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LIGHTCURVES AND PERIOD DETERMINATION FOR 6146 ADAMKRAFFT

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Minor planet 6146 Adamkrafft was observed over a period of 13 days (41 rotations) during August, 2001. Lightcurves obtained on 6 nights with an unfiltered CCD have yielded a rotational (synodic) period of 6.964 ± 0.009 hrs. The complete lightcurve is doubly periodic, with a total amplitude range of 0.18 ± 0.05 magnitude. The rotation period is atypical of C and S class asteroids of this diameter.

Introduction

Adamkrafft was discovered by C.J. van Houten, I. van Houten-Groeneveld and T. Gehrels at Mt Palomar on Sept 30, 1973 as a result of the Palomar-Leiden Trojan – 2 asteroid survey. Previous provisional designations were 1934 NG, 1979FA and 3262 T-2. This main-belt asteroid was subsequently named after the German sculptor Adam Krafft, 1460-1508. The name was cited in *Minor Planet Circular* No. 26765. The H magnitude is 13.0 and its assumed diameter is given as 16.6 km.

This asteroid was chosen from the suggested targets in the observing list of Pravec and Harris (2001). The most recent tabulation examined for previous lightcurve data was that of Harris (2001), but no lightcurve data are listed there.

Observations and Results

At this opposition Adamkrafft was at Declination -23^{0}, making it particularly suitable for southern hemisphere observers. Observations were made from Mt Tarana Observatory near Bathurst, NSW. The site is at 880m altitude and the latitude is S 33.4348, longitude E 149.7576. The equipment and methodology have been described by Bembrick (2001).

The observational circumstances for August, 2001 have been summarised in Table I, which also shows the percent of the rotational light curve covered on each night of observation. The data from each night were plotted as differential instrumental magnitude vs U.T. No light time corrections were applied. Data from the better nights show two maxima and two minima, with the least noisy light curve on 25 August. Thus the epoch of zero phase was chosen as the prominent maximum of Aug. 25 at 13.85 UT (JDGeo 2452147.07708).

In all, 18 extrema were identified from the lightcurves and the time differences between these were used to estimate the rotational period. This led to an estimate of 6.964 ± 0.009 hours. On this basis the observations cover 41 rotational cycles. Using the above epoch and period, the data were phase folded (Figure 1), with the magnitudes of the primary maxima from other nights being adjusted to the magnitude of the zero phase maximum on the night of epoch. Results were posted on the CALL website on Oct. 14, 2001.

As the composite lightcurve is somewhat noisy, a smoothed, phase-folded plot (Figure 1) was produced by the method of "phase binning", using 32 overlapping bins. This smoothed curve is displaced 0.2 magnitudes from the composite curve in the figure. From this smoothed curve the average amplitudes of the extrema were estimated. The overall amplitude of this lightcurve is 0.18 magnitudes. The one-sigma error bars for these phase bins are generally 0.05 magnitudes or less, giving an indication of the overall accuracy of the quoted amplitudes.

Discussion and Conclusion

Using AAVSO variable star software, a period search was made using data from all six nights. The results agree well with the graphical method outlined above. The best frequency was found to be 3.448 (cycles/day), which is a period of 6.96 hours. Tests with other software also found a frequency of 2.450 (period of 9.79 hours), however phase stacking using this period did not produce an acceptable composite lightcurve. Thus this period was rejected as an alias. To a first approximation, the maximum amplitude of 0.18 magnitudes implies a ratio a/b of 0.85, where a, b and c are the axes of a tri-axial ellipsoid and the rotation is about the shortest axis, c. The small difference of around 0.04 magnitudes between the two maxima implies little difference in albedo or reflecting surface area between the opposite hemispheres.

Minor planet 6146 Adamkrafft was observed over 41 rotational cycles and the synodic period determined as 6.964 ± 0.009 hours. This is believed to be a secure result as all rotational phases of the lightcurve were observed. The lightcurve shows the doubly periodic features typical of an irregularly shaped, tri-axial ellipsoid.

With a revolution rate of 3.44/day, Adamkrafft is one of the faster rotators among the asteroids less than 50 km diameter. This group of asteroids may have a bimodal distribution of rotation rates peaking at slightly less than one rev/day and at approximately 3 revs/day (Binzel et al. 1989). The deduced revolution rate is not typical of C or S class asteroids of this diameter (Burns and Tedesco, 1979).

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Table I. Observational Circumstances, 2001

Obs. Date	Hel. Lat. (B^0)	Hel. Long. (L^0)	R (AU)	Solar Phase Angle	Phase Coverage
13 Aug.	-8.14	316.32	1.731	5.4	28%
14 Aug.	-8.12	316.15	1.732	5.8	50
16 Aug.	-8.06	315.79	1.735	6.6	71
23 Aug.	-7.78	314.68	1.744	10.1	107
24 Aug.	-7.73	314.55	1.746	10.6	121
25 Aug.	-7.68	314.42	1.747	11.1	107

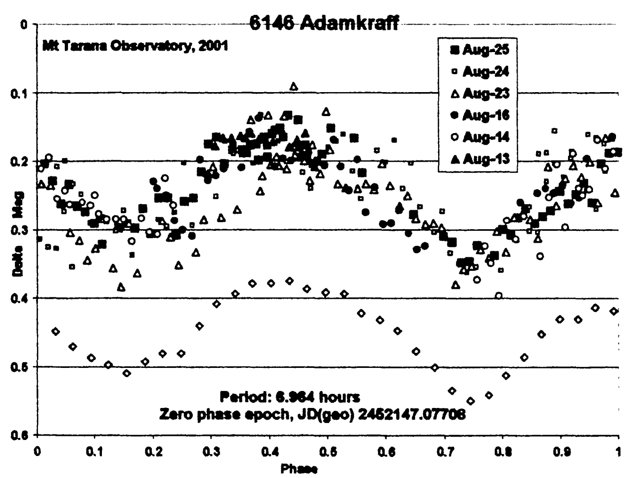

Figure 1. Composite Lightcurve for 6146 Adamkrafft.

PHOTOMETRY OF 866 FATME, 894 ERDA, 1108 DEMETER, AND 3443 LETSUNGDAO

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Minor planets 866 Fatme, 894 Erda, 1108 Demeter, and 3443 Letsungdao were observed from Santana Observatory (MPC Code 646). The rotational period of 866 Fatme was determined to be 20.03 ± 0.01 hours with an amplitude of 0.28 ± 0.05 magnitude. 894 Erda was determined to have a rotational period of 4.69 ± 0.01 hours with an amplitude of 0.08 ± 0.05 magnitude. The rotational period of 1108 Demeter was determined to be 9.70 ± 0.01 hours with an amplitude of 0.17 ± 0.01 magnitude. Finally, 3443 Letsungdao was found to have a rotational period of 3.44 ± 0.02 hours with an amplitude of 0.30 ± 0.04 magnitude.

Santana Observatory is located in Rancho Cucamonga, California at an elevation of 400 meters and is operated by Robert D. Stephens. Details of the equipment used can be found in Stephens (2000). All of the asteroids whose results are presented here were selected from the CALL web site "List of Potential Lightcurve Targets" (Warner 2000).

Aperture photometry was performed using the software program Canopus developed by Brian Warner and including the Fourier analysis routine developed by Alan Harris (Harris et al., 1989). This program allows combining data from different observers and adjusting the zero points to compensate for different equipment and comparison stars. All observations were unfiltered. Dark frames and flat fields were used to calibrate the images.

Fatme is a main-belt asteroid discovered 25 February 1917 by M. Wolf at Heidelberg. It is named after a character from Abu Hassam by the German composer Carl Maria Friedrich Ernst von Weber. Three hundred five observations over 11 sessions between 14 May and 8 June 2001 used to derive the rotational period of 20.03 ± 0.01 hours with an amplitude of 0.28 ± 0.05 magnitude.

Erda is a main-belt asteroid discovered 4 June 1918 by M. Wolf at Heidelberg. It is named for the Norse goddess. Two hundred six observations over five sessions between 15 July and 19 July 2001 were used to derive the rotational period of 4.69 ± 0.01 hours with an amplitude of 0.08 ± 0.05 magnitude. Thirty observations by Laurent Bernasconi on 24/25 July 2001 as analyzed by Raoul Behred although which cannot independently determine the period, are consistent with this period.

Demeter is a main-belt asteroid discovered 31 May 1929 by K. Reinmuth at Heidelberg. It is named for the Greek goddess of the fruitful soil and of agriculture. One hundred fifty one observations over seven sessions 9 July and 29 July 2001 were used to derive the rotational period of 9.70 ± 0.01 hours with an amplitude of 0.17 ± 0.02 magnitude. Observations by René Roy and Stéphane Charonnel taken on 25 June 2001 and 3 July 2001 as analyzed by Raoul Behred, although which cannot independently determine the period, are consistent with this data.

Letsungdao is a main-belt asteroid discovered by Purple Mountain Observatory at Nanking on 26 September 1979. It is named in honor of the theoretical physicist Tsung-Dao Lee. One hundred fifty nine observations over three sessions spanning three days were used to derive the rotational period of 3.44 ± .02 hours with an amplitude of 0.30 ± 0.04 magnitude. Observations by Laurent Bernasconi and Stéphane Charonnel taken on 22 July 2001, 23 July 2001, and 31 July 2001 as analyzed by Raoul Behred derived a rotational period of 3.438 ± 0.0005 hours.

Acknowledgements

Many 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.

References

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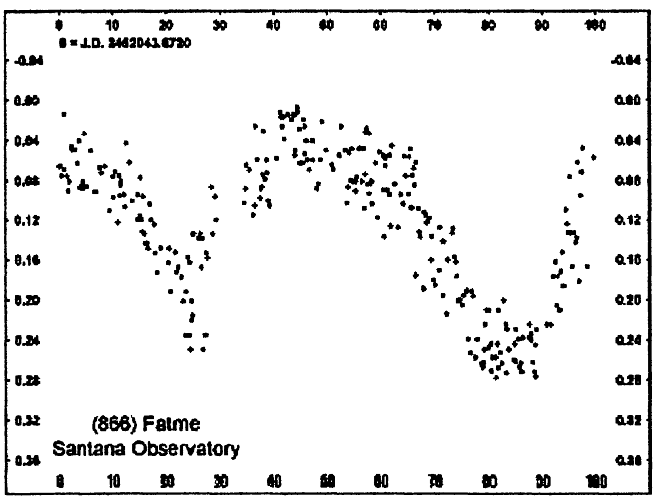

Figure 1: Lightcurve of 866 Fatme based upon a derived period of 20.03 ± 0.01 hours.

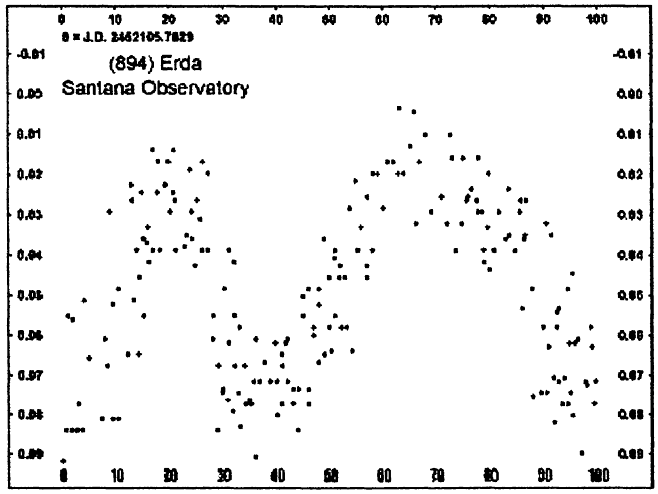

Figure 2: Lightcurve of 894 Erda based upon a derived period of 4.69 ± 0.01 hours.

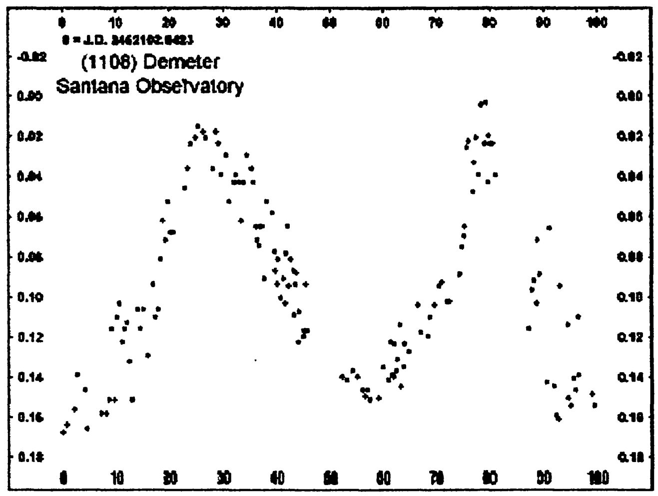

Figure 3: Lightcurve of 1108 Demeter based upon a derived period of 9.70 ± 0.01 hours.

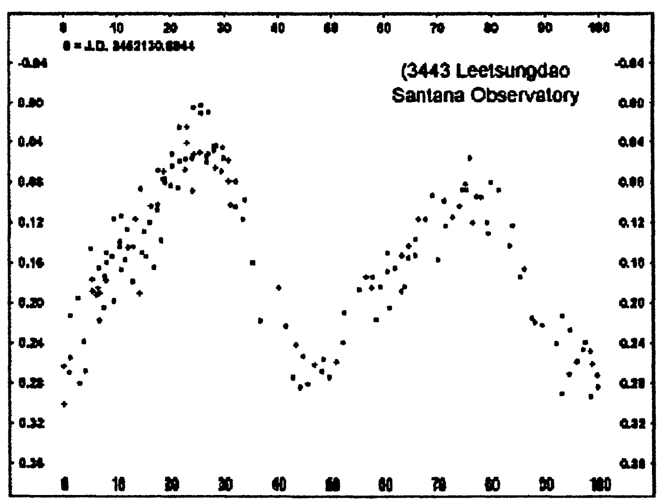

Figure 4: Lightcurve of 3443 Leetsungdao based upon a derived period of 3.44 ± 0.02 hours.

CLOSE APPROACHES OF MINOR PLANETS TO NAKED EYE STARS IN 2002

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A list is presented of approaches of minor planets brighter than magnitude 14 to naked eye stars. This may be helpful in finding some faint minor planets.

The accompanying table lists close approaches of minor planets to stars during 2002 where:

- The event takes place more than 30° from the Sun.
- The minor planet is brighter than visual magnitude 14.
- The star is brighter than magnitude 6.
- The minimum angular separation is smaller than 120".

This list can be helpful in locating some otherwise faint minor planets. By carefully drawing the star field around the predicted position down to the magnitude of the minor planet and comparing it to the situation some time later, one can detect the intruder by its apparent motion.

The information contained in the list is divided into 5 groups:

1. Date: gives the date and time in U.T. of the closest geocentric approach. All subsequent data pertain to this instant.

2. Closest approach: the two columns give the position of the minor planet with respect to the star:
   - the minimum geocentric distance in seconds of arc
   - the position angle in degrees, measured from north over east

3. Minor planet: gives information about the minor planet:
   - number and name
   - visual magnitude
   - apparent motion in seconds of arc per hour
   - parallax in seconds of arc

4. Star: the following data of the star are given:
   - Hipparcos star number
   - visual magnitude
   - right ascension for the equinox 2000.0
   - declination (2000.0)

5. Sun and Moon:
   - elongation of the Sun in degrees
   - elongation of the Moon (degrees)
   - illuminated fraction of the Moon in %

The *observed* minimum distance depends on the location of the observer on the Earth's surface but is always comprised between the minimum *geocentric* distance plus and minus the parallax. An occultation will be visible somewhere on the Earth when the parallax is greater than the geocentric separation.

The close approaches in this article were computed at the Computer Center of Agfa-Gevaert N.V., Mortsel, Belgium.

Close approaches of minor planets to stars

(Dist. < 120" ; El. Sun > 55°
Star < 6.0 ; Min. pl. < 14.0)

	Date (U.T.)		Minim. dist.	Pos. ang.	Minor planet Name	Vis. mag.	App. mot.	Hor. par.	Star Designation	Vis. mag.	Right ascens. (2000.0)	Declination (2000.0)	Elongation Sun	Elongation Moon	Ill. frac Moon
		h m	"	0			"/h	"			h m	0 '	0	0	%
2001	dec 26	9 41.5	80.54	345	233 Asterope	13.3	61.73	3.25	HIP 110578	5.8	22 24.11	- 4 50.2	61	69	82
	dec 28	5 0.4	109.29	343	410 Chloris	13.4	73.17	2.94	HIP 105576	5.7	21 23.01	-22 40.1	40	111	94
	dec 30	16 32.8	86.39	339	77 Frigga	13.9	60.20	2.80	TYC1 1577	5.1	21 53.30	-13 33.1	46	136	100
2002	jan 1	11 4.2	118.91	165	403 Cyane	12.8	30.58	5.27	HIP 25278	5.1	5 24.42	+17 23.0	159	47	94
	jan 7	23 18.3	47.37	221	127 Johanna	12.3	19.86	5.13	TYC1 371	3.9	9 52.76	+26 0.4	144	79	30
	jan 19	7 4.6	93.49	348	66 Maja	13.4	29.68	5.22	TYC1 1081	5.8	2 58.09	+20 40.1	109	47	28
	jan 20	23 47.3	92.95	356	88 Thisbe	11.8	26.53	3.95	TYC1 241	2.9	6 22.96	+22 30.8	154	73	43
	jan 21	9 1.9	27.37	180	312 Pierretta	13.9	75.11	2.78	HIP 89931	2.9	18 20.99	-29 49.7	27	112	46
	jan 25	15 21.7	49.11	172	211 Isolda	12.7	28.11	4.05	HIP 13702	5.7	2 56.44	+18 1.4	101	35	86
	jan 25	16 38.5	74.53	340	241 Germania	13.3	55.12	2.69	TYC1 3908	4.9	23 46.39	+ 3 29.2	52	84	86
	jan 28	8 53.7	14.03	149	498 Tokio	13.8	55.44	3.74	TYC1 2121	5.9	1 48.43	+ 3 41.1	78	94	99
	jan 30	10 33.4	30.80	71	140 Siwa	13.7	2.67	3.47	HIP 21604	5.9	4 38.26	+20 41.1	120	80	97
	feb 3	10 40.4	20.48	168	790 Pretoria	13.9	55.86	2.42	HIP 89439	5.3	18 15.22	-20 43.7	40	63	62
	feb 3	21 51.3	55.28	191	849 Ara	13.6	27.82	3.20	HIP 45751	4.9	9 19.77	-11 58.5	151	74	57
	feb 3	22 8.2	117.01	182	135 Hertha	12.6	27.64	4.54	HIP 35025	5.9	7 14.70	+24 53.1	151	110	57
	feb 10	1 5.9	48.62	208	1107 Lictoria	13.5	14.30	4.53	HIP 32968	5.8	6 52.00	+23 36.1	140	166	5
	feb 11	2 44.5	8.21	192	476 Hedwig	13.8	24.50	3.52	HIP 17954	5.3	3 50.32	+25 34.8	98	112	1
	feb 17	7 43.1	35.50	340	54 Alexandra	13.2	59.47	2.76	HIP 3632	5.4	0 46.55	+15 28.5	49	15	21
	feb 20	3 5.8	7.03	201	12 Victoria	11.4	33.71	4.63	TYC1 1223	4.1	8 37.66	+ 5 42.2	155	73	46
	feb 24	5 4.2	29.78	173	24 Themis	12.3	24.75	3.45	HIP 21881	4.2	4 42.25	+22 57.4	96	39	86
	mar 1	8 29.1	77.02	340	74 Galatea	13.6	74.95	3.19	TYC1 60	4.3	1 45.39	+ 9 9.5	47	161	94
?	mar 9	15 17.6	5.09	167	712 Boliviana	12.9	36.88	4.64	HIP 28110	6.0	5 56.47	+ 9 30.6	99	145	17
	mar 13	9 16.4	39.49	158	234 Barbara	13.8	77.32	3.22	TYC1 2173	5.3	2 31.50	+ 2 16.0	44	51	1
	mar 17	7 3.5	69.82	161	17 Thetis	13.4	52.13	2.67	TYC1 2220	5.6	3 6.39	+13 11.2	51	16	9
	mar 19	1 13.4	58.97	355	776 Berbericia	13.3	55.44	2.58	HIP 103389	5.8	20 56.79	-26 17.8	49	103	21
	mar 23	14 7.8	19.52	254	71 Niobe	11.0	35.19	5.20	HIP 76618	5.4	15 38.82	-52 22.4	112	128	66
	mar 24	1 19.9	64.13	166	52 Europa	12.7	42.78	2.23	TYC1 1548	5.9	20 57.68	-16 1.9	50	165	71
	mar 26	2 21.2	8.97	347	60 Echo	12.5	78.14	3.71	TYC1 1106	6.0	3 53.17	+17 19.6	54	88	89
	mar 29	18 39.3	59.41	168	441 Bathilde	14.0	61.83	2.64	HIP 13654	5.4	2 55.81	+18 19.9	38	156	98
	apr 3	8 5.6	46.76	259	1036 Ganymed	13.7	25.85	4.67	TYC1 1417	4.9	15 58.19	-14 16.8	132	28	63

	Date (U.T.)		Minim. dist.	Pos. ang.	Minor planet Name	Minor planet Vis. mag.	Minor planet App. mot.	Minor planet Hor. par.	Star Designation	Star Vis. mag.	Star Right ascens. (2000.0)	Star Declination (2000.0)	Elongation Sun	Elongation Moon	Ill. frac Moon
		h m	"	o			"/h	"			h m	o '	o	o	%
	apr 6	3 0.4	12.00	159	308 Polyxo	13.6	60.49	2.66	HIP 110273	5.3	22 20.20	- 7 49.3	42	32	36
	apr 6	4 24.7	76.92	353	451 Patientia	12.3	42.19	2.92	HIP 27629	5.8	5 50.97	+27 58.1	71	144	35
	apr 6	15 47.4	93.57	189	423 Diotima	12.8	31.43	3.18	TYC1 3533	5.8	19 13.23	-25 54.4	90	23	31
x	apr 7	9 41.6	0.92	27	55 Pandora	13.2	25.94	3.36	HIP 37826	1.3	7 45.31	+28 1.6	95	155	24
	apr 10	13 51.4	48.50	34	264 Libussa	13.8	15.95	3.42	TYC1 3439	4.6	18 8.08	-28 27.4	108	84	5
	apr 16	9 59.6	94.28	197	13 Egeria	12.0	34.74	3.45	HIP 98421	5.4	19 59.86	-34 41.9	91	130	12
	apr 23	13 5.3	39.14	356	326 Tamara	13.4	77.99	4.76	HIP 108294	5.5	21 56.38	-37 15.2	76	150	82
	apr 28	1 36.3	107.50	207	107 Camilla	12.5	23.39	3.35	TYC1 1420	5.5	16 0.79	- 8 24.7	154	13	99
	apr 28	19 26.3	23.41	181	712 Boliviana	13.5	58.51	3.42	HIP 34033	5.3	7 3.63	+10 57.1	68	135	96
	may 1	21 55.0	113.99	338	46 Hestia	13.2	78.65	3.21	TYC1 3920	5.8	23 54.78	+ 0 6.6	42	75	73
	may 5	18 51.7	47.79	333	639 Latona	13.8	60.11	2.62	TYC1 902	4.0	23 59.31	+ 6 51.8	42	33	36
	may 6	15 3.3	7.62	334	174 Phaedra	12.2	19.23	5.62	HIP 82676	5.5	16 54.03	-41 48.4	143	83	28
	may 9	22 12.4	43.69	181	776 Berbericia	12.9	43.46	3.24	HIP 109737	5.7	22 13.74	-25 10.9	82	54	6
	may 14	19 35.2	14.16	354	746 Marlu	14.0	33.12	4.98	HIP 74707	5.3	15 16.07	-41 29.5	157	148	6
	may 19	22 52.5	30.53	183	48 Doris	12.8	53.26	2.50	HIP 33929	6.0	7 2.43	+17 45.3	46	47	51
	may 21	11 50.9	17.29	348	176 Iduna	13.5	61.70	2.54	HIP 7535	5.6	1 37.10	+12 8.5	33	145	69
	may 25	15 50.6	8.03	203	471 Papagena	12.3	43.48	2.73	TYC1 2719	5.4	9 8.00	+29 39.3	67	102	99
	may 26	14 55.1	75.60	156	119 Althaea	13.5	55.72	3.42	HIP 116495	5.8	23 36.39	+ 2 6.1	69	108	100
	may 28	21 45.1	22.99	155	75 Eurydike	13.2	86.90	3.66	HIP 5737	5.3	1 13.73	+ 7 34.5	47	102	93
	may 31	3 16.3	21.26	14	76 Freia	13.8	46.11	2.64	HIP 44001	5.8	8 57.59	+15 34.9	62	172	77
	jun 3	23 13.0	80.81	340	240 Vanadis	14.0	73.26	3.10	TYC1 60	4.3	1 45.39	+ 9 9.5	45	34	41
	jun 9	3 15.8	86.55	5	451 Patientia	12.5	56.50	2.37	HIP 36393	5.1	7 29.34	+28 7.1	32	54	4
	jun 15	19 41.3	14.00	338	308 Polyxo	13.3	36.91	3.48	HIP 117491	5.8	23 49.46	+ 1 4.6	86	147	26
	jun 17	13 58.2	90.06	192	80 Sappho	13.6	51.00	2.78	HIP 46457	5.9	9 28.49	+ 8 11.3	55	31	45
	jun 18	8 33.3	36.86	166	779 Nina	13.7	22.60	3.40	TYC1 1309	5.2	11 56.02	-17 9.0	98	22	54
	jun 19	5 33.7	92.84	338	186 Celuta	11.6	34.62	7.51	HIP 90662	5.9	18 29.93	-47 13.2	154	84	64
	jun 21	14 10.6	68.01	10	774 Armor	12.2	22.74	5.62	HIP 96808	5.5	19 40.72	-16 17.6	155	67	87
	jun 22	11 20.6	30.69	156	596 Scheila	12.3	29.10	5.92	HIP 80079	4.6	16 20.64	-24 10.2	156	9	93
	jun 23	2 14.5	13.70	146	679 Pax	13.9	30.82	3.97	HIP 77070	2.8	15 44.27	+ 6 25.5	134	29	96
	jun 23	6 37.4	108.25	162	268 Adorea	13.2	18.79	3.93	HIP 101123	6.0	20 29.90	-18 35.0	146	54	97
	jun 23	10 55.9	4.85	20	108 Hecuba	13.6	16.90	3.28	TYC1 1335	4.8	12 54.35	- 9 32.3	104	57	97
	jul 5	15 20.2	19.37	299	618 Elfriede	12.9	23.31	4.24	HIP 106039	4.7	21 28.72	-21 48.4	145	88	23
	jul 6	13 17.9	13.85	196	12 Victoria	12.8	54.45	2.66	HIP 48519	6.0	9 53.72	+ 5 57.5	44	91	16
	jul 11	1 26.4	68.90	23	148 Gallia	13.8	41.28	2.45	TYC1 2918	5.5	11 30.48	+18 24.6	58	50	1
	jul 13	9 41.8	109.20	192	386 Siegena	13.6	48.13	2.25	HIP 49637	4.5	10 7.90	+ 9 59.8	39	6	11
	jul 16	1 49.2	71.67	180	774 Armor	11.8	29.89	5.79	HIP 95176	4.6	19 21.73	-15 57.3	172	101	37
	jul 16	14 50.0	39.19	348	345 Tercidina	13.6	59.76	3.64	HIP 13108	6.0	2 48.53	+18 17.0	68	150	43
	jul 17	1 57.9	67.67	349	42 Isis	12.6	64.11	3.08	HIP 20542	4.9	4 24.10	+17 26.6	47	136	49
	jul 20	14 47.4	78.47	173	415 Palatia	13.8	84.16	3.50	HIP 21673	5.1	4 39.15	+15 48.0	47	174	85
	jul 20	21 33.0	117.28	203	111 Ate	13.4	62.10	2.89	HIP 54336	5.7	11 6.90	+ 1 57.3	49	89	87
	jul 21	13 3.1	63.69	157	735 Marghanna	13.3	64.56	5.61	HIP 10305	5.8	2 12.79	- 2 23.6	88	124	91
	jul 22	11 13.0	107.26	205	27 Euterpe	12.2	55.88	3.25	HIP 60129	3.9	12 19.91	- 0 40.0	65	92	96
x	jul 23	16 51.6	2.36	346	68 Leto	12.2	59.52	3.02	HIP 20186	5.3	4 19.61	+21 46.4	53	134	99
	jul 27	16 59.3	25.21	339	75 Eurydike	13.1	65.95	4.39	TYC1 114	4.4	3 11.63	+19 43.6	73	69	89
	jul 27	20 4.8	34.46	359	762 Pulcova	13.1	30.13	3.59	TYC1 773	5.1	20 40.05	-18 8.3	176	37	88
	jul 31	3 12.5	40.95	34	579 Sidonia	13.7	39.51	2.78	TYC1 3074	6.0	13 26.19	- 1 11.5	72	176	62
	aug 3	5 55.8	90.92	160	75 Eurydike	13.1	62.43	4.50	HIP 15737	5.3	3 22.75	+20 44.5	77	8	33
	aug 7	7 0.3	50.58	1	98 Ianthe	14.0	15.60	3.71	HIP 145	5.1	0 1.82	- 3 1.7	135	115	3
	aug 9	1 30.5	76.79	182	287 Nephthys	13.4	64.08	2.90	HIP 29434	4.9	6 12.05	+16 7.8	43	48	0
	aug 9	22 57.3	46.11	10	441 Bathilde	13.9	64.12	2.61	TYC1 269	4.0	7 4.11	+20 34.2	32	48	2
	aug 12	12 38.9	82.31	327	464 Megaira	12.5	32.77	6.46	TYC1 1546	4.1	20 51.82	-26 55.1	165	117	19
	aug 13	4 4.8	40.41	168	337 Devosa	12.1	36.92	5.64	HIP 109332	5.8	22 8.98	-18 31.2	170	127	25
	aug 14	2 56.8	5.42	11	78 Diana	12.9	80.13	3.00	HIP 36962	4.2	7 35.92	+26 53.7	30	102	35
	aug 19	0 28.2	112.50	141	931 Whittemora	13.7	30.16	4.27	TYC1 1597	5.2	22 47.55	-19 36.8	165	56	85
	sep 1	22 11.7	24.97	25	128 Nemesis	13.6	49.60	2.34	HIP 65420	5.9	13 24.55	- 5 9.8	42	111	32
	sep 2	22 17.6	94.09	123	357 Ninina	13.2	27.20	4.36	TYC1 2048	4.8	0 44.19	-10 36.6	150	98	22
	sep 4	7 11.0	12.97	345	500 Selinur	14.0	26.93	4.26	HIP 85755	4.8	17 31.42	-23 57.8	101	141	11
	sep 4	13 57.6	116.59	194	139 Juewa	13.2	53.77	3.06	HIP 72323	5.6	14 47.38	-25 37.5	65	101	9
	sep 4	18 47.6	100.41	181	103 Hera	13.0	38.80	3.26	HIP 25499	5.4	5 27.17	+17 57.7	79	48	8
	sep 14	5 59.1	59.28	33	6 Hebe	9.8	34.08	4.93	TYC1 3454	5.8	18 17.19	-17 22.4	102	10	55
	sep 14	7 51.4	86.88	165	71 Niobe	11.9	58.19	3.72	HIP 80390	5.4	16 24.53	-37 34.0	79	23	56
	sep 14	21 0.3	93.44	148	798 Ruth	13.7	31.36	4.35	TYC1 1614	4.3	23 27.97	+ 6 22.7	170	80	62
x	sep 17	0 52.6	2.30	15	345 Tercidina	12.8	26.64	5.28	TYC1 1115	5.5	4 9.17	+19 36.6	109	121	81
	sep 27	13 47.3	99.29	6	415 Palatia	13.4	67.43	4.59	HIP 34440	5.6	7 8.37	+15 55.8	77	37	71
	oct 3	17 9.8	67.15	267	312 Pierretta	13.1	13.36	4.83	HIP 106039	4.7	21 28.72	-21 48.4	127	166	11
	oct 8	7 5.7	31.88	355	980 Anacostia	13.3	54.34	3.08	HIP 83176	5.9	16 59.96	-25 5.5	61	36	5
	oct 12	10 55.8	9.36	211	714 Ulula	13.7	39.69	4.15	HIP 33914	5.9	7 2.29	+15 20.2	93	169	42
	oct 13	16 4.6	47.08	196	25 Phocaea	11.4	78.93	5.85	HIP 94477	5.1	19 13.71	+ 2 17.6	90	29	55
	oct 15	17 1.1	85.37	18	11 Parthenope	12.1	53.37	2.76	HIP 49669	1.3	10 8.37	+11 58.0	52	170	74
	oct 19	19 14.2	86.11	25	735 Marghanna	11.6	48.05	8.90	HIP 12828	4.3	2 44.94	+10 6.8	163	32	98
	oct 21	9 29.2	52.55	355	65 Cybele	12.7	30.21	2.85	TYC1 1517	4.9	19 46.36	-19 45.7	87	94	100
	oct 22	22 27.1	91.77	19	22 Kalliope	12.2	54.43	2.50	HIP 56080	5.9	11 29.70	+15 24.8	43	120	98
	oct 29	20 29.6	32.99	43	2 Pallas	10.2	28.47	2.84	HIP 101847	4.5	20 38.34	- 1 6.3	95	158	43
	nov 2	0 39.6	79.07	197	109 Felicitas	10.7	31.34	9.33	TYC1 1088	5.7	3 9.61	+29 4.6	162	124	12
x	nov 3	1 43.2	2.41	348	431 Nephele	13.2	27.38	4.31	TYC1 2288	5.9	4 0.81	+18 11.6	158	133	5
	nov 5	4 6.5	89.18	351	774 Armor	13.9	49.55	3.29	HIP 98258	5.0	19 57.95	-15 29.5	75	71	0
	nov 11	10 8.4	67.33	214	89 Julia	12.2	37.70	2.96	TYC1 2835	5.6	10 25.25	+ 8 47.1	73	158	46
	nov 12	2 58.1	70.39	12	17 Thetis	12.9	24.50	3.60	HIP 44001	5.8	8 57.59	+15 34.9	97	168	53
	nov 15	10 36.3	15.67	173	1074 Beljawskya	13.7	28.03	5.30	HIP 20641	5.3	4 25.42	+22 12.0	164	66	82
	nov 20	1 2.6	25.38	354	161 Athor	12.2	39.46	6.17	HIP 14893	5.8	3 12.24	+27 15.4	169	11	100

	Date	(U.T.)	Minim. dist.	Pos. ang.	Minor planet Name	Minor planet Vis. mag.	Minor planet App. mot.	Minor planet Hor. par.	Star Designation	Star Vis. mag.	Right ascens. (2000.0)	Declination (2000.0)	Elongation Sun	Elongation Moon	Ill. frac Moon
		h m	"	0			"/h	"			h m	0 '	0	0	%
	nov 24	12 2.0	107.26	201	313 Chaldaea	12.9	63.80	4.85	TYC1 2841	5.1	10 30.29	- 0 38.2	82	48	81
	nov 24	17 21.8	31.14	359	731 Sorga	13.7	30.77	4.63	HIP 13654	5.4	2 55.81	+18 19.9	164	69	80
	nov 27	8 57.5	109.09	171	269 Justitia	13.8	35.30	4.22	HIP 21036	5.5	4 30.62	+13 43.5	171	84	53
	nov 28	11 5.5	26.26	170	241 Germania	12.0	29.33	4.25	HIP 25695	5.5	5 29.28	+25 9.0	162	83	41
	nov 28	17 39.3	109.85	169	65 Cybele	13.0	44.97	2.42	HIP 100881	5.1	20 27.32	-18 12.7	58	134	38
	nov 29	15 28.3	47.93	118	344 Desiderata	13.9	17.07	3.05	HIP 47080	5.5	9 35.66	+35 48.6	111	50	28
	dec 1	13 14.6	28.24	354	236 Honoria	13.6	67.10	2.94	HIP 96808	5.5	19 40.72	-16 17.6	45	83	11
	dec 2	9 18.8	90.21	173	206 Hersilia	12.1	34.56	5.31	HIP 20894	3.5	4 28.66	+15 52.3	173	155	5
x	dec 2	20 29.1	6.31	180	282 Clorinde	13.7	33.81	7.21	TYC1 2258	5.6	3 39.85	+ 3 3.4	156	165	3
	dec 3	0 12.8	36.92	343	678 Fredegundis	13.7	60.89	3.80	HIP 105761	5.8	21 25.22	- 9 44.9	70	88	2
	dec 3	23 16.8	90.08	360	731 Sorga	14.0	24.86	4.49	HIP 13108	6.0	2 48.53	+18 17.0	153	158	0
	dec 7	16 35.2	91.82	7	740 Çantabia	13.3	31.13	4.39	HIP 27316	5.8	5 47.22	+14 29.3	165	145	14
	dec 10	2 5.0	60.96	333	337 Devosa	13.7	50.88	3.52	TYC1 3771	5.4	22 10.62	-11 33.9	72	5	35
	dec 10	11 42.3	90.44	148	606 Brang"ne	13.1	32.98	7.12	HIP 18434	5.5	3 56.48	+35 4.9	160	91	39
	dec 11	23 46.0	26.27	175	206 Hersilia	12.3	31.91	5.25	HIP 20205	3.8	4 19.79	+15 37.7	164	72	53
	dec 15	8 33.2	62.52	350	790 Pretoria	13.9	54.10	2.52	HIP 101847	4.5	20 38.34	- 1 6.3	50	83	82
	dec 15	10 5.7	17.17	200	192 Nausikaa	13.1	54.39	2.40	HIP 73184	5.9	14 57.47	-21 25.0	35	164	83
	dec 16	4 11.4	42.51	321	606 Brang"ne	13.3	29.44	6.94	HIP 18081	5.8	3 51.90	+34 21.5	155	26	88
	dec 16	17 58.1	28.87	207	675 Ludmilla	13.9	42.75	2.53	HIP 65301	5.5	13 23.02	-17 44.1	59	154	91
	dec 18	8 36.3	92.73	105	735 Marghanna	13.0	19.54	6.34	HIP 9110	5.3	1 57.35	+17 49.1	127	36	98
	dec 18	23 4.8	89.63	3	120 Lachesis	12.4	29.76	3.92	HIP 31173	5.9	6 32.45	+32 27.3	166	21	99
	dec 29	17 31.2	119.10	182	203 Pompeja	12.5	34.91	5.34	TYC1 2504	5.3	6 35.20	+28 1.3	175	125	21
	2003 jan 2	8 50.2	4.13	162	110 Lydia	13.1	67.38	2.67	TYC1 3690	5.3	21 8.56	-21 11.6	32	38	0

A COLLABORATIVE WORK ON THREE ASTEROID LIGHTCURVES: 506 MARION, 585 BILKIS, 1506 XOSA

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The lightcurve periods for three asteroids, 506 Marion, 585 Bilkis, and 1506 Xosa were determined through the collaborative work of the two authors. The period for 506 Marion was determined to be 10.58 ±0.01h with an amplitude of 0.35 ±0.03m. The lightcurve for 585 Bilkis was found to have a period of 6.442 ±0.002h and an amplitude of 0.38 ±0.02m. Asteroid 1506 Xosa was found to have a lightcurve period of 5.9 ±0.01h and an amplitude of 0.28 ±0.02m.

When attending the Asteroids III conference in Palermo, Sicily, in 2001 June, we met with many professionals who encouraged a more coordinated collaborative effort among amateurs and between amateurs and professionals. The primary goal of this effort is to help concentrate observations on targets that are most needing of work, e.g., radar targets, asteroids with very long periods or periods with aliases close to 24 hours, and so on. Every journey begins with a first step and ours upon returning from Italy was to work out the process whereby one or both of us would accumulate images while one of us (Warner) would reduce the data and determine the lightcurve characteristics. Eventually both of us plan to reduce data gathered from each other and by other amateurs.

For 506 Marion and 585 Bilkis, Robinson took all images from his backyard observatory in Olathe, Kansas, a short distance from downtown Kansas City. He used a 0.30m SCT and SBIG ST-9E for images of 60s duration separated by approximately three minutes. The unguided images were accumulated on a hard disk, copied to a CD-ROM, and then sent to Warner for reduction using MPO Canopus. For 1506 Xosa, both authors acquired images, Warner using a 0.5m f/8.1 Ritchey-Chretien and FLI KAF-1001E. Exposures were also 60s in duration and spaced about 3 minutes apart.

The disparity in signal-to-noise ratios between the different systems made reductions a bit more difficult than might have been, mostly because of the increased noise in the Robinson data. Too, in some cases, the data sets were separated by several weeks, meaning adjustments had to be made for changing phase angle and distances of the asteroid from the earth and sun. Despite the difficulties, reasonable results for all three asteroids were obtained and are published below.

506 Marion

R. Dugan discovered 506 Marion in 1903 February and it was subsequently named for his cousin. It is a type C asteroid of about 104km size. As might be guessed from its spectral classification, Marion resides in the outer reaches of the main belt, having a semi-major axis of 3.04AU and inclination of about 17°.

Robinson obtained observations on the nights of 2001 July 1, 14, 21, and 30. Data were also obtained on two other nights, 2001 June 30 and August 1. They were of short duration and suffered from considerable noise and so were not used in the period determinations. Over the total span, the phase angle of the asteroid decreased from about 14° to 7°. Using the four "good" sessions, a period of 10.58 ±0.01h was found as well as an amplitude of 0.35 ±0.03m. A plot of the phased curve is shown in Figure 1.

585 Bilkis

Bilkis is a type C asteroid of about 52 km size. It has a semi-major axis of about 2.4AU and inclination of 7.5°. It was discovered by A. Kopff in 1906 February and was given the Koran name for the Queen of Sheba. Robinson obtained data on several nights in 2001 May through August. Specifically, the data used to find a lightcurve solution were obtained on 2001 May 14, 15, June 25, July 8, 9 and 16. During the span of used observations, the phase angle of Bilkis decreased from 17° to about 11.5°. The resulting lightcurve, shown in the phased plot of Figure 2, has a period of 6.442 ±0.002h and amplitude of 0.38 ±0.02m

1506 Xosa

The effort to determine the period of this asteroid was truly collaborative as both authors contributed data towards finding a lightcurve. Robinson's data were acquired on 2001 July 29 and August 3 while Warner worked the asteroid 2001 July 25 and August 8. Data were also obtained on other nights but were either dominated by noise or too short of coverage to contribute effectively to a solution. Figure 3 shows a phased plot based on the period of 5.9 ±0.01h. The amplitude of the curve is 0.28 ±0.02m

C. Jackson found Xosa in 1939 May while working in Johannesburg. The name is that of a South African tribe. The asteroid's orbit has a semi-major axis of about 2.55AU and inclination of 12.5°. Its size is estimated to be about 14-15km but its spectral classification has not yet been determined.

More on Collaborative Work

The ultimate goal of collaboration is to obtain continuous coverage for the entire rotational period of an asteroid. In the case of long period rotators or objects with periods that are synchronous with our diurnal period, this may require observation by observers spaced around the globe. This type of collaboration will involve a variety of optics, detectors and observing conditions. The work on 1506 Xosa illustrates how it is possible to combine data collected from different sites and even at different segments of the rotational period and still obtain a reliable solution.

Acknowledgements

The authors thank the entire professional community at the Asteroids III conference for extending a warm welcome and for their encouragement of amateur efforts around the world. In particular, we thank Richard Binzel, co-chairman of the conference, Alan Harris of Jet Propulsion Laboratory, Petr Pravec of Ondrejov Observatory, Czech Republic, and Ted Bowell of Lowell Observatory for their extraordinary support and assistance.

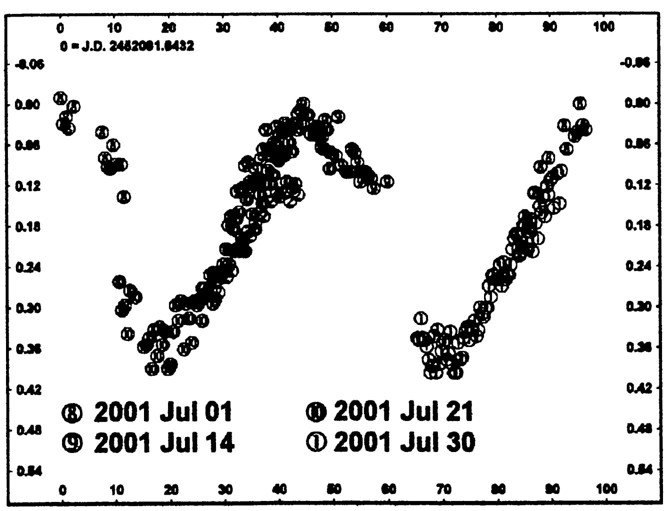

Figure 1. The phased plot for the data used on 506 Marion. The period is 10.58 ±0.01h with an amplitude of 0.35m ±0.03m. The data were obtained at the Sunflower observatory during 2001 July.

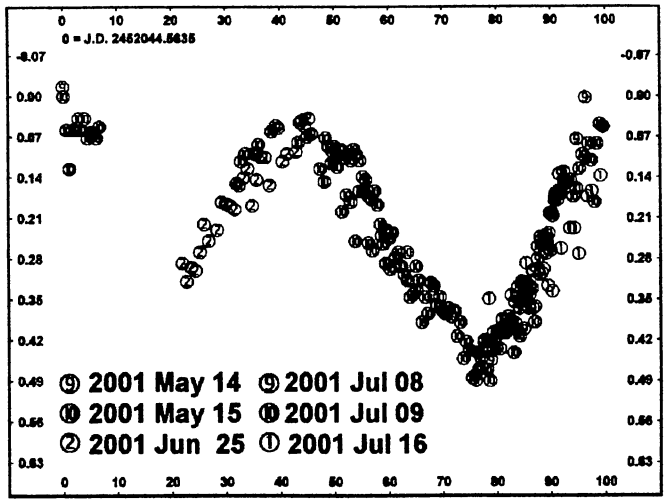

Figure 2. Data taken at Sunflower Observatory during the period 2001 May 14 – July 16 were used to create this phased plot based on a period of 6.442 ±0.002h. The amplitude is 0.38 ±0.02m

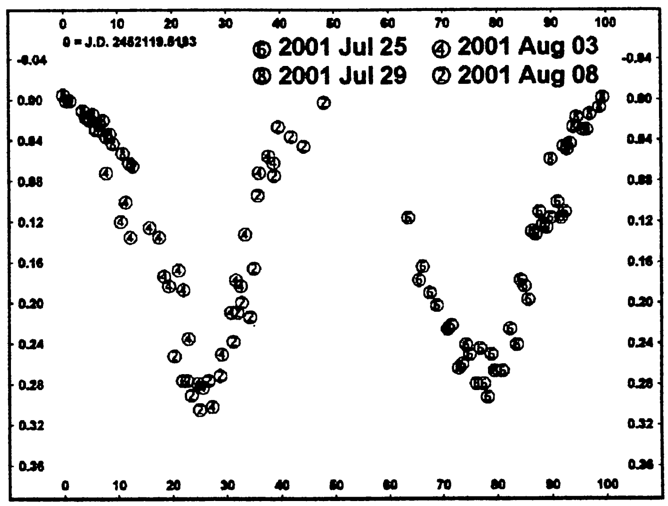

Figure 3. Observations from Sunflower and Palmer Divide Observatories taken in late 2001 July and early August produced this phased plot based on a period of 5.9 ±0.01h. The amplitude was found to be 0.28 ±0.02m.

MINOR PLANETS AT UNUSUALLY FAVORABLE ELONGATIONS IN 2002

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A list is presented of minor planets which are much brighter than usual at their 2002 apparitions. A very close approach within 0.077 AU of 5604 1992 FE, and moderately close approaches of planets 1580 Betulia and 6455 1992 HE, are especially noteworthy.

The minor planets in the lists which follow will be much brighter at their 2002 apparitions than at their average distances at maximum elongation. Many years may pass before these planets will be again as bright as in 2002. Observers are encouraged to give special attention to those which lie near the limit of their equipment.

Planet 1580 Betulia makes 4 revolutions every 13 years, and continues in 2002 the series of close approaches of 1950, 1963, 1976, and 1989. However the period is not exactly commensurable with Earth's, and each is now farther distant than the previous. Not again in the 21st century will Betulia become as bright as magnitude 15.0.

Planet 5604 1992 FE approaches with 0.077 AU on 2002 June 22 in an event observable only at far southern declinations, being south of declination -30° the entire interval in which it is brighter than magnitude 15.

Planet 6455 1992 HE has two moderately close approaches in the year 2002, to 0.366 AU on May 4, and to 0.444 AU on September 28, brighter than magnitude 14 on both occasions.

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 planets for which new or improved elements have been published subsequently in the Minor Planet Circulars, 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 planets whose brightest magnitudes near the time of maximum elongation vary by at least 2.0 in this interval and in 2002 will be within 0.3 of the brightest occurring, or vary by at least 3.0 and in 2002 will be within 0.5 of the brightest occurring; and which are visual magnitude 14.5 or brighter, are included. For planets 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 planets. 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. In a few cases absolute magnitudes have been improved by the results of the Magnitude Alert Program.

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 1. Numerical Sequence of Favorable Elongations

Planet	Max Elon D	Max E	RA	Dec	Min Mag D	Mag	Min Dist D	Min Dist
15	2002/09/13	162.1°	22h59m	+13°	2002/09/15	8.0	2002/09/17	1.251
18	2002/09/26	167.3°	0h38m	- 9°	2002/09/27	7.8	2002/09/28	0.814
20	2002/12/10	178.8°	5h 7m	+21°	2002/12/10	8.4	2002/12/12	1.103
25	2002/06/15	142.1°	18h12m	+13°	2002/06/22	10.0	2002/06/26	0.929
28	2002/02/21	177.6°	10h23m	+12°	2002/02/21	9.9	2002/02/20	1.406
32	2002/04/06	176.0°	12h53m	- 9°	2002/04/06	10.3	2002/04/07	1.376
77	2002/12/10	175.9°	5h 5m	+26°	2002/12/10	11.2	2002/12/08	1.344
86	2002/10/13	172.6°	1h26m	+ 1°	2002/10/13	11.7	2002/10/14	1.496
109	2002/11/12	168.0°	2h59m	+29°	2002/11/12	10.5	2002/11/13	0.927
111	2002/02/10	177.6°	9h34m	+11°	2002/02/10	10.7	2002/02/09	1.373
121	2002/10/20	171.6°	1h49m	+ 2°	2002/10/19	11.4	2002/10/17	1.968
137	2002/09/28	173.1°	0h 4m	+ 7°	2002/09/27	11.5	2002/09/20	1.616
162	2002/04/22	179.0°	13h58m	-11°	2002/04/21	12.3	2002/04/17	1.713
188	2002/06/01	176.6°	16h39m	-18°	2002/06/01	12.1	2002/06/08	1.430
197	2002/08/08	167.3°	21h30m	-28°	2002/08/08	12.0	2002/08/08	1.300
200	2002/11/12	168.3°	2h55m	+29°	2002/11/12	11.3	2002/11/11	1.400
229	2002/09/12	177.9°	23h23m	- 6°	2002/09/12	13.0	2002/09/10	1.908
239	2002/09/24	179.7°	0h 3m	+ 0°	2002/09/24	12.8	2002/09/27	1.342
240	2002/12/03	177.3°	4h39m	+19°	2002/12/03	11.1	2002/11/30	1.146
278	2002/04/10	170.9°	13h26m	+ 0°	2002/04/10	12.4	2002/04/11	1.399
322	2002/09/06	164.9°	22h38m	+ 7°	2002/09/07	11.5	2002/09/10	1.142
350	2002/12/05	167.0°	4h48m	+ 9°	2002/12/05	12.0	2002/12/05	1.665
352	2002/10/01	173.8°	0h20m	+ 8°	2002/10/02	11.5	2002/10/03	0.888
361	2002/01/28	162.9°	9h 2m	+34°	2002/01/27	13.0	2002/01/24	2.291
390	2002/02/20	170.3°	10h 4m	+ 1°	2002/02/20	13.2	2002/02/19	1.340
428	2002/10/13	179.4°	1h13m	+ 8°	2002/10/13	12.8	2002/10/14	0.907
429	2002/10/06	172.2°	0h34m	+12°	2002/10/06	12.5	2002/10/06	1.304
444	2002/10/03	178.2°	0h35m	+ 5°	2002/10/03	10.3	2002/09/30	1.305
459	2002/11/25	169.0°	3h59m	+31°	2002/11/25	12.7	2002/11/22	1.112
464	2002/08/02	171.8°	21h 0m	-25°	2002/08/02	12.4	2002/08/08	1.358
488	2002/02/13	164.0°	10h15m	+27°	2002/02/14	11.5	2002/02/15	1.659
503	2002/02/08	171.7°	9h40m	+22°	2002/02/08	11.9	2002/02/05	1.311
549	2002/01/28	177.8°	8h40m	+16°	2002/01/28	13.0	2002/01/21	1.089
593	2002/12/05	178.1°	4h45m	+20°	2002/12/05	11.5	2002/12/09	1.191
596	2002/06/02	179.5°	16h39m	-22°	2002/06/02	11.7	2002/06/02	1.432
638	2002/05/18	170.0°	15h47m	- 9°	2002/05/18	12.5	2002/05/18	1.288
654	2002/01/09	171.7°	7h25m	+13°	2002/01/10	9.7	2002/01/13	0.808
668	2002/10/28	179.8°	2h10m	+13°	2002/10/28	14.5	2002/10/19	1.418
670	2002/09/20	179.4°	23h51m	- 1°	2002/09/20	12.2	2002/09/21	1.269
676	2002/08/18	177.9°	21h46m	-11°	2002/08/18	12.7	2002/08/18	1.654
688	2002/08/28	175.0°	22h20m	- 4°	2002/08/28	13.3	2002/08/25	1.342
711	2002/07/08	166.9°	19h17m	-35°	2002/07/09	13.2	2002/07/10	0.798
725	2002/12/12	178.6°	5h16m	+24°	2002/12/12	13.9	2002/12/05	1.151
735	2002/11/01	177.3°	2h29m	+11°	2002/11/01	11.2	2002/10/21	0.988
753	2002/06/02	175.9°	16h39m	-26°	2002/06/02	11.3	2002/06/05	0.807
759	2002/08/27	168.8°	22h13m	+ 0°	2002/08/26	12.7	2002/08/23	1.089
774	2002/07/12	174.0°	19h24m	-15°	2002/07/12	11.8	2002/07/11	1.515
784	2002/05/04	169.5°	14h36m	-26°	2002/05/05	12.1	2002/05/10	1.410
788	2002/03/15	178.6°	11h37m	+ 0°	2002/03/15	12.0	2002/03/19	1.867
789	2002/06/13	170.3°	17h31m	-13°	2002/06/13	13.6	2002/06/15	1.288

Planet	Max Elon D	Max E	RA	Dec	Min Mag D	Mag	Min Dist D	Min Dist
817	2002/10/13	160.1°	1h43m	-10°	2002/10/14	13.5	2002/10/15	1.210
963	2002/11/25	179.4°	4h 1m	+20°	2002/11/25	13.9	2002/11/24	0.953
969	2002/10/06	175.3°	0h38m	+ 9°	2002/10/06	14.2	2002/10/05	0.966
984	2002/10/07	166.0°	0h28m	+18°	2002/10/06	11.8	2002/10/05	1.276
985	2002/07/28	177.6°	20h28m	-16°	2002/07/28	13.5	2002/08/08	0.746
1000	2002/04/28	146.9°	13h33m	-45°	2002/05/01	13.2	2002/05/04	1.507
1013	2002/12/10	163.4°	5h 7m	+39°	2002/12/12	12.9	2002/12/16	1.270
1040	2002/01/09	175.8°	7h18m	+18°	2002/01/08	13.6	2002/01/05	1.576
1052	2002/12/15	177.3°	5h29m	+20°	2002/12/15	13.7	2002/12/10	1.004
1059	2002/05/27	166.8°	16h28m	- 8°	2002/05/28	13.4	2002/06/02	1.235
1060	2002/08/24	167.5°	21h53m	+ 0°	2002/08/23	14.1	2002/08/18	0.810
1074	2002/11/28	179.2°	4h14m	+21°	2002/11/28	13.2	2002/11/27	1.641
1088	2002/10/03	167.6°	0h52m	- 7°	2002/10/03	12.6	2002/10/02	0.782
1107	2002/01/07	179.1°	7h15m	+21°	2002/01/07	12.6	2002/01/07	1.788
1116	2002/12/27	151.8°	6h25m	+51°	2002/12/25	12.9	2002/12/24	1.352
1125	2002/11/30	177.6°	4h25m	+19°	2002/11/30	14.4	2002/12/04	1.579
1130	2002/07/17	175.3°	19h41m	-16°	2002/07/17	13.3	2002/07/23	0.824
1131	2002/07/13	178.7°	19h29m	-23°	2002/07/13	13.8	2002/07/27	0.739
1153	2002/08/22	174.5°	21h58m	- 6°	2002/08/22	13.4	2002/08/18	0.848
1155	2002/05/31	173.3°	16h31m	-28°	2002/05/31	13.5	2002/05/30	1.066
1187	2002/12/19	163.0°	5h41m	+40°	2002/12/17	13.9	2002/12/12	1.207
1222	2002/06/25	161.0°	18h28m	- 4°	2002/06/27	13.8	2002/07/01	1.158
1275	2002/10/24	170.8°	2h12m	+ 3°	2002/10/24	13.3	2002/10/22	1.249
1281	2002/05/11	175.2°	15h16m	-13°	2002/05/11	13.9	2002/05/19	1.160
1324	2002/08/03	178.7°	20h54m	-16°	2002/08/03	13.9	2002/07/29	0.861
1354	2002/05/28	173.8°	16h15m	-27°	2002/05/28	14.5	2002/06/02	1.507
1397	2002/08/11	174.0°	21h30m	-20°	2002/08/10	13.5	2002/08/03	1.068
1527	2002/09/21	176.3°	23h56m	- 4°	2002/09/20	13.4	2002/09/13	0.839
1530	2002/08/27	172.7°	22h16m	- 2°	2002/08/28	14.5	2002/09/02	0.851
1534	2002/01/16	164.7°	8h11m	+35°	2002/01/15	14.0	2002/01/14	1.079
1547	2002/01/15	178.4°	7h48m	+19°	2002/01/15	12.5	2002/01/10	1.030
1550	2002/12/01	178.8°	4h28m	+22°	2002/12/01	13.3	2002/11/18	0.944
1580	2002/05/31	116.1°	12h54m	+13°	2002/05/30	14.0	2002/05/29	0.238
1585	2002/08/19	176.6°	21h48m	- 9°	2002/08/20	14.0	2002/08/29	1.624
1658	2002/06/23	178.8°	18h 8m	-22°	2002/06/23	13.4	2002/06/25	1.085
1709	2002/08/10	175.0°	21h17m	-10°	2002/08/11	14.2	2002/08/14	0.884
1734	2002/10/11	175.8°	1h13m	+ 3°	2002/10/11	13.9	2002/10/08	1.149
1761	2002/02/11	176.2°	9h43m	+17°	2002/02/11	14.3	2002/02/09	1.431
1789	2002/07/07	179.5°	19h 7m	-22°	2002/07/07	14.0	2002/07/13	0.818
1874	2002/09/30	175.9°	0h34m	- 0°	2002/09/30	13.4	2002/09/26	1.227
1883	2002/11/26	165.7°	3h59m	+ 6°	2002/11/25	14.5	2002/11/22	0.819
1885	2002/08/19	179.8°	21h53m	-12°	2002/08/19	14.0	2002/08/19	0.681
1922	2002/05/16	151.0°	16h51m	+ 2°	2002/05/18	13.6	2002/05/21	0.742
1954	2002/07/01	179.4°	18h38m	-23°	2002/07/01	13.9	2002/07/12	1.346
2013	2002/09/30	163.6°	0h52m	-12°	2002/09/28	14.1	2002/09/22	0.838
2093	2002/08/03	174.7°	20h45m	-12°	2002/08/02	14.2	2002/07/28	0.926
2236	2002/08/21	165.2°	22h16m	-26°	2002/08/20	13.8	2002/08/16	0.846
2254	2002/09/04	179.4°	22h51m	- 6°	2002/09/04	14.1	2002/09/05	1.001
2257	2002/10/27	176.4°	2h 1m	+16°	2002/10/27	14.5	2002/10/20	0.955
2362	2002/09/19	177.9°	23h48m	- 3°	2002/09/19	14.5	2002/09/18	0.768
2433	2002/04/04	178.1°	12h55m	- 3°	2002/04/04	14.2	2002/04/13	1.245
2536	2002/08/09	173.1°	21h 8m	- 9°	2002/08/10	14.5	2002/08/17	0.884
2569	2002/11/17	172.0°	3h32m	+10°	2002/11/16	13.8	2002/11/13	1.246
2585	2002/10/29	167.5°	2h28m	+ 1°	2002/10/28	14.1	2002/10/25	0.882
2755	2002/11/06	178.5°	2h41m	+17°	2002/11/06	14.5	2002/11/01	1.166
2768	2002/09/11	168.1°	23h37m	-15°	2002/09/12	14.0	2002/09/16	0.918
2820	2002/10/03	177.1°	0h33m	+ 6°	2002/10/03	14.2	2002/10/03	0.871
2829	2002/07/03	163.4°	18h50m	-39°	2002/07/04	13.7	2002/07/06	1.534
2830	2002/04/27	166.2°	14h23m	- 0°	2002/04/27	14.4	2002/04/25	0.925
2834	2002/01/12	168.3°	7h30m	+ 9°	2002/01/13	14.5	2002/01/14	1.180
3034	2002/09/11	175.9°	23h24m	- 8°	2002/09/11	13.6	2002/09/05	0.854
3093	2002/09/16	157.1°	22h59m	+18°	2002/09/14	14.2	2002/09/12	1.171
3127	2002/08/30	173.6°	22h24m	- 3°	2002/08/29	14.3	2002/08/27	1.078
3485	2002/07/31	179.5°	20h41m	-18°	2002/07/31	14.3	2002/07/29	1.023
3679	2002/10/15	171.3°	1h 6m	+16°	2002/10/14	14.5	2002/10/11	0.724
3699	2002/07/01	179.1°	18h42m	-23°	2002/07/01	14.4	2002/07/08	1.030
3761	2002/04/28	174.9°	14h31m	- 9°	2002/04/29	14.5	2002/05/09	1.633
3768	2002/08/12	176.2°	21h21m	-11°	2002/08/12	14.5	2002/08/17	1.564
4155	2002/09/08	173.1°	23h15m	-12°	2002/09/08	14.2	2002/09/12	0.885
4287	2002/08/12	167.5°	21h45m	-26°	2002/08/12	14.5	2002/08/09	0.795
4288	2002/11/18	175.0°	3h31m	+24°	2002/11/18	14.4	2002/11/12	1.286
4460	2002/08/10	171.7°	21h26m	-23°	2002/08/11	14.2	2002/08/14	1.475
4577	2002/02/05	160.9°	9h44m	+33°	2002/02/04	14.0	2002/02/02	0.922
4925	2002/10/13	169.8°	0h56m	+17°	2002/10/13	14.4	2002/10/12	1.326
5095	2002/08/18	179.1°	21h49m	-12°	2002/08/18	14.4	2002/08/19	0.891
5142	2002/11/03	176.4°	2h39m	+11°	2002/11/03	13.6	2002/11/01	0.859
5349	2002/10/10	153.2°	1h 9m	+33°	2002/10/20	14.2	2002/10/28	0.756
5391	2002/09/09	178.8°	23h11m	- 4°	2002/09/09	13.9	2002/09/02	0.734
5438	2002/01/28	170.0°	8h39m	+ 8°	2002/01/29	13.6	2002/02/05	1.155
5604	2002/05/31	143.8°	17h44m	-55°	2002/06/14	13.2	2002/06/22	0.077
6455	2002/04/15	172.1°	13h32m	- 1°	2002/04/19	13.2	2002/05/04	0.366
6455	2002/10/18	165.3°	1h17m	- 4°	2002/10/11	13.8	2002/09/28	0.444
6522	2002/07/14	177.5°	19h34m	-24°	2002/07/14	14.4	2002/07/08	0.979
6610	2002/11/14	177.4°	3h19m	+15°	2002/11/14	14.3	2002/11/13	0.909
7564	2002/03/03	178.2°	10h58m	+ 8°	2002/03/03	14.5	2002/03/02	1.235
8270	2002/06/09	170.3°	17h 5m	-32°	2002/06/09	14.4	2002/06/13	0.820
9021	2002/08/15	178.5°	21h39m	-12°	2002/08/15	14.3	2002/08/14	1.118
10142	2002/10/25	165.0°	2h13m	- 2°	2002/10/25	14.4	2002/10/23	1.080
10772	2002/01/02	178.0°	6h50m	+20°	2002/01/02	14.0	2002/01/09	0.891
15127	2002/09/20	176.6°	23h53m	- 4°	2002/09/20	14.2	2002/09/21	1.183
16143	2002/09/04	165.2°	22h41m	+ 7°	2002/09/02	14.5	2002/08/29	0.502
18487	2002/07/18	170.8°	19h39m	-12°	2002/07/19	14.2	2002/07/22	1.215

Table 2. Temporal Sequence of Favorable Elongations

Planet	Max Elon D	Max E	RA	Dec	Min Mag E	Mag	Min Dist D	Min Dist
10772	2002/01/02	178.0°	6h50m	+20°	2002/01/02	14.0	2002/01/09	0.891
1107	2002/01/07	179.1°	7h15m	+21°	2002/01/07	12.6	2002/01/07	1.788
654	2002/01/09	171.7°	7h25m	+13°	2002/01/10	9.7	2002/01/13	0.808
1040	2002/01/09	175.8°	7h18m	+18°	2002/01/08	13.6	2002/01/05	1.576
2834	2002/01/12	168.3°	7h30m	+ 9°	2002/01/13	14.5	2002/01/14	1.180
1547	2002/01/15	178.4°	7h48m	+19°	2002/01/15	12.5	2002/01/10	1.030
1534	2002/01/16	164.7°	8h11m	+35°	2002/01/15	14.0	2002/01/14	1.079
361	2002/01/28	162.9°	9h 2m	+34°	2002/01/27	13.0	2002/01/24	2.291
549	2002/01/28	177.8°	8h40m	+16°	2002/01/28	13.0	2002/01/21	1.089
5438	2002/01/28	170.0°	8h39m	+ 8°	2002/01/29	13.6	2002/02/05	1.155
4577	2002/02/05	160.9°	9h44m	+33°	2002/02/04	14.0	2002/02/02	0.922
503	2002/02/08	171.7°	9h40m	+22°	2002/02/08	11.9	2002/02/05	1.311
111	2002/02/10	177.6°	9h34m	+11°	2002/02/10	10.7	2002/02/09	1.373
1761	2002/02/11	176.2°	9h43m	+17°	2002/02/11	14.3	2002/02/09	1.431
488	2002/02/13	164.0°	10h15m	+27°	2002/02/14	11.5	2002/02/15	1.659
390	2002/02/20	170.3°	10h 4m	+ 1°	2002/02/20	13.2	2002/02/19	1.340
28	2002/02/21	177.6°	10h23m	+12°	2002/02/21	9.9	2002/02/20	1.406
7564	2002/03/03	178.2°	10h58m	+ 8°	2002/03/03	14.5	2002/03/02	1.235
788	2002/03/15	178.6°	11h37m	+ 0°	2002/03/15	12.0	2002/03/19	1.867
2433	2002/04/04	178.1°	12h55m	- 3°	2002/04/04	14.2	2002/04/13	1.245
32	2002/04/06	176.0°	12h53m	- 9°	2002/04/06	10.3	2002/04/07	1.376
278	2002/04/10	170.9°	13h26m	+ 0°	2002/04/10	12.4	2002/04/11	1.399
6455	2002/04/15	172.1°	13h32m	- 1°	2002/04/19	13.2	2002/05/04	0.366
162	2002/04/22	179.0°	13h58m	-11°	2002/04/21	12.3	2002/04/17	1.713
2830	2002/04/27	166.2°	14h23m	- 0°	2002/04/27	14.4	2002/04/25	0.925
1000	2002/04/28	146.9°	13h33m	-45°	2002/05/01	13.2	2002/05/04	1.507
3761	2002/04/28	174.9°	14h31m	- 9°	2002/04/29	14.5	2002/05/09	1.633
784	2002/05/04	169.5°	14h36m	-26°	2002/05/05	12.1	2002/05/10	1.410
1281	2002/05/11	175.2°	15h16m	-13°	2002/05/11	13.9	2002/05/19	1.160
1922	2002/05/16	151.0°	16h51m	+ 2°	2002/05/18	13.6	2002/05/21	0.742
638	2002/05/18	170.0°	15h47m	- 9°	2002/05/18	12.5	2002/05/18	1.288
1059	2002/05/27	166.8°	16h28m	- 8°	2002/05/28	13.4	2002/06/02	1.235
1354	2002/05/28	173.8°	16h15m	-27°	2002/05/28	14.5	2002/06/02	1.507
1155	2002/05/31	173.3°	16h31m	-28°	2002/05/31	13.5	2002/05/30	1.066
1580	2002/05/31	116.1°	12h54m	+13°	2002/05/30	14.0	2002/05/29	0.238
5604	2002/05/31	143.8°	17h44m	-55°	2002/06/14	13.2	2002/06/22	0.077
188	2002/06/01	176.6°	16h39m	-18°	2002/06/01	12.1	2002/06/08	1.430
596	2002/06/02	179.5°	16h39m	-22°	2002/06/02	11.7	2002/06/02	1.432
753	2002/06/02	175.9°	16h39m	-26°	2002/06/02	11.3	2002/06/05	0.807
8270	2002/06/09	170.3°	17h 5m	-32°	2002/06/09	14.4	2002/06/13	0.820
789	2002/06/13	170.3°	17h31m	-13°	2002/06/13	13.6	2002/06/15	1.288
25	2002/06/15	142.1°	18h12m	+13°	2002/06/22	10.0	2002/06/26	0.929
1658	2002/06/23	178.8°	18h 8m	-22°	2002/06/23	13.4	2002/06/25	1.085
1222	2002/06/25	161.0°	18h28m	- 4°	2002/06/27	13.8	2002/07/01	1.158
1954	2002/07/01	179.4°	18h38m	-23°	2002/07/01	13.9	2002/07/12	1.346
3699	2002/07/01	179.1°	18h42m	-23°	2002/07/01	14.4	2002/07/08	1.030
2829	2002/07/03	163.4°	18h50m	-39°	2002/07/04	13.7	2002/07/06	1.534
1789	2002/07/07	179.5°	19h 7m	-22°	2002/07/07	14.0	2002/07/13	0.818
711	2002/07/08	166.9°	19h17m	-35°	2002/07/09	13.2	2002/07/10	0.798
774	2002/07/12	174.0°	19h24m	-15°	2002/07/12	11.8	2002/07/11	1.515
1131	2002/07/13	178.7°	19h29m	-23°	2002/07/13	13.8	2002/07/27	0.739
6522	2002/07/14	177.5°	19h34m	-24°	2002/07/14	14.4	2002/07/08	0.979
1130	2002/07/17	175.3°	19h41m	-16°	2002/07/17	13.3	2002/07/23	0.824
18487	2002/07/18	170.8°	19h39m	-12°	2002/07/19	14.2	2002/07/22	1.215
985	2002/07/28	177.6°	20h28m	-16°	2002/07/28	13.5	2002/08/08	0.746
3485	2002/07/31	179.5°	20h41m	-18°	2002/07/31	14.3	2002/07/29	1.023
464	2002/08/02	171.8°	21h 0m	-25°	2002/08/02	12.4	2002/08/08	1.358
1324	2002/08/03	178.7°	20h54m	-16°	2002/08/03	13.9	2002/07/29	0.861
2093	2002/08/03	174.7°	20h45m	-12°	2002/08/02	14.2	2002/07/28	0.926
197	2002/08/08	167.3°	21h30m	-28°	2002/08/08	12.0	2002/08/08	1.300
2536	2002/08/09	173.1°	21h 8m	- 9°	2002/08/10	14.5	2002/08/17	0.884
1709	2002/08/10	175.0°	21h17m	-10°	2002/08/11	14.2	2002/08/14	0.884
4460	2002/08/10	171.7°	21h26m	-23°	2002/08/11	14.2	2002/08/14	1.475
1397	2002/08/11	174.0°	21h30m	-20°	2002/08/10	13.5	2002/08/03	1.068
3768	2002/08/12	176.2°	21h21m	-11°	2002/08/12	14.5	2002/08/17	1.564
4287	2002/08/12	167.5°	21h45m	-26°	2002/08/12	14.5	2002/08/09	0.795
9021	2002/08/15	178.5°	21h39m	-12°	2002/08/15	14.3	2002/08/14	1.118
676	2002/08/18	177.9°	21h46m	-11°	2002/08/18	12.7	2002/08/18	1.654
5095	2002/08/18	179.1°	21h49m	-12°	2002/08/18	14.4	2002/08/19	0.891
1585	2002/08/19	176.6°	21h48m	- 9°	2002/08/20	14.0	2002/08/29	1.624
1885	2002/08/19	179.8°	21h53m	-12°	2002/08/19	14.0	2002/08/19	0.681
2236	2002/08/21	165.2°	22h16m	-26°	2002/08/20	13.8	2002/08/16	0.846
1153	2002/08/22	174.5°	21h58m	- 6°	2002/08/22	13.4	2002/08/18	0.848
1060	2002/08/24	167.5°	21h53m	+ 0°	2002/08/23	14.1	2002/08/18	0.810
759	2002/08/27	168.8°	22h13m	+ 0°	2002/08/26	12.7	2002/08/23	1.089
1530	2002/08/27	172.7°	22h16m	- 2°	2002/08/28	14.5	2002/09/02	0.851
688	2002/08/28	175.0°	22h20m	- 4°	2002/08/28	13.3	2002/08/25	1.342
3127	2002/08/30	173.6°	22h24m	- 3°	2002/08/29	14.3	2002/08/27	1.078
2254	2002/09/04	179.4°	22h51m	- 6°	2002/09/04	14.1	2002/09/05	1.001
16143	2002/09/04	165.2°	22h41m	+ 7°	2002/09/02	14.5	2002/08/29	0.502
322	2002/09/06	164.9°	22h38m	+ 7°	2002/09/07	11.5	2002/09/10	1.142
4155	2002/09/08	173.1°	23h15m	-12°	2002/09/08	14.2	2002/09/12	0.885
5391	2002/09/09	178.8°	23h11m	- 4°	2002/09/09	13.9	2002/09/02	0.734
2768	2002/09/11	168.1°	23h37m	-15°	2002/09/12	14.0	2002/09/16	0.918
3034	2002/09/11	175.9°	23h24m	- 8°	2002/09/11	13.6	2002/09/05	0.854
229	2002/09/12	177.9°	23h23m	- 6°	2002/09/12	13.0	2002/09/10	1.908
15	2002/09/13	162.1°	22h59m	+13°	2002/09/15	8.0	2002/09/17	1.251
3093	2002/09/16	157.1°	22h59m	+18°	2002/09/14	14.2	2002/09/12	1.171
2362	2002/09/19	177.9°	23h48m	- 3°	2002/09/19	14.5	2002/09/18	0.768
670	2002/09/20	179.4°	23h51m	- 1°	2002/09/20	12.2	2002/09/21	1.269
15127	2002/09/20	176.6°	23h53m	- 4°	2002/09/20	14.2	2002/09/21	1.183
1527	2002/09/21	176.3°	23h56m	- 4°	2002/09/20	13.4	2002/09/13	0.839
239	2002/09/24	179.7°	0h 3m	+ 0°	2002/09/24	12.8	2002/09/27	1.342
18	2002/09/26	167.3°	0h38m	- 9°	2002/09/27	7.8	2002/09/28	0.814
137	2002/09/28	173.1°	0h 4m	+ 7°	2002/09/27	11.5	2002/09/20	1.616
1874	2002/09/30	175.9°	0h34m	- 0°	2002/09/30	13.4	2002/09/26	1.227
2013	2002/09/30	163.6°	0h52m	-12°	2002/09/28	14.1	2002/09/22	0.838
352	2002/10/01	173.8°	0h20m	+ 8°	2002/10/02	11.5	2002/10/03	0.888
444	2002/10/03	178.2°	0h35m	+ 5°	2002/10/03	10.3	2002/09/30	1.305
1088	2002/10/03	167.6°	0h52m	- 7°	2002/10/03	12.6	2002/10/02	0.782
2820	2002/10/03	177.1°	0h33m	+ 6°	2002/10/03	14.2	2002/10/03	0.871
429	2002/10/06	172.2°	0h34m	+12°	2002/10/06	12.5	2002/10/06	1.304
969	2002/10/06	175.3°	0h38m	+ 9°	2002/10/06	14.2	2002/10/05	0.966
984	2002/10/07	166.0°	0h28m	+18°	2002/10/06	11.8	2002/10/05	1.276
5349	2002/10/10	153.2°	1h 9m	+33°	2002/10/20	14.2	2002/10/28	0.756
1734	2002/10/11	175.8°	1h13m	+ 3°	2002/10/11	13.9	2002/10/08	1.149
86	2002/10/13	172.6°	1h26m	+ 1°	2002/10/13	11.7	2002/10/14	1.496
428	2002/10/13	179.4°	1h13m	+ 8°	2002/10/13	12.8	2002/10/14	0.907
817	2002/10/13	160.1°	1h43m	-10°	2002/10/14	13.5	2002/10/15	1.210
4925	2002/10/13	169.8°	0h56m	+17°	2002/10/13	14.4	2002/10/12	1.326

Planet	Max Elon D	Max E	RA	Dec	Min Mag D	Mag	Min Dist D	Min Dist
3679	2002/10/15	171.3°	1h 6m	+16°	2002/10/14	14.5	2002/10/11	0.724
6455	2002/10/18	165.3°	1h17m	- 4°	2002/10/11	13.8	2002/09/28	0.444
121	2002/10/20	171.6°	1h49m	+ 2°	2002/10/19	11.4	2002/10/17	1.968
1275	2002/10/24	170.8°	2h12m	+ 3°	2002/10/24	13.3	2002/10/22	1.249
10142	2002/10/25	165.0°	2h13m	- 2°	2002/10/25	14.4	2002/10/23	1.080
2257	2002/10/27	176.4°	2h 1m	+16°	2002/10/27	14.5	2002/10/20	0.955
668	2002/10/28	179.8°	2h10m	+13°	2002/10/28	14.5	2002/10/19	1.418
2585	2002/10/29	167.5°	2h28m	+ 1°	2002/10/28	14.1	2002/10/25	0.882
735	2002/11/01	177.3°	2h29m	+11°	2002/11/01	11.2	2002/10/21	0.988
5142	2002/11/03	176.4°	2h39m	+11°	2002/11/03	13.6	2002/11/01	0.859
2755	2002/11/06	178.5°	2h41m	+17°	2002/11/06	14.5	2002/11/01	1.166
109	2002/11/12	168.0°	2h59m	+29°	2002/11/12	10.5	2002/11/13	0.927
200	2002/11/12	168.3°	2h55m	+29°	2002/11/12	11.3	2002/11/11	1.400
6610	2002/11/14	177.4°	3h19m	+15°	2002/11/14	14.3	2002/11/13	0.909
2569	2002/11/17	172.0°	3h32m	+10°	2002/11/16	13.8	2002/11/13	1.246
4288	2002/11/18	175.0°	3h31m	+24°	2002/11/18	14.4	2002/11/12	1.286
459	2002/11/25	169.0°	3h59m	+31°	2002/11/25	12.7	2002/11/22	1.112
963	2002/11/25	179.4°	4h 1m	+20°	2002/11/25	13.9	2002/11/24	0.953
1883	2002/11/26	165.7°	3h59m	+ 6°	2002/11/25	14.5	2002/11/22	0.819
1074	2002/11/28	179.2°	4h14m	+21°	2002/11/28	13.2	2002/11/27	1.641
1125	2002/11/30	177.6°	4h25m	+19°	2002/11/30	14.4	2002/12/04	1.579
1550	2002/12/01	178.8°	4h28m	+22°	2002/12/01	13.3	2002/11/18	0.944
240	2002/12/03	177.3°	4h39m	+19°	2002/12/03	11.1	2002/11/30	1.146
350	2002/12/05	167.0°	4h48m	+ 9°	2002/12/05	12.0	2002/12/05	1.665
593	2002/12/05	178.1°	4h45m	+20°	2002/12/05	11.5	2002/12/09	1.191
20	2002/12/10	178.8°	5h 7m	+21°	2002/12/10	8.4	2002/12/12	1.103
77	2002/12/10	175.9°	5h 5m	+26°	2002/12/10	11.2	2002/12/08	1.344
1013	2002/12/10	163.4°	5h 7m	+39°	2002/12/12	12.9	2002/12/16	1.270
725	2002/12/12	178.6°	5h16m	+24°	2002/12/12	13.9	2002/12/05	1.151
1052	2002/12/15	177.3°	5h29m	+20°	2002/12/15	13.7	2002/12/10	1.004
1187	2002/12/19	163.0°	5h41m	+40°	2002/12/17	13.9	2002/12/12	1.207
1116	2002/12/27	151.8°	6h25m	+51°	2002/12/25	12.9	2002/12/24	1.352

CLOSE MUTUAL APPROACHES OF MINOR PLANETS IN 2002

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The table below lists 30 cases where one minor planet comes to within 120" of another and both are of 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 2002 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 U.T.). 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: contains information about the *nearest* minor planet:
   - 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. The same data as for the nearest one are given. In addition the right ascension and declination (2000.0) are printed.

5. Sun and Moon:
   - elongation of the Sun in degrees
   - elongation of the Moon (degrees)
   - illuminated fraction of the Moon in %

The author wants to acknowledge the Computer Center of Agfa-Gevaert N.V. (Mortsel, Belgium), where the computations were executed.

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)	Declination (2000.0)	Elongation Sun	Elongation Moon	Ill. frac. Moon
		h m	"	°			"	"/h	°			"	"/h	°	h m	° '	°	°	%
	2002 jan 22	19 37.3	83.64	334	564 Dudu	15.47	2.94	75.70	62	593 Titania	15.13	2.47	56.16	61	23 02.67	-20 41.3	38	61	58
	feb 4	20 35.0	100.13	201	159 Aemilia	13.22	3.72	20.18	57	559 Nanon	14.59	3.58	17.99	47	4 00.99	+14 44.2	105	162	49
	feb 5	21 0.2	106.24	165	78 Diana	13.38	3.17	54.62	70	366 Vincentina	14.55	2.54	43.44	68	0 57.53	+13 49.7	61	130	38
	feb 11	21 47.5	16.52	355	253 Mathilde	15.08	3.41	69.44	69	1567 Alikoski	15.81	2.33	39.77	57	1 28.27	+ 4 49.9	59	64	1
?	feb 14	13 46.6	11.26	163	60 Echo	12.33	4.36	64.75	72	834 Burnhamia	15.93	2.33	28.46	70	2 37.30	+12 11.8	75	52	4
	mar 20	10 53.3	109.68	169	84 Klio	13.29	4.68	38.53	284	3793 Leonteus	15.29	2.16	21.66	307	12 01.26	- 9 01.5	170	110	33
?	mar 31	17 31.9	3.72	338	66 Maja	14.29	3.42	65.08	84	476 Hedwig	14.26	2.78	46.99	90	4 43.44	+24 59.4	61	150	87
	apr 9	7 23.5	109.55	343	113 Amalthea	13.72	3.06	59.13	80	11 Parthenope	11.99	2.88	55.97	80	4 49.39	+20 13.8	54	93	11
	may 17	21 44.0	78.95	232	245 Vera	13.17	3.51	7.04	220	648 Pippa	15.76	2.84	9.02	273	19 14.85	-25 50.8	129	157	30
	may 20	22 17.8	107.58	250	936 Kunigunde	15.06	3.77	16.54	285	721 Tabora	15.32	2.83	15.26	277	13 18.95	- 6 33.7	140	37	62
	may 21	19 17.4	116.84	328	75 Eurydike	13.22	3.60	88.39	65	167 Urda	14.99	2.56	55.17	69	0 58.74	+ 5 46.7	44	159	71
	jun 20	15 7.0	56.02	215	360 Carlova	14.50	2.61	40.96	112	893 Leopoldina	15.90	2.34	33.74	110	10 39.42	+16 05.4	66	55	76
	jun 23	10 22.6	13.61	6	230 Athamantis	12.30	3.52	43.92	101	539 Pamina	15.84	2.64	28.31	104	11 19.65	- 2 59.7	80	83	94
	jun 24	14 20.0	92.40	104	1356 Nyanza	15.84	2.46	51.78	73	260 Huberta	15.10	2.34	49.24	78	3 03.29	+13 07.3	45	137	97
	jul 8	21 45.5	97.60	222	127 Johanna	13.82	2.77	58.28	117	758 Mancunia	14.42	2.30	45.88	113	10 37.83	+13 15.7	49	72	5
?	aug 15	8 40.7	4.13	178	105 Artemis	13.34	3.12	76.84	103	16 Psyche	12.17	2.15	47.65	113	11 52.59	+ 2 27.0	35	53	48
	sep 14	3 27.8	115.83	20	638 Moira	14.70	3.69	55.73	106	62 Erato	15.09	2.48	29.41	102	16 25.36	-20 12.3	76	24	54
	sep 28	16 23.4	91.92	63	389 Industria	12.97	3.68	27.44	89	446 Aeternitas	14.24	3.42	24.55	66	5 56.62	+28 44.0	96	24	60
	oct 3	6 6.0	92.21	15	551 Ortrud	15.23	2.54	58.06	111	184 Dejopeja	14.26	2.37	54.22	111	10 13.55	+11 13.1	38	9	15
	oct 7	23 12.2	98.01	343	456 Abnoba	14.25	2.99	71.87	98	861 Aida	15.52	2.42	53.94	108	15 41.76	-14 49.6	42	25	4
	oct 20	1 14.7	87.32	6	113 Amalthea	13.49	3.05	71.74	110	66 Maja	14.86	2.69	58.37	113	11 03.73	+ 7 39.8	42	153	98
	nov 8	2 5.5	86.99	151	221 Eos	13.99	2.21	46.87	107	361 Bononia	14.94	2.00	41.37	116	12 21.55	+ 2 42.8	41	84	16
	nov 24	10 13.0	52.42	20	79 Eurynome	13.52	2.58	55.00	111	1143 Odysseus	15.94	1.48	29.17	112	13 13.22	- 9 09.9	41	87	81
	dec 2	5 38.9	61.60	181	660 Crescentia	14.25	3.08	67.20	87	190 Ismene	14.97	1.76	31.84	82	20 07.94	-16 11.5	50	81	9
	dec 8	20 20.1	10.05	9	236 Honoria	13.55	2.89	68.78	83	466 Tisiphone	14.84	2.09	44.27	74	19 54.44	-15 55.3	41	18	24
?	dec 17	8 35.7	0.35	25	116 Sirona	13.01	3.08	61.81	110	21 Lutetia	12.96	2.80	53.46	110	13 53.82	- 9 02.5	55	150	91
	dec 18	20 29.9	35.66	75	977 Philippa	14.12	4.12	32.71	282	1669 Dagmar	15.71	3.79	29.66	264	4 56.28	+23 47.8	168	19	96
	dec 27	11 35.1	68.13	129	333 Badenia	15.02	2.65	60.45	70	909 Ulla	15.24	2.23	47.55	80	21 25.95	-16 14.9	43	129	47
	dec 28	2 35.6	22.01	153	308 Polyxo	13.46	3.27	39.04	69	34 Circe	14.07	3.09	33.94	70	23 56.30	- 1 50.3	82	158	40
	dec 28	10 40.6	52.40	166	102 Miriam	13.91	3.08	82.62	77	190 Ismene	14.91	1.68	37.12	79	20 32.78	-15 09.7	30	103	36

THE MINOR PLANET OBSERVER: CAPS

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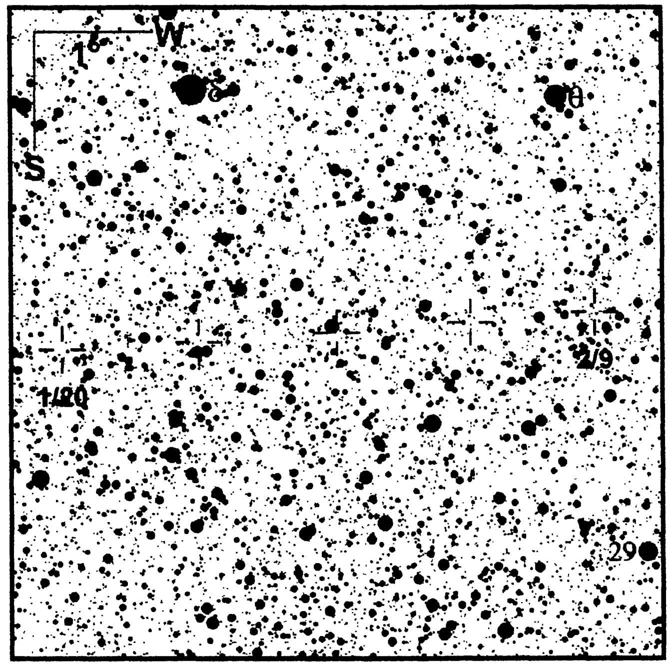
The past few issues of the *Minor Planet Bulletin* have shown the value of collaborating with others to get results. This is true in everyday life and is particularly valuable when working asteroid lightcurves. I've covered the reasons why a single observer cannot always get results, or at least will have a great deal of difficulty doing so: periods near 24 hours, weather, and so on. That's not to say a solitary observer can't do quite a bit of work; again these pages are testament to that. However, as more amateurs get involved with lightcurve work, there also becomes the need to help direct observing programs so that the most benefit can be derived from observations. Amateurs may have more scope time than professionals but even amateurs have their time limitations.

A couple of years ago, I started the Collaborative Asteroid Lightcurve Link (CALL), which is a web site where one can download a list of those asteroids with established lightcurves, view lists of potential targets for the upcoming months, post notifications of which asteroids are being worked, and post summaries of results obtained. The site's popularity has been growing but it lacked some resources to help direct those just getting started with lightcurve work and those who knew how to do the work but weren't exactly sure on how to proceed.

Establishing such resources and a network of amateur observers, who would work with one another and work with the professional community was one of the topics in small discussions during the Asteroids III conference. Out of those discussions came the Center for Asteroid Physical Studies (CAPS). CAPS is not a formal organization with membership dues but simply a means of trying to build that network of observers. In early September 2001, three amateurs observers, well known for their work in astrometry and photometry, and I met at my house in Colorado Springs to form the beginnings of what CAPS would be and how it would develop.

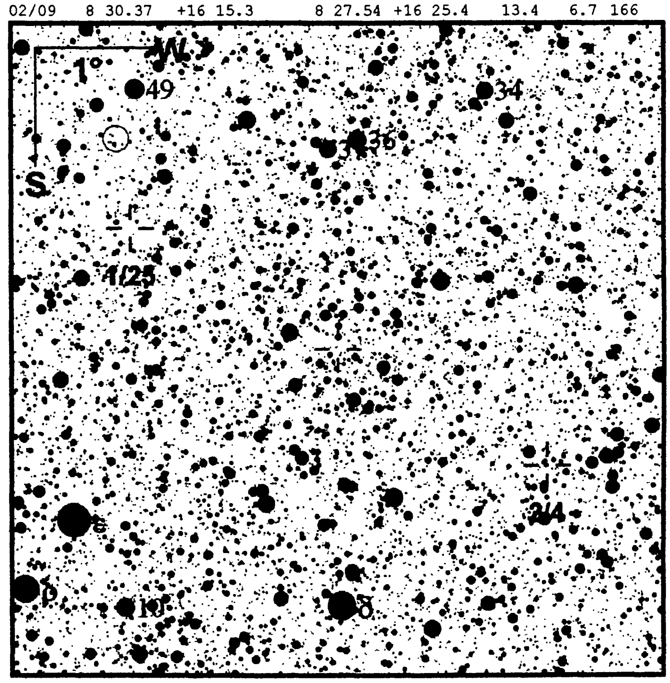
You'll find more details at the CAPS web site (http://www.MinorPlanetObserver.com/caps/default.htm – a work in progress!) but, in short, we hope to encourage amateurs to take part in directed observing programs (go for specific targets). We will also try to provide on-line resources to help the beginner to advanced observer understand the process and techniques involved in quality lightcurve work. Our first directed program is to encourage observers to determine the lightcurves for the first 1000 numbered asteroids. There are quite a few yet to be measured and as these targets tend to be brighter, they will make good starter projects for individuals or schools building a photometry program. In regards to the latter, remember that the results can be published on these pages. Hold up an MPB with a published article and tell how that lightcurve work helped the students with their math skills, and those budget purse strings may loosen just a little.

As the talks at Palermo went on, it became very clear that there was so much work that could and should be done and that amateurs could make significant contributions. Even the most prolific of observers from the MPB pages could not hope to do it alone or even with the combined efforts of all the "MPB regulars." If you're willing to give even a little time, please visit the CAPS site and join the effort to build our knowledge of the system of minor planets. Clear Skies!



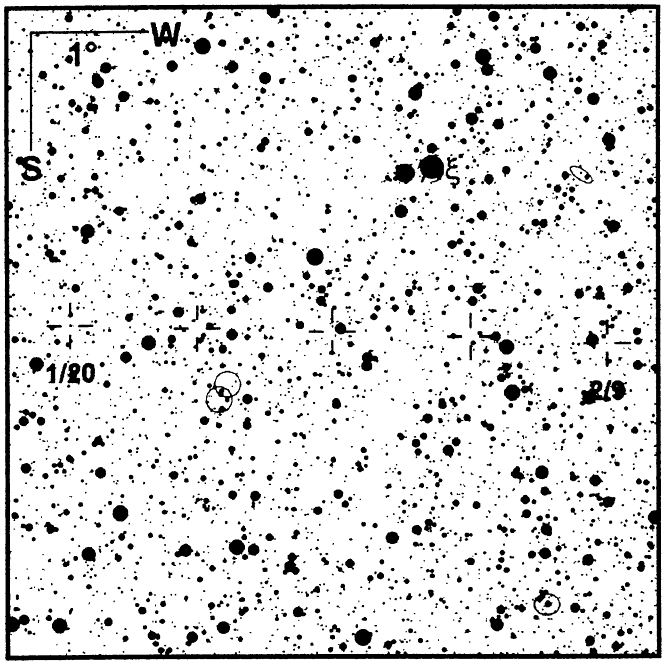
549 Jessonda (F) M. Wolf found Jessonda in 1904 November. It's named after a character in an opera by Spohr. The unclassified asteroid has a diameter of about 27km. Its path during late January take the asteroid south of Delta and Theta Cancri.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
01/20	8 49.21	+15 56.1	8 46.41	+16 07.2	13.2	5.1	169
01/25	8 44.38	+16 00.4	8 41.58	+16 11.3	13.0	2.3	175
01/30	8 39.50	+16 05.4	8 36.69	+16 16.0	13.0	1.4	177
02/04	8 34.76	+16 10.5	8 31.95	+16 20.9	13.2	3.9	172
02/09	8 30.37	+16 15.3	8 27.54	+16 25.4	13.4	6.7	166



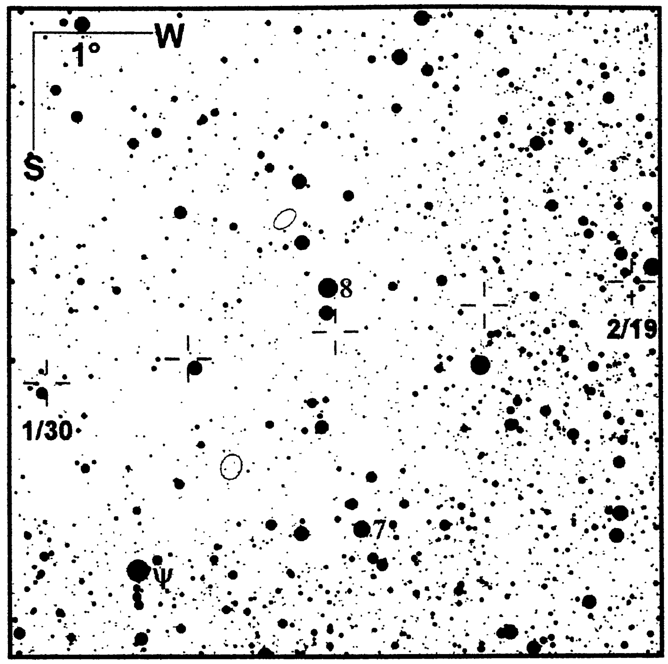
5438 Lorre (F) Named after Jean Lorre, a software developer for NEAT and JPL, Lorre was discovered by E.F. Helin in 1990 August. The asteroid will not be in the13s again until 2011. The field covers the Hydra-Cancer border with the three bright stars at bottom belonging to Hydra.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
01/20	8 51.82	+ 9 57.1	8 49.11	+10 08.4	13.8	6.7	165
01/25	8 44.91	+ 8 54.2	8 42.21	+ 9 05.2	13.6	5.0	169
01/30	8 37.76	+ 7 52.7	8 35.08	+ 8 03.2	13.6	4.7	170
02/04	8 30.60	+ 6 53.3	8 27.93	+ 7 03.4	13.6	6.2	167
02/09	8 23.67	+ 5 56.7	8 21.01	+ 6 06.4	13.7	8.5	162



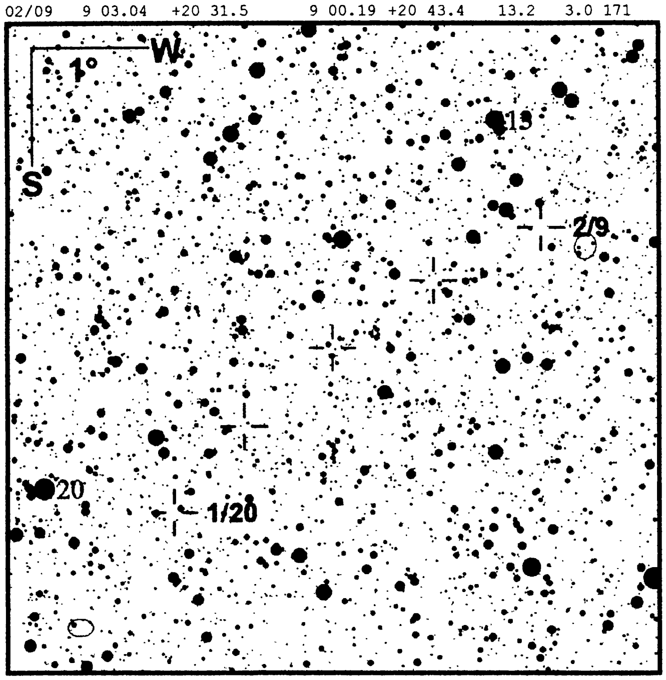
1113 Katja (F) Katja is an unclassified asteroid of about 46km size. P.F. Shajn found the asteroid in 1928 August. M. Wolf found it ten days later. It is named after lab assistant and orbit calculator, Katya Iosko. Xi Cancri serves is near center. A small group of galaxies lies near the 1/25 position.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
01/20	9 22.59	+20 41.5	9 19.76	+20 54.4	13.4	6.2	162
01/25	9 17.93	+20 40.6	9 15.09	+20 53.2	13.2	4.2	168
01/30	9 13.02	+20 38.9	9 10.18	+20 51.3	13.1	2.2	174
02/04	9 08.01	+20 36.0	9 05.16	+20 48.1	13.1	1.5	176
02/09	9 03.04	+20 31.5	9 00.19	+20 43.4	13.2	3.0	171



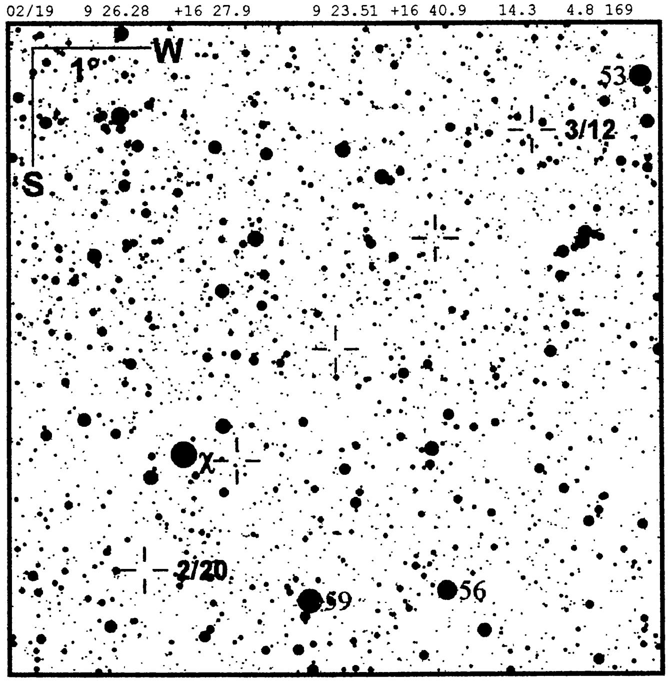
1152 Pawona (F) Here's a perfect testament to collaboration. Pawona is a combination of Palisa and Wolf, two famous asteroid discovers who worked together. The 21km asteroid wends its way through Leo in late January, pass close to several galaxy fields.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
01/30	9 47.00	+15 36.9	9 44.27	+15 50.8	14.3	5.8	166
02/04	9 42.03	+15 50.4	9 39.29	+16 04.1	14.2	3.2	172
02/09	9 36.80	+16 03.9	9 34.05	+16 17.4	14.0	0.9	178
02/14	9 31.49	+16 16.6	9 28.73	+16 29.9	14.1	2.2	175
02/19	9 26.28	+16 27.9	9 23.51	+16 40.9	14.3	4.8	169



4577 Chikako (F) Chikako is named in honor of Japanese educator Chikako Mihashi, who contributed considerable effort towards developing the "Astro Village" in Yatsugatake. The field covers a corner of Leo and includes part of Leo Minor, including 20 Leo Minoris.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
01/20	9 55.75	+31 44.7	9 52.83	+31 58.9	14.2	13.7	153
01/25	9 52.97	+32 29.3	9 50.03	+32 43.4	14.1	11.9	157
01/30	9 49.43	+33 09.6	9 46.47	+33 23.6	14.1	10.6	160
02/04	9 45.34	+33 43.8	9 42.36	+33 57.6	14.0	9.9	161
02/09	9 40.92	+34 10.3	9 37.92	+34 24.0	14.1	10.1	160



1988 CA (F) There's not much to tell about this asteroid save that rarely does it rise above 15th magnitude and that this is the best (brightest) the asteroid gets from now through 2050. R. Rajamohan found the asteroid in 1988 February. The field is in Leo.

Date	RA1950	Dec1950	RA2000	Dec2000	M	PA	E
02/20	11 06.39	+ 6 21.6	11 03.80	+ 6 37.8	14.9	6.2	166
02/25	11 03.22	+ 7 17.3	11 00.63	+ 7 33.5	14.7	3.6	172
03/02	10 59.84	+ 8 14.3	10 57.24	+ 8 30.4	14.6	1.1	178
03/07	10 56.39	+ 9 10.9	10 53.77	+ 9 26.9	14.7	2.2	175
03/12	10 53.01	+10 05.6	10 50.39	+10 21.5	14.8	4.8	169

ASTEROID PHOTOMETRY AT SUNFLOWER OBSERVATORY: RESULTS FOR 507 LAODICA AND 1147 STAVROPOLIS

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Lightcurves for two asteroids were measured in August and September 2001 at the Sunflower Observatory located in Olathe, KS. The period of 507 Laodica was found to be 4.705 ±0.02h with an amplitude of 0.22 ±0.02m. 1147 Stavropolis was determined to have a period of 5.66 ±0.01h and the amplitude measured was 0.45 ±0.02m.

Sunflower Observatory is a participant in the Center for Asteroid Physical Studies (CAPS), a goal of which is to determine accurate lightcurves on the 1000 – 1500 brightest asteroids. Target selection is made from the Collaborative Asteroid Lightcurve Link (CALL) web site maintained by Brian Warner (http://www.MinorPlanetObserver.com/astlc/default. htm). All planned targets are posted to avoid duplication of effort unless needed for collaboration and results are posted when obtained.

The current instrumentation at Sunflower Observatory is a 0.30-m Meade LX-200 SCT and Santa Barbara Instruments Group ST9E CCD camera. The effective focal ratio of the system is f7.2 yielding a pixel size of 2.3 arc sec. square. During August and September the camera is cooled to -5°C and the usual exposure is 120 sec. using the tracking feature of the SBIG camera. The objective is to reach a S/N ratio ≥50 for the target. Exposures are generally started at 300 second intervals while the target is ≥30 degrees elevation. All images are unfiltered. All images are dark subtracted and flat fielded before measurement. Usually four comparison stars are chosen in the same field and selected on the basis of similar magnitude and spectra to the target.

Canopus software is used to measure the images and determine best fit of a lightcurve to the data. More information on this software may be obtained at http://www.MinorPlanet Observer.com.

507 Laodica

Discovered 1903 February 19 by R. S. Dugan at Heidelberg. Named for a daughter of Priam and Hecuba. She fell in love with Acamas, son of Theseus and Phaedra, when he and Diomedes came from the Greeks to demand the restoration of Hellen. The minor planet was not named by the discoverer. It had previously been observed by A. Charlois in Nice, but later lost. The name appeared when an ephemeris was published.

A total of 152 observations were used from data acquired on August 12, 17, 18, 19, 20, and 29 covering the entire lightcurve with no gaps. The period of the lightcurve was determined to be 4.705 ± 0.005h. The curve is somewhat asymmetrical with a maximum amplitude of 0.22 ± 0.02m.

1147 Stavropolis

1929 LF was discovered 1929 June 11 by G. N. Neujmin at Simeis. Numbered 1147 and named by the discoverer, it honors the city of Stavropol' in northern Caucasus region. Between 1936 and 1946 the city was named Woroschilowsk.

A total of 150 observations were used from data acquired on September 2, 3, and 5 covering the entire lightcurve with no gaps. The period of the lightcurve was determined to be 5.66 ±0.01h. The curve is asymmetrical with a maximum amplitude of 0.45 ±0.02m.

References

Schmadel, Lutz D. (1999). *Dictionary of Minor Planet Names* Springer-Verlag.

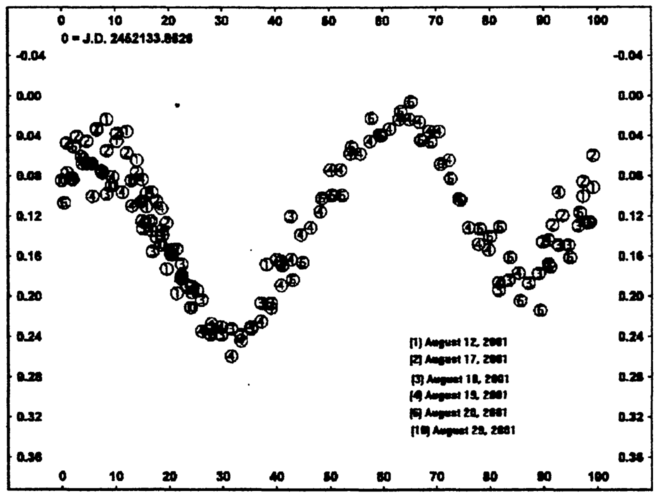

Figure 1. The lightcurve for 507 Laodica. The period is 4.705 ± 0.005h with an amplitude of 0.22 ± 0.02m.

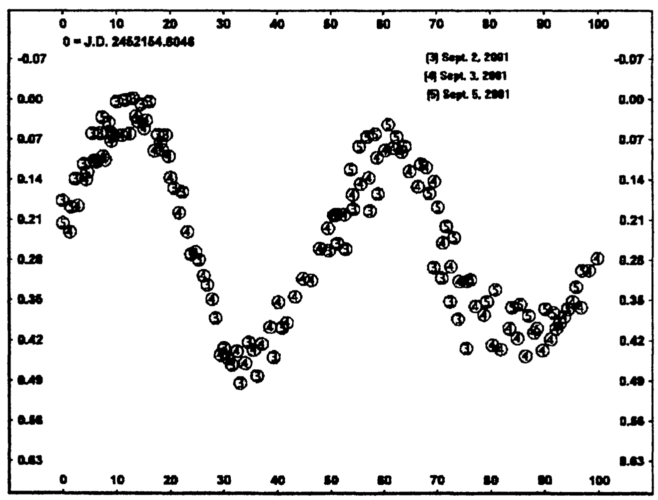

Figure 2. The lightcurve for 1147 Stavropolis. The derived period is 5.66 ± 0.01h; the amplitude is 0.45 ± 0.02m.

ASTEROID PHOTOMETRY AT THE PALMER DIVIDE OBSERVATORY: RESULTS FOR 573 RECHA, 1329 ELIANE, AND 8041 MASUMOTO

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Lightcurves for three asteroids were measured in 2001 January, April, and August at the Palmer Divide Observatory located near Colorado Springs, CO. The period of 573 Recha was found to be 6.53 ±0.05h with an amplitude of 0.25 ±0.05m. 1329 Eliane was determined to have a period of 8.0 ±0.1h with an amplitude of 0.08 ±0.02m. For 8041 Masumoto, the period was found to be 14.10 ±0.02h and the amplitude 0.30 ±0.02m.

The goal of the initial Palmer Divide Observatory asteroid photometry program is to measure the lightcurves for as many asteroids as possible. A successful measurement is considered when the period has been determined to within 0.05h or better and 0.02m or better for the amplitude. The current instrumentation is a 0.5m Ritchey-Chretien working at f/8.1 The camera is a Finger Lakes Instrumentation camera using the Kodak KAF-1001E non-antiblooming CCD chip working at –30°C and 2x2 binning (0.48um pixels). This yields a scale of about 2.4 arcseconds per pixel. Given that the average seeing at the Palmer Divide Observatory is on the order of 4-5 arcseconds, this is usually a satisfactory match. All observations for this paper were unfiltered with unguided exposures of either 60s or 70s. All images were dark subtracted and flat-fielded before measuring.

Initial targets are determined by referring to the list of lightcurves maintained by Dr. Alan Harris (Harris 2001) as well as those posted on the Collaborative Asteroid Lightcurve Link (CALL) web site maintained by the author (http://www.MinorPlanetObserver.com/astlc/default.htm). At least two nights are dedicated to the initial run for every target. Depending on the preliminary analysis of the lightcurve data from those two nights, additional runs are allocated as necessary to assure full coverage of the lightcurve with no significant gaps, if possible. For asteroids with periods approaching and exceeding 24 hours or with aliases close to 24 hours, this becomes difficult.

Custom software written by the author, *MPO Canopus*, is used to measure the images since it allows automatic storage of the measured magnitudes of the comparison stars and targets. It uses aperture photometry with magnitudes determined by calibrating images against field or, preferably, standard stars. The package includes a Fourier analysis routine, the original FORTRAN code for which was supplied by Alan Harris (Harris et al, 1989) and converted to Delphi Pascal. If the data from a single night appears to cover at least half a period or more, then an estimate based on a plot of the raw data is used to help narrow the possibilities when using data from two or more nights.

For two of the measured asteroids, 573 Recha and 1329 Eliane, the old addage "If at first you don't succeed, try, try again" comes to mind. The data for these targets was gathered in early 2001, initially measured, and no satisfactory results determined. During a cleanup of the computer's hard drive to archive images and data reduction files to CD-ROM, I was determined to give these two and a couple of other unresolved asteroids another try. Eventually, all the images for all the asteroids were remeasured, taking care to avoid measuring images where field stars may have affected the data. This effort paid off in the case of Recha and Eliane as the new data allowed reasonable solutions to be determined. Part of the success can also be attributed to refinements in the code for determining the centroid and total flux made after discussing the topic with a number of professional and amateur photometrists.

573 Recha

This 39km unclassified asteroid was discovered by Max Wolf in 1905 September. It is named after a character in Lessing's *Nathan the Wise*. The semi-major axis of 3.017AU places the asteroid towards the outer main belt. The inclination is about 9° and the eccentricity 0.109. Observations were obtained on the nights of 2001 January 1 (my way of celebrating the 200th anniversary of Ceres' discovery) and January 4. Data were also obtained on January 5 but suffered from excessive noise due to less than ideal conditions and so the data were not used in the final solution, which included about 135 observations from the nights of January 1 and 4. In the original measurements, the data from all three nights showed considerable noise and no solution could be found. The remeasuring "quieted" the data for two of the nights and so lead to a least a preliminary and apparently reasonable solution.

The observations are plotted in Figure 1, which is phased against the period of 6.53 ±0.05h. The amplitude of the curve is 0.25 ±0.05. While the extrema of the plots matched well, there was a decided difference in the amplitude of the curve between the two nights, with the data from January 4 showing a smaller amplitude by about 0.06-0.08m.

1329 Eliane

E. Delporte found Eliane in 1933 March. It was subsequently named after the daughter of astronomer Paul Bourgeois. The asteroid is of type SU and about 26km in size. The semi-major axis of the asteroid's orbit is 2.615AU, the inclination 14.5°, and the eccentricity is 0.175.

Data from the nights of 2001 April 27 and 28 were used to find a period of 8.0 ±0.1h. The amplitude of the curve is 0.08 ±0.02m. Figure 2 shows the data phased to this period. There is a considerable gap in the data. However, prior to remeasuring the original images, no solution could be found at all. In addition, based on a typical double maximum/minimum curve, the data from April 27 agree fairly well with the eight-hour period. Assuming this is the correct value, the with the period having an integral alias close to twenty-four hours, any single observer would have to spend a considerable amount of time and effort to obtain sufficient data to cover the entire curve. This asteroid presents an excellent opportunity for collaborative efforts at future apparitions. The next is in 2002 September when the asteroid will be at –16° when at its brightest of about 14.1. Unfortunately for Northern Hemisphere observers, Eliane is generally at its brightest when at or south of the celestial equator

8041 Masumoto

There was no lack of data for this asteroid, with observations being made on the nights of 2001 August 12, 17, 18, and 19. Figure 3 shows a phased plot on the derived period of 14.10 ±0.02h. The amplitude of the curve is 0.30 ±0.03m. The curve shows a decided asymmetry between the first and second minima, with the latter having a markedly smaller amplitude and different shape.

8041 Masumoto was discovered by F. Uto at Kashihara in 1993 November. It is named in honor of the man who built Uto's observatory, Takeji Masumoto. Masumoto has a semi-major axis of 2.625AU, an orbital inclination of 11.4°, and eccentricity of 0.186.

Acknowledgements

Thanks go to Dr. Alan Harris of the Jet Propulsion Laboratory for making available the source code to his Fourier Analysis program and his continuing support and advice.

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Harris, Alan W. (2001). "Minor Planet Lightcurve Parameters". On Minor Planet Center web site: http://cfa-www.harvard.edu/iau/lists/LightcurveDat.html

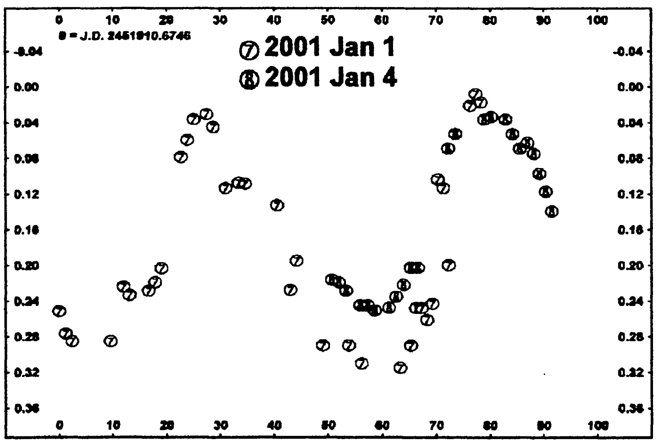

Fig. 1 – The lightcurve plot for 573 Recha. The period is 6.53 ± 0.05h with an amplitude of 0.25 ±0.05m.

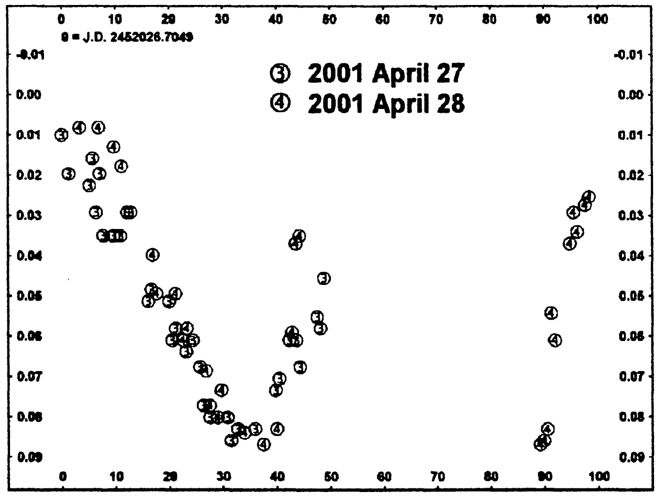

Fig. 2 – The lightcurve plot for 1329 Eliane. The derived period is 8.0 ±0.1h; the amplitude is 0.08 ±0.02m.

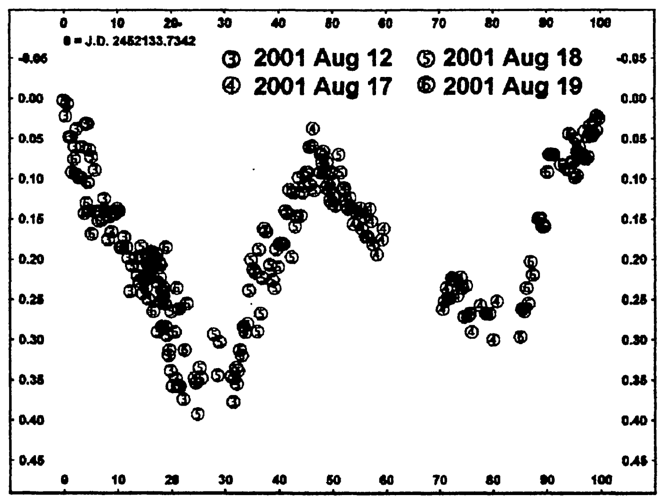

Fig. 3 – The lightcurve plot for 8041 Masumoto. The period is 14.10 ±0.02h with an amplitude of 0.3 ±0.03m.

ASTEROID-DEEPSKY APPULSES IN 2002

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A list of favorable appulses between asteroids and brighter deepsky objects during the year 2002 is presented.

The following list is a subset of the results of a search for asteroid-deepsky appulses meeting the following criteria:

1. The asteroid was brighter than 14.0.
2. The separation between the two was less than 360 arcseconds.
3. The phase of the moon was between mid-waning gibbous to mid-waxing gibbous
4. The event was at least 45° from the Sun.

The list below is not comprehensive by any means. However, it's a good first check. For a more complete check, the Minor Planet Center's web site at

http://cfaps8.harvard.edu/~cgi/CheckSN.COM

allows you to enter the location of a suspected asteroid or supernova and check if there are any known targets in the area.

The complete set from which the table below is a small subset can be found at the MPO web site:

http://www.MinorPlanetObserver.com/htms/dso.htm

The table gives the following data:

Date/Time	Universal Date and Time of closest approach
#/Asteroid	The number and name of the asteroid
RA/Dec	The J2000 position of the asteroid
Mag	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
Mag	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	#	Asteroid	RA	Dec	AM	Sep	PA	DSO	Type	Mag	SE	ME	MP
01/05	00:04	498	Tokio	1 22.26	- 0 50.4	13.4	198	321	NGC 497	G	13.0	94	160	-0.630
01/06	19:36	665	Sabine	12 06.19	-14 29.3	13.7	301	59	NGC 4094	G	11.8	99	25	-0.425
01/10	00:16	71	Niobe	14 07.97	-33 18.5	11.9	36	225	NGC 5488	G	11.9	69	33	-0.126
01/11	23:17	914	Palisana	6 37.74	+ 4 40.9	13.1	187	169	Cr 107	OC	5.1	158	160	-0.025
01/11	19:45	80	Sappho	8 57.57	+ 2 59.6	11.7	326	185	NGC 2716	G	11.8	152	134	-0.030
01/12	02:01	80	Sappho	8 57.33	+ 2 59.9	11.7	297	5	NGC 2713	G	11.8	152	137	-0.021
01/14	01:43	411	Xanthe	9 36.99	+23 32.0	13.8	251	226	NGC 2927	G	12.9	153	160	0.003
01/14	05:53	5438	Lorre	8 59.19	+11 10.2	13.9	12	326	NGC 2720	G	12.8	159	165	0.005
01/17	22:07	291	Alice	6 10.86	+20 32.0	13.9	240	189	NGC 2175s	OC	6.8	155	106	0.169
02/07	13:31	241	Germania	0 04.54	+ 5 13.3	13.3	145	339	NGC 7820	G	12.9	45	98	-0.202
02/08	19:52	247	Eukrate	1 38.33	+35 17.6	12.4	336	160	NGC 634	G	13.0	77	114	-0.111
02/08	00:20	145	Adeona	18 02.27	-23 06.9	14.0	293	186	M20	CNB	6.3	49	1	-0.167
02/10	04:48	423	Diotima	18 03.06	-24 28.3	13.1	322	186	M8	CNB	5.0	51	27	-0.041
02/16	14:48	74	Galatea	1 21.40	+ 7 01.0	13.5	2	144	NGC 485	G	13.0	54	8	0.159
02/18	05:26	247	Eukrate	1 57.80	+36 24.6	12.5	283	341	NGC 759	G	12.7	73	28	0.284
02/18	23:20	774	Armor	18 07.18	-23 15.1	14.0	297	356	NGC 6546	OC	8.0	59	131	0.351
02/19	04:25	85	Io	12 47.08	-11 33.1	12.6	285	35	NGC 4680	G	13.0	135	149	0.370
02/19	15:36	100	Hekate	9 05.49	+18 22.2	13.0	207	23	NGC 2749	G	11.8	163	83	0.415
02/21	05:05	326	Tamara	18 59.59	-36 38.5	13.7	32	190	NGC 6723	GC	7.3	52	145	0.572
02/21	12:04	28	Bellona	10 23.74	+12 33.8	9.9	62	40	NGC 3230	G	12.8	178	79	0.602
03/04	05:23	186	Celuta	17 32.22	-32 39.3	13.7	206	201	NGC 6374	OC	9.0	80	36	-0.693
03/04	00:45	61	Danae	9 38.60	+17 04.9	12.8	171	359	NGC 2943	G	12.4	158	86	-0.713
03/05	13:40	704	Interamnia	2 03.65	+23 59.9	11.7	249	170	UGC 1551	G	12.5	53	146	-0.550
03/08	16:49	186	Celuta	17 39.74	-33 09.8	13.6	331	21	NGC 6404	OC	10.6	82	24	-0.243
03/09	06:12	667	Denise	6 30.45	+ 5 01.5	13.6	162	123	NGC 2237	CNB	5.5	109	153	-0.197
03/12	12:29	584	Semiramis	13 07.09	-23 43.2	13.2	131	183	NGC 4968	G	12.8	144	127	-0.023
03/12	12:22	192	Nausikaa	11 20.24	+ 2 55.0	11.0	190	196	NGC 3630	G	11.9	178	164	-0.023
03/12	09:07	123	Brunhild	3 44.86	+24 11.4	13.9	267	353	vdB 20	BN	11.6	68	87	-0.027
03/12	04:33	454	Mathesis	10 49.35	+16 09.6	12.4	207	191	NGC 3399	G	12.8	164	173	-0.033
03/13	22:44	1011	Laodamia	11 45.88	+10 51.3	13.6	102	42	NGC 3869	G	12.8	171	176	0.002
03/20	19:59	186	Celuta	17 59.11	-34 32.4	13.4	231	24	NGC 6453	GC	9.9	90	161	0.369
04/05	03:40	141	Lumen	13 07.15	-23 38.2	13.0	173	14	NGC 4968	G	12.8	162	86	-0.447
04/08	05:31	375	Ursula	13 47.59	-30 53.3	12.3	162	357	NGC 5292	G	11.9	154	109	-0.178
05/02	08:40	24	Themis	6 05.00	+24 02.1	12.7	125	1	IC 2157	OC	8.4	49	162	-0.688
05/06	16:11	174	Phaedra	16 54.02	-41 48.4	12.2	28	147	NGC 6231	OC	2.6	144	84	-0.279
05/07	19:35	31	Euphrosyne	12 26.79	+ 7 56.2	11.8	15	324	NGC 4416	G	12.4	135	171	-0.188
05/08	22:22	639	Latona	0 03.79	+ 7 27.4	13.8	26	333	NGC 7816	G	12.8	45	12	-0.113
05/10	00:03	6455	1992 HE	11 10.04	-23 47.3	13.8	228	147	IC 2627	G	12.0	125	142	-0.056
05/13	07:02	88	Thisbe	7 09.38	+20 36.8	13.2	130	188	NGC 2342	G	12.6	54	44	0.007
05/14	01:09	387	Aquitania	6 53.77	+19 23.7	13.8	346	355	UGC 3587	G	12.8	50	31	0.026
05/14	02:47	224	Oceana	9 40.48	+14 54.4	13.8	42	208	NGC 2954	G	12.4	89	70	0.028
05/16	11:35	1018	Arnolda	15 39.88	-30 37.9	14.0	236	184	NGC 5968	G	12.2	168	136	0.164
05/18	19:42	326	Tamara	22 57.21	-36 26.6	13.2	94	176	IC 1459	G	10.0	87	153	0.388

Date	UT	#	Asteroid	RA	Dec	AM	Sep	PA	DSO	Type	Mag	SE	ME	MP
06/01	15:36	477	Italia	17 40.17	-32 17.4	13.0	270	167	M6	OC	4.2	163	60	-0.627
06/03	18:21	1222	Tina	18 45.01	- 9 25.6	13.3	190	241	M26	OC	8.0	149	72	-0.426
06/03	07:13	757	Portlandia	15 49.84	-29 21.0	13.8	240	8	NGC 6000	G	12.2	166	103	-0.470
06/06	22:45	477	Italia	17 34.75	-32 28.6	12.8	325	351	NGC 6383	OC	5.5	168	123	-0.157
06/07	18:18	8	Flora	10 44.41	+14 05.4	11.3	25	26	NGC 3357	G	12.6	81	118	-0.103
06/09	14:14	1349	Bechuana	17 37.99	-35 05.5	13.6	343	197	NGC 6396	OC	8.5	166	153	-0.020
06/09	05:15	477	Italia	17 32.27	-32 32.2	12.8	228	353	NGC 6374	OC	9.0	169	151	-0.032
06/10	10:04	73	Klytia	17 02.57	-26 20.3	12.6	262	185	M19	GC	7.2	176	174	-0.002
06/11	11:44	477	Italia	17 29.73	-32 35.0	12.7	302	175	Antalova 2	OC	8.8	170	171	0.003
06/13	04:28	96	Aegle	13 32.30	-33 14.7	12.4	300	97	NGC 5193	G	11.6	128	105	0.056
06/15	20:49	5	Astraea	1 58.77	+ 8 16.6	12.6	214	163	NGC 766	G	12.7	54	116	0.263
06/16	18:44	485	Genua	12 44.48	+ 0 27.2	13.4	107	191	UGC 7911	G	12.9	105	31	0.359
06/17	13:44	5604	1992 FE	12 06.64	-61 15.7	13.3	52	233	NGC 4103	OC	7.4	113	70	0.448
06/17	22:28	119	Althaea	0 04.57	+ 5 11.9	13.3	57	336	NGC 7820	G	12.9	83	168	0.490
06/19	05:53	94	Aurora	1 22.96	+ 8 58.4	13.5	311	153	NGC 502	G	12.8	65	170	0.640
07/01	07:59	640	Brambilla	18 39.75	- 8 32.6	13.1	217	191	Tr 34	OC	8.6	165	76	-0.629
07/05	05:33	128	Nemesis	12 27.06	+ 2 31.3	13.3	92	33	NGC 4420	G	12.1	82	145	-0.267
07/08	22:18	358	Apollonia	18 18.40	-18 24.3	13.7	41	355	NGC 6603	OC	11.1	167	171	-0.026
07/15	22:06	96	Aegle	13 47.59	-30 55.2	12.9	48	346	NGC 5292	G	11.9	102	38	0.355
07/17	14:09	1032	Pafuri	18 55.16	-30 31.4	13.8	150	160	M54	GC	7.7	165	73	0.545
07/30	02:33	192	Nausikaa	11 48.96	- 2 00.0	13.2	130	25	UGC 6780	G	13.0	52	165	-0.713
08/03	06:42	415	Palatia	5 10.70	+16 31.6	13.7	21	174	NGC 1807	OC	7.0	53	17	-0.322
08/07	22:39	115	Thyra	13 13.35	-19 27.7	13.2	206	14	NGC 5022	G	12.9	70	82	-0.010
08/07	16:31	443	Photographica	18 20.04	-17 11.1	13.7	223	145	M18	OC	6.9	140	153	-0.017
08/08	11:13	63	Ausonia	12 49.46	-10 04.7	12.2	147	23	AM 3	G	11.6	60	65	-0.002
08/10	13:20	201	Penelope	1 16.01	+ 5 12.2	12.1	75	7	NGC 455	G	12.6	118	142	0.046
08/10	17:16	63	Ausonia	12 53.18	-10 27.3	12.3	177	23	NGC 4760	G	11.4	59	33	0.054
08/30	18:52	631	Philippina	0 21.06	+22 26.1	13.5	330	338	NGC 80	G	12.1	139	52	-0.531
08/30	05:47	631	Philippina	0 21.33	+22 27.5	13.5	163	338	NGC 83	G	12.5	139	47	-0.584
09/14	15:13	106	Dione	16 17.06	-22 54.5	13.7	278	12	M80	GC	7.2	75	26	0.595
09/15	22:56	753	Tiflis	17 36.20	-33 34.5	13.9	329	180	Tr 27	OC	6.7	92	26	0.724
09/29	22:44	480	Hansa	7 56.66	+ 7 28.1	13.6	63	211	NGC 2485	G	12.2	68	26	-0.475
10/01	02:45	89	Julia	9 40.49	+14 54.7	12.3	22	206	NGC 2954	G	12.4	45	28	-0.353
10/03	23:38	45	Eugenia	2 39.17	+ 6 35.1	12.0	217	327	NGC 1026	G	12.6	150	116	-0.092
10/06	07:57	326	Tamara	22 57.80	-36 01.3	12.7	81	64	IC 5269	G	12.2	132	136	-0.001
10/07	00:24	487	Venetia	17 52.86	-22 24.2	13.6	194	190	NGC 6469	OC	8.2	75	67	0.006
10/08	15:34	209	Dido	2 34.02	+20 57.1	13.3	173	175	NGC 976	G	12.4	152	172	0.071
10/11	11:02	1874	Kacivelia	0 28.16	- 1 52.5	13.7	254	146	NGC 124	G	13.0	167	99	0.315
10/12	12:30	1	Ceres	0 56.53	- 9 58.8	7.6	108	166	NGC 309	G	11.9	162	88	0.427
10/15	04:42	6	Hebe	18 53.53	-20 20.4	10.1	157	11	Cr 394	OC	6.3	81	33	0.694
10/15	12:08	804	Hispania	17 17.29	-35 32.3	13.1	42	353	Bochum 13	OC	7.2	60	57	0.722
10/30	18:34	37	Fides	10 06.72	+14 19.6	12.1	215	200	NGC 3121	G	12.6	69	3	-0.332
11/06	10:48	170	Maria	3 20.34	+41 19.2	12.9	110	162	NGC 1282	G	12.9	154	157	0.037
11/07	09:00	881	Athene	2 42.42	+34 47.5	13.7	107	321	NGC 1050	G	12.6	161	146	0.089
11/08	16:44	70	Panopaea	5 24.04	+29 34.1	12.6	121	206	Berk 19	OC	11.4	144	164	0.191
11/25	10:31	441	Bathilde	9 26.33	+ 7 53.0	13.4	233	221	NGC 2882	G	12.6	101	20	-0.732
11/26	13:23	404	Arsinoe	10 54.73	+17 42.8	13.8	351	4	NGC 3457	G	12.6	86	19	-0.619
12/04	13:49	202	Chryseis	20 23.60	-19 18.7	13.8	21	350	NGC 6903	G	11.9	51	48	0.001
12/07	05:08	24	Themis	11 55.56	+ 1 10.2	12.4	316	203	UGC 6903	G	12.3	76	114	0.106
12/09	06:59	478	Tergeste	10 10.76	- 4 45.9	13.1	277	231	UA 205	G	11.5	100	154	0.275
12/14	01:10	79	Eurynome	13 39.43	-11 31.9	13.5	186	200	NGC 5254	G	13.0	55	169	0.719

ASTEROID PHOTOMETRY OPPORTUNITIES JANUARY-MARCH 2002

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Winter season with its long nights and the opposition point high in the sky for northern hemisphere observers provides more opportunities for collaborative work among observers at far different longitudes (across oceans), that is particularly suitable for working longer period asteroids. We encourage observers from different continents to take this opportunity and establish a collaboration on such objects. That will help to suppress a bias against longer periods in the available sample.

In the Table below, we present a list of suitable photometric targets for the January-March 2002 period. Most of the objects have been selected from a more extensive list prepared by Brian Warner. We selected objects with the predicted V<14 in opposition and unknown or not reliably established periods. Some of the targets have listed previous less reliable period estimates that are generally relatively long; that is a selection effect – long periods are usually more difficult to be established reliably. We have comments on some of them: The period of 654 Zelinda was derived by Schober (1975) and it is worth checking, it may be wrong. The amplitude of 0.03 mag for 151 Abundantia has been observed by Shevchenko et al. (1992); the asteroid may display different amplitude at the present apparition. The period of 111 Ate may be a half of the listed value (Harris and Young 1983). The lower limits on the period and amplitude of 488 Kreusa was derived by Harris and Young (1989); the period may be actually very long – it will be interesting to know if it is not the largest (D~150 km) member of the unexplained population of very slow rotators with periods longer than a few days. The period estimates for 259 Aletheia and 823 Sisigambis have reliability codes of 1 (Weidenschilling et al. 1990, Barucci et al. 1994), Aletheia being probably the largest (D~180 km) of the targets listed below. The lower limit on the period of 514 Armida was derived by Lagerkvist (1978) from photographic observations; it may be an easy target for today's CCD observers. 58 Concordia is the lowest number asteroid with reliability code 1 (its lower limit period estimate was derived by Gil Hutton 1993). Observers interested in asteroids fainter than V=14 are encouraged to check the full list on the Brian Warner's CALL website (http://www.MinorPlanetObserver.com/astlc/default.htm). Note: Full references to the period and amplitude estimates cited in this article can be found in the list prepared by Alan Harris which is available at http://cfa-www.harvard.edu/iau/lists/LightcurveDat.html .

Asteroid	Opp'n Date 2002	Opp'n V	Per [h]	Ampl
1176 Lucidor	Jan 07	13.7		
1107 Lictoria	Jan 07	12.6		
1040 Klumpkea	Jan 08	13.6		
654 Zelinda	Jan 10	9.7	31.9	0.3
1547 Nele	Jan 15	12.5		
549 Jessonda	Jan 28	12.9		
5438 Lorre	Jan 28	13.6		
1113 Katja	Feb 03	13.1		
412 Elisabetha	Feb 08	12.7	15	0.1
151 Abundantia	Feb 09	12.6		0.03
111 Ate	Feb 10	10.7	22.2	0.1
384 Burdigala	Feb 13	12.7		
488 Kreusa	Feb 19	11.5	>28	>0.2
259 Aletheia	Mar 11	12.2	15	0.19
754 Malabar	Mar 11	13.1		
823 Sisigambis	Mar 15	13.4	>12	>0.2
1011 Laodamia	Mar 16	13.6		
514 Armida	Mar 17	13.4	>20	>0.3
58 Concordia	Mar 22	12.1	>16	>0.07
976 Benjamina	Mar 24	13.3		
399 Persephone	Mar 30	12.9		

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* * * * *

The deadline for the next issue (29-2) is January 15, 2002. The deadline for issue 29-3 is April 15, 2002.