

Nicholson, S. and Shapley, H. (1916). "The Orbit and Probable Size of a Very Faint Asteroid" *Astron. Journal* **710**, 127.

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

THE LIGHTCURVE OF JOVIAN TROJAN ASTEROID 884 PRIAMUS

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Observations of Jovian Trojan Asteroid 884 Priamus in July and August 2010 yield a symmetrical lightcurve with a period of 6.8605 ± 0.0005 h and an amplitude of 0.24 mag.

The Jovian Trojan asteroids are found in orbits near the stable L4 and L5 Lagrange points of Jupiter's orbit. As of 29 September 2010, 2791 had been found in the L4 (preceding) region and 1732 in the L5 region.

As yet, the rotation properties of Trojan asteroids are poorly known relative to those of main belt asteroids, due to the low albedo and greater distance of the Trojans. No rotation period has been reported for 884 Priamus; Hartmann *et al.* (1988) reported a lower limit to the lightcurve amplitude of 0.37 mag., but did not publish a rotation period or a lightcurve. One of us (LF) had attempted observations of Priamus in 1987 on two successive nights which showed identical-looking fragments of a lightcurve. This suggested aliasing might be present (see the following discussion).

Observations at CTIO (Cerro Tololo Interamerican Observatory, MPC 807) were made with the CTIO 0.9-m telescope. The NOAO CFCCD camera has a field of view of $13.5'$ on a side. At $0.401''$ per pixel, a quarter-chip configuration was used to yield 1024×1024 -pixel images with a read noise of 3.5 and a gain of 1.5. All images taken at CTIO were unbinned; V and R filters were used. Data analysis was carried out using IRAF and MPO Canopus. Period analysis was done using Canopus, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (1989).

The results are summarized in the accompanying plot of all the lightcurve data. The plot is phased so that the data range from 0.0 to 1.0 of the best-fit period. Night-to-night calibration of the data (generally less than ± 0.05 mag) was done using field stars converted to approximate Cousins R magnitudes based on 2MASS J-K colors (Warner 2007, Stephens 2010).

As mentioned previously, fragmentary observations from two successive nights in 1987 looked identical, suggesting that aliasing might be present. The best-fit period, 6.8605 ± 0.0005 h, is quite close to the period one would observe for an asteroid rotating 3.5 times in 24 hours, 6.8571 h. Observations on three nights, two of them closely spaced, were necessary to determine the period adequately.

By chance, the three observing dates found the asteroid at very nearly the same phase angle, although the July date was before opposition and the August dates after. Since some Trojans do not show the opposition effect implied by the standard IAU value of $G = 0.150$ for dark asteroids (French 1987; Shevchenko *et al.* 2009), we have chosen not to assume a value for G and have left the lightcurve in terms of relative magnitudes. In the future we will observe Priamus at a wider range of phase angles in order to see whether it shows the same unusual phase behavior as other Trojans.

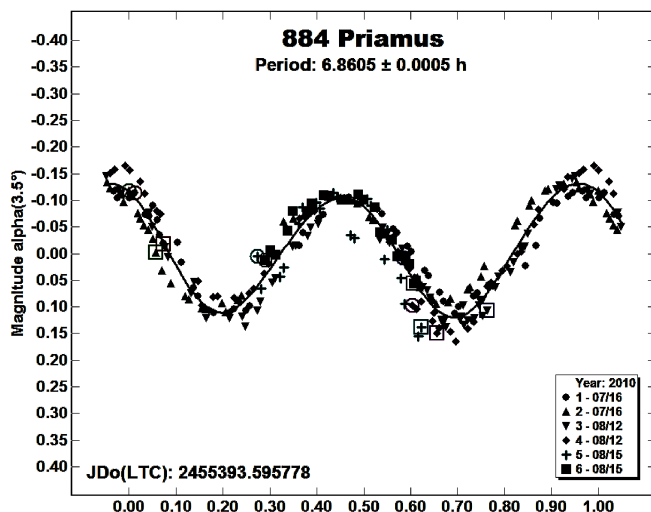
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References

- French, L.M. (1987). "Rotation Properties of Four Trojan Asteroids from CCD Photometry." *Icarus* **72**, 325-341.
- 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. (1989). "Photoelectric Observations of Asteroids 3, 24, 60, 261, and 863." *Icarus* **77**, 171-186.
- Hartmann, W., *et al.* (1988). "Trojan and Hilda asteroid lightcurves. I - Anomalous elongated shapes among Trojans (and Hildas?)." *Icarus* **73**, 487-498.
- Shevchenko, V. G.; Krugly, Yu. N.; Belskaya, I. N.; Chiorny, V. G.; Gaftonyuk, N. M.; Slyusarev, I. G.; Tereschenko, I. A.; Donchev, Z.; Ivanova, V.; Borisov, G.; Ibrahimov, M. A.; Marshalkina, A. L.; and Molotov, I. E.. (2009). "Do Jupiter Trojans Have the Brightness Opposition Effect?" *Abst. LPSC* 1391.
- Stephens, R. D. (2010). "Trojan Asteroids Observed from GMARS and Santana Observatories: 2009 October-December." *Minor Planet Bul.* **37**, 47-48.
- Warner, B.D. (2007). "Initial Results from a Dedicated H-G Project." *Minor Planet Bul.* **34**, 113-119.

U.T. Date	Phase Angle
16 July 00:00	3.5°
12 August 00:00	2.8°
15 August 00:00	3.5°



LIGHTCURVE ANALYSIS OF 2261 KEELER

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A collaborative effort to obtain CCD photometric observations of the Phocaea asteroid, 2261 Keeler, was conducted during 2010 April. We found a low amplitude lightcurve with a favored synodic period of 22.810 ± 0.005 h, but one-half this period is not ruled out.

Independent observations of Phocaea asteroid 2261 Keeler were started by Warner and Durkee in 2010 April. Durkee's work was

part of the Binary Asteroid Survey conducted out of the Astronomical Institute in Ondřejov (Pravec et al., 2006). The initial observations by Warner indicated a long period object and so the two joined forces with Pray and Galád, also working under the Binary Asteroid Survey, to assure maximum coverage.

The sessions from Warner, Durkee, and Pray were linked to one another using comparison star magnitudes derived from J-K 2MASS magnitudes (Warner, 2006). The combined data set from all observers was analyzed by Kušnirák. He found a best fit of 22.810 ± 0.005 h with an amplitude of 0.10 ± 0.01 mag. However, due to the uncertainties in the nightly zero points using the 2MASS converted magnitudes, it was not possible to exclude a half period solution of ~ 11.4 h. Unfortunately, the next opposition (2011 September) will be about 160° different in phase angle bisector longitude, meaning that the amplitude of the curve may not be much different since the viewing aspect is about the same, save that we'll be seeing the opposite pole. It won't be until 2012 November that we'll get a viewing aspect at about right angles to the one in 2010 and, maybe, a larger amplitude curve which would make finding the true period more certain.

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References

Pravec, P., Scheirich, P., Kušnirák, P.; Šarounová, L.; Mottola, S.; Hahn, G.; Brown, P.; Esquerdo, G.; Kaiser, N.; Krzeminski, Z.; and 47 coauthors. (2006) "Photometric survey of binary near-Earth asteroids." *Icarus* **181**, 63-93.

Warner, B.D. (2006). "Initial Results of a Dedicated H-G Project" *Minor Planet Bul.* **34**, 113-119.

