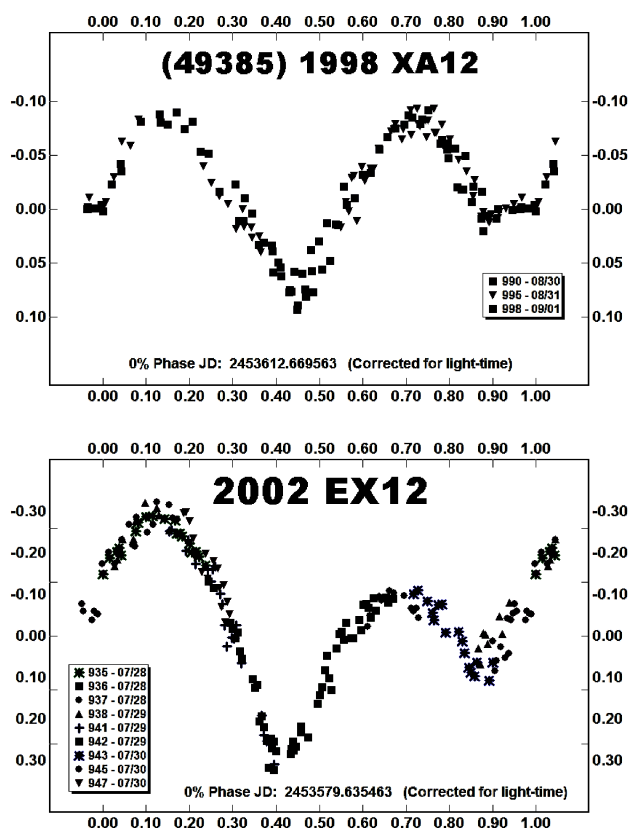




ANALYSIS OF 13 ASTEROID LIGHTCURVES OBTAINED AT THE PALMER DIVIDE OBSERVATORY

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The lightcurves for the following asteroids were obtained and then analyzed to find the synodic period and amplitude. 321 Florentina: 2.8711 ± 0.0003 h, 0.37 ± 0.02 m; 787 Moskva: 6.056 ± 0.001 h, 0.61 ± 0.02 m; 839 Valborg: 10.366 ± 0.005 h, 0.14 ± 0.02 m; 912 Maritima: 48.43 ± 0.05 h, $>0.12 \pm 0.02$ m; 1176 Lucidor: 4.0791 ± 0.0006 h, 0.06 ± 0.02 m; 1862 Apollo: 3.0680 ± 0.0002 h, $0.30 - 1.20 \pm 0.02$ m; 2266 Tchaikovsky: 4.883 ± 0.003 h, 0.04 ± 0.01 m; 2951 Perepadin: 4.7808 ± 0.0001 h, 0.60 ± 0.02 m; 5108 Lubeck: 8.769 ± 0.003 , 0.43 ± 0.02 m; (17864) 1998 KK₃₈: 6.56 ± 0.01 h, 0.17 ± 0.02 m; (18582) 1997 XK₉: 114 ± 10 h, 0.94 ± 0.02 m; (20231) 1997 YK: 48.2 ± 0.1 h, $>0.22 \pm 0.02$ m. Asteroid 868 Lova was also observed but its long period is only constrained as >24 h.

Observations of thirteen asteroids were made at the Palmer Divide Observatory from 1999 through late 2005. For the 2005 observations, one of three telescopes/camera combinations was

used: 0.5m Ritchey-Chretien/FLI-100E, 0.35m SCT/FLI-1001E, or 0.35m SCT/ST-9E. The scale for each was about 2.4 arcseconds/pixel. Exposure times were 120–240s, all unguided. The operating temperature for the FLI cameras was -30°C while the ST-9E was run between -15° to -25°C , depending on ambient conditions. The 1999 and 2003 observations were made with a 0.25m SCT and the ST-9E.

When selecting targets, first priority is given to members of the Hungaria group, those being part of an ongoing study at the Palmer Divide Observatory. When no suitable Hungarias were available, other targets were chosen by comparing the list of known lightcurve periods maintained by Harris and Warner (Harris 2005) against a list of well placed asteroids. Asteroids are often selected with the intent of removing the observational biases against faint objects (due to size and/or distance) as well as those with lightcurves of small amplitudes, long periods, or a complex nature. All images were measured using MPO Canopus, which employs differential aperture photometry to determine the values used for analysis. The period analysis was also done within Canopus, which incorporates the Fourier analysis algorithm developed by Harris (1989).

The results are summarized in the table below. The individual plots are presented afterwards. The data and curves are presented without additional comment except when the circumstances for a given asteroid require more details. Column 3 gives the full range of dates of observations while column 4 gives the number of data points used in the analysis. Column 5 is the range of phase angles over the full date range. If there are three values in the column, this means the phase angle reached a minimum with the middle value being the minimum. Columns 6 and 7 give the range of values (or average if the range was relatively small) for the Phase Angle Bisector (PAB) longitude and latitude respectively. Columns 8 and 10 give the period and amplitude of the curve while columns 9 and 11 give the respective errors in hour and magnitudes.

321 Florentina. This asteroid was previously studied by several authors, among them Van Houten (1958) and Slivan (1996 and 2003). Of particular interest are the results reported by Frey (2000), who found a period of 2.869h and an amplitude of 0.61m based on observations made in December 1999. The observations made at PDO a month earlier and recently reanalyzed give nearly an identical period, 2.8711 ± 0.0003 h, but an amplitude of only 0.37 ± 0.02 m. Using data from October 1999, Behrend (2004) reported a period and amplitude similar to the PDO results. The PAB values changed relatively little from November to December and the phase angle was about the same, though on opposing sides of opposition, thus providing no strong reason for the significant difference in amplitude.

787 Moskva. The period was previously reported by the author (Warner 1999) as 5.381h. A posting on the Behrend web site (2004) with a period of 6.0556h prompted a re-examination of the original data, whereupon a revised period of 6.056 ± 0.001 h was found to provide a better fit of the data than the shorter period.

839 Valborg. The three maxima solution is not common but provided the best fit of the data, especially considering the different heights of the maxima.

#	Name	Date Range (mm/dd) 2005	Data Pts	Phase	L _{PAB}	B _{PAB}	Per (h)	PE	Amp (m)	AE
321	Florentina	11/02–06 (1999)	112	4.5–2.8	49.5	47.7	2.8711	0.0003	0.37	0.02
787	Moskva	05/18–22 (1999)	77	11.0–12.5	217.8	12.3	6.056	0.001	0.61	0.02
839	Valborg	11/13–18	262	7.8–8.9	43.8	15.2	10.366	0.005	0.14	0.02
868	Lova	11/11–13 (1999)	101	5.5–6.3	41.2	–7.6	>24		>0.1	0.02
912	Maritima	11/13–20	217	2.8–4.0	51.3	7.0	48.43	0.05	>0.12	0.02
1176	Lucidor	11/13–22	238	4.8–8.5	44.5	6.4	4.0791	0.006	0.06	0.02
1862	Apollo	11/06–20	223	101.3–28.6	97.2–71.0	14.5–12.4	3.0680	0.002	0.30–1.20	0.02
2266	Tchaikovsky	11/04–10	205	0.9, 0.8, 2.2	42.5	1.9	4.883	0.003	0.04	0.01
2951	Perepadin	11/21–22	201	6.0–6.3	43.7	6.6	4.7808	0.001	0.60	0.02
5108	Lubeck	11/23–29	147	6.0–7.7	58.1	9.3	8.769	0.003	0.43	0.02
17864	1998 KK38	11/23	54	0.3	60.1	–0.1	6.56	0.01	0.17	0.02
18582	1997 XK9	11/21–12/01	193	1.1, 0.9, 6.1	60.2	–1.8	114	10	0.94	0.02
20231	1997 YK	09/27–10/24	159	28.6–18.9	41.0	22.7	48.2	0.1	>0.22	0.02

912 Maritima. Due to the absence of data covering a minimum, the full amplitude could not be determined. The period being nearly commensurate with 24h made covering the entire curve from a single station difficult. However, the plots of the raw data favor the solution over possible aliases of between 24h and 48h and almost certainly preclude a period shorter than 24h.

1862 Apollo. The observations were made in response to a request from Steve Ostro who had recently reported the asteroid to be binary (Ostro 2005). The lightcurve shape changed significantly over the range of dates, as might be expected given the severe change in both phase angle and PAB values.

2951 Perepadin. This was a “bonus” target, being in the same field as a selected target for two consecutive nights. The period agrees with the one previously reported by Behrend (2004) of 4.781h.

(17864) 1998 KK₃₈. This was another “bonus” target. It was in the field of the selected target on only one night. Higher priority targets prevented returning to the asteroid before it faded too much for additional observations. The data cover more than one cycle of the derived period, which lead to an unambiguous solution.

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