LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2023 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 using lightcurve inversion. The "Radar-Optical Opportunities" section includes a list of potential radar targets as well as some that might be in critical need of astrometric data.

We present several lists of asteroids that are prime targets for photometry and/or astrometry during the period 2023 January through March. The "Radar-Optical Opportunities" section provides an expanded list of potential NEA targets, many of which are planned or good candidates for radar observations.

In the first three sets of tables, "Dec" is the declination and "U" is the quality code of the lightcurve. See the latest asteroid lightcurve data base (LCDB from here on; Warner et al., 2009) documentation for an explanation of the U code:

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

The ephemeris generator on the MinorPlanet.info web site allows creating custom lists for objects reaching V ≤ 18.0 during any month in the current year and up to five years in the future, e.g., limiting the results by magnitude and declination, family, and more.

https://www.minorplanet.info/php/callopplcdbquery.php

We refer you to past articles, e.g., Warner et al. (2021a; 2021b) for more detailed discussions about the individual lists and points of advice regarding observations for objects in each list.

Once you've obtained and 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. We urge you to consider submitting your raw data to the ALCDEF database, accessible for uploading and downloading at *http://www.alcdef.org.* The database contains almost 10.2 million observations for 24,075 objects (as of 2022 October 5), making it one of the more useful sources for raw data of *dense* time-series asteroid photometry.

Lightcurve/Photometry Opportunities

Objects with U = 3– or 3 are excluded from this list since they will likely appear in the list for shape and spin axis modeling. Those asteroids rated U = 1 or have only a lower limit on the period, should be given higher priority over those rated U = 2 or 2+. 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 highly-rated result 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.

		Brightest				LCDB Data		
Number	Name	Date	Mag	Dec		Period	Amp	U
33697	1999 KJ11	01 03.6	16.4	+24		4.888	0.28	2
54906	2001 OT80	01 04.6	15.6	+27		9.93	0.10	1
11254	Konkohekisui	01 05.1	16.3	+16		8.794	0.24	2
20602	1999 RC198	01 05.4	15.7	+40		7.306	0.37	2
17663	1996 VK30	01 05.7	16.2	+19		34.062	0.17	2
4439	Muroto	01 05.9	16.0	+26	S	8.314		2
58625	1997 VE2	01 06.8	16.4	+13		124.572	0.61	2
4739	Tomahrens	01 07.4	16.3	+20		5.104	0.20-0.26	2
19668	1999 RB145	01 07.5	16.5	+43		170.497	0.55	2
2378	Pannekoek	01 11.1	14.6	+0		11.874	0.08-0.19	2
6287	Lenham	01 11.2	16.4	+24		5.623	0.34-0.45	2
2212	Hephaistos	01 11.9	12.9	+43		48	0.08-0.35	2
1478	Vihuri	01 14.0	14.9	+27		19.5	0.23	1
3809	Amici	01 14.6	15.6	+19		5.71	0.39	2+
21486	1998 HA148	01 16.2	16.1	+15		12.3	1.0	2-
15853	Benedettafoglia	01 17.1	16.5	+20		75.183	0.56	2
17847	1998 HQ115	01 18.5	16.5	+17		289.84	0.64	2
11303	1993 CA1	01 19.0	16.0	+30		5.618	0.31	2
27026	1998 QG86	01 19.0	16.1	+16		25.488	0.14	2
15781	1993 OJ7	01 19.1	16.3	+20		3.863		2-
9833	Rilke	01 19.9	16.4	+19		7.819	0.16	2
3299	Hall	01 20.9	15.7	+13		10.45	0.08-0.71	2
131774	2002 AZ18	01 20.9	16.4	+21		187.273	0.75	2
3210	Lupishko	01 21.6	15.0	+18		14.255	0.67-0.74	2+
162385	2000 BM19	01 24.1	16.4	+69		9.463	1.34-1.38	2+
10893	1997 SB10	01 26.3	16.5	+11		2.924	0.20	2
13338	1998 SK119	01 27.8	16.1	+33	S	4.129		2
33634	Strickler	01 29.1	16.2	+24		2.939	0.30	2
1956	Artek	01 29.2	15.9	+17		9.4	0.07	1+
37586	1991 BP2	02 01.6	15.1	+9		887	0.92-0.96	2+
3201	Sijthoff	02 03.2	15.7	+19		4.607	0.29	2
16993	1999 CC10	02 04.0	15.3	+17		94.762	0.32	2
5478	Wartburg	02 06.4	15.4	+2		8.552	0.38	2
1903	Adzhimushkaj	02 06.8	14.3	+16		4.622	0.04	2
2560	Siegma	02 07.2	15.5	+14		10.309	0.07-0.10	2
11928	Akimotohiro	02 07.7	15.5	+17		2.957	0.12	2
9769	Nautilus	02 08.4	16.4	+17		6.184	0.63	2
1178	Irmela	02 08.5	14.6	+9		11.989	0.25-0.40	2
2846	Ylppo	02 08.8	15.7	+14		18.894	0.17-0.25	2
1911	Schubart	02 10.0	14.7	+13		11.915	0.11-0.22	2
6393	1990 HM1	02 12.0	16.0	+28		32.7	0.24-0.41	2
16858	1997 YG10	02 12.9	16.4	+19		5.232	0.24	2
6302	Tengukogen	02 13.9	16.2	+20		3.092	0.46	1+
15692	1984 RA	02 14.2	16.4	+15		37.44	0.66	2
6652	1991 SJ1	02 15.7	15.4	+4		85.56	0.75	2
19246	1994 EL7	02 15.7	16.1	+18		4.05	0.44	2
1483	Hakoila	02 16.9	14.5	+20		239.1	0.62	2
8548	Sumizihara	02 16.9	14.8	+14		3.192	0.10	2
12552	1998 QQ45	02 17.5	16.1	+10		4.8	0.33	2
56071	1998 YF6	02 18.8	16.2	+10		13.36	0.16	2
1907	Rudneva	02 21.7	15.0	+11		44	0.1	1+
8788	Labeyrie	02 21.7	16.2	+8		12.571	0.50	2
39510	1982 DU	02 25.0	15.7	+13	S	15.582		2
7895	Kaseda	02 25.2	15.1	+17		5.11	0.10	2+
36057	1999 RC33	02 25.2	16.3	+10		5.424	0.35	2
6793	Palazzolo	02 25.7	16.3	+15		6.231	0.14-0.16	2
6529	Rhoads	02 27.2	16.0	+0		9.729	0.43	2
4113	Rascana	03 01.0	15.5	+14		4.416	0.25-0.46	2
2396	Kochi	03 01.7	15.0	+8		26.17	0.14-0.26	2
52005	Maik	03 02.6	16.2	+6		10.655	0.34	2
2796	Kron	03 02.9	15.1	+8		22.99	0.07- 0.6	2
3286	Anatoliya	03 04.0	15.9	+24	S	5.81		2
19125	1987 CH	03 07.6	16.4	+9		76	0.66-0.86	2
3142	Kilopi	03 09.1	15.2	-6		15.128	0.04-0.29	2

Number	Name	Brightest Date	Mag	Dec	LCDB Data Period	Amp	U
45156	1999 XV114	03 09.5	16.4	-4	18.929	0.05	2
33131	1998 CW3	03 12.9	16.5	+9	S 8.35		2
7896	Svejk	03 13.9	16.1	+5	S 16.206		2
8404	1995 AN	03 14.2	15.5	-4	3.202	0.06-0.16	2+
9123	Yoshiko	03 14.9	15.7	-5	3.359	0.21	2
9192	1992 AR1	03 15.2	15.8	-8	43.297	0.24	2
11736	Viktorfischl	03 18.1	15.9	+7	9.783		2-
9325	Stonehenge	03 19.7	16.3	-5	4.607	0.16-0.22	2
4219	Nakamura	03 19.8	15.9	+4	115.492	0.20	2
21037	1990 EB	03 19.8	16.1	+11	17.923	0.12	2
86666	2000 FL10	03 19.8	15.7	-23	206	0.85	2
4486	Mithra	03 20.6	14.4	+35	67.5	1.	2
218863	2006 WO127	03 20.9	16.1	+21	S 3.275		2
21976	1999 XV2	03 21.5	15.5	-14	3.848	0.11	2
3527	McCord	03 22.8	14.8	-6	321	0.44	2
9324	1989 CH4	03 23.1	15.9	-3	6.558	0.16	2
16091	Malchiodi	03 26.4	16.3	-1	20.362	0.30-0.31	2
20771	2000 QY150	03 28.4	16.5	-10	S 8.3		2
5274	Degewij	03 28.7	15.5	-6	7.58	0.19-0.20	2
6767	Shirvindt	03 30.9	16.3	+0	10.787	0.48	2
22298	1990 EJ	03 31.2	16.0	-10	S 2.986		2
6667	Sannaimura	03 31.3	15.6	-1	2.893	0.05	2

Low Phase Angle Opportunities

The Low Phase Angle list includes asteroids that reach very low phase angles ($\alpha < 1°$). 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." Use the on-line query form for the LCDB to get more details about a specific asteroid.

https://www.minorplanet.info/php/callopplcdbquery.php

The best chance of success comes with covering at least half a cycle a night, meaning periods generally < 16 h, when working objects with low amplitude. Objects with large amplitudes and/or long periods are much more difficult for phase angle studies since, for proper analysis, the data must be reduced to the average magnitude of the asteroid for each night. Refer to Harris et al. (1989) for the details of the analysis procedure.

As an aside, it is arguably better for physical interpretation (e.g., *G* value versus albedo) to use the maximum light rather than mean level to find the phase slope parameter (*G*), which better models the behavior of a spherical object of the same albedo, but it can produce significantly different values for both *H* and *G* versus using average light, which is the method used for values listed by the Minor Planet Center. Using and reporting the results of both methods can provide additional insights into the physical properties of an asteroid.

The International Astronomical Union (IAU) has adopted a new system, H-G_{12}, introduced by Muinonen et al. (2010). It will be some years before H-G_{12} becomes widely used, and hopefully not until a discontinuity flaw in the G_{12} function has been fixed. This discontinuity results in false "clusters" or "holes" in the solution density and makes it impossible to draw accurate conclusions.

We strongly encourage obtaining data as close to 0° as possible, then every 1-2° out to 7°, below which the curve tends to be non-linear due to the opposition effect. From 7° out to about 30°, observations at 3-6° intervals should be sufficient. Coverage beyond 50° or so is not generally helpful since the H-G system is best defined with data from 0-30°.

It's important to emphasize that all observations should (must) be made using high-quality catalogs to set the comparison star magnitudes. These include ATLAS, Pan-STARRS, SkyMapper, and Gaia2/3. Catalogs such as CMC-15, APASS, or the MPOSC from *MPO Canopus* have too high of significant systematic errors.

Also important is that that there are sufficient data from each observing run such that their location can be found on a combined, phased lightcurve derived from two or more nights obtained *near the same phase angle.* If necessary, the magnitudes for a given run should be adjusted so that they correspond to mid-light of the combined lightcurve. This goes back to the H-G system being based on average, not maximum or minimum light.

The asteroid magnitudes are brighter than in others lists because higher precision is required and the asteroid may be a full magnitude or fainter when it reaches phase angles out to 20-30°.

Num	Name	Date	α	V	Dec	Period	Amp	U
64	Angelina	01 03.7	0.43	10.4	+24	8.752	0.04-0.42	3
449	Hamburga	01 04.9	0.81	12.0	+24	36.516	0.06-0.17	3
43	Ariadne	01 05.3	0.72	11.2	+21	5.762	0.06-0.73	3
891	Gunhild	01 08.2	0.22	13.7	+23	11.892	0.18-0.37	3-
165	Loreley	01 16.3	0.57	12.5	+23	7.226	0.06-0.17	3
544	Jetta	01 20.1	0.10	13.9	+20	7.745	0.44-0.52	3
295	Theresia	01 26.7	0.87	13.1	+17	10.702	0.11-0.22	3
551	Ortrud	01 28.1	0.20	13.2	+19	17.416	0.14-0.19	3
53	Kalypso	02 02.8	0.77	11.0	+15	9.036	0.09-0.14	3
221	Eos	02 04.6	0.55	12.3	+15	10.443	0.05-0.12	3
461	Saskia	02 11.5	0.25	14.0	+14	7.348	0.25-0.36	3
1639	Bower	02 19.0	0.57	14.0	+10	22.181	0.15-0.38	3-
335	Roberta	02 24.6	0.37	12.6	+11	12.054	0.05-0.78	3
50	Virginia	02 25.0	0.40	13.6	+8	14.315	0.07-0.20	3
185	Eunike	02 26.5	0.78	11.7	+11	21.797	0.08-0.22	3
489	Comacina	03 05.9	0.23	12.5	+5	9.02	0.12-0.33	3
308	Polyxo	03 06.2	0.68	11.9	+4	12.029	0.08-0.15	3-
573	Recha	03 08.3	0.35	14.0	+4	7.166	0.16-1.05	3
570	Kythera	03 09.9	0.54	14.0	+3	8.117	0.09-0.20	3
693	Zerbinetta	03 10.4	0.34	13.5	+5	11.475	0.14-0.29	3-
586	Thekla	03 13.1	0.70	13.3	+1	13.670	0.24-0.30	3
737	Arequipa	03 17.8	0.87	13.1	-1	7.026	0.08-0.26	3
257	Silesia	03 18.8	0.97	13.9	+4	15.709	0.29-0.30	3
190	Ismene	03 22.7	0.23	13.1	+0	6.521	0.10-0.16	3
73	Klytia	03 24.9	0.09	12.4	-1	8.297	0.26-0.35	3
787	Moskva	03 28.9	0.61	13.1	-2	6.056	0.27-0.68	3
62	Erato	03 29.7	0.79	13.7	-1	9.221	0.12-0.28	3
373	Melusina	03 30.0	0.55	14.0	-5	12.987	0.20-0.31	3

Shape/Spin Modeling Opportunities

Those doing work for modeling should contact Josef Ďurech at the email address above. If looking to add lightcurves for objects with existing models, visit the Database of Asteroid Models from Inversion Techniques (DAMIT) web site.

https://astro.troja.mff.cuni.cz/projects/damit/

Additional lightcurves could lead to the asteroid being added to or improving one in DAMIT, thus increasing the total number of asteroids with spin axis and shape models.

Included in the list below are objects that:

1. Are rated U = 3– or 3 in the LCDB.
2. Do not have reported pole in the LCDB Summary table.
3. Have at least three entries in the Details table of the LCDB where the lightcurve is rated U ≥ 2.

The caveat for condition #3 is that no check was made to see if the lightcurves are from the same apparition or if the phase angle bisector longitudes differ significantly from the upcoming apparition. The last check is often not possible because the LCDB does not list the approximate date of observations for all details records. Including that information is an on-going project.

With the wide use of sparse data from the surveys for modeling that produces hundreds of statistically valid poles and shapes, the need for data for main-belt objects is not what it used to be. The best use of observing time might be to concentrate on near-Earth asteroids, or on asteroids where the only period was derived from sparse data, which can help eliminate alias periods. The latter targets are usually flagged with an ‘S’ on the LCDB summary line. Regardless, it’s a good idea to visit the DAMIT site and see what it has, if anything, on the target(s) you’ve picked for observations.

Objects in **bold** text are at a favorable apparition.

		Brightest			LCDB Data		
Num	Name	Date	Mag	Dec	Period	Amp	U
701	Oriola	01 02.1	13.4	+17	9.09	0.20-0.37	3
468	Lina	01 03.6	14.1	+23	16.33	0.13-0.18	3
2491	**Tvashtri**	**01 07.4**	**15.0**	**+4**	**4.085**	**0.06-0.24**	**3**
891	**Gunhild**	**01 08.2**	**13.6**	**+23**	**11.892**	**0.18-0.37**	**3-**
4497	Taguchi	01 09.0	14.7	+27	3.563	0.07-0.21	3
764	Gedania	01 11.2	13.9	+14	24.968	0.01-0.35	3-
577	Rhea	01 11.4	14.4	+26	12.249	0.19-0.24	3-
477	Italia	01 12.2	14.0	+30	19.413	0.15-0.32	3
1093	Freda	01 14.7	15.0	+49	19.67	0.06-0.21	3
191	Kolga	01 15.8	13.1	+9	17.604	0.24-0.50	3
392	Wilhelmina	01 15.9	14.0	-1	13.058	0.06-0.70	3
464	Megaira	01 18.5	13.8	+25	12.879	0.08-0.12	3
359	Georgia	01 19.8	13.5	+29	5.537	0.14-0.54	3
2209	Tianjin	01 21.2	14.8	+18	9.47	0.41-0.42	3
1078	**Mentha**	**01 22.5**	**13.3**	**+26**	**85**	**0.31-0.87**	**3**
1224	Fantasia	01 22.9	14.3	+10	4.995	0.06-0.47	3
530	Turandot	01 24.7	14.5	+18	19.96	0.10-0.17	3-
2965	**Surikov**	**01 25.4**	**14.7**	**+17**	**9.061**	**0.23-0.29**	**3**
295	Theresia	01 26.6	13.1	+17	10.702	0.11-0.22	3
551	Ortrud	01 28.1	13.1	+19	17.416	0.14-0.19	3
261	**Prymno**	**01 30.7**	**11.7**	**+21**	**8.002**	**0.08-0.37**	**3**
1544	Vinterhansenia	01 31.9	14.6	+23	13.536	0.11-0.18	3-
1823	Gliese	02 06.9	15.0	+15	4.486	0.13-0.27	3
654	**Zelinda**	**02 07.2**	**10.4**	**-12**	**31.735**	**0.08- 0.3**	**3**
868	Lova	02 11.2	13.9	+18	41.118	0.28-0.40	3
197	Arete	02 17.4	14.1	+23	6.608	0.10-0.16	3
5080	Oja	02 18.8	14.8	+14	7.222	0.31-0.39	3
1639	Bower	02 18.9	14.0	+10	22.181	0.15-0.38	3-
169	Zelia	02 20.2	12.9	+14	14.537	0.13-0.17	3
1523	**Pieksamaki**	**02 20.5**	**14.1**	**+10**	**5.32**	**0.28- 0.5**	**3**
613	Ginevra	02 20.6	13.7	+15	12.906	0.12-0.20	3
1189	Terentia	02 23.1	14.6	-2	19.308	0.32-0.38	3
514	Armida	02 25.2	13.5	+4	21.851	0.16-0.27	3
111	Ate	02 25.4	11.0	+5	22.072	0.08-0.18	3
796	Sarita	02 26.9	14.2	+28	8.175	0.27-0.33	3
2196	Ellicott	03 06.1	14.9	-4	9.071	0.10-0.23	3-
308	**Polyxo**	**03 06.2**	**11.8**	**+4**	**12.029**	**0.08-0.15**	**3-**
1516	Henry	03 11.2	14.8	+14	17.599	0.35-0.54	3-
2323	Zverev	03 11.6	15.0	+5	3.921	0.28-0.39	3
586	Thekla	03 13.1	13.3	+1	13.67	0.24-0.30	3
626	Notburga	03 14.6	13.5	-6	19.353	0.10-0.21	3
535	Montague	03 15.5	12.7	+12	10.248	0.18-0.25	3
737	Arequipa	03 18.0	13.1	-1	7.026	0.08-0.26	3
3099	**Hergenrother**	**03 18.8**	**14.5**	**+16**	**25.58**	**0.28-0.35**	**3-**
841	**Arabella**	**03 19.2**	**14.9**	**+0**	**3.142**	**0.22-0.32**	**3**
1250	Galanthus	03 20.4	14.7	-29	3.92	0.22-0.28	3
410	Chloris	03 23.9	11.9	+17	32.5	0.19-0.33	3
379	Huenna	03 24.3	14.0	-1	14.141	0.07-0.22	3
1394	Algoa	03 25.2	14.5	-1	2.768	0.20-0.21	3
1830	Pogson	03 27.5	14.8	+2	2.57	0.07-0.18	3
605	Juvisia	03 28.0	15.0	-14	15.851	0.18-0.26	3
907	Rhoda	03 29.3	13.1	+14	22.44	0.06-0.16	3-
194	Prokne	03 29.9	12.1	+10	15.679	0.08-0.27	3
301	Bavaria	03 31.2	13.9	+1	12.253	0.25-0.31	3
522	Helga	03 31.2	14.6	+1	8.129	0.13-0.31	3

Radar-Optical Opportunities

Table I below gives a list of near-Earth asteroids reaching maximum brightness for the current quarter-year based on calculations by Warner. We switched to this presentation in lieu of ephemerides for reasons outlined in the 2021 October-December opportunities paper (Warner et al., 2021b), which centered on the potential problems with ephemerides generated several months before publication.

The initial list of targets started using the planning tool at:

https://www.minorplanet.info/php/callopplcdbquery.php

where the search was limited to near-Earth asteroids only that were V ≤ 18 for at least part of the quarter.

The list was then filtered to include objects that might be targets for the Goldstone radar facility or, if it were still operational, the Arecibo radar. This was based on the calculated radar SNR using

http://www.naic.edu/~eriverav/scripts/index.php

and assuming a rotation period of 4 hours (2 hours if $D \leq 200$ m) if a period was not given in the asteroid lightcurve database (LCDB; Warner et al., 2009). The SNR values are estimates only and assume that the radar is fully functional.

If an asteroid was on the list but failed the SNR test, we checked if it might be a suitable target for radar and/or photometry sometime through 2050. If so, it was kept on the list to encourage physical and astrometric observations during the current apparition. In most of those cases, the SNR values in the “A” and “G” columns are not for the current quarter but the year given in the Notes column. If a better apparition is forthcoming through 2050, the Notes column in Table I contains SNR values for that time.

The final step was to cross-reference our list with that found on the Goldstone planned targets schedule at

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

In Table I, objects in bold text are on the Goldstone proposed observing list as of early 2022 October.

It’s important to note that the final list in Table I is based on *known* targets and orbital elements when it was prepared. It is common for newly discovered objects to move in or out of the list. We recommend that you keep up with the latest discoveries by using the Minor Planet Center observing tools.

In particular, monitor NEAs and be flexible with your observing program. In some cases, you may have only 1-3 days when the asteroid is within reach of your equipment. Be sure to keep in touch with the radar team (through Benner’s email or their Facebook or Twitter accounts) if you get data. The team may not always be observing the target but your initial results may change their plans. In all cases, your efforts are greatly appreciated.

For observation planning, use these two sites

MPC: *http://www.minorplanetcenter.net/iau/MPEph/MPEph.html*
JPL: *http://ssd.jpl.nasa.gov/?horizons*

Cross-check the ephemerides from the two sites just in case there is discrepancy that might have you imaging an empty sky.

About YORP Acceleration

Near-Earth asteroids are particularly sensitive to YORP acceleration. YORP (Yarkovsky-O'Keefe-Radzievskii-Paddack; Rubincam, 2000) is the asymmetric thermal re-radiation of sunlight that can cause an asteroid’s rotation period to increase or decrease. High precision lightcurves at multiple apparitions can be used to model the asteroid’s *sidereal* rotation period and see if it’s changing.

Num	Name	H	Diam	BDate	BMag	BDec	Period	AMn	AMx	U	A	G	Notes
	2020 DG4	28.20	0.007	02 19.4	17.8	-29							
	2009 QH6	22.50	0.094	02 16.0	17.0	-77					10	–	
367789	**2011 AG5**	**21.88**	**0.125**	**02 01.9**	**14.3**	**-9**					**7200**	**2000**	**PHA, NHATS**
199145	**2005 YY128**	**18.36**	**0.632**	**02 15.0**	**13.3**	**-80**					**3800**	**1100**	**PHA** **N Obs: Jan 23-Feb11**
	2006 BE55	**21.90**	**0.124**	**02 26.7**	**16.1**	**50**					**625**	**180**	**PHA**
	2017 BM123	**23.8**	**0.052**	**02 27.0**	**18.2**	**39**	**2.150**	**0.37**	**0.55**	**3**	**65**	**20**	**NHATS** **Warner (2017)** **Pravec (2020web)**
535844	**2015 BY310**	**21.87**	**0.126**	**03 03.5**	**16.3**	**-17**	**0.09267**	**0.67**	**0.7**	**3**	**90**	**25**	**NHATS** **Pravec (2019web)**
	2018 UQ1	**21.98**	**0.119**	**03 20.6**	**16.5**	**-49**	**3.9291**	**0.65**	**0.88**	**3**	**530**	**150**	
	2007 ED125	**21.00**	**0.187**	**03 07.3**	**16.2**	**-28**	**5.62**		**0.55**	**3-**	**830**	**235**	**Warner (2015)**
	2012 BV13	22.20	0.108	01 14.3	17.0	43					190	55	
199145	2005 YY128	18.36	0.632	02 14.5	13.1	-53					3800	1100	
37638	**1993 VB**	**19.26**	**0.418**	**02 25.3**	**14.5**	**38**					**525**	**150**	**PHA**
	2017 WO28	22.50	0.094	02 26.0	17.6	19					10	–	
226554	2003 WR21	19.64	0.351	01 02.3	15.6	55					40	10	
	2019 BC1	20.34	0.254	01 16.2	17.9	-2					30	–	
162385	2000 BM19	18.58	0.571	01 24.1	16.4	69	9.463	1.34	1.38	2+	100	25	Skiff (2019)
	2009 CT5	18.80	0.516	02 01.9	16.6	-29					20	–	
137175	1999 JA11	18.36	0.632	02 20.7	17.4	65					20	5	
140039	2001 SO73	18.22	0.675	02 19.2	16.1	-37					20	5	
98943	2001 CC21	18.80	0.516	02 01.9	15.9	49	5.017		0.81	3	10		Pravec (2002web)
4486	Mithra	15.68	2.170	03 20.6	14.4	35	67.5		1	2	145	40	Brozovic (2010) Goldstone: April
2212	Hephaistos	13.53	5.850	01 11.9	12.9	43	48	0.08	0.35	2	130	35	Warner (2021)

Table I. A list of near-Earth asteroids reaching brightest in 2023 January-March. PHA: potentially hazardous asteroid. NHATS: Near-Earth Object Human Space Flight Accessible Targets Study. Diameters are based on p_V = 0.20. The Date, V, and Dec columns are the mm/dd.d, approximate magnitude, and declination when at brightest. Amp is the single or range of amplitudes. The A and G columns are the approximate SNRs for an assumed full-power Arecibo (not operational) and Goldstone radars. The references in the Notes column are those for the reported periods and amplitudes. `

It usually takes four apparitions to have sufficient data to determine if the asteroid rotation rate is changing under the influence of YORP. This is why observing an asteroid that already has a well-known period remains a valuable use of telescope time. It is even more so when considering the BYORP (binary-YORP) effect among binary asteroids that has stabilized the spin so that acceleration of the primary body is not the same as if it would be if there were no satellite.

The Quarterly Target List Table

The Table I columns are

Num	Asteroid number, if any.
Name	Name assigned by the MPC.
H	Absolute magnitude from MPCOrb.
Dkm	Diameter (km) assuming $p_V = 0.2$.
Date	Date (mm dd.d) of brightest magnitude.
V	Approximate V magnitude at brightest.
Dec	Approximate declination at brightest.
Period	Synodic rotation period from summary line in the LCDB summary table.
Amp	Amplitude range (or single value) of reported lightcurves.
U	LCDB U (solution quality) from 1 (probably wrong) to 3 (secure).
A	Approximate SNR for Arecibo (if operational and at full power).
G	Approximate SNR for Goldstone radar at full power.
Notes	Comments about the object.

"PHA" is a potentially hazardous asteroid. NHATS is for "Near-Earth Object Human Space Flight Accessible Targets Study." Presume that that astrometry and photometry have been requested to support Goldstone observations. The sources for the rotation period are given in the Notes column. If none are qualified with a specific period, then the periods from multiple sources were in general agreement. Higher priority should be given to those where the current apparition is the last one V ≤ 18 through 2050 or several years to come.

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