LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2013 OCTOBER-DECEMBER

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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 October-December. 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, d*o 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 < 15.0 at brightest during the period and have either no or poorly-constrained lightcurve parameters.

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 ≤ 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.

Lightcurve Opportunities

Objects in bold italics are near-Earth asteroids (NEA), defined as q < 1.3 AU. An asterisk (*) follows the name if the asteroid is reaching a particularly favorable apparition.

#	Name	Brightest Date	Mag	Dec	LCDB Data Period	Amp	U
2771	Polzunov*	10 02.2	14.7	+11	11.66	0.15	2
4517	Ralpharvey	10 02.9	14.4	+1			
1180	Rita	10 03.3	14.4	-5	9.605	0.05-0.30	2
2212	***Hephaistos***	***10 05.2***	***14.0***	***-44***	***> 20.***	***0.08-0.11***	***1***
9199	1993 FO1*	10 06.3	15.0	-3	5.322	0.47	2+
2286	Fesenkov*	10 06.6	14.5	+3			
828	Lindemannia	10 07.9	14.5	+6		0.08	
6634	1987 KB	10 07.9	14.4	+21	4.492	0.22	2
1653	Yakhontovia*	10 08.3	12.7	+14	15.41	0.03	2
2259	Sofievka	10 08.3	14.8	+14	31.6	0.10	2
1070	Tunica	10 08.4	14.8	-6			
2443	Tomeileen	10 10.0	14.7	-8	3.974	0.10-0.13	2
712	Boliviana	10 11.0	10.9	+18	11.732	0.10-0.11	2
1428	Mombasa	10 11.8	13.7	-19	16.67	0.15-0.25	2+
2660	Wasserman	10 13.0	14.9	+9		0.07	
1246	Chaka*	10 13.6	13.0	+40	> 20.	0.2	2
3330	Gantrisch	10 15.7	14.8	+12			
1557	Roehla	10 16.9	15.0	+17			
7288	1991 FE1*	10 16.9	14.8	+15			
641	Agnes*	10 17.2	13.9	+8	8.9	0.18	1
2112	Ulyanov*	10 17.3	13.9	+13	3.	0.33	2
4905	Hiromi*	10 17.8	14.2	+7			
3250	Martebo*	10 18.0	14.5	+9			
1359	Prieska	10 18.1	14.4	-1		0.04	
1384	Kniertje	10 18.2	14.4	-6	9.807	0.11-0.33	2
3062	Wren*	10 21.2	14.5	-6	7.097	0.17-0.22	2
1639	Bower	10 23.5	13.7	+24	12.5	0.15-0.38	2
16009	1999 CM8*	10 23.5	14.0	+7			
2281	Biela	10 23.8	15.0	+11			
5110	Belgirate*	10 23.8	15.0	+18	11.04	0.08	1
983	Gunila	10 25.7	14.5	+25	D	0.05-0.25	
3500	Kobayashi	10 25.7	14.5	+21			
7167	Laupheim*	10 26.0	15.0	+17			
691	Lehigh	10 26.4	12.9	-4	12.891	0.12-0.16	2+
1457	Ankara	10 26.9	15.0	+21	31.8	0.21	2
1305	Pongola	10 27.0	15.0	+11	8.03	0.14-0.18	2
2254	Requiem	10 27.3	14.3	+21			
1167	Dubiago	11 01.0	14.5	+15	14.3	0.23	2
1447	Utra*	11 01.0	14.5	+15	257.	0.63	2
5256	Farquhar	11 01.2	14.5	+15		0.04	
2305	King*	11 02.3	14.9	+18			
445	Edna	11 03.9	13.2	+45	19.97	0.21	2
425	Cornelia	11 05.2	13.6	+14	17.56	0.19	2
1079	Mimosa	11 05.6	14.5	+17	64.6	0.07-0.13	2
941	Murray*	11 05.8	13.9	+14			

Lightcurve Opportunities (cont'd)

#	Name	Brightest Date	Mag	Dec	LCDB Data Period	Amp	U
8648	Salix*	11 09.0	14.5	+14			
431	Nephele	11 09.2	12.6	+14	18.821	0.03-0.30	2
2325	Chernykh*	11 09.3	15.0	+14			
3905	Doppler*	11 09.4	14.6	+41			
583	Klotilde	11 10.3	13.5	+23	9.2116	0.18-0.41	2
3248	Farinella	11 12.5	15.0	+28	6.676	0.20	2
2280	Kunikov	11 14.3	14.7	+13			
1603	Neva	11 14.4	14.1	+5	6.4249	0.22	2
2077	Kiangsu*	11 14.4	14.8	-14			
1033	Simona	11 14.6	14.7	+7	10.07	0.04	1+
1233	Kobresia	11 14.7	14.9	+26	27.83	0.32-0.34	2
2086	Newell*	11 14.7	14.7	+7	78.2	1.0	2
7355	Bottke*	11 16.0	14.8	+17			
507	Laodica	11 16.2	13.2	+31	6.737	0.22-0.29	2
4135	Svetlanov	11 17.6	14.9	+11	10.559	0.15	2
4067	Mikhel'son*	11 17.9	15.0	+30			
2053	Nuki*	11 19.3	14.7	+10			
3702	Trubetskaya	11 19.4	14.1	-5			
1055	Tynka	11 20.0	14.2	+11	11.893	0.06-0.33	2
2675	Tolkien	11 21.2	14.0	+24	1060.	0.75	2+
1911	Schubart	11 21.4	14.9	+22			
946	Poesia	11 22.0	13.9	+20	108.5	0.24-0.32	2+
1027	Aesculapia	11 22.7	15.0	+21	6.83	0.15	1
2271	Kiso	11 23.0	14.6	+15		0.12	
4649	Sumoto*	11 24.8	14.3	+12	26.31	0.15-0.30	2
2239	Paracelsus	11 25.0	15.0	+32			
6246	Komurotoru*	11 25.2	14.4	+31			
1887	Virton	11 26.8	14.7	+35			
920	Rogeria*	11 27.1	14.3	+6	8.09	0.16-0.21	2-
341	California	11 27.3	13.0	+27	8.74	0.02-0.07	1
2043	Ortutay	11 27.3	14.5	+26			
2413	van de Hulst	11 27.5	15.0	+5			
3437	Kapitsa*	11 27.5	15.0	+25			
1326	Losaka*	11 29.4	13.6	+5	6.9	0.03	2
1112	Polonia	12 01.0	13.8	+33	82.5	0.20	2
786	Bredichina	12 02.3	13.7	+15	18.61	0.05-0.60	2+
1365	Henyey	12 02.3	14.8	+23	18.986	0.23	2+
279	Thule	12 03.1	14.3	+22	15.962	0.04-0.10	2+
1085	Amaryllis	12 04.1	14.4	+14	18.2	0.20	2
1539	Borrelly	12 04.1	14.4	+20			
1194	Aletta	12 04.3	14.7	+33	20.39	0.28-0.32	2+
2531	Cambridge	12 04.6	14.9	+13	8.8	0.21	2-
2393	Suzuki	12 05.0	15.0	+15	9.31	0.40	2+
856	Backlunda	12 05.1	14.3	+4	12.08	0.24-0.33	2
2391	Tomita*	12 07.2	14.5	+17			
496	Gryphia*	12 10.1	13.5	+17	18.	0.05	1
1574	Meyer*	12 11.0	14.8	+18	12.64	0.12	2
2638	Gadolin*	12 12.5	14.5	+17			
560	Delila*	12 14.0	13.6	+17		0.1	
365	Corduba	12 15.9	12.5	+3	6.354	0.05-0.15	2
767	Bondia	12 17.7	14.2	+24			
666	Desdemona	12 17.8	13.0	+13	15.45	0.07-0.16	2
2536	Kozyrev	12 18.3	14.3	+25	7.188	0.52	2+
707	Steina	12 19.0	14.0	+25	414.	0.1- 1.0	2+
6906	Johnmills*	12 19.2	15.0	+30			
1596	Itzigsohn*	12 20.8	13.9	+16	39.722	0.15-0.41	2
537	Pauly	12 21.3	13.7	+16	14.15	0.15-0.20	2+
437	Rhodia	12 23.5	13.7	+22	56.	0.06-0.38	1
318	Magdalena*	12 24.0	13.6	+8	59.5	0.11	1
1191	Alfaterna	12 24.9	14.9	+4	3.664	0.03-0.05	1
1678	Hveen	12 26.3	14.8	+39			
1888	Zu Chong-Zhi*	12 27.4	13.8	+18	15.9	0.50	2
703	Noemi	12 27.6	14.2	+19			
1826	Miller*	12 28.7	14.5	+23	30.049	0.08	2
1264	Letaba	12 29.3	14.5	-1	32.16	0.11-0.13	1

Low Phase Angle Opportunities

#	Name	Date	α	V	Dec	Period	Amp	U
149	Medusa	10 01.9	0.43	12.6	+03	26.023	0.47-0.56	3
641	Agnes	10 17.1	0.52	13.9	+08	8.9	0.18	1
546	Herodias	10 21.1	0.97	13.0	+13	10.77	0.07-0.18	3
1675	Simonida	10 26.9	0.38	13.5	+13	5.2885	0.16-0.65	3
168	Sibylla	10 27.7	0.30	12.2	+12	47.009	0.16	3
326	Tamara	10 28.3	0.79	12.4	+15	14.445	0.10-0.27	3
99	Dike	10 30.3	0.55	13.7	+12	18.127	0.08-0.22	3
798	Ruth	10 30.5	0.23	13.6	+13	8.550	0.19-0.36	3
1074	Beljawskya	10 31.8	0.10	13.3	+14	6.284	0.28-0.37	3
20	Massalia	11 01.0	0.12	8.7	+14	8.098	0.15-0.27	3
425	Cornelia	11 05.2	0.63	13.7	+14	17.56	0.19	2
941	Murray	11 05.8	0.83	14.0	+14			
126	Velleda	11 08.1	0.86	11.7	+18	5.3672	0.07-0.22	3
284	Amalia	11 08.5	0.76	13.0	+18	8.545	0.16	3
431	Nephele	11 09.4	0.88	12.6	+14	18.821	0.02-0.30	2

Low Phase Angle Opportunities (cont'd)

#	Name	Date	α	V	Dec	Period	Amp	U
1567	Alikoski	11 12.6	0.23	13.9	+17	16.405	0.16	3
946	Poesia	11 22.0	0.14	14.0	+20	108.5	0.32	2+
76	Freia	11 23.3	0.64	11.8	+19	9.969	0.06-0.33	3
447	Valentine	12 02.3	0.15	12.7	+22	9.651	0.18	3
567	Eleutheria	12 03.0	0.87	13.7	+25	7.72	0.26-0.50	3
138	Tolosa	12 04.2	0.59	11.9	+24	10.101	0.18-0.45	3
64	Angelina	12 06.0	0.72	10.5	+24	8.752	0.04-0.42	3
899	Jokaste	12 07.0	0.33	13.1	+22	6.245	0.25-0.31	3
977	Philippa	12 09.4	0.22	13.8	+23	15.405	0.49	3
405	Thia	12 10.1	0.32	12.1	+22	10.08	0.15-0.23	3
222	Lucia	12 12.7	0.10	14.0	+23	7.80	0.25-0.38	3
535	Montague	12 14.3	0.24	12.4	+23	10.2482	0.18-0.25	3
437	Rhodia	12 23.7	0.65	13.7	+22	56.	0.06-0.38	1
277	Elvira	12 26.8	0.42	13.6	+22	29.69	0.34-0.59	3
3169	Ostro	12 27.3	0.63	13.6	+22	6.483	0.42-1.2	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 more apparitions will allow either an initial or a refined solution.

Occultation Profiles Available

		Brightest			LCDB DATA		
#	Name	Date	Mag	De	Period	Amp	U
568	Cheruskia	10 02.1	13.2	+26	13.209	0.10-0.44	3
828	Lindemannia	10 07.9	14.5	+06		0.08	
404	Arsinoe	10 13.2	13.5	-10	8.887	0.27-0.38	3
99	Dike	10 30.3	13.6	+12	18.127	0.08-0.22	3
566	Stereoskopia	11 06.2	12.1	+12	12.103	0.05-0.25	3
431	Nephele	11 09.2	12.6	+14	18.821	0.02-0.30	2
76	Freia	11 23.3	11.8	+19	9.969	0.06-0.33	3
134	Sophrosyne	11 26.2	11.6	+40	17.196	0.19	3
638	Moira	12 01.4	14.3	+16	9.875	0.31	3
350	Ornamenta	12 07.6	11.9	+11	9.178	0.10-0.23	3
522	Helga	12 07.6	13.8	+19	8.129	0.13-0.30	3
366	Vincentina	12 09.8	13.3	+38	15.5	0.08	1
120	Lachesis	12 27.6	12.2	+32	46.551	0.14-0.22	3
381	Myrrha	12 28.8	13.2	+15	6.572	0.36	3
18	Melpomene	12 31.	9.8	+08	11.570	0.10-0.32	3
141	Lumen	12 31.	12.5	+23	19.87	0.12-0.2	3
51	Nemausa	12 31.	10.4	+06	7.783	0.10-0.25	3

Inversion Modeling Candidates

		Brightest			LCDB Data		
#	Name	Date	Mag	Dec	Period	Amp	U
482	Petrina	10 01.2	12.9	+00	11.794	0.07-0.45	3-
6634	1987 KB	10 07.9	14.4	+21	4.492	0.22	2
718	Erida	10 25.9	14.6	+11	17.447	0.37	3
1426	Riviera	10 31.5	14.9	+26	4.404	0.30	3
20	Massalia	11 01.0	8.7	+14	8.098	0.15-0.27	3
1691	Oort	11 02.7	14.2	+14	10.2705	0.38	3
214	Aschera	11 06.8	12.4	+21	6.835	0.22	3
3737	Beckman	11 07.0	13.4	+60	3.124	0.16	3
1003	Lilofee	11 11.4	14.3	+15	8.255	0.52	3
1233	Kobresia	11 14.7	14.9	+26	27.83	0.34	2
2086	Newell	11 14.7	14.7	+07	78.2	1.0	2
734	Benda	11 20.7	13.7	+27	7.11	0.28	3
1125	China	11 22.4	14.8	+17	5.367	0.38	3
804	Hispania	11 23.9	11.9	+43	14.845	0.19-0.24	3
656	Beagle	11 24.8	14.1	+20	7.035	0.9 -1.2	3
228	Agathe	11 26.0	14.5	+25	6.484	0.27	3
1204	Renzia	11 29.8	14.3	+24	7.885	0.42	3
274	Philagoria	11 30.8	14.4	+20	17.96	0.43-0.51	3
638	Moira	12 01.4	14.3	+16	9.875	0.31	3
567	Eleutheria	12 03.1	13.6	+25	7.72	0.26-0.50	3
2393	Suzuki	12 05.0	15.0	+15	9.31	0.40	2+
856	Backlunda	12 05.1	14.3	+04	12.08	0.29	2
1797	Schaumasse	12 08.0	15.0	+27	6.105	0.75	3-
744	Aguntina	12 09.5	14.7	+13	17.47	0.50	3
3155	Lee	12 11.4	14.5	+33	8.310	0.22-0.35	3
707	Steina	12 19.0	14.0	+25	414.	0.1 -1.0	2+
537	Pauly	12 21.3	13.7	+16	14.15	0.15-0.20	2+

Inversion Modeling Candidates (cont'd)

		Brightest			LCDB Data		
#	Name	Date	Mag	Dec	Period	Amp	U
5489	Oberkochen	12 21.8	14.5	+18	5.625	0.40	3
607	Jenny	12 22.7	13.9	+27	8.526	0.17-0.26	3-
1703	Barry	12 26.2	14.8	+21	107.1	0.5	3
1826	Miller	12 28.7	14.6	+23	30.049	0.08	2
1368	Numidia	12 29.9	14.8	+46	3.64	0.35	3
345	Tercidina	12 31.	11.7	+03	12.371	0.11-0.23	3
317	Roxane	12 31.	13.5	+17	8.169	0.61-0.75	3
1618	Dawn	12 31.	15.0	+23	43.19	0.38	2+
208	Lacrimosa	12 31.	13.7	+13	14.085	0.15-0.33	3
239	Adrastea	12 31.	14.1	+12	18.4707	0.34-0.51	3
271	Penthesilea	12 31.	14.0	+25	18.787	0.33	3
868	Lova	12 31.	14.2	+17	41.3	0.40	2
2381	Landi	12 31.	14.7	+05	3.91	0.75	2
1339	Desagneauxa	12 31.	14.5	+25	9.380	0.48	3
1021	Flammario	12 31.	11.5	+16	12.160	0.14-0.40	3-
1219	Britta	12 31.	13.7	+30	5.575	0.48-0.75	3
616	Elly	12 31.	14.9	+19	5.297	0.34-0.44	3
4299	WIYN	12 31.	14.9	+22	26.	0.06	2
502	Sigune	12 31.	15.0	+06	10.922	0.25-0.53	3
1494	Savo	12 31.	14.3	+18	5.35011	0.45-0.52	3
822	Lalage	12 31.	15.0	+11	3.345	0.47-0.58	3

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.

89 Julia (Oct-Nov, H = 6.6)

The rotation period for this inner main-belt asteroid is 11.38 hours. This makes it difficult for a single station to get complete coverage of the lightcurve without an prolonged campaign. A collaboration involving observers well-separated in longitude would be ideal. The estimated diameter is 151 km.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
10/01	23 21.6	+22 22	1.14	2.09	9.2	11.8	155	137	-0.16	-36
10/08	23 15.3	+22 04	1.16	2.09	9.3	13.3	151	122	+0.11	-36
10/15	23 10.5	+21 37	1.19	2.09	9.4	15.4	146	32	+0.82	-35
10/22	23 07.3	+21 05	1.23	2.10	9.6	17.5	141	70	-0.91	-36
10/29	23 06.0	+20 32	1.28	2.10	9.7	19.6	135	147	-0.31	-36
11/05	23 06.5	+20 00	1.34	2.11	9.9	21.4	129	111	+0.03	-36
11/12	23 08.7	+19 33	1.40	2.11	10.0	23.0	123	23	+0.69	-37
11/19	23 12.5	+19 13	1.47	2.12	10.2	24.3	118	77	-0.98	-38

216 Kleopatra (Oct-Jan, H = 7.30)

This is the "dog bone" asteroid, so-called because of it shape. The period and even shape are well determined. It's included here because it often helps to have supporting lightcurve observations to go with the latest radar data. It's also an excellent teaching object of the high amplitude lightcurve, brightness, and ability to get a complete cycle (or more) in a single night's run.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
10/01	03 52.0	+19 18	1.33	2.10	10.4	22.1	128	80	-0.16	-26
10/15	03 53.3	+17 17	1.23	2.10	10.1	17.1	142	88	+0.82	-27
10/29	03 48.2	+14 44	1.16	2.11	9.8	10.7	157	89	-0.31	-30
11/12	03 38.7	+11 58	1.14	2.12	9.5	4.3	171	74	+0.69	-34
11/26	03 28.0	+09 26	1.16	2.13	9.7	6.8	165	103	-0.48	-37
12/10	03 19.9	+07 35	1.24	2.15	10.1	13.3	150	58	+0.54	-40
12/24	03 16.9	+06 38	1.35	2.17	10.4	18.6	135	114	-0.65	-41
01/07	03 19.5	+06 30	1.50	2.19	10.8	22.4	122	49	+0.38	-41

324 Bamberga (Oct-Nov, H = 6.82)

This middle main-belt asteroid has an estimated diameter of 230 km. It's a type CP (Tholen, 1989), meaning is has a lower albedo on the order of 0.06. The rotation period of 29.4 h makes this another object where a collaboration among observers will have the best chance of securing a complete lightcurve.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
10/01	22 56.0	+06 48	0.83	1.79	8.5	12.8	157	152	-0.16	-46
10/06	22 52.9	+07 05	0.84	1.79	8.6	15.4	152	141	+0.01	-45
10/11	22 50.8	+07 22	0.86	1.79	8.8	17.9	147	71	+0.39	-45
10/16	22 49.6	+07 38	0.89	1.78	8.9	20.2	142	10	+0.90	-44
10/21	22 49.5	+07 54	0.92	1.78	9.0	22.3	137	66	-0.96	-44
10/26	22 50.4	+08 11	0.95	1.78	9.2	24.1	133	125	-0.59	-44
10/31	22 52.3	+08 29	0.98	1.78	9.3	25.8	129	168	-0.14	-44
11/05	22 55.1	+08 50	1.02	1.78	9.4	27.2	125	105	+0.03	-44

1627 Ivar (Oct-Dec, H = 13.2)

This near-Earth asteroid (NEA) is well-placed for most of the quarter. It's not quite as bright as earlier this year, but still be careful about overexposing it, at least in October. The period is well-known: 4.798 h. The amplitude has ranged from 0.25 to 1.4 mag.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
10/01	02 06.8	-12 46	0.44	1.40	12.7	20.4	151	111	-0.16	-67
10/11	01 54.0	-13 51	0.48	1.45	12.9	16.3	156	106	+0.39	-70
10/21	01 41.8	-13 57	0.54	1.51	13.2	15.9	155	39	-0.96	-72
10/31	01 32.4	-13 11	0.62	1.56	13.6	18.4	150	147	-0.14	-73
11/10	01 26.7	-11 46	0.71	1.61	14.1	21.7	143	65	+0.48	-73
11/20	01 25.0	-09 56	0.81	1.67	14.5	24.6	135	68	-0.95	-71
11/30	01 26.8	-07 51	0.93	1.72	14.9	27.0	128	160	-0.12	-69
12/10	01 31.7	-05 39	1.06	1.77	15.3	28.7	120	32	+0.54	-66

(85774) 1998 UT18 (Oct-Dec, H = 19.2)

Krugly *et al*. (2002; *Icarus* **158**, 294-304) reported a period of 34 hours for this NEA but the result is considered likely wrong (U = 1 in the LCDB). Skiff *et al*. (2008; *MPB* **39**, 111-130) reported only an amplitude of 0.34 mag. Don't let past results influence your analysis. Given past results, it might be wise to collaborate with observers at widely-separated longitudes.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
10/20	05 55.3	+00 15	0.31	1.16	18.8	50.8	115	54	-0.99	-12
10/27	06 27.9	+02 37	0.26	1.13	18.5	53.5	114	30	-0.50	-4
11/03	07 08.7	+06 02	0.22	1.09	18.2	57.3	112	105	+0.00	+7
11/10	08 00.9	+10 38	0.19	1.06	18.0	62.8	107	165	+0.48	+20
11/17	09 06.1	+15 56	0.18	1.03	18.0	70.0	100	87	+1.00	+37
11/24	10 20.3	+20 33	0.17	1.01	18.1	77.9	92	23	-0.67	+55
12/01	11 32.7	+23 11	0.19	0.99	18.5	84.5	85	59	-0.06	+72
12/08	12 34.1	+23 46	0.21	0.97	18.8	88.6	79	136	+0.32	+85

(138095) 2000 DK79 (Oct-Dec, H = 15.8)

This NEA has no reported lightcurve parameters in the LCDB. Assuming $p_V = 0.2$, the estimated size if about 2 km. This asteroid makes the celestial rounds, going from far south to far north of the celestial equator during the last three months of the year.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
10/01	07 08.9	-53 44	0.73	1.15	17.5	59.7	82	70	-0.16	-19
10/15	06 48.4	-57 00	0.50	1.09	16.8	65.6	87	105	+0.82	-23
10/29	05 05.3	-62 55	0.26	1.06	15.4	68.9	97	89	-0.31	-36
11/12	22 57.4	-15 55	0.13	1.04	13.7	63.5	110	13	+0.69	-61
11/26	21 21.2	+31 13	0.32	1.05	15.9	70.5	92	141	-0.48	-13
12/10	20 58.3	+40 45	0.56	1.07	17.0	65.6	83	53	+0.54	-3
12/24	20 51.2	+45 15	0.78	1.12	17.6	59.2	78	125	-0.65	+1

2007 CN26 (Oct-Nov, H = 21.0, PHA)

There is no reported rotation period in the LCDB. 2007 CN26 is an NEA with an estimated diameter of 200 meters. This puts it on the edge of being a candidate for having a period of less than 2 hours. Statler *et al.* (2013; *Icarus* **225**, 141-155) report that 170 meters is about the upper limit with the number of faster rotators dropping rapidly at larger sizes. Until you know one way or the other, keep exposures to a minimum but long enough to avoid letting scintillation noise dominate (~10 sec for small telescopes).

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
10/01	02 04.9	-21 52	0.14	1.12	18.1	30.3	146	112	-0.16	-72
10/02	02 03.0	-22 01	0.14	1.12	18.1	29.7	146	122	-0.10	-73
10/03	02 01.0	-22 08	0.15	1.13	18.2	29.2	147	132	-0.05	-73
10/04	01 59.2	-22 14	0.15	1.13	18.2	28.7	147	140	-0.01	-74
10/05	01 57.3	-22 19	0.16	1.13	18.3	28.3	148	145	+0.00	-74
10/06	01 55.6	-22 22	0.16	1.14	18.3	27.8	148	146	+0.01	-75
10/07	01 53.9	-22 25	0.16	1.14	18.4	27.5	148	142	+0.05	-75
10/08	01 52.2	-22 26	0.17	1.15	18.5	27.2	148	135	+0.11	-75

(52760) 1998 ML14 (Nov-Jan, H = 17.6, PHA)

Hicks *et al.* (1998; *B.A.A.S.* **30**, 1029) reported a period of 14.98 hours for this NEA estimated to have an effective diameter of about 1 km (Ostro *et al.* 2001; *Meteoritics and Planetary Sci.* **36**, 1225-1236). It's not exceptionally bright but it should be within reach of larger backyard telescopes. For northern observers at least, the high declination will mean long runs, which may help find a reliable solution sooner than later.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
11/10	08 00.3	+28 01	0.40	1.19	17.8	51.0	111	158	+0.48	+27
11/17	07 51.6	+28 25	0.42	1.25	17.8	43.4	120	67	+1.00	+25
11/24	07 39.7	+28 50	0.44	1.31	17.7	35.7	129	24	-0.67	+23
12/01	07 25.1	+29 11	0.46	1.37	17.7	27.9	140	113	-0.06	+20
12/08	07 08.8	+29 23	0.49	1.43	17.7	20.1	150	138	+0.32	+16
12/15	06 52.0	+29 24	0.53	1.49	17.7	12.7	161	46	+0.95	+13
12/22	06 36.2	+29 13	0.57	1.55	17.7	6.2	170	44	-0.82	+10
12/29	06 22.4	+28 52	0.63	1.61	17.9	3.6	174	134	-0.16	+7

1997 WQ23 (Nov-Dec, H = 20.3)

The estimated size of this NEA (assuming $p_V = 0.2$) is about 250 meters. As with 2007 CN26, this asteroid could have a rotation period under 2 hours. The LCDB does not have a reported period.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
11/10	21 43.8	-20 51	0.08	1.00	17.7	81.7	94	14	+0.48	-47
11/13	22 47.2	-13 20	0.08	1.02	17.2	68.2	108	20	+0.79	-58
11/16	23 43.8	-05 19	0.08	1.03	17.0	55.4	121	41	+0.97	-63
11/19	00 29.6	+01 34	0.10	1.05	17.1	45.2	131	65	-0.98	-61
11/22	01 05.0	+06 50	0.11	1.07	17.2	38.0	138	91	-0.83	-56
11/25	01 32.3	+10 41	0.13	1.09	17.5	33.2	143	118	-0.58	-51
11/28	01 53.5	+13 29	0.15	1.11	17.7	30.2	145	150	-0.29	-47
12/01	02 10.4	+15 34	0.17	1.14	18.0	28.3	147	173	-0.06	-43

2006 CT (Dec-Jan, H = 22.3)

At only 100 meters diameter, this is the smallest object included this time, and reason that it is not very bright. Because of the wide range of phase angles, there is an excellent chance to get a series of lightcurves that show amplitude and/or shape evolution from late December into 2014 January. The LCDB has no period.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
12/25	09 56.3	+19 07	0.07	1.03	18.5	48.5	128	33	-0.56	+49
12/30	09 15.3	+18 52	0.08	1.05	18.4	34.6	143	108	-0.09	+40
01/04	08 41.3	+18 23	0.09	1.07	18.4	22.4	155	167	+0.10	+32
01/09	08 13.9	+17 50	0.11	1.09	18.4	12.1	167	93	+0.59	+26
01/14	07 52.6	+17 20	0.12	1.11	18.4	4.3	175	27	+0.96	+21
01/19	07 36.5	+16 55	0.14	1.13	18.8	6.3	173	36	-0.93	+17
01/24	07 24.7	+16 37	0.16	1.14	19.4	12.3	166	101	-0.52	+15
01/29	07 16.5	+16 24	0.19	1.16	19.9	17.8	159	173	-0.06	+13

2009 WZ104 (Dec-Jan, H = 20.0)

Karashevich *et al.* (2012; *Solar System Research* **46**, 143-148) reported a period of 19.304 hours, but could not formally exclude the half-period of 9.652 hours. Be prepared for either possibility.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
12/25	11 07.0	-16 23	0.16	1.02	18.6	73.0	98	17	-0.56	+40
12/28	11 10.4	-20 53	0.15	1.02	18.5	73.3	98	44	-0.26	+36
12/31	11 14.0	-25 39	0.15	1.01	18.5	73.9	98	81	-0.03	+32
01/03	11 17.6	-30 40	0.14	1.01	18.4	74.8	97	118	+0.04	+28
01/06	11 21.6	-35 53	0.14	1.01	18.4	75.9	96	143	+0.28	+24
01/09	11 25.9	-41 15	0.14	1.00	18.4	77.3	95	137	+0.59	+19
01/12	11 30.8	-46 44	0.14	1.00	18.4	79.1	93	116	+0.85	+14
01/15	11 36.6	-52 14	0.14	1.00	18.5	81.0	91	94	+0.99	+9

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