

LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2013 JANUARY-MARCH

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We present lists of asteroid photometry opportunities for objects reaching a favorable apparition and have no or poorly-defined lightcurve parameters. Additional data on these objects will help with shape and spin axis modeling via lightcurve inversion. We also include lists of objects that will be the target of radar observations. Lightcurves for these objects can help constrain pole solutions and/or remove rotation period ambiguities that might not come from using radar data alone.

We present lists of “targets of opportunity” for the period 2013 January-March. For background on the program details for each of the opportunity lists, refer to previous issues, e.g., *Minor Planet Bulletin* **36**, 188. In the first three sets of tables, “Dec” is the declination and “U” is the quality code of the lightcurve. See the asteroid lightcurve data base (LCDB) documentation for an explanation of the U code:

<http://www.minorplanet.info/lightcurvedatabase.html>

Objects with $U = 1$ should be given higher priority over those rated $U = 2$ or $2+$ but not necessarily over those with no period. On the other hand, do not overlook asteroids with $U = 2/2+$ on the assumption that the period is sufficiently established. Regardless, do not let the existing period influence your analysis since even high quality ratings have been proven wrong at times. Note that the lightcurve amplitude in the tables could be more or less than what’s given. Use the listing only as a guide.

The first list is an *abbreviated list* of those asteroids reaching $V < 14.5$ at brightest during the period and have either no or poorly-constrained lightcurve parameters. An asterisk (*) after the name indicates that the asteroid is reaching one of its five brightest apparitions between the years 1995-2050.

The goal for these asteroids is to find a well-determined rotation rate. The target list generator on the CALL web site allows you to

create custom lists for objects reaching $V \leq 18.0$ during any month in the current year, e.g., limiting the results by magnitude and declination.

http://www.minorplanet.info/PHP/call_OppLCDBQuery.php

In a general note, small objects with periods up to 4 hours or even longer are possible binaries. For longer periods (4-6 hours or so), the odds of a binary may be less, but the bonus is that the size of the secondary, if it exists, is likely larger (see Pravec *et al.* (2010), *Nature* **466**, 1085-1088), thus eclipses, if they occur, will be deeper and easier to detect.

The Low Phase Angle list includes asteroids that reach very low phase angles. The “ α ” column is the minimum solar phase angle for the asteroid. Getting accurate, calibrated measurements (usually V band) at or very near the day of opposition can provide important information for those studying the “opposition effect.” You will have the best chance of success working objects with low amplitude and periods that allow covering, e.g., a maximum, every night. Objects with large amplitudes and/or long periods are much more difficult for phase angle studies since, for proper analysis, the data have to be reduced to the average magnitude of the asteroid for each night. Without knowing the period and/or the amplitude at the time, that reduction becomes highly uncertain. As an aside, some use the maximum light to find the phase slope parameter (G). However, this can produce a significantly different value for both H and G versus using average light, which is the method used for values listed by the Minor Planet Center.

The third list is of those asteroids needing only a small number of lightcurves to allow spin axis and/or shape modeling. Those doing work for modeling should contact Josef Ďurech at the email address above and/or visit the Database of Asteroid Models from Inversion Techniques (DAMIT) web site for existing data and models:

<http://astro.troja.mff.cuni.cz/projects/asteroids3D>

The fourth list gives a brief ephemeris for planned radar targets. Supporting optical observations to determine the lightcurve period, amplitude, and shape are needed to supplement the radar data. *High-precision work, 0.01-0.02 mag, is preferred, especially if the object is a known or potential binary.* Those obtaining lightcurves in support of radar observations should contact Dr. Benner directly at the email given above.

Future radar targets:

<http://echo.jpl.nasa.gov/~lance/future.radar.nea.periods.html>

Past radar targets:

<http://echo.jpl.nasa.gov/~lance/radar.nea.periods.html>

Arecibo targets:

<http://www.naic.edu/~pradar/sched.shtml>

<http://www.naic.edu/~pradar>

Goldstone targets:

http://echo.jpl.nasa.gov/asteroids/goldstone_asteroid_schedule.html

As always, we encourage observations of asteroids even if they have well-established lightcurve parameters and especially if they are lacking good spin axis and/or shape model solutions. Every lightcurve of sufficient quality supports efforts to resolve a number of questions about the evolution of individual asteroids and the general population. For example, pole directions are known for only about 30 NEAs out of a population of 8000. This is hardly

sufficient to make even the most general of statements about NEA pole alignments, including whether or not the thermal YORP effect is forcing pole orientations into a limited number of preferred directions (see La Spina *et al.*, 2004, *Nature* **428**, 400-401). Data from many apparitions can help determine if an asteroid's rotation rate is being affected by YORP, which can also cause the rotation rate of a smaller, irregularly-shaped asteroid to increase or decrease. See Lowry *et al.* (2007) *Science* **316**, 272-274 and Kaasalainen *et al.* (2007) *Nature* **446**, 420-422.

The ephemeris listings for the optical-radar listings include lunar elongation and phase. Phase values range from 0.0 (new) to 1.0 (full). If the value is positive, the moon is waxing – between new and full. If the value is negative, the moon is waning – between full and new. The listing also includes the galactic latitude. When this value is near 0°, the asteroid is likely in rich star fields and so may be difficult to work. It is important to emphasize that the ephemerides that we provide are only guides for when you might observe a given asteroid. Obviously, you should use your discretion and experience to make your observing program as effective as possible.

Once you've analyzed your data, it's important to publish your results. Papers appearing in the *Minor Planet Bulletin* are indexed in the Astrophysical Data System (ADS) and so can be referenced by others in subsequent papers. It's also important to make the data available at least on a personal website or upon request.

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Lightcurve Opportunities

#	Name	Brightest			LCDB Data		
		Date	Mag	Dec	Period	Amp	U
275	Sapientia	01 02.4	12.1	+19	14.766	0.06	2
1024	Hale	01 02.4	14.8	+40			
3211	Louispharaailda	01 02.4	15.0	+39			
467	Laura	01 03.3	14.4	+29	36.7	0.14	1
269	Justitia	01 04.9	14.0	+16	16.545	0.14-0.25	2
1128	Astrid	01 06.1	14.6	+24	10.228	0.29	2+
2448	Sholokhov	01 07.6	14.6	+11	10.065	0.63	2+
3115	Baily	01 08.5	13.7	+13	16.22	0.08-0.14	2+
555	Norma	01 09.5	14.1	+21	19.55	0.06-0.20	2+
577	Rhea	01 10.6	14.3	+27	12.266	0.21-0.31	2
3063	Makhaon	01 12.0	14.9	+21	8.64	0.03-0.15	2
2950	Rousseau	01 12.8	14.1	+22	18.228	0.30	2
1242	Zambesia	01 13.9	13.6	+35	17.305	0.24	2
4807	Noboru	01 14.3	14.9	+22			
9780	Bandersnatch	01 16.8	14.7	+21	8.234	0.16	2+
1328	Devota	01 17.6	15.0	+13	17.49	0.20	2-
2569	Madeline	01 20.5	14.3	+32		0.1	
1311	Knopfia	01 20.6	14.9	+16	9.65	1.3	1+
806	Gyldenlia *	01 22.0	14.5	+40	14.45	0.10-0.27	2
309	Fraternitas	01 25.3	14.6	+23	13.2	0.12	2
393	Lampetia	01 25.5	13.8	+0	38.7	0.14	2-
814	Tauris	01 26.3	13.4	+37	35.8	0.20	2
1544	Vinterhansenia	01 27.9	14.4	+24	13.77	0.18	2
395	Delia	01 29.4	14.4	+14	19.71	0.25	2
47035	1998 WS	01 31.7	14.5	+69	3.99	0.08-0.15	2
4874	Burke	02 01.6	14.8	+19	3.657	0.22	2+
3141	Buchar	02 04.8	14.9	+18	11.41	0.47	2+
838	Seraphina	02 05.4	14.7	+2	15.67	0.07-0.30	2
2040	Chalonge	02 05.4	14.8	+38			
705	Erminia	02 06.6	12.6	+43	53.96	0.05-0.17	2
784	Pickeringia *	02 06.7	14.0	+31	13.17	0.20-0.40	2
1724	Vladimir	02 06.9	14.7	+7	12.57	0.14	2
1145	Robelmonte	02 08.1	14.4	+20	9.01	0.05-0.18	2
3940	Larion	02 08.3	14.9	-21	84.	0.08-0.31	2
319	Leona	02 09.6	14.6	+4	9.6	0.03	1
645	Agrippina	02 10.1	13.9	+21	32.6	0.11-0.18	2
530	Turandot	02 11.8	14.6	+17	19.947	0.10-0.16	2+
2088	Sahlia	02 13.6	14.5	+19	10.37	0.12	2
331	Etheridgea	02 14.3	14.2	+20		0.05	1
375	Ursula	02 14.8	12.2	+17	16.83	0.17	2
764	Gedania	02 15.2	14.1	+0	24.975	0.09-0.35	2
879	Ricarda	02 15.3	14.9	-4	82.9	0.37	2

Lightcurve Opportunities (cont'd)

#	Name	Brightest			LCDB Data		
		Date	Mag	Dec	Period	Amp	U
924	Toni	02 16.9	13.7	+12	21.	0.1	1
498	Tokio	02 19.5	13.5	+21	30.	0.18	1
2719	Suzhou	02 19.5	14.7	+12			
4350	Shibecha	02 19.9	14.7	+32	2.89	0.11-0.16	2+
1159	Granada	02 20.1	14.7	+18	31.	0.28	2
6618	1936 SO	02 20.1	14.5	+16	8.297	0.20	2+
605	Juvisia	02 21.2	14.7	+16	15.93	0.26	2
1622	Chacornac	02 22.9	14.7	+16	12.206	0.25	2
1182	Ilona	02 23.6	14.0	+11	29.8	1.2	2
609	Fulvia	02 24.6	14.4	+9	20.	0.08	1+
407	Arachne	03 02.8	12.6	-1	22.62	0.31-0.45	2
619	Triberga	03 02.8	13.5	-2	29.412	0.30-0.45	2
192642	1999 RD32	03 04.5	14.5	+2	17.08	0.28	2
6329	Hikonejyo	03 04.8	15.0	+17	8.066	0.18	2
1502	Arenda	03 06.3	14.7	+2	45.8	0.4	2
1558	Jarnefelt	03 08.7	14.9	+16	18.22	0.40	2
2540	Blok	03 10.0	15.0	+4			
746	Marlu	03 10.1	15.0	+9	7.787	0.23	2
7895	Kaseda	03 16.4	15.0	+14	5.11	0.10	2+
791	Ani	03 17.0	14.5	+17	16.72	0.17-0.38	2
1228	Scabiosa	03 17.0	14.8	-2			
3747	Belinskij	03 17.3	15.0	+25	3.31	0.02	1
4892	Chrispollas	03 18.0	15.0	-7		0.10	
1029	La Plata	03 21.2	14.5	+1	15.31	0.26-0.58	2
1269	Rollandia	03 21.5	13.7	+2	15.4	0.08	2
1114	Lorraine	03 23.1	14.5	-4	33.	0.16	1
741	Botolphia	03 26.2	13.3	+10	23.93	0.15- 0.4	2-
1048	Feodosia	03 27.2	12.9	+18	10.46	0.14	2
1465	Autonoma	03 27.6	14.8	+2	4.88	0.13	2
823	Sisigambis	03 28.2	13.3	-9	146.	0.08- 0.6	2
379	Huenna	03 30.1	13.8	-3	14.14	0.09	2
1001	Gaussia	03 31.7	14.8	-16	9.17	0.04-0.16	2-
1409	Isko	03 31.9	14.7	-2	11.643	0.20	2

Low Phase Angle Opportunities

#	Name	Date	α	V	Dec	Period	Amp	U
211	Isolda	01 01.7	0.73	11.1	+21	18.365	0.09-0.14	3
410	Chloris	01 02.6	0.43	12.9	+24	32.50	0.28	3
300	Geraldina	01 03.8	0.29	14.0	+24	6.8423	0.15-0.32	3
758	Mancunia	01 09.5	0.22	11.8	+22	12.7253	0.15-0.27	3
543	Charlotte	01 12.9	0.20	13.0	+22	10.718	0.26	3
182	Elsa	01 15.8	0.29	11.1	+22	80.088	0.72	3
1011	Laodamia	01 27.2	0.91	12.6	+17	5.17247	0.44	3
1113	Katja	02 07.3	0.79	13.0	+17	18.465	0.15	3
201	Penelope	02 08.3	0.80	12.7	+13	3.7474	0.11-0.73	3
108	Hecuba	02 11.2	0.91	12.4	+17	17.859	0.05-0.17	3-
100	Hekate	02 11.4	0.65	12.6	+16	27.066	0.11-0.23	3
551	Ortrud	02 20.7	0.17	13.2	+11	13.05	0.09-0.18	2
624	Hektor	02 20.7	0.85	14.0	+15	6.924	0.1 -1.1	3
75	Eurydike	02 23.9	0.81	13.8	+12	5.357	0.10-0.15	3
192	Nausikaa	02 24.9	0.46	10.8	+10	13.625	0.15-0.40	3
65	Cybele	02 25.9	0.08	11.3	+09	6.0814	0.04-0.12	3
175	Andromache	03 02.2	0.70	13.7	+10	8.324	0.21-0.30	3
63	Ausonia	03 02.4	0.31	10.4	+06	9.298	0.15-0.95	3
215	Oenone	03 06.0	0.57	13.2	+07	>20.	0.1	2
577	Rhea	03 08.1	0.71	14.0	+03	12.2667	0.21-0.31	2
206	Hersilia	03 09.6	0.88	12.2	+07	11.11	0.08-0.14	3
180	Garumna	03 10.7	0.40	12.9	+03	23.866	0.42-0.6	3
29	Amphitrite	03 12.8	0.30	9.1	+04	5.3921	0.01-0.15	3
1651	Behrens	03 16.4	1.00	13.9	+00	34.34	0.16	2
693	Zerbinetta	03 18.2	0.74	13.5	-01	11.475	0.14-0.29	3-
74	Galatea	03 20.0	0.52	13.4	-01	17.268	0.08-0.16	3
177	Irma	03 20.0	0.12	14.0	+00	13.856	0.30-0.37	3-
927	Ratisbona	03 21.5	0.94	13.5	+02	12.994	0.12	2
1396	Uteniqua	03 28.3	0.58	13.9	-04	3.08158	0.42	3
490	Veritas	04 01.4	0.87	13.1	-02	7.930	0.33-0.58	3
203	Pompeja	04 01.5	0.69	12.5	-06	24.052	0.10	3
158	Koronis	04 03.8	0.51	13.2	-07	14.218	0.28-0.43	3
119	Althaea	04 10.3	0.22	12.0	-09	11.484	0.23-0.36	3

Shape/Spin Modeling Opportunities

There are two lists here. The first is for objects for which good occultation profiles are available. These are used to constrain the models obtained from lightcurve inversion, eliminating ambiguous solutions and fixing the size of asteroid. Lightcurves are needed for modeling and/or to establish the rotation phase angle at the time

the profile was obtained. The second list is of those objects for which another set of lightcurves from one or more apparitions will allow either an initial or a refined solution.

Occultation Profiles Available

#	Name	Brightest			LCDB DATA		
		Date	Mag	Dec	Period	Amp	U
200	Dynamene	01 01.	12.4	+22	37.394	0.10	3
40	Harmonia	01 01.	10.6	+13	8.910	0.13-0.36	3
230	Athamantis	01 01.	11.3	+12	24.0055	0.1	0.26 3
420	Bertholda	01 01.	13.5	+19	11.04	0.24-0.29	3
27	Euterpe	01 01.	11.0	+03	10.4082	0.13-0.21	3
466	Tisiphone	01 03.4	12.9	+27	8.824	0.12-0.16	3
153	Hilda	01 06.4	13.6	+14	5.9587	0.05-0.20	3
204	Kallisto	01 06.5	13.3	+11	19.489	0.09-0.26	3
790	Pretoria	01 15.1	13.7	+03	10.37	0.05-0.18	3
70	Panopaea	01 17.3	12.6	+36	15.797	0.06-0.12	3
757	Portlandia	01 27.0	12.9	+32	6.5837	0.24-0.45	3
490	Veritas	01 27.8	13.0	+08	7.930	0.33-0.58	3
578	Happelia	01 29.2	14.0	+27	10.061	0.11-0.16	3
25	Phocaea	02 03.8	12.4	-13	9.9341	0.03-0.25	3
1437	Diomedes	02 08.2	14.9	+14	24.49	0.22-0.70	3-
530	Turandot	02 11.8	14.6	+17	19.947	0.10-0.16	2+
375	Ursula	02 14.8	12.2	+17	16.83	0.17	2
386	Siegena	02 16.6	11.7	+03	9.763	0.11-0.18	3
498	Tokio	02 19.5	13.5	+21	30.	0.18	1
144	Vibilia	02 28.1	12.3	+15	13.819	0.13-0.20	3
559	Nanon	03 08.6	13.0	+16	10.059	0.09-0.26	3
791	Ani	03 17.0	14.5	+17	16.72	0.17-0.38	2
106	Dione	03 17.9	12.4	+06	16.26	0.08	3
93	Minerva	03 21.7	11.2	+00	5.982	0.04-0.20	3
334	Chicago	03 22.7	13.0	+04	7.361	0.15-0.67	3
49	Pales	03 25.9	12.9	-06	10.42	0.18	3

Inversion Modeling Candidates

#	Name	Brightest			LCDB Data		
		Date	Mag	Dec	Period	Amp	U
446	Aeternitas	01 01.	13.6	+23	15.7413	0.36-0.51	3
1665	Gaby	01 01.	14.8	+10	66.	0.27	2
852	Wladilena	01 01.	14.2	+04	4.6134	0.28-0.32	3
281	Lucretia	01 01.	14.9	+18	4.348	0.38	3
622	Esther	01 01.	13.2	+01	47.5	0.57	2
270	Anahita	01 01.	12.2	+16	15.06	0.25-0.34	3
915	Cosette	01 01.	14.0	+30	4.445	0.30-1.02	3
1282	Utopia	01 01.	14.9	+37	13.623	0.28-0.36	3
1188	Gothlandia	01 01.	15.0	+10	3.4916	0.59-0.78	3
1243	Pamela	01 01.	14.3	+14	26.017	0.42-0.71	2
336	Lacadiera	01 01.	12.8	+17	13.70	0.27-0.34	3
966	Muschi	01 01.	14.3	+31	5.355	0.31	3
391	Ingeborg	01 02.3	14.3	-15	26.391	0.22-0.79	3
1185	Nikko	01 17.4	14.1	+28	3.79	0.27-0.50	3
235	Carolina	01 17.5	13.1	+31	17.610	0.30-0.38	3
233	Asterope	01 19.5	12.1	+09	19.70	0.25-0.55	3
1013	Tombecka	01 20.7	12.7	+42	6.053	0.44	3
629	Bernardina	01 21.8	13.5	+28	3.763	0.23-0.39	3
399	Persephone	01 26.8	13.0	+32	9.136	0.40	3
540	Rosamunde	01 27.2	13.0	+09	9.336	0.40-0.66	3-
573	Recha	01 30.9	13.8	+25	7.16633	0.20-0.34	3
1687	Glarona	02 04.4	14.3	+19	6.3	0.75	3
753	Tiflis	02 05.9	13.7	+31	9.85	0.35-0.8	3
784	Pickeringia	02 06.7	14.0	+31	13.17	0.20-0.40	2
1379	Lomonosowa	02 14.3	13.8	+03	24.488	0.63	3
1301	Yvonne	02 17.5	13.8	-04	7.320	0.52-0.90	3
553	Kundry	02 18.7	14.5	+20	12.605	0.41-0.61	3
605	Juvisia	02 21.2	14.7	+16	15.93	0.26	2
746	Marlu	03 10.1	15.0	+09	7.787	0.23	2
510	Mabella	03 10.9	13.5	-03	19.4	0.25	3
1889	Pakhmutova	03 19.6	15.0	+16	17.490	0.50	3-
823	Sisigambis	03 28.2	13.3	-09	146.	0.08-0.6	2

Radar-Optical Opportunities

Use the ephemerides below as a guide to your best chances for observing, but remember that photometry may be possible before and/or after the ephemerides given below. Some of the targets may be too faint to do accurate photometry with backyard telescopes. However, accurate astrometry using techniques such as “stack and track” is still possible and can be helpful for those asteroids where the position uncertainties are significant. Note that the intervals in

the ephemerides are not always the same and that *geocentric* positions are given. Use these web sites to generate updated and *topocentric* positions:

MPC: <http://www.minorplanetcenter.org/iau/MPEph/MPEph.html>
JPL: <http://ssd.jpl.nasa.gov/?horizons>

In the ephemerides below, ED and SD are, respectively, the Earth and Sun distances (AU), V is the estimated Johnson V magnitude, and α is the phase angle. SE and ME are the great circles distances (in degrees) of the Sun and Moon from the asteroid. MP is the lunar phase and GB is the galactic latitude. “PHA” in the header indicates that the object is a “potentially hazardous asteroid”, meaning that at some (long distant) time, its orbit might take it very close to Earth.

Some of the objects below are repeats from the previous issue of the *Minor Planet Bulletin* and those with opportunities extending into the next quarter may be featured again in the next issue of the *MPB*.

(214869) 2007 PA8 (2013 Jan, H = 16.2, PHA)

2007 PA8 is an NEA with an estimated diameter of 1.6 km. There are no entries in the LCDB.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/01	12 09.1	-04 14	0.30	1.06	16.2	66.7	97	43	-0.88	+57
01/06	12 10.8	-03 43	0.32	1.09	16.2	61.6	102	22	-0.41	+58
01/11	12 11.2	-03 06	0.34	1.13	16.3	56.4	107	96	-0.01	+58
01/16	12 10.0	-02 23	0.35	1.17	16.3	51.1	113	168	+0.22	+59
01/21	12 07.2	-01 32	0.37	1.21	16.3	45.8	119	129	+0.69	+59
01/26	12 03.1	-00 35	0.38	1.25	16.3	40.3	125	68	+0.99	+60
01/31	11 57.6	+00 29	0.40	1.29	16.3	34.8	132	5	-0.85	+60
02/05	11 51.1	+01 38	0.42	1.33	16.3	29.2	139	68	-0.34	+61

2010 BB (2012 Dec – 2013 Jan, H = 20.0, PHA)

This small (0.3 km) NEA has no entries in the LCDB. The observing window extends into 2013 January, assuming good photometry can still be obtained at $V \sim 18$.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
12/20	20 22.7	+20 09	0.06	0.95	18.8	119.8	57	51	+0.48	-10
12/23	21 24.0	+20 49	0.06	0.96	18.0	111.4	65	65	+0.76	-21
12/26	22 34.8	+19 46	0.06	0.97	17.3	101.1	76	81	+0.95	-33
12/29	23 43.8	+16 57	0.06	0.98	17.0	90.7	86	101	-1.00	-43
01/01	00 41.3	+13 23	0.06	0.99	16.9	82.1	94	126	-0.88	-49
01/04	01 25.0	+10 03	0.07	1.00	17.0	76.0	100	156	-0.62	-52
01/07	01 57.6	+07 20	0.08	1.01	17.2	72.0	103	168	-0.30	-52
01/10	02 22.3	+05 13	0.10	1.01	17.4	69.5	105	131	-0.05	-51

2002 AY1 (2012 Dec, H = 20.9, PHA)

There are no entries in the LCDB for this NEA of about 0.2 km size. The semi-major axis is only 0.78 AU. With an orbital eccentricity of 0.44, the asteroid distance from the Sun ranges from about 0.44 to 1.12 AU, or almost entirely within the Earth’s orbit.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
12/20	11 40.1	+59 54	0.19	1.07	19.5	58.7	112	118	+0.48	+55
12/23	11 39.5	+61 56	0.16	1.06	19.1	58.2	114	99	+0.76	+53
12/26	11 36.3	+64 51	0.14	1.05	18.6	57.7	116	79	+0.95	+50
12/29	11 27.3	+69 19	0.11	1.04	18.1	57.3	117	64	-1.00	+46
01/01	10 54.4	+76 44	0.08	1.02	17.4	57.4	119	68	-0.88	+38
01/04	04 22.7	+84 04	0.06	1.01	16.7	59.9	117	96	-0.62	+23
01/07	00 54.9	+54 37	0.04	0.99	16.3	72.1	106	137	-0.30	-8
01/10	00 31.0	+12 31	0.04	0.98	17.3	95.0	82	107	-0.05	-50

(99942) Apophis (2012 Dec – 2013 Feb, H = 19.3, PHA)

This is probably the most famous and debated NEA of recent times. The rotation period for the 400 meter NEA is about 30.4 h,

based on observations in 2005 analyzed by Behrend. Again, such a period is best confirmed and refined by several observers at multiple longitudes, in this case, those south of the equator.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
12/10	11 38.1	-26 13	0.11	0.96	17.9	99.9	74	34	-0.16	+34
12/20	10 56.7	-27 13	0.10	0.99	17.2	83.1	91	153	+0.48	+29
12/30	10 09.4	-27 11	0.10	1.02	16.6	66.5	108	55	-0.98	+23
01/09	09 13.6	-24 52	0.10	1.04	16.1	50.0	126	98	-0.11	+16
01/19	08 16.0	-19 16	0.10	1.06	15.8	36.3	140	101	+0.50	+9
01/29	07 29.7	-11 32	0.11	1.08	16.0	31.6	145	42	-0.96	+3
02/08	07 00.4	-03 55	0.13	1.09	16.5	36.3	139	158	-0.07	+0
02/18	06 46.7	+02 23	0.16	1.10	17.1	43.8	130	45	+0.52	+0

(52762) 1998 MT24 (January, H = 14.6)

This NEA has an estimated diameter of 3.5 km. Pravec *et al.* found a period of 12.066 h based on observations in 1998. Given that the period is so closely commensurate with an Earth day, a collaboration among observers at widely-separated longitudes will have a better chance of producing a secure lightcurve and period.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/01	11 02.0	+25 13	0.53	1.34	15.5	38.3	122	28	-0.88	+65
01/06	11 09.0	+21 04	0.46	1.30	15.1	38.7	124	49	-0.41	+66
01/11	11 15.9	+15 26	0.38	1.25	14.7	39.4	126	114	-0.01	+65
01/16	11 23.0	+07 29	0.32	1.20	14.2	40.6	127	172	+0.22	+61
01/21	11 30.8	-03 57	0.26	1.16	13.8	43.6	126	122	+0.69	+53
01/26	11 40.2	-20 03	0.22	1.11	13.5	50.0	120	71	+0.99	+40
01/31	11 53.5	-40 14	0.21	1.07	13.6	60.6	109	38	-0.85	+21
02/05	12 17.0	-60 24	0.22	1.03	14.0	72.5	95	57	-0.34	+2

3752 Camillo (January-March, H = 15.5)

There is a chance that this NEA is a tumbler, i.e., in non-principal axis rotation (see Pravec *et al.*, 2005). That and the long period of 37.846 h make this another candidate for a collaborative effort. In this case, calibrating all the data to a common system to within 0.01-0.02 mag will be very important. The estimated diameter is 2.5 km.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/15	12 40.6	-62 56	0.47	1.00	16.2	74.0	78	109	+0.13	+0
01/25	12 57.4	-54 31	0.33	1.02	15.4	74.0	87	107	+0.95	+8
02/04	13 15.0	-33 38	0.20	1.05	14.2	65.9	103	31	-0.45	+29
02/14	13 31.8	+20 10	0.15	1.08	13.0	46.9	127	149	+0.16	+78
02/24	13 44.3	+61 35	0.25	1.12	14.3	51.7	117	71	+0.96	+54
03/06	13 46.3	+75 41	0.39	1.16	15.5	54.7	107	103	-0.38	+41
03/16	13 28.6	+81 11	0.54	1.21	16.2	54.2	100	82	+0.18	+36
03/26	12 51.0	+83 12	0.68	1.25	16.8	52.5	95	83	+0.98	+34

(137199) 1999 KX4 (January, H = 16.8)

There are no entries in the LCDB for this NEA, which has an estimated size of 1.2 km. This makes it a little large to expect a rotation period of < 2 hours, but the first rule of good science is never assume.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/01	10 03.4	+19 17	0.30	1.21	16.2	35.7	134	13	-0.88	+51
01/06	10 23.7	+23 23	0.27	1.19	15.9	35.5	135	59	-0.41	+56
01/11	10 47.6	+28 14	0.25	1.17	15.7	36.3	135	123	-0.01	+63
01/16	11 16.1	+33 42	0.23	1.15	15.6	38.3	133	146	+0.22	+68
01/21	11 50.3	+39 22	0.22	1.14	15.5	41.8	130	104	+0.69	+72
01/26	12 30.9	+44 42	0.21	1.12	15.5	46.3	125	67	+0.99	+72
01/31	13 17.1	+49 05	0.21	1.10	15.6	51.4	119	56	-0.85	+67

(136993) 1998 ST49 (January, H = 17.6)

Galad (2007) found a period of 2.302 h and amplitude of 0.11 mag for this near-Earth asteroid. These make it an ideal candidate for being binary even though he reported no indications of such. The phase angle bisector longitude this time around is about 100° from

the time of Galad's observations. If the viewing geometry was not right the first time, it's about as likely as can be that it will be this time. In which case, you'll need observations on the order 0.01-0.02 mag precision to look for evidence of a satellite.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/01	10 03.4	+19 17	0.30	1.21	16.2	35.7	134	13	-0.88	+51
01/06	10 23.7	+23 23	0.27	1.19	15.9	35.5	135	59	-0.41	+56
01/11	10 47.6	+28 14	0.25	1.17	15.7	36.3	135	123	-0.01	+63
01/16	11 16.1	+33 42	0.23	1.15	15.6	38.3	133	146	+0.22	+68
01/21	11 50.3	+39 22	0.22	1.14	15.5	41.8	130	104	+0.69	+72
01/26	12 30.9	+44 42	0.21	1.12	15.5	46.3	125	67	+0.99	+72
01/31	13 17.1	+49 05	0.21	1.10	15.6	51.4	119	56	-0.85	+67

2008 DG17 (February, H = 19.7)

This NEA has an estimated effective diameter of 0.3 km. This is at the upper limit that roughly defines the potential for it being a superfast rotator ($P < 2$ hours). Keep that in mind as you make your observations, possibly keeping exposures as short as possible until you have a good indication of the rotation period.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
02/05	11 10.5	+58 46	0.18	1.12	17.9	40.9	132	100	-0.34	+54
02/07	10 39.0	+56 16	0.16	1.11	17.5	37.8	137	120	-0.14	+52
02/09	10 03.3	+52 13	0.14	1.10	17.1	33.6	142	137	-0.02	+50
02/11	09 25.3	+45 52	0.12	1.09	16.6	28.6	148	139	+0.01	+45
02/13	08 47.2	+36 30	0.10	1.08	16.2	24.1	153	122	+0.09	+38
02/15	08 11.4	+23 58	0.10	1.07	16.0	24.4	153	95	+0.24	+28
02/17	07 39.5	+09 35	0.09	1.07	16.2	32.1	145	66	+0.42	+15
02/19	07 12.0	-04 14	0.10	1.06	16.6	42.9	133	43	+0.61	+3

2012 DA14 (February, H = 24.4, Very Close Approach)

This is the highlight object of the group. On February 15, it will come to about 58000 km distance from Earth. According to the Minor Planet Center ephemeris service and based on orbital elements in mid-September 2012, the asteroid will be moving at a rate of more than 30 *arcminutes* per minute around 20 UT and be $V \sim 8.2$. This will allow short exposures without too much trailing, although scintillation noise for exposures of only 1-2 seconds may dominate the data.

The ephemeris is only a guideline since it is geocentric and the elements may be improved considerably prior to closest approach. What is particularly noteworthy, however, is that in the course of only one day, Feb 15-16, the asteroid moves from near the south celestial pole to the north. Also interesting is that of 2012 September, the asteroid is *not* listed on the MPC site as being potentially hazardous.

There is every possibility that this will be a super-fast rotator, with a period on the order of a few minutes. Complicating matters will be the significant range of phase angles, over which the amplitude and shape of the lightcurve could change dramatically. In addition, light-time and phase angle corrections will have to be done for each observation and not use constant correction values based on an average time in order to properly de-trend the data. Despite these difficulties, lightcurve data will be of enormous help when combined with radar data in modeling the shape and spin axis.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
02/13	00 21.0	-71 44	0.01	0.98	19.0	116.5	63	75	+0.09	-45
02/14	00 20.6	-72 37	0.01	0.98	18.0	115.8	64	81	+0.16	-44
02/15	00 18.0	-75 37	0.00	0.99	16.1	113.2	67	88	+0.24	-41
02/16	12 50.7	+76 05	0.00	0.99	11.7	65.2	115	89	+0.33	+43
02/17	13 01.2	+85 07	0.01	0.99	15.7	73.8	106	77	+0.42	+32
02/18	13 05.5	+86 02	0.01	0.99	17.1	74.7	105	73	+0.52	+31
02/19	13 07.8	+86 23	0.02	0.99	17.9	75.1	104	72	+0.61	+31
02/20	13 09.0	+86 34	0.02	0.99	18.5	75.3	104	71	+0.70	+31

1685 Toro (February-April, H = 14.2)

The rotation period of this NEA is fairly well stabled at 10.195 h. However, it is a good candidate for YORP spin-up/down, meaning that data from each succeeding apparition can be used to determine if the period is changing slowly over time.

It's important to note that the shape and amplitude of the curve can change significantly over an apparition, e.g., see Warner, http://www.minorplanetobserver.com/pdalc/A1685_2012.HTM, which also shows that the synodic period can change over a relatively short time. If you get a plan a protracted campaign, it would be good to subdivide it into blocks of dates, each having a relatively small range of phase angles and treating them as stand-alone sets. Putting all the data into a single set may not only affect the final solution but hide critical data about the lightcurve shape and amplitude vital to good modeling.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
02/13	00 21.0	-71 44	0.01	0.98	19.0	116.5	63	75	+0.09	-45
02/14	00 20.6	-72 37	0.01	0.98	18.0	115.8	64	81	+0.16	-44
02/15	00 18.0	-75 37	0.00	0.99	16.1	113.2	67	88	+0.24	-41
02/16	12 50.7	+76 05	0.00	0.99	11.7	65.2	115	89	+0.33	+43
02/17	13 01.2	+85 07	0.01	0.99	15.7	73.8	106	77	+0.42	+32
02/18	13 05.5	+86 02	0.01	0.99	17.1	74.7	105	73	+0.52	+31
02/19	13 07.8	+86 23	0.02	0.99	17.9	75.1	104	72	+0.61	+31

(329614) 2003 KU2 (March, H = 19.0, PHA)

Coming back after a close approach in 2012 July, this NEA was found to have a period of 3.278 h (Hicks *et al.*, 2012). The estimated size is about 0.9 km.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
03/10	12 38.7	+05 54	1.28	2.24	19.5	8.5	161	137	-0.04	+69
03/15	12 34.2	+06 15	1.25	2.23	19.3	6.3	166	151	+0.11	+69
03/20	12 29.1	+06 35	1.23	2.22	19.2	4.5	170	92	+0.53	+69
03/25	12 23.8	+06 54	1.22	2.21	19.1	4.0	171	31	+0.93	+69
03/30	12 18.4	+07 10	1.21	2.20	19.2	5.2	168	43	-0.91	+69
04/04	12 12.9	+07 22	1.21	2.19	19.3	7.3	164	114	-0.41	+68
04/09	12 07.8	+07 30	1.22	2.18	19.4	9.8	158	168	-0.02	+68