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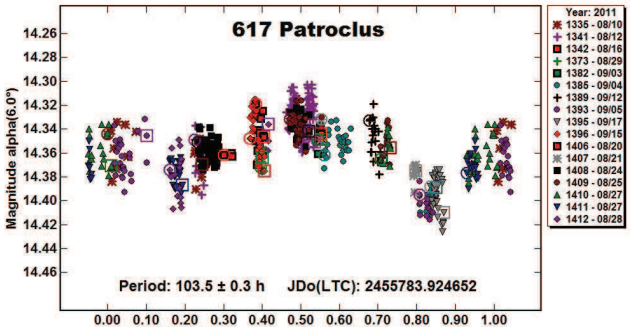
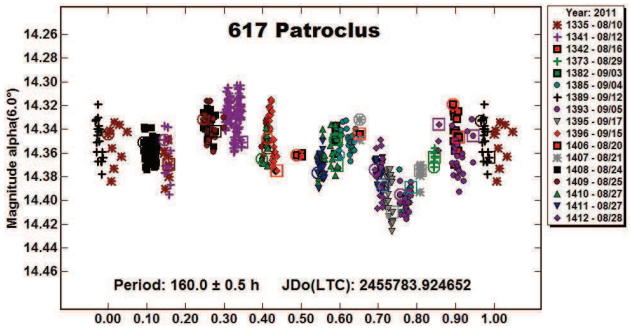
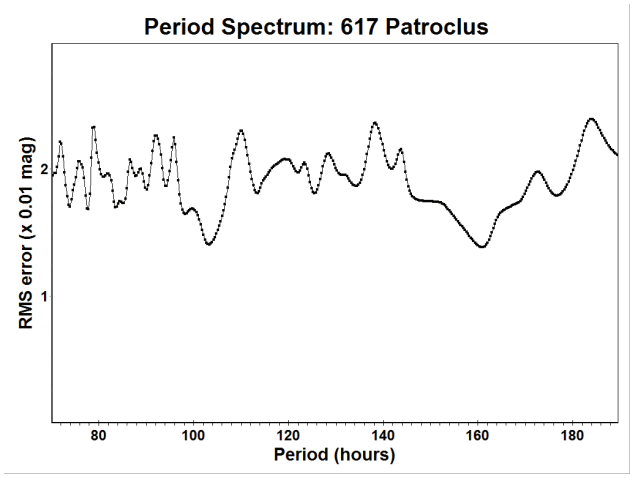






CCD LIGHTCURVES FOR ASTEROIDS 201 PENELOPE AND 360 CARLOVA

Kevin B. Alton
UnderOak Observatory
70 Summit Ave.
Cedar Knolls, NJ 07927
mail@underoakobservatory.com

(Received: 21 February)

Fourier analysis of CCD-derived lightcurves produced synodic period solutions for 201 Penelope (3.7491 ± 0.0012 h) and 360 Carlova (6.1894 ± 0.0003 h).

CCD photometric observations were made in late 2011 and early 2012 of asteroids 201 Penelope and 360 Carlova to determine their lightcurve parameters. The instrument used at UnderOak Observatory (UO) is a 0.2-m catadioptric OTA (*f*/7) equipped with an SBIG ST402ME CCD. The optical assembly produces a field-of-view ~11×17 arcmin, or 1.33 arcsec/pixel. See Alton (2010) for a more complete description of observing and data analysis procedures. Unfiltered 60-s (201 Penelope) or I_c-filtered 90-s (360 Carlova) exposures were continually captured during each session lasting from 3.5 to 6 h. Data were light-time corrected and reduced to instrumental magnitudes with *MPO Canopus* (Warner, 2010). At least 2 non-varying comparison stars were used to generate lightcurves by differential aperture photometry. Fourier analysis (Harris *et al.*, 1989) yielded a period solution from each folded dataset and then was independently verified using *Peranso* (Vannmunster, 2006) as previously described (Alton, 2011). Relevant aspect parameters for each of these main belt asteroids taken at the mid-point from each observing session are in Table I. Phased data are available upon request by contacting the author.

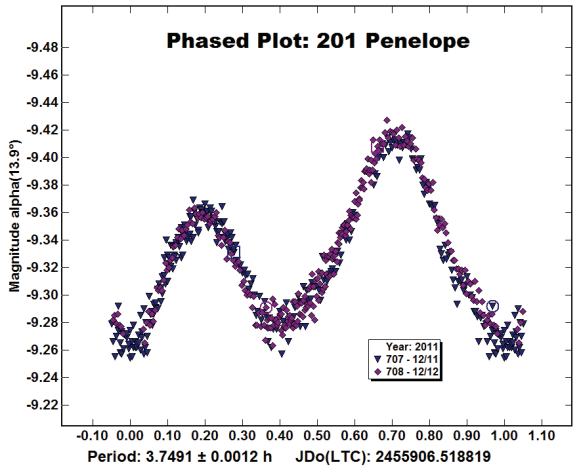
201 Penelope. Discovered in 1879 by Johan Palisa, this M-type asteroid (D = 68 km) has been studied by numerous investigators, mostly over the past three decades. Photometric studies that initially established the color index and/or determined its synodic period include Lagerkvist *et al.* (1981), Surdej *et al.* (1983), and Pfleiderer *et al.* (1987). A spectrophotometric analysis of surface material covering the range of 0.338-0.762 μm (Busarev 1998) revealed the presence of hydrated silicates. Physical modeling of this asteroid (Torppa *et al.* 2003) suggests a regular triaxial ellipsoid shape (a/b = 1.5 and b/c = 1.1). At UO, a total of 555 images were taken over 2 nights (2011 Dec 10 and 11). Lightcurve analysis produced the best folded fit at a slightly longer period (3.7491 h) than the value (3.7474 h) presently posted at the JPL Solar System Dynamics website (*http://ssd.jpl.nasa.gov/sbdb.cgi*). The peak-to-peak amplitude A = 0.16 mag observed during this most recent apparition was within the range (0.15-0.73 mag) reported for this object by Foglia *et al.* (2000).

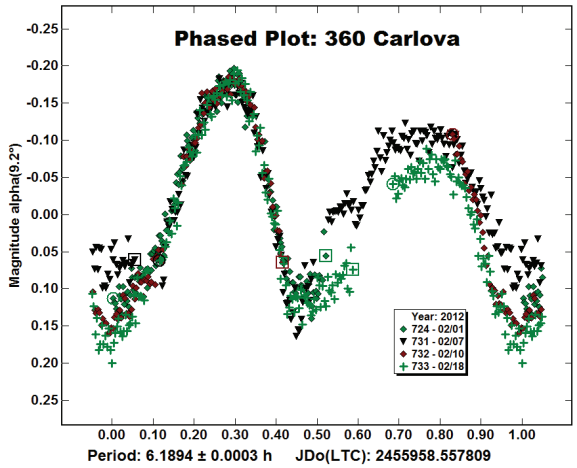
360 Carlova. This sizeable C-type asteroid (D = 116 km) was discovered by Auguste Charlois in 1893. Harris and Young (1983) published the earliest lightcurve followed by similar investigations from DiMartino *et al.* (1987), Michalowski *et al.* (2000), Wang

Object	Range Over Observation Period			
	UT Date	Phase Angle	L_{PAB}	B_{PAB}
201 Penelope	2011 Dec 10 - 2011 Dec 11	13.9 - 14.2	48.8 - 48.9	-7.2 - -7.2
360 Carlova	2012 Feb 01 - 2012 Feb 18	9.2 - 15.0	111.2 - 112.3	-4.4 - -3.2

Table I. Observation circumstances.

(2002), and Wang and Zhang (2006). More recently, Durech *et al*. (2009) published a spin-state solution for 360 Carlova using a combination of sparse and dense photometric data. During the CCD photometric study at UO, 750 images were acquired on four nights between 2012 Feb 01 and 18. The synodic period solution (6.1894 h) estimated by *MPO Canopus* was very similar to the composite value (6.1896 h) recently reported by Durech *et al*. (2009). This lightcurve exhibited a peak-to-peak amplitude A = 0.38 mag, which was within the range of 0.30-0.49 mag estimated from all the lightcurves referenced herein.





Acknowledgement

Many thanks to the SAO/NASA Astrophysics Data System and the Asteroid Lightcurve Database (LCDB), both of which proved indispensable for locating relevant literature references.

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