

LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2025 APRIL-JULY

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We present lists of asteroid photometry opportunities for 2025 April-July. The extended four-month listing continues the changes announced in MPB 51-4 (Warner et al., 2024). Extending to the month beyond the usual quarter-year allows better observation planning, especially for those working in wide-spread collaborations. With the massive input of survey photometry, even if mostly sparse data, the small telescope researcher's role is moving away generic studies to those concentrating on specific needs and targets and so, we hope, leading to even more fulfilling and fruitful efforts.

We refer the reader to the lightcurve photometry opportunities article in *Minor Planet Bulletin* 51-4 (Warner et al., 2024) for a detailed discussion on the evolution of the lists presented here and the purpose behind each one. In addition, we refer the reader to other prior releases of this paper (e.g., Warner et al., 2023) for more detailed discussions about the requirements and considerations for the targets in the lists and to Warner et al. (2021a; 2021b).

On-Line Planning Tool

The ephemeris generator on the <https://MinorPlanet.info> web site allows creating custom lists for numbered objects reaching $V \leq 18.0$ during a given month from 2020 through 2035 by setting search parameters based on a number of parameters.

<https://www.minorplanet.info/php/calopplcdbquery.php>

The updated page added data for the minimum phase angle of any object included in the search: the date (0.001 d), the minimum phase angle (0.1°), and the declination. Searches can limit results to a phase angle range between 0-120°. Also new is limiting the results to a range of rotation periods and so, for example, one can look for only long, or especially short, period objects.

Important and Useful Web Sites

The dates and values given on the MinorPlanet.info site are very good estimates in most cases. NEAs are sometimes an important exception. Use the site for preliminary planning for objects and then confirm those plans using the Minor Planet Center or JPL Horizons web sites.

MPC: <http://www.minorplanetcenter.net/iau/MPEph/MPEph.html>
JPL: <https://ssd.jpl.nasa.gov/sb/orbits.html>

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/>

to see what, if any, information it has on a chosen target.

For near-Earth asteroids in particular, check the list found on the Goldstone planned targets schedule at

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

and keep in touch with Lance Benner at the email above. The radar team often needs updated astrometry and photometry (rotation period) prior to observing. Keep in mind as well that the *MinorPlanet.info* site opposition database includes only numbered objects. Keep a close eye on the MPC NEA pages.

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

<http://www.alcdef.org>

The database contains about 10.69 million observations for 24,454 objects (as of 2024 May 27), making it one of the more useful sources for raw data of *dense* time-series asteroid photometry.

The Planning Lists

The lists, excluding the one for NEAs, are usually restricted to objects reaching $V \leq 15.5$ during the covered months. To include every object within a list that met this criterium alone resulted in far too many targets than the known community of asteroid photometrists could possibly handle, so only the "better" candidates are included. This is entirely subjective and the reader is encouraged to visit the <https://MinorPlanet.info> web site and use all the planning tools available there should our preferences not match yours.

Don't presume that something rated $U \geq 3$ —doesn't need more work nor, at the other end, that something not rated at all or $1 < U < 2+$ or has a long period should be skipped in lieu of an "easier" project. The often-heard saying, "Past performance is not a guarantee of future results" should be part of your work ethic. Someone's "certain" result may not be so certain after all, especially if it's based on data that are minimal in quantity and/or quality.

Favorable Apparitions includes objects reaching one of the five brighter (favorable) apparitions from 1995 and 2050 and rated $U < 3$ - in the LCDB.

No Pole Solutions includes objects rated $U > 2+$ but do not have a pole indicated on the LCDB summary line. This list is the most likely needing further confirmation by checking the DAMIT web site, which grows in spurts large and small quite frequently and so the LCDB can lag considerably.

Poor Pole Solutions includes objects rated $U < 3$ - that have a pole solution on the summary line. In this case, the period is often based on using sparse survey data, with or without support of dense lightcurve data. An additional set of dense data may help elevate both the U rating and the quality of the pole solution.

Low Phase Angles includes objects, regardless of U rating or even having a period, that reach a solar phase angle $< 1^\circ$. You should refer to Warner et al. (2023) to review important information about low solar phase angle work.

Long Periods includes objects with $P \geq \sim 24$ hours. These are often overlooked because they are very difficult for a single-station campaign. However, they are ideal for collaborations, especially those with stations well-separated in longitude.

NEAs (aka Radar Target) is limited to *known* near-Earth asteroids that might be on the radar team's radar (pun intended). It is common for newly discovered objects to move into or out of the list. We recommend that you keep up with the latest discoveries by using the Minor Planet Center observing tools.

The List Data

If the list includes the "Fam" column, this is the orbital group (> 9000) using criteria from the LCDB or the collisional family (< 9000) based on Nesvorný et al. (2015) and Nesvorný (2015). To convert the number to a name, see the LCDB documentation on the LCDB web site or use the One Asteroid Lookup page on the site:

<https://www.minorplanet.info/php/lcdb.php>

<https://minorplanet.info/php/oneasteroidinfo.php>

Table Columns

Num	Asteroid number, if any.
Name	Name (or designation) assigned by the MPC.
Fam	Orbital group or collisional family.
BMD	Date of maximum brightness (to 0.1 d precision).
BMg	Approximate V magnitude at brightest.
BDC	Approximate declination at brightest.
PD	Date of minimum phase angle (to 0.001 d precision).
PMn	Phase angle at minimum (solar elongation $> 90^\circ$).
PDC	Approximate declination at minimum phase angle.
P (h)	Synodic rotation period from summary line in the LCDB summary table. An * indicates a sidereal period.
U	LCDB solution quality (U) from 1 (probably wrong) to 3 (secure).
Notes	Comments about the object.

Some asteroids may appear in more than one list. The reader is referred to the latest LCDB release (Warner et al., 2009) and, where and when necessary, the original reference source should be used. The Notes column is rarely used, for now, except for the NEAs list.

All periods are taken from the summary line of the LCDB. If needed, the LCDB should be checked to find the source of the summary line period.

Favorable Apparitions ($U < 3$ -)											
Num	Name	Fam	BMD	BMg	BDC	PD	PMn	PDC	P (h)	U	Notes
1287	Lorcia	606	04 02.4	15.0	-7	04 02.576	0.9	-7	8.878	2	
1841	Masaryk	9106	04 04.4	15.0	-5	04 05.675	0.6	-4	7.53	2+	
85953	1999 FK21	9101	04 05.0	14.6	34	03 31.001	30.1	11	28.08	2	
1512	Oulu	9107	04 08.5	14.3	-8	04 06.829	0.3	-8	132.3	2+	
1101	Clematis	2012	04 15.5	14.9	-8	04 13.453	0.3	-8	34.3	2	
1155	Aenna	9104	04 16.1	14.0	-7	04 15.971	1.4	-7	8.07	2+	
992	Swasey	9106	04 17.4	14.0	-12	04 16.987	0.6	-12	13.305	2+	
6372	Walker	604	05 15.5	14.9	-15	05 15.378	1.7	-15	44.25	2	
1905	Ambartsumian	9104	05 16.8	14.1	-16	05 16.674	1.7	-16	92.153	2	
2120	Tyumenia	9106	05 31.5	14.9	-9	05 30.689	4.8	-9	17.507	2	
3507	Vilas	602	06 01.5	14.8	-20	05 31.330	0.6	-20	3.959	2+	
1457	Ankara	9105	06 09.5	13.5	-30	06 09.831	2.9	-30	35.54	2	
2660	Wasserman	502	06 14.0	14.9	-4	06 12.481	8.7	-4	527.991	2	
2324	Janice	602	06 24.4	14.5	-24	06 25.835	0.2	-24	23.2	2-	
7747	Michalowski	9103	06 27.9	14.7	-26	06 27.556	1.6	-26	4.5	2	
896	Sphinx	9104	07 11.3	13.5	-12	07 12.270	5.2	-12	21.038	2+	
2898	Neuvo	9104	07 15.5	14.8	-20	07 15.431	0.7	-20	13.83	2	
4826	Wilhelms	701	07 16.0	14.8	-39	07 14.779	9.8	-39	15.004	2	
1728	Goethe Link	9104	07 22.2	14.2	-10	07 22.169	4.7	-10	81	2	
6422	Akagi	502	07 25.4	14.8	-18	07 25.748	0.9	-18	7.74	2	
2865	Laurel	506	07 30.9	14.3	-24	07 31.204	2.5	-24	21.5	2	

Table I. A partial list of numbered asteroids reaching a favorable apparition and with an LCDB rating $U < 3$ -.

Spin Axis and Modeling (Favorable Apparition, $U > 2+$, No LCDB pole, not in DAMIT)

Num	Name	Fam	BMD	BMg	BDC	PD	PMn	PDC	P (h)	U	Notes
1093	Freda	9106	05 18.5	12.3	-20	05 16.999	0.1	-20	19.670	3	
4185	Phystech	9104	05 24.0	14.9	-22	05 24.169	0.9	-22	4.669	3	
4223	Shikoku	606	06 21.5	14.7	-23	06 20.297	0.1	-24	9.137	3	
5386	Bajaja	9104	06 23.5	14.5	-24	06 23.080	0.2	-24	16.841	3	

Table II. A partial list of numbered asteroids reaching a favorable apparition that have high-quality periods solutions but do not have a pole solution in the LCDB or DAMIT databases.

Spin Axis and Modeling (Any Apparition, $U < 3-$, Pole in LCDB/DAMIT)

Num	Name	Fam	BMD	BMg	BDC	PD	PMn	PDC	P (h)	U	Notes
1287	Lorcia	606	04 02.4	15.0	-7	04 02.576	0.9	-7	8.878	2	
1841	Masaryk	9106	04 04.4	15.0	-5	04 05.675	0.6	-4	7.530	2+	
1365	Henye	2009	04 06.5	13.9	-14	04 05.840	4.4	-14	18.986	2	
1244	Deira	9104	04 09.9	14.1	-22	04 10.217	7.4	-22	210.600	2	
2115	Irakli	606	04 24.8	15.0	-19	04 24.806	2.2	-19	29.765	2	
818	Kapteynia	9106	05 16.3	14.0	-13	05 16.062	1.9	-13	16.350	2	
1905	Ambartsumian	9104	05 16.8	14.1	-16	05 16.674	1.7	-16	*92.153	2	
5518	Mariobotta	9104	05 18.8	14.8	-4	05 16.998	8.2	-4	108.600	2+	
2091	Sampo	606	05 27.5	15.0	-9	05 27.575	4.0	-9	71.340	2	
2120	Tyumenia	9106	05 31.5	14.9	-9	05 30.689	4.8	-9	17.507	2	
3507	Vilas	602	06 01.5	14.8	-20	05 31.330	0.6	-20	3.959	2+	
1236	Thais	9104	06 01.2	14.9	-30	05 30.808	3.4	-30	*47.989	2	
1457	Ankara	9105	06 09.5	13.5	-30	06 09.831	2.9	-30	35.540	2	
1326	Losaka	9105	06 12.8	14.9	-14	06 11.669	3.3	-14	6.900	2	
7747	Michalowski	9103	06 27.9	14.7	-26	06 27.556	1.6	-26	4.500	2	
3702	Trubetskaya	9105	07 05.0	14.9	-15	07 03.609	3.5	-14	*8.291	2	
896	Sphinx	9104	07 11.3	13.5	-12	07 12.270	5.2	-12	21.038	2+	
4826	Wilhelms	701	07 16.0	14.8	-39	07 14.779	9.8	-39	15.004	2	
1728	Goethe Link	9104	07 22.2	14.2	-10	07 22.169	4.7	-10	81.000	2	
6422	Akagi	502	07 25.4	14.8	-18	07 25.748	0.9	-18	7.740	2	
2865	Laurel	506	07 30.9	14.3	-24	07 31.204	2.5	-24	21.500	2	

Table III. A partial list of numbered asteroids reaching brightest magnitude that have a reported pole position but the LCDB rating is $U < 3-$. A period with an asterisk is sidereal.

Low Phase Angle ($V \leq 15.0$, phase angle $\alpha \leq 1.0^\circ$)

Num	Name	Fam	BMD	BMg	BDC	PD	PMn	PDC	P (h)	U	Notes
175	Andromache	9106	04 03.5	13.7	-3	03 31.940	0.2	-4	8.324	3	
1512	Oulu	9107	04 08.5	14.3	-8	04 06.829	0.3	-8	132.3	2+	
1101	Clematis	2012	04 15.5	14.9	-8	04 13.453	0.3	-8	34.3	2	
510	Mabella	9105	04 16.5	12.6	-9	04 15.233	0.3	-9	19.4	3	
2052	Tamriko	606	04 18.5	14.9	-12	04 19.714	0.3	-12	7.469	3	
1675	Simonida	402	04 23.4	14.6	-14	04 24.056	0.3	-14	5.289	3	
468	Lina	602	04 26.5	14.6	-13	04 24.059	0.1	-13	16.33	3	
1060	Magnolia	402	04 28.5	14.5	-15	04 28.055	0.3	-15	2.911	3	
419	Aurelia	9104	05 09.5	10.2	-17	05 08.532	0.2	-17	16.784	3	
1093	Freda	9106	05 18.5	12.3	-20	05 16.999	0.1	-20	19.67	3	
2957	Tatsuo	606	05 28.5	14.7	-22	05 27.179	0.3	-22	6.819	3	
1716	Peter	9106	05 27.4	15	-21	05 28.711	0.3	-21	11.514	3	
690	Wratislavia	9106	06 04.5	12.5	-22	06 02.179	0.2	-23	8.64	3	
552	Sigelinde	9106	06 14.2	13.3	-24	06 14.897	0.2	-24	17.156	3	
4223	Shikoku	606	06 21.5	14.7	-23	06 20.297	0.1	-24	9.137	3	
5386	Bajaja	9104	06 23.5	14.5	-24	06 23.080	0.2	-24	16.841	3	
2324	Janice	602	06 24.4	14.5	-24	06 25.835	0.2	-24	23.2	2-	
551	Ortrud	9106	07 06.5	14.1	-23	07 04.323	0.2	-23	17.416	3	
295	Theresia	9106	07 08.5	14.1	-22	07 06.639	0.2	-22	10.702	3	
891	Gunhild	9106	07 11.5	13.6	-23	07 10.298	0.3	-23	11.892	3-	
1853	McElroy	9106	07 23.5	14.9	-20	07 21.728	0.1	-20	8.016	3-	
522	Helga	9106	07 28.5	13.7	-20	07 26.068	0.2	-20	8.129	3	
3478	Fanale	9104	07 27.5	14.9	-19	07 27.092	0.2	-19	3.245	3	
390	Alma	9105	07 26.5	14.1	-19	07 28.418	0.2	-19	3.741	3	

Table IV. A partial list of numbered asteroids reaching a minimum phase angle $\alpha \leq 1.0^\circ$.

Long Period (Favorable Apparition, $P \geq 24$ h, $U < 3$)											
Num	Name	Fam	BMD	BMg	BDC	PD	PMn	PDC	P (h)	U	Notes
85953	1999 FK21	9101	04 05.0	14.6	34	03 31.001	30.1	11	28.08	2	
1512	Oulu	9107	04 08.5	14.3	-8	04 06.829	0.3	-8	132.30	2+	
1101	Clematis	2012	04 15.5	14.9	-8	04 13.453	0.3	-8	34.30	2	
6372	Walker	604	05 15.5	14.9	-15	05 15.378	1.7	-15	44.25	2	
1905	Ambartsumian	9104	05 16.8	14.1	-16	05 16.674	1.7	-16	*92.153	2	
1457	Ankara	9105	06 09.5	13.5	-30	06 09.831	2.9	-30	35.54	2	
2660	Wasserman	502	06 14.0	14.9	-4	06 12.481	8.7	-4	527.99	2	
1728	Goethe Link	9104	07 22.2	14.2	-10	07 22.169	4.7	-10	81.00	2	

Table V. A partial list of numbered asteroids reaching a favorable apparition and with a reported period $P \geq 24$ hours. A period with an asterisk is sidereal.

NEAs (aka Radar) Reaching Brightest for Year (Any Apparition, $V \leq 17.0$, $\alpha \leq 90^\circ$)											
Num	Name	Fam	BMD	BMg	BDC	PD	PMn	PDC	P (h)	U	Notes
85953	1999 FK21	9101	04 05.0	14.6	34	03 31.001	30.1	11	28.08	2	
152754	1999 GS6	9101	04 09.6	16.9	-32	04 24.276	8.3	-22	8.021	2	
223456	2003 UB10	9101	04 10.2	16.8	8	08 11.472	2.1	-18			
462959	2011 DU	9101	04 21.2	16.0	35	12 29.403	5.4	15	10.290	3	PHA
436030	2009 JO2	9101	04 25.8	16.7	67	06 04.873	50.0	29			
9058	1992 JB	9101	04 26.3	14.7	-15	05 05.449	30.5	1			
433992	2000 HD74	9101	05 15.8	17.0	-44	05 12.689	21.5	-35	9.360	2	
390725	2003 HB	9101	05 20.1	16.7	61	04 14.120	55.9	19			PHA
4957	Brucemurray	9101	05 24.5	16.7	-44	05 15.842	20.9	-50	2.892	3	
163696	2003 EB50	9101	05 27.4	14.2	-20	05 26.664	1.8	-20	62.060	3-	Last radar: 2015
424482	2008 DG5	9101	06 01.9	13.8	13	11 19.765	2.1	22			PHA
85839	1998 YO4	9101	06 03.5	16.0	-53	07 01.968	25.0	-57	2.450	1	
4953	1990 MU	9101	06 09.1	15.1	-37	07 05.480	18.4	-52	14.218	3	Next radar: 2027
65733	1993 PC	9101	06 14.5	16.7	-44	06 29.433	13.2	-40	4.185	3	
138205	2000 EZ148	9101	06 17.1	14.3	-86	10 28.843	10.3	28			
7889	1994 LX	9101	06 25.3	16.8	13	06 28.840	21.1	10	2.741	3	
263976	2009 KD5	9101	06 30.2	15.9	-4	06 18.948	24.0	4	2.664	2+	
348400	2005 JF21	9101	07 13.5	16.5	9	12 07.061	14.2	-1	2.415	3	
437844	1999 MN	9101	07 02.4	16.4	-32	07 01.890	8.6	-32	5.495	3	Next radar: 2030
442609	2012 KU42	9101	07 29.1	16.7	5	12 20.839	23.4	-14			

Table VI. A list of near-Earth asteroids known as of 2024 Oct 10. Green bar lines are on the Goldstone list of planned targets. PHA: Potentially Hazardous Asteroid. NHATS: Near-Earth Object Human Space Flight Accessible Targets Study. BA: Binary asteroid. This is not necessarily a complete list of Goldstone targets. Check their web site.

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