

TYC 2255-01354-1 Duplicity Discovery from Asteroidal Occultation by (790) Pretoria

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Abstract: An occultation of TYC 2255-01354-1 by the asteroid 790 Pretoria on 2009 July 19 showed this star to be a double star with a separation of 144.8 ± 0.4 mas, PA 192.4 ± 0.2 degrees. Both components of the double star were occulted as seen by all observers. The magnitude of the primary component is estimated to be 10.63 (VT). The magnitude of the secondary component is estimated to be 10.83 (VT).

Observation

On 2009 July 19 seven independent IOTA observers (Cooke, Degenhardt, Dunham, Kazmierczak, Messner, Suggs and Venable) observed the asteroid 790 Pretoria occult the star TYC 2255-01354-1. See the path map in Figure 1. The event was observed from 13 different locations in the USA resulting in 22 separate occultation chords. See Table 1.

The target star is magnitude 10.02 (VT) as listed in the Tycho-2 catalog (VizieR). The asteroid magnitude as predicted by Occult4 was 13.5(v). The expected magnitude drop at occultation was 3.5 magnitudes from the combined magnitude of asteroid and star of 9.97 (VT). The star is not listed in either the Fourth Interferometric Catalog or the Washington Double Star catalog.

The light curves obtained from the occultations show two clear events at all but two of the twelve locations where an occultation was observed. There was a clear indication of a double star. At two of the locations, only one occultation was observed. The

light curves of the event (which lasted from 7 to 14 seconds) are shown in Figures 2A and Figure 2B. These are not shown in any particular order, but so the reader may see the variety of light curves obtained, and how, in most of them, the double occultation can be seen in the data.

Timing of the event disappearance and reappearance was obtained through either:

1. GPS time inserted in each frame,
2. GPS time inserted at the start and end of video and then inserted by frame based on frame count
3. WWV time recording/ simultaneous video recording with frame times interpolated from WWV time tones.

A detailed discussion of these timing techniques is given in Nugent [1].

The companion seen in all double-event light curves is nearly equal in brightness to the primary star. Using the Cooke/Suggs light curve data, the

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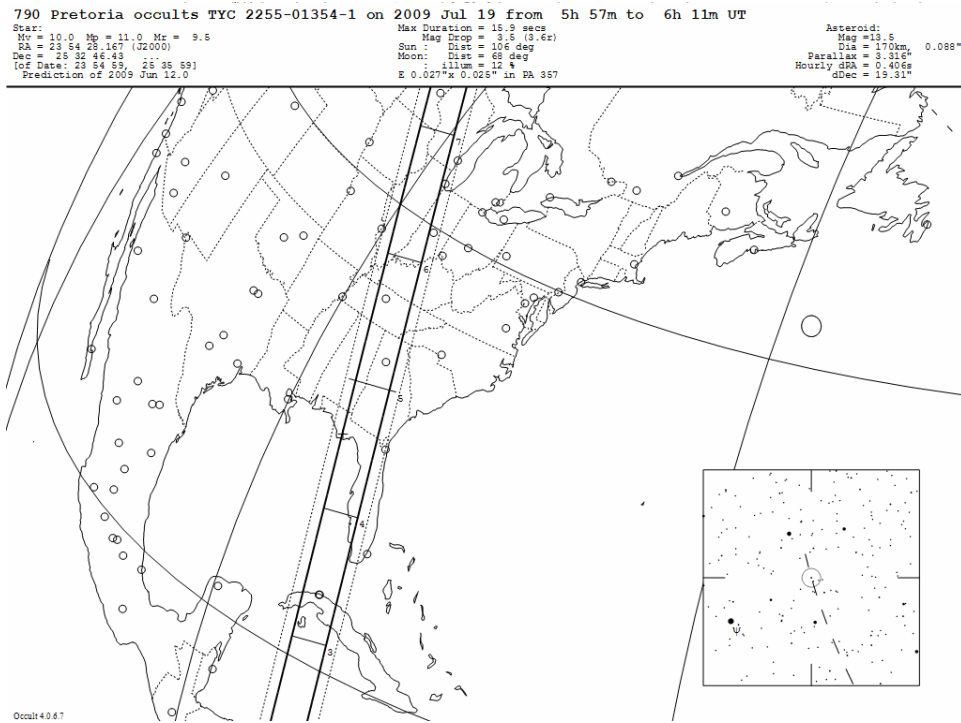


Figure 1: July 19, 2009 (790) Pretoria occultation of TYC 2255-01354 Path Mag

Table 1: Observer(s), site locations, equipment and methods

Site No.	Observer	Location	Telescope Type	Tele Diam	Observing Method	Fig 3A and 3B Chord #	Result
1	B. Cooke	Huntsville, AL	SCT	50 cm	Video+GPS time insert	1	Miss
2	S. Degenhardt	Lewisburg, TN (mobile)	Refractor	5 cm	Video+GPS other insert	2	2 nd Star Occ
3	S. Messner	Northfield, MN	Newtonian	45 cm	Video+GPS time insert	3,4	2 nd Event only
4	S. Degenhardt	Shelbyville, TN (mobile)	Refractor	5 cm	Video+GPS other	5,6	Both Occ
5	R. Suggs	Chickamauga, GA	SCT	36 cm	Video+GPS time insert	8,9	Both Occ
6	D. Dunham	Silver Point, TN (mobile)	Refractor	8 cm	Video+GPS other insert	10,11	Both Occ
7	R. Venable	Five Point, GA (mobile)	SCT	10 cm	Video+GPS time insert	12,13	Both Occ
8	M. Kazmierczak	Conyers, GA	SCT	20 cm	Visual+tape time	14	Wrong Star?
9	R. Venable	Hawkinsville, GA (mobile)	SCT	20 cm	Video+GPS time insert	15,16	Both Occ
10	R. Venable	Empire, GA (mobile)	SCT	28 cm	Video+GPS time insert	17,18	Both Occ
11	R. Venable	Chester, GA (mobile)	SCT	35 cm	Video+GPS time insert	19,20	Both Occ
12	D. Dunham	Lawnville, TN (mobile)	Refractor	8 cm	Video+GPS time insert	21,22	Both Occ
13	W. Warren	Crossville, TN (mobile)	SCT	13 cm	Video+GPS video	NA	Clouded out

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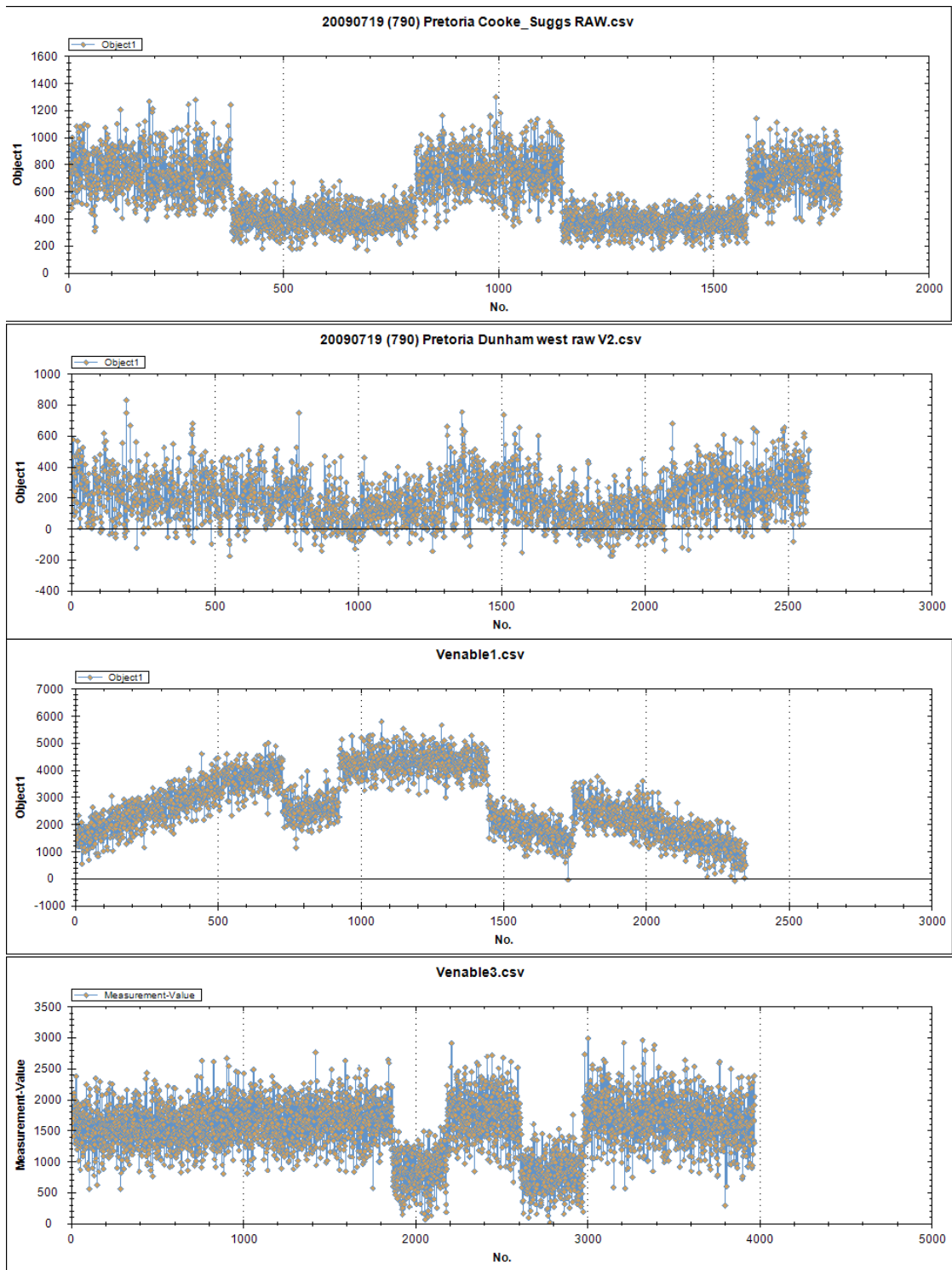


Figure 2A: Light curves (various) for visual representation of the data – without regard to site order

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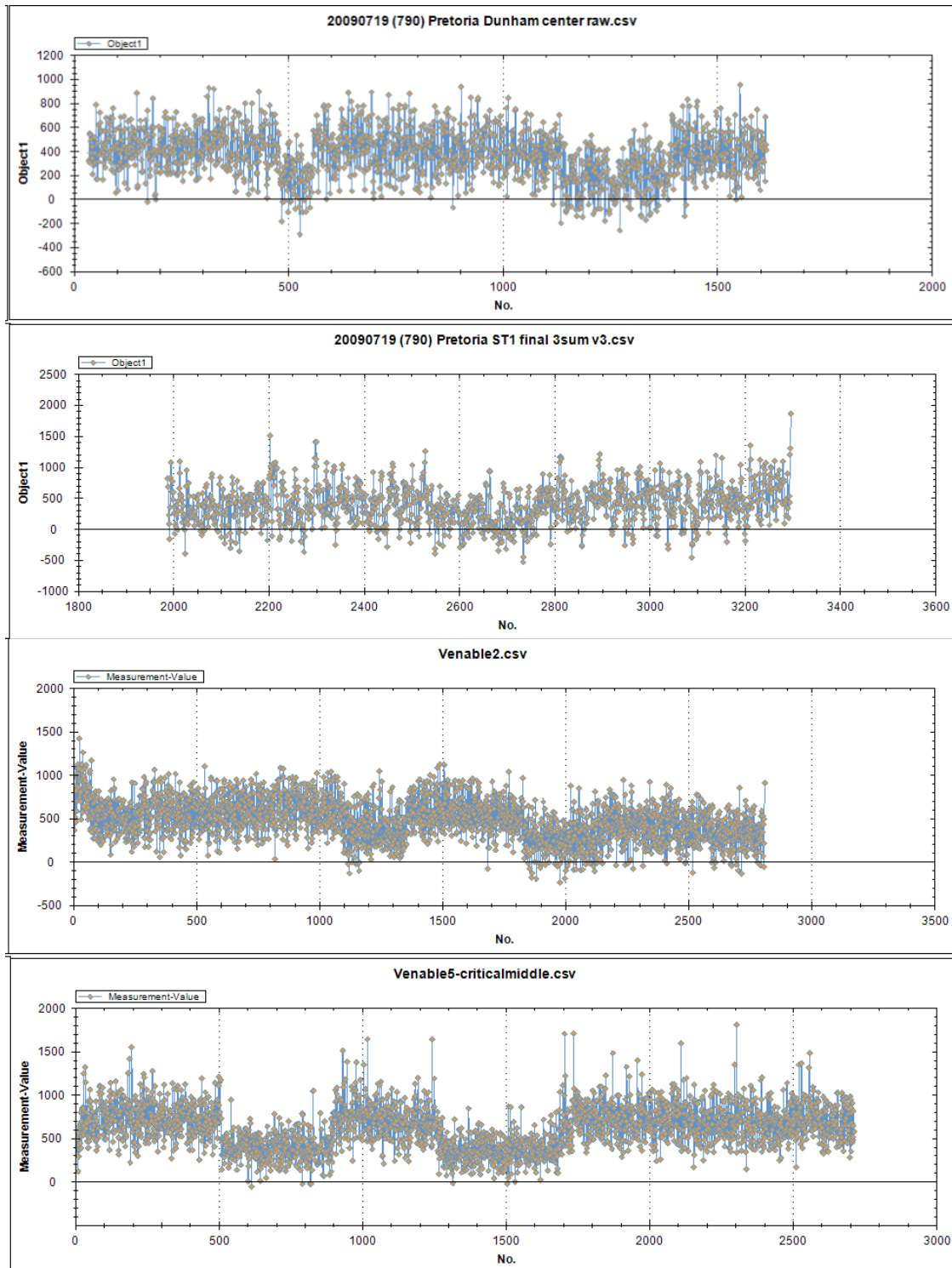


Figure 2B: Light curves continued (various) for visual representation of the data – without regard to site order

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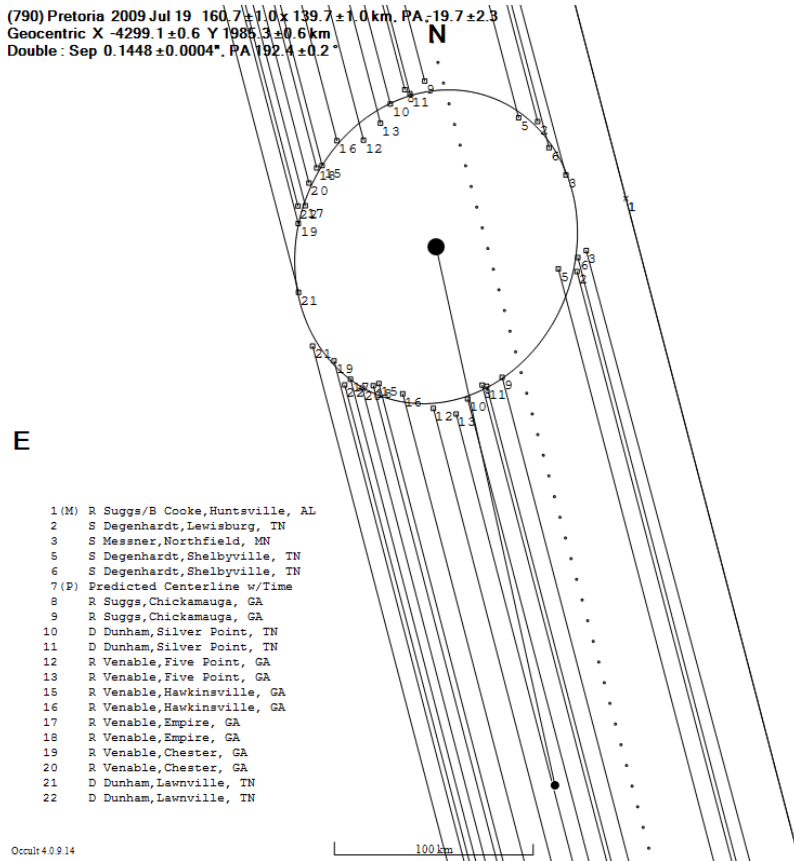
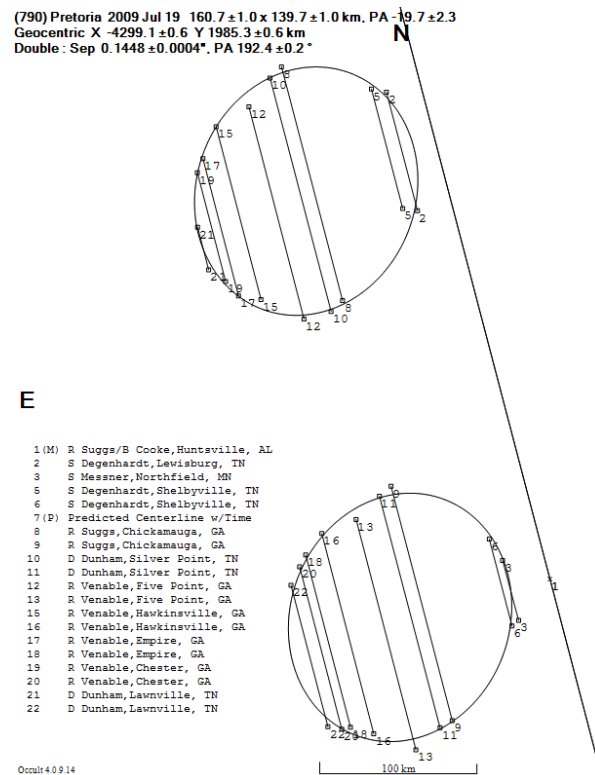


Figure 3A: Asteroid profile plot – primary and secondary stars aligned

Figure 3B: Asteroid profile plot -- primary and secondary stars separate



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magnitude drop of the disappearance and reappearance of each star was calculated using the brightness measurements derived by Occular 4.0; the Magnitude calculator routine in Occult4 (Method 3 – Magnitudes from light curve values), and the VT combined magnitude from the TYC catalog. The magnitude for each component was determined separately. See Figure 4 for a representative calculation of the primary component. The magnitudes of the two stars are estimated to be 10.63 (VT) and 10.83 (VT).

The observations were analysed in the standard manner described by Herald [2]. There is no ambiguity in the solution. Assuming the asteroid had an elliptical profile, the double star characteristics are shown in Figures 3A and 3B, and summarized in Table 2.

References

1. “Chasing The Shadow: The IOTA Occultation Observer’s Manual, The Complete Guide to Observing Lunar, Grazing, and Asteroid Occultations”, Richard Nugent, April 2007.
2. New Double Stars from Asteroidal Occultations, 1971 – 2008, Dave Herald, Canberra, Australia, Journal of Double Star Observations, Volume 6 Number 1 January 1, 2010

Table 2: Double star identification and properties

Star	TYC 2255-01354-1
	UCAC2 40960166
	UCAC3 77654452
	NOMAD 1155-0022566
	GSC 02255-01354
	2MASS J23542816+2532467
Coordinates (J2000*)	23 54 28.1787 +25 32 46.640
Mag A	10.63 ±0.1 (VT)
Mag B	10.83 ±0.1 (VT)
Separation	144.8 mas ±0.4 mas
Position Angle	192.4° ± 0.2°
Epoch	2009.546

*Coordinates ICRS (equinox and epoch = J2000.0) as reported in Simbad.

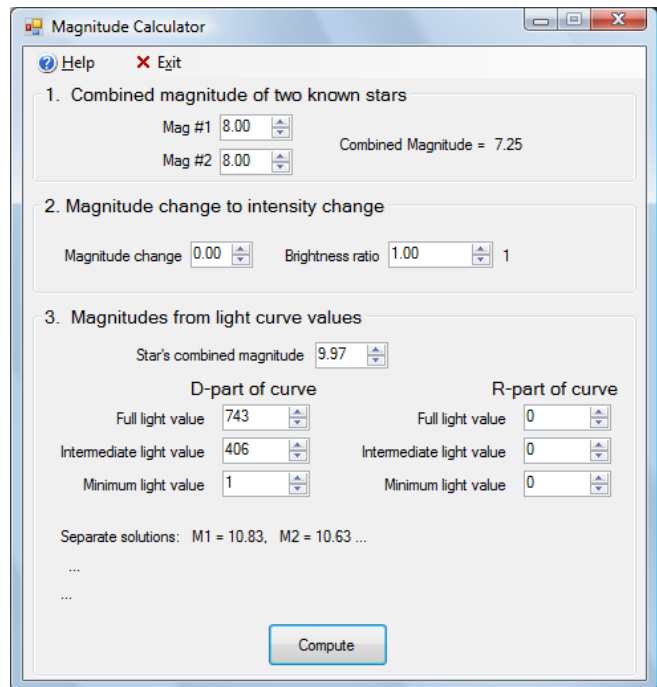


Figure 4: Component magnitudes derived from Occult4 magnitude Calculator