

MINOR PLANET	OBSERVER & APERTURE (cm)	OBSERVING PERIOD (2022)	NO. OBS.
16171 2000 AD97	Harvey, 81	Feb 6	3
16432 1998 VL2	Harvey, 81	Nov 29	3
16827 1997 WD2	Harvey, 81	Nov 28	3
16835 1997 WT34	Harvey, 81	Oct 5 0.4f@16.2	3
17170 Vsevustinov	Harvey, 81	Apr 10	3
17445 Avatcha	Harvey, 81	Sep 16 0.4f@16.1	3
18153 2000 OC61	Harvey, 81	Sep 21	3
18882 1999 YN4	Harvey, 81	Jan 4	6
19230 Sugazi	Harvey, 81	Aug 30	3
19364 Semafor	Harvey, 81	Apr 1	3
19515 1998 QM76	Harvey, 81	Mar 3-7	5
19517 Robertocarlos	Harvey, 81	Mar 27	3
20460 Robwhiteley	Harvey, 81	Jan 6	6
20524 Bustersikes	Harvey, 81	Oct 5	3
21055 1990 YR	Harvey, 81	Oct 15	3
21609 Williamcaleb	Harvey, 81	Oct 19	3
22176 2000 XG36	Harvey, 81	Nov 28	3
23448 1988 BG	Harvey, 81	Jan 23	3
23606 1996 AS1	Harvey, 35	Jul 19	3
	Faure, Rayon, 45	Jul 26	5
23978 1999 JF21	Harvey, 81	Nov 4	3
24642 1984 SA	Harvey, 81	Oct 5	3
25880 2000 QG196	Harvey, 81	Jan 30	3
25916 2001 CP44	Rayon, 20	Jul 1	2CCD
26828 1989 WZ1	Harvey, 81	Oct 27	3
26967 1997 RZ7	Harvey, 81	Aug 28	3
27057 1998 SP33	Harvey, 81	Nov 28	3
30397 2000 KU39	Harvey, 81	Oct 19	3
31383 1998 XJ94	Harvey, 81	Mar 7	3
35143 1992 UF1	Harvey, 81	Oct 15-19	8
35368 1997 UB8	Harvey, 81	Oct 19	3
35369 1997 UJ11	Harvey, 81	Dec 17	6
39002 2000 UO33	Harvey, 81	Oct 21	6
39979 1998 HT12	Harvey, 81	Nov 28	3
51700 2001 KV23	Harvey, 81	Oct 4	3
53090 1998 YS7	Harvey, 81	Sep 15	3
53312 1999 JZ	Harvey, 81	Jan 6	3
55401 2001 SX316	Harvey, 81	Feb 9	3
66875 1999 VY52	Harvey, 81	Nov 28	3
115916 2003 WB8	Harvey, 81	Jan 23	6
118303 1998 UG	Harvey, 81	Dec 17	3
158091 2000 WH56	Harvey, 81	Aug 28	3
163692 2003 CY18	Harvey, 81	May 5	6
195208 2002 DZ3	Harvey, 81	Dec 17	6
217628 Lugh	Harvey, 81	Nov 4	6
226554 2003 WR21	Harvey, 81	Dec 28	6
306399 1996 AX2	Harvey, 81	Nov 29	6
312942 1995 EK1	Harvey, 81	Oct 20	6
317255 2002 DJ5	Harvey, 81	Mar 26-27	12
422787 2001 WS1	Harvey, 81	Oct 19	6
455176 1999 VF22	Harvey, 81	Feb 20	6
506459 2002 AL14	Harvey, 81	Jan 23	6
523823 2015 BG311	Harvey, 81	Oct 15	6
2005 LW3	Harvey, 81	Nov 24	6
2008 TB27	Harvey, 81	Dec 17	6
2010 XC15	Harvey, 81	Dec 24	6
2013 YA14	Harvey, 81	Dec 24	6
2014 HK129	Harvey, 81	Dec 18	6
2015 RN35	Harvey, 81	Dec 17	6
2022 AC4	Harvey, 81	Jan 11	6
2022 BH7	Harvey, 81	Feb 16	6
2022 CO6	Harvey, 81	Feb 15	6
2022 FB2	Harvey, 81	Mar 28	6
2022 UC1	Harvey, 81	Oct 22	6

LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2023 JULY-SEPTEMBER

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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 July through September. 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 $V \leq 18.0$ 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. This can be accessed for uploading and downloading data at

The database contains more than 10.4 million observations for 24,202 objects (as of 2023 April 6), 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.

All objects are reaching one of their five brightest apparitions from 1995-2050. Bold text indicates a near-Earth asteroid (NEA).

Number	Name	Brightest			Period	LCDB Data Amp	U
		Date	Mag	Dec			
9328	1990 DL3	07 09.4	15.4	-36	58.495	1.00	2
6400	Georgealexander	07 17.1	15.5	-31	41.348	0.08-0.12	2
10546	Nakanomakoto	07 17.3	15.4	-24	4.219		2
5248	Scardia	07 19.7	15.1	-21	6.046		2
11466	Katharinaotto	07 19.9	15.2	-20	166.093	0.55	2
3713	Pieters	07 21.8	15.2	-23	6.9	0.07-0.10	2
1341	Edmee	07 22.8	13.9	-25	23.745	0.22-0.60	2+
6405	Komiyama	07 24.1	15.1	-20	19.855	0.13	2
9566	Rykhlova	07 26.5	15.4	-13	8.8	0.56-0.95	2
154993	2005 EA94	07 28.4	15.1	-55	13.761	0.29	2
6790	Pinguin	07 30.3	15.5	+4	> 12	0.45	2-
8778	1931 TD3	07 31.3	14.6	-39	3.833	0.51	2
3257	Hanzlik	08 01.0	14.8	-30	8.465	0.20	2
17939	1999 HH8	08 01.2	15.2	-22	5.1	0.05-0.26	2
9053	Hamamelis	08 03.5	15.5	-25	10.386	0.29-0.33	2
14815	Rutberg	08 03.6	15.2	-11	150	1.0	2
16591	1992 SY17	08 03.6	15.4	+2	2.737	0.17-0.18	2
4770	Lane	08 05.3	13.9	-20	34.75	0.23	2
23268	2000 YD55	08 05.6	15.3	-23	3.368	0.12	2
2683	Brian	08 10.3	15.5	-17	22.528		2
3130	Hillary	08 11.2	15.3	-19	25.282	0.84	2
3739	Rem	08 15.0	14.9	-18	68.906		2-
6108	Glebov	08 16.0	15.3	-8	2.831	0.05-0.22	2
6205	Menottigalli	08 20.0	15.0	-20	15.252	0.36-0.38	2+
3184	Raab	08 21.2	14.4	-24	274.944	0.09	1
12867	Joeloic	08 22.9	15.1	-8	813	0.71	2+
1329	Eliane	08 25.2	13.4	-19	137.8	0.18-0.43	2
35085	1990 SL11	08 27.0	15.5	-10	128	0.95	2-
1557	Roehla	08 27.8	15.1	-16	5.679		2
12374	Rakhat	08 28.6	15.2	-19	18.17	0.31	2
6982	Cesarchavez	08 28.7	15.5	+7	16.08	0.10	2-
3811	Karma	08 31.1	14.7	-9	13.23	0.33-0.50	2+
903	Nealley	08 31.7	14.3	-8	19.72	0.10-0.15	2
10152	Ukichiro	09 01.3	15.5	-10	5.182		2-
14657	1998 YU27	09 02.1	15.3	+9	33.58	0.30-0.46	2
7422	1992 LP	09 02.2	15.2	-13	81.493	0.51	2
3855	Pasasympsonia	09 03.0	14.5	-19	6.513	0.18	2
2461	Clavel	09 03.9	15.2	-10	3.5	0.33	2
1051	Merope	09 06.9	14.2	+4	27.2	0.11-0.20	2
4226	Damiaaan	09 07.3	14.1	+1	24	0.05	1
4121	Carlin	09 08.9	15.0	-47	97.295	0.77	2
2090	Mizuho	09 09.0	14.3	-4	5.47	0.25-0.30	2+
3127	Bagration	09 10.5	14.8	+2	> 16	0.1	1
2029	Binomi	09 10.7	15.3	+5	3.756	0.51-0.52	2
6427	1995 FY	09 11.0	15.5	-3	6.195	0.59-0.84	2
11065	1991 XE2	09 13.3	15.4	-20	> 8	0.1	1+
1525	Savonlinna	09 16.3	14.9	+8	14.634	0.50-0.52	2
2630	Hermod	09 17.9	15.5	-3	19.428		2
4729	Mikhailmil'	09 21.5	14.1	+3	38.31	0.36-0.37	2+
2096	Vaino	09 24.2	15.1	+2	5.55	0.06-0.10	2
2687	Tortali	09 24.2	14.9	-12	21.75	0.19	2
3055	Annapavlova	09 24.2	15.5	-1	44.626	0.41	2
4190	Kvasnica	09 25.7	15.4	+7	13.42	0.09	2-
4278	Harvey	09 27.0	15.3	-5	9.647		2
4288	Tokoyotech	09 27.3	14.4	-15	3.18	0.11-0.19	2+
2374	Vladvysotskiy	09 28.1	14.8	+9	5.398	0.48	2
2831	Stevin	09 30.7	13.9	-6	3213	0.3-0.50	2

Low Phase Angle Opportunities

The Low Phase Angle list includes asteroids that reach very low phase angles ($\alpha < 1^\circ$). 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 $1-2^\circ$ 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 $3-6^\circ$ intervals should be sufficient. Coverage beyond 50° or so is not generally helpful since the $H-G$ system is best defined with data from $0-30^\circ$.

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 systematic errors.

Also important is 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 $20-30^\circ$. Even so, starting now, the list will include objects that reach $V \leq 15.0$ at opposition. The list of objects using the previous limit of $V \leq 14.0$ was becoming very short.

Num	Name	Date	α	V	Dec	Period	Amp	U
9945	Karinaxavier	07 02.4	0.56	15.0	-22			
1461	Jean-Jacques	07 03.6	0.44	14.6	-22	16.56	0.08	0.09 2
364	Isara	07 04.6	0.30	12.6	-22	9.156	0.30	0.40 3
710	Gertrud	07 04.9	0.61	14.8	-21	8.288	0.26	0.30 3-
1154	Astronomia	07 07.1	0.81	14.8	-25	18.115		0.39 3-
15	Eunomia	07 08.0	0.98	8.8	-25	6.083	0.40	0.53 3
1456	Saldanha	07 08.7	0.39	14.6	-21	19.035	0.09	0.26 3-
380	Fiducia	07 09.7	0.90	12.5	-25	13.69	0.04	0.32 3
1939	Loretta	07 10.1	0.46	15.0	-24	23.88		0.20 2
851	Zeissia	07 11.4	0.97	14.2	-20	9.341	0.38	0.53 3
811	Nauheima	07 12.3	0.69	14.2	-20	4.001	0.11	0.20 3
1442	Corvina	07 14.8	0.70	15.0	-20	77.920		0.19 2
1074	Beljawskya	07 15.0	0.32	15.0	-23	6.284	0.31	0.37 3
1284	Latvia	07 18.5	0.81	14.0	-23	9.55	0.10	0.23 3-
1699	Honkasalo	07 19.6	0.91	13.7	-19	11.115	0.15	0.32 3-
3520	Klopsteg	07 22.8	0.34	14.7	-20			
3002	Delasalle	07 22.9	0.45	14.4	-21	6.534	0.31	0.47 3
507	Laodica	07 23.5	0.54	13.5	-18	4.706	0.18	0.47 3
7234	1986 QV3	07 23.9	0.21	15.0	-20	2.848	0.29	0.30 3
1262	Sniadeckia	07 29.6	0.23	14.3	-19	17.57	0.06	0.16 3
296	Phaetusa	07 31.9	0.22	14.3	-19	4.539	0.38	0.70 3
889	Erynia	08 01.1	0.42	14.0	-17	9.89	0.47	0.67 3
402	Chloe	08 03.2	0.17	12.7	-18	10.664	0.19	0.37 3
888	Parysatis	08 03.4	0.94	13.1	-20	5.931	0.22	0.26 3
240	Vanadis	08 05.0	0.37	12.6	-18	10.64	0.13	0.34 3
275	Sapientia	08 09.0	0.07	13.1	-16	14.931	0.05	0.12 3-
773	Irminttraud	08 16.2	0.16	12.4	-14	6.751	0.05	0.25 3
2043	Ortutay	08 19.5	0.20	14.7	-13	7.747	0.44	0.56 3-
1156	Kira	08 21.9	0.94	14.9	-14	2.971	0.19	0.26 3
1085	Amaryllis	08 23.2	0.54	14.1	-13	18.111	0.14	0.20 3-
5144	Achates	08 23.9	0.40	14.6	-10	5.958	0.18	0.35 3
318	Magdalena	08 28.6	0.56	14.1	-8	42.65	0.06	0.16 3
3811	Karma	08 31.1	0.22	14.8	-9	13.23	0.33	0.50 2+
2326	Tololo	08 31.4	0.30	14.4	-9	9.488	0.14	0.33 3-
903	Nealley	08 31.7	0.20	14.3	-8	19.72	0.10	0.15 2
163	Erigone	09 01.7	0.17	12.8	-8	16.136	0.32	0.37 3
232	Russia	09 02.3	0.42	14.1	-9	21.905	0.14	0.31 3
1004	Belopolskya	09 06.3	0.26	14.0	-7	9.038	0.09	0.14 3-
366	Vincentina	09 06.7	0.32	12.7	-7	12.736	0.05	0.09 3-
684	Hildburg	09 06.8	0.51	13.7	-5	11.91	0.07	0.23 3-
656	Beagle	09 08.4	0.13	15.0	-6	7.035	0.57	1.20 3
2090	Mizuho	09 09.1	0.76	14.3	-4	5.47	0.25	0.30 2+
1269	Rollandia	09 12.0	0.48	14.7	-6	65. .	0.02	0.13 2
51	Nemasa	09 12.8	0.77	10.7	-2	7.783	0.10	0.25 3
834	Burnhamia	09 15.4	0.40	13.4	-2	13.875	0.15	0.22 3
327	Columbia	09 18.1	0.08	13.4	-2	5.932	0.16	0.42 3
1142	Aetolia	09 20.6	0.57	14.9	-3	10.730	0.15	0.22 3-
1622	Chacornac	09 21.2	0.63	14.5	-2	12.206	0.21	0.25 2
238	Hypatia	09 21.4	0.80	11.6	+1	8.875	0.10	0.21 3
321	Florentina	09 21.7	0.95	13.9	-3	2.871	0.31	0.52 3
263	Dresda	09 22.2	0.49	13.7	+1	16.809	0.37	0.55 3
60	Echo	09 22.4	0.58	11.4	+1	25.208	0.10	0.22 3
1305	Pongola	09 23.8	0.94	15.0	-3	8.333	0.14	0.19 3-
313	Chaldaea	09 24.6	0.58	12.4	-1	8.392	0.08	0.24 3
1227	Geranium	09 25.8	0.26	14.4	+1	12.363		0.08 3
256	Walpurga	09 26.9	0.07	14.1	+1	16.664	0.34	0.58 3
3451	Mentor	09 27.5	0.51	15.0	-1	7.702	0.11	0.63 3
1369	Ostanina	09 30.1	0.92	14.2	+0	8.400	0.73	1.11 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 $\geq$ 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. Those in italic text are near-Earth objects.

Num	Name	Brightest			LCDB Data		
		Date	Mag	Dec	Period	Amp	U
1344	Caubeta	07 02.0	15.2	-30	3.122	0.16-0.55	3
1644	Rafita	07 02.3	15.4	-21	3.344	0.13-0.38	3
19516	1998 QF80	07 03.7	15.0	-29	5.438	0.32-0.35	3
143	Adria	07 05.0	12.8	-37	22.005	0.07-0.10	3
3447	Burckhalter	07 05.1	15.1	-61	59.8	0.30-0.39	3
4440	Tchantches	07 06.8	15.5	-22	2.788	0.21-0.34	3
1416	Renauxa	07 08.2	15.4	-36	8.7	0.09-0.40	3
1456	Saldanha	07 08.8	14.6	-21	19.035	0.09-0.26	3
1765	Wrubel	07 08.9	14.0	-41	5.26	0.11-0.33	3
2409	Chapman	07 09.0	14.6	-19	3.153	0.14	3
326	Tamara	07 11.0	11.9	-65	14.445	0.10-0.27	3
3782	Celle	07 11.2	15.2	-19	3.84	0.11-0.17	3
811	Nauheima	07 12.3	14.2	-20	4.001	0.11-0.20	3
3001	Michelangelo	07 14.3	15.3	-26	8.345	0.12-0.28	3
49385	1998 XA12	07 15.8	15.4	-9	2.523	0.15-0.30	3
2873	Binzel	07 17.2	14.3	-24	2.704	0.06-0.14	3
971	Alsatia	07 21.8	14.4	-32	9.614	0.17-0.29	3
1539	Borrelly	07 23.0	15.4	-19	15.922	0.54-0.76	3
894	Erda	07 26.4	13.7	-2	4.69	0.05-0.27	3
11386	1998 TA18	07 26.9	15.3	-10	15.959	0.49-0.84	3
914	Palisana	07 27.5	11.7	+22	8.681	0.03-0.24	3-
1262	Sniadeckia	07 29.6	14.2	-19	17.57	0.06-0.16	3
633	Zelima	07 30.0	13.8	-13	11.73	0.14-0.49	3
1567	Alikoski	08 03.9	14.9	-40	16.374	0.08-0.16	3
240	Vanadis	08 05.0	12.5	-18	10.64	0.13-0.34	3
6265	1985 TW3	08 08.2	14.7	-26	2.709	0.26-0.36	3
275	Sapientia	08 09.0	13.0	-16	14.931	0.05-0.12	3
612	Veronika	08 12.1	14.3	+15	8.243	0.09-0.14	3
677	Aaltje	08 14.1	13.9	-5	16.608	0.10-0.37	3
3833	Calingasta	08 14.9	15.5	+2	199	0.70-1.20	3
773	Irminttraud	08 16.2	12.4	-14	6.751	0.05-0.25	3
2763	Jeans	08 21.2	13.7	-10	7.8	0.13-0.18	3
5144	Achates	08 23.8	14.5	-10	5.958	0.18-0.35	3
973	Aralia	08 24.6	14.7	-18	7.366	0.20-0.25	3
213	Lilaea	08 25.3	12.0	-16	12.042	0.07-0.20	3
1319	Disa	08 25.3	15.1	-7	7.08	0.24-0.27	3
9873	1992 GH	08 27.9	15.0	-26	2.926	0.15-0.39	3
318	Magdalena	08 28.7	14.0	-8	42.65	0.06-0.16	3
142	Polana	08 30.3	13.4	-7	9.764	0.11-0.24	3
7288	1991 FE1	08 30.8	15.5	-6	4.889	0.47-0.53	3
1867	Deiphobus	09 02.3	15.5	+19	58.66	0.10-0.27	3-
3317	Paris	09 07.4	15.2	-22	7.081	0.08-0.14	3
3606	Pohjola	09 08.8	14.8	+16	5.847	0.11-0.21	3
81	Terpsichore	09 09.2	11.7	-9	10.943	0.02-0.15	3
863	Benkoela	09 14.6	14.2	-30	7.032	0.05-0.27	3
8356	Wadhwa	09 14.6	14.4	-8	3.043	0.11-0.15	3
834	Burnhamia	09 15.3	13.3	-2	13.875	0.15-0.22	3
1149	Volga	09 15.7	14.3	+14	27.262	0.14-0.26	3-
1302	Werra	09 15.7	15.1	-7	8.183	0.09-0.26	3-
766	Moguntia	09 16.1	14.0	-7	4.816	0.06-0.23	3
786	Bredichina	09 17.4	14.1	-20	29.434	0.04-0.60	3-
1305	Pongola	09 23.7	15.1	-3	8.335	0.14-0.19	3-
862	Franzia	09 24.5	13.6	+18	7.523	0.07-0.13	3
2729	Urumqi	09 26.4	15.2	-3	3.127	0.19-0.35	3
465	Alekto	09 26.7	14.8	+7	10.936	0.12-0.18	3
5806	Archieroy	09 27.2	15.5	+37	12.163	0.34-0.55	3
429	Lotis	09 28.2	12.8	+11	13.577	0.09-0.24	3
542	Susanna	09 28.7	12.7	-8	10.069	0.11-0.30	3

Num	Name	H	Diam	BDate	BMag	BDec	Period	AMn	AMx	U	A	G	Notes
68548	2001 XR31	16.71	1.350	07 28.6	15.7	-22					55	15	
154244	2002 KL6	17.66	0.873	08 06.3	14.0	47	4.6063	0.39	1.15	3	370	405	Galad et al. (2010)
4769	Castalia	17.53	0.927	08 16.4	15.6	19	4.095		1.00	3	45	15	Hudson et al. (1997)
6037	1988 EG	19.0	0.471	08 19.7	14.6	28	2.7602	0.19	0.20	3-	690	240	PHA Pravec et al. (2021web)
358744	2008 CR118	18.95	0.482	08 29.1	15.1	-56					220	65	
523950	1998 SZ27	20.30	0.259	09 11.2	16.5	-10					45	15	
458732	2011 MD5	17.93	0.771	09 14.5	13.9	-4					155	45	
518640	2008 KZ5	20.08	0.286	09 19.2	17.6	-81	5.789		0.31	3-	25	8	Pravec et al. (2019web)
	2009 UG	23.3	0.065	10 02.3	15.8	-19	5.88		0.38	2+	1795	515	Warner (2017) See text

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 adopted period.

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 $V \leq 18$ 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 2023 April.

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.

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.

2009 UG

2009 UG has been included, even though it doesn't reach brightest until early October, because it will never be as bright through 2050. About every seven years, a "favorable" apparition occurs but each one after 2023 will be increasingly worse. For example, at the next possibility, 2030 October, the asteroid will be $V \sim 16.7$ at brightest and in 2037 October, $V \sim 18.8$ will be all it can muster. All non-favorable apparitions are at $V < 23.5$.

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 $V \leq 18$ through 2050 or several years to come.

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