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ASTEROID LIGHTCURVE ANALYSIS AT THE OAKLEY SOUTHERN SKY OBSERVATORY: 2009 OCTOBER THRU 2010 APRIL

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Photometric data for 44 asteroids were collected over 54 nights of observing during 2009 October thru 2010 April at the Oakley Southern Sky Observatory. The asteroids were: 826 Henrika, 918 Itha, 983 Gunila, 1049 Gotho, 1167 Dubiago, 1181 Lilith, 1227 Geranium, 1604 Tombaugh, 1636 Porter, 1826 Miller, 1977 Shura, 2004 Lexell, 2196 Ellicott, 2303 Retsina, 2307 Garuda, 2601 Bologna, 2609 Kiril-Metodi, 2851 Harbin, 2881 Meiden, 3118 Claytonsmith, 3324 Avsyuk, 3640 Gostin, 4207 Chernova, 4536 Drewpinsky, 4838 Billmclaughlin, 5235 Jean-Loup, 5274 Degewij, 5240 Kwasan, (6019) 1991 RO6, 6091 Mitsuru, 6961 Ashitaka, (7111) 1985 QA1, (8228) 1996 YB2, 11017 Billputnam, (13023) 1988 XT1, (14741) 2000 EQ49, 15938 Bohnenblust, 16463 Nayoro, (17633) 1996 JU, (21023) 1989 DK, 21558 Alisonliu, (21594) 1998 VP31, (34459) 2000 SC91, and (189099) 2001 RO.

Forty-four asteroids were observed from the Oakley Southern Sky Observatory in New South Wales, Australia, on the nights of 2009 October 20-24; November 9-10, 14; 2010 January 18-23; February 15, 17-20, 24; March 10-24; and April 1-5, 10, 12-16, 18-19, 21-23. From the data, we were able to find lightcurves for 35 asteroids. Out of those 35, 28 were previously unrecorded results. Out of the 7 previously recorded, 3 were consistent with previously published periods, 2 were reasonably close to previous results, and 2 were inconsistent with previously published periods. The 9 remaining asteroids produced no repeatable data.

Selection of asteroids was based on their sky position about one hour after sunset. Asteroids without previously published lightcurves were given higher priority than asteroids with known periods, but asteroids with uncertain periods were also selected with the hopes that we would be able to improve previous results. A 20-inch f/8.1 Ritchey-Chretien optical tube assembly mounted on a Paramount ME was used with a Santa Barbara Instrument Group STL-1001E CCD camera and a clear filter. The image scale was 1.2 arcseconds per pixel. Exposure times varied between 90 and 240 seconds. Calibration of the images was done using master twilight flats, darks, and bias frames. All calibration frames were created using *CCDSoft*. *MPO Canopus* was used to measure the processed images.

No repeatable pattern was found for the following asteroids: 918 Itha, 983 Gunila, 1167 Dubiago, 1181 Lilith, 2601 Bologna, 4536 Drewpinsky, 5235 Jean-Loup, (13023) 1988 XT1, and (14741) 2000 EQ49. Our data for these asteroids were too noisy or insufficient in number for us to determine periods, so we are reporting the magnitude variations only. Results from all of the asteroids are listed in the table below.

826 Henrika. Our data are consistent with the period of 5.984 ± 0.0003 h found by Pilcher (2010).

983 Gunila. Shipley et al. (2008) reported no period but an amplitude of 0.25 mag from observations in 2008.

1167 Dubiago. Dahlgren et al. (1991) reported a period of 14.3 h and amplitude of 0.23 mag.

1604 Tombaugh. Our data are reasonably close to the period of 7.040 ± 0.001 h found by Binzel (1987), although Sarneczky (1999) found a period of 6.15 h.

1826 Miller. Our data are inconsistent with the period of 6.77 ± 0.01 h found by Behrend (2009).

2303 Retsina. Our data are consistent with the period of 10.82 ± 0.01 h found by Carbo et al. (2009).

5274 Degewij. We tried fitting to the period of 3.731 ± 0.002 h, but the data fit better to 7.5802 ± 0.0005 h.

5240 Kwasan. Our data are reasonably close to the periods of 5.35 ± 0.01 h found by Ivanova (2002) and 5.50 ± 0.01 h found by Behrend (2010).

(8228) 1996 YB2. Our data are inconsistent with the period of 10 h found by Behrend (2009).

(189099) 2001 RO. Our data are consistent with the period of 5.7161 ± 0.0010 h found by Pravec et al. (2010).

Acknowledgements

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Number	Name	Dates mm/dd/2010 (2009*)	Data Points	Period (h)	P.E (h)	Amp (mag)	A.E. (mag)
826	Henrika	4/2-4,18-19,21-23	118	5.9840	0.0003	0.26	0.02
918	Itha	4/1-5,10,18-19,21-23	78	-	-	0.15	0.01
983	Gunila	1/18-23	128	-	-	0.05	0.04
1049	Gotho	4/12-16	70	8.470	0.007	0.17	0.03
1167	Dubiago	3/20-24	79	-	-	0.10	0.01
1181	Lilith	3/16-22	124	-	-	0.13	0.02
1227	Geranium	4/1-5,10,19,21-23	123	12.363	0.004	0.13	0.05
1604	Tombaugh	4/12-16	74	7.047	0.004	0.18	0.02
1636	Porter	1/18-23	111	2.9653	0.0007	0.26	0.03
1826	Miller	1/24,26-27, 4/12-16	100	30.049	0.001	0.11	0.02
1977	Shura	3/20-24	73	7.461	0.004	0.40	0.04
2004	Lexell	3/20-24	76	5.441	0.002	0.60	0.06
2196	Ellicott	2/15,17-20,24	80	9.0706	0.006	0.14	0.03
2303	Retsina	2/15,17-20,24	79	10.818	0.003	0.43	0.03
2307	Garuda	3/16-19,21,24	138	29.64	0.03	0.35	0.04
2601	Bologna	3/16-20,23	132	-	-	0.10	0.01
2609	Kiril-Metodi	2/15,17-20	75	4.9433	0.0007	0.85	0.04
2851	Harbin	10/20-21*	29	5.414	0.006	0.79	0.04
2881	Meiden	2/15,17-20	44	20.08	0.07	0.24	0.02
3118	Claytonsmith	3/20-24	97	15.794	0.012	0.42	0.04
3324	Avsyuk	3/16-19,21,23	126	8.6140	0.0018	0.34	0.03
3640	Gostin	3/10-15	75	3.2641	0.0005	0.47	0.05
4207	Chernova	3/10-15	56	10.288	0.015	0.14	0.03
4536	Drewpinsky	4/12-16	54	-	-	0.15	0.03
4838	Billmclaughlin	3/10-15	54	5.199	0.005	0.09	0.02
5235	Jean-Loup	4/12-16	72	-	-	0.09	0.01
5240	Kwasan	3/20-24	58	5.676	0.003	0.56	0.03
5274	Degewij	4/2-5,19,21-23	117	7.5802	0.0006	0.22	0.03
6019	1991 RO6	3/16-19,22,24	143	5.760	0.007	0.41	0.04
6091	Mitsuru	4/19,21-23	45	5.853	0.003	0.88	0.05
6961	Ashitaka	4/1-5,10,18-23	136	3.1457	0.0002	0.16	0.03
7111	1985 QA1	3/16-19	90	11.21	0.01	0.24	0.02
8228	1996 YB2	1/18-23	131	8.353	0.005	0.24	0.03
11017	Billputnam	11/9-10,14*	45	6.749	0.001	0.46	0.02
13023	1988 XT1	10/22-24*	91	-	-	0.23	0.07
14741	2000 EQ49	1/18-23	105	-	-	0.07	0.01
15938	Bohnenblust	4/12-16	83	3.906	0.003	0.16	0.03
16463	Nayoro	1/18-23	132	14.666	0.009	0.30	0.03
17633	1996 JU	2/15,17-20,24	76	6.2098	0.0004	0.29	0.02
21023	1989 DK	2/15,17-20,24	85	7.598	0.002	0.29	0.02
21558	Alisonliu	4/13-16	67	4.886	0.003	0.14	0.02
21594	1998 VP31	4/1-5,10,19,21-23	137	5.5865	0.0004	0.36	0.05
34459	2000 SC91	2/15,17-20,24	72	2.7791	0.0006	0.16	0.02
189099	2001 RO	1/18-23	131	5.722	0.005	0.17	0.04

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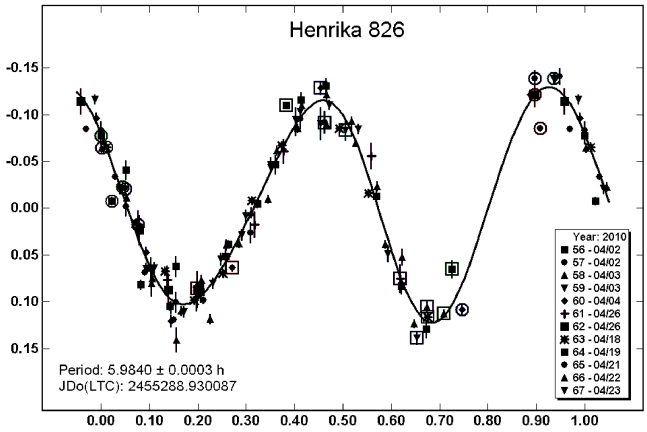

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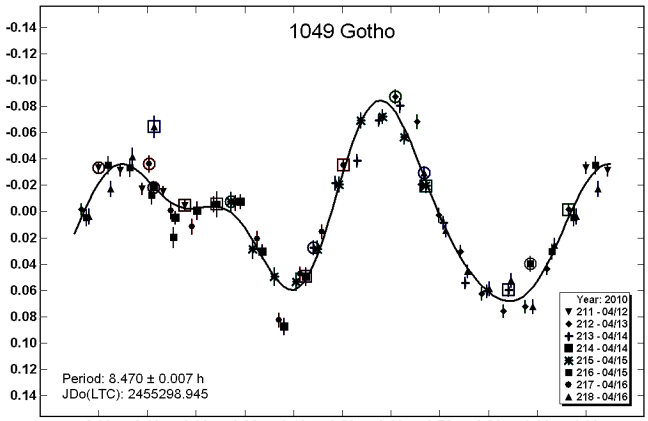

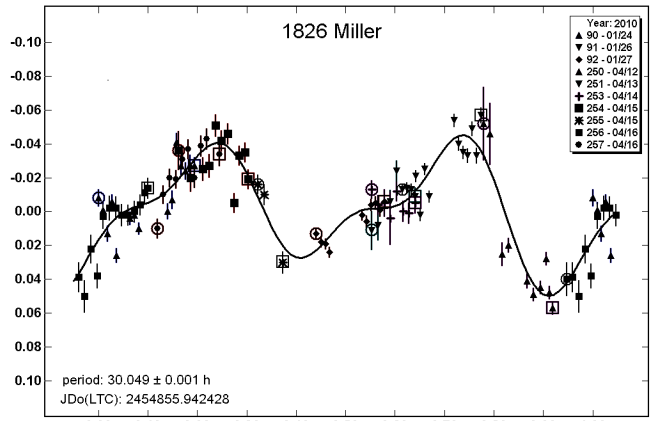

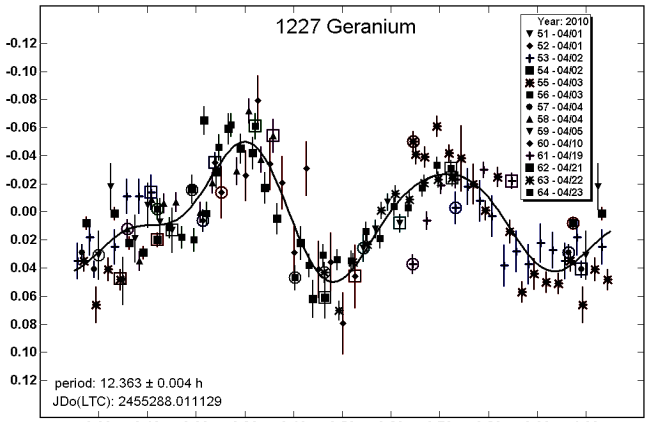

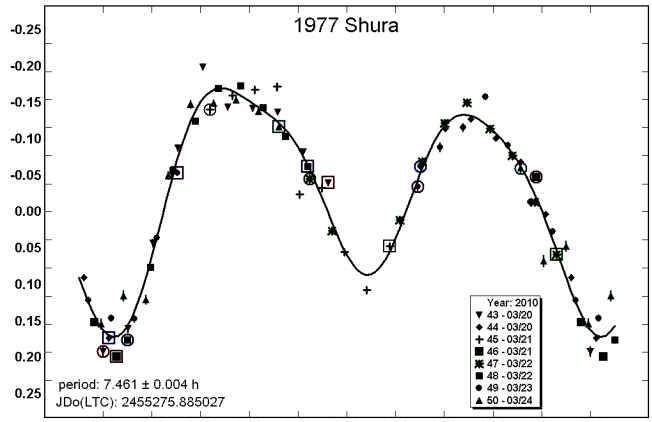

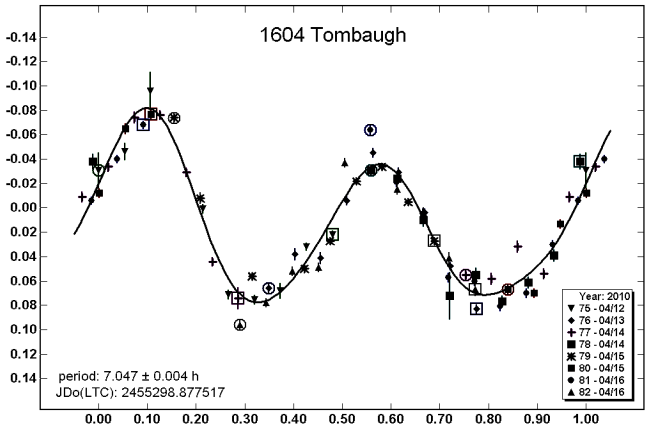

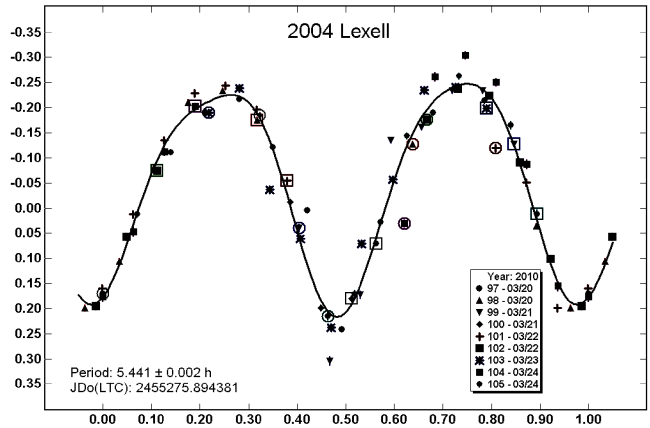

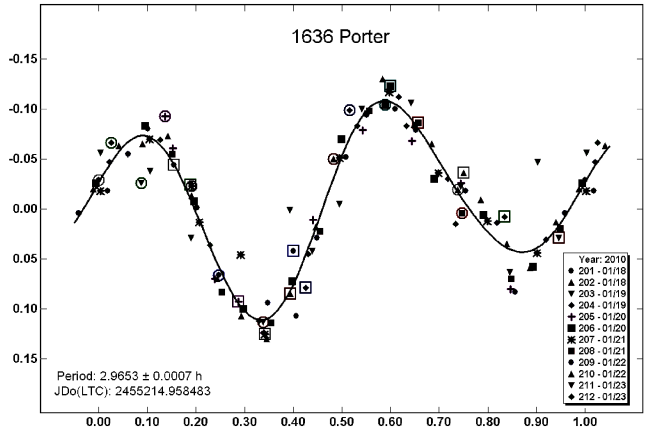

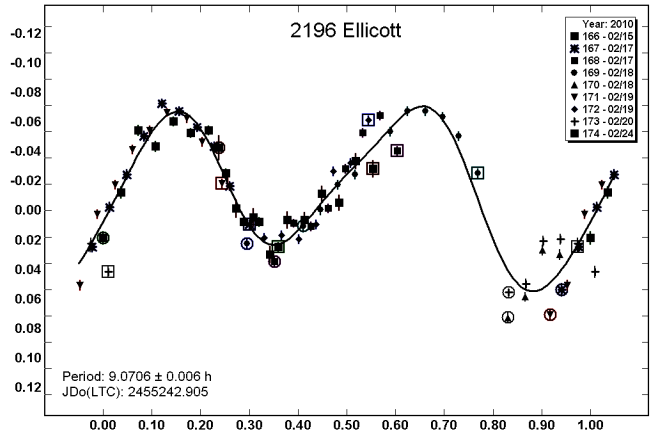

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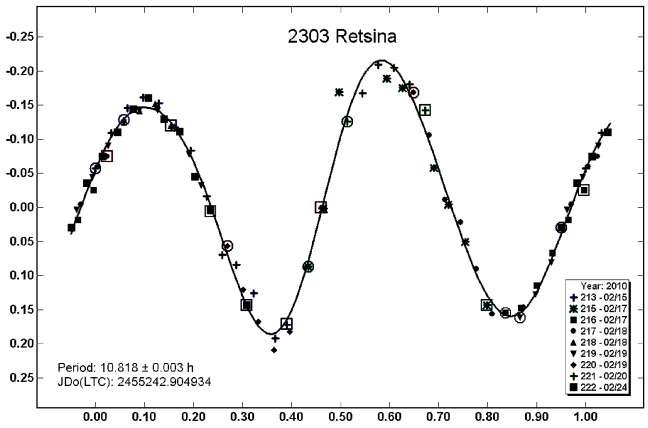

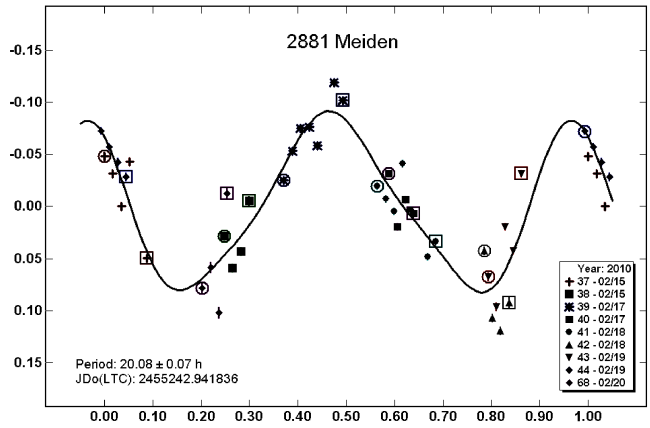

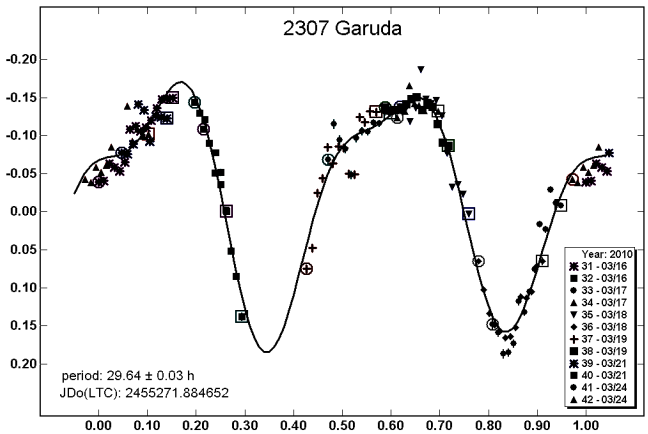

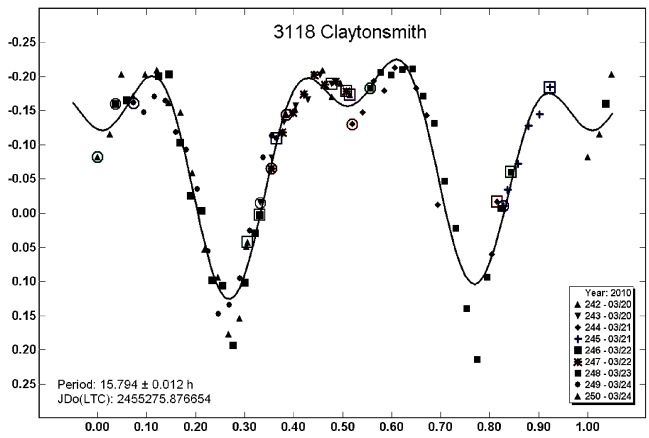

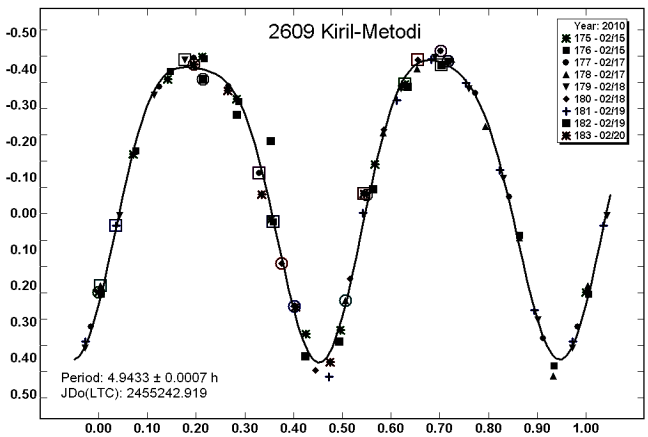

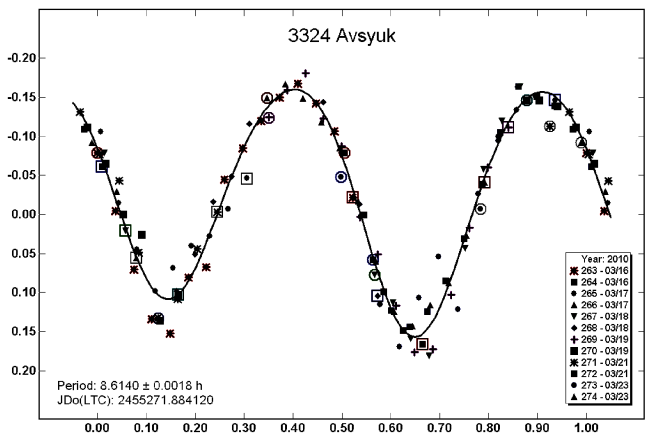

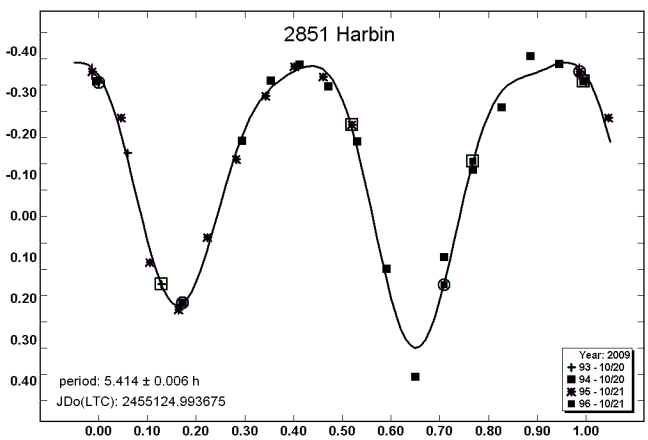

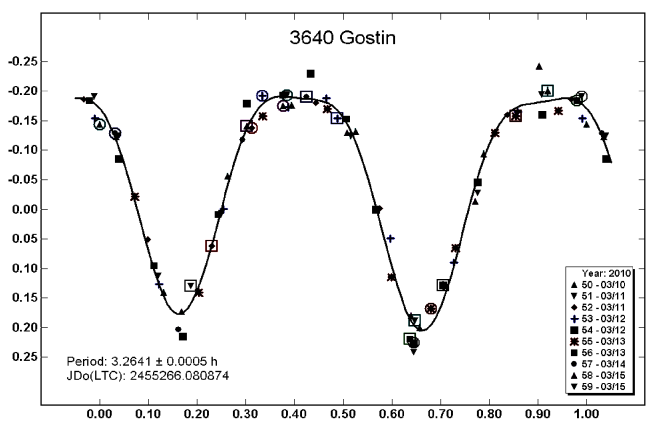

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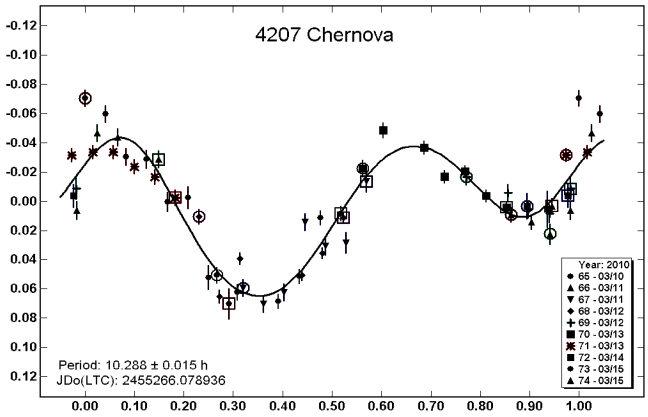

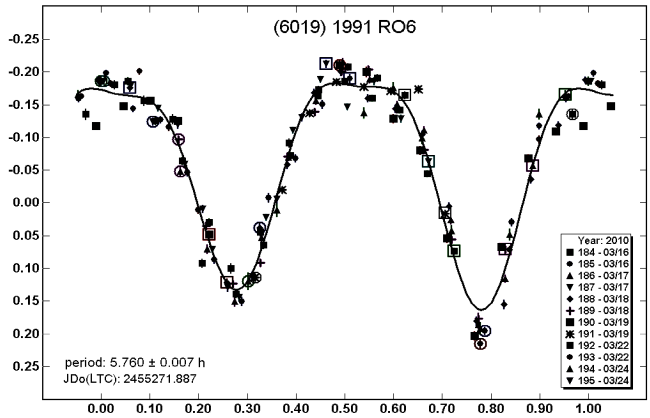

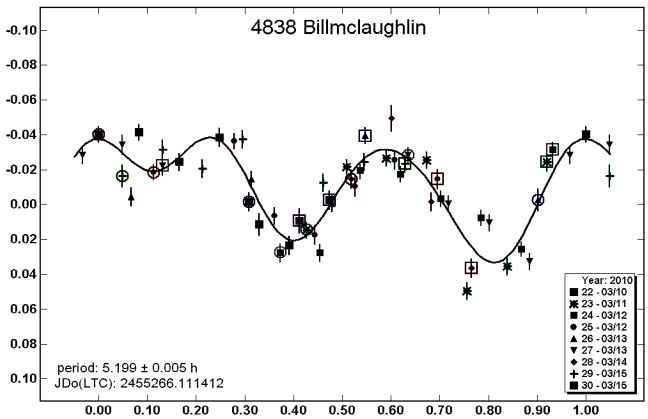

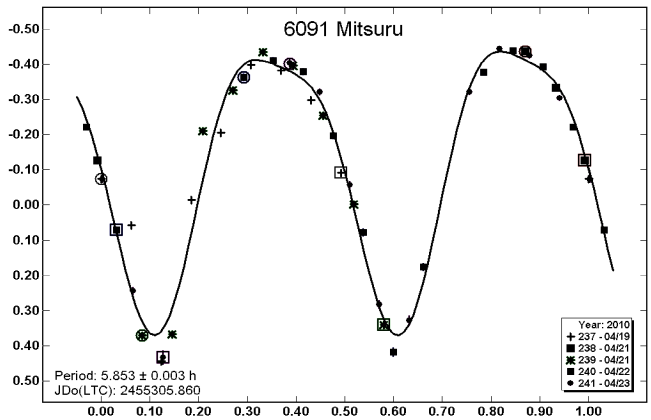

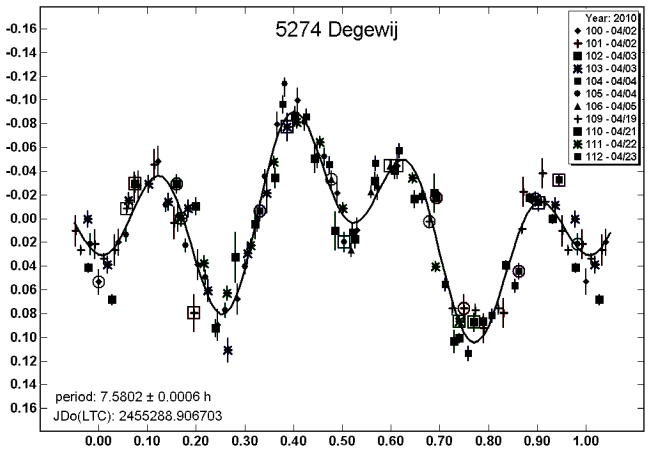

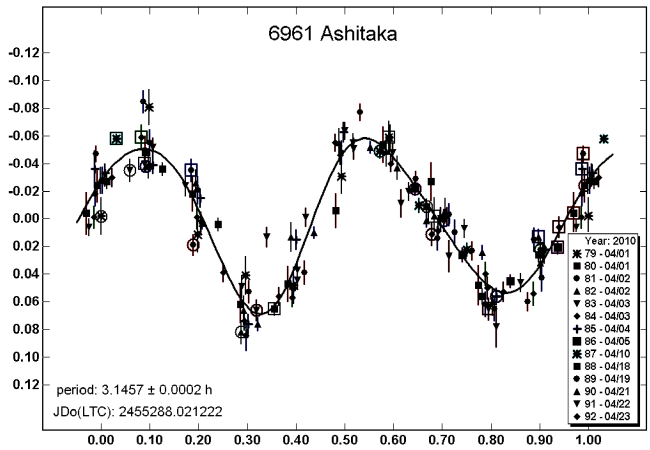

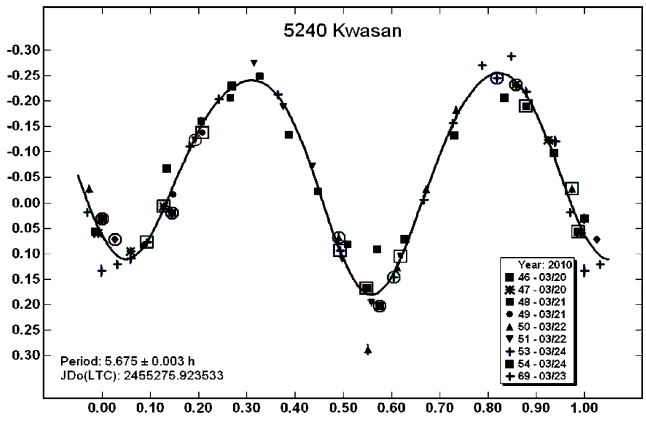

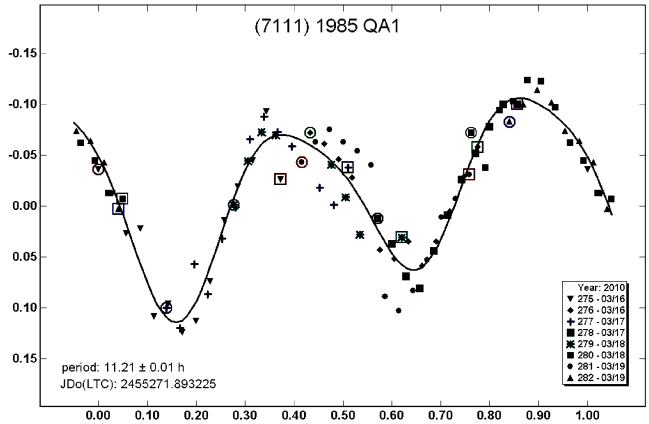

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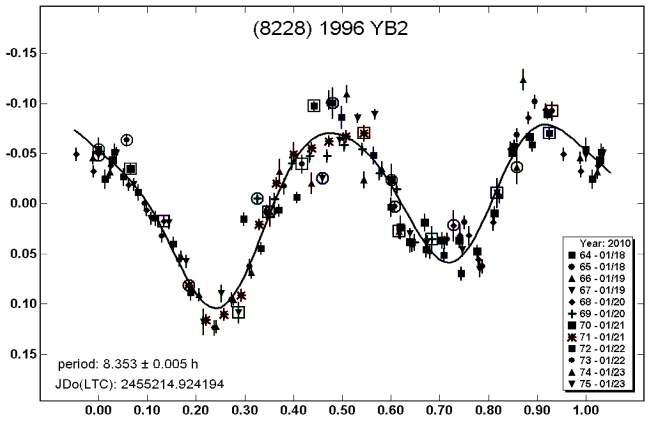

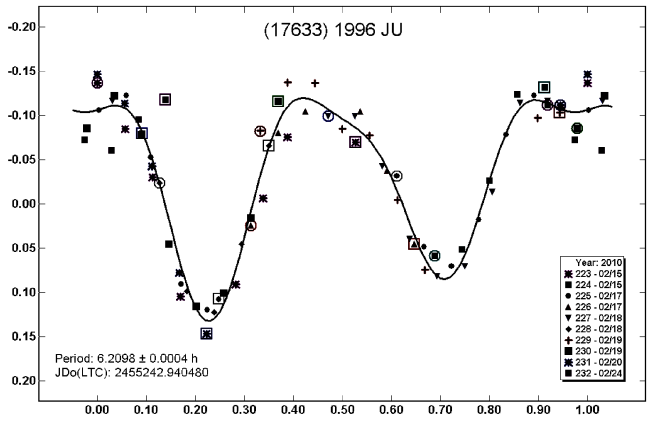

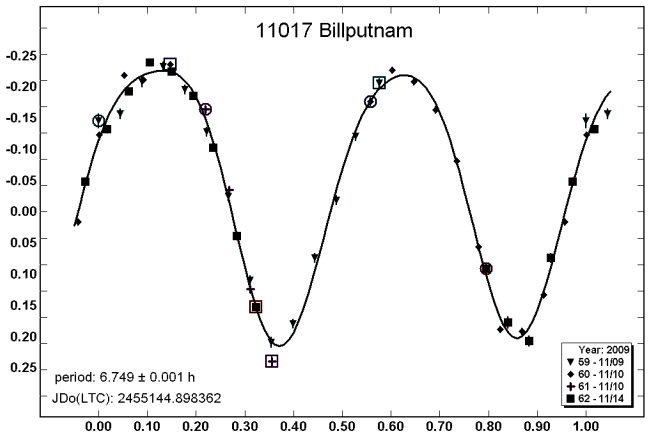

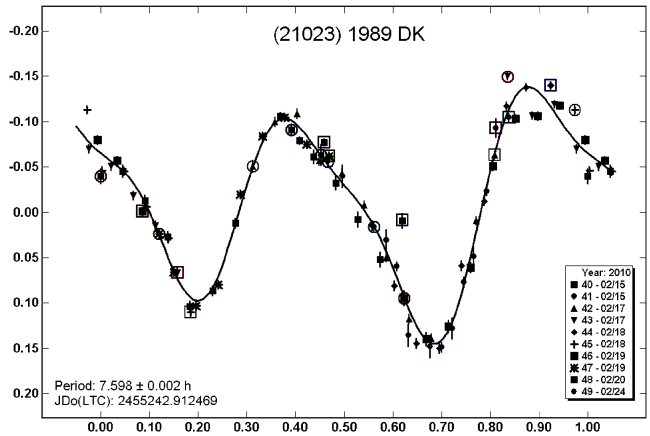

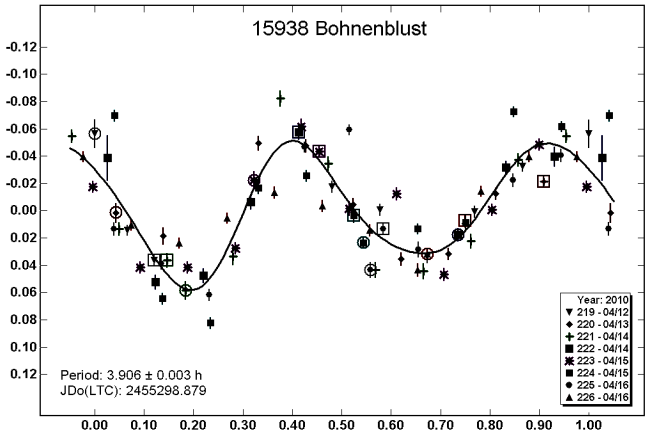

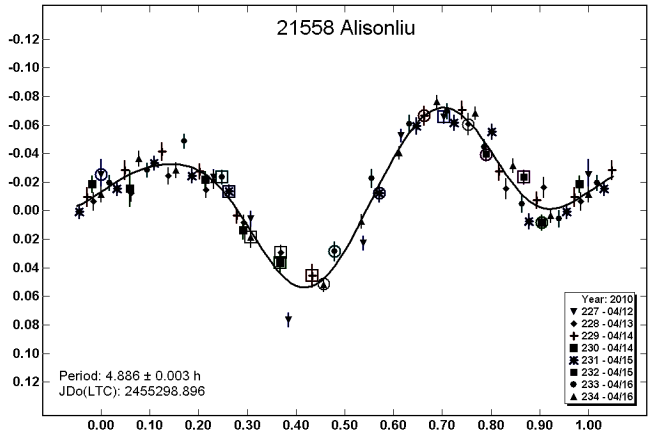

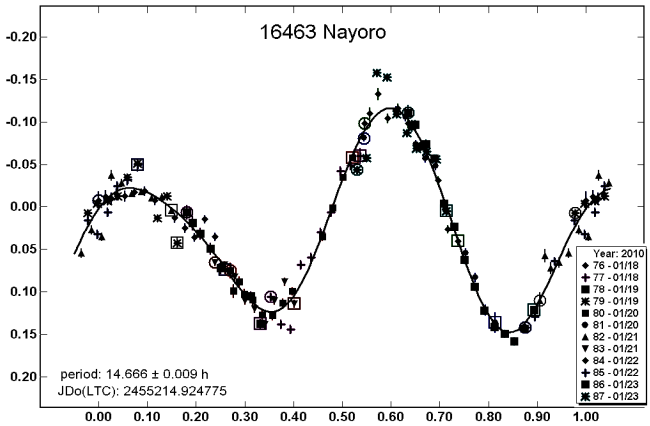

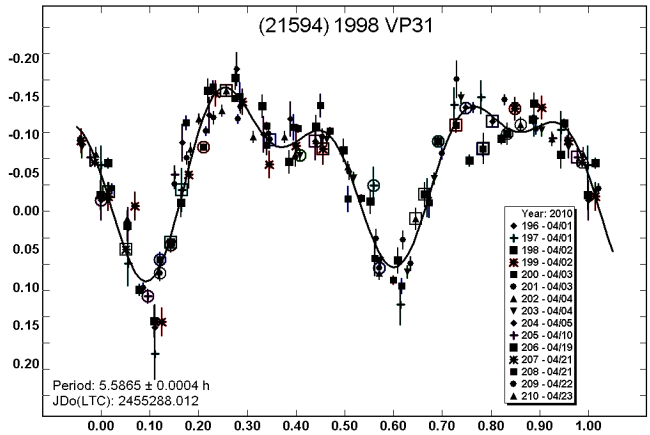

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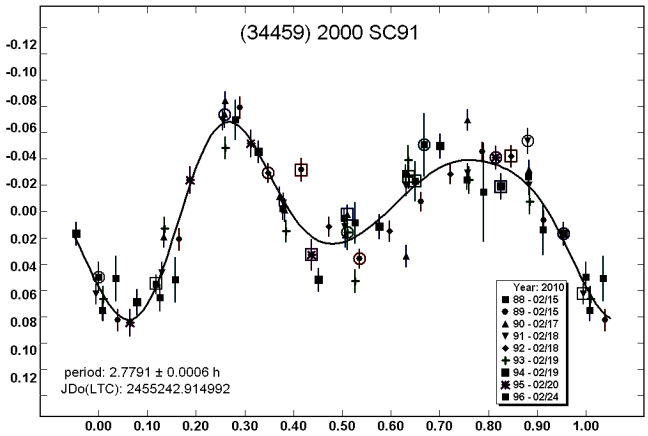

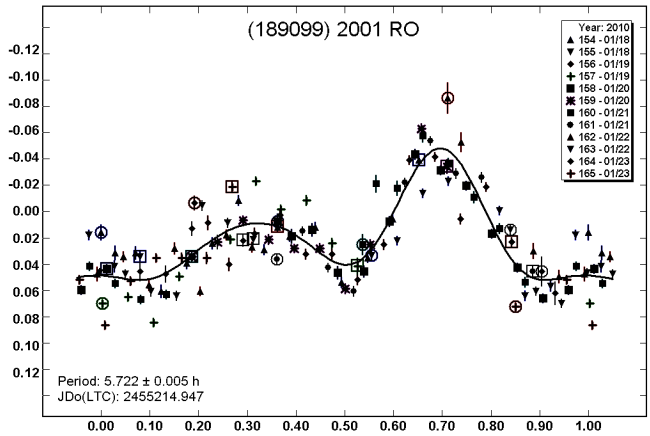

LIGHTCURVE ANALYSIS OF MAIN BELT ASTEROIDS 185 EUNIKE, 567 ELEUTHERIA, AND 2500 ALASCATTALO

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Photometric measurements for three main-belt asteroids from 2010 April through yield results: 185 Eunike, P = 11.20±0.05 h, A = 0.14±0.05 mag. 567 Eleutheria, P = 7.71±0.05 h, A = 0.30±0.05 mag. No reasonable period determination could be made for 2500 Alascattalo, with A < 0.20 mag.

Observations and lightcurve analysis were conducted at Shadowbox Observatory during 2010 April and May on main-belt asteroids 195 Eunike, 567 Eleutheria and 2500 Alascattalo. The first two were observed using a 0.3-m Schmidt-Cassegrain (SCT) operating at f/6.1 on a German Equatorial mount (GEM). The CCD imager was an SBIG ST9 working at 1x1 binning, which resulted in an image scale of 2.2 arc seconds/pixel. An SBIG AO-8 adaptive optics unit was employed. All images were taken through a Johnson V-band filter. Depending on ambient air temperature, the camera temperature was set between –15°C and –40°C. Image acquisition and reduction were done with *CCDSoft*. Images were reduced with master dark and sky-flat frames.

Imaging sessions of 195 Eunike and 567 Eleutheria began when they reached 30 degrees or higher elevation, and continued until the telescope tube came into close proximity to the telescope mount. Due to 567 Eleutheria's relatively low declination (–3 degrees), the geometry of the telescope tube and equatorial mount combination allowed continuous tracking for nearly 2 hours past the meridian. This allowed the target to be imaged close to the 30 degree elevation practical limit for photometry (Warner, 2006) without the need to "meridian flip" the mount (*not* an automated process at Shadowbox Observatory). Not only was the meridian flip problem described by Miles and Warner (2009) avoided, but an interruption of the observer's sleep was equally unnecessary!

Observations were reduced using differential photometry. Period analysis was done with *MPO Canopus*, incorporating the Fourier analysis algorithm developed by Harris (Harris et al., 1989). A minimum of two comparison stars from the UCAC3 catalog were used on each image.

185 Eunike. A total of 614 data points were analyzed. A period of P = 11.20 ± 0.05 h and amplitude of A = 0.14 ± 0.05 mag were found. Debehogne et al. (1978) found a period of 10.83 h. To match the 10.83 h period the author would have to remove an observing session that there was no compelling reason to remove (interference by clouds, a drastic change in transparency, equipment problems or the like). So while not ruling out 10.83 h, a better fit was found at 11.20 h.

567 Eleutheria. This asteroid was observed in support of a call for lightcurves of asteroids having either no or poorly constrained lightcurve parameters (Warner et al., 2010a). A check of the Observing Notification Page of the Collaborative Asteroid Lightcurve Link (CALL) website (Warner et al., 2010b) did not reveal that any other observers were working this target. A total of 297 data points were analyzed. A period of P = 7.71 ± 0.05 h was found with an amplitude of A = 0.30 ± 0.05 mag.

2500 Ascallatto. This asteroid was observed from 2010 May 2-7 using the 0.61-m f/10 classical Cassegrain telescope at Sierra Stars Observatory. The imager was a FLI ProLine camera with a KAF-9000 (12-micron pixels). The resulting scale was 0.8 arcseconds/pixel. Only four observing sessions were obtained before a mechanical problem disabled the telescope for an extended period of time. No discernable pattern outside the margin of error of the observations was noted. The sparse data set over a short period of time prevented determining if the asteroid has a low lightcurve amplitude due to a nearly spheroidal shape and/or its rotation axis being along the light of sight, or that it has a long rotation period. No published lightcurve data for this object were found to offer any clues about the true nature of the system. The figure shows a period of 2.85 h, one of many possible solutions.

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References

Debehogne, H., Surdej, A., and Surdej, J. (1978). "Photoelectric lightcurves of the minor planets 29 Amphitrite, 121 Hermione and 185 Eunike." *Astron. Astrophys. Suppl. Ser.* **32**, 127-133.

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