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A ROTATION PERIOD FOR 1493 SIGRID

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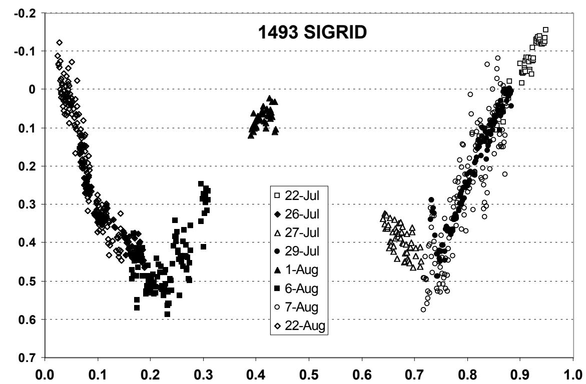
Minor planet 1493 Sigrid was observed over 8 nights in 2006. The synodic period was found to be 43.296±0.048hr with a peak-to-peak amplitude of at least 0.6 magnitudes. The axial ratio a/b implied by the peak to peak variation is 1.74.

Minor planet 1493 Sigrid was observed over a period of 32 days from two sites in NSW, Australia, Mt Tarana Observatory (S 33d 26.1m E 149d 45.4m +880m) and Cecil Sayers Observatory (S 33d 46.9m E 151d 05.1m +80m). The Cecil Sayers Observatory utilizes a 20cm f/7 Newtonian reflector and Cookbook CCD camera. The equipment of the Mt Tarana Observatory is described in Bembrick (2001). No data on this asteroid was found in the latest list of rotational parameters (Harris & Warner, 2006).

The aspect data for the eight nights of observation are shown in the table. Observations were made using unfiltered differential photometry and all data were light time corrected. The aspect data table also shows the percentage of the lightcurve observed each night and PAB is the Phase Angle Bisector.

Period analysis was carried out using the "AVE" software (Barbera, 2004). The period derived for Sigrid appears to be the best fit to the available data, but note that full phase coverage has not been achieved. A period of half the derived value gives a monomodal phase stack and this is thought to be less likely than the bimodal light curve adopted herein. The arbitrary zero phase maximum in 2006 is at JD 2453939.200. The 2006 composite lightcurve for 1493 Sigrid has been compiled assuming a bimodal lightcurve. The phase coverage is not complete and the period determined could be modified with additional data. The peak-to-peak variation of at least 0.6 magnitudes implies an axial ratio a/b of 1.74. With a period of 43.296±0.048hr, Sigrid is a slow rotator compared with most asteroids of less than 50km diameter, which have mean rotation rates of 2-3 revs/day (Binzel et al, 1989).



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UT Date	PAB Long	PAB Lat	Phase Angle	%Phase Coverage
2006 Jul 22	305.7	-1.8	4.5	10
2006 Jul 26	306.1	-1.7	2.3	12
2006 Jul 27	306.2	-1.7	1.8	8
2006 Jul 29	306.4	-1.6	1.1	15
2006 Aug 01	306.6	-1.5	2.0	5
2006 Aug 06	307.1	-1.4	4.8	15
2006 Aug 07	307.2	-1.4	5.4	16
2006 Aug 22	308.8	-1.0	13.6	12

LIGHTCURVE ANALYSIS OF 1495 HELSINKI

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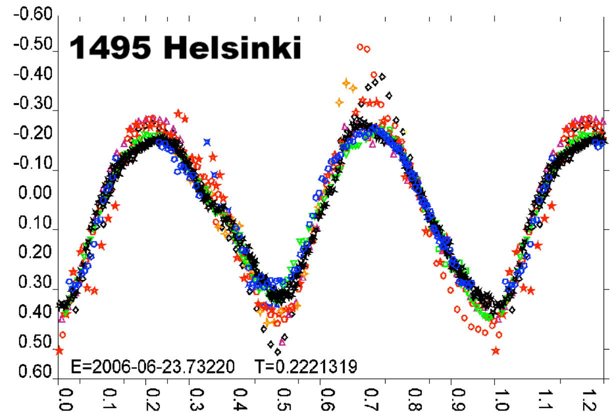
This is a collective effort from observers at different longitudes to derive an accurate synodic period of 5.33116±0.00003hr with amplitude of 0.83 and 0.61±0.03 mag in May and June 2006, respectively, for the minor planet 1495 Helsinki.

Leura observatory is located about 100km west of Sydney Australia at an altitude of 950m. It houses a 0.35m Celestron Schmidt-Cassegrain Telescope operating at f/11. Attached to it is an SBIG ST9XE CCD camera which has a Kodak KAF-0261 CCD giving 1.07 arc second/pixel at binning 1x1. No filters were used for all images. Dark frames and Flat Field frames were used for image calibration. L ‘Observatoire des Makes is located in La Reunion Island in the Indian Ocean. It houses a 0.35m Celestron Schmidt-Cassegrain telescope mounted on CDM mount with MCMT II. Attached to it is an ST7 SBIG CCD camera and a focal reducer operating at f3.3. An 80x900 refractor telescope is piggy backed on the main telescope along with an ST6 SBIG CCD which operates as an autoguider.

For data reduction, Oey used the Canopus V9 software where differential photometry was employed whereas Teng et al. sent all data to Behrend that were latter reduced and compiled in his web site (Behrend 2006). The composite lightcurves were then combined and reproduced for this publicatiton.

Asteroid 1495 Helsinki was originally selected due to its lack of published results. The work was started from Leura Observatory on 13 April 2006 and continued for six sessions that ended on 21 May 2006. A month later, Behrend of Genève Observatory contacted Oey regarding the merging of data by one of his contributors with the recently obtained data from Leura. After the merge, the initial appearance of the curve was one that does not fit well into a clean bimodal curve. It was considered that the data may be caused by either a binary asteroid or a tumbling object. Communications were initiated with Pravec of Ondrejov Observatory. He had the opportunity to analyze Oey’s six sessions data earlier on separate occasion; the initial data showed a complex behavior, with some of sessions having a larger amplitude and others being shifted in phase. No good solution could be found from the initial data, however, and he suggested



that other observers from different longitude should be recruited to help resolve the data further.

The combined effort from J.P. Teng et al. gave no indication of the variability shown in Oey’s earlier lightcurve. It was realized that an error may have occurred in Oey’s light curve data. An analysis of the more complete dataset has shown that all but two sessions fitted entirely with a single periodicity; the two unfitting sessions were 2006-5-8.6 and 13.6, both of the initial dataset of six nights. While the 5-8.6 session showed a higher amplitude, the 5-13.6 session showed a shift in time. A revisit of the original images of the two sessions was obviously needed.

At this time, a new version of Canopus reduction software (Canopus V9.101) was released. It incorporated a new feature with the ability to subtract nearby faint stars allowing data contaminated with these faint stars useful. (Warner 2006). The data were then reduced once more and the revised data of 5-8.6 fitted entirely with the single periodicity; the higher amplitude of the first reduction of the night was caused by uneliminated background stars. At that point, there remained the one unfitting session of 5-13.6, which showed a phase shift; when adding 0.010 day to all times of the session, it fit well with all the other data. A re-reduction of the original images by Oey showed that there was a time error in the initial reduction; while a cause of the time error of the initial reduction was not revealed, the newly reduced data showed a perfect fit. So, the revisit has eliminated the serious reduction problems in the two sessions and it confirmed that there was only one periodicity present in the asteroid during the whole observational interval.

All data were merged by Behrend to obtain a lightcurve of period 5.33116±0.00003hr with amplitude of 0.61±0.03 mag. It's worth noting that the larger amplitude in early May was at around phase angle 22° and the smaller amplitude in late June was at about 12° phase angle.

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THE ROTATION PERIOD OF 562 SALOME

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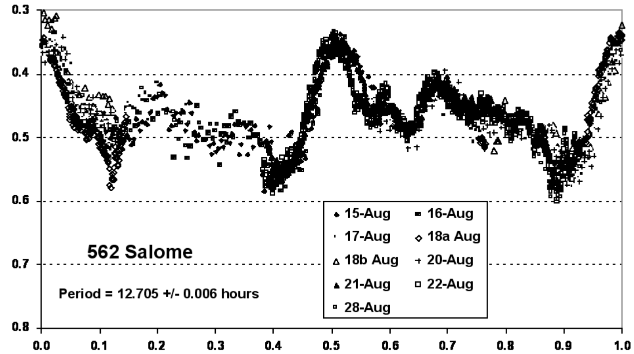
Minor planet 562 Salome was observed over 8 nights in 2006. The synodic period was found to be 12.705±0.006hr with a peak-to-peak amplitude of a little more than 0.2 magnitudes. An axial ratio (a/b) of 1.2 is implied by this variation

562 Salome is an inner main-belt asteroid with a diameter of 35 km, an albedo of 0.13 and B-V=0.8 (GUIDE ver 8). It an S-type asteroid belonging to the Eos family (Binzel, 1987). The latest list of rotational parameters (Harris & Warner, 2006) quotes a period of 10.4 hours with a reliability of only one. This is derived from a sparsely sampled lightcurve of Binzel (1987), who says that the suggested period "is only an educated guess".

The observations of Salome in 2006 were conducted from two sites – one in New Zealand and one in Australia. The locations of these sites are listed in Bembrick et al (2004). All observations were made using unfiltered differential photometry and all data were light time corrected. The aspect data table also shows the percentage of the lightcurve observed each night. PAB is the Phase Angle Bisector. Period analysis was carried out using the "AVE" software (Barbera, 2004). After visual inspection of the data a period search was made between 0.25 and 1.0 days using the Phase Dispersion Minimisation method. The "best" period derived was 0.264 days, but this gave a unimodal lightcurve. A deep and prominent minimum in the periodogram at twice this period gave an acceptable phase stack. This was adopted as the more realistic period. Trials with periods close to 10.4 hours produced highly confused phase stacks. Thus a period of 12.705 hours was used to compile the composite lightcurve with the arbitrary zero phase maximum at JD 2453964.425 (see Figure 1). The peak to peak variation in the lightcurve implies an axial ratio, a/b=1.2. The composite lightcurve for 562 Salome – one of the Eos family – is somewhat noisy in part, but full phase coverage was achieved. This is considered a secure result. Salome is fairly typical of asteroids of less than 50 km diameter which have mean rotation rates of 2-3 rev/day (Binzel et al., 1989).



UT Date	PAB Long	PAB Lat	Phase Angle	%Phase Coverage
2006 Aug 15	324.2	-13.7	6.2	51
2006 Aug 16	324.2	-13.7	6.2	49
2006 Aug 17	324.2	-13.7	6.1	28
2006 Aug 18	324.2	-13.7	6.2	30
2006 Aug 20	324.3	-13.8	6.3	55
2006 Aug 21	324.3	-13.8	6.4	38
2006 Aug 22	324.3	-13.8	6.5	53
2006 Aug 28	324.4	-13.8	7.6	57

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LETTER TO THE EDITOR

With the increase in the number of lightcurves published in *The Minor Planet Bulletin* it would be very helpful to have clearly displayed information within each lightcurve figure. For example, it would be very helpful to include in all lightcurve figures the derived period, so that one does not endlessly have to read back and forth between the figure and the text to decipher the complete results. I am writing to request that all contributors of lightcurve papers include the derived period with the formal errors within the figure itself.

Frederick Pilcher
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RESPONSE: While we have very few rigid format requirements for manuscripts and figures submitted to *The Minor Planet Bulletin*, this suggestion is one that should be heeded to the best of the abilities of the authors and Editors. We will begin working toward this goal for all (or nearly all) lightcurve figures published within the *MPB*. See this issue's "Minor Planet Observer" column for more details on the practicalities of its implementation.

Richard P. Binzel, Editor
Brian D. Warner, Assistant Editor

ASTEROID-DEEPSKY APPULSES IN 2007

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The following list is a very small subset of the results of a search for asteroid-deepsky appulses for 2007, presenting only the highlights for the year based on close approaches of brighter asteroids to brighter DSOs. The complete set of predictions is available at

http://www.minorplanetobserver.com/Misc/DSOAppulses.htm

For any event not covered, the Minor Planet Center's web site at http://scully.harvard.edu/~cgi/CheckMP allows you to enter the location of a suspected asteroid or supernova and check if there are any known targets in the area.

The table gives the following data:

Date/Time	Universal Date (MM DD) and Time of closest approach
#/Asteroid	The number and name of the asteroid
RA/Dec	The J2000 position of the asteroid
AM	The approximate visual magnitude of the asteroid
Sep/PA	The separation in arcseconds and the position angle from the DSO to the asteroid
DSO	The DSO name or catalog designation
DM	The approximate total magnitude of the DSO
Type	The type of DSO: OC = Open Cluster; GC = Globular Cluster; G = Galaxy
SE/ME	The elongation in degrees from the sun and moon respectively
MP	The phase of the moon: 0 = New, 1.0 = Full. Positive = waxing; Negative = waning

Date	UT	#	Name	RA	Dec	AM	Sep	PA	DSO	DM	Type	SE	ME	MP
01/14	03:08	476	Hedwig	08 46.00	+12 36.5	12.7	93	178	NGC 2661	12.8	G	162	101	-0.260
01/18	10:24	162	Laurentia	12 29.01	+ 3 35.5	13.3	32	16	NGC 4457	10.9	G	113	104	-0.007
01/18	16:47	117	Lomia	01 47.49	+27 21.9	13.4	115	357	IC 1727	11.5	G	97	103	-0.003
01/22	08:00	203	Pompeja	02 03.78	+16 03.1	13.7	67	343	NGC 803	12.6	G	93	51	0.129
01/22	18:56	170	Maria	02 16.09	+28 35.3	14.0	42	194	NGC 865	13.1	G	99	52	0.167
01/23	07:47	471	Papagena	09 42.96	+31 51.9	10.7	69	45	NGC 2964	11.3	G	158	136	0.215
02/11	18:34	103	Hera	02 33.22	+ 9 36.3	13.0	48	156	NGC 975	13.1	G	77	149	-0.367
02/22	19:47	727	Nipponia	11 40.18	+15 20.8	13.4	20	229	NGC 3800	12.7	G	160	123	0.334
03/14	15:59	546	Herodias	14 42.28	-17 13.7	13.8	131	306	NGC 5728	11.4	G	130	70	-0.248
03/14	22:18	65	Cybele	12 17.91	+ 0 23.6	11.5	167	208	UGC 7332	13.5	G	170	114	-0.224
03/15	***21:36***	***270***	***Anahita***	***16 16.99***	***-23 00.2***	***12.9***	***75***	***190***	***M80***	***7.2***	***GC***	***108***	***64***	***-0.139***
03/17	20:17	912	Maritima	12 04.20	+20 15.1	12.3	69	0	NGC 4065	12.6	G	161	158	-0.023
03/17	22:41	912	Maritima	12 04.10	+20 15.2	12.3	69	0	NGC 4061	13.1	G	161	158	-0.019
03/18	03:18	286	Iclea	12 31.09	+11 31.4	13.8	112	43	NGC 4491	12.6	G	165	157	-0.013
03/19	14:30	306	Unitas	11 40.40	+ 9 02.3	12.4	165	32	IC 719	13.1	G	171	164	0.004
03/20	10:31	579	Sidonia	12 29.93	+14 02.7	12.5	150	205	NGC 4474	11.5	G	164	155	0.027
03/20	20:04	579	Sidonia	12 29.62	+14 04.7	12.5	47	25	NGC 4468	12.8	G	164	150	0.046
03/22	15:35	127	Johanna	12 28.96	+ 3 32.6	11.8	145	193	NGC 4457	10.9	G	173	133	0.178
03/23	15:17	286	Iclea	12 27.50	+12 17.9	13.8	5	223	NGC 4431	12.9	G	166	114	0.274
03/24	22:42	348	May	13 42.31	+ 4 14.2	13.9	11	27	NGC 5270	13.5	G	157	116	0.413
04/11	18:28	914	Palisana	12 48.38	-40 56.7	12.4	133	227	NGC 4696E	13.5	G	147	92	-0.391
04/15	05:51	576	Emanuela	13 09.69	-23 24.4	14.0	27	202	NGC 4993	12.3	G	165	146	-0.073
04/22	***10:11***	***456***	***Abnoba***	***17 19.41***	***-18 31.4***	***12.8***	***177***	***97***	***M9***	***7.9***	***GC***	***131***	***159***	***0.310***
05/16	16:11	49	Pales	13 19.59	-12 43.3	13.6	23	208	NGC 5079	12.0	G	148	150	-0.001
05/16	21:09	49	Pales	13 19.49	-12 42.6	13.6	165	28	NGC 5076	13.0	G	147	147	-0.001
05/17	00:11	49	Pales	13 19.43	-12 42.1	13.6	142	208	NGC 5077	11.4	G	147	145	0.002
05/17	19:29	50	Virginia	15 13.76	-14 17.8	13.6	115	197	NGC 5878	11.5	G	173	158	0.017
05/19	13:04	776	Berbericia	22 13.21	-26 07.8	12.8	72	9	NGC 7225	12.2	G	92	130	0.104
05/20	13:55	287	Nephthys	11 15.06	+14 45.9	12.5	77	209	NGC 3596	11.3	G	105	54	0.185
06/11	16:52	912	Maritima	11 41.76	+10 17.2	13.8	165	231	NGC 3817	13.3	G	91	137	-0.159
06/15	03:12	173	Ino	11 55.47	+11 57.4	13.9	43	213	NGC 3968	11.8	G	91	90	-0.001
07/13	12:21	312	Pierretta	00 42.70	+ 0 50.9	13.8	8	149	NGC 223	13.2	G	101	88	-0.013
07/15	***07:25***	***357***	***Ninina***	***20 58.90***	***-12 35.9***	***13.3***	***153***	***325***	***M73***	***8.9***	***OC***	***158***	***167***	***0.009***
08/12	05:07	925	Alphonsina	01 46.55	+36 26.2	13.6	115	109	NGC 668	13.1	G	100	91	-0.006
08/15	07:41	63	Ausonia	02 07.57	+17 12.6	11.8	44	318	NGC 817	13.2	G	106	134	0.057
10/03	13:28	905	Universitas	01 37.29	+ 5 55.6	13.3	158	355	NGC 632	12.3	G	165	78	-0.482
10/03	17:21	391	Ingeborg	23 13.79	+24 54.2	11.2	159	86	NGC 7527	13.3	G	151	100	-0.464
10/05	21:56	391	Ingeborg	23 14.32	+23 39.9	11.2	65	264	NGC 7539	12.5	G	151	127	-0.245
10/19	03:39	342	Endymion	23 54.02	+ 7 55.9	13.8	166	138	NGC 7782	12.2	G	155	70	0.479
11/06	09:34	200	Dynamene	08 12.81	+26 21.8	12.8	47	9	NGC 2540	13.5	G	104	66	-0.109
11/06	19:57	800	Kressmannia	02 34.70	+23 25.9	13.8	7	157	NGC 984	12.8	G	172	146	-0.085
11/10	10:48	308	Polyxo	02 39.12	+10 49.1	11.9	58	158	NGC 1024	12.1	G	172	165	0.004
11/13	15:15	26	Proserpina	08 32.20	+22 35.2	12.6	71	0	NGC 2599	12.2	G	106	146	0.120
11/16	04:43	478	Tergeste	08 41.62	+ 5 00.6	13.1	144	49	NGC 2644	12.3	G	102	162	0.324
11/17	03:01	6	Hebe	09 32.20	+ 8 26.0	10.3	2	15	NGC 2906	12.7	G	92	169	0.415
12/02	04:42	445	Edna	23 16.33	+24 30.0	14.0	68	24	NGC 7568	13.5	G	109	152	-0.432
12/03	12:57	3200	Phaethon	10 17.76	+21 50.6	13.4	93	204	NGC 3187	13.4	G	102	37	-0.307
12/03	***15:50***	***248***	***Lameia***	***05 34.53***	***+21 57.2***	***13.8***	***173***	***170***	***M1***	***8.4***	***PN***	***167***	***101***	***-0.296***
12/05	15:47	432	Pythia	09 46.79	+22 01.2	13.6	12	328	NGC 2991	12.6	G	111	68	-0.143
12/13	09:17	409	Aspasia	07 13.24	+12 13.2	11.6	115	161	NGC 2350	12.3	G	151	161	0.125

LIGHTCURVE AND ROTATIONAL PERIOD OF ASTEROIDS 1456 SALDANHA, 2294 ANDRONIKOV, AND 2006 NM

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CCD images recorded in July, August and September 2006 allowed the determination of the rotational periods and lightcurve amplitudes for two main-belt and one near-Earth asteroid: 1456 Saldanha (19.035±0.005hr, 0.24mag); 2294 Andronikov (3.153±0.001hr, 0.4mag), 2006 NM (~20hr, ~0.8mag).

Saint-Barthelemy Observatory is located near a very small alpine village North-West of Italy, at 1,675 m above the sea level. In this site the sky is dark and free from light pollution. The observatory belongs to the Regione Autonoma della Valle d'Aosta (Italy), and was inaugurated in 2003. Asteroid observations were carried out between June 20 and September 15 2006 using the largest telescope of the observatory, an 810mm f/7.9 Bowen-Vaughan equipped with a HiSis 39 CCD camera. The camera sensor is a Kodak 1001E, 1024 × 1024 square pixel, 24 μm side. At the prime focus the camera field of view is about 13' × 13'. All images were unfiltered. For every observing session, continuous image acquisition was done using the camera software "Giotto", while image calibrations (flat-field and dark frame), were done with Astroart MSB Software. The asteroid was singled out in the sky by the free planetarium software "Carte du Ciel" by Patrick Chevalley. Orbital elements were taken from MPCORB database of the Minor Planet Center. Photometric measurements and lightcurves were reduced and plotted by using the MPO Canopus software by BDW Publishing. Differential photometry (Warner, 2006) with five comparison stars was used in all cases. The first two main-belt asteroids (MBAs) were selected from the CALL website (Warner and Harris, 2006), while the NEO was chosen on the basis of the brightness and acceptable mean motion. We observed asteroids that did not have previously reported measurements. The results are described below.

1456 Saldanha: We observed this asteroid over 11 nights, 2006 July 30, August 2, 7, 8, 15, 23, 24, 25, 26, 27 and 28. Of these sessions, four have been rejected due to poor weather conditions and bad photometry. During the observations, 1456 Saldanha was about +14.4 apparent mag bright. The exposure time was 120s, with a time interval between two consecutive images of 10s. The typical length of a session was 5hr and the SNR about 150-200. We first used the last six consecutive sessions to obtain a good Fourier analysis period spectrum and the first four as a check. The period found was 19.035±0.005hr with an amplitude of 0.24mag. The lightcurve amplitude gives an approximate ratio of the largest and smallest face presented to the observer during a rotation (Warner 2006a). For 1456 Saldanha this ratio is 1.25.

2294 Andronikov: We observed this asteroid during four nights, 2006 August 30, 31 and September 1, 3. The magnitude and the observation circumstances were similar to 1456 Saldanha. We found a period of 3.153±0.001hr with an amplitude of 0.4 mag. This implies a ratio between faces of 1.44. In a single session (about 6h length) the lightcurve covers two rotations. Interestingly, the single lightcurves does not exactly overlap, but instead, it presents a mean magnitude shift of about 0.02 mag/hr. This behavior has been confirmed by Petr Pravec that with a linear shift subtraction from our raw data reconstructed the Andronikov lightcurve very well. The Pravec period and amplitude are the same. We have checked for a possible error in the flat-field, dark frame and comparison stars, but no obvious errors or mistakes were discovered.

2006 NM: We observed this object during only two nights, September 4 and 5, 2006. The fast proper motion (about 4"/m) limited the exposure time to 60s and the comparison stars were changed every 2 hours. Due to the faintness of the object (+15.9 mag) the SNR was about 30. Unfortunately, due to the bad weather conditions we did not cover the full lightcurve cycle. Nevertheless, we have roughly estimated a rotational period of about 20hr with an amplitude of 0.8mag.

Acknowledgements

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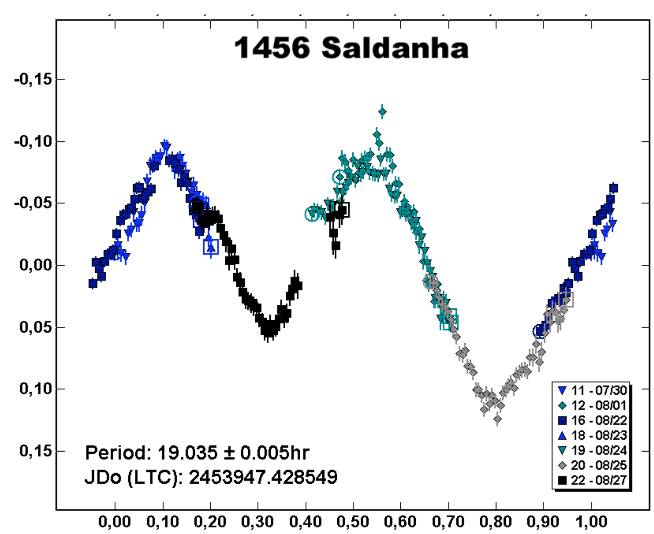

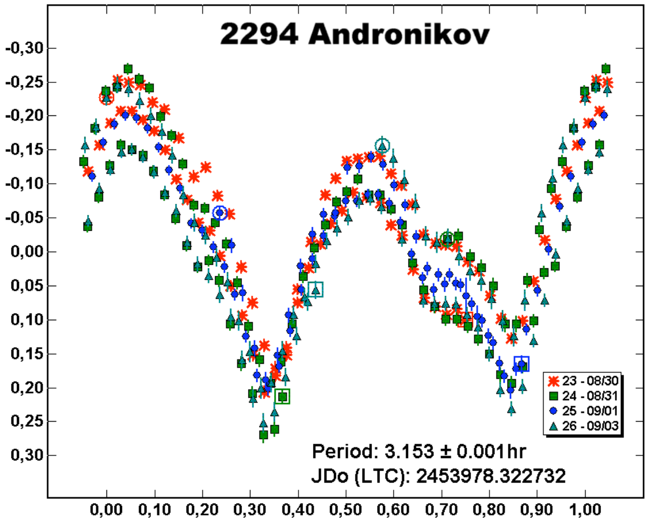

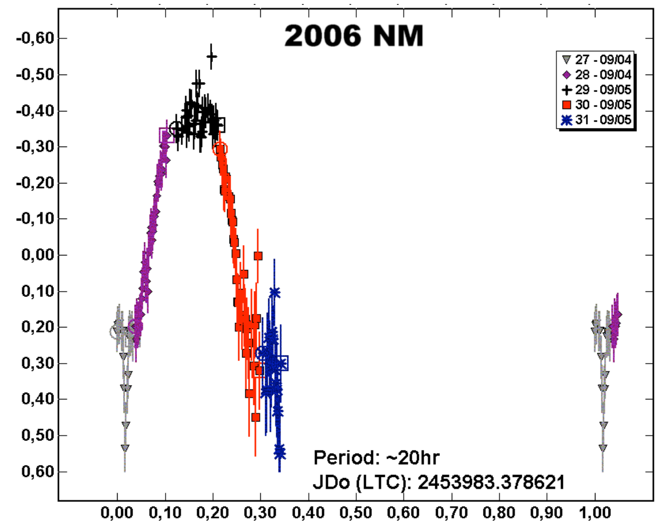

MINOR PLANETS AT UNUSUALLY FAVORABLE ELONGATIONS IN 2007

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A list is presented of minor planets that are much brighter than usual at their 2007 apparitions. Close approaches of three minor planets: 1862 Apollo, 3200 Phaethon, and 4954 Eric, are the highlights of the year.

The minor planets in the lists that follow will be much brighter at their 2007 apparitions than at their average distances at maximum elongation. Many years may pass before these minor planets will be again as bright as in 2007. Observers are encouraged to give special attention to those that lie near the limit of their equipment.

Three small minor planets will make moderately to extremely close approaches to Earth in calendar 2007 and are especially worthy of observational scrutiny. 1862 Apollo has pairs of close approaches 18 months apart and separated by many years. The second of the current pair occurs in 2007 with maximum elongation April 20, brightest magnitude 13.2 on May 4, and closest approach 0.071 AU May 8. The previous pair of close approaches occurred in 1980, 1982, and the next will not take place until 2046, 2048. Minor planet 3200 Phaethon is notable as the parent body of the Geminid meteors, and also for having the smallest perihelion distance of any numbered asteroid, 0.140 AU. It will not be in opposition near this approach to Earth, but will be observable only before sunrise as it plunges inward ahead of the Earth toward perihelion 2008 Jan. 14. Maximum elongation 114.8° west of the Sun occurs 2007 Nov. 21, with brightest magnitude 13.3 on Dec. 6 and minimum distance 0.121 AU on Dec. 10. An unusually numerous Geminid meteor display is not expected, however. An even closer approach will occur in Dec. 2017. The third highlighted minor planet, 4954 Eric makes its closest approach since discovery, 0.287 AU, on Oct. 11, with magnitude a very bright 11.6 on Sept. 24. It will be even closer and brighter in the years 2024 and 2041.

These lists have been prepared by an examination of the maximum elongation circumstances of minor planets computed by the author for all years through 2060 with a full perturbation program written by Dr. John Reed, and to whom he expresses his thanks. Elements are from EMP 1992, except that for all objects for which new or improved elements have been published subsequently in the Minor Planet Circulars or in electronic form, the newer elements have been used. Planetary positions are from the JPL DE-200 ephemeris, courtesy of Dr. E. Myles Standish. Dr. Reed's ephemeris generating program, a list of minor planet elements, and the JPL planetary ephemeris are freeware which may be obtained from the author by sending a 100 Megabyte zip disk and stamped, addressed return mailer. They cannot be downloaded directly over the Internet.

Any objects whose brightest magnitudes near the time of maximum elongation vary by at least 2.0 in this interval and in 2007 will be within 0.3 of the brightest occurring, or vary by at least 3.0 and in 2007 will be within 0.5 of the brightest occurring; and which are visual magnitude 14.5 or brighter, are included. For objects brighter than visual magnitude 13.5, which are within the range of a large number of observers, these standards have been relaxed somewhat to include a larger number of objects. Magnitudes have been computed from the updated magnitude parameters published in MPC28104-28116, on 1996 Nov. 25, or more recently in the Minor Planet Circulars.

Oppositions may be in right ascension or in celestial longitude. Here we use still a third representation, maximum elongation from the Sun, instead of opposition. Though unconventional, it has the advantage that many close approaches do not involve actual opposition to the Sun near the time of minimum distance and greatest brightness and are missed by an opposition-based program. Other data are also provided according to the following tabular listings: Minor planet number, date of maximum elongation from the Sun in format yyyy/mm/dd, maximum elongation in degrees, right ascension on date of maximum elongation, declination on date of maximum elongation, both in

J2000 coordinates, date of minimum or brightest magnitude in format yyyy/mm/dd, minimum magnitude, date of minimum distance in format yyyy/mm/dd, and minimum distance in AU.

Users should note that when the maximum elongation is about 177° or greater, the minimum magnitude is sharply peaked due to enhanced brightening near zero phase angle. Even as near as 10 days before or after minimum magnitude the magnitude is generally about 0.4 greater. This effect takes place in greater time interval for smaller maximum elongations. There is some interest in very small minimum phase angles. For maximum elongations E near 180° at Earth distance Δ, an approximate formula for the minimum phase angle ϕ is $\phi=(180°-E)/(\Delta+1)$.

Table I. Numerical Sequence of Favorable Elongations

Planet	Max Elon D	Max E	RA	Dec	Min Mag D	Mag	Min Dist D	Min Dist
4	2007/05/30	172.2°	16h32m	-14°	2007/05/31	5.4	2007/05/31	1.143
8	2007/11/19	169.9°	3h44m	+ 9°	2007/11/18	8.0	2007/11/15	0.890
20	2007/01/29	178.7°	8h45m	+16°	2007/01/29	8.4	2007/01/27	1.108
30	2007/09/03	177.8°	22h46m	- 5°	2007/09/03	9.7	2007/09/07	1.156
37	2007/01/17	174.9°	8h 0m	+25°	2007/01/17	9.9	2007/01/12	1.298
76	2007/12/24	177.0°	6h 6m	+20°	2007/12/24	11.7	2007/12/24	1.881
78	2007/01/25	172.0°	8h36m	+26°	2007/01/25	10.3	2007/01/26	1.097
95	2007/12/10	174.6°	5h10m	+17°	2007/12/10	11.4	2007/12/06	1.710
102	2007/10/18	178.9°	1h30m	+10°	2007/10/18	11.0	2007/10/12	1.035
116	2007/02/12	174.0°	9h50m	+19°	2007/02/12	10.7	2007/02/14	1.412
137	2007/07/16	157.4°	19h27m	+ 0°	2007/07/17	11.5	2007/07/19	1.479
162	2007/03/21	174.1°	12h10m	+ 5°	2007/03/21	12.1	2007/03/19	1.564
183	2007/08/29	165.4°	23h 5m	-21°	2007/09/02	12.2	2007/09/11	1.141
185	2007/09/15	165.8°	0h 3m	-14°	2007/09/16	10.8	2007/09/16	1.424
188	2007/08/08	159.8°	20h51m	+ 3°	2007/08/08	12.2	2007/08/07	1.296
194	2007/08/20	171.1°	21h39m	- 4°	2007/08/20	9.6	2007/08/19	0.995
198	2007/11/20	170.7°	3h27m	+28°	2007/11/18	10.5	2007/11/10	1.097
225	2007/07/23	146.5°	19h38m	+12°	2007/07/23	12.4	2007/07/23	1.574
226	2007/07/28	174.4°	20h21m	-13°	2007/07/28	12.0	2007/07/25	1.158
294	2007/08/07	179.7°	21h 7m	-16°	2007/08/07	12.2	2007/08/07	1.371
322	2007/11/15	175.0°	3h14m	+23°	2007/11/14	11.5	2007/11/07	1.234
351	2007/12/16	175.9°	5h35m	+19°	2007/12/16	11.9	2007/12/20	1.452
360	2007/02/01	179.8°	8h58m	+16°	2007/02/01	11.9	2007/01/27	1.748
372	2007/01/24	162.4°	8h36m	+36°	2007/01/23	10.5	2007/01/19	1.462
431	2007/09/23	177.4°	0h 5m	- 2°	2007/09/23	12.1	2007/09/19	1.640
445	2007/09/27	147.6°	23h21m	+31°	2007/09/27	13.2	2007/09/27	1.688
449	2007/03/04	174.4°	11h 9m	+11°	2007/03/04	11.8	2007/03/02	1.173
453	2007/06/03	169.9°	16h41m	-32°	2007/06/03	12.4	2007/06/02	0.951
456	2007/06/04	169.0°	16h57m	-11°	2007/06/04	12.0	2007/06/02	1.294
464	2007/09/23	162.2°	0h31m	-16°	2007/09/23	12.3	2007/09/22	1.261
493	2007/10/05	173.7°	0h35m	+10°	2007/10/05	13.8	2007/10/07	1.651
501	2007/09/07	172.0°	23h13m	-13°	2007/09/07	12.6	2007/09/07	1.719
512	2007/10/07	158.4°	1h23m	-14°	2007/10/04	11.7	2007/09/30	0.675
516	2007/03/30	163.0°	12h14m	-20°	2007/04/02	10.5	2007/04/08	1.046
575	2007/09/08	177.9°	23h 9m	- 7°	2007/09/08	13.3	2007/09/05	1.243
584	2007/11/19	164.1°	3h11m	+34°	2007/11/16	10.6	2007/11/09	0.962
591	2007/03/24	168.3°	11h57m	-12°	2007/03/24	13.0	2007/03/26	1.148
596	2007/06/01	179.9°	16h35m	-21°	2007/06/01	11.6	2007/06/01	1.428
632	2007/05/17	176.4°	15h29m	-22°	2007/05/17	13.8	2007/05/20	1.144
679	2007/08/27	141.5°	0h16m	-39°	2007/09/05	11.3	2007/09/08	0.963
704	2007/12/21	174.7°	5h55m	+28°	2007/12/21	9.9	2007/12/16	1.879
713	2007/08/17	164.8°	21h26m	+ 1°	2007/08/18	13.1	2007/08/20	1.891
763	2007/10/21	171.4°	1h28m	+18°	2007/10/21	14.0	2007/10/18	0.882
774	2007/05/31	179.8°	16h30m	-21°	2007/05/31	11.6	2007/06/04	1.556
855	2007/06/08	160.3°	17h 0m	-42°	2007/06/08	13.8	2007/06/07	0.955
886	2007/11/05	171.0°	2h46m	+ 6°	2007/11/04	11.9	2007/10/29	1.475
905	2007/10/15	176.9°	1h25m	+ 5°	2007/10/15	12.9	2007/10/14	0.881
913	2007/05/24	173.3°	16h 8m	-14°	2007/05/25	13.3	2007/05/31	0.875
917	2007/10/14	173.7°	1h 5m	+13°	2007/10/13	12.7	2007/10/06	0.970
922	2007/08/08	167.3°	20h54m	- 4°	2007/08/08	14.2	2007/08/10	1.191
934	2007/10/14	158.4°	0h48m	+28°	2007/10/15	13.0	2007/10/14	1.195
959	2007/11/12	178.8°	3h10m	+16°	2007/11/12	13.2	2007/11/09	1.531
970	2007/10/22	169.6°	1h31m	+20°	2007/10/23	14.0	2007/10/25	0.896
971	2007/12/08	176.4°	4h57m	+19°	2007/12/08	12.5	2007/12/09	1.239
980	2007/07/23	172.9°	20h 4m	-13°	2007/07/23	10.7	2007/07/29	1.345
1006	2007/11/09	160.9°	2h25m	+34°	2007/11/06	13.7	2007/11/01	1.130
1044	2007/06/07	177.8°	16h59m	-24°	2007/06/07	13.3	2007/06/11	1.228
1064	2007/06/27	178.2°	18h22m	-25°	2007/06/27	12.5	2007/06/30	1.110
1099	2007/09/22	171.6°	0h 9m	- 8°	2007/09/23	13.2	2007/09/23	1.344
1116	2007/12/28	151.9°	6h32m	+51°	2007/12/27	12.8	2007/12/25	1.350
1127	2007/11/05	150.5°	3h15m	-12°	2007/11/06	13.2	2007/11/06	0.986
1150	2007/11/03	178.8°	2h35m	+13°	2007/11/03	13.9	2007/10/25	0.877
1164	2007/03/01	176.4°	10h55m	+10°	2007/03/01	14.2	2007/02/26	0.891
1166	2007/07/07	178.4°	19h 1m	-21°	2007/07/07	12.7	2007/07/09	1.001
1240	2007/08/06	176.9°	21h 7m	-19°	2007/08/06	12.6	2007/08/09	1.424
1251	2007/08/05	178.4°	20h57m	-15°	2007/08/05	13.2	2007/08/09	1.378
1313	2007/11/18	159.2°	3h 3m	+38°	2007/11/17	14.4	2007/11/15	1.165
1325	2007/09/11	172.9°	23h25m	-11°	2007/09/11	13.0	2007/09/11	0.892
1418	2007/09/17	179.7°	23h38m	- 2°	2007/09/17	13.1	2007/09/10	0.830
1432	2007/09/24	164.9°	0h31m	-13°	2007/09/23	13.3	2007/09/19	0.873
1475	2007/10/03	178.3°	0h32m	+ 5°	2007/10/03	14.4	2007/10/06	0.997
1501	2007/09/28	176.8°	0h21m	- 1°	2007/09/28	13.7	2007/10/02	0.968
1539	2007/10/14	177.6°	1h21m	+ 6°	2007/10/14	13.8	2007/10/15	1.585
1555	2007/08/05	178.8°	21h 3m	-17°	2007/08/06	13.7	2007/08/15	1.110
1607	2007/09/15	164.8°	0h 1m	-16°	2007/09/15	12.9	2007/09/15	0.786
1608	2007/09/05	177.8°	22h56m	- 9°	2007/09/05	14.1	2007/08/30	0.861
1689	2007/11/23	168.8°	4h 0m	+ 9°	2007/11/22	13.8	2007/11/17	1.016
1736	2007/10/17	173.2°	1h39m	+ 3°	2007/10/17	13.6	2007/10/20	0.883
1752	2007/07/25	172.9°	20h10m	-12°	2007/07/25	14.5	2007/07/30	0.825
1803	2007/06/01	134.5°	15h24m	-66°	2007/05/26	14.2	2007/05/25	0.915
1842	2007/05/24	168.7°	16h13m	- 9°	2007/05/25	14.1	2007/05/31	0.906
1862	2007/04/20	142.4°	16h22m	-21°	2007/05/04	13.2	2007/05/08	0.071
1884	2007/02/15	155.5°	10h 5m	+37°	2007/02/11	13.6	2007/02/08	0.919
1925	2007/07/16	179.5°	19h43m	-21°	2007/07/16	14.4	2007/07/23	1.263
1954	2007/06/26	178.2°	18h20m	-25°	2007/06/27	14.1	2007/07/08	1.406
1978	2007/08/11	169.6°	21h36m	-25°	2007/08/11	13.9	2007/08/11	0.719
1987	2007/07/30	172.4°	20h38m	-26°	2007/07/31	13.1	2007/08/06	0.938
2118	2007/10/26	169.4°	1h48m	+22°	2007/10/27	14.2	2007/10/31	1.086
2167	2007/02/23	168.7°	10h10m	- 0°	2007/02/24	14.4	2007/02/26	1.109
2287	2007/07/22	174.9°	20h11m	-25°	2007/07/22	14.3	2007/07/23	0.848
2440	2007/07/14	171.9°	19h28m	-13°	2007/07/14	14.5	2007/07/16	0.849
2445	2007/11/28	175.6°	4h17m	+16°	2007/11/28	14.5	2007/11/28	0.949
2554	2007/06/24	175.8°	18h12m	-27°	2007/06/24	14.5	2007/06/24	0.922
2623	2007/09/04	178.7°	22h53m	- 8°	2007/09/04	13.9	2007/09/09	0.762
2637	2007/09/04	176.9°	22h54m	-10°	2007/09/04	13.9	2007/09/02	0.717
2648	2007/10/15	170.1°	1h 6m	+17°	2007/10/16	14.5	2007/10/19	0.903
2776	2007/01/26	171.6°	8h24m	+10°	2007/01/26	14.4	2007/01/30	1.000
2896	2007/09/11	179.2°	23h15m	- 3°	2007/09/11	14.1	2007/09/02	0.921
3106	2007/10/09	156.5°	1h38m	-15°	2007/10/11	14.4	2007/10/14	1.549
3125	2007/01/12	170.3°	7h23m	+12°	2007/01/12	14.5	2007/01/15	1.118
3163	2007/09/04	175.7°	22h45m	- 3°	2007/09/04	13.9	2007/08/24	0.616
3200	2007/11/21	114.8°	8h34m	+29°	2007/12/06	13.3	2007/12/10	0.121
3300	2007/07/06	150.0°	19h23m	-52°	2007/07/06	14.1	2007/07/07	1.574
3330	2007/08/27	169.7°	22h37m	-19°	2007/08/27	14.5	2007/08/24	1.507
3628	2007/09/26	173.0°	0h25m	- 4°	2007/09/26	13.8	2007/09/20	0.801
3687	2007/09/17	157.1°	22h53m	+17°	2007/09/16	14.3	2007/09/14	1.239
3824	2007/11/14	173.6°	3h10m	+24°	2007/11/15	14.2	2007/11/19	0.763
4066	2007/07/19	170.1°	19h46m	-11°	2007/07/20	14.5	2007/07/26	0.783
4293	2007/12/10	174.0°	5h 8m	+28°	2007/12/11	14.4	2007/12/15	1.193
4374	2007/03/11	176.9°	11h31m	+ 6°	2007/03/11	14.4	2007/03/07	0.914
4388	2007/10/24	174.8°	1h38m	+15°	2007/10/24	14.4	2007/10/27	0.718
4460	2007/08/10	171.6°	21h25m	-23°	2007/08/11	14.2	2007/08/14	1.484
4614	2007/09/29	178.8°	0h25m	+ 1°	2007/09/29	14.4	2007/09/20	0.850
4954	2007/09/08	161.7°	23h 9m	-24°	2007/09/24	11.6	2007/10/11	0.287
5331	2007/12/03	162.3°	4h35m	+ 4°	2007/11/29	13.4	2007/11/20	0.797
5358	2007/11/15	161.3°	2h57m	+36°	2007/11/15	14.5	2007/11/15	1.358
5746	2007/09/21	179.4°	23h54m	- 0°	2007/09/21	14.0	2007/09/23	0.836
6091	2007/07/07	163.8°	19h 9m	-38°	2007/07/08	14.4	2007/07/10	0.723
6265	2007/07/19	171.0°	20h 1m	-29°	2007/07/20	14.6	2007/07/24	0.773
6649	2007/08/20	179.5°	21h55m	-12°	2007/08/20	14.1	2007/08/16	0.889
6823	2007/12/23	177.3°	6h 8m	+25°	2007/12/23	14.4	2007/12/21	1.263
6905	2007/11/14	178.6°	3h15m	+19°	2007/11/14	13.8	2007/11/07	1.276
7304	2007/04/23	153.2°	14h36m	+12°	2007/04/28	13.8	2007/05/03	0.541
7318	2007/08/02	177.7°	20h43m	-15°	2007/08/02	14.3	2007/08/06	1.194
7405	2007/06/15	179.4°	17h34m	-23°	2007/06/15	14.5	2007/06/14	1.281
7409	2007/11/24	179.4°	3h59m	+21°	2007/11/24	14.3	2007/11/20	0.908
7517	2007/11/05	171.0°	2h32m	+24°	2007/11/06	14.4	2007/11/07	0.831
7559	2007/07/06	172.8°	19h 8m	-29°	2007/07/07	14.4	2007/07/12	0.866
10562	2007/09/22	171.1°	0h 4m	- 9°	2007/09/22	14.5	2007/09/22	0.970
11780	2007/10/06	166.2°	1h13m	- 7°	2007/10/06	14.5	2007/10/05	0.865
15549	2007/07/16	175.7°	19h34m	-17°	2007/07/16	14.4	2007/07/17	0.740
15779	2007/07/16	168.5°	19h47m	- 9°	2007/07/18	14.1	2007/07/24	0.861
17583	2007/07/26	173.8°	20h18m	-13°	2007/07/26	14.2	2007/07/25	0.806
21652	2007/07/15	178.8°	19h36m	-20°	2007/07/15	14.4	2007/07/24	1.153
30105	2007/08/08	158.8°	21h47m	-35°	2007/08/08	13.9	2007/08/08	0.507
34777	2007/01/03	175.1°	6h48m	+27°	2007/01/03	13.5	2007/01/08	0.736
41223	2007/10/05	169.8°	0h49m	- 5°	2007/10/04	13.9	2007/09/30	0.671

Table II. Temporal Sequence of Favorable Elongations

Planet	Max Elon D	Max E	RA	Dec	Min Mag D	Mag	Min Dist D	Min Dist
34777	2007/01/03	175.1°	6h48m	+27°	2007/01/03	13.5	2007/01/08	0.736
3125	2007/01/12	170.3°	7h23m	+12°	2007/01/12	14.5	2007/01/15	1.118
37	2007/01/17	174.9°	8h 0m	+25°	2007/01/17	9.9	2007/01/12	1.298
372	2007/01/24	162.4°	8h36m	+36°	2007/01/23	10.5	2007/01/19	1.462
78	2007/01/25	172.0°	8h36m	+26°	2007/01/25	10.3	2007/01/26	1.097
2776	2007/01/26	171.6°	8h24m	+10°	2007/01/26	14.4	2007/01/30	1.000
20	2007/01/29	178.7°	8h45m	+16°	2007/01/29	8.4	2007/01/27	1.108
360	2007/02/01	179.8°	8h58m	+16°	2007/02/01	11.9	2007/01/27	1.748
116	2007/02/12	174.0°	9h50m	+19°	2007/02/12	10.7	2007/02/14	1.412
1884	2007/02/15	155.5°	10h 5m	+37°	2007/02/11	13.6	2007/02/08	0.919
2167	2007/02/23	168.7°	10h10m	- 0°	2007/02/24	14.4	2007/02/26	1.109
1164	2007/03/01	176.4°	10h55m	+10°	2007/03/01	14.2	2007/02/26	0.891
449	2007/03/04	174.4°	11h 9m	+11°	2007/03/04	11.8	2007/03/02	1.173
4374	2007/03/11	176.9°	11h31m	+ 6°	2007/03/11	14.4	2007/03/07	0.914
162	2007/03/21	174.1°	12h10m	+ 5°	2007/03/21	12.1	2007/03/19	1.564
591	2007/03/24	168.3°	11h57m	-12°	2007/03/24	13.0	2007/03/26	1.148
516	2007/03/30	163.0°	12h14m	-20°	2007/04/02	10.5	2007/04/08	1.046
1862	2007/04/20	142.4°	16h22m	-21°	2007/05/04	13.2	2007/05/08	0.071
7304	2007/04/23	153.2°	14h36m	+12°	2007/04/28	13.8	2007/05/03	0.541
632	2007/05/17	176.4°	15h29m	-22°	2007/05/17	13.8	2007/05/20	1.144
913	2007/05/24	173.3°	16h 8m	-14°	2007/05/25	13.3	2007/05/31	0.875
1842	2007/05/24	168.7°	16h13m	- 9°	2007/05/25	14.1	2007/05/31	0.906
4	2007/05/30	172.2°	16h32m	-14°	2007/05/31	5.4	2007/05/31	1.143
774	2007/05/31	179.8°	16h30m	-21°	2007/05/31	11.6	2007/06/04	1.556
596	2007/06/01	179.9°	16h35m	-21°	2007/06/01	11.6	2007/06/01	1.428
1803	2007/06/01	134.5°	15h24m	-66°	2007/05/26	14.2	2007/05/25	0.915
453	2007/06/03	169.9°	16h41m	-32°	2007/06/03	12.4	2007/06/02	0.951
456	2007/06/04	169.0°	16h57m	-11°	2007/06/04	12.0	2007/06/02	1.294
1044	2007/06/07	177.8°	16h59m	-24°	2007/06/07	13.3	2007/06/11	1.228
855	2007/06/08	160.3°	17h 0m	-42°	2007/06/08	13.8	2007/06/07	0.955

Table II. Temporal Sequence of Favorable Elongations (cont'd)

Planet	Max Elon D	Max E	RA	Dec	Min Mag D	Mag	Min Dist D	Min Dist
7405	2007/06/15	179.4°	17h34m	-23°	2007/06/15	14.5	2007/06/14	1.281
2554	2007/06/24	175.8°	18h12m	-27°	2007/06/24	14.5	2007/06/24	0.922
1954	2007/06/26	178.2°	18h20m	-25°	2007/06/27	14.1	2007/07/08	1.406
1064	2007/06/27	178.2°	18h22m	-25°	2007/06/27	12.5	2007/06/30	1.110
3300	2007/07/06	150.0°	19h23m	-52°	2007/07/06	14.1	2007/07/07	1.574
7559	2007/07/06	172.8°	19h 8m	-29°	2007/07/07	14.4	2007/07/12	0.866
1166	2007/07/07	178.4°	19h 1m	-21°	2007/07/07	12.7	2007/07/09	1.001
6091	2007/07/07	163.8°	19h 9m	-38°	2007/07/08	14.4	2007/07/10	0.723
2440	2007/07/14	171.9°	19h28m	-13°	2007/07/14	14.5	2007/07/16	0.849
21652	2007/07/15	178.8°	19h36m	-20°	2007/07/15	14.4	2007/07/24	1.153
137	2007/07/16	157.4°	19h27m	+ 0°	2007/07/17	11.5	2007/07/19	1.479
1925	2007/07/16	179.5°	19h43m	-21°	2007/07/16	14.4	2007/07/23	1.263
15549	2007/07/16	175.7°	19h34m	-17°	2007/07/16	14.4	2007/07/17	0.740
15779	2007/07/16	168.5°	19h47m	- 9°	2007/07/18	14.1	2007/07/24	0.861
4066	2007/07/19	170.1°	19h46m	-11°	2007/07/20	14.5	2007/07/26	0.783
6265	2007/07/19	171.0°	20h 1m	-29°	2007/07/20	14.6	2007/07/24	0.773
2287	2007/07/22	174.9°	20h11m	-25°	2007/07/22	14.3	2007/07/23	0.848
225	2007/07/23	146.5°	19h38m	+12°	2007/07/23	12.4	2007/07/23	1.574
980	2007/07/23	172.9°	20h 4m	-13°	2007/07/23	10.7	2007/07/29	1.345
1752	2007/07/25	172.9°	20h10m	-12°	2007/07/25	14.5	2007/07/30	0.825
17583	2007/07/26	173.8°	20h18m	-13°	2007/07/26	14.2	2007/07/25	0.806
226	2007/07/28	174.4°	20h21m	-13°	2007/07/28	12.0	2007/07/25	1.158
1987	2007/07/30	172.4°	20h38m	-26°	2007/07/31	13.1	2007/08/06	0.938
7318	2007/08/02	177.7°	20h43m	-15°	2007/08/02	14.3	2007/08/06	1.194
1251	2007/08/05	178.4°	20h57m	-15°	2007/08/05	13.2	2007/08/09	1.378
1555	2007/08/05	178.8°	21h 3m	-17°	2007/08/06	13.7	2007/08/15	1.110
1240	2007/08/06	176.9°	21h 7m	-19°	2007/08/06	12.6	2007/08/09	1.424
294	2007/08/07	179.7°	21h 7m	-16°	2007/08/07	12.2	2007/08/07	1.371
188	2007/08/08	159.8°	20h51m	+ 3°	2007/08/08	12.2	2007/08/07	1.296
922	2007/08/08	167.3°	20h54m	- 4°	2007/08/08	14.2	2007/08/10	1.191
30105	2007/08/08	158.8°	21h47m	-35°	2007/08/08	13.9	2007/08/08	0.507
4460	2007/08/10	171.6°	21h25m	-23°	2007/08/11	14.2	2007/08/14	1.484
1978	2007/08/11	169.6°	21h36m	-25°	2007/08/11	13.9	2007/08/11	0.719
713	2007/08/17	164.8°	21h26m	+ 1°	2007/08/18	13.1	2007/08/20	1.891
194	2007/08/20	171.1°	21h39m	- 4°	2007/08/20	9.6	2007/08/19	0.995
6649	2007/08/20	179.5°	21h55m	-12°	2007/08/20	14.1	2007/08/16	0.889
679	2007/08/27	141.5°	0h16m	-39°	2007/09/05	11.3	2007/09/08	0.963
3330	2007/08/27	169.7°	22h37m	-19°	2007/08/27	14.5	2007/08/24	1.507
183	2007/08/29	165.4°	23h 5m	-21°	2007/09/02	12.2	2007/09/11	1.141
30	2007/09/03	177.8°	22h46m	- 5°	2007/09/03	9.7	2007/09/07	1.156
2623	2007/09/04	178.7°	22h53m	- 8°	2007/09/04	13.9	2007/09/09	0.762
2637	2007/09/04	176.9°	22h54m	-10°	2007/09/04	13.9	2007/09/02	0.717
3163	2007/09/04	175.7°	22h45m	- 3°	2007/09/04	13.9	2007/08/24	0.616
1608	2007/09/05	177.8°	22h56m	- 9°	2007/09/05	14.1	2007/08/30	0.861
501	2007/09/07	172.0°	23h13m	-13°	2007/09/07	12.6	2007/09/07	1.719
575	2007/09/08	177.9°	23h 9m	- 7°	2007/09/08	13.3	2007/09/05	1.243
4954	2007/09/08	161.7°	23h 9m	-24°	2007/09/24	11.6	2007/10/11	0.287
1325	2007/09/11	172.9°	23h25m	-11°	2007/09/11	13.0	2007/09/11	0.892
2896	2007/09/11	179.2°	23h15m	- 3°	2007/09/11	14.1	2007/09/02	0.921
185	2007/09/15	165.8°	0h 3m	-14°	2007/09/16	10.8	2007/09/16	1.424
1607	2007/09/15	164.8°	0h 1m	-16°	2007/09/15	12.9	2007/09/15	0.786
1418	2007/09/17	179.7°	23h38m	- 2°	2007/09/17	13.1	2007/09/10	0.830
3687	2007/09/17	157.1°	22h53m	+17°	2007/09/16	14.3	2007/09/14	1.239
5746	2007/09/21	179.4°	23h54m	- 0°	2007/09/21	14.0	2007/09/23	0.836
1099	2007/09/22	171.6°	0h 9m	- 8°	2007/09/23	13.2	2007/09/23	1.344
10562	2007/09/22	171.1°	0h 4m	- 9°	2007/09/22	14.5	2007/09/22	0.970
431	2007/09/23	177.4°	0h 5m	- 2°	2007/09/23	12.1	2007/09/19	1.640
464	2007/09/23	162.2°	0h31m	-16°	2007/09/23	12.3	2007/09/22	1.261
1432	2007/09/24	164.9°	0h31m	-13°	2007/09/23	13.3	2007/09/19	0.873
3628	2007/09/26	173.0°	0h25m	- 4°	2007/09/26	13.8	2007/09/20	0.801
445	2007/09/27	147.6°	23h21m	+31°	2007/09/27	13.2	2007/09/27	1.688
1501	2007/09/28	176.8°	0h21m	- 1°	2007/09/28	13.7	2007/10/02	0.968
4614	2007/09/29	178.8°	0h25m	+ 1°	2007/09/29	14.4	2007/09/20	0.850
1475	2007/10/03	178.3°	0h32m	+ 5°	2007/10/03	14.4	2007/10/06	0.997
493	2007/10/05	173.7°	0h35m	+10°	2007/10/05	13.8	2007/10/07	1.651
41223	2007/10/05	169.8°	0h49m	- 5°	2007/10/04	13.9	2007/09/30	0.671
11780	2007/10/06	166.2°	1h13m	- 7°	2007/10/06	14.5	2007/10/05	0.865
512	2007/10/07	158.4°	1h23m	-14°	2007/10/04	11.7	2007/09/30	0.675
3106	2007/10/09	156.5°	1h38m	-15°	2007/10/11	14.4	2007/10/14	1.549
917	2007/10/14	173.7°	1h 5m	+13°	2007/10/13	12.7	2007/10/06	0.970
934	2007/10/14	158.4°	0h48m	+28°	2007/10/15	13.0	2007/10/14	1.195
1539	2007/10/14	177.6°	1h21m	+ 6°	2007/10/14	13.8	2007/10/15	1.585
905	2007/10/15	176.9°	1h25m	+ 5°	2007/10/15	12.9	2007/10/14	0.881
2648	2007/10/15	170.1°	1h 6m	+17°	2007/10/16	14.5	2007/10/19	0.903
1736	2007/10/17	173.2°	1h39m	+ 3°	2007/10/17	13.6	2007/10/20	0.883
102	2007/10/18	178.9°	1h30m	+10°	2007/10/18	11.0	2007/10/12	1.035
763	2007/10/21	171.4°	1h28m	+18°	2007/10/21	14.0	2007/10/18	0.882
970	2007/10/22	169.6°	1h31m	+20°	2007/10/23	14.0	2007/10/25	0.896
4388	2007/10/24	174.8°	1h38m	+15°	2007/10/24	14.4	2007/10/27	0.718
2118	2007/10/26	169.4°	1h48m	+22°	2007/10/27	14.2	2007/10/31	1.086
1150	2007/11/03	178.8°	2h35m	+13°	2007/11/03	13.9	2007/10/25	0.877
886	2007/11/05	171.0°	2h46m	+ 6°	2007/11/04	11.9	2007/10/29	1.475
1127	2007/11/05	150.5°	3h15m	-12°	2007/11/06	13.2	2007/11/06	0.986
7517	2007/11/05	171.0°	2h32m	+24°	2007/11/06	14.4	2007/11/07	0.831
1006	2007/11/09	160.9°	2h25m	+34°	2007/11/06	13.7	2007/11/01	1.130
959	2007/11/12	178.8°	3h10m	+16°	2007/11/12	13.2	2007/11/09	1.531
3824	2007/11/14	173.6°	3h10m	+24°	2007/11/15	14.2	2007/11/19	0.763
6905	2007/11/14	178.6°	3h15m	+19°	2007/11/14	13.8	2007/11/07	1.276
322	2007/11/15	175.0°	3h14m	+23°	2007/11/14	11.5	2007/11/07	1.234
5358	2007/11/15	161.3°	2h57m	+36°	2007/11/15	14.5	2007/11/15	1.358
1313	2007/11/18	159.2°	3h 3m	+38°	2007/11/17	14.4	2007/11/15	1.165
8	2007/11/19	169.9°	3h44m	+ 9°	2007/11/18	8.0	2007/11/15	0.890
584	2007/11/19	164.1°	3h11m	+34°	2007/11/16	10.6	2007/11/09	0.962
198	2007/11/20	170.7°	3h27m	+28°	2007/11/18	10.5	2007/11/10	1.097
3200	2007/11/21	114.8°	8h34m	+29°	2007/12/06	13.3	2007/12/10	0.121
1689	2007/11/23	168.8°	4h 0m	+ 9°	2007/11/22	13.8	2007/11/17	1.016
7409	2007/11/24	179.4°	3h59m	+21°	2007/11/24	14.3	2007/11/20	0.908
2445	2007/11/28	175.6°	4h17m	+16°	2007/11/28	14.5	2007/11/28	0.949
5331	2007/12/03	162.3°	4h35m	+ 4°	2007/11/29	13.4	2007/11/20	0.797
971	2007/12/08	176.4°	4h57m	+19°	2007/12/08	12.5	2007/12/09	1.239
95	2007/12/10	174.6°	5h10m	+17°	2007/12/10	11.4	2007/12/06	1.710
4293	2007/12/10	174.0°	5h 8m	+28°	2007/12/11	14.4	2007/12/15	1.193
351	2007/12/16	175.9°	5h35m	+19°	2007/12/16	11.9	2007/12/20	1.452
704	2007/12/21	174.7°	5h55m	+28°	2007/12/21	9.9	2007/12/16	1.879
6823	2007/12/23	177.3°	6h 8m	+25°	2007/12/23	14.4	2007/12/21	1.263
76	2007/12/24	177.0°	6h 6m	+20°	2007/12/24	11.7	2007/12/24	1.881
1116	2007/12/28	151.9°	6h32m	+51°	2007/12/27	12.8	2007/12/25	1.350

ASTEROID LIGHTCURVE ANALYSIS AT THE PALMER DIVIDE OBSERVATORY – JUNE-SEPTEMBER 2006

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Lightcurves for 12 asteroids were obtained at the Palmer Divide Observatory from late June through late September 2006: 1355 Magoeba, 2083 Smither, 2150 Nyctimene, 3115 Baily, 3353 Jarvis, 5841 Stone, 6255 Kuma, (6382) 1988 EL, 9298 Geake, 9387 Tweedledee, 9739 Powell, and (22722) 1998 SE54.

Observations of 12 asteroids were made at the Palmer Divide Observatory from June through September 2006. One of three telescopes/camera combinations was used: 0.5m Ritchey-Chretien/FLI IMG-1001E, 0.35m SCT/FLI IMG-1001E, or 0.35m SCT/STL-1001E. The scale for each was about 2.5 arcseconds/pixel. Exposure times were 120–240s. Images taken with the 0.5m scope were guided. The operating temperature for the FLI cameras was –30°C while the STL-1001E was run between –20° to –30°C depending on ambient conditions.

All images were measured using MPO Canopus, which employs differential aperture photometry to determine the values used for analysis. Period analysis was also done using Canopus, based on a Fourier analysis algorithm developed by Harris (1989).

The results are summarized in the table below with individual plots presented afterwards. The data and curves are presented without comment except when warranted. Column 3 gives the full range of dates of observations; column 4 gives the number of data points used in the analysis. Column 5 gives the range of phase angles. If there are three values in the column, 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.

An "(H)" follows the name of an asteroid if it is a member of the Hungaria group or family.

1355 Magoeba. The period is supported by a half-period at about 16hr (monomodal curve).

3115 Baily. Originally reported in the Harris list (Harris 2006) to have a period of 10.0hr as found by Behrend et al. The Behrend site (2006) now reports a period of 16.277hr.

3353 Jarvis. The 40.8hr solution was supported by a half-period search.

5841 Stone. A period of 2.805hr was also found but eliminated after data were obtained on Sept. 19.

6255 Kuma. This is a main belt member that happened to be in the same field as 5841 on Sept. 16.

#	Name	Date Range (mm/dd) 2006	Data Pts	Phase	L_{PAB}	B_{PAB}	Per (h)	PE	Amp (m)	AE
1355	Magoeba (H)	06/29-07/23	251	28.1-24.1	314.0	32.0	32.9	0.1	0.22	0.03
2083	Smither (H)	09/18-09/20	169	17.9	357.8	27.1	2.676	0.003	0.10	0.02
2150	Nyctimene (H)	09/17-09/18	160	15.3	13.8	10.0	6.120	0.005	0.62	0.02
3115	Baily	09/05-09/17	332	6.8-10.0	337.4	13.1	16.22	0.01	0.14	0.02
3353	Jarvis (H)	06/29-07/23	184	29.1-25.2	311.3	28.6	40.8	0.1	0.10	0.03
5841	Stone (H)	08/29-09/19	206	12.6,4.2,5.5	352.1	1.0-6.2	2.8902	0.0005	0.11	0.02
6255	Kuma	09/16-09/26	170	2.8-5.2	352.4	6.4	9.70	0.01	0.15	0.03
6382	1988 EL (H)	09/27-10/01	110	11.6-10.1	16.7	10.6	2.898	0.001	0.08	0.02
9298	Geake	07/27-09/15	399	17.2,13.8,20.2	322.0	18.6-15.4	38.29	0.02	0.78	0.03
9387	Tweedledee (H)	09/16-09/19	199	13.7	2.5	16.0	7.08	0.01	0.15	0.02
9739	Powell (H)	09/25-10/01	334	22.6-21.5	18.8	28.3	18.2	0.1	0.09	0.02
22722	1998 SE54	06/29-07/16	209	13.4-17.5	266.0	19.3	10.934	0.002	0.50	0.03

(6382) 1988 EL. Follow up on previous work (Warner 2005).

9739 Powell. An alternate solution of 36.5hr is possible, though the fit of the data is not as good.

Acknowledgements

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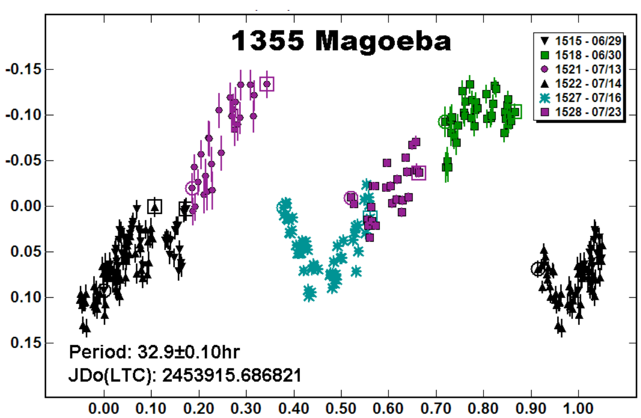
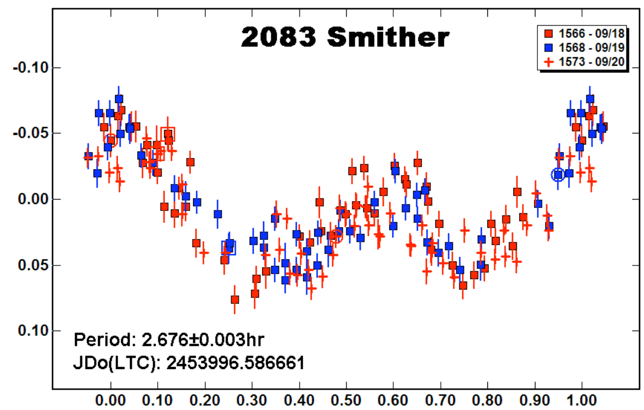
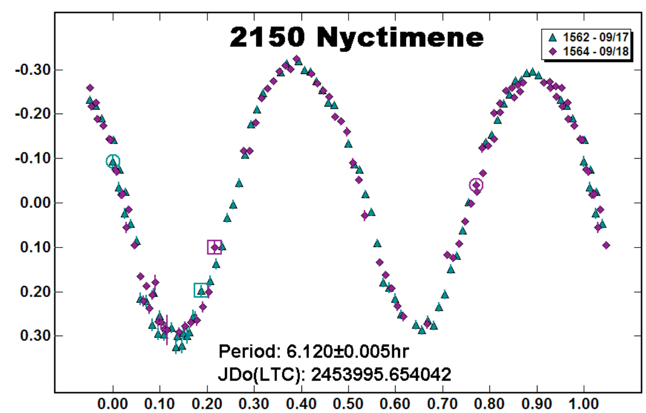
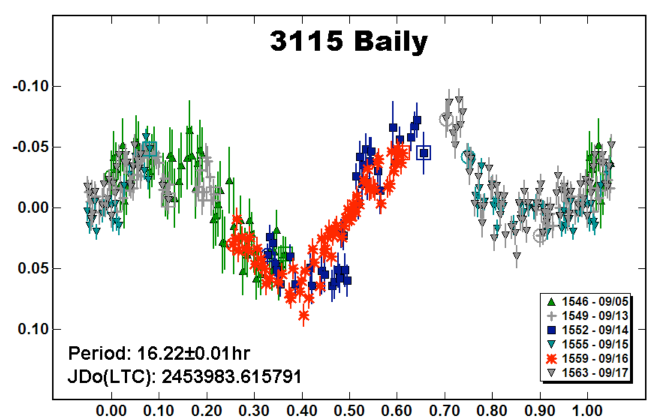
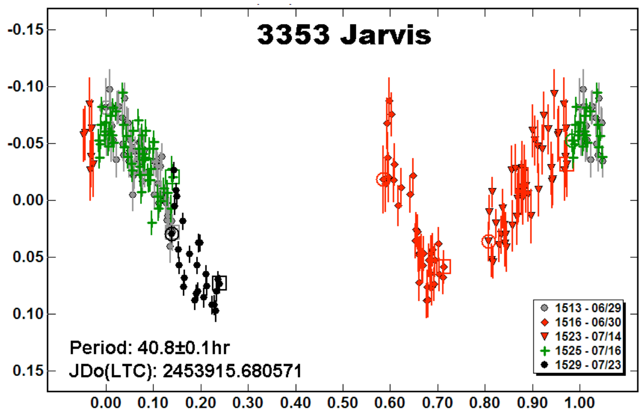
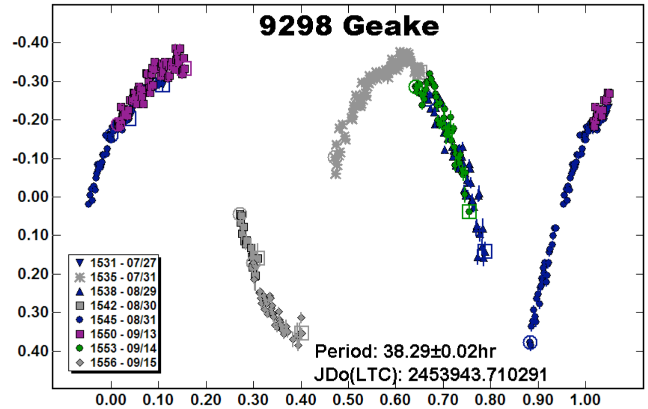


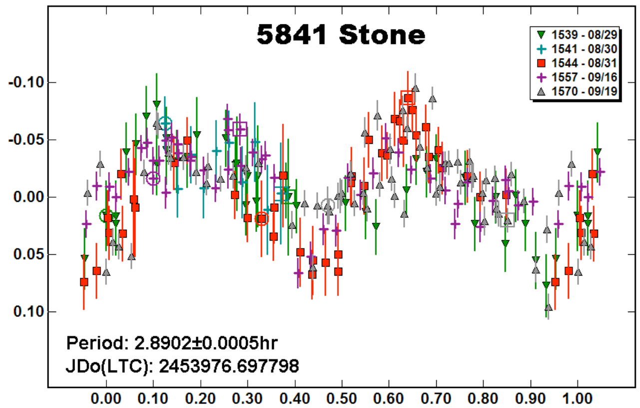







3353 Jarvis
1513 - 06/29
1516 - 06/30
1523 - 07/14
1525 - 07/16
1529 - 07/23
Period: 40.8±0.1hr
JDo(LTC): 2453915.680571


9298 Geake
1531 - 07/27
1535 - 07/31
1538 - 08/29
1542 - 08/30
1545 - 08/31
1550 - 09/13
1553 - 09/14
1556 - 09/15
Period: 38.29±0.02hr
JDo(LTC): 2453943.710291


5841 Stone
1539 - 08/29
1541 - 08/30
1544 - 08/31
1557 - 09/16
1570 - 09/19
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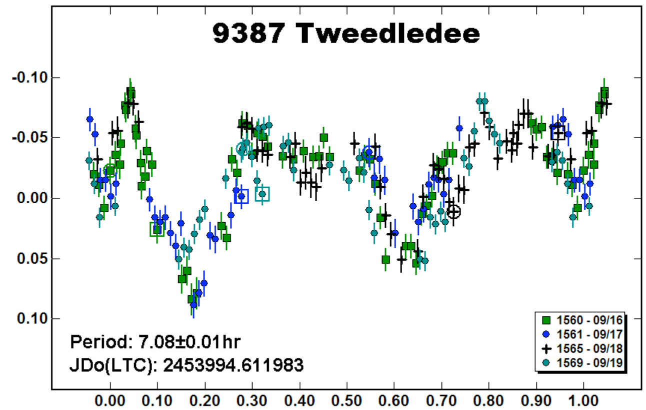
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1561 - 09/17
1565 - 09/18
1569 - 09/19
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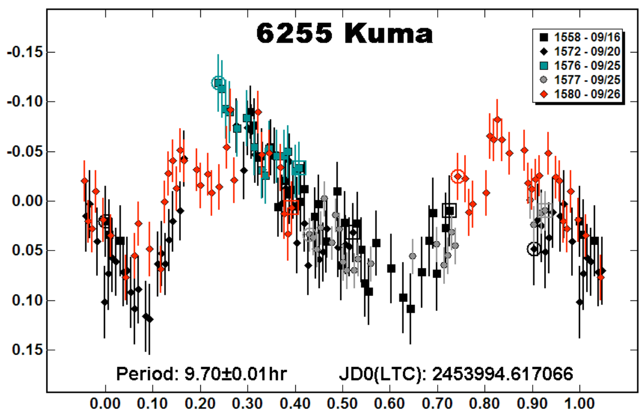
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1572 - 09/20
1576 - 09/25
1577 - 09/25
1580 - 09/26
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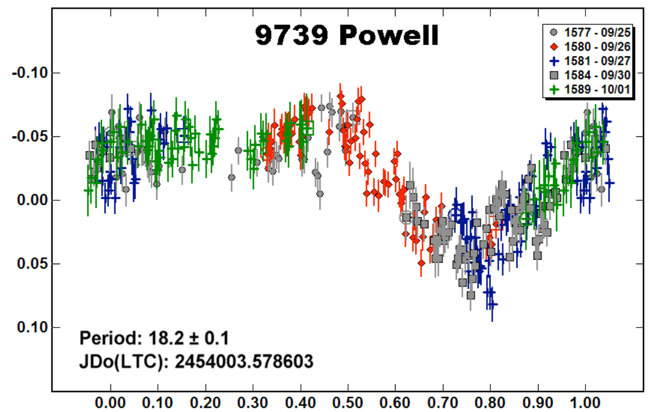
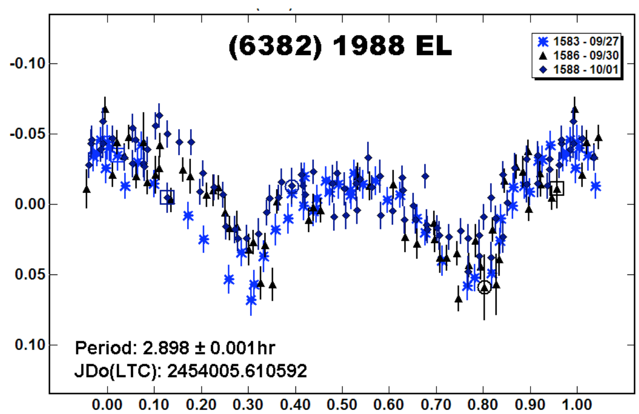
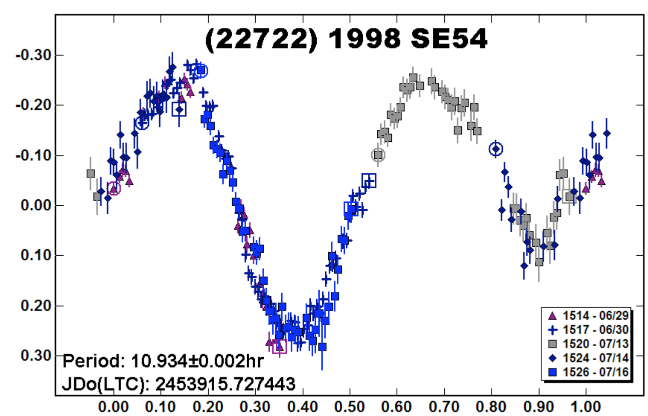
JD0(LTC): 2453994.617066


9739 Powell
1577 - 09/25
1580 - 09/26
1581 - 09/27
1584 - 09/30
1589 - 10/01
Period: 18.2 ± 0.1
JDo(LTC): 2454003.578603


(6382) 1988 EL
1583 - 09/27
1586 - 09/30
1588 - 10/01
Period: 2.898 ± 0.001hr
JDo(LTC): 2454005.610592


(22722) 1998 SE54
1514 - 06/29
1517 - 06/30
1520 - 07/13
1524 - 07/14
1526 - 07/16
Period: 10.934±0.002hr
JDo(LTC): 2453915.727443

THE MINOR PLANET OBSERVER: MAKING LIFE EASIER. SOME CHANGES IN THE *MPB* SUBMISSION GUIDELINES

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The last issue of the *Minor Planet Bulletin* was a record setter. There were 34 pages and more than 90 lightcurves included. It wasn't so long ago that we hoped to have 70 lightcurves in an entire year. Having such a volume of papers is what's often called a "golden problem." There are difficulties involved with having to edit and process so many papers but they are to be preferred to those of having to find some way to fill a minimum number of pages because of a dearth of material.

However, having more people is not always the answer, though I'm glad to be on staff as Assistant Editor and try to take some of the load where possible. Sometimes it's the process itself that needs an occasional adjustment to keep things under control. Such is the case now, and so were are asking you – the potential authors – to help us by working with a new template and suggested guidelines when submitting papers. Visit the *MPB* e-Journal site to download the new template and guidelines. The URL is:
http://www.minorplanetobserver.com/mpb/default.htm

Those using MPO Canopus will also find an updated tutorial on how to generate and edit plots from that program to make them best suited for using in papers for the *MPB*. You'll find that tutorial at http://www.minorplanetobserver.com/MPOSoftware/MPOSoftwareHintsTips.htm. Of course, some of the suggestions there can be used regardless of the program you use to generate your plots, so please be sure to take a look even if you don't use MPO Canopus.

Here are some things we'd like you to consider when preparing your papers that will make life easier for everyone.

Use the Template. We receive papers that use a variety of paragraph styles and formatting that are not included in the original template. This can sometimes make editing a paper difficult.

Tables. When submitting a large number of asteroid lightcurves, it's common to summarize the results in a table that spans both columns of a page. In Microsoft Word®, one way to do this is to insert two continuous section breaks, switch to one column between the breaks, and create the wide table there. Some authors then move the table and the two section breaks so that the table occupies the bottom of the first page of their manuscript, a natural location.

However, positioning a table and its section breaks in this way can cause a problem. In the *MPB*, an article might not start at the top of a page, but partway down. This alignment means the carefully positioned table no longer appears where intended.

One way to address this problem is for you not to position the table within the article, but leave that task for the *MPB* Producer. Perhaps include a note with the manuscript stating the placement you prefer. Another way, which the *MPB* Producer is adopting, is to use the "text box" feature of Word. A text box can contain anything – text, figure, table – and can be positioned anywhere on a page, no matter where the article actually starts. For the situation under discussion, a text box would be inserted in the first page, resized to be the width of both columns, and the table entered inside. Finally, the text box would be positioned with both its left and bottom borders on the margins. Within reason, Word automatically positions the text box there no matter where on the *MPB* page that the article actually starts.

Within the box, use the "Table" style, which is Courier New and 9-point font. Since this is a fixed pitch font, it will be easy to line up values in columns. If you're familiar and comfortable with the process, you could first create a table and fill it in, then convert it to text using tabs to separate the columns. Copy and paste the text into a text box and start playing with the tab settings and other formatting. I've tried both, and found each to have its advantages and disadvantages.

You are not required to use text boxes in your manuscripts – we will format articles for you. However, if you do want to position wide tables within the manuscript yourself, and are comfortable with Word's text boxes, then using them instead of section breaks can save the editors and producer some work.

Plots (General). Please submit simple graphics files, preferably GIF or JPG. 24-bit BMP files can be very large (several MB) and, while acceptable, bloat the size of the entire document needlessly. Please *do not* submit embedded or linked objects, e.g., Excel® plots and worksheets. Do not create multi-layer graphics with grouping, force a set position, or "float over text." Any of these techniques can make reformatting or editing a minor correction time consuming. Not only that, they can make the overall file much larger, going in some cases from a few hundred KB to several MB.

It's OK to use colors but test the plots to be sure they will be easily readable when printed to B/W. For example, yellow plot symbols on a white background do not work well.

It's preferred that you put the graphics at the end of the article and let the Producer place them. Again, since there's no guarantee where on the published *MPB* page an article will start or end your placement may change during final layout.

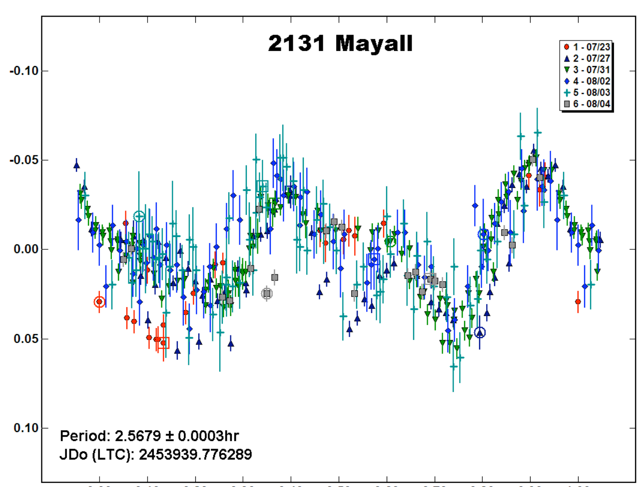

Figure 1. Sample plot following new guidelines.

Plots (Legend). The legend allows the reader to tell which symbols belong to which data. We recommend that the legend include the symbol and date of the data. A symbol/observer combination can be ambiguous since there may be several data segments attributable to one observer. Use a different symbol/color combination for each subset of the data, e.g., a single observer on a given night.

Plots (What to Include). In response to a request from Prof. Frederick Pilcher, see “Letters to the Editor” in this issue, the recommendation is that a plot now include the name of the asteroid, the JD zero point, and the period. The amplitude is not required nor recommended. This information as well as the legend should be entirely within the plot area to maximize the data area. Figure 1 shows an example using MPO Canopus.

Note that the axis labels are only on the left and bottom. Having the numbers on all four sides is both redundant and takes up space needlessly.

Change is always a burden but we hope that you won't find these too difficult to manage. You'll receive our profound thanks when you do. Clear Skies!

CLOSE MUTUAL APPROACHES OF MINOR PLANETS IN 2007

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(Received: 23 April)

Tabulated are 32 cases where one minor planet comes to within 120" of another and both are magnitude 16 or brighter. A challenge for minor planet observers!

Here I present a list of close approaches between numbered minor planets larger than 40 km during 2007 where:

- the elongation of the Sun is more than 30°,
- both minor planets are brighter than visual magnitude 16,
- and the minimum geocentric separation is less than 120".

The table gives the following data:

1. Date: date and time of closest geocentric approach (in UT). All other information is given for this instant.
2. Closest approach: gives the minimum geocentric distance (in seconds of arc) and the position angle (in degrees) of the *nearest* minor planet with respect to the *farthest* one.
3. Minor planet 1: information on the *nearest* one:
   - number and name visual magnitude,
   - parallax in seconds of arc,
   - apparent motion in seconds of arc per hour,
   - position angle of the direction of motion in degrees.
4. Minor planet 2: information about the *farthest* minor planet of the two. The same data as for the nearest one are given. In addition the right ascension and declination (2000).
5. Sun and Moon:
   - elongation of the Sun in degrees,
   - elongation of the Moon (degrees),
   - illuminated fraction of the Moon in %.

Close mutual approaches of minor planets

(Dist. < 120" ; El. Sun > 30° ; magn. < 16.0)

	Date (U.T.)		Min. dist.	Pos. ang.	Minor planet 1 Name	Vis. mag.	Hor. par.	Motion per hour	Motion pos. ang.	Minor planet 2 Name	Vis. mag.	Hor. par.	Motion per hour	Motion pos. ang.	Right ascens. (2000.0)	Decli- nation (2000.0)	Elon- gation Sun	Elon- gation Moon	Ill. frac. Moon
		h m	"	0			"	"/h	0			"	"/h	0	h m	0 '	0	0	%
	2007 jan 18	18 59.5	57.61	191	638 Moira	14.83	2.84	73.95	94	358 Apollonia	15.36	2.15	49.71	90	17 46.63	-20 33.5	31	31	2
	jan 22	15 54.5	51.88	324	980 Anacostia	13.54	2.52	60.92	87	152 Atala	14.67	2.13	48.91	97	17 52.21	-29 39.2	34	82	16
	jan 25	6 5.3	83.21	170	606 Brang‰ne	14.60	4.74	51.32	83	227 Philosophia	15.19	2.45	16.47	91	2 10.70	+23 22.8	93	21	41
	jan 26	23 13.5	97.19	137	85 Io	13.05	2.98	54.43	92	423 Diotima	13.11	2.66	46.06	104	16 11.05	-17 03.7	62	162	60
	feb 21	4 34.5	91.78	3	9 Metis	11.70	3.03	48.17	95	121 Hermione	13.88	2.25	34.74	96	17 40.28	-23 05.1	66	114	17
	feb 21	16 16.6	27.86	207	45 Eugenia	13.38	2.43	54.95	67	508 Princetonia	14.42	2.24	50.33	60	0 45.44	+ 0 10.8	38	17	21
	feb 27	17 47.7	21.18	137	573 Recha	14.31	3.88	30.44	277	175 Andromache	13.93	3.01	27.17	287	9 53.35	+16 27.8	165	39	82
	mar 2	22 1.4	49.47	101	282 Clorinde	14.21	6.42	19.01	325	123 Brunhild	12.83	5.26	14.47	262	8 18.65	+18 02.2	140	30	98
	apr 8	23 13.8	86.27	251	347 Pariana	14.27	2.93	58.46	75	551 Ortrud	15.02	2.83	59.33	82	4 31.59	+22 13.2	50	154	67
?	apr 21	4 19.3	34.06	207	163 Erigone	12.70	6.21	35.55	296	2207 Antenor	15.82	2.11	19.10	295	13 15.34	- 1 56.5	166	117	20
	apr 21	13 39.7	53.71	198	554 Peraga	13.64	3.31	79.48	85	347 Pariana	14.26	2.84	61.71	78	4 52.81	+23 22.9	43	23	24
?	may 24	7 25.1	3.66	31	403 Cyane	14.38	3.18	53.33	100	1469 Linzia	15.68	2.57	40.70	92	8 38.69	+ 9 45.4	67	29	55
	may 31	8 9.9	51.90	50	21 Lutetia	9.88	6.75	36.77	273	1115 Sabauda	13.81	3.82	32.06	263	16 30.34	-20 44.4	178	17	98
	jun 16	15 34.8	19.98	352	313 Chaldaea	12.77	5.48	10.38	241	166 Rhodope	15.11	3.63	17.51	250	14 50.81	- 0 10.5	133	118	6
	jun 18	7 15.3	60.47	17	487 Venetia	12.88	4.19	22.77	98	911 Agamemnon	15.58	1.82	3.86	23	22 44.98	-12 58.5	108	145	15
	jun 22	0 30.9	111.17	202	590 Tomyris	15.52	3.18	24.02	93	361 Bononia	14.98	2.31	13.38	76	23 44.77	-11 31.1	98	167	46
	jul 5	3 14.8	91.12	139	76 Freia	13.84	2.35	55.74	81	663 Gerlinde	15.51	2.16	47.71	88	4 19.98	+20 36.1	35	86	76
	jul 13	5 34.1	30.45	186	403 Cyane	14.53	2.69	63.60	107	696 Leonora	15.36	2.16	46.72	111	9 55.94	+ 5 03.5	39	55	5
	jul 22	7 27.3	77.84	203	332 Siri	15.48	2.34	52.19	113	175 Andromache	15.24	1.87	38.74	113	10 32.11	+10 57.2	36	53	50
	jul 28	0 24.9	80.78	303	30 Urania	10.89	6.49	6.65	281	114 Kassandra	13.17	3.97	14.42	238	23 10.40	- 3 59.7	137	68	93
	aug 4	21 1.4	86.07	219	128 Nemesis	13.19	3.02	29.85	117	62 Erato	15.22	2.45	22.05	113	14 23.88	-12 00.8	85	169	62
	aug 8	23 28.1	119.02	20	704 Interamnia	11.73	2.84	52.16	87	545 Messalina	15.27	2.27	38.71	78	5 07.61	+32 47.8	57	29	19
?	aug 15	18 20.5	10.40	48	267 Tirza	15.38	3.89	38.75	111	1177 Gonnessia	15.42	2.72	23.37	88	15 24.51	-19 05.4	91	58	8
	aug 19	17 3.4	60.95	333	351 Yrsa	14.31	3.19	49.74	84	45 Eugenia	13.34	2.82	40.27	90	5 00.21	+16 27.4	70	146	37
	aug 23	5 3.4	98.51	37	99 Dike	14.16	3.57	70.51	118	49 Pales	14.59	2.09	33.16	108	13 45.89	-13 41.2	59	58	70
	sep 8	23 43.2	20.20	46	535 Montague	14.76	3.25	48.93	108	1177 Gonnessia	15.61	2.46	34.09	94	15 44.32	-19 13.4	72	100	7
	sep 15	10 51.4	31.90	27	441 Bathilde	13.97	2.58	63.46	112	701 Oriola	15.17	2.32	55.41	111	9 25.47	+ 9 45.3	31	75	14
	oct 11	16 56.5	36.53	166	432 Pythia	14.27	3.06	47.02	96	987 Wallia	15.80	2.31	30.83	106	8 52.91	+21 40.4	68	73	0
	oct 27	23 21.5	75.31	336	415 Palatia	14.14	3.38	60.81	106	240 Vanadis	14.18	3.16	56.12	110	10 24.49	+10 34.4	60	96	94
	nov 25	20 56.4	66.15	188	411 Xanthe	14.85	2.45	52.89	105	471 Papagena	12.93	2.20	43.30	107	13 24.72	+ 4 31.2	46	119	95
	dec 7	0 51.9	46.08	152	40 Harmonia	11.65	3.83	63.24	68	1069 Planckia	15.66	2.40	33.91	74	21 51.37	-17 06.1	69	101	8
	dec 9	7 27.0	107.87	143	521 Brixia	12.81	4.85	56.72	53	590 Tomyris	15.48	3.13	30.96	53	23 23.00	-16 30.9	88	97	3

LIGHTCURVES FOR 122 GERDA, 217 EUDORA, 631 PHILLIPINA, 670 OTTEGEBE, AND 972 COHNIA

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Lightcurve observations have yielded period determinations for the following asteroids: 122 Gerda, 10.687±0.001hr; 217 Eudora, 25.253±0.003hr; 631 Phillipina, 5.899±0.001hr; 670 Ottegebe, 10.041±0.002hr; and 972 Cohnia, 18.472±0.004hr.

This article reports on asteroid photometry studies conducted at Altimira Observatory during 2005 and 2006. Altimira Observatory is located in southern California, and is equipped with a 0.28-m Schmidt-Cassegrain telescope (Celestron NexStar-11 operating at F/6.3), and CCD imager (ST-8XE NABG, with Johnson-Cousins filters). Details of the equipment and instrument characterization are available at the observatory's website (http://www.geocities.com/oca_bob). Supporting data were provided by Blauvac Observatory, located in southern France and equipped with a 310mm f/3.4 Newtonian telescope and Audine CCD imager. Results are summarized in the table below.

122 Gerda: Gil-Hutton (1993) reported a lightcurve period of 8.9hr based on two consecutive nights of photoelectric photometry that showed one definite brightness maximum and a poorly-defined secondary maximum. DiMartino et al. (1994) reported a period of 10.332hr. Altimira Observatory data from the present study is best fit using a period of 10.6875±0.001hr. The resulting lightcurve using the V-band data from Altimira Observatory is shown herein. Alternative periods near 8.9hr and 10.3hr were tested, but the fits (both subjectively, and based on RMS error) were poor. We judge the reported 10.6875hr as "provisional" because the photometry from Blauvac Observatory was discordant with that from Altimira, and the two data sets could not be successfully combined using this (or any other) period. R- and B-band lightcurves from Altimira show that the asteroid's color does not change (to within ±0.03 mag) as it rotates.

217 Eudora: Lagerkvist et al. (1998) reported a rotation period of 12.54hr based on three nights of photometry that provided a partial lightcurve, but did not include any definite maxima or minima. Asteroids whose rotation is nearly synchronous with the Earth's are difficult to deal with from a single observing station because each night provides a repetition of the previous night's portion of the lightcurve. By combining photometry from Altimira and Blauvac Observatories (which are separated by about 120 degrees of longitude) we were able to determine a reliable rotation period of 25.253±0.003hr. Examination of the B, V, and R-band curves from Altimira indicate that there is no change in the asteroid's color (within ±0.02 mag) as it rotates.

631 Phillipina: Behrend (2006) reports a reliable period of 5.9±0.005hr, from lightcurves gathered in 2001, 2002, and 2004. The lightcurve using data from Altimira Observatory during the 2006 apparition yields 5.899±0.001, in agreement with Behrend's results. Comparison of the V- and R-band lightcurves shows that the asteroid's color does not change (within ±0.03 mag).

670 Ottegebe: Kirkpatrick et al (2003) reported a period of 10.045hr based on a complete lightcurve from the 2003 apparition. Data from Altimira Observatory at the 2006 apparition confirms their result, with a period of 10.041±0.002hr.

972 Cohnia: Observations from Altimira Observatory indicate a period of 18.472±0.004hr. This is apparently the first lightcurve reported for this asteroid.

References

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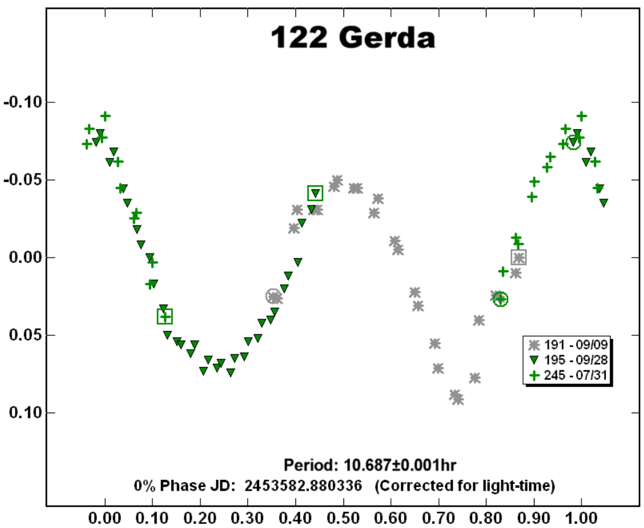
DiMartino, M., Blanco, C., Riccioli, D., De Santis, G. (1994). "Lightcurves and Rotation Periods of Nine Main-Belt Asteroids", *Icarus* **107**, 269-275.

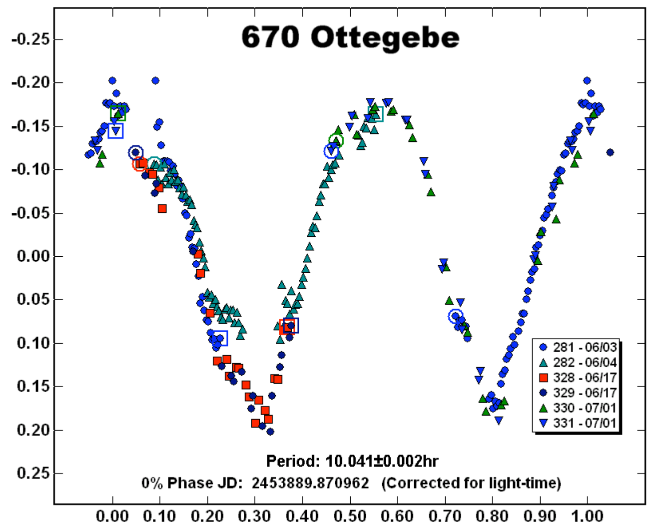
Gil-Hutton, R. (1993). "Photoelectric Photometry of Asteroids 58 Concordia, 12 Gerda, 326 Tamara, and 441 Bathilde". Rev Mexicana Astron. Astrof. **25**, 75-77.

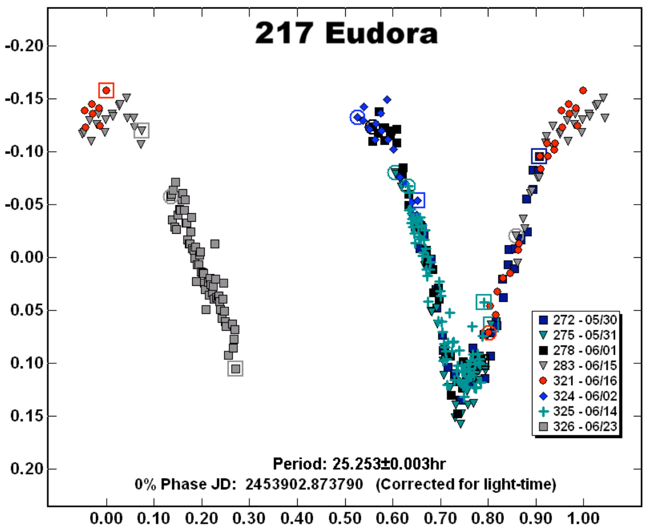
Kirkpatrick, E. et al. (2003). "Oakley Observatory Lightcurves of Asteroids 670 Ottegebe and 1035 Amata". *Minor Planet Bulletin* **30**, 41.

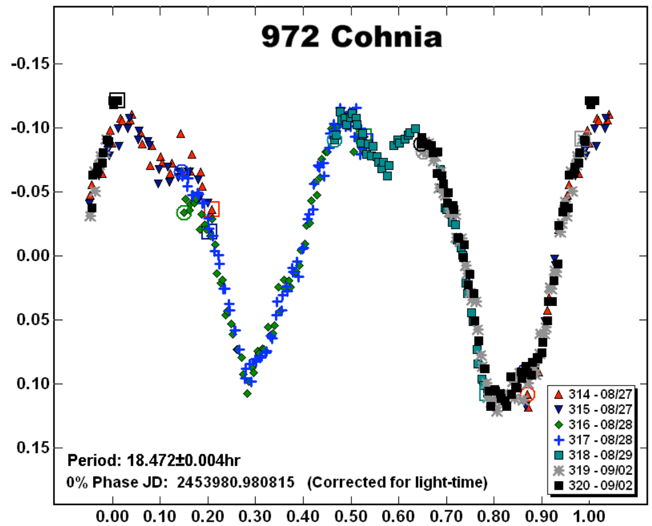
Lagerkvist, C.-I., Belskaya, I., Erikson A., Schevchenko V., Mottola S., Chiorny V., Magnusson P., Nathues A., Piironen, J. (1998). "Physical Studies of Asteroids XXXIII. The Spin-rate of M-type Asteroids", Astron. Astrophys Suppl Ser. **131**, 55-62.

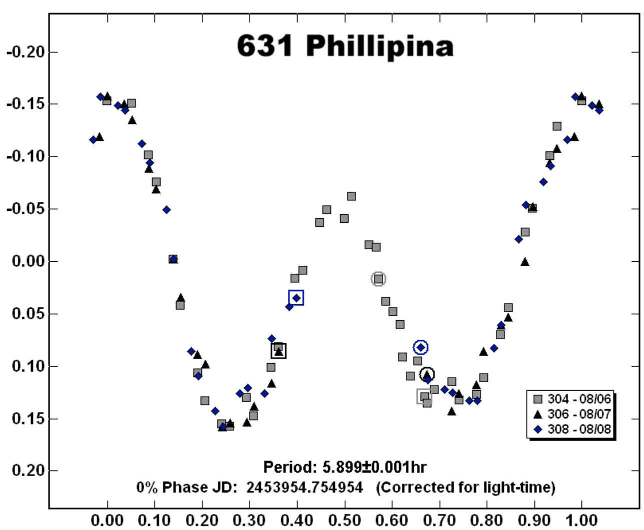
#	Name	Date Range	Phase	Filters	Period (hrs)	Amp (P-P)
122	Gerda	7/31 - 9/28/2005	11.6,0.2,7.2	BVR	10.687±0.001	0.16
217	Eudora	5/30 - 6/23/2006	7.7,15.0	BVRC	25.253±0.003	0.24
631	Phillipina	8/06 - 8/08/2006	9.0,9.1	VR	5.899±0.001	0.30
670	Ottegebe	6/03 - 7/02/2006	6.8,4.1,7.4	BVRC	10.041±0.002	0.35
972	Cohnia	8/27 - 9/02/2006	13.8, 11.7	VR	18.472±0.004	0.20











ASTEROID LIGHTCURVE PHOTOMETRY FROM SANTANA AND GMARS OBSERVATORIES – MID-2006

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(Received: 21 September)

Lightcurve period and amplitude results from Santana and GMARS Observatories are reported for 2006 July-September. 601 Nerthus (13.59±0.01 hours and 0.29 mag.); 685 Hermia (50.44±0.01 hours and 0.90 mag.); 2393 Suzuki (9.31 ± 0.01 hours and 0.40 mag.)

The author operates telescopes at two observatories. Santana Observatory is located in Rancho Cucamonga, California at an elevation of 400 meters and contains a Meade 0.3m RCX400 telescope. GMARS (Goat Mountain Astronomical Research Station) is located at the Riverside Astronomical Society's observing site at an elevation of 879 meters. The author's observatory at GMARS contains a Celestron 0.35m mounted on a Paramount from Software Bisque. All observations were obtained with an SBIG ST1001 CCD camera with the image scale of approximately 2.2 arcseconds per pixel at Santana Observatory and 2.4 arcseconds per pixel at GMARS. Further details of the equipment used can be found at the author's web site (http://members.dslextreme.com/users/rstephens/). Unless otherwise noted, all observations were obtained from Santana Observatory. The targets were chosen from the list of asteroid photometry opportunities published by Brian Warner and Alan Harris on the Collaborative Asteroid Lightcurve Link (CALL) website (Harris 2006). The images were measured and period analysis was done using the software program MPO Canopus which uses differential aperture photometry to determine the values used for analysis.

The results are summarized in the accompanying table. Column 2 gives the dates over which the observations were made, Column 3 gives the number of actual runs made during that time span and column 4 gives the number of observations used. Column 5 is the range of phase angles over the full data range. If there are three values in the column, this means the phase angle reached a minimum with the middle valued being the minimum. Columns 6 and 7 give the range of values for the Phase Angle Bisector (PAB) longitude and latitude respectively. Column 8 gives the period and column 9 gives the error in hours. Columns 10 and 11 give the amplitude and error in magnitudes.

685 Hermia. Observations were initially obtained with Santana's 0.3m telescope in suburban city skies. It became quickly apparent that this was a long period target whose period was nearly commensurate with 48 hours. Observations of critical minima's were obtained from GMARS on August 26, September 16, and 17.

Acknowledgements

Thanks are given to Dr. Alan Harris of the Space Science Institute, Boulder, CO, and Dr. Petr Pravec of the Astronomical Institute, Czech Republic, for their ongoing support of all amateur asteroid. Also, thanks to Brian Warner for his continuing work and enhancements to the software program "Canopus" which makes it possible for amateur astronomers to analyze and collaborate on asteroid rotational period projects and for maintaining the CALL Web site which helps coordinate collaborative projects between amateur astronomers.

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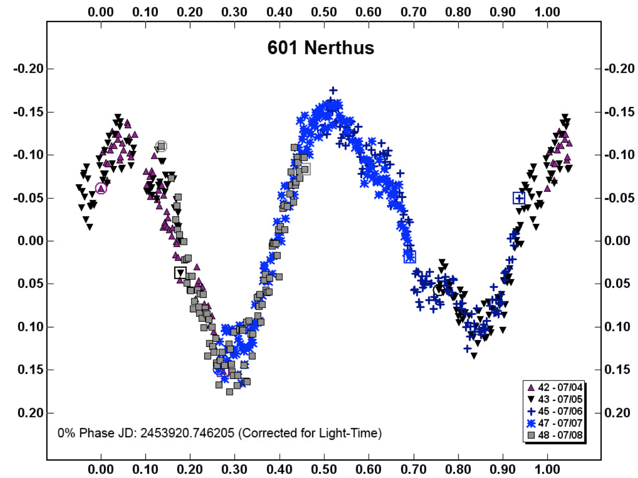

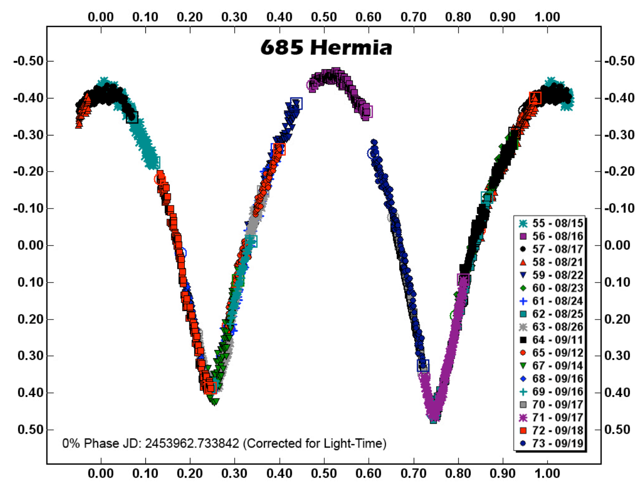

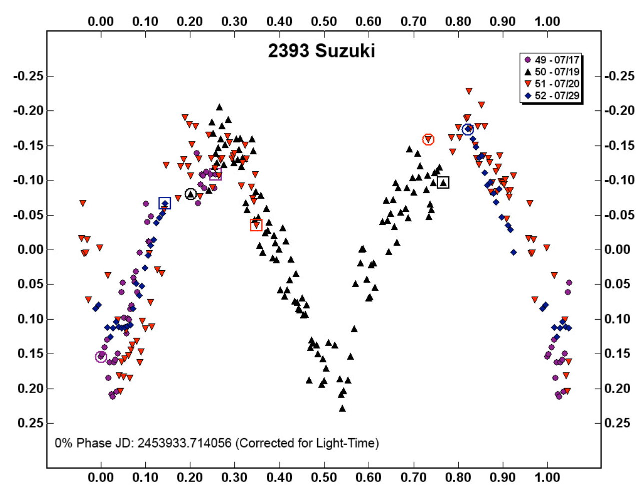

Asteroid	Dates	Sess	# Points	Phase	L_{PAB}	B_{PAB}	Per (h)	PE	Amp	AE
601 Nerthus	2006 07/04 – 08	5	599	10.6, 9.6	302.4, 302.5	15.9, 15.8	13.59	0.01	0.29	0.03
685 Hermia	2006 08/15 – 09/19	16	2,495	15.0, 8.5	341.3, 345.4	5.6, 5.2	50.44	0.01	0.90	0.03
2393 Suzuki	2006 07/17 – 29	4	291	8.0, 7.1	306.2, 306.3	12.9, 13.0	9.31	0.01	0.40	0.03

ASTERIOD LIGHTCURVE ANALYSIS AT HUNTERS HILL OBSERVATORY AND COLLABORATING STATIONS – JUNE-SEPTEMBER 2006

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Lightcurves for the following asteroids were obtained at Hunters Hill Observatory and collaborating stations resulting in period and amplitude determinations: 894 Erda, 1273 Helma, 1293 Sonja, (6409) 1992 MJ, 2510 Shandong, 3913 Chemin, (6406) 1992 MJ, 7168 Linda, 11574 d'Alviella, 13070 Seanconnery, (20452) 1999 KG4, (40559) 1999 RO118, (45263) 2000 AD5 and (108846) 2001 OW91.

Hunters Hill Observatory is equipped as described in Higgins (2005). All observations for this paper were made using a Clear filter with guided exposure times ranging from 120 seconds to 240 seconds. MaxIm DL/CCD, driven by ACP4, was used for telescope and camera control whilst calibration and image measurements were undertaken by MPO Canopus version 9.

Linhaceira Observatory is located in the center of Portugal and is equipped with a 0.35m SCT (Celestron C14) and Starlight Xpress MX916 CCD at f/8.055. A Meade LX200 0.25m SCT fitted with an Audine CCD (Kaf0400) CCD at f/6.73 is used for guiding. All images were collected unfiltered and pre-processed with bias, dark and flat-field frames. Image measurement was undertaken with MPO Canopus.

Targets were chosen either from the CALL list provided by Warner (2006) or from Binary Asteroid Photometric Survey list provided by Pravec (2005a). Results are summarised in the table below with the individual plots presented at the end. Additional comment, where appropriate, is provided. Binary candidates and collaborative targets for which Hunters Hill was not the principal observer are not included. Binary candidates will be reported separately by the Binary Asteroid Photometric Survey Principal Investigator, Dr Petr Pravec. The strategy is to work objects carefully for potential deviations that would indicate the presence of a satellite. Considerable effort was made to identify and eliminate sources of observational errors that might corrupt the observations and lead to false attenuation events. It was particularly important to identify and eliminate data points affected by faint background stars, bad pixels, and cosmic ray hits.

894 Erda. This asteroid was chosen from the CALL list as its known period was rated 2. Interestingly, all previous observations of this target have resulted in very low amplitude (0.08 mag) lightcurves. In this apparition the amplitude has extended to 0.27 mag. In the 2001 observations of Szekely (2005), potential indications of an occulting event were observed. No such indications were noted in the current data. Previously derived periods of 4.69±0.01hrs by Szekely (2005) and Stephens (2002) are in agreement with our results.

7169 Linda. This asteroid has a long synodic rotation period. The figure provided represents a best fit of the data. No minima or maxima were captured on any single night and each night either represented a flat plot or a continuous increase over the entire session. As each session exceeded 7 hours in duration, the minimum possible period for this target is 28 hours. The plot presented for 7169 represents the half-period of 42 hours and is provided for indicative purposes only.

11574 d'Alviella. The asteroid was also observed by Simeiz Observatory. However, their data were not included here as they did not impact on the solution in any way. Unfortunately the data were insufficient to rule out a double period of 25.10 hrs even with Simeiz's data as analysed by Dr Petr Pravec of the Astronomical Institute, Czech Republic.

13070 Seanconnery. This asteroid was also observed on 4 nights by Linhaceira Observatory. Goncalves used the Audine CCD for session 1 and his MX916 CCD for the last 3 sessions.

(40559) 1999 RO118. This target appeared in the same images as 7169 Linda on 19 August 2006. Measurements were taken from the single night only as the object was too faint to warrant further follow-up.

(108846) 2001 OW91. This target appeared in the same images as 11574 d"Alviella on 04 July 2006 BINAST target. Measurements were taken from the single night only as the object was too faint to warrant further follow-up.

#	Name	Date Range	Sess	Period Hrs	P.E.	Amp Mag.
894	Erda	12Jun-24Jun06	4	4.6897	0.0003	0.27
1273	Helma	26Jul-04Aug06	3	6.0851	0.0006	0.32
1293	Sonja	24Jun-25Jun06	2	2.878	0.001	0.21
2510	Shandong	28Aug-04Sep06	4	3.4963	0.0003	0.49
3913	Chemin	26Aug-12Sep06	6	3.4077	0.0004	0.17
6406	1992 MJ	26Jun-28Jun06	3	6.819	0.002	1.10
7169	Linda	05Aug-19Aug06	5	> 28	na	na
11574	d'Alviella	29Jun-26Jul06	8	12.549	0.003	0.15
13070	Seanconnery	20Aug-30Aug06	9	7.085	0.001	0.18
20452	1999 KG4	26Jun-28Jun06	3	3.849	0.002	0.34
40559	1999 RO118	19Aug-19Aug06	1	4.81	0.08	0.30
45263	2000 AD5	28Aug-30Aug06	3	14.18	0.02	0.60
108846	2001 OW91	04Jul-04Jul06	1	2.99	0.03	0.45

Acknowledgements

The SBIG ST-8E used by Hunters Hill was funded by The Planetary Society under the 2005 Gene Shoemaker NEO Grants program. Thanks go to Brian D. Warner for his continued development and support for the data analysis software, MPO Canopus v9 and in particular his development of StarBGone which has enabled me to gather data even in the presence of interfering background stars.

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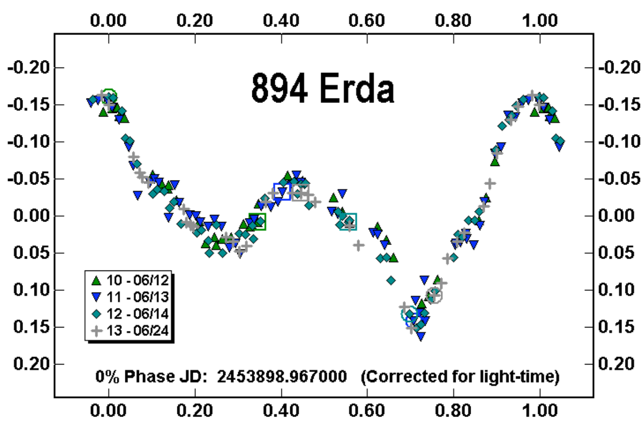

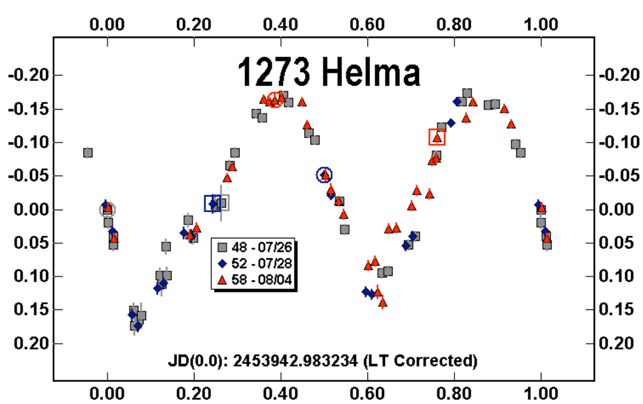

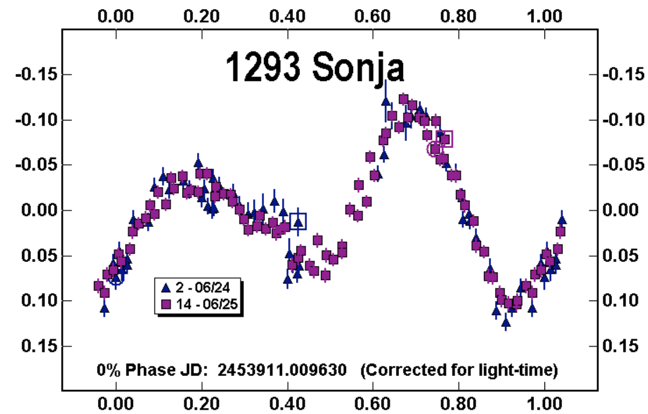

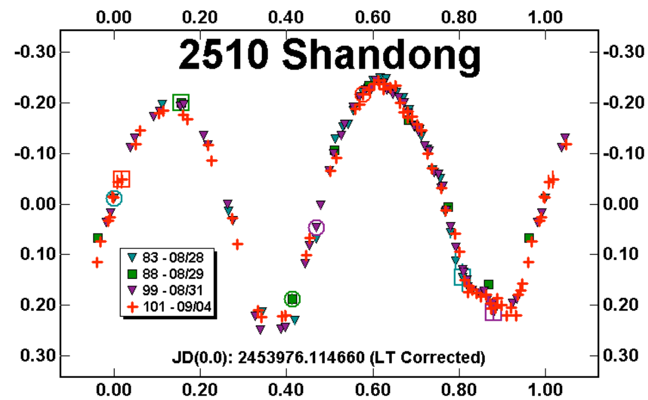

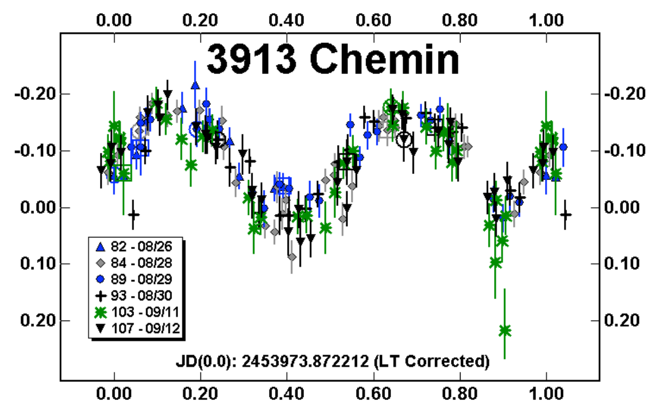

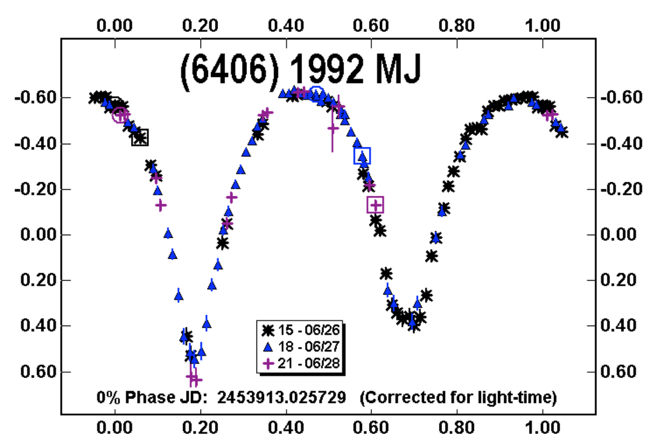

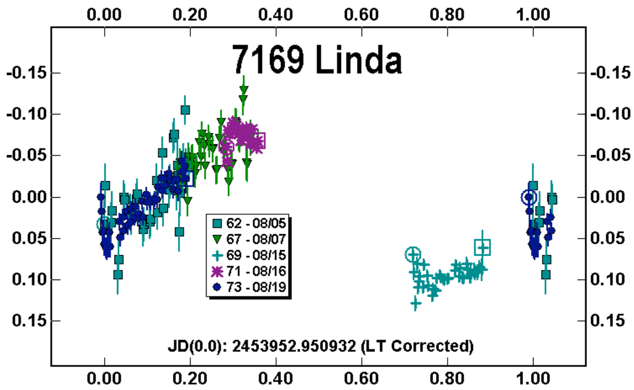
7169 Linda
62 - 08/05
67 - 08/07
69 - 08/15
71 - 08/16
73 - 08/19
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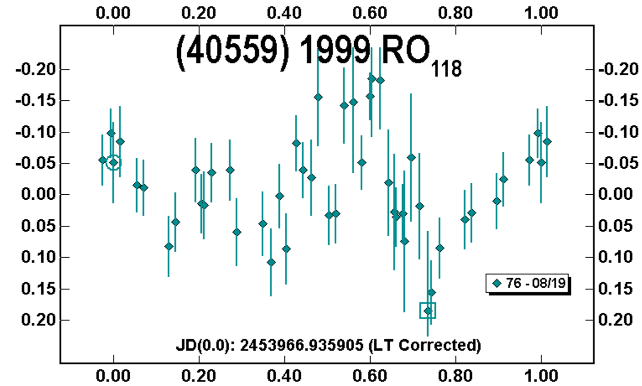
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76 - 08/19
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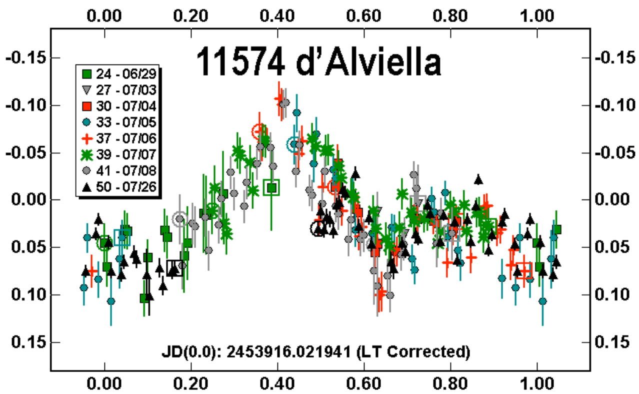
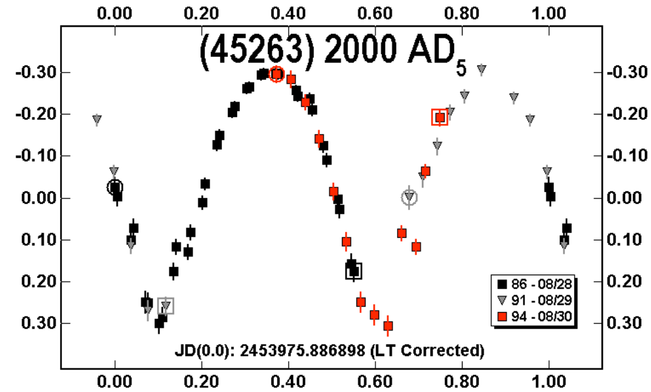

11574 d'Alviella
24 - 06/29
27 - 07/03
30 - 07/04
33 - 07/05
37 - 07/06
39 - 07/07
41 - 07/08
50 - 07/26
JD(0.0): 2453916.021941 (LT Corrected)


(45263) 2000 AD5
86 - 08/28
91 - 08/29
94 - 08/30
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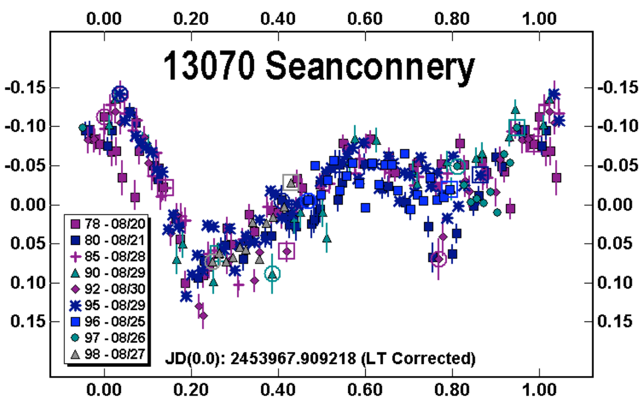
13070 Seanconnery
78 - 08/20
80 - 08/21
85 - 08/28
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96 - 08/25
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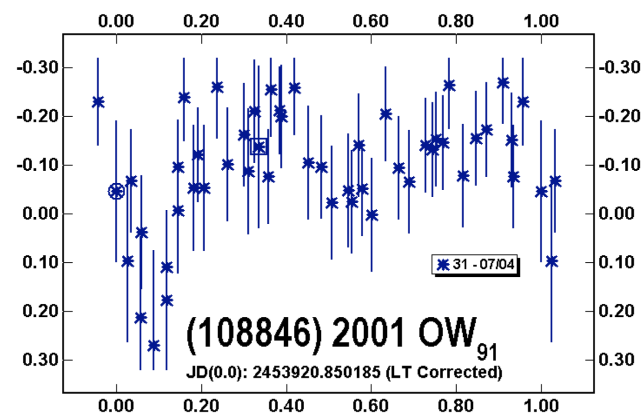
31 - 07/04
(108846) 2001 OW91
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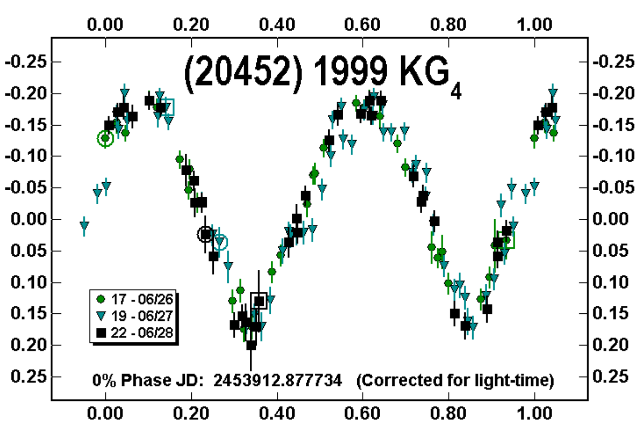
(20452) 1999 KG4
17 - 06/26
19 - 06/27
22 - 06/28
0% Phase JD: 2453912.877734 (Corrected for light-time)

LIGHTCURVE RESULTS FOR 1318 NERINA, 2222 LERMONTOV, 3015 CANDY, 3089 OUJIANQUAN, 3155 LEE, 6410 FUJIWARA, 6500 KODAIRA, (8290) 1992 NP, 9566 RYKHLOVA, (42923) 1999 SR18, AND 2001 FY

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Lightcurve period and amplitude results for 10 minor planets are presented. The observations were made at 3 locations: the Montgomery College Observatory, Chiro Observatory, and the Rosemary Hill Observatory. (1318) Nerina: 2.536±0.001hr, 0.16±0.02 mag. (2222) Lermontov: 4.344±0.001hr, 0.58±0.01 mag. (3015) Candy: 4.265±0.001hr, 1.05±0.01 mag. (3089) Oujianquan: 11.198±0.003hr, 0.45±0.05 mag. (3155) Lee: 8.36±0.01hr, 0.4±0.1 mag. (6410) Fujiwara: 7.008±0.001hr, 0.80±0.02 mag. (6500) Kodaira: 5.496±0.009hr, 0.80±0.02 mag. (8290) 1992 NP: 4.453±0.001hr, 0.58±0.02 mag. (9566) Rykhlova: 8.800±0.001hr, 0.95±0.02 mag. (42923) 1999 SR18: 8.392±0.001hr, 1.38±0.05 mag. 2001 FY: 5.207±0.005hr, 0.45±0.05 mag. Also reported are indefinite period results for four objects in the hope that they may be useful for future observers: 1110 Jaroslawa, 1720 Neils, 3872 Akirafuji, and 6790 Pingouin.

Montgomery College Observatory is situated on the campus of Montgomery Community College in Rockville, Maryland. The main instrument is a 40cm SCT with SBIG ST-9E and f/6.3 focal reducer. A second instrument used was a 10" f/6.3 SCT with an SBIG ST-8XE. Rosemary Hill Observatory, is situated near Bronsen, FL and is owned and operated by the University of Florida, Gainesville. Two telescope/camera setups were used. The first being a 76cm Newtonian with SBIG ST-9E while the second was a 46cm Ritchey-Chretien with SBIG ST-8E. Chiro Observatory is a private observatory owned by Akira Fuji near Yerecion in Western Australia. The main instrument is a 300mm f/6 Newtonian. An SBIG ST-9XE was used with this telescope. At all observatories, ST-9 images were binned 1x1, while ST-8 images were binned 2x2. All images were unfiltered and were reduced with dark frames and sky flats.

For the most part, the asteroids observed were chosen from the Collaborative Asteroid Lightcurve Link (CALL) home page that is maintained by Brian Warner. Image analysis was accomplished using differential aperture photometry with MPO Canopus. Period analysis was also done in Canopus, which implements the algorithm developed by Alan Harris (Harris et al. 1989). Differential magnitudes were calculated using reference stars from the USNO-A 2.0 catalog and the UCAC2 catalog. Results are summarized in the table below, and the lightcurve plots are presented at the end of the paper. The data and curves are presented without additional comment except were circumstances warrant. Column 3 gives the range of dates of observations and column 5 gives the number of nights on which observations were undertaken.

1110 Jaroslawa. Observations were made on 4 nights between June 21 and 29. The results could be fit into a single-peak period of 9.408 hours. Attempts to fit the data to a double peak period were inconclusive since considerable sections of the lightcurve were missed since a period of around 18 hours was such a simple fraction of a day.

1318 Nerina. Observations on two nights, two weeks apart resulted in a period of 2.536 hours. A third night of data was obtained 9 nights later under adverse conditions. Although noisy, this data supported that somewhat asymmetric lightcurve.

1720 Neils. Although observations were made on four nights, the duration for each night was never more than 4.5 hours. This duration, combined with a single-peak period of close to 10 hours, allowed only a small lightcurve portion to be covered each night. The accompanying lightcurve is based on a single peak that best fit the data and is submitted only as a guide for future observations.

3089 Oujianquan. Observations of this asteroid were made on six nights, however each night's run was less than 4 hours duration. As a result each night covered only a portion of the lightcurve. The accompanying lightcurve is a good fit to the data, however, in view of the limited duration of each observing run, it still has some uncertainty associated with it.

3155 Lee. This asteroid was observed on two nights when it was in the field of 6410. On analyzing the data, it was very difficult to fit a good period, until I came across a report by Warner (2003). Warner described a similar problem with this asteroid until advised by Dr. W. Ryan that this asteroid had 4 minima and maxima per period. Reanalyzing my data for this, yielded a period very similar to that found by Warner. 8.358 hours against

#	Name	Date Range	Obs	Sess	Per (h)	Err	Amp	Err
1110	Jaroslawa	Jun 21 - Jun 29, 2004	MCO	4	9.41?	0.01	0.16	0.02
1318	Nerina	Feb 26 - Mar 23, 2004	MCO	3	2.536	0.001	0.16	0.02
1720	Neils	Dec 23 - Dec 30, 2005	RHO	4	9.976	-	0.15	0.03
2222	Lermontov	Dec 23 - Dec 25, 2005	RHO	3	4.344	0.001	0.58	0.01
3015	Candy	Dec 22 - Dec 29, 2005	RHO	5	4.625	0.001	1.05	0.01
3089	Oujianquan	Jun 4 - Jun 29, 2004	MCO	6	11.198	0.003	0.45	0.05
3155	Lee	Aug 3 - Aug 4, 2005	Chiro	2	8.36	0.01	0.4	0.1
3872	Akirafuji	Jul 30 - Aug 6, 2005	Chiro	7	10.635	-	0.8	0.3
6410	Fujiwara	Jul 30 - Aug 13, 2005	Chiro	6	7.008	0.001	0.80	0.02
6500	Kodaira	Oct 2, 2005	MCO	1	5.496	0.009	0.80	0.02
6790	Pingouin	Jul 3 - Jul 10, 2005	Chiro	2	6.380	0.009	0.60	0.05
8290	1992 NP	Sep 4 - Sep 11, 2005	MCO	3	4.453	0.001	0.58	0.02
9566	Rykhlova	Sep 4 - Oct 2, 2005	MCO	4	8.800	0.001	0.95	0.02
42923	1999 SR18	May 8 - May 29, 2005	MCO	5	8.392	0.001	1.38	0.05
	2001 FY	Jul 30 - Aug 4, 2005	Chiro	4	5.207	0.005	0.45	0.05

Warner's 8.312. However, although the periods were very similar, both of my nights observations showed a very deep minimum near 0.56 phase, which is absent from Warner's data. I am uncertain what to make of this difference.

3872 Akirafuji. The reason for observing this asteroid was because it is named after the owner of the Chiro observatory. Observations of this asteroid were made on 7 nights. However each session was rather short due to the position of the asteroid low in the western sky. Due to this short duration, each session covered only a portion of the lightcurve. The best fit of the data came using a single peak and a period of 5.321 hours. A solution using a double peak could be made at 10.635 hours with a slightly less good fit.

6790 Pingouin. Observations of this asteroid were made on only two nights, each less than 6 hours. A period of a little over 6 hours with a single peak could be derived from the data, however this is more than a little uncertain.

Acknowledgments

I would like to thank Dr John Oliver at the University of Florida at Gainesville for access to the Rosemary Hill Observatory, Lance Taylor and Akira Fujii for access to the Chiro Observatory, and Brian Warner for all of his work with the program MPO Canopus.

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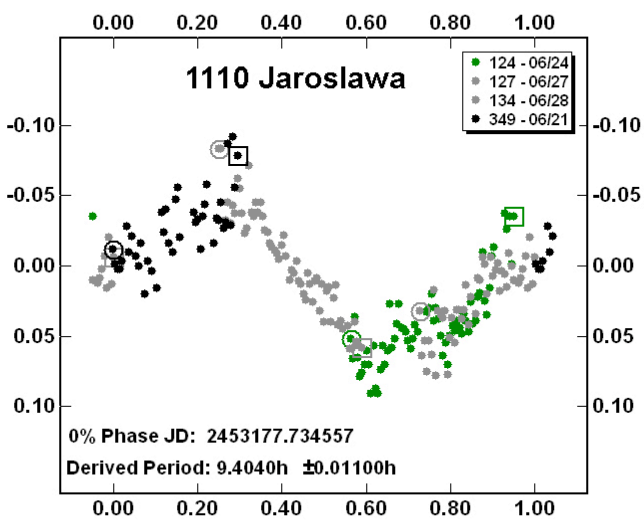
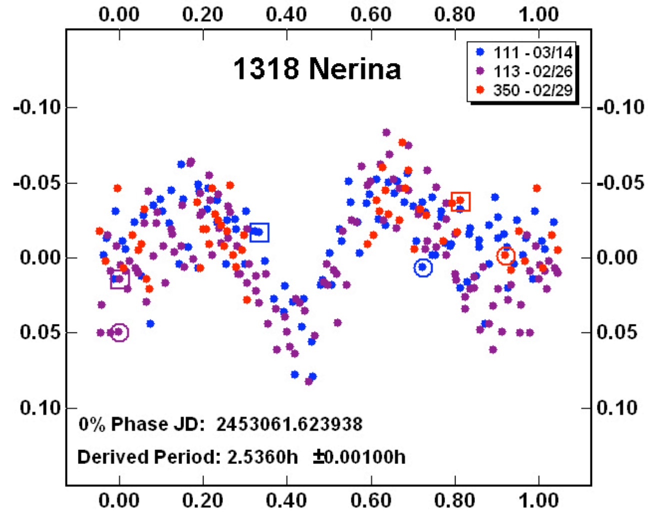
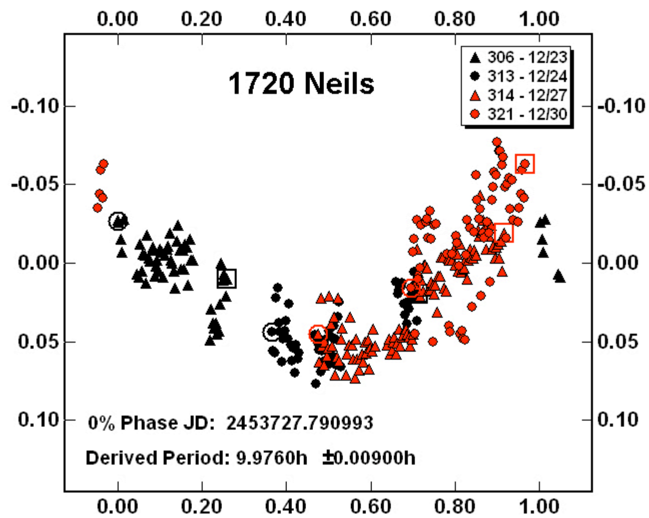
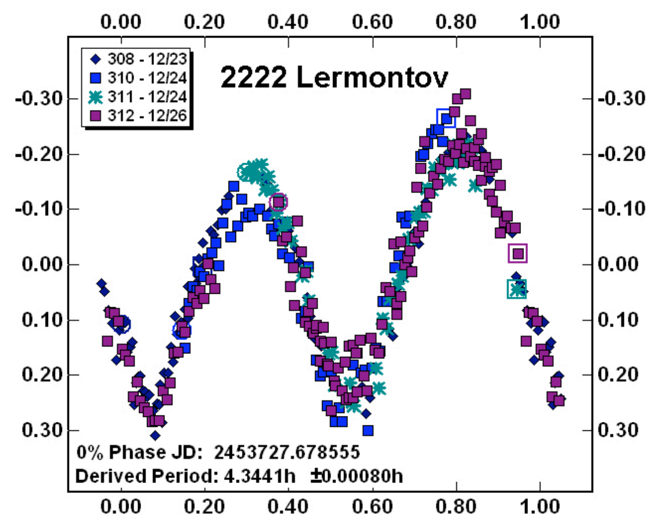
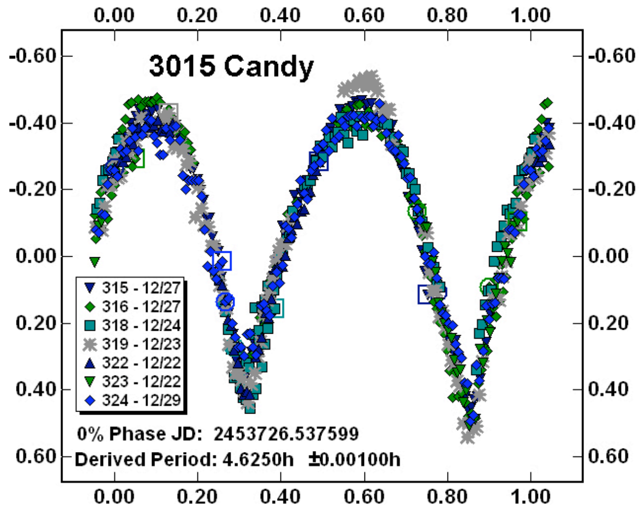
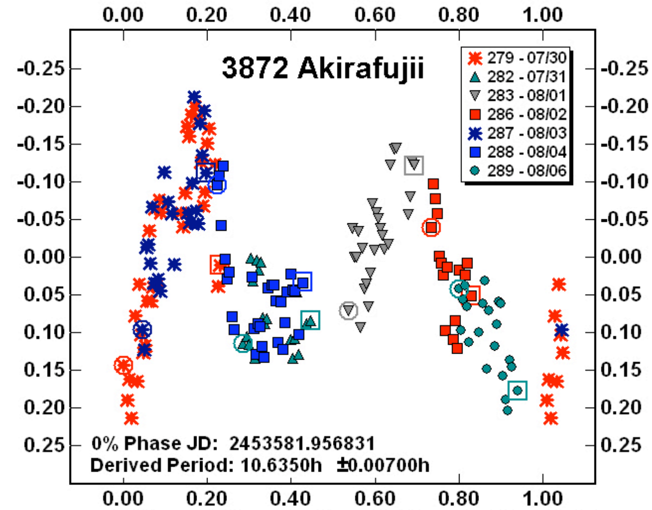


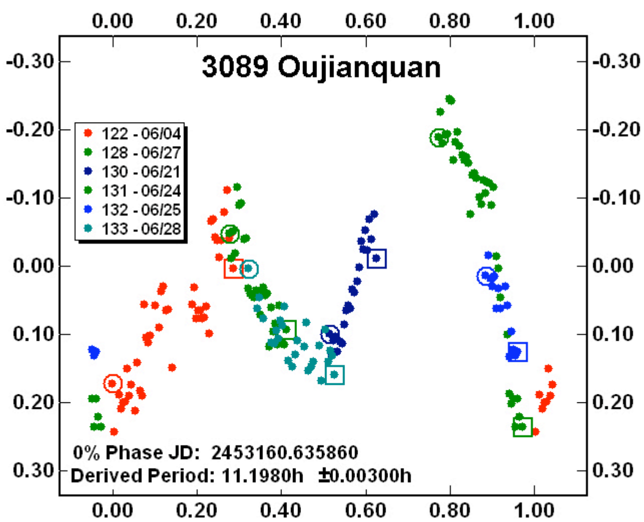







3015 Candy
315 - 12/27
316 - 12/27
318 - 12/24
319 - 12/23
322 - 12/22
323 - 12/22
324 - 12/29
0% Phase JD: 2453726.537599
Derived Period: 4.6250h ±0.00100h


3872 Akirafujii
279 - 07/30
282 - 07/31
283 - 08/01
286 - 08/02
287 - 08/03
288 - 08/04
289 - 08/06
0% Phase JD: 2453581.956831
Derived Period: 10.6350h ±0.00700h


3089 Oujianquan
122 - 06/04
128 - 06/27
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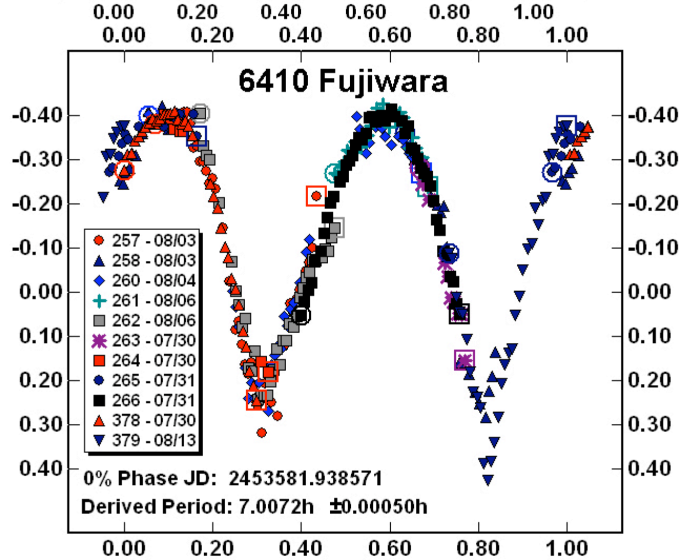
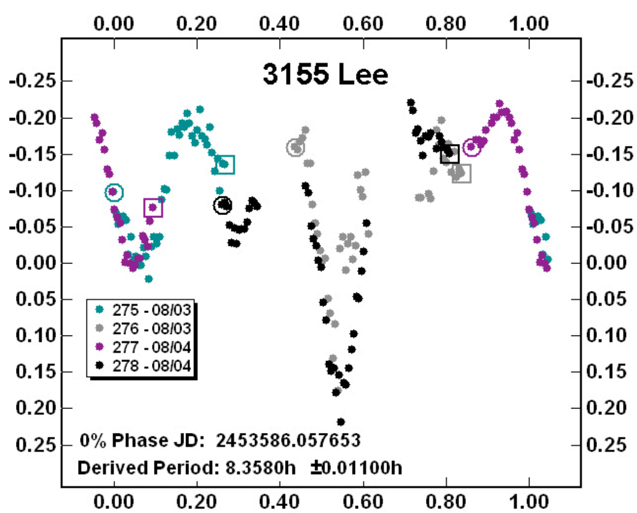
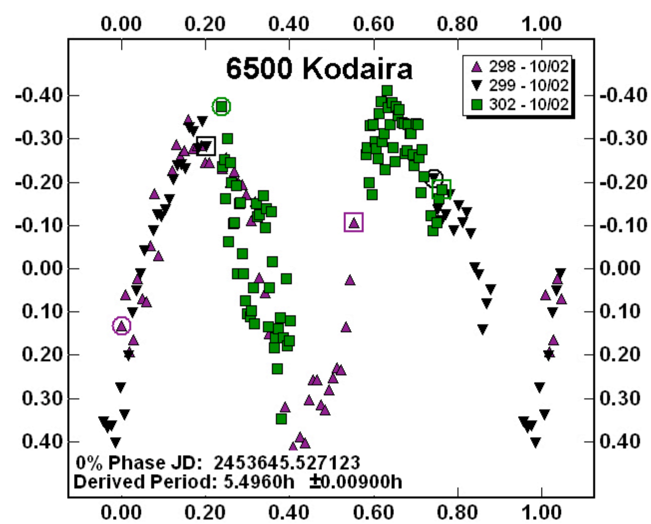
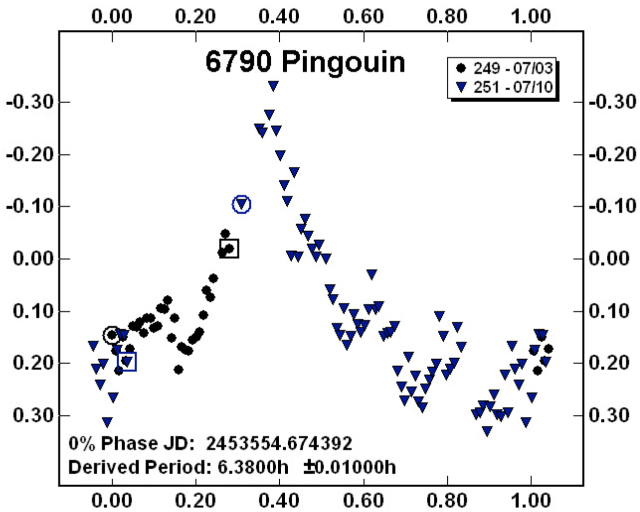
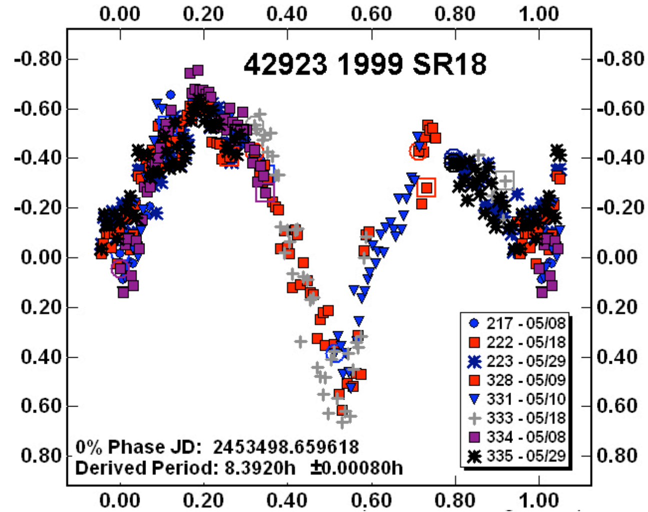
131 - 06/24
132 - 06/25
133 - 06/28
0% Phase JD: 2453160.635860
Derived Period: 11.1980h ±0.00300h

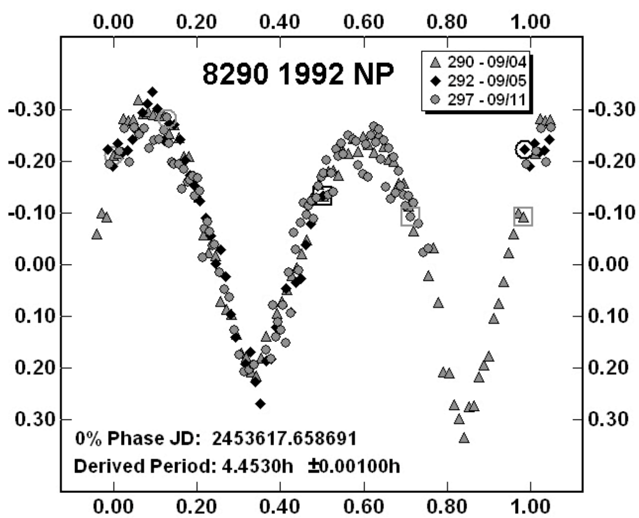

6410 Fujiwara
257 - 08/03
258 - 08/03
260 - 08/04
261 - 08/06
262 - 08/06
263 - 07/30
264 - 07/30
265 - 07/31
266 - 07/31
378 - 07/30
379 - 08/13
0% Phase JD: 2453581.938571
Derived Period: 7.0072h ±0.00050h

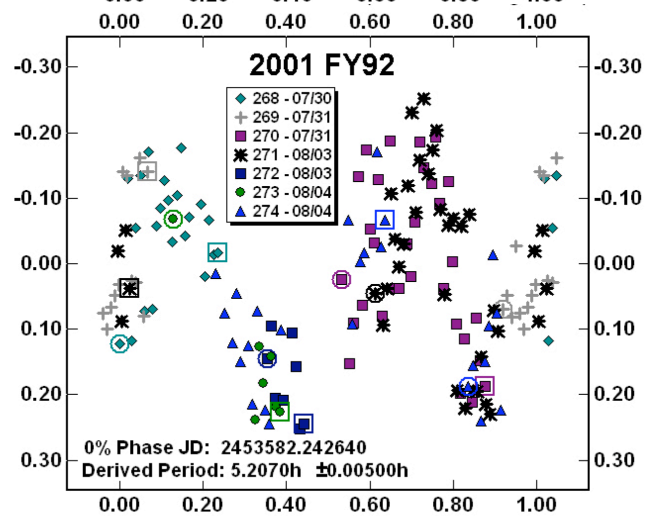

3155 Lee
275 - 08/03
276 - 08/03
277 - 08/04
278 - 08/04
0% Phase JD: 2453586.057653
Derived Period: 8.3580h ±0.01100h

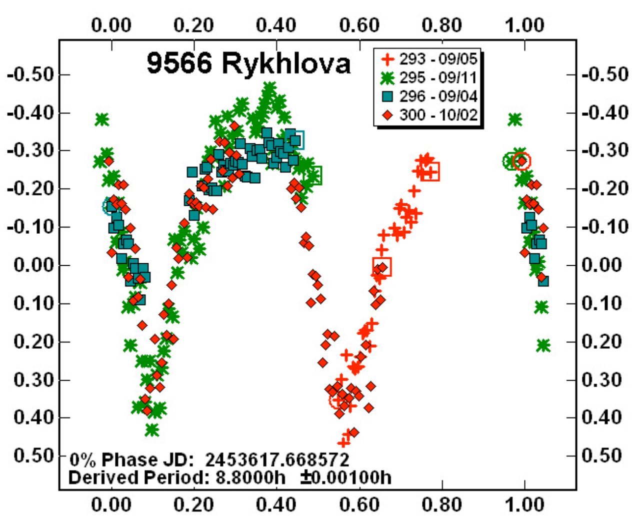

6500 Kodaira
298 - 10/02
299 - 10/02
302 - 10/02
0% Phase JD: 2453645.527123
Derived Period: 5.4960h ±0.00900h


6790 Pingouin
249 - 07/03
251 - 07/10
0% Phase JD: 2453554.674392
Derived Period: 6.3800h ±0.01000h


42923 1999 SR18
217 - 05/08
222 - 05/18
223 - 05/29
328 - 05/09
331 - 05/10
333 - 05/18
334 - 05/08
335 - 05/29
0% Phase JD: 2453498.659618
Derived Period: 8.3920h ±0.00080h


8290 1992 NP
290 - 09/04
292 - 09/05
297 - 09/11
0% Phase JD: 2453617.658691
Derived Period: 4.4530h ±0.00100h


2001 FY92
268 - 07/30
269 - 07/31
270 - 07/31
271 - 08/03
272 - 08/03
273 - 08/04
274 - 08/04
0% Phase JD: 2453582.242640
Derived Period: 5.2070h ±0.00500h


9566 Rykhlova
293 - 09/05
295 - 09/11
296 - 09/04
300 - 10/02
0% Phase JD: 2453617.668572
Derived Period: 8.8000h ±0.00100h

THE LIGHTCURVE OF 2131 MAYALL IN 2006

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(Received: 1 October)

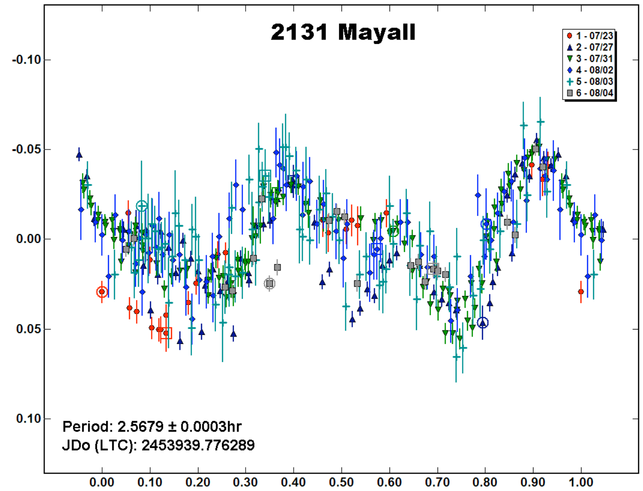
2131 Mayall was previously observed by Warner as part of an ongoing study at the Palmer Divide Observatory of the Hungaria group and family. Observations were made again in mid-2006 in order to add to the data set for the asteroid, the aim being eventually to derive a spin axis and shape model. The size and previously found rotation period, ~8km and 2.5hr, also made the asteroid a potential binary candidate. The data from 2006 did not show any signs of occultation or eclipse events that would indicate the asteroid is binary.

The Hungaria research program at the Palmer Divide Observatory aims not only to determine the rotation rates for as many of the group's members as possible but also to obtain lightcurves from a number of apparitions in order to facilitate spin axis and shape modeling (e.g., Kaasalainen 2001a, 2001b). It was for the latter reason that observations of 2131 Mayall were started in late July 2006 at the PDO.

Phasing the data obtained on July 23, 27, and 31 to the period of 2.572hr found previously by Warner (2005), showed that the shape of the curve was somewhat different from the one obtained in 2005. The data were sent to Pravec for his analysis, who suggested additional observations with less time between runs to clarify differences in the synodic periods between the 2005 and 2006 apparitions. Because of bad weather prospects at PDO, Stephens and Higgins were asked to observe the asteroid and so joined the observing campaign (see table below).

Warner	July 23, 27, 31	0.35m SCT, FLI-1001E
Stephens	Aug. 2, 3	0.35m SCT, STL-1001E
Higgins	Aug. 4	0.35m SCT, ST-8E

More than 360 data points were obtained and analyzed for a final result of a synodic period of 2.5679±0.0003hr and amplitude of 0.09±0.02mag. This compares to a period of 2.572±0.002hr and 0.08mag amplitude reported for the 2005 apparition. It should be noted that the Phase Angle Bisector longitude differed by about 200° between the two apparitions and the latitude by only 4°. Observations with PAB longitudes at nearly right angles to these apparitions would aid spin and shape modeling considerably (as would the availability of a calibrated sparse data set with observations covering a good part of the asteroid's orbit.)



Acknowledgements

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Warner, B.D. (2005). *Minor Planet Bulletin* **32**, 54-58.

LIGHTCURVE PHOTOMETRY OPPORTUNITIES JANUARY – MARCH 2007

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We present here four lists of “targets of opportunity” for the period 2007 January – March. The first list is those asteroids reaching a favorable apparition, are <15m at brightest, and have either no or poorly constrained lightcurve parameters. By “favorable” we mean the asteroid is unusually brighter than at other times. In many cases, a favorable apparition may not come again for many years. The goal for these asteroids is to find a well-determined rotation rate, if at all possible. Don’t hesitate to solicit help from other observers at widely spread longitudes should the initial finding for the period indicated that it will be difficult for a single station to find the period.

The Low Phase Angle list includes asteroids that reach very low phase angles. Getting accurate, calibrated measurements (usually V band) at or very near the day of opposition can provide important information for those studying the “opposition effect”, which is when objects near opposition brighten more than simple geometry would predict.

The third list is of those asteroids needing only a small number of lightcurves to allow Kaasalainen and others to complete a shape model. Some of the asteroids have been on the list for some time, so work on them is strongly encouraged in order to allow models to be completed. For these objects, we encourage you to do absolute photometry, meaning that the observations are not differential but absolute values put onto a standard system, such as Johnson V. If this is not possible or practical, accurate relative photometry is also permissible. This is where all differential values are against a calibrated zero point that is not necessarily on a standard system.

Keep in mind that as new large surveys, e.g., Pan-STARRS, come on line and start producing data, individual lightcurves obtained by smaller observatories will become even more important – especially if the data are reduced to a standard system. Observers should not see the surveys as competition but as a means to obtaining the ever needed “more data” and the opportunity to make new discoveries.

The fourth list gives a brief ephemeris for planned radar targets. Supporting optical observations made to determine the lightcurve’s period, amplitude, and shape are needed to supplement the radar data. Reducing to standard magnitudes is not required but high precision work usually is, i.e., on the order of 0.01-0.03mag. A *geocentric* ephemeris is given for when the asteroid is brighter than 16.0. The date range may not always coincide with the dates of planned radar observations, which – for Arecibo – are limited to a relatively narrow band of declinations.

Those obtaining lightcurves in support of radar observations should contact Dr. Benner directly at the email given above. There are two web sites of particular interest for coordinate radar and optical observations. Future targets (up to 2010) can be found at *http://echo.jpl.nasa.gov/~lance/future.radar.nea.periods.html*. Past radar targets, for comparison to new data, can be found at *http://echo.jpl.nasa.gov/~lance/radar.nea.periods.html*.

Once you have data and have analyzed them, it’s important that you publish your results, if not part of a pro-am collaboration, then in the *Minor Planet Bulletin*. It’s also important to make the data available at least on a personal website or upon request.

Note that the lightcurve amplitude in the tables could be more, or less, than what’s given. Use the listing as a guide and double-check your work. Also, if the date is '1 01. ' or '12 31. ', i.e., there is no value after the decimal, it means that the asteroid reaches its brightest just as the year begins (it gets dimmer all year) or it reaches its brightest at the end of the year (it gets brighter all year).

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<u>Lightcurve Opportunities</u>

#	Name	Brightest Date	Brightest Mag	Brightest Dec	U	Harris Data Period	Harris Data Amplitude
4421	Kayor	1 03.5	14.7	+26	0		
865	Zubaida	1 04.6	14.1	- 2	0		
34777	2001 QO252	1 04.0	13.5	+27	0		
1579	Herrick	1 05.2	14.9	+10	0		
8532	Mineosaito	1 06.4	14.7	+29	0		
1502	Arenda	1 06.8	14.7	+16	0		
6771	Fugate	1 09.1	15.0	+24	0		
5288	Heishu	1 09.1	14.5	+17	0		
1940	Whipple	1 10.0	14.8	+18	0		
5824	Oryo	1 11.3	15.0	+25	0		
34704	2001 OD22	1 16.2	14.8	+18	0		
13006	1982 RR	1 23.9	14.9	+12	0		
372	Palma	1 23.2	10.4	+37	2	8.591	0.10-0.16
741	Botolphia	1 24.1	13.6	+24	1	16.	0.4
4540	Oriani	1 25.9	14.7	+10	0		
525	Adelaide	1 25.1	14.6	+ 8	0		
78	Diana	1 25.7	10.2	+27	2	7.225	0.02-0.14
2212	Hephaistos	1 26.1	14.8	+50	1	>20.	0.08-0.11
2776	Baikal	1 27.0	14.3	+11	0		
1911	Schubart	1 29.4	14.6	+17	?		
2086	Newell	1 30.1	14.7	+17	0		
1624	Rabe	2 01.9	14.9	+17	0		
2472	Bradman	2 02.0	15.0	+22	0		
1228	Scabiosa	2 03.8	14.8	+16	0		
6136	Billowen	2 06.9	15.0	+16	0		
242	Kriemhild	2 06.1	12.6	- 1	2	4.543	0.08
2137	Priscilla	2 09.0	15.0	+15	0		
7341	1991 UA2	2 14.7	15.0	-42	0		
856	Backlunda	2 16.3	13.3	+21	2	12.08	0.29
1698	Christophe	2 17.7	14.9	+14	0		
5448	Lallement	2 17.1	14.3	+11	0		
4452	Ullacharles	2 18.9	14.7	+ 9	0		
5129	Wakabayashi	2 19.3	14.7	+ 6	0		
1489	Attila	2 23.3	14.6	+10	0		

Lightcurve Opportunities (continued)

#	Name	Brightest Date	Mag	Dec	U	Harris Data Period	Amplitude
2167	Erin	2 24.3	14.3	- 1	2	7.0	0.3
3410	Vereshchagin	3 03.1	14.9	+ 7	0		
1602	Indiana	3 06.0	14.4	+13	0		
2521	Heidi	3 06.5	15.0	- 5	0		
1218	Aster	3 07.6	14.8	+11	0		
5556	Wimberly	3 10.1	14.8	+ 4	0		
4374	Tadamori	3 11.5	14.4	+ 7	0		
912	Maritima	3 14.0	12.2	+20	2	48.43	>0.11
1696	Nurmela	3 15.4	14.8	+ 7	0		
2658	Gingerich	3 17.4	15.0	- 8	0		
162	Laurentia	3 21.3	12.0	+ 5	2	11.87	0.28
1907	Rudneva	3 25.3	14.7	+ 1	2	45.	>0.1
4570	Runcorn	3 26.1	14.5	- 5	0		
99	Dike	3 29.8	12.2	+11	2	10.35	0.1 -0.25

Low Phase Angle Opportunities

#	Name	Date	PhA	V	Dec
498	Tokio	01 02.6	0.38	12.7	+24
140	Siwa	01 11.0	0.07	12.8	+22
317	Roxane	01 11.7	0.79	12.8	+20
100	Hekate	01 12.6	0.66	12.6	+19
92	Undina	01 13.5	0.79	11.3	+24
559	Nanon	01 15.6	0.27	13.0	+22
655	Briseis	01 24.4	0.38	13.4	+18
387	Aquitania	01 24.6	0.59	12.0	+17
123	Brunhild	01 29.1	0.10	11.8	+18
20	Massalia	01 29.7	0.62	8.4	+17
877	Walkure	01 29.8	0.64	13.7	+19
360	Carlova	02 01.7	0.14	11.9	+17
243	Ida	02 01.9	0.14	13.5	+17
17	Thetis	02 08.5	0.81	11.0	+17
1000	Piazzia	02 15.2	0.40	13.8	+12
175	Andromache	02 16.2	0.89	13.7	+16
924	Toni	02 18.9	0.09	13.7	+11
33	Polyhymnia	02 25.6	0.36	13.8	+10
303	Josephina	02 27.5	0.33	13.0	+09
16	Psyche	03 03.3	0.30	10.3	+08
586	Thekla	03 07.3	0.75	13.1	+03
604	Tekmessa	03 07.9	0.78	13.9	+08
490	Veritas	03 11.7	0.52	13.1	+02
223	Rosa	03 12.9	0.84	13.5	+06
190	Ismene	03 18.0	0.04	12.8	+01
720	Bohlinia	03 19.7	0.77	13.5	+03
569	Misa	03 20.9	0.67	13.4	-02
19	Fortuna	03 21.4	0.47	10.6	-01
65	Cybele	03 23.4	0.68	11.2	+01
160	Una	03 26.9	0.13	12.7	-02
47	Aglaja	03 29.1	0.20	12.0	-04

Shape/Spin Modeling Opportunities

#	Name	Brightest Date	Mag	Dec	Per (h)	Amp.	U
54	Alexandra	1 01.	12.6	+31	7.024	0.10-0.31	4
77	Frigga	1 01.	12.9	+10	9.012	0.07-0.19	3
233	Asterope	1 01.	12.5	+12	19.70	0.35	3
258	Tyche	1 01.	12.0	+03	10.041	0.40	3
441	Bathilde	1 01.	12.8	+19	10.447	0.13	3
480	Hansa	1 01.	11.9	+03	16.19	0.58	3
419	Aurelia	1 02.9	12.9	+18	16.709	0.08	2 A
221	Eos	1 14.1	12.2	+14	10.436	0.04-0.11	4
344	Desiderata	1 16.6	13.1	+44	10.77	0.17	3
31	Euphrosyne	1 20.3	10.6	+59	5.531	0.09-0.13	4
416	Vaticana	1 30.2	12.3	+35	5.372	0.17-0.38	4
471	Papagena	1 30.9	10.6	+33	7.113	0.11-0.13	3
36	Atalante	2 02.3	11.9	+36	9.93	0.15-0.17	3
386	Siegena	2 10.7	11.7	+02	9.763	0.11	3
47	Aglaja	3 29.1	11.9	-04	13.20	0.03-0.17	4

Radar-Optical Opportunities

2004 XL14

No known lightcurve parameters. **Note – positions are for 2006.**

Date mm/dd	Geocentric RA(2000)	DC(2000)	V	PA	E
12/16/2006	7 23.16	+13 54.2	15.97	26.6	152
12/17/2006	7 06.88	+20 58.2	15.46	20.1	159
12/18/2006	6 42.72	+30 07.5	14.98	14.7	165
12/19/2006	6 04.54	+41 14.6	14.86	17.7	162
12/20/2006	5 01.08	+52 40.2	15.13	29.9	149
12/21/2006	3 21.05	+60 42.2	15.61	44.5	134

(7341) 1991 VK

This asteroid has a period of 4.2096hr, amplitude 0.28-0.70mag.

Date mm/dd	Geocentric RA(2000)	DC(2000)	V	PA	E
03/01	13 43.88	-38 44.5	15.20	53.5	118
03/02	13 40.86	-38 27.0	15.22	52.0	119
03/03	13 37.90	-38 09.2	15.23	50.5	121
03/05	13 32.15	-37 32.4	15.26	47.6	124
03/10	13 18.66	-35 53.4	15.33	40.7	131
03/15	13 06.36	-34 04.6	15.40	34.2	138
03/20	12 55.32	-32 07.6	15.49	28.2	145
03/25	12 45.69	-30 05.8	15.60	23.0	150
03/30	12 37.61	-28 03.3	15.73	18.7	155

2006 AM4

This asteroid has a period of 5.22hr, amplitude 0.65-0.87mag.

Date mm/dd	Geocentric RA(2000)	DC(2000)	V	PA	E
01/30	11 40.12	+21 01.6	15.96	39.4	139
01/31	12 37.10	+27 53.5	15.39	51.5	128
02/01	15 17.87	+36 34.4	15.49	83.2	96

2001 BE10

No known lightcurve parameters

Date mm/dd	Geocentric RA(2000)	DC(2000)	V	PA	E
01/18	10 37.53	- 3 17.3	15.97	41.8	134
01/19	10 24.44	- 4 30.4	15.90	39.1	137
01/20	10 11.21	- 5 41.8	15.84	36.5	140
01/21	9 57.93	- 6 50.7	15.79	34.2	142
01/22	9 44.73	- 7 56.3	15.76	32.2	144
01/23	9 31.68	- 8 58.0	15.74	30.5	146
01/24	9 18.90	- 9 55.2	15.75	29.2	148
01/25	9 06.48	-10 47.5	15.77	28.3	149
01/26	8 54.47	-11 34.8	15.81	27.9	149
01/27	8 42.95	-12 17.0	15.87	27.8	149

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* * * * *

The deadline for the next issue (34-2) is January 15, 2007. The deadline for issue 34-3 is April 15, 2007.