

ASTEROIDS OBSERVED FROM GMARS AND SANTANA OBSERVATORIES: 2010 OCTOBER - DECEMBER

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Lightcurves for two asteroids were obtained from Santana and GMARS Observatories from 2010 October to December: 571 Dulcinea and 1177 Gonnessia.

Observations at Santana Observatory (MPC Code 646) were made with a 0.30-m Schmidt-Cassegrain (SCT) with a SBIG STL-1001E. Observations at GMARS (Goat Mountain Astronomical Research Station, MPC G79) were made with a 0.35-m SCT using SBIG STL-1001E CCD Camera. All images were unguided and unbinned with no filter. Measurements were made using *MPO Canopus*, which employs differential aperture photometry to produce the raw data. Period analysis was done using *Canopus*, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (1989). The asteroids were selected from the list of asteroid photometry opportunities published on the Collaborative Asteroid Lightcurve Link (CALL) website (Warner et al. 2010).

The results are summarized in the table below, as are individual plots. Night-to-night calibration of the data (generally $< \pm 0.05$ mag) was done using field stars converted to approximate Cousins R magnitudes based on 2MASS J-K colors (Warner 2007 and Stephens 2008).

571 Dulcinea. Images on 11/12 and 11/13 were taken at GMARS. All others were taken at Santana Observatory. Based upon a single night's observations in February 2004, Behrend (2010) reported the period was approximately 24 h. Once a single rotational period was completed, Dulcinea started showing signs of being a classic tumbler. The asteroid completed 6 rotational cycles during the observing run, with each cycle following a different Fourier curve. Petr Pravec (private communication) reported that a second period

cannot be uniquely determined from the available data. A second period of 150 h is one of several possible solutions. The 126.3 h period is presented here as the primary period.

1177 Gonnessia. All images were obtained at Santana. Behrend (2010) reported a period of approximately 12 hours with an amplitude of about 0.25 magnitudes using a partial lightcurve from a single night in July 2002. Warner (2003) observed Gonnessia in for five nights July 2002, including the same night as Behrend. Warner remeasured his original images and reports the sparse 2002 data has a best fit to a 42 or 80 h period (private communication). The L_{PAB} was 312 for the 2002 observations. All nights observed in 2010/11 showed a small amplitude. It was difficult to differentiate between competing period solutions. Periods of about 35 h and 63 hours continues to be possibilities.

References

Behrend, R. (2010). Observatoire de Geneve web site, http://obswww.unige.ch/~behrend/page_cou.html.

Harris, A.W., Young, J.W., Bowell, E., Martin, L.J., Millis, R.L., Poutanen, M., Scaltriti, F., Zappala, V., Schober, H.J., Debehogne, H., and Zeigler, K.W. (1989). "Photoelectric Observations of Asteroids 3, 24, 60, 261, and 863." *Icarus* **77**, 171-186.

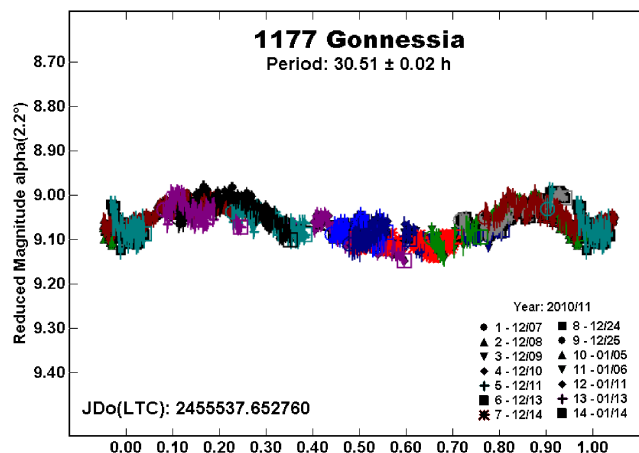
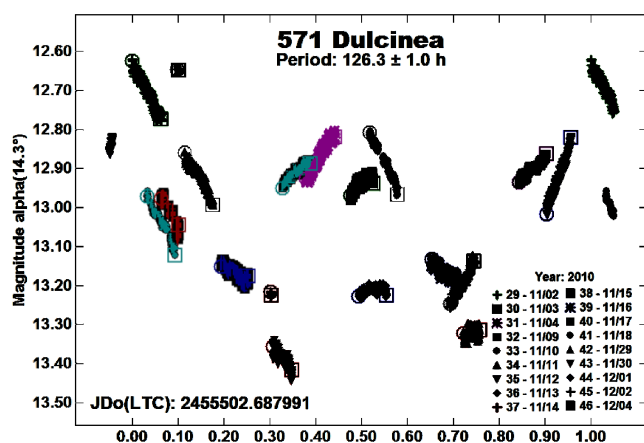
Stephens, R.D. (2008). "Long Period Asteroids Observed from GMARS and Santana Observatories." *Minor Planet Bul.* **35**, 31-32.

Warner, B.D. (2003). "Lightcurve analysis for asteroids 607 Jenny, 1177 Gonnessia, 4440 Tchanchies, 4896 Tomoegezen, and (4495) 1984 QR." *Minor Planet Bul.* **30**, 33-35.

Warner, B.D. (2007). "Initial Results from a Dedicated H-G Project." *Minor Planet Bul.* **34**, 113-119.

Warner, B.D., Harris, A.W., and Pravec, P. (2010). Asteroid Lightcurve Data File, <http://www.MinorPlanetObserver.com/astlc/LightcurveParameters.htm>.

Warner, B.D., Harris, A.W., and Pravec, P. (2010). Lightcurve Targets <http://www.MinorPlanetObserver.com/astlc/default.htm>.



#	Name	mm/dd 2010/11	Data Pts	α	L_{PAB}	B_{PAB}	Per (h)	PE	Amp (mag)	AE
571	Dulcinea	11/02 - 12/04	2,675	14.4, 4.9, 8.0	60	6	126.3	1.0		
1177	Gonnessia	12/07 - 01/14	1,771	2.2, 0.9, 10.8	80	-4	30.51	.02	0.10	0.02

PRELIMINARY RESULTS FROM A STUDY OF TROJAN ASTEROIDS

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Lightcurve results are presented for 13 Jupiter Trojan asteroids from observations obtained at Cerro Tololo Interamerican Observatory and GMARS Observatory from October 2009 to January 2011.

Observations

Observations at GMARS (Goat Mountain Astronomical Research Station, MPC 779) were made by Stephens and Coley with three telescopes, all were 0.35-m SCTs, two using a SBIG STL-1001E CCD Cameras and the other using a SBIG ST-9e CCD camera. All images were unbinned with no filter. Measurements were made using *MPO Canopus*, which employs differential aperture photometry to produce the raw data. Period analysis was done using *MPO Canopus*, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (1989). Observations at CTIO (Cerro Tololo Interamerican Observation, MPC 807) were made with the CTIO 1.0-m or 0.9-m telescopes. All images taken at CTIO were unbinned; V and R filters were used. Data and period analysis was done using *MPO Canopus*.

The results are summarized in Table 1. Night-to-night calibration of the data (generally $< \pm 0.05$ mag) was done using field stars converted to approximate Cousins R magnitudes based on 2MASS J-K colors (Warner 2007 and Stephens 2008).

1172 Aneas. Hartman (1988) reported a period of 8.33 h, in fair agreement with our period of 8.705 ± 0.001 h. Observations on July 22 were taken by Lederer and Rohl at CTIO. Observations from August 5 – 9 were taken by Stephens at GMARS.

1404 Ajax. Hartman (1988) reported a period of 34 h. Behrend (2010) reported a period of 28.4 h from a single night of observations in October 2009 covering less than one quarter of the phased lightcurve. Both results reasonably agree with our period of 29.38 ± 0.01 h.

1749 Telamon. No previous period has been reported. Telamon showed a low amplitude, irregular lightcurve $P = 19.675 \pm 0.001$ h,

with repeating features over the six week observing run at GMARS.

2241 Alcahous. De Sanctis (1994) reported a period of 9.41 h. Our data could not be phased to a period around nine hours. Observations on June 25 and 26 were obtained during French's service observing run at CTIO. All others were by Stephens at GMARS. We find $P = 7.690 \pm 0.001$ h.

2357 Phereclos. No previous period has been reported. We find $P = 7.16 \pm 0.01$ h. While observing Phereclos at CTIO, French and Stephens noticed a second asteroid in the field which turned out to be 878 Mildred. Mildred was originally discovered on September 6, 1916, by Seth Nicholson (1916) and Harlow Shapley using the 1.5 m Telescope at Mount Wilson Observatory. It was then lost for 75 years. The asteroid was named for Shapley's infant daughter "Mildred". Mildred's rotational period was determined to be 2.660 h. Mildred Shapley Matthews commented "I want to thank you... for your work on Mildred 878 that evidentially got in the way of your original goal. The same thing happened to my father!" (private communication).

2797 Teucer. Binzel (1992) reported a period of 14.8 h based upon two nights of observations separated by 44 hours. This appears to be an alias of our period of 10.145 ± 0.001 h.

3063 Makhaon. Binzel (1992) reported a period of 17.3 h based upon two consecutive nights of observations. Behrend (2010) reported a period of 2.6 h based upon a single night of observations where the amplitude was ~ 0.02 magnitudes. The Binzel period appears to be an alias of our 8.64 ± 0.01 h period.

3451 Mentor. Sauppe (2007) reported a period of 7.70 h. Duffard (2008) reported a period of 7.682 h. Melita (2010) reported a period of 7.68 h. Behrend (2010) reported a period of 7.699 h. Phasing our data to these periods resulted in some nights not lining up by a quarter of the phase. The Sauppe period was obtained over three 3 nights spanning 4 days in 2007. The Behrend period is from a single night in August 2010 which does not appear to complete a full rotational period. We find the best result for $P = 7.730 \pm 0.001$ h.

3540 Protesilaos. No previous period has been reported. The two nights were observed at GMARS. We find $P = 8.95 \pm 0.01$ h.

(4489) 1988 AK. No previous period has been reported. French and Lederer measured a period of 12.6 h in October 2009. Stephens obtained a period of 12.58 ± 0.01 h in September 2010.

4834 Thoas. No previous period has been reported. Coley and Stephens measured $P = 18.192 \pm 0.001$ h in October 2010. French and Lederer obtained a period of 18 hours in October 2009.

4867 Polites. No previous period has been reported. French and Stephens obtained sparse data over 5 nights at CTIO to determine the low amplitude lightcurve with $P = 9.21 \pm 0.01$ h.

Period Analysis

All targets were followed sufficiently to determine a period in order to minimize the likelihood of observation bias. We stress that no asteroids have been abandoned due to long period or low amplitude light curves.

Typical main-belt asteroid rotation periods are in the 3-15 hour range. Molnar *et al.* (2008) designed a study of Trojan rotation periods that would not introduce bias against slow rotators; once an