

Recent successful asteroidal occultations in our region in the past year.

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Presenter:

Abstract:

A selection of interesting minor planet occultation results observed from Australia and New Zealand during 2013 is presented.

Background:

This is the fifth in a series, highlighting the more interesting results from the previous year. Previous papers covering 2008 to 2012 were presented at TTSO4 ^{Error! Reference source not found.}, TTSO5 ^{Error! Reference source not found.}, TTSO6 ³, and TTSO7 ⁴, copies can be made available if required.

Some Statistics:

Since 2006 the number of events with positive observations for the region has run 2006 – 23, 2007 – 31, 2008 – 47, 2009 – 46, 2010 – 50, 2011 – 51, 2012 – 51, 2013 56. Our region recorded 17.8% of all events in the IOTA global database for 2011 (11% in 2010 and 2011, 17.8% in 2012).

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

May to September were the best months for observing with 5 to 9 positive events and up to 45 miss events each. December was the worst with just 1 positive

Year	Reports	Observers	Positive observations	Negative observations
2008	280	26	66	214
2009	320	29	75	245
2010	343	29	74	269
2011	289	28	70	218
2012	383	34	77	324
2013	532	45	89	443

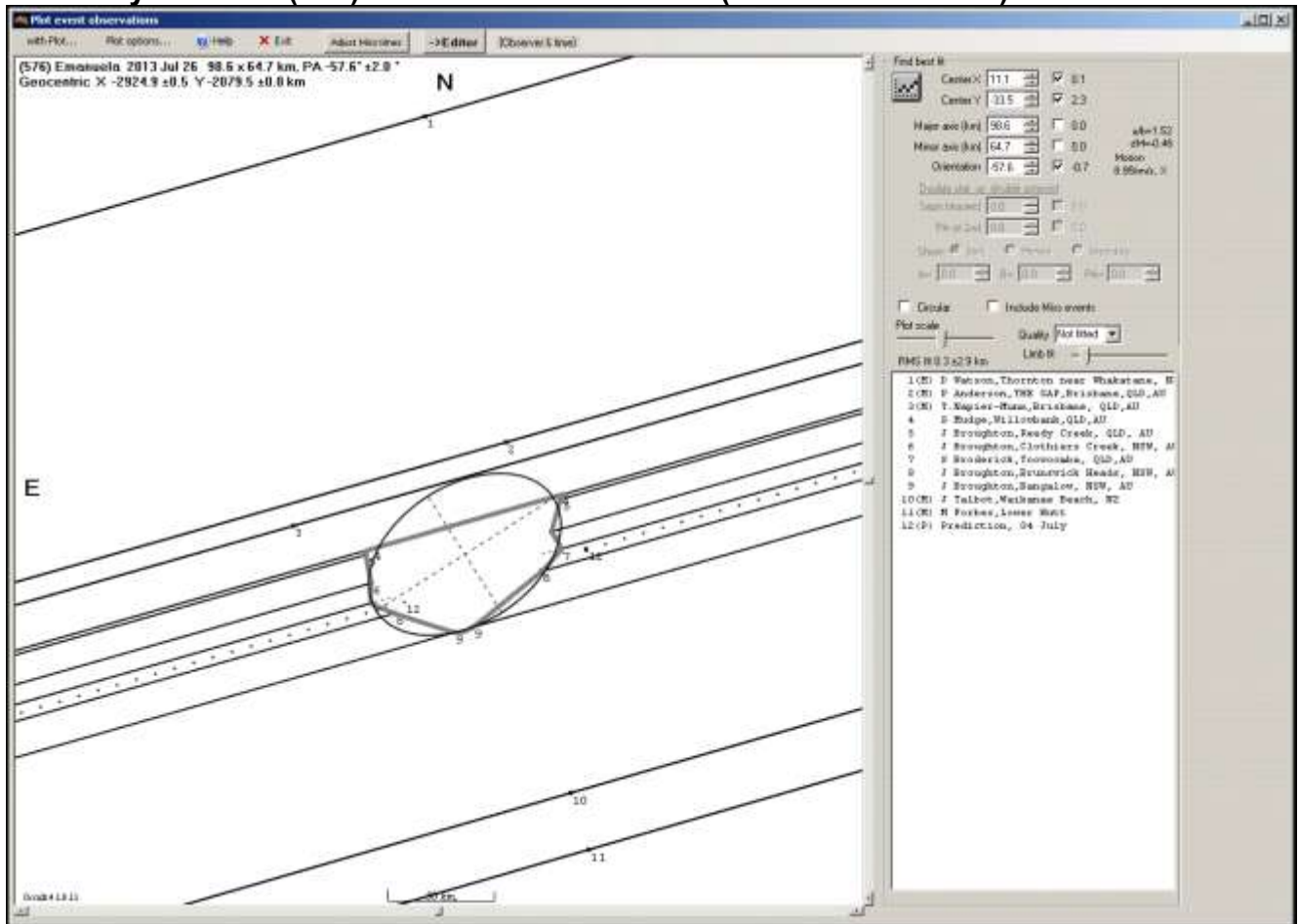
Our total number of observers rose by about 32% and positive events by 15%, and the number of reports has increased by about 39%, this year compared to last year.

Our top observers (positive and negatives) were Brian Loader with 80, John Broughton with 54, Chris Chad 37, Jonathan Bradshaw with 26, and Bill Hanna and Dave Herald with 22 each

The Occsec web site now has over 750Mb of disk space used, most for predictions and results, and is growing at over 50 Mb per year. During the year we had to change our web host service and our URL which is now <http://www.occultations.org.nz/>

Best Positive Results:

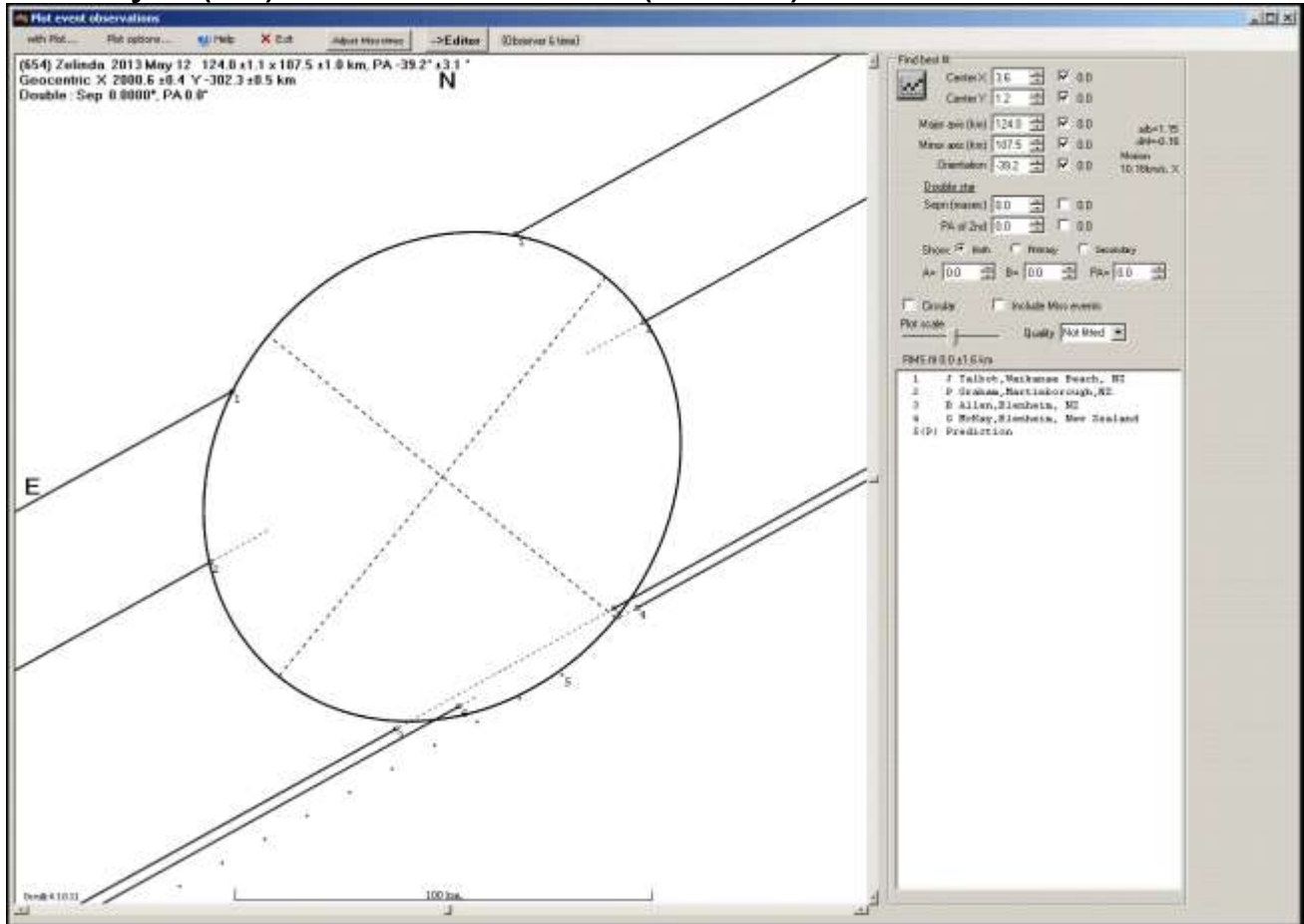
2013 July 26 08:54 (576) Emanuela occultation - (6 chords 4 Misses)



Sadly there is no Damit/ISAM/Miriade 3D model to help refine the analysis. Light curve data had suggested a maximum axis ratio of only 1.05:1 but if we constrain the ellipse by chord 3 then we have measured ratio about 1.52:1

Paper in JDSO Vol. 9 No. 4 October 1, 2013 P226

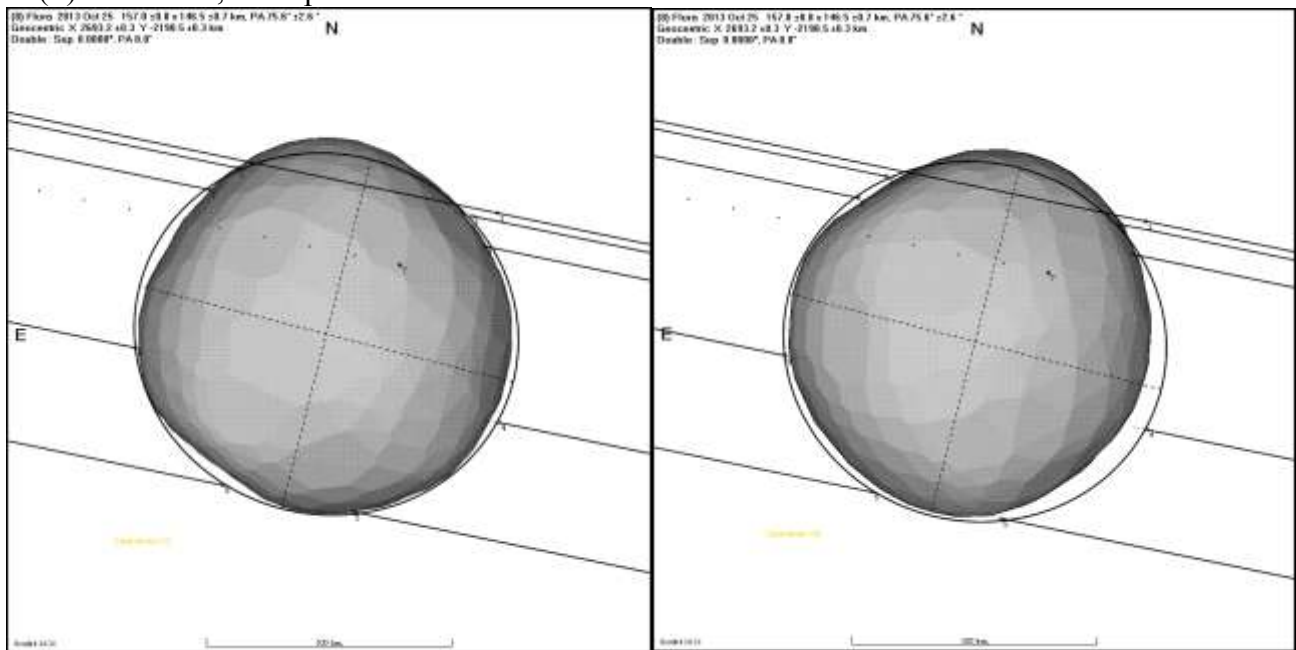
2013 May 12 (654) - Zelinda occultation - (4 Chords)



The ellipse above is plotted at the best fit axis ratio as determined by Occult. The area is very close to that of the predicted circle of 123 km diameter. With 4 chords we can be confident of the path of Zelinda and that it was north of the predicted line.

2013 October 25 - (8) Flora occultation - (4 Chords)

- 1 (Cloud) G Hudson, Porirua, NZ
- 2 B Allen, Blenheim, NZ
- 3 G Blow etal, Carter Obs Wellington, NZ
- 4 L Field, Kaikoura, NZ
- 5 B Loader, Darfield, NZ
- 6(M) A Pennell, B Begg Observatory Dunedin NZ
- 7(P) Prediction, 15 Sept

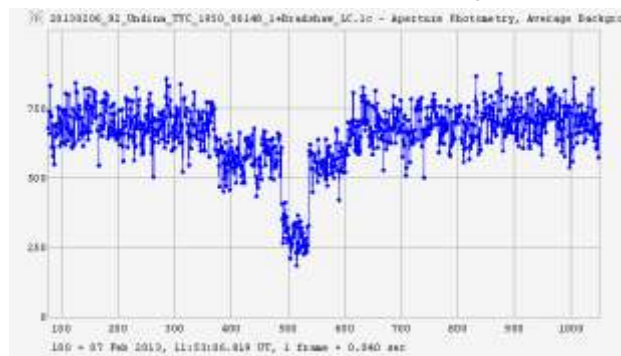


The ellipse above is plotted at the best fit axis ratio as determined by Occult. With 4 chords we can be confident of the path of Flora and that it was a little south of the predicted line. The 2 possible DAMIT 3D models have been overlaid on the measured ellipse below and both show good fit, and they are not different enough to rule out either. There is a slight preference for the second one.

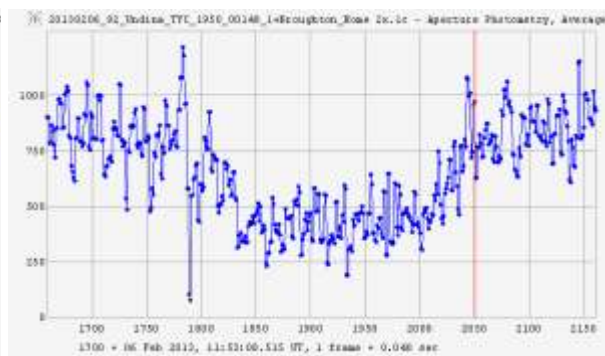
Close Double Star discoveries from occultations:

These have extra scientific value over observations of a single star in that not only do they result in knowledge of close double stars but the Relative magnitudes, Separation and Position Angles are also able to be measured. These results have also been published in JDSO journal.

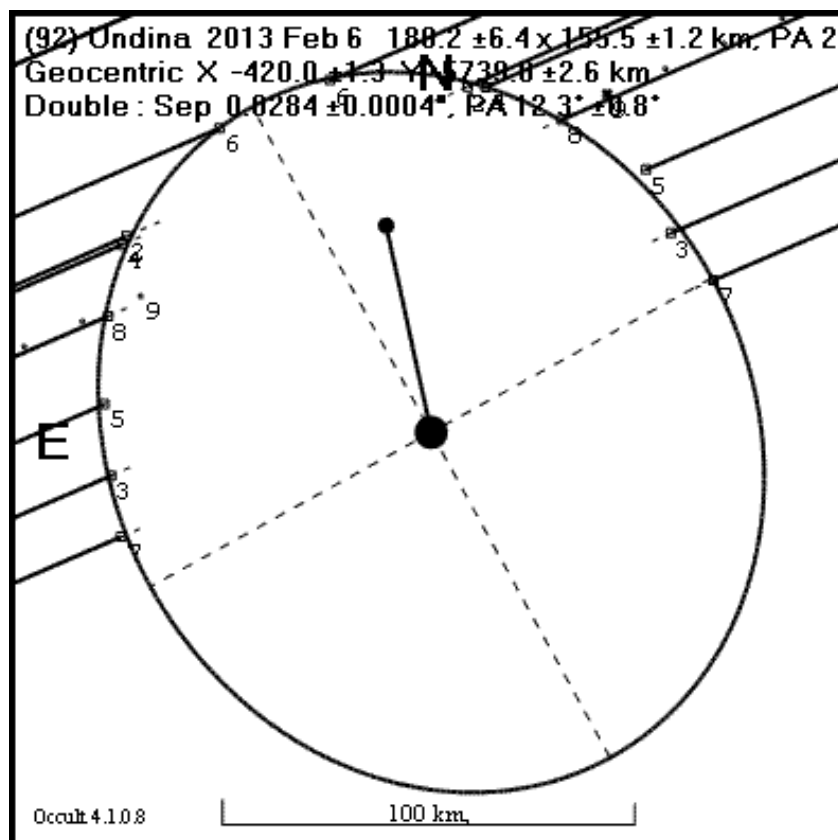
2013 February 92 Undina 06 occultation OF TYC 1950-00148-1 (New double star discovery) with 6 chords.



J. Bradshaw (5,6)



J Broughton (7,8)



- Observers:
- 1 (M) D Watson, Thornton near Whakatane, NZ
 - 2 W Hanna, Alice Springs, NT, Australia
 - 3 J Broughton, Pimpama, QLD, AU
 - 4 J Broughton, Pimpama, QLD, AU
 - 5 J Bradshaw, Samford Valley, Qld, AU
 - 6 J Bradshaw, Samford Valley, Qld, AU
 - 7 J Broughton, Reedy Creek, QLD, AU
 - 8 J Broughton, Reedy Creek, QLD, AU
 - 9(P) Prediction, 27 January

Paper in JDSO Vol. 9 No. 4 October 1, 2013 P22

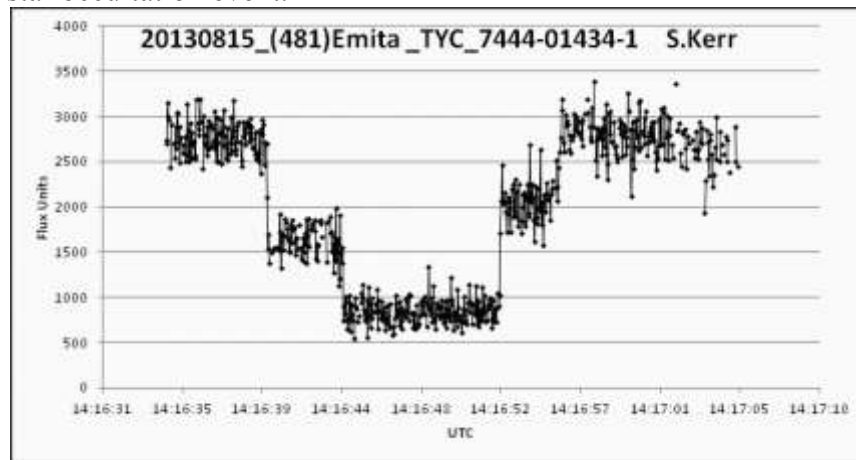
Observer	Telescope	Camera	Timing	
Watson, NZ	20 cm	Visual	Tape Recorder and Time signal	
Bradshaw, AU	36 cm	CCD	GPS time inserted	
Broughton Reedy Creek, AU	25 cm	WAT120N	GPS time inserted	
Broughton Mobile Pimpama, AU	32cm	WAT120N	GPS other linking	
Hanna, AU	20cm	StellaCam 3	GPS time inserted	

2013 August 15 - (481) Emita occultation - (New double star discovery)

2013 August 15 Steve Kerr observed the asteroid (481) Emita occult the star TYC 7444-01434-1 from Rockhampton, QLD, Australia. The observation was made with equipment in Table 1.

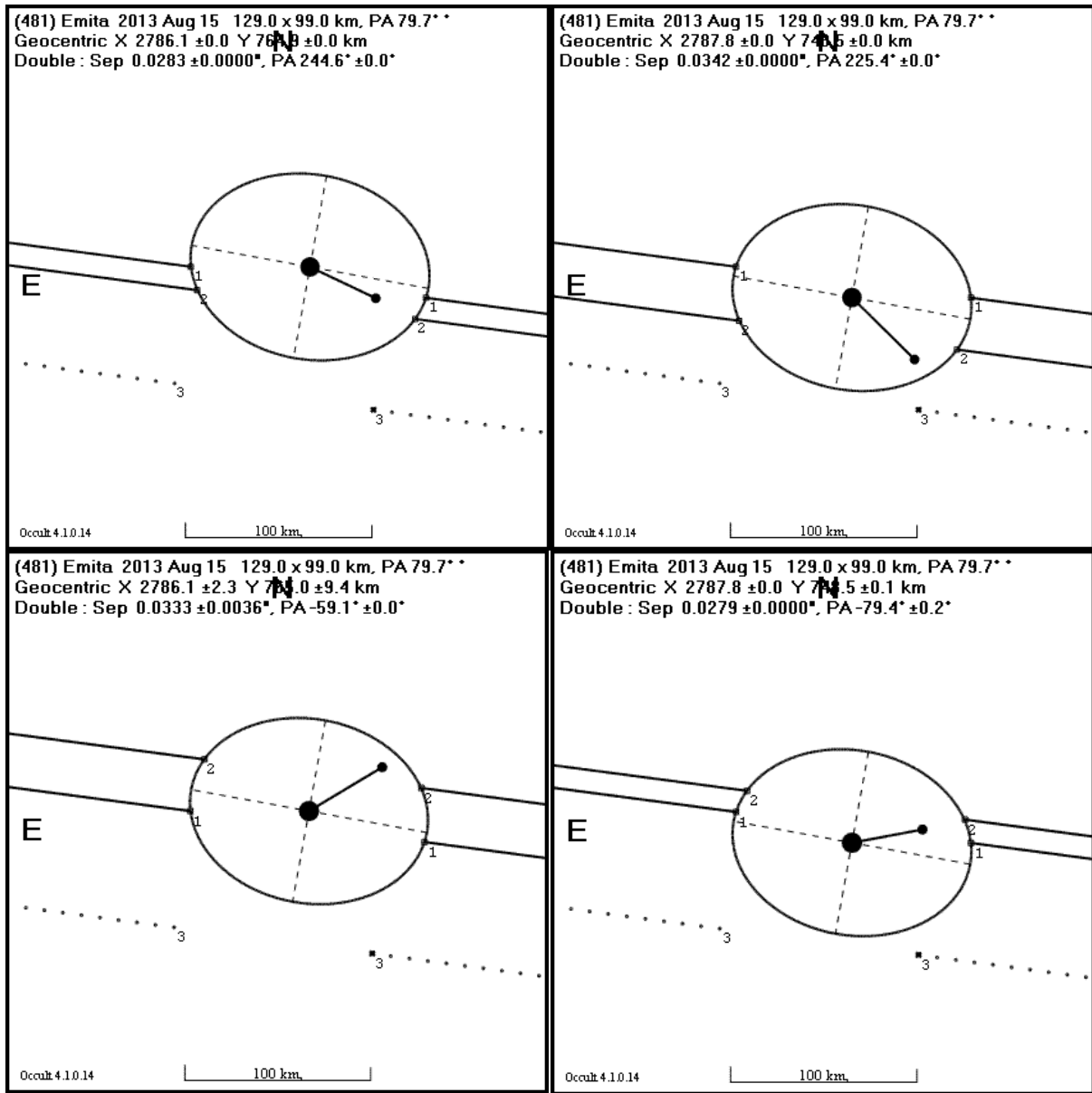
Observer	Telescope	Camera	Timing	Event
S. Kerr, QLD, AU	30 cm	Watec 120N+ video	GPS Time Inserted	Stepped D and R

The light curve Fig 1 obtained from the occultation shows clear steps that are characteristic of an ABBA double star occultation event.



Steve Kerr's Light curve from Tangra analysis.

For the rest of this analysis we examine the four possible solutions for PA and Separation. We have also used the plot with stars aligned as it is easier to see the vector of PA and Separation.



Plot showing offset centres for the two stars for the observation.

With only one observer we get 4 known points and are trying to fit 7 parameters. Even when fixing the size and shape parameters, there are four possible solutions shown above..

Model No	A Km	B km	a/b	Seprn mas	PA Deg
1	129	99	1.30	33.3	300.9
2	129	99	1.30	27.9	280.6
3	129	99	1.30	28.3	244.6
4	129	99	1.30	34.2	225.4

Summary of 4 solutions

Examination of the star in Google Sky shows a hint double diffraction spikes that sometimes indicate a double star. The star image is much larger than the measured separation.

The double star characteristics are:

Star TYC 7444-01434-1 = UCAC2 17843758 = UCAC4 284-205625 =
 GSC O000673
 Coordinates (J2000) RA 20h 03m:37.24s , -DEC 33° 15' 15.57"
 Spectral type (none found)
 Mag A 11.02 ± 0.5 (V)
 Mag B 11.54 ± 0.5 (V)
 Separation 31 mas ±10.0 mas
 Position Angle Ambiguous 290° ±10° or 235 ° ± 10°
 Epoch 2013.6210 (Besselian)

A paper published in JDSO Vol. 10 No. 2 April 1, 2014

2013 August 15 - (611) Valeria occultation - (New double star discovery)

2013 August 15 (the same night as the above event) Chris Chad observed the asteroid (611) Valeria occult the star UCAC2 30429828 from Gunnedah, NSW, Australia. The observation was made with equipment in Table below.

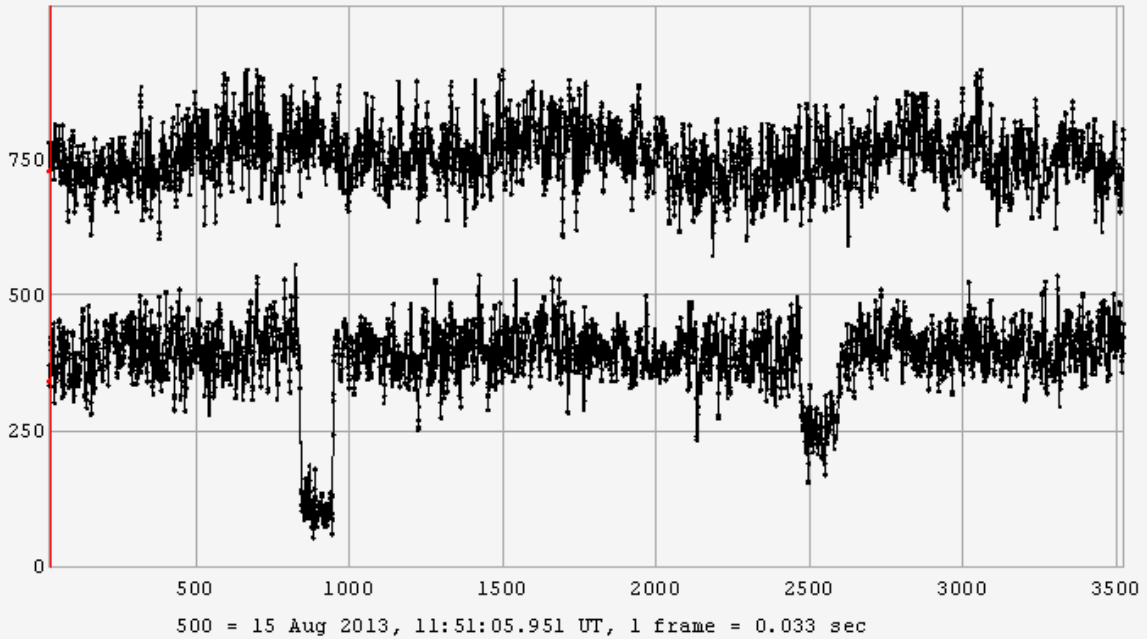
Observer	Telescope	Camera	Timing	Event
C. Chad, NSW,AU	25 cm	Samsung SCB-2000 Video	GPS time inserted	2 separate dips
J Broughton, QLD,AU	25 cm	Watec 120N+ video	GPS Time Inserted	Miss
P. Anderson, QLD,AU	41 cm	Visual	Radio Time	Miss

Observers

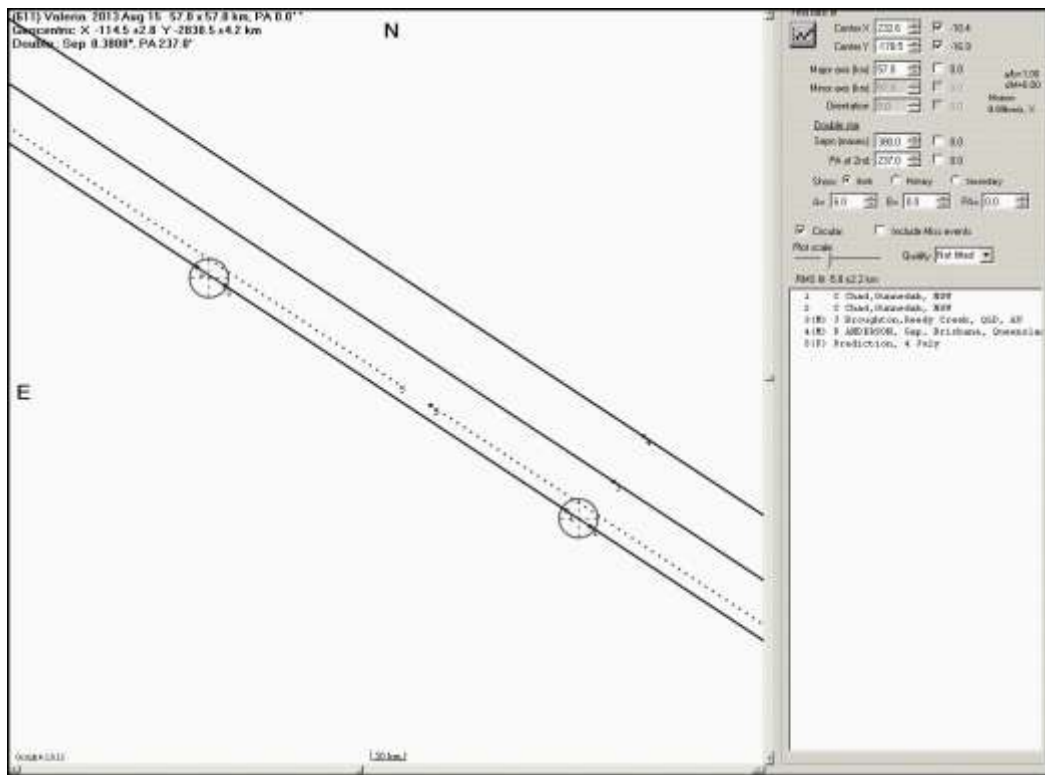
The star is not listed in the Fourth Interferometric Catalogue, nor in the Washington Double Star catalogue.

The light curve below obtained from the occultation shows two clear separate dips of similar duration (3.5 sec and 4.1 sec) but with differing magnitude drop (1.5 mag and 0.5 mag) that were both lower than the predicted 2.2). This is characteristic of a double star event. The possibility of a binary asteroid was considered; however the different light drops in the two occultation events excludes that as an explanation.

20130815_611_Valeria_UCAC2_30429828+Chad.lc - Aperture Photometry, Average Background

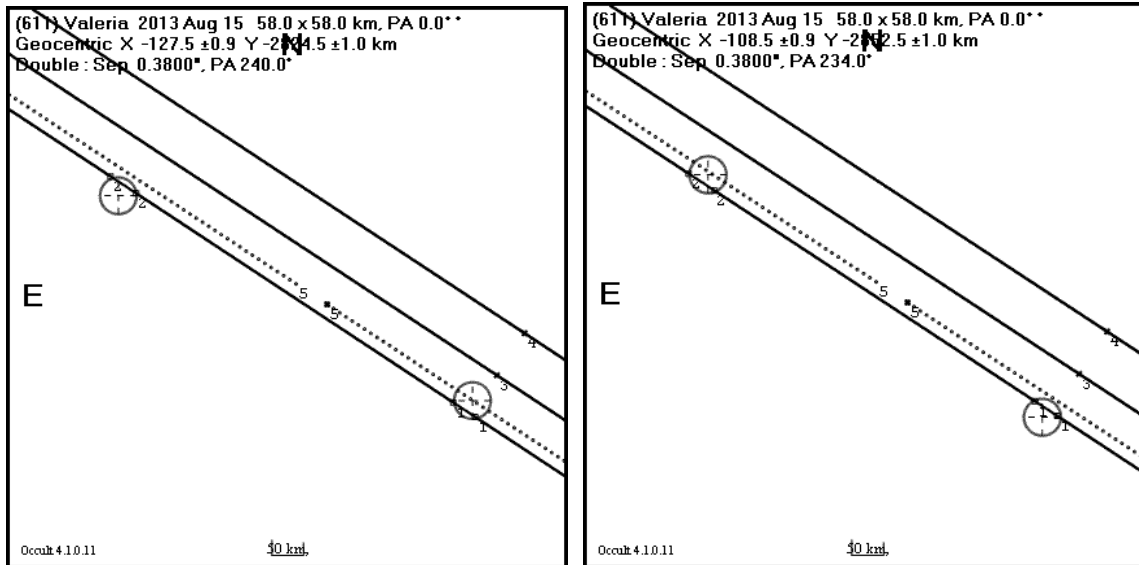


Chris Chad's Light curve together with a comparison star from Tangra analysis.



Plot of result and predicted times.

With only one chord for each star there are 4 possible solutions which give rise to very small uncertainty in separation and a small uncertainty in PA. Fig below shows the two most extreme solutions where the two stars are on opposite sides of the observed path.



Plot showing offset shadows for the two stars with the two extreme possible solutions for the observation.

The resultant PA and Separation for the 4 solutions are shown in the table below.

N	PA Deg	Separation mas
1	240	380
2	234	380
3	237	380
4	237	380

Four possible solutions for PA.

Examination of the star in Google Sky shows a very small distortion in the star shape compared to nearby stars of similar brightness. The star image is much larger than the measured separation. There are no obvious double diffraction spikes that sometimes indicate a double star.

The double star characteristics are:

Star UCAC2 30429828 = UCAC4 429-099842 = GSC 5152-00921
 Coordinates (J2000) 19h 33m 16.3s, -04° 17' 33.3"
 Spectral type (none found)
 Mag A 12.44 ± 0.5 (V)
 Mag B 13.36 ± 0.5 (V)
 Separation 380 mas ± 1.0 mas
 Position Angle 237° ± 3°
 Epoch 2013.1008 (Besselian)

Published in JDSO Vol. 10 No. 1 January 1, 2014

Conclusion:

Minor planet occultation observing continues to be alive, well and still growing in Australasia. We have shown in the past that for some events we can muster 20 or more stations but we could always do with a few more reports and a few more regular observers, particularly in the North of the North Island, for the less exciting and smaller object events.

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

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

The Occsec Circular

I wish to give a special thank you to Murray Forbes who has been working on catching up on the backlog of all observations reported in our region in a Journal format. The 2007, 2008, and 2009 and much of 2010 events have now been completed. I hope he can further close the gap this year.

Acknowledgements:

1. Dave Herald for the provision of Occult4 software for prediction and analysis of occultations including the new AOTA light curve analyser.
2. Kazuhisa Miyashita for provision of Limovie software for analysis of video recordings and production of light curves.
3. Hristo Pavlov for provision of Tangra and Occult Watcher software for planning and analysis of video recordings and production of light curves.
4. Bob Anderson and Tony George for the provision of Occular software for analysis of lightcurve data using statistical methods to discover the event times.
5. Josef Durech from Prague, Czech Republic, for providing DAMIT models at <http://astro.troja.mff.cuni.cz/projects/asteroids3D/web.php>
6. Przemysław Bartczak from Poznan, Poland for providing the ISAM service at <http://isam.astro.amu.edu.pl/>
7. And all observers who have attempted observations and sent 532 reports that contributed to the success of this valuable observing program.