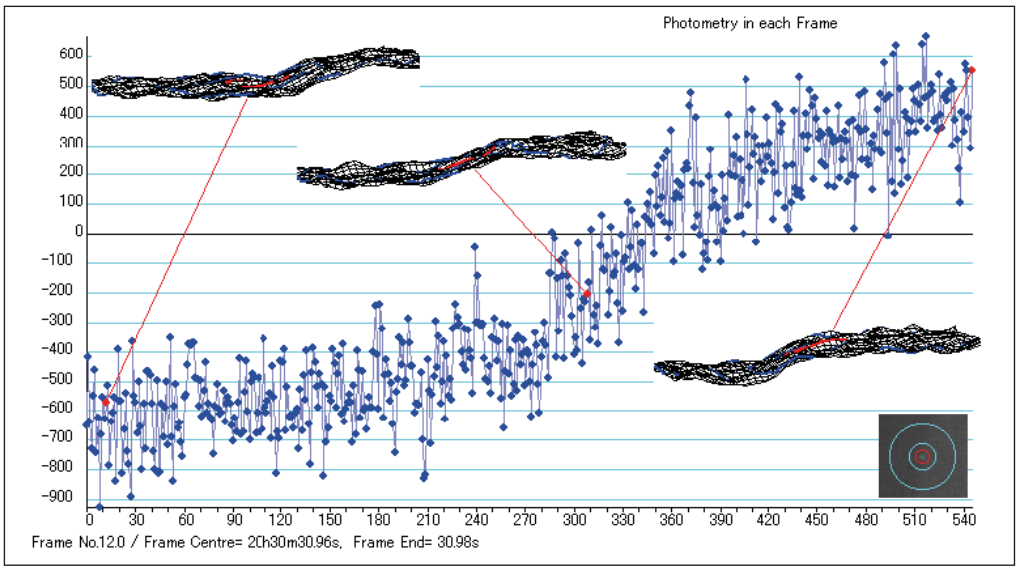
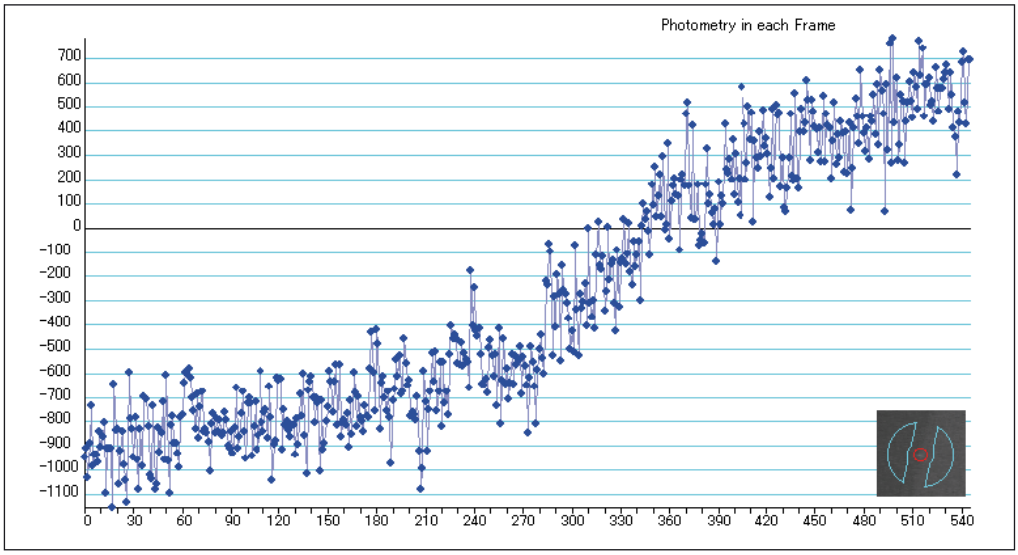


Figure 4: Light change of aperture which does not include any star during moon limb passes through on it. Using annular background aperture.



Using gapped annular background aperture.

One possible solution is to use a gapped annular background aperture. The background region with such shape makes the estimated background value invariable. However, the result of photometry is similar to the light curve which is derived from standard annular region - because the background-light in the aperture changes with the movement of the moon.

To avoid this problem it is necessary to provide a background region which has same background to measurement aperture. The rectangle background region provides a solution. The picture B in Figure 3 explains how it works. The background region lies on the same slope with measurement aperture. The background-light of background area is very near to that of the measurement aperture. In the case of A and C, similar effect to case B is expected.

Figure 5 shows the effect of this rectangle region. There is no change in the measurement during the passing of lunar limb. It means the background light in the measurement aperture is almost completely calibrated. It is expected that the magnitude of a double star's components will be estimated more accurately if

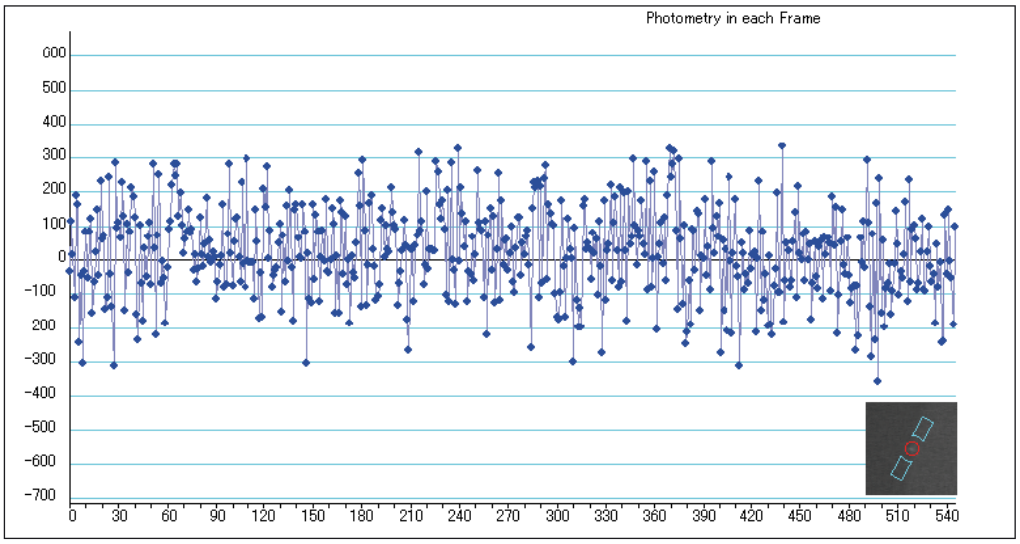


Figure 5 Using rectangle background regionalong lunar limb

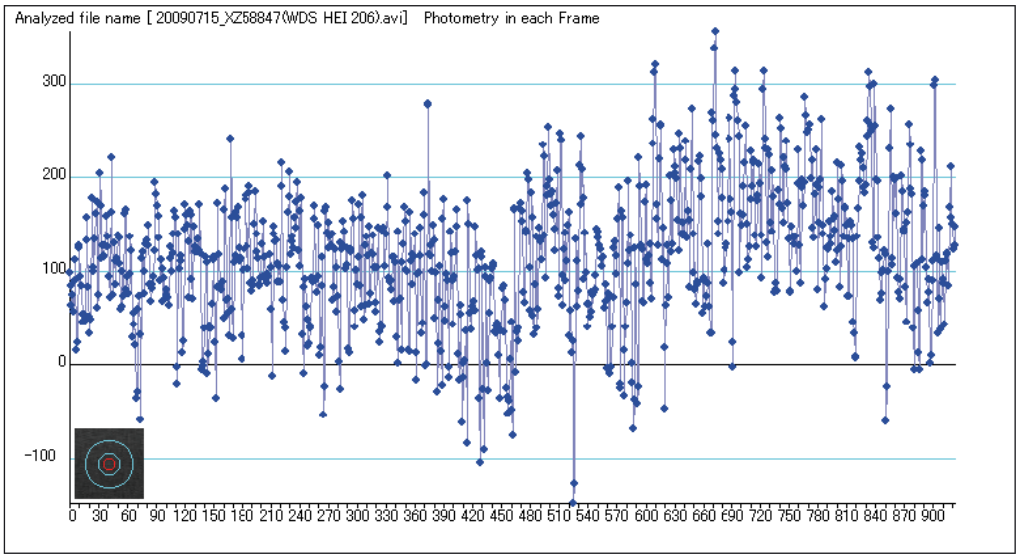


Figure 7 Light curve derived from Limovie photometry using annular background aperture

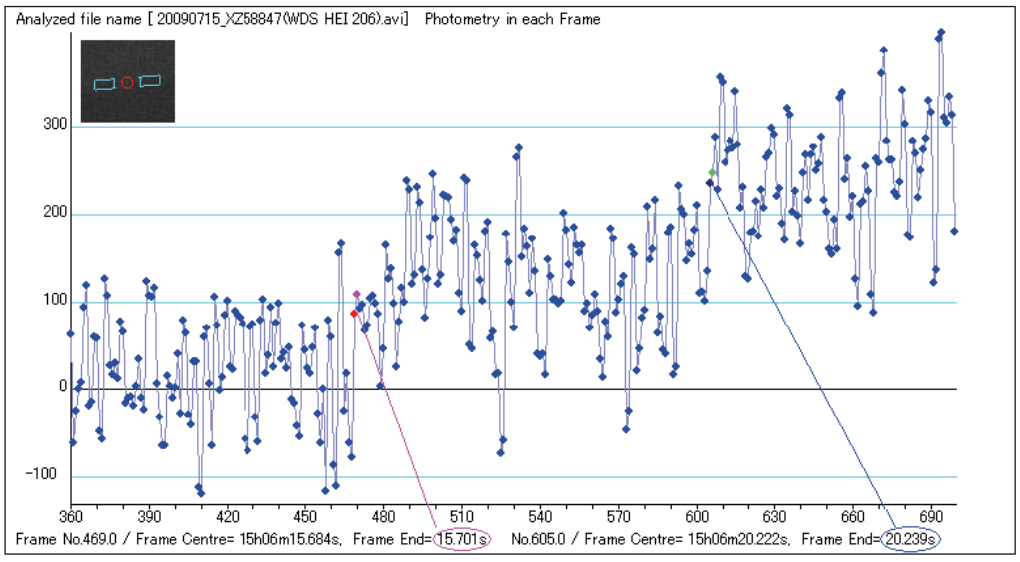


Figure 8, Light curve derived from using rectangle background aperture

this background region is used. The operation of this in Limovie is as follows.

1st. In Form of BKG Area box, select Meteor / Lunar Limb.

2nd. Set Gap to zero, and set Width to the same value as the aperture's radius.

Some other approaches were also considered. One involved two circular background areas, each having the same size as the measurement aperture. They would sit on either side of measurement aperture. It is expected they would provide complete compensation. However it was not incorporated into Limovie, as it would result in a new source of noise. It is necessary to make the measurement aperture small to minimise noise, and this would mean that the two background regions would also become small. However too small a background region creates large noise compared with a larger background region. The rectangle region allows the background region to be larger than circle of the measurement region.

3. Application to occultation observation

It is difficult to obtain the accurate time of a faint star occultation. When viewed on a video monitor, the star gets mixed among many peaks of CCD thermal noise, and has heavy blinking caused by air scintillation - which makes the event time inaccurate. Even in such situation, Limovie photometry gives us the material for an objective decision. And for this photometry, it is important that value of background level on the graph is constantly zero. I have confirmed the effect of using a rectangle background region for faint star occultation. XZ58847 is listed on WDS cata-

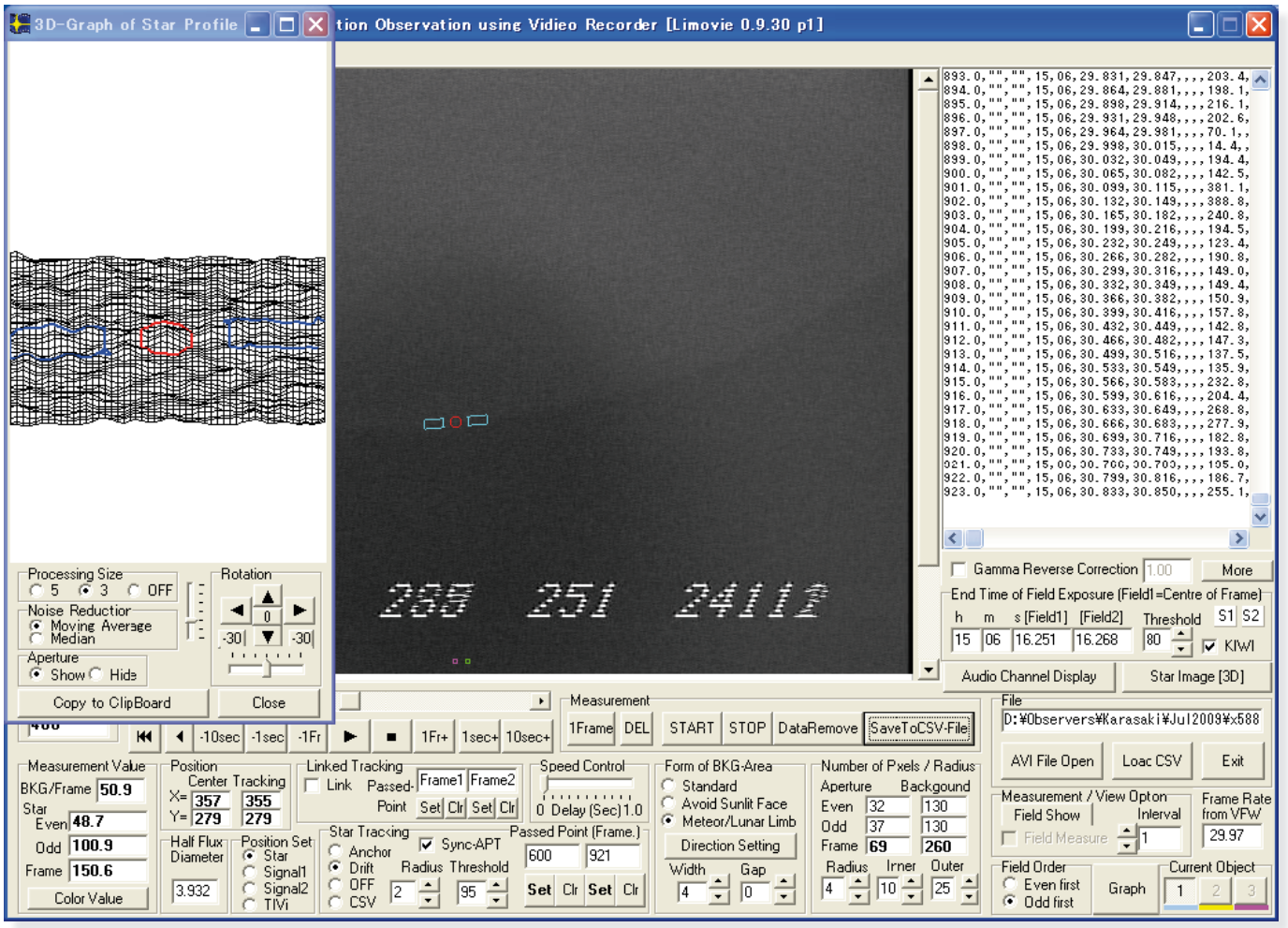


Figure 10 Analysis used rectangle background region (observed by H. Karasaki)

logue as double star which contains 10.70 magnitude main star and 10.78 magnitude companion star with 2.4 arcseconds separation and 57 degree position angle. The time difference between

the event times of the components is 4.1 seconds.

Figure 7 shows a result of Limovie analysis using an annular background aperture. It shows the star appearing at about frame No.470. However event of the other component is indistinct. On the other hand, the use of a rectangle background region clearly brings out the step of double star from this noisy video image. And this graph shows the magnitude of two stars is comparable each other, in agreement with the WDS description. Thus, it is understood that the magnitude of double star components can be reliably estimated by this analysis.

4. Conclusion

The rectangle setting for the background region enables accurate photometry in the analysis of lunar occultation. Almost all observable lunar occultation events occur against an earth-lit lunar surface (or a nearby bright terminator with strong glare which changes across the measurement aperture). For compensation of this, I strongly recommend using a rectangle-shaped background regionfor all of lunar occultation observation.

Acknowledgement

I want to thank Hideyoshi Karasaki and Masayuki Ishida for providing their valuable video of lunar occultation observation, and for discussing with me about observation and analysis technique of lunar occultation. And also, I thank Dave Herald for giving many advice for this paper.

Reference

Note: All of following references are written in Japanese.

K. Miyashita, T. Hayamizu, M. Soma, Limovie, a new light measurement tool for occultation observations using video recorded, Report of the National Astronomical Observatory of Japan (ISSN 0915-6321), Vol. 9, No. 1 - 2, p. 1 - 26 (2006), http://library.nao.ac.jp/naoreport/9-12.pdf

K. Miyashita, Confirmation of the component of SAO75671 by occultation observation, (2007), http://astro-limovie.info/occultation_observation/doublestaranalysis/071123sao75671/sao75671jp.html

K. Miyashita, Applying Limovie to photometry for a faint star occultation, (2005), http://astro-limovie.info/occultation_observation/20021013.html

Journal for Occultation Astronomy

An Apology and a Pledge

by David Dunham (IOTA), Hans-Joachim Bode and Michael Busse (IOTA/ES)

The first two papers of this issue were submitted a few years ago for publication in Occultation Newsletter. We owe a deep apology to the authors for the long delay in the publication of their papers, and we pledge that such delays will not happen again, that future papers that are accepted for publication will be published in a timely manner.

The article by Kazuhisa Miyashita was submitted after publication of the last issue of Occultation Newsletter (Vol. 14, No. 1); that issue was dated January 2009 but was actually distributed in June 2009. Receipt of Miyashita-san's paper was acknowledged by the Occultation Newsletter (ON) editor on 2009 September 21, but unfortunately, no more issues of ON were prepared in the USA. With the establishment of Journal of Occultation Astronomy by IOTA/ES last year, the successor journal of ON, we hoped to publish the articles left over from the demise of ON, but in the rush to establish JOA, only new articles were published in the first issue published last December. A formal arrangement was established for submitting articles for publication in JOA using national coordinators, as described in the box on writing and sending articles for JOA on p. 2 of this, and previous, issues. In February, Mitsuru Sôma, the Japanese national coordinator, submitted Miyashita-san's paper in time for publication in issue #2 of JOA. Inexcusably, the article was overlooked when issue #2 was assembled and published in March this year, also assembled quickly to meet JOA's first quarterly deadline; we are committed to maintain a quarterly publication schedule. We apologize to Miyashita-san for this oversight. Although appearing late, the article is as relevant today as it was in 2009.

Unfortunately, Henk Bulder's paper was delayed even more. His archival paper about double star information derived from occultation observations is one of a series of papers on double stars discovered during occultations that go back to the earliest issues of ON. Apparently, it was submitted to ON in the middle of 2007; at least three issues of ON were published without including it. The paper had been forgotten, inexcusably "slipped through the cracks", until Miyashita-san brought the omission to our attention in May. It is important to document these observations. The paper is probably the last of the long series of occultation double star papers published in ON (and now, in JOA) since, with IOTA's assumption of collection of all lunar occultation observations from the International Lunar Occultation Centre in late 2008/early 2009, the reporting procedures were changed. In collaboration with other astronomers working on cataloging double star discoveries, we decided that such articles should henceforth be published in **Journal of Double Star Observations (JDSO),** the avenue for incorporation into the double star catalogues maintained by the International Astronomical Union, and we have published some articles in JDSO, as indicated in the external publications articles in this and the previous issue of JOA.

We thank Henk Bulder, and Tony Murray before him, for carefully documenting double star results derived from occultations for so many years. We profusely apologize to Henk Bulder for the very long delay in publishing his paper, which includes important results of Japanese observations submitted by Miyashita-san.

If readers know of any other articles that were submitted to ON and never published, please let us know. We pledge to do better in the future, rigorously following the procedures that we have established for submitted articles. We will publish all articles cleared by the national coordinators and JOA editorial board (if there are any problems, they will be promptly discussed with the national coordinator and/or the author) either in the issue for which a deadline has been set, or at the latest, for non-time-critical articles, in the following issue if for reasons of space and layout it is too inconvenient to publish in the current issue. So in the future, there should be a possible delay of at most one issue, but not (that is, no delay) for time-critical articles, relating especially to events or meetings in the next 4-5 months.

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New double star discoveries

Henk Bulder · This publication is a follow-up on the publication in ON 13,1,7-8.

I heard that several observers assume that occultations reported to ILOC containing double star information are automatically forwarded to me. This is not the case, so, please always send me a copy of your ILOC reports. Several observers have video recorded known double stars and processed the video with LiMovie. They found no double star evidence. Any such reports sent to me may result in the stars being marked single in the double star files of WinOccult. This is especially true if the original discovery of the double star was made visually and the spectral type is G or later. In such cases the original discovery might have been caused by stellar diameter effects. If the double star discovery was made by video I will need two independent video observations at different position angles to declare the star single again. Gerhard Dangl recorded some negative video observations too but his observations are not included here yet. He has to reprocess his video material first using LiMovie. To keep track of the negative observations for future use I have created a file XZNegatives.DAT.

OCC	X	SAO/ZC	MAG	DATE	(DISCOVERER)	OBSERVED BY	REMARKS
0000	3517	387	6.9	20060911	(?)	B Loader	video
0000	25814	2721	3.2	20070603	(MI ?)	B Loader	video phi Sagittarii
109	24233	2583	5.8	20070602	(W M Worssell)	D Herald	video
699	10561	79122	7.6	20070131	(J Vannuland)	S Messner	video

TABLE 1 Known doubles observed to be single

As you can see one of the above stars was discovered to be double by W.M. Worssell. In the previous publication 4 of the negatives were discovered by him too. From this we can deduce that many of his double star discoveries were likely due to other causes, although we need more observations to be sure.
In table 2 possible new double stars are presented. For stars for which no estimates were given for the individual components both components are assumed to be equal in magnitude. If the sum of the reported estimates does not match the total magnitude of the pair, the estimates are up- or downgraded until they do. That is why the magnitudes can differ from the ones reported. If the first component is reported to be fainter than the second 180 is added to position angle.

OCC	X	SAO/ZC	MAG1	MAG2	SEP	PA	DATE	DISCOVERER	REMARKS
1130	9863	1042	6.7	9.8	.05	88	20070326	A Ling	video
1131	21454	183591	8.8	8.8			20070518	H Raab	video (1177) Gonnessia
1132	22387	2370	7.6	7.6	.25	112	20060901	B Culbertson & S Black	video
1133	28426	189292	9.4	10.3	.24	235	20070411	B Loader	video

TABLE 2: New double star discoveries till 1.9.2007

A nice confirmation of a known double X 17514 (SAO 118981, ZC 1692) was video recorded by three Japanese observers Masayuki Ishida, Tomohisa Ohno and Kazuhisa Miyashita. A combination of the three video recordings resulted in the data presented in table 3. For comparison the last entry in the double star catalog dating from 1991 is listed too. The new data for separation and position angle are entered in the double star catalog. The original magnitudes are kept since they lie within the accuracy range of the new data. A full report of the analyses by Kazuhisa Miyashita can be found at:

http://www005.upp.so-net.ne.jp/k_miyash/occ02/doublestaranalysis/070428sao118981/sao118981_new.html

	Observation	Catalog (1991)
Separation (arcsec)	0.68 +/–0.10	0.8
Position Angle (degree)	127 +/– 10	131
First star(mag)	7.00 +/– 0.03	6.99
Second star(mag)	9.79 +/– 0.42	9.97

TABLE 3: New data for know double star ZC 1692

Updated XZDoubles.DAT, XZDoubles Discoveries.DAT, XZConfirmations.DAT and XZNegatives.DAT can be downloaded from http://www.lunar-occultations.com/iota. Copy these files to the StarCats directory in WinOccult. Don't forget to use option 6 (Update XZ catalogue if new double files...) in star catalogues menu to make them active.

Journal for Occultation Astronomy

Total Lunar Eclipse in the Bukowiec Observatory – short report.

By Pawel Maksym

Total eclipses of our Moon are always a good opportunity to make some timings of total lunar occultations. Obviously, in the Pope Silvester II's Observatory in Bukowiec (Poland) the equipment was ready and well prepared for timing the events during the phase of totality. Our biggest problem during the eclipse was the low altitude of our only natural satellite above the horizon.

During the whole day the weather was quite good and we were positive that the evening observation would be successful. Finally, when the Moon rose above the horizon at known azimuth, it was covered by a quite dense layer of clouds.

After one hour we were able to see a totally clear sky in the zenith but near to the southeast horizon only the brightest stars like Antares were visible… so we were surprised that we could not see the eclipsed Moon!

After several minutes I saw a very dark lunar limb through a 50mm finder scope and soon also through the main 250 mm SC scope. As anticipated the eclipse was very dark, so we were unable to detect lunar light through thin clouds with the naked eye. To take a photo with a 10 cm f/10 refractor it was necessary to use 5-8 sec. of exposure time at ISO 800! Even with such a long time the totally eclipsed Moon was dark as presented in the photo below:

There was no chance to make any registrations of occultation events but we were happy that we were able to see such a dark lunar eclipse. There is no doubt that the eclipse was one of the darkest in modern history. Due to the favorable geometry of the Moon's path through the umbra and the quantity of volcanic ash in the atmosphere, in our opinion this event reached L=4 in the Danjon scale.

To show how dark the eclipse was I took a photo which demonstrates the Moon's appearance at the end of the phase of totality, as observed with the naked eye:

We are looking forward to observe the next lunar eclipse – on 10th December 2011 – to see for what period of time ashes from the Icelandic and Chilean eruptions will affect the transparency of the Earth's shadow.

Journal for Occultation Astronomy

Eta Geminorum Graze in Arizona April 10: The Rise of the Machines

David Dunham · dunham@starpower.net

Some warned that Judgment Day would be on April 21st this year, but for me, it came eleven days earlier as the jagged northern edge of the Moon's shadow from the grazing occultation of 3rd-mag. eta Geminorum crossed North 387th Avenue in the Arizona desert northeast of Tonopah about 50 miles west of Phoenix. It was a humiliating defeat, with the machines scoring three and humans, zero. For the first time, three stationary remote telescope systems recorded the lunar profile while human attempts in the area failed. John Connor, where were you when we needed you?

The grazing occultation occurred around 4:57 UT April 10 (9:57 pm MST Sat. April 9 in Arizona), about 90 minutes after a squall line drenched the area with heavy rain. The prediction of the narrow graze zone was accurate; there were five occultations of the star, including one about a minute long at the southern station, a good recording with an 80 mm short-tube refractor "midi" system. The northern station, about 0.1 km north of the predicted northern limit, had only one occultation lasting about four seconds, by the highest mountain on the profile; the view was better than I expected, using only a binocular-based "mighty mini" video recording system. The central station recorded three occultations with a midi, but I made a time adjustment error (my pre-point charts were made for Casa Grande, about 70 miles to the southeast where the graze occurred a minute earlier, so I mentally adjusted the times on the charts to compensate) so that the first disappearance occurred only a second or so after the star drifted into the field of view; it probably missed some earlier occultations. So due to operator error, the machine successes were really about 2 1/2 rather than 3.

Between the central and southern station, I tried to observe from a fourth station with a 120-mm refractor "maxi" system, near where the most multiple events were expected from the predicted profile, but I arrived there shortly before the graze, after starting the recordings at the other stations. The machines struck back, with the camcorder giving an error message, "eject tape" (I hadn't seen that before) so it wouldn't record. By the time I switched to another camcorder and acquired the star, the graze was over, so I was disappointed; humans, zero. But I was encouraged when I reviewed the remote station recordings back at my motel. Overall, as long as the Moon is a crescent (the slimmer, the better) and the cusp angle is greater than about five degrees, the mini's can probably record grazes of stars to about 5th mag. while the midi's can probably reach 7th mag. (but with their field of view, the graze duration should be less than three minutes, precluding some slow southern-limit grazes). If I had had all the time from dusk to the graze with clear skies (instead of the approximately 70 min. that I had), I could have set up several more mighty mini stations; I look forward to a future opportunity where I'll have enough dark time for a suitable graze to do that. I thank Ernie Iverson for the pre-point charts that he prepared for the eta Gem graze.

When I arrived at Phoenix airport about 1 pm that afternoon, it was overcast with light rain and cool, unusual conditions for that area due to a front moving through. I might have changed my reservation to fly to California instead, but that would have added about $200 to my "internet special" ticket cost, and it was not obvious that the weather forecast favored sites in northern California until after I had printed my boarding pass to Phoenix. Before the graze, Wayne Thomas and I had decided to try the graze from Eagle Eye Rd., approximately a 40-minute drive farther west; the graze path crossed no paved roads between North 387th Ave. and Eagle Eye Rd. But as we drove west from Phoenix, the sky cleared well as we approached Buckeye, and Michael Collins (an observer who lives southeast of Phoenix) called me saying he could reach Buckeye to observe the graze, but not farther west, and was concerned about observing from a site on Turner Rd. (an earlier site just west of Buckeye, AZ about 30 miles west of Phoenix) without notifying the residents of the house there. So we drove there and informed the residents what we were doing. The sky looked promising; the view of the satellite loop earlier indicated that the clouds were moving mainly from south to north. At the Turner Ave. site, the sky was clear in the south;

I thought the clouds in the west would move north or dissipate. We decided to set up there, but when I set up my first remote station and tried to pre-point it, the clouds in the west increased and covered the Moon and the pre-point area; the clouds were now moving eastward. Although they would likely leave the area before the graze, it would clear up farther west first, allowing more time to set up and pre-point remote stations. So I decided to go to the North 387th Ave. sites (there were no houses along that road in the graze path) about 25 miles northwest of Buckeye, while Wayne stayed at Turner Ave. to set up his 11-inch SCT. As I was starting to deploy stations along North 387th Ave., Wayne called saying he had just been drenched by the squall line moving across Turner Ave., and wanted to know how it was where I was; he decided to try to reach North 387th Ave. But his new GPS somehow misled him (more machine mischief) and he ended up on a road about two miles farther east; we mentally tried to estimate where the path was there when we realized the problem, but we didn't have the time to locate Wayne accurately in the path, and he was too far north, having a miss. In the meantime, Michael Collins reached the Turner Ave. site, where it did clear up and he obtained a good recording, with about 8 occultations of the star during the graze there. The humans also won in two large efforts in California, in a 9-station expedition near I-80 south of Dixon, and in a 15-station expedition near Farmington east of Stockton.

Although I've had earlier successes recording lunar grazing occultations from remote stations, those were almost all with relatively large telescopes with clock drives that are harder and more expensive to transport by airplane than the small systems, designed primarily for asteroidal occultations were Moonlight interference is rarely an issue (see Scotty Degenhardt's description of them at

http://scottysmightymini.com/PR/Effects_miniature_optics_occultations.html), that I used for the eta Gem graze.

Journal for Occultation Astronomy

Highlights and Minutes of the 28th IOTA Annual Meeting, December 4-5, 2010

AAVSO Headquarters, Cambridge Massachusetts, Clay Science Center, Brookline, Massachusetts

by Richard Nugent, Executive Secretary

The 28th annual meeting of the International Occultation Timing Association was held on Saturday December 4, 2010 at the American Association of Variable Star Observers (AAVSO) Headquarters in Cambridge Massachusetts and at the Clay Science Center on Sunday December 5, 2010 in Brookline. Massachusetts. This location was chosen to coincide with 3 asteroid occultations: 628 Christine, Dec 4 and 212 Medea/10 Hygiea Dec 5. Nearly all observers who tried these were clouded out except for a handful.

Positive chords were obtained only for Medea and the results are posted at the asteroid occultation results page:

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

The meeting location was kindly hosted by the AAVSO on Saturday and the Clay Science Center on Sunday. 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/2010Meeting/Presentations/

A total of 50 persons participated in the meeting:

President Dr. David Dunham from Maryland,
Executive Secretary Richard Nugent from Texas,
Dr. Terrence Redding from Florida,
Marco Auerelio Minozzo, San Paulo Brazil,
Steve Conard from Maryland,
Frank Suits, New York,
Ted Blank, New Hampshire, and
Bruce Berger, Ron Dantowitz, Arne Henden, Gary Jacobson, Marek Kozubal, Doc Kinne, Glen Meurer, Mario Motta, Don Price, Roger Sinnott, Alan Sliski, and Paul Valleli from Massachusetts.

Video Internet Conference (EVO) Attendees: IOTA webmaster Rob Robinson, Jan Manek, Hans Heynan, Bob Sandy, Dave Clark, Wolfgang Rothe, Scott Degenhardt, Pedro Sada, Gerhard Dangl, Dave Herald, Roger Venable, John Grismore, Dave Gault, Brad Timerson, Aart Olsen, Derek Breit, Chad Ellington, (IOTA Secretary/Treasurer), Steve Messner, Gene Mroz, Lawrence Garrett, Tony George, Eberherd Bredner, Wofgang Biesker, Tim Haymes, Rick Hunter, Wayne Warren, Ryc Rienks, Ned Smith, Ernie Iverson, Kerry Coughlin and Randy Peterson.

Technical Session – Saturday morning

President Dr. David Dunham opened the meeting at 8:40 AM and welcomed everyone. Dunham then asked the attendees to introduce themselves. Following the introductions, it was found out that no one was able to obtain chords for the Christine occultation the night before due to overcast skies in the area. Dunham had made a last minute dash to Rhode Island and with the setup time needed for his equipment he wasn't able to acquire the target star until 2 minutes after the occultation.

Business meeting 9 AM

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

Starting Balance:	$6,753.66	2009, November 20
Ending Balance:	$7,089.65	2010, December 4
Net Increase in Balance:	$ 335.99	

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 has represented an embarrassment for IOTA, as some Library subscribers has asked where are the 4 issues/year that they pay for. All members need to consider contributing articles on any aspect of occultation science as the ON Editor has a lack of material for publishing. Along this line, ON has undergone a name change, (Journal for Occultation Astronomy, JOA) format changes and has new Editor. More about this from Richard Nugent's talk later on.

New Server: Currently a new web site is being used for membership in IOTA, http://www.asteroidoccultation.com/iota/ . This page also allows payment for subscriptions to ON/JOA. The old site, www.occultations.org was being paid for by Art Lucas and maintained by John Graves. Chad had difficulty uploading files to it and the usernames/passwords for access to issues of ON were very archaic to remember and use. (For example, Nugent's username was KV8247, password 522948). Occultations.org will be lost unless we continue to pay for it. Dave Herald mentioned that all of our websites need to be cross-correlated to avoid scattering of information on the Internet.

A google group website is currently up and running to be used for accessing past ON issues and IOTA business. The URL is http://groups.google.com/group/iota_us. All users and access would be approved by Chad, as he would maintain the site. In this scenario, users would be able to customize their access page such as having links to the asteroid predictions, lunar graze events, software programs, IOTA-ES, RASNZ, Euraster, weather forecasts, etc.

Derek Breit asked if such a page would increase IOTA's exposure. The consensus of the attendees is that it probably will. This means the web access needs to be good looking and user friendly with links to all IOTA activities: asteroids, grazes, JOA, Manual, member pages, etc.

David Dunham then announced the creation of a new IOTA section in the Middle East. The website is http://www.iota-me.com/. The web page has the left half in English and the right half in Arabic. Users may contact the group via a general email address: otamiddleeast@yahoo.

com. The new section had their first meeting on November 17-19, 2010 in Gonbad, Iran. Seventy-four (74) persons attended (mostly women as seen from the conference videos) making this probably the most attended Occultation meeting to date (1st was the European Symposium on Occultation Projects meeting in Stuttgart, Germany in August 1999, where a total solar eclipse boosted attendance). Dunham had recorded an introductory video in English for the group that was played at the meeting. Richard Nugent has been corresponding with the organization's webmaster about the IOTA Manual and its possible translation into their language.

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 2010 Homer F. Daboll award recipient was Hristo Pavlov from Australia for his dedicated contributions in "writing software that coordinate observations, keeps occultation astronomers informed and aids in analysis of their data." Hristo's OccultWatcher program located here: http://www.hristopavlov.net/OccultWatcher/OccultWatcher.html allows observers to post their proposed asteroid occultation sites to avoid duplication of chord efforts along with many other useful features.

Hristo also wrote and released Tangra, photometry software for analyzing asteroid occultation events. Tangra also has an astrometry feature for determining precise positions of slow and fast moving targets from videos.

There was no method of contacting Hristo at the time of the award's announcement (Hristo was not logged onto the EVO) so an email was sent to him. The next day Hristo sent out the following email to the IOTA Yahoo discussion group accepting the 2010 Homer Daboll award:

From: Hristo Pavlov To: iotaoccultations@yahoogroups.com 12/6/2010
Subject: [IOTAoccultations] Homer Daboll 2010

Dear IOTA,

I would like to sincerely thank you for the honor of presenting me with this year's Homer DaBoll award!

I would also like to apologize. A combination of technical issues, the late time of the session and my demanding family (3 months old daughter and 23 months old son) prevented me from preparing and responding more adequately during the online EVO session of the IOTA meeting. Thanks to Dave Herald who recorded and sent me Terry's presentation I finally watched it yesterday.

Someone on the record said that I should probably prepare and present a speech before I am allowed to have the award :) Well, fair enough. Let's start with a bit of a history.

After I moved to Australia and renewed my astronomical activity in 2006 I met many people in IOTA and in Australia in particular that inspired me to observe occultations, helped me to learn and treated me as a good friend. I have to say that it really takes a special person to drive to a dark road in the middle of nothing, setup a telescope, wait to record a few seconds event, not observe anything interesting most of the time and still feel happy and fulfilled. These are people like you, that have the desire to help the science with their efforts and actually do science without being a scientist. This is what inspired me most to start observing occultations and not for example to start taking more pictures of M-42.

Occultations however are a team work and team work needs coordination. In 2007 I met David Dunham in Auckland, New Zealand and we discused some aspects of an automated global occultation coordination software. I have had just presented the very first version of OccultWatcher at the First Trans Tasman Symposium on
Occultations and back then OW couldn't do more than grabbing Steve Preston's events and showing you very basic details of what is close to you and showing you when Steve has updated some of his predictions.

With time I kept adding new bits to OccultWatcher to become what it currently is. Some people have told me that with OccultWatcher I have revolutionized the way occultation observers plan and coordinate their observations but to be honest from my point of view I have just made my life easier which also turned out to make other people's life easier as well. But I have to admit that I am glad that observers use OccultWatcher and It makes me happy to see events in U.S. and Europe with more than 10 stations in OccultWatcher. It is really good to see when people go out, coordinate and most importantly observe.

I guess the other part of this story is also about analysis of video observations. I have to say that Kazuhisa Miyashita's LiMovie was also something that impressed me along the way and I always thought it should be very difficult and complicated to write something like it. Now that have done it with Tangra I can tell you that I was not wrong. Writing video light measurement tool with

automatic tracking is not an easy job. And I think you can also tell this from your experience with LiMovie and Tangra's tracking which doesn't aways work the way you want it.

When I started writing Tangra I wasn't absolutely sure that having a second light measurement tool was a very good idea. I still don't know but I hope that what I have added as 'improvements' will really be seen as improvements one day. And if you ask me what is the biggest advantage of Tangra I will say that this is the ability to see how the measuring apertures have been positioned for every single measured data-point in every measured frame. And not only this but also the ability to send a much smaller .lc file to someone else to evaluate your light curve. That's right, I may not be able to guarantee that Tangra will do better tracking and better measurements than other tools but I can really guarantee that if there is a bogus measurement you can definitely identify it after the measurement looking at the .lc file in Tangra.

Some people have also asked me why the name "Tangra" and others have even suggested I have named it after my favorite rock band. I thought it may be curious to say where the name comes from. It is in fact the name of the supreme god of the ancient Bulgarian tribes and this also reveals my background – I was born in Bulgaria. Oh yes, and Tangra was the god of the sky, of course.

And finally I should also say that I was a little surprised that the award was given to me this year when I think that there are other more experienced people that have been contributing for IOTA for a much longer period of time than me. I hope in future years to see people being presented with the Homer DaBoll award for observing, organizing observers and also doing scientific research using occultations with the observations provided by you – the observer, because in my opinion it is those people that have helped most to advance the occultation science.

One more time, Thank You so much for giving me this honor, I appreciate it very much!

Now, can I have my award please?

Cheers,
Hristo.

Elections – Executive Secretary Richard Nugent presented the results of this years elections (Officer elections are every 3 years). Nugent presented the results of the 2010 IOTA election of Officers and Directors. As of the meeting, email votes were received with no additional nominations for any positions. All attendees were in favor of the straight slate of Officer and Director positions. The elected positions are for a 3-year term and they are:

President ..... David Dunham
Vice President ..... Paul Maley
Executive Secretary ..... Richard Nugent
Secretary/Treasurer ..... Chad Ellington
V.P. Grazing Occultation Services ..... Mitsuru Sôma
V.P. Planetary Occultation Services ..... Jan Manek
V.P. for Lunar Occultation Services ..... Walt "Rob" Robinson
Editor Journal of Occultation Astronomy ..... Michael Busse (formerly Occultation Newsletter)

Michael Busse (IOTA-ES) has volunteered to edit the renamed ON (Journal of Occultation Astronomy). This position taken over from John Graves.

Richard Nugent presented the new format of the Journal of Occultation Astronomy. Occultation Newsletter, ON has not been published for some time now and at this years ESOP meeting, it was proposed that IOTA-ES would take over the responsibilities of editing and publishing ON. At the same time, it was suggested that the name be changed to reflect occultation astronomy for what it has evolved to be – an accepted scientific field of astronomy that produces new discoveries, new methods, and new techniques. Nugent showed a few screen shots of the new JOA format. Articles would be submitted to the Editor as specified on the inside cover page. This page also has article submission requirements. The first new issue (covering the time period December 2010-March 2011) has already been proofread and should be online within the next month (December 2010).

Dunham then presented a talk on behalf of Vice President Paul Maley. Maley has been actively involved in international outreach to assist and educate occultation observers in several different countries. He travels to places where high ranking asteroid occultation events occur and recruits new and experienced observers to do the observations. To date he has traveled to 19 countries and had positive chords on three events.

On the subject of occultation expedition funding there are funding discussions with the Southwest Research Institute (SWRI) which started in 2009. To date, 3 proposals were submitted by SWRI to NASA and NSF. These proposals are for research into asteroid sizes/shapes and asteroid satellites for Main Belt and Trojan asteroids (Bill Merline, PI) and regarding occultations of Pluto and/or KBOs, (Marc Buie, PI) for which he has solicited IOTA help. Funding is potentially available for travel only and the following events are being considered for 2011 with priority given to multi-station deployment to maximize chances of acquiring data [so far, as of late June, none have been selected].

Potential Major Expedition List		
Asteroid	**UT Date**	**Star magnitude**
Parthenope	Jan 26	10.6
Aurelia	Feb 2	8.8
Feronia	Mar 9	8.2
Iris	Apr 30	9.9
Europa	Jul 4	10.0
Antiope	Jul 19	6.7
Prokne	Aug 6	8.9

Another proposal does not entail any funding for new occultation data. Instead it seeks to combine existing photometric data with existing asteroid occultation data to get better sizes/shapes of asteroids, using the KOALA method. IOTA help is sought in finding and interpreting existing occultation data and, what's more, the occultation data will contribute

to key new science results, leading to betterunderstanding of asteroid sizes, shapes, densities and compositions.

On eclipse planning, Maley has planned for the next two solar eclipses: An expedition to Australia for the November 14, 2012 total solar eclipse (the southern edge site was scouted in 2010) and an expedition to the central line in Utah for the annular eclipse of May 20, 2012.

2011 IOTA Meeting. Dunhan/Maley have proposed that IOTA's 2011 meeting be held in Rocklin, California (near Sacramento) at Sierra College to coincide with the asteroid event of the 90 Antiope (m = 6.7 star) on July 19, 2010. The target star is in the ZC catalog, ZC 3339 and Antiope is a known binary asteroid with each component about 90 km across. Dave Herald said the HIP position is good and upcoming lunar occultations can confirm this. Steve Preston's current prediction shows a low error ellipse size 0.025" x 0.016".

Good weather is almost a sure thing and the event is just before sunrise allowing ample time for multi-station deployments. This would be a repeat location as the 2003 IOTA meeting was held at Sierra College.

With no further business the business meeting was closed. and ended at 11:08 AM.

Technical Session – Saturday

Dave Herald told about the status of the Occult program. The current version is 4.0.9.10 and it is stable and reliable with only minor issues arising from time to time usually from new users. The next major revision will be associated with an update of the main star catalogue used for asteroidal predictions. He will also be keeping an eye out for useful downloads that will enhance data availability. Dave asked if anyone comes across a useful dataset for IOTA activities to contact him for possible inclusion in Occult's data base.

Occult's data base consists of updates of asteroidal observations, lunar observations, and binary asteroid discoveries. Dave also monitors the IAU announcements for binary asteroids. Occult's periodic updates of the XZ catalogue for doubles and variables is almost 'routine'. The main issue is coordinating these updates with Brian Loader (New Zealand). A new compilation star catalogue consisting of the UCAC3 & CMC14 has been withheld from release for 12 months. This may include the UCAC4. This subset will likely be the basis for future Occult star catalogues.

On the lunar occultation/graze archive effort – the main achievement is completion of all past observations. This is a huge task, but now all past observations are considered 'safe'.

Double star discoveries and measurements represent an important 'new' area of lunar occultations. Occult Watcher has the capability to 'announce' lunar occultations of interesting doubles – but this will need someone to generate a feed for the region (North America for example).

If new double found, follow-up observations can usually be made the following month in Europe, Australia or Japan – however this needs global coordination.

On asteroid events the subject of reliable observations was brought up – visual vs. video. A GPS time inserted video can be analyzed carefully for events, blinks, flashes, etc. A visual event (even with a tape recorder) will always be subject to known or unknown personal errors, reaction times or whether the event was real. Visual observations must have WWV or similar radio standard to be considered reliable.

To illustrate this concept, if a visual observer has a 0.5 reaction time it would produce a more accurate data point with a 20-second event vs. a 2-second event. For the 20-second event, the error would be on the order of 2.5%, and the 2-second event's error would be 25%.

On the subject of which star catalogue produces the best asteroid prediction, this is an ongoing judgment call. The star catalogue comparison option in Occult only produces predictions based on estimated star position errors. As we have seen, sometimes the catalogue with the highest error gives the best prediction and vice-versa.

On the asteroid occultation results database to date the total number of events recorded = 1810. In 2010 to date, 167 events have been observed compared to 2009 when 211 events were observed.

Lunch Break

David Dunham presented the best (remaining) occultation events for 2010 and 2011.

1115 Sabouda Dec 11, m = 10.8 star, Dunham will use a soon to expire free plane ticket to do this one

1409 Isko Dec 16 m = 10.2 star, Florida

Grazes – Dec 21 – Total lunar eclipse. There are no good grazes during totality in the USA

Dunham showed a list of 31 grazes for 2011 from the Observer's Handbook for 2011. The star magnitudes range from +2.3 to +8.0 with most stars in the m= 4-5 range.

2011 Asteroid events:			
1424 Sundmania	Jan 12	m = 8.3,	Washington state to Georgia
66 Maja	Jan 16	m = 8.7	British Columbia to Long Island (NY)
150 Nuwa	Jan 18	m = 6. 8	Canada, Europe, China
635 Vundtia	Jan 22	m = 10.4	Washington state to Georgia
11 Parthenope	Jan 26	m = 10.6	Southern California, Texas, Florida
419 Aurelia	Feb 2	m = 8.8	British Columbia to Maryland
72 Feronia	Mar 9	m = 8.4	Washington State to Louisiana
7 Iris	Apr 30	m = 10.3	Washington State to Maryland
194 Prokne	Jun 1	m = 7.4	Australia

52 Europa	Jul 4	m = 10.1	East central USA, SE USA
90 Antiope	Jul 19	m = 6.8	California to western Canada (2011 IOTA meeting)
194 Prokne	Aug 6	m = 9.2	Baja Mexico to Ontario (Canada)
704 Interamnia	Nov 5	m = 10.3	California, Mexico to cenrtal USA

Grazes – Dec 11 – Total lunar eclipse. There are no good grazes during totality in the USA

Frank Suits presented his continuing research/development into the low cost AllTimer video system. This recording system uses a USB camera that is GPS time based. Digital video cameras, e.g. USB, are preferred but his system can also handle analog input. The system will accurately set a PC clock in the field using USB and GPS and includes an "occultation" LED for self-checks for timing accuracy. The time on USB cameras comes from a projected spot that ramps up and down each second. All power for the system is supplied directly from the computer from the USB port, however there is a battery backup.

On his circuit board (about 6-7 inches size) is the PIC18F4550 m-controller, the Venus 634 GPS module, MAX 7456 Text insertion, a PIC Ready1 board, GPS Antenna and LCD display. Frank showed sample screens showing the display format. The text shows standard items such as

time and field count. The display cycles through items such as: No. of satellites, Lat/Long, elevations plus more. The displayed character set is designed to be read by software for each field.

One of the advantages of this system can be the use of high speed recording rates - 245 frames/sec. As the AllTimer system is PC based, its applications go beyond occultations.

Richard Nugent presented two new video methods to measure double stars. Using the same equipment as for an occultation observation, the observer will video record a double star drift completely across the DVR/camcorder screen with the telescope motor drive turned off along with GPS time insertion. The drift should be fairly close to the east-west direction, but need not be perfect. The offset from a true east-west drift will compensated for in the reduction.

Using an overlooked feature in the program LiMovie, (x,y) data points for each aperture ring (star) for each video frame is stored in the output CSV file. This is all one needs to compute position angle and distance of the double star after correcting for a scale factor.

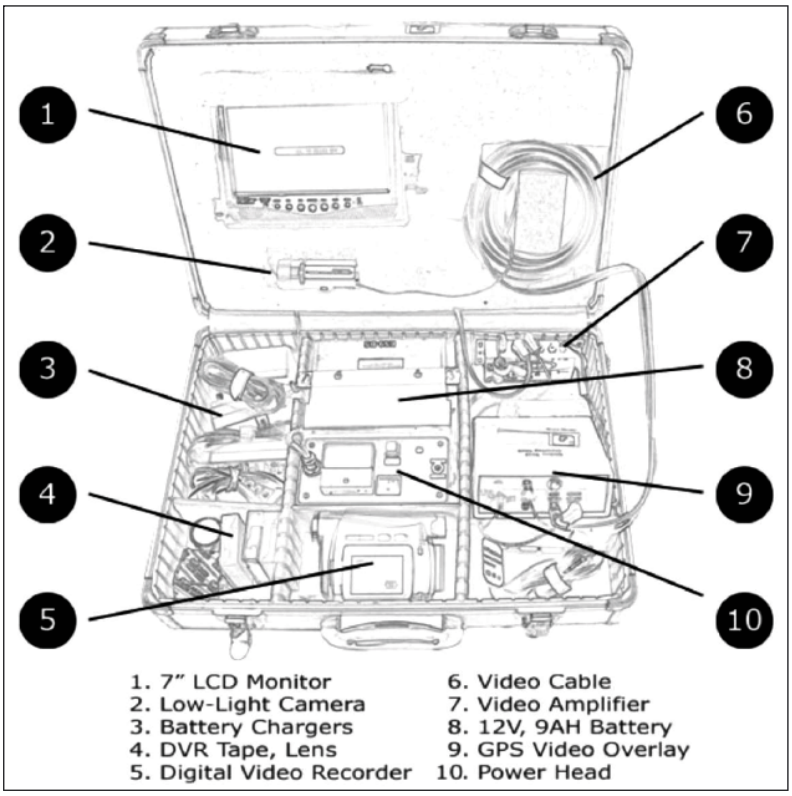
For a 60 second video and a 30 frame/sec video recording rate, this means that LiMovie will generate (60 sec) x (30 frame/sec) = 1,800 (x,y) data pairs for analysis. This amount of data pairs for analysis is unprecedented compared to any other visual, video or CCD method to measure double stars. Typical scale factors for an optical systems will be in the range of 0.6 – 2.0 arc-seconds/pixel. Nugent and Ernie Iverson have been making test video to test out this technique. They have used several telescopes so far: 3.5" Questar, Meade 14" ACF LX-200, and a Meade 14-inch f/10. Iverson has used several focal reducers, f6.3, f3.3 and f10 and the best results seem to come from the f10 system. In positional astronomy, the less glass between the star and the video/camera chip, the better.

Richard showed a table of double star measures as compared to the Washington Double Star Catalog (WDS). Most separations were within 0.0 – 1.0" of the WDS values and position angles were either right on or within 3-4 degrees. The source of the larger than expected differences in position angle will be investigated. Communications with Brain Mason of the USNO indicate that the WDS values are not necessarily accurate as many of the entries come from amateurs that publish their results in the Journal for Double Star Observations, Webb Society Double Star Section and other places. His research into this area is described here: http://www.poyntsource.com/Richard/double_stars_video.htm .

Russ Genet and Bruce Holenstein presented their design for a portable 1-meter class telescope that can be used for occultations. Named the "Alt-Az Initiative" their goal was to reduce the cost of 1-meter size telescopes to that of a currently equipped Celestron 14 (C-14). With such a medium cost portable telescope system several of the faint KBO occultations would be within reach of the occultation observer. They compared the cost of a typical 1-meter telescope and it's features to their proposed design. A commercially available 1-meter telescope can cost upwards to 1.8 million US dollars. Their prototype version would be in the range of $20,000. Their telescope is an f/4 system and weigh in at 300 pounds. Their "Banich Bylaw" is for this telescope is 1) to be enjoyable 2) repeatedly used, 3) must be happily set up by no more than two people of ordinary strength and dexterity, 4) setup time - 30 minutes or less. They showed slides showing the setup. Setup time averaged 30-45 minutes with two persons. The weight of the largest component (the mirror) as 200 lbs.

The design of such a telescope involves new mirror technologies all to reduce the weight and cost: slumped meniscus design, foam glass, sandwiched glass, spin-cast epoxy and multiple spherical mirrors. They discussed and showed prototypes of the foam glass design by Andrew Aurigema, the sandwich design by Tong Liu (similar to the Hubble Optics) and spin-cast epoxy methods. The website method by Lisa Broadhacker from Lander University, is the multiple –spherical mirror design as modeled after the MMT on Mt. Hopkins, AZ and the Giant Magellan mirror in Hawaii. A non-vacuum coating method was shown from the work of Sagar Venkateswaran at Peacock Labs. This method would place a silvered coating on the glass followed by a "permaloc" coating. They also showed new designed of their mounts and compute controlled deformable mirror cell. Russ and Bruce will be presenting their 1-meter telescope system designs at the "Light Bucket Astronomy Conference" at the Canada France Hawaii Telescope Headquarters in Hawaii this coming December 3, 2010-January 2, 2011.

Bruce Holenstein continued with the efforts to improve signal to noise ratio of occultation sources. This research follows from the Alt-Az research initiative. Applications of a high S/N ratio include 1) detection of stellar companions, 2) stellar sizes, 3) limb darkening effects, 4) presence of spots on stars and possibly 4) detection of hot Jupiters. To increase the S/N, one would need a larger telescope aperture which requires new mirror technologies, mounts and controllers. These aims



could possibly be achieved with the 1-meter class telescope used along with a visible bandwidth photometer, high gain low noise amplifiers, and off the shelf CMOS fast CCD camera.

The web site for the Alz-Az initiative is http://www.altazinitiative.org and their discussion group is http://groups.yahoo.com/group/AltAzInitiative.

Dave Gault showed a short video from the November 17-19, 2010 meeting of the new IOTA Middle East Group from Gonbad, Iran. He them presented Tony Barry's talk about a low cost GPS-VTI. This newly designed GPS time inserter was made with commercially available parts. It required that the user solder 30 wires which could be done in an afternoon by someone with experience with small circuit boards. Dave showed the circuit diagram and some screen shots of the setup screen and timing screen. The display screens were easy to read and included No. of satellites, lat/long, altitude, UTC CPU statistics, etc. The software is free for the microcontroller. The estimated cost for these units is the range of $100-$140 and they should be available in 2011.

Dave G. then presented the current status of the archiving of lunar grazing occultations, a huge project he has been involved along with Dave Herald. A few years ago there was a huge dataset of non-computerized grazes and the plan was to merge them with the existing file into a single collection to be part of the Occult program. Dr. Ken Coles has been assisting in this effort and has scanned a large number of paper graze reports and sent them to Dave G. Dave G. has reported that approximately 85% of the pre-1970 grazes have been reviewed and restored and this includes 49 new ones found. Six months into the project, the Kaguya data was released replacing the outdated Watts profiles.

The graze dataset includes the 1st successful graze in which a team traveled to record the event: The Sep 8, 1963 graze of the star ZC 464 near Davis, California. Also restored was a graze Dunham had been using is many of his talks: 1981 May 9-10, delta Cancri. A preliminary finding from the Kaguya data is that several grazes show a possible error in the proper motions.. Dave G. is investigating this and is working on a paper on this topic.

Thus far 3,618 grazes have bee reviewed and considered. 193 new grazes have been found that were previously unreported. Dave mentioned that if anyone knows of a graze that is not included in the dataset (the Occult program) to please contact him. The attendees both in person at the meeting and on the EVO held Dave G. in the highest regard for his dedicated work in logging and computerizing the huge amount of graze observations.

Steve Conard proposed an idea to create an Astronomical League (AL) observing award for occultations. The AL has 240 member astronomy clubs/societies in the US and Canada. They have a yearly convention and publish a quarterly newsletter. There is currently 34 observing club awards including the Messier certificates, observations of double stars, clusters and nebula, etc. An occultation award certificate would encourage occultation visibility (especially among younger people) and help gain new observers.

Steve said Aaron Clevenson (Houston) is one of two national AL coordinators that would approve of an occultation observing certificate. Steve mentioned AL's procedure to create such an award. It would involve submitting to AL a proposal, develop a manual to instruct observers on how to make and report their observations. The proposal would be

considered at the next AL convention in the Spring 2011. To be considered the proposal must be submitted to the AL coordinators at least 1 month before their convention. There was a brief discussion on whether IOTA should pursue an AL observing occultation award. Most agreed as it not only satisfies IOTA outreach and educational objectives, but the recruiting of new observers is crucial to bring new blood into IOTA (also many of the membership is advancing in age). Steve will be working on this new observing award and will keep the rest of the group posted.

Bruce Berger brought his highly portable occultation system (named SCORE, Self Contained Occultation Recording Equipment) and demonstrated its use. Bruce is a newcomer to occultations and his first experience was the Antares graze on January 11, 2010 event time 7:39 AM. The temperature of the event was +2 F (-16C) and Bruce had major difficulty setting up his equipment, connecting cables, positioning and reviewing the small camcorder screen, etc. (Bruce succeeded in collecting data for this graze). He thus came up with the idea to place all components of the recording system (except the telescope) in an aluminum briefcase for easy access and operation.

The requirements for this compact box was that it had to have all hardware in a single easily transportable case, have all components connected and ready to go by turning on only power switches, operate in New England winters, and be able to fit in a airplane overhead bin as carry on luggage. It has a 7-inch (18-cm) flat screen monitor, video amplifier, GPS VTI, 25-ft (8-meter) cable, camcorder, Supercircuits camera and all components are powered by a 12volt motorcycle battery. The motorcycle battery has the advantage over typical AA sized (and rechargeable) batteries in that it can last and operate in extremely cold conditions. A photo of the SCORE system is shown below along with a diagram identifying the components:

Bruce had his SCORE system featured in the July 2010 Sky and Telescope issue. Bruce's website is http://scopemaker.com

The meeting adjourned at 5:30 PM. The attendees made plans for tonight's Medea and Hygiea occultations.

Sunday December 5, Clay Center, Brookline, MA. 11:30 AM, technical sessions continue.

David Dunham opened the meeting summarizing the expeditions of the French for the July 11, 2010 total eclipse over islands in French Polynesia at a post eclipse meeting he attended on September 30, 2010. The previous month before the eclipse in June saw the launch of the long awaited French satellite, PICARD which is designed to measure the Sun's seismology along with its radius. The radius measurements will compliment and help calibrate the ground based radii obtained during eclipses. The French set up several stations at several islands including some stations near the edge of the Moon's shadow. They used multiple photometers on different atolls including the island of Hao where Richard Nugent and Chuck Herald made their observations.

Their experiments were to measure the flash spectrum at 2nd and 3rd contact. Their recording camera at Hao had a high frame rate and the goal was to pin down the spectral line change at the moment totality started and ended. This method was first tried by the Japanese in the 1970's-1990's. Isao Sato also attempted this technique at the February 26, 1998 eclipse on the island of Curacao. A comparison was made of the flash spectral lines vs. the lunar limb profile with estimated contact times from inflection points.

At this same meeting, Costantino Sigismondi presented a talk on his efforts into the possible changing solar radius changes. Dunham described Sigismondi's summary of the various techniques that have been used to measure the solar diameter : the drift scan method, angular direct measurements, Mercury and Venus Transits and eclipses. These methods suffer from unavoidable seeing effects and timing issues. The IOTA manual describes these methods in detail along with their results in Chapter 11.

Richard Nugent presented the results of IOTA's expedition to the Hao atoll for the July 11, eclipse. Paul Maley, Richard Nugent and Chuck Herold traveled to 2 Atolls in the South Pacific in the French Polynesia and set up two stations - Hikueru Atoll and Hao Atoll. Unfortunately the Hikueru station where Maley was had cloud/rain problems immediately after 2nd contact. IOTA's method of planning eclipse stations normally places them at the north and south eclipse limits, however the path of this eclipse was just about entirely over water so Nugent/Herold and Maley set up on complementary sides of the center line: Maley at Hikueru just 10km north of the eclipse center line and Nugent/Herold at Hao 70 km south of the center line.

Maley obtained video of Baily's Beads at 2nd contact just before a cloud moved in. Unfortunately he was unable to get his KIWI time inserter to work. The clouds obscured the Sun during the entire duration of totality. At Nugent/Herold's site it was clear skies for totality plus 2nd and 3rd contact. Nugent obtained high resolution GPS time inserted video of Baily's Beads at 2nd and 3rd contact. Following 2nd contact, Nugent removed the solar filter and panned around the Sun's corona during totality still maintaining GPS time insertion. At the meeting he mentioned the point, "we do not know what data astronomers of the future will need, but we do know they will need this data more accurately." Nugent postulated that future astronomers might have a need for time inserted video of the Sun's coronal structure.

Although not at the eclipse limits, independent inner chords of the Sun's shape could be obtained from the Baily's Beads data. This effect is illustrated in the diagram on Nugent's webpage http://weblore.com/richard/Jul_11_2010_Eclipse.htm along with a summary of the expedition.

Lunch break 12:40, Pizzas were delivered and were consumed by the members after the technical session resumed.

1:35 PM Technical session continued.

Ron Dantowitz, Clay Science Center's Director presented a talk titled "Dynamic Astronomy". He began by explaining that the Clay Science Center is geared mainly toward education/research activities for younger students in the local Boston metro area. The Center houses a 25-inch (0.6 meter) telescope in a domed observatory on the roof of the 5-story building. The Center also has 30 other telescopes ranging in size from 3 to 16 inches (8 cm to 40 cm).

Ron is one of the top innovators of high resolution imagery using video/CCD camera techniques and has had numerous images published in Sky and Telescope and other publications. He utilized his techniques and

the 60-inch (1.5 meter) telescope at Mt. Wilson to obtain high resolution photos of the lunar crater Tycho that rival those taken by Ranger spacecraft. One particular photo was taken 60 seconds before Ranger impacted the lunar surface. The ground based photo from the Mt. Wilson 60-inch telescope looked identical to this Ranger spacecraft image and had a 140 meter/pixel resolution.

One of the Clay Center's students has collaborated with NASA and Google to image meteors from an aircraft (Google loaned the use of a plane). He showed high resolution video of the Virgo area of the galaxy on one such flight that was 20 km altitude. In 2005 a laser was pointed at the Space Station and when Ron imaged the Station it had spread to a diameter of 5-6 feet. Ron showed more high resolution images of the Shuttle docked to the Space Station. Details on the solar panels and the Shuttle were easily seen. Next year Ron mentioned that the Clay Center would try and get more involved with IOTA activities, as his techniques have a wide application to IOTA's video recording and data reduction.

David Dunham presented a brief review of remote station observing. The first ever successful remote video station asteroid event was that of 9 Metis on September 7, 2001. Over 35 successful additional remote video station asteroid events were made since then, 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. Terry Redding asked if the asteroid size /shape data IOTA obtains is catalogued anywhere. Dunham said it was, it's located on the NASA small bodies website.

David Dunham continued the meeting with a status report on IOTA's long-term effort in the solar radius experiment and research. Dunham had previously presented the results of his research at the 2005 SORCE (SOlar Radiation and Climate Experiment, a NASA satellite launched in 2003) Science Meeting September 14-15, 2005 in Durango, Colorado. A 3-year grant proposal was submitted in April 2003 and accepted in December 2003, and finally funded by NASA in June 2004. The principal investigator is David Dunham, with co-investigators: Wayne Warren, Jr., Alan Fiala (deceased), Harry Bates, Sabatino Sofia, David Herald, Patricia Rosenzweig and help from many IOTA observers. The main focus of the research was to analyze Baily's Beads timing data from solar eclipses to search for solar radius variations. Previous eclipse data analyzed and published in 1994 included eight eclipses from 1715 to 1987 indicated small changes of the solar radius relative to the 959.63[2] standard value for each of the eclipses.

Cosantino Sigismondi from Italy had joined the effort in IOTA's solar radius research. He has analyzed the Baily's Beads videos from the eclipses of eclipses of 2006 and 2008. His plots of the solar radius changes didn't show any obvious trend, however this doesn't indicate that there isn't a cycle of small scale solar radius changes occurring with the Sun.

Dunham said a few words about the passing of Tom van Flandern (2009) and of Alan Fiala (2010). Both worked at the US Naval Observatory and both were experts in celestial mechanics and solar eclipses.

Scotty Deganhardt presented his research entitled: "Io and Europa's Atmosphere ad Io Torus Detection through Occultations and Conjunctions" . On August 7, 2009 Scotty video recorded Io eclipsing Europa and 23 minutes later Io occulting Europa. The entire event was 46 minutes long. An unknown dimming and brightening trend occurred before and after the occultation. He postulated causes for the effect: Camera response, the recording method, the reduction method and or extinction via Io's atmosphere. Scotty investigated all of these possible causes and concluded that the cause was a Torus or extended atmosphere around Io. Thus he launched the IAEP project: Io Atmospheric Extinction Project and a global plea for observations was made. The results included 11 observers from 4 countries that acquired 53 data sets from 28 individual events.

He also presented the results in early 2010, Degenhardt, S. et. al, Io and Europa Atmosphere Detection through Jovian Mutual Events, at The Society for Astronomical Sciences:

Proceedings for the 29th Annual Symposium on Telescope Science. Web page:

http://scottysmightymini.com/IAEP/SAS2010_Io_Europa_Degenhardt.doc. Scotty made four (4) YouTube videos describing the event and its results.

One of the primary conclusions Scotty reached (and are obvious by looking at the light curves) is that occultations on Io's Jupiter facing limb have longer extinction slopes. These longer extinctions indicate more extinction material. And with more extinction material on Io's Jupiter facing limb, this implies that a stream of material exists from Io towards Jupiter. This comes as no surprise given that Jupiter is called the "vacuum cleaner" of our solar system. What is the source of the extinction material ? It is well known that Io has a geologically active surface with extensive volcanic activity. During the Voyager II flyby in 1979, ash from an erupting volcano was photographed being ejected into space. Much of this material is in orbit around Io and is replenished constantly, although it has been shown that it dissipates after a few days. Scotty provided some slides showing the more favorable occultation events by Io for 2011 and 2012. He issued a challenge to observers to obtain spectrums of Io to detect spectral line changes during extinction events.

Persons who have contributed datasets to the research effort included Salvador Aguirre (Sonora, Mexico), Dave Clark (Texas), Scotty Deganhardt (Principal Investigator, Tennessee), Terry Redding and Don Parker (Florida), Tony George (Oregon), Andy Scheck (Maryland), John Talbot (New Zealand), Brad Timerson, (New York), Wayne Green (Colorado), Mike Hoskinson (Alberta, Canada), John Menke (Maryland) and Roger Venable (Georgia).

The meeting adjourned at 4:50 PM.

Journal for Occultation Astronomy

IOTA External Publications

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It is important for members of IOTA to publish in external publications, to inform the wider astronomical community of the important results that we are obtaining, and the research that we are performing. This is an update of the article with the same name published in the last issue of JOA, Vol. 1, No. 2, pages 16-17, which covered papers published from 2009 to early April, 2011. If I have missed an external publication about occultations for which you are a co-author, please let us know so that it can be included in a similar list in the next issue. First we list publications that have been published, then articles that have been submitted for publication.

Published Papers

David Dunham and Victor Slabinski, "Obituary: Thomas C. Van Flandern (1940-2009), **Bulletin of the American Astronomical Society,** Vol. 43, p. 23, 2011 June. Available at http://aas.org/baas/obits/obit?Full_Name=Tom_C._Van%20Flandern&Date=2009-01-09

Papers Submitted for Publication

Tony George, Brad Timerson, Kerry Coughlin, and Roc Fleishman, "A New Double Star from an Asteroidal Occultation: UCAC2 41168613", **Journal of Double Star Observations,** Vol. 7, No. 2, pp. 129-132, April 1, 2011. The results of the occultation of UCAC2 41168613 by (675) Ludmilla observed on 2010 October 20 from Baja California Sur, Mexico, are described. Available at http://www.jdso.org/volume7/number2/George_67_70.pdf .

Tony George, Brad Timerson, Bill Cooke, Scott Degenhardt, David W. Dunham, Steve Messner, Robert Suggs, Roger Venable, and Wayne H. Warren, Jr,, "TYC 2255-01354-1 duplicity discovery from asteroidal occultation by (790) Pretoria", **Journal of Double Star Observations,** Vol. 7, No. 3, pp.172-177, July 1, 2011. The results of the occultation of TYC 2255-01354-1 by (790) Pretoria observed on 2009 July 19 from Minnesota, Tennessee, Alabama, and Georgia are described. Available at http://www.jdso.org/ .

Tony George, Brad Timerson, Tom Beard, Ted Blank, Ron Dantowitz, Jack Davis, Dennis di Cicco, David W. Dunham, Mike Hill, Aaron Sliski, and Red Sumner, "HIP 46249 duplicity discovery from asteroidal occultation by (160) Una", **Journal of Double Star Observations,** Vol. 7, No. 3, pp. 178-182, July 1, 2011. The results of the occultation of HIP 46249 by (160) Una observed on 2011 January 24 from Nevada and Massachusetts are described. Available at http://www.jdso.org/ .

Josef urech, Mikko Kaasalainen, David Herald, David Dunham, Brad Timerson, Josef Hanuš, Eric Frappa, John Talbot, Tsutomu Hayamizu, Brian Warner, Frederick Pilcher, and Adrián Galád, "Combining asteroid models derived by lightcurve inversion with asteroidal occultation silhouettes", was listed last time as submitted to Icarus, but now it has been accepted for publication, is in press, and should appear soon. The analysis of over 40 asteroidal occultations observed from 1977 to 2010, combined with lightcurve inversion models, is described. This important paper is now available at http://astro.troja.mff.cuni.cz/projects/asteroids3D/download/durech_et_al_2011_occ_paper.pdf .

Phobos slips past Jupiter

Earlier this month, ESA's Mars Express performed a special manoeuvre to observe an unusual alignment of Jupiter and the martian moon Phobos. The impressive images have now been processed into a movie of this rare event. At the moment when Mars Express, Phobos, and Jupiter aligned on 1 June 2011, there was a distance of 11,389 km between the spacecraft and Phobos, and a further 529 million km to Jupiter.

The High Resolution Stereo Camera on Mars Express was kept fixed on Jupiter for the conjunction, ensuring that the planet remained static in the frame. The operation returned a total of 104 images over a period of 68 seconds, all of them taken using the camera's super-resolution channel. By knowing the exact moment when Jupiter passed behind Phobos, the observation will help to verify and even improve our knowledge of the orbital position of the martian moon. The images shown here were processed at the Department of Planetary Sciences and Remote Sensing at the Institute of Geological Sciences of the Freie Universität Berlin.

More information at: http://www.esa.int/esaCP/SEMJ53E1XOG_index_0.html

Journal for Occultation Astronomy

Pluto Occultation May 22, 2011

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On this day at approximately 0623UTC, Pluto occulted a 14.3 mag star. I observed this event from Barnesville, Md at longitude 77° 22′ 31″ W, latitude 39° 13′ 30″ N using my 18 in. f/3.5 Newtonian, SBIG 1603 CCD camera (using approx 200 x 200 subframe Before binning x2), no filter. The exposure was 1 sec, yielding a Pluto plus star image of about 1500 counts at a SNR = 10. High thin clouds were present.

The camera was controlled by MaximDL5 in fast sequence mode yielding approximately 35 images per minute. Each image had a FITS file with the midpoint of exposure time derived from the PC clock. The PC clock was set via a Dim4 program, synchronized just before data taking started at approximately 0610UTC. During the interval 0625-0630, at one minute intervals I visually compared the time of the image taking to a GPS display from a KIWI OSD device. Subsequent comparison of the FITS times and the GPS times showed that the FITS times were accurate to within one second.

Data

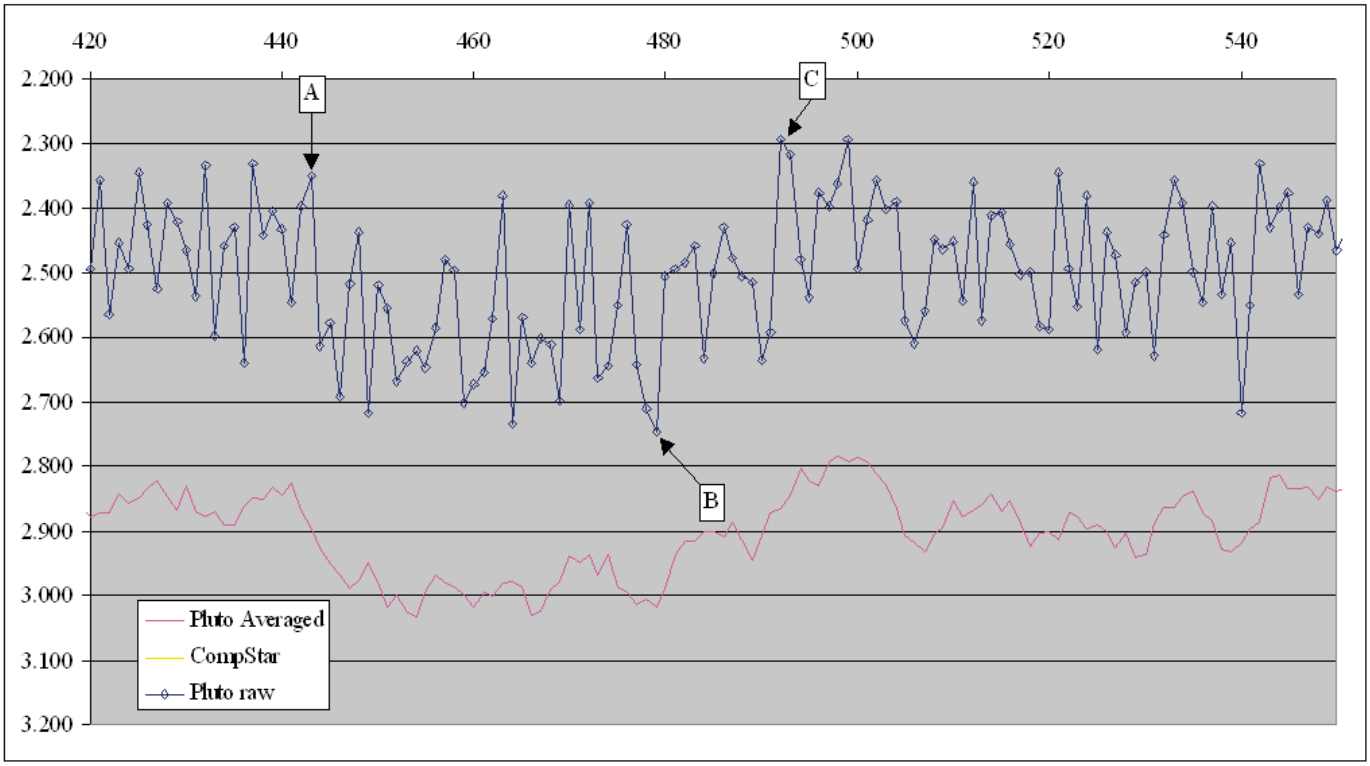
The attachment shows the field image resulting from averaging the approximately 700 images. The original averaged image has been enlarged with interpolation, thus the pixels have been smoothed (stars in the original image are approximately 2 pixels wide). Of course, the individual images are far noisier than this averaged image. Using MaximDL, Pluto/star and CHK star were measured relative to the RefStar in magnitudes.

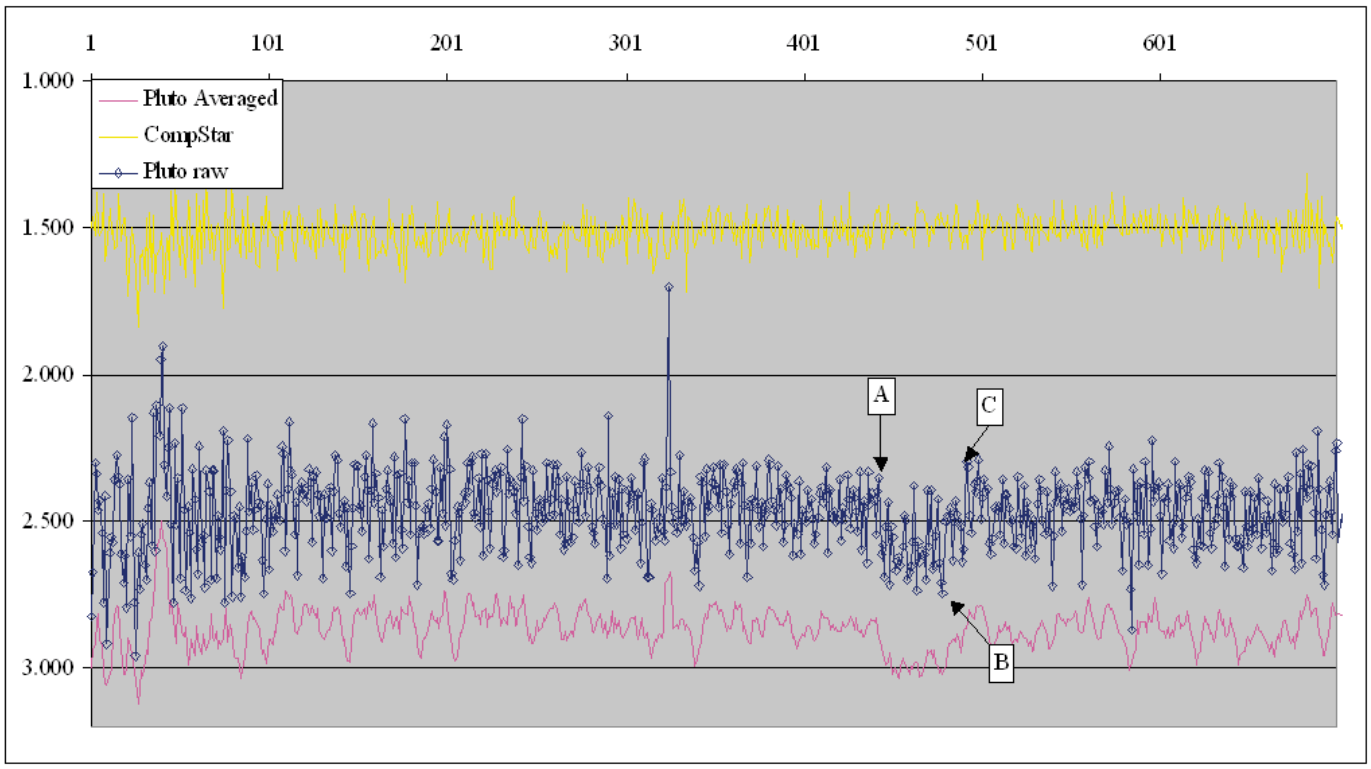
The data set from Maxim is a csv file giving the Julian Date of the midpoint of exposure and the magnitudes of PI and CHK.

The data were imported into Excel and graphed as shown. The X-axis is the image count identifier, the Y-Axis is magnitudes relative to the RefStar (the user may derive intensities by taking the antilog of the magnitude).

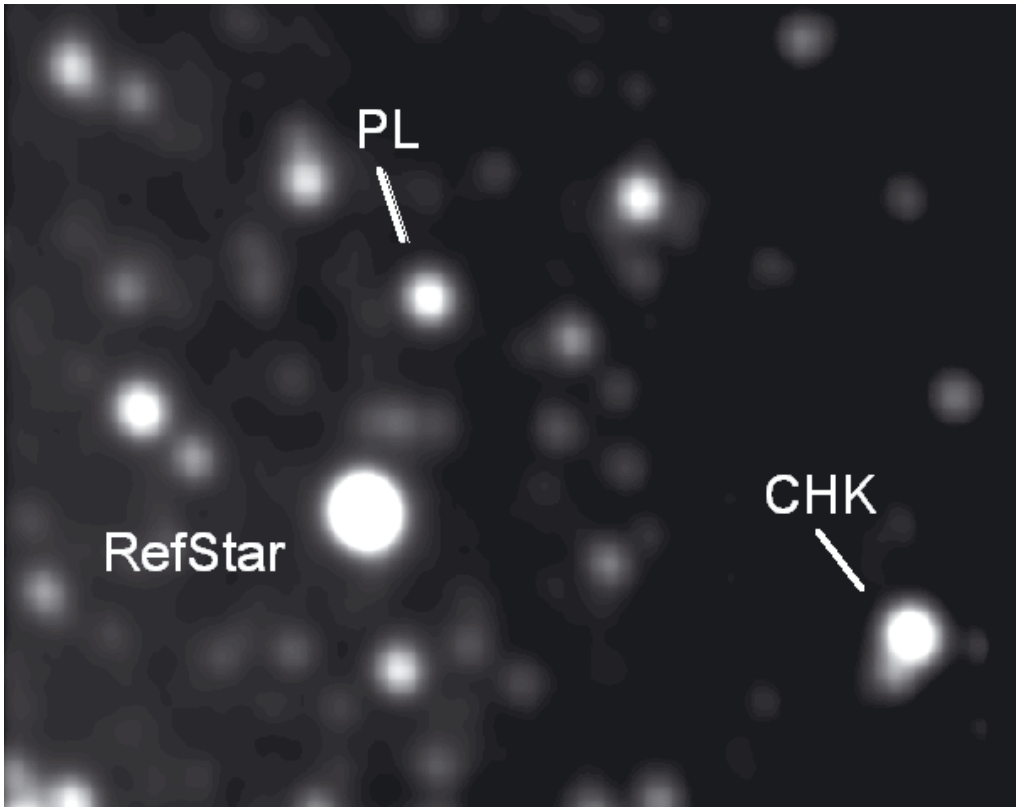
The CHK star data are shown with an average magnitude of approximately 1.5, while the PI data are at about 2.4 mag. Scatter of the PI data is about 0.1 mag (eyeball) correlating with the Maxim reported SN of about 10. The predicted decrease during the occultation was 0.3 mag, while I observed a bit under 0.2 mag decrease in the region around Image460. The third (lowest, red) curve is the PI data averaged over the five images centered on each image, and is vertically offset on the graph simply for clarity. This curve shows the occultation signal more clearly.

Times of Exposures:
A 443 6:22:49.5 B 479 6:23:51 C 492 6:24:14.5





Occultation midpoint:
A-B 6:23:20.2 A-C 6:23:32.5



Pluto Occultation May 22, 2011
Nominally 06:23 UTC

Discussion

As seen in the graphs, the event was not highly symmetric and its duration is ambiguous. The Disappearance appears to be unambiguous and occurs just after Image443 at 06:22:49.5. However, the reappearance is confused by the noise. If the Re-appearance is taken to begin at Image479 at 06:23:51, then the time at midpoint is 06:23:20.2 and the event duration was 61.5 sec. If the Reappearance is taken to conclude at Image492, the the time at midpoint was 06:23:32.5 and the duration was 85.0 sec.

My own interpretation is that the event is more likely measured by the first reading noted, because the signal between Image 479 and Image 492 is quite consistent with low data elsewhere in the data trace.

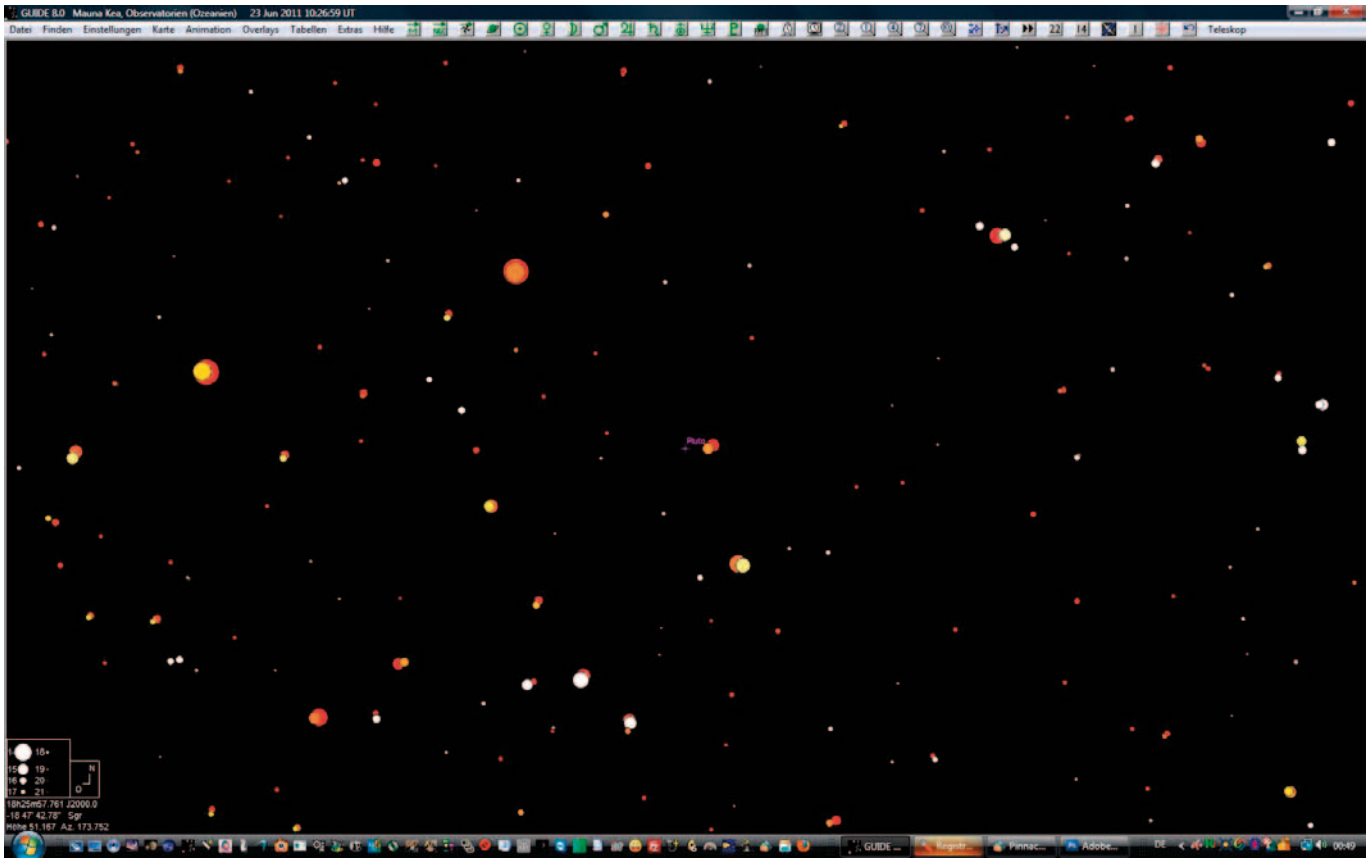
Journal for Occultation Astronomy

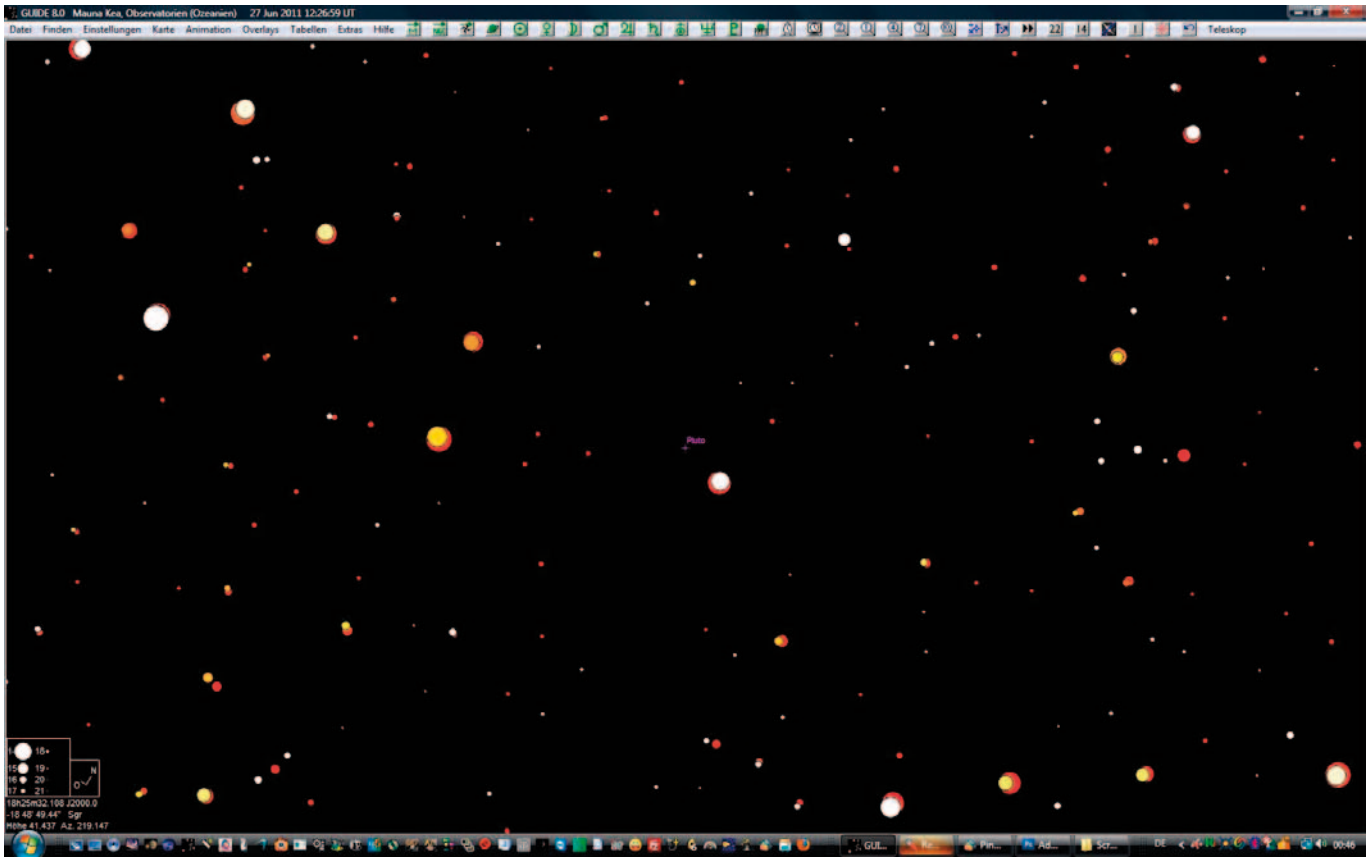
ESOP XXX in Berlin at the Archenhold Observatory

The 30th European Conference on Occultation Projects is held in Berlin at the Archenhold-Observatory, the oldest and largest public observatory in Germany, from the 26th to the 31st of August 2011. The **E**uropean **S**ymposium on **O**ccultation **P**rojects (ESOP) is the annual conference of the European section of the International Occultation and Timing Association IOTA/ES. This event provides you with the opportunity to get in touch with professional and amateur astronomers dealing with occultation observations and calculations from many European countries. You will find a friendly atmosphere and will meet a lot of interesting people. Lectures, discussions and time to talk are typical of ESOP Symposia.

The provisional scientific program (27th and 28th of August) of the conference will contain, among others, the following sessions and lectures. This program is NOT the final program, therefore changes are highly possible.

Prologue	Kursus für Beobachter (mainly in German, organized by the Archenhold Observatory)	• Video-Beobachtung • Visuelle Beobachtung • Auswertung
Opening Ceremony		
Opening Lecture I	Bruno Sicardy, France	Exploring the solar system beyond Neptune with stellar occultations
Opening Lecture II	Szilard Scizmadia	Transit timing of exoplanets by space and earth telescopes
Pluto and TNOs	Marcelo Assafin, Brazil	Astrometry of TNOs by the RIO Team
	Felipe Graga-Ribas, Brazil	Predictions for TNOs
	Hans-Joachim. Bode	Pluto-Occultations June 2011 from Mauii
Asteroids	Mike Kretlow	On the reduction of asteroidal occultations
	Alexander Pratt, Great Britain	(42) Isis on 3rd May, 2011
	Wolfgang Rothe	Occultations by Minor Planets - Where I should observe?
	Claus-Peter Heidmann	Occultations by Antiope und Makemake
Occultation Phenomena and other projects	Apostolos Christou, Greece/Ireland	Pro-Am observations of mutual events between the Galilean satellites during the PHEMU09 campaign from Greece
	Myriam Pajuelo, Peru	Astronomical projects in Peru and ancient astronomy
The Moon	Carles Schnabel, Spain	Grazing double star occultations
	Konrad Guhl	The lunar atmosphere
	Roman Kostenko, Ukraine	History and results of occultation (both lunar & asteroid programme in Poltava gravimetric observatory
	Eberhard Riedel	GRAZEPREP unplugged
New Technologies	Wolfgang Beisker	Comparison of CCD cameras
	Maksym Pavel, Poland	Remote observations of occultations
	Michael Busse	A highly portable Telescope for occultation work
Workshop Section	Wolfgang Beisker	Practical Evaluation of CCD cameras
	Jan Manek, Czech Republic	How to use WINOCCULT


GUIDE 8.0 Mauna Kea, Observatorien (Ozeanien) 23 Jun 2011 10:26:59 UT
Pluto


GUIDE 8.0 Mauna Kea, Observatorien (Ozeanien) 27 Jun 2011 12:26:59 UT
Pluto

Journal for Occultation Astronomy

Occultations of UCAC 143-31 4889 and UCAC 143-31 3802 by Pluto and his moons

Hans-Joachim Bode

Based on predictions by Bruno Sicardy and Dave Herald and refinements by the RIO-group's exact measurements of both occultations were possible on the Hawaiian Islands. With the help of our American colleagues arrangements could be made on the islands of Kauai and Maui where 2 C14 telescopes are situated. It was decided that a French team would observe on Kauai whereas I would do the measurements at the Hyatt Regency's Public Observatory donated to the guests of the hotel. Although I was well equipped with the necessary devices Bruno proposed to use one of his recording systems using a very fast and high sensitive camera (RAPTOR) and all the other devices you need for every kind of telescope-connection including a laptop (French Windows XP: I can speak French but now I had to get accustomed to French computer terms…). I got a 2.5 hour crash course by phone on "How to use a RAPTOR" given by Bruno one week before departure. In northern Germany there are only a few hours of darkness and no total darkness during summer – so only poor chances to test everything, but clouds prevented it anyway !

We arrived on Maui June 20 late at night. Next evening we could do the first test: Everything was connected and after plugging in the RAPTOR its software was started – the first stars could be seen. Edward Mahoney (Director of Astronomy at the Hyatt) moved the C14 via a reference-star to the Pluto-position showing a whole number of stars – but which one of the spots was Pluto, what was the limiting magnitude, what was the size of the field of view?

Clouding started and spread to our area in the sky: We stopped searching even though the next day (June 23rd) was to be the first occultation event for Charon and Pluto.

Early next evening we started again, no technical problems. Yesterdays telescope-balance-problems had been solved in the meantime by Eddy. Again we were looking for Pluto: nothing, no hint, no idea – and time was slowly running out …

On a second laptop I had taken along (including my recording system in case of problems or additional measurements with a second telescope) we could see the GUIDE-8 star field (including all UCAC stars) and compared it to reality by zooming in and out: No similarity could be recognized!

So we decided to use the selected position for which Eddy made several positioning tests between 2 known stars which were OK. We decided it might be better to at least record something even at a possibly wrong position than to do nothing. Better prepared for the June 27th event we could identify Pluto and the surrounding stars and started the recording fur Pluto and Hydra in time. Most recent last-minute-measurements had shifted the occultation-line of Pluto north of Hawaii and therefore Hydra off the Hawaiian Islands.

Until the beginning of dawn we could record the possible occultation – to the naked eye no change of light could be seen …

Let us wait for the reduction!

Journal for
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Astronomy

IOTA's Mission

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

The Offices and Officers of IOTA

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(IOTA maintains the following web 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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