LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2015 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 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 several lists of asteroids that are prime targets for photometry during the period 2015 July-September.

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; Warner *et al.*, 2009) documentation for an explanation of the U code:

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

The ephemeris generator on the CALL web site allows you to create custom lists for objects reaching V ≤ 18.5 during any month in the current year, e.g., limiting the results by magnitude and declination.

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

We refer you to past articles, e.g., *Minor Planet Bulletin* **36**, 188, 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 page on the Minor Planet Center web site:

http://www.minorplanetcenter.net/light_curve

We believe this to be the largest publicly available database of raw lightcurve data that contains 1.8 million observations for more than 2700 objects.

Now that many backyard astronomers and small colleges have access to larger telescopes, we have expanded the photometry opportunities and spin axis lists to include asteroids reaching V = 15.5.

In both of those lists, a line in *italics text* indicates a near-Earth asteroid (NEA). In the spin axis list, a line in **bold text** indicates a particularly favorable apparition. To keep the number of objects manageable, the opportunities list includes only those objects reaching a particularly favorable apparition, meaning they could all be presented in bold text.

Lightcurve/Photometry Opportunities

Objects with U = 3– or 3 are excluded from this list since they will likely appear in the list below for shape and spin axis modeling. Those asteroid rated 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.

		Brightest			LCDB Data		
Number	Name	Date	Mag	Dec	Period	Amp	U
12214	Miroshnikov	07 02.8	15.4	-13			
14687	1999 YR13	07 04.0	15.0	-23			
5445	Williwaw	07 04.3	14.4	-18			
8895	Nha	07 04.3	15.1	-16		0.1	
3466	Ritina	07 04.9	15.0	-23			
19576	1999 LP22	07 05.0	15.3	-22			
5631	Sekihokutouge	07 05.3	15.5	-25			
11438	Zeldovich	07 05.4	14.7	-16	5.2	0.12	2-
1476	Cox	07 05.8	14.6	-33			
16147	Jeanli	07 06.7	15.2	-32			
21188	1994 GN	07 06.8	15.4	-29			
21967	1999 WS9	07 07.5	15.3	-30			
31367	1998 WB9	07 07.7	15.1	-43			
9648	Gotouhideo	07 08.4	15.5	-30			
3298	Massandra	07 08.9	15.2	-22			
4802	Khatchaturian	07 08.9	15.4	-23			
684	Hildburg	07 09.2	13.6	-30	15.89	0.22-0.23	2
10682	1980 KK	07 10.0	15.0	-21			
3477	Kazbegi	07 10.4	15.0	-10	12.65	0.25	2
1247	Memoria	07 10.5	13.7	-20			
14229	1999 XV94	07 10.5	15.5	-31			
8289	An-Eefje	07 12.2	15.4	-20			
5861	Glynjones	07 12.4	15.1	-25			
5930	Zhiganov	07 12.4	15.5	-17			
9561	van Eyck	07 13.5	15.1	-30			
5512	1988 VD7	07 13.9	14.8	-30			
11865	1989 SC	07 14.5	15.3	-37			
40429	1999 RL27	07 15.1	15.2	-46	>24.	0.1	1
2407	Haug	07 15.5	13.8	-25			
19281	1996 AP3	07 16.0	15.1	-17			
4864	1988 RA5	07 17.5	15.3	-24			
1353	Maartje	07 17.7	13.6	-7	22.98	0.40	2
1569	Evita	07 18.7	15.1	-26			
9773	1993 MG1	07 19.3	14.3	-7			
4901	1988 VJ	07 20.0	15.0	-12			
2389	Dibaj	07 20.7	14.3	-31			
3050	Carrera	07 20.7	15.1	-18			
32143	2000 LA27	07 20.9	15.2	-12			
12229	Paulsson	07 21.4	15.2	-30			
6701	Warhol	07 21.9	15.1	-26			
14083	1997 GH22	07 22.7	15.4	-40			
13844	1999 XW34	07 22.9	15.5	-22			
5051	Ralph	07 23.9	15.1	-14			
3302	Schliemann	07 26.9	15.0	-16			
27995	1997 WL2	07 28.0	14.9	-27			
3858	Dorchester	07 28.4	14.4	-33			
12746	Yumeginga	07 29.1	15.1	-13			
11861	1988 VY2	07 29.3	15.3	-35			
6469	Armstrong	07 30.8	15.3	-14			

Number	Name	Brightest Date	Mag	Dec	LCDB Data Period	Amp	U
6649	Yokotatakao	07 31.0	14.4	-23			
11864	1989 NH1	07 31.0	14.6	-20			
11927	Mount Kent	07 31.1	15.4	-24			
2160	Spitzer	07 31.9	15.3	-18	5.9		2-
3303	Merta	08 01.1	15.5	-22			
7899	Joya	08 01.1	15.4	-27			
10005	Chernega	08 01.2	15.5	-25			
5518	Mariobotta	08 01.5	14.2	-19			
2166	Handahl	08 01.6	14.1	-12			
12234	Shkuratov	08 01.6	15.4	-12			
6609	1992 BN	08 03.1	15.5	-20			
5480	1989 YK8	08 03.8	14.9	-19			
22409	1995 SU3	08 04.1	14.6	-22			
5463	Danwelcher	08 04.3	15.0	-24			
6140	Kubokawa	08 04.4	15.3	-20			
2684	Douglas	08 04.5	15.5	-13			
39551	1992 EW5	08 05.8	15.5	-21			
9801	1997 FX3	08 07.1	14.7	-12			
18487	1996 AU3	08 07.6	14.8	-17	6.512	0.72	2
2997	Cabrera	08 08.0	14.8	-25			
18229	3222 T-1	08 08.4	15.5	-12			
5717	Damir	08 08.6	15.4	-19			
12207	1981 EU28	08 08.8	15.1	-13			
61123	2000 MN1	08 09.1	15.3	-29			
49953	1999 XL215	08 09.5	15.5	-8			
1260	Walhalla	08 10.0	15.5	-13		0.16	
26818	1987 QM	08 10.3	15.1	-27			
16157	Toastmasters	08 11.7	15.4	-15			
47410	1999 XE135	08 12.1	15.4	-15			
53168	1999 CV10	08 12.2	15.1	-14			
56696	2000 LQ26	08 12.2	15.5	-13			
3945	Gerasimenko	08 13.1	15.0	-17			
10672	Kostyukova	08 14.0	15.4	+0			
6630	Skepticus	08 14.1	14.7	-28			
8930	Kubota	08 14.2	15.2	-9			
348400	***2005 JF21***	***08 14.3***	***12.5***	***-49***			
1331	Solvejg	08 14.9	13.2	-16	>10.	0.3	1
783	Nora	08 15.4	12.0	-14	34.4	0.08-0.2	2-
1056	Azalea	08 15.4	12.9	-21	11.893	0.07-0.79	2+
7702	1991 PO13	08 15.8	15.5	-19			
206378	***2003 RB***	***08 16.0***	***13.8***	***+5***	***>16.***	***0.2***	***2***
2243	Lonnrot	08 16.2	13.8	-27			
5330	Senrikyu	08 16.8	15.3	+8	14.44	0.08	2
13999	1993 FH43	08 16.9	15.5	-15			
3093	Bergholz	08 17.0	14.0	+3			
6184	Nordlund	08 17.4	15.3	-24			
14198	1998 XZ73	08 18.1	15.4	-19			
3326	Agafonikov	08 18.4	14.9	-17			
7776	Takeishi	08 19.9	14.4	-7	8.9	0.05	1
9038	Helensteel	08 20.4	15.5	-16			
3040	Kozai	08 20.5	15.1	-21			
18389	1992 JU2	08 20.6	15.5	-2			
4556	Gumilyov	08 22.1	15.2	-17			
2676	Aarhus	08 22.2	14.8	-7			
5657	Groombridge	08 22.2	15.4	-4			
4615	Zinner	08 22.6	14.7	-27			
1357	Khama	08 22.8	15.0	-31			
7254	Kuratani	08 23.6	15.4	-15			
14938	1995 DN	08 24.3	15.5	-7			
20963	Pisarenko	08 25.2	15.2	-16			
31044	1996 NY	08 25.4	15.2	-34			
3964	Danilevskij	08 26.3	15.3	-11			
1383	Limburgia	08 27.2	15.0	-10	> 5.	0.07	
16579	1992 GO	08 27.6	15.5	-11			
44506	1998 XS39	08 27.8	15.5	+2			
4145	Maximova	08 28.5	14.6	-3			
23120	Paulallen	08 29.5	14.4	+6			
981	Martina	08 30.2	13.5	-12	11.267	0.20	2
3434	Hurless	08 31.0	15.0	-15			
11786	Bakhchivandji	08 31.0	15.5	-10			
53090	1998 YS7	08 31.6	15.4	-2			
7748	1987 TA	09 01.0	14.5	-9			
4327	Ries	09 01.2	14.6	-36			
11282	Hanakusa	09 01.2	15.4	-16			
8563	1995 US	09 01.5	15.0	-1			
2740	Tsoj	09 01.9	15.3	+0			
1988	Delores	09 02.3	15.1	-15			
11624	1996 UF	09 03.0	15.5	-8			
23941	1998 UW1	09 03.6	15.5	-28			
7107	Peiser	09 04.6	15.5	-5			
2379	Heiskanen	09 05.4	13.3	-7			
18070	2000 AC205	09 06.5	15.1	-52			
4919	Vishnevskaya	09 06.6	14.4	-8			
24642	1984 SA	09 06.9	15.4	+6			
18085	2000 JZ14	09 07.0	15.4	-19			
14457	1993 FR23	09 07.1	15.4	-10			
31450	1999 CU9	09 07.4	14.1	+3			
9947	Takaishuji	09 07.8	15.5	+5			
9955	1991 PU11	09 08.0	15.1	-6			
10360	1993 VN	09 08.0	15.2	-5			
3084	Kondratyuk	09 09.0	14.8	-3			
26573	2000 EG87	09 09.0	15.4	-4			
1024	Hale	09 09.2	13.8	-32	16.	0.10	1+
1611	Beyer	09 09.8	15.3	+1	13.29	0.35	2+
3054	Strugatskia	09 10.0	14.4	-6			
3875	Staehle	09 10.0	14.5	-12			
18096	2000 LM16	09 10.2	15.1	-7	86.	0.18	2-
8860	Rohloff	09 11.1	15.5	-15			
22303	1990 QE4	09 11.1	15.4	-10			
5981	Kresilas	09 12.0	14.8	-6			
2311	El Leoncito	09 14.6	15.3	-6			
2748	Patrick Gene	09 14.8	15.1	-3			
6295	Schmoll	09 15.1	15.3	-1			
5505	Rundetaarn	09 15.3	15.2	+7			
2362	Mark Twain	09 15.5	14.2	-6			
8145	Valujki	09 15.6	15.1	+12			
5873	Archilochos	09 15.7	15.2	-9			
26097	1988 VJ1	09 15.9	15.1	+7			
4962	Vecherka	09 16.7	15.0	+11			
13852	Ford	09 17.8	15.3	+0			
4714	Toyohiro	09 17.9	14.8	+2			
2057	Rosemary	09 20.9	15.2	-2			
7195	Danboice	09 21.0	15.1	-14	8.67	0.16	1+
7345	Happer	09 21.1	15.3	-9			
8079	Bernardlovell	09 21.9	15.3	+4			
9442	1997 GQ27	09 21.9	15.3	-23			
3111	Misuzu	09 22.4	15.0	-4	>40.	0.25	2-
14276	2000 CF2	09 22.5	14.7	-8		0.12	
2219	Mannucci	09 22.8	14.9	-11		0.3	
3045	Alois	09 23.3	15.1	-3		0.52	
5792	Unstrut	09 23.7	15.1	-12			
3958	Komendantov	09 24.1	14.0	-2			
1136	Mercedes	09 24.3	12.7	+9	24.64	0.10-0.15	2
10318	Sumaura	09 24.4	15.0	-9			
6440	Ransome	09 24.8	15.5	+0			
30522	2001 MQ15	09 24.9	15.2	-15			
4800	Veveri	09 26.7	15.2	+0			
2671	Abkhazia	09 27.2	15.4	+3			
26843	1991 UK1	09 27.3	15.5	+7			
91252	1999 CS49	09 27.4	15.5	+19			
8556	Jana	09 27.9	14.6	-9			
14893	1992 DN6	09 27.9	14.9	-3			
6934	1994 YN2	09 28.2	15.4	-12			
15012	1998 QS92	09 28.6	15.1	-11			
14480	1994 PU1	09 28.7	15.3	-4			
6277	1949 QC1	09 28.8	15.2	+10			
27351	2000 DO73	09 29.2	14.8	+3			
6174	Polybius	09 29.3	15.0	-4			
3537	Jurgen	09 29.7	15.3	-13	>14.	0.3	1
2188	Orlenok	09 29.8	15.0	+0			
85950	1999 FQ7	09 29.8	15.3	+3			
16556	1991 VQ1	09 30.0	14.9	-11		0.17	
3781	Dufek	09 30.2	15.5	+3			
9400	***1994 TW1***	***09 30.2***	***14.7***	***+52***			
1570	Brunonia	09 30.4	15.3	+3			
5455	Surkov	09 30.9	15.0	+3			

Low Phase Angle Opportunities

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." To allow asteroids with longer names in the list, only the maximum amplitude in the LCDB is given. Uses the on-line query form for the LCDB

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

to get more details about a select asteroid.

You will have the best chance of success working objects with low amplitude and periods that allow covering at least half a cycle 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. This reduction requires that you

determine the period and the amplitude of the lightcurve; for long period objects that can be tricky. Refer to Harris, *et al.* ("Phase Relations of High Albedo Asteroids." *Icarus* **81**, p365 ff) for the details of the analysis procedure.

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 when using average light, which is the method used for values listed by the Minor Planet Center.

Num	Name	Date	α	V	Dec	Period	Amp	U
1247	Memoria	07 10.5	0.93	13.7	-20			
1210	Morosovia	07 16.3	0.74	13.6	-23	15.2616	0.56	3
551	Ortrud	07 21.0	0.17	13.9	-21	13.05	0.18	2
468	Lina	07 23.0	0.26	13.2	-21	16.33	0.18	3
415	Palatia	07 31.7	0.15	13.0	-19	20.73	0.33	3
301	Bavaria	08 01.8	0.74	13.4	-16	12.253	0.28	3
100	Hekate	08 03.0	0.22	10.7	-18	27.066	0.23	3
442	Eichsfeldia	08 09.2	0.15	12.6	-16	11.871	0.38	3
65	Cybele	08 13.4	0.44	11.0	-13	6.0814	0.12	3
1331	Solvejg	08 15.0	0.72	13.2	-16 >	10.	0.3	1
783	Nora	08 15.5	0.25	12.0	-14	34.4	0.2	2
893	Leopoldina	08 18.9	0.10	12.8	-13	14.115	0.35	3
182	Elsa	08 19.1	0.95	11.7	-15	80.088	0.72	3
1430	Somalia	08 19.5	0.23	13.8	-13	6.913	0.45	3
200	Dynamene	08 25.0	0.51	11.5	-10	37.394	0.10	3
1082	Pirola	08 27.0	0.11	13.4	-11	15.8525	0.60	3
3628	Boznemcova	08 28.1	0.40	13.5	-09	3.33541	0.09	3
177	Irma	09 02.0	0.17	11.8	-09	13.856	0.37	3
303	Josephina	09 02.4	0.29	12.8	-09	12.497	0.15	3
2379	Heiskanen	09 05.4	0.19	13.3	-07			
661	Cloelia	09 06.2	0.57	13.8	-05	5.536	0.26	3
1636	Porter	09 07.2	0.34	14.0	-06	2.9653	0.22	3-
201	Penelope	09 10.1	0.85	10.6	-07	3.7474	0.73	3
846	Lipperta	09 10.8	0.19	13.5	-05	1641.	0.30	2
325	Heidelberga	09 13.4	0.42	12.5	-03	6.737	0.20	3
328	Gudrun	09 15.5	0.14	13.0	-03	10.992	0.32	3
788	Hohensteina	09 18.5	0.32	13.2	-01	37.176	0.18	3
3958	Komendantov	09 24.0	0.93	14.0	-02			
3447	Burckhalter	09 24.5	0.25	13.8	+00	59.8	0.39	3
1160	Illyria	09 27.1	0.09	13.8	+01	4.1025	0.91	3
1275	Cimbria	09 28.4	0.72	13.1	+03	5.65	0.57	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

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

Included 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 two 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 longitude at either of the two apparitions differs 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 a long, on-going project.

An additional dense lightcurve, along with sparse data, 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.

		Brightest			LCDB Data		
Num	Name	Date	Mag	Dec	Period	Amp	U
2511	**Patterson**	**07 01.5**	**14.5**	**-27**	**4.144**	**0.65- 0.8**	**3**
1113	Katja	07 02.0	14.4	-36	18.465	0.08-0.17	3
308	Polyxo	07 04.1	11.6	-16	12.029	0.08-0.15	3-
4440	Tchantches	07 04.9	15.2	-24	2.7883	0.21-0.34	3
117	Lomia	07 05.1	12.4	-43	9.127	0.10-0.35	3
1318	Nerina	07 05.6	15.5	-62	2.528	0.06-0.32	3
829	Academia	07 06.7	14.6	-35	7.891	0.36-0.44	3-
1563	Noel	07 09.5	15.0	-31	3.5495	0.14-0.18	3
244	Sita	07 09.7	14.0	-17	129.51	0.80-0.82	3-
469	Argentina	07 09.8	13.3	-34	17.573	0.12	3-
909	Ulla	07 10.9	14.1	-6	8.73	0.08-0.24	3
840	**Zenobia**	**07 11.1**	**13.7**	**-18**	**5.565**	**0.08-0.20**	**3**
688	Melanie	07 11.7	13.6	-6	18.87	0.07-0.14	3
9068	1993 OD	07 12.2	15.3	-34	3.4073	0.19-0.20	3
385186	1994 AW1	07 15.0	14.1	-26	2.5193	0.10-0.17	3
781	**Kartvelia**	**07 16.0**	**13.5**	**-8**	**19.04**	**0.16-0.28**	**3-**
1210	**Morosovia**	**07 16.3**	**13.6**	**-23**	**15.2616**	**0.36-0.56**	**3**
175	Andromache	07 17.7	11.6	-27	8.324	0.21-0.30	3
826	Henrika	07 19.2	14.1	-9	5.9846	0.26	3
1297	Quadea	07 20.4	14.9	-20	6.267	0.35	3
21088	***Chelyabinsk***	***07 21.3***	***14.3***	***-48***	***22.49***	***0.13***	***3***
85989	***1999 JD6***	***07 21.9***	***13.8***	***+59***	***7.6638***	***0.99- 1.2***	***3***
3121	Tamines	07 22.9	15.4	-19	4.043	0.04-0.16	3
468	Lina	07 23.1	13.2	-21	16.33	0.10-0.18	3
57	Mnemosyne	07 23.6	11.9	+1	12.463	0.12-0.14	3
1119	Euboea	07 23.7	13.9	-33	11.41	0.46-0.50	3
1406	Komppa	07 23.7	15.3	-31	3.508	0.16-0.20	3
3382	Cassidy	07 25.2	14.5	-31	4.258	0.10-0.15	3-
1377	Roberbauxa	07 26.5	15.4	-9	7.3627	0.22-0.24	3
1313	Berna	07 27.7	14.8	-17	25.46	0.20-0.28	3
907	Rhoda	07 27.8	14.7	-46	22.44	0.08-0.16	3-
604	Tekmessa	07 28.8	13.7	-25	5.5596	0.49-0.52	3
2365	Interkosmos	07 29.6	15.0	-16	6.1548	0.23-0.25	3
3409	Abramov	07 30.5	15.5	-16	7.791	0.49-0.50	3
1338	Duponta	07 30.9	15.4	-21	3.8545	0.23-0.26	3
78	Diana	07 31.4	12.3	+21	7.2991	0.02-0.30	3
853	Nansenia	07 31.5	14.2	-5	7.931	0.13-0.20	3-
251	Sophia	07 31.9	14.5	-11	20.216	0.30-0.61	3
1806	Derice	08 01.0	14.9	-14	3.224	0.07-0.19	3
301	**Bavaria**	**08 01.7**	**13.4**	**-16**	**12.253**	**0.25-0.31**	**3**
772	Tanete	08 01.9	13.2	-53	17.258	0.07-0.18	3
921	Jovita	08 01.9	13.8	+7	15.64	0.07-0.12	3-
3478	Fanale	08 02.3	14.6	-18	3.245	0.47-0.60	3
500	**Selinur**	**08 02.7**	**12.0**	**-12**	**8.0111**	**0.10-0.16**	**3**
4949	Akasofu	08 02.9	15.3	-21	2.6798	0.1-0.15	3
100	**Hekate**	**08 03.0**	**10.7**	**-18**	**27.066**	**0.11-0.23**	**3**
4223	**Shikoku**	**08 03.3**	**14.4**	**-8**	**9.137**	**0.17-0.18**	**3**
1680	Per Brahe	08 04.2	14.1	-22	3.428	0.08-0.17	3
21688	1999 RK37	08 04.8	15.3	-39	5.696	0.68-0.80	3
2453	Wabash	08 05.0	15.0	-31	6.878	0.63-0.67	3
5635	**Cole**	**08 06.1**	**15.0**	**-6**	**5.7937**	**0.30-0.33**	**3**
976	Benjamina	08 07.8	13.9	-6	9.746	0.17-0.18	3-
1189	Terentia	08 07.8	13.5	-7	19.308	0.32-0.38	3
657	Gunlod	08 08.8	14.6	-11	15.6652	0.19-0.20	3
442	Eichsfeldia	08 09.1	12.6	-16	11.871	0.24-0.38	3
956	**Elisa**	**08 11.0**	**13.5**	**-5**	**16.492**	**0.35-0.37**	**3**
316	Goberta	08 11.8	14.5	-16	8.605	0.20-0.27	3
701	Oriola	08 14.0	13.6	-5	9.09	0.20	3
1687	Glarona	08 14.3	14.4	-17	6.3	0.75	3
854	Frostia	08 15.0	14.0	-6	37.56	0.05-0.38	3
2494	Inge	08 15.0	15.0	-4	6.79	0.90-0.92	3
3982	**Kastel'**	**08 15.2**	**14.0**	**-3**	**8.488**	**0.12-0.28**	**3**
3007	Reaves	08 15.9	14.8	-29	4.1555	0.38	3
1304	Arosa	08 16.0	13.9	-35	7.7478	0.13-0.38	3
1008	La Paz	08 16.1	14.9	-25	8.998	0.14-0.19	3
1449	Virtanen	08 17.9	14.2	-20	30.495	0.08-0.69	3-
893	***Leopoldina***	***08 18.9***	***12.8***	***-13***	***14.115***	***0.18-0.35***	***3***
942	Romilda	08 19.3	15.0	-28	6.965	0.26-0.35	3
1430	**Somalia**	**08 19.5**	**13.8**	**-13**	**6.913**	**0.40-0.45**	**3**
1427	**Ruvuma**	**08 19.7**	**13.7**	**-28**	**4.797**	**0.26-0.36**	**3**
402	Chloe	08 20.1	12.8	-18	10.664	0.07-0.37	3
466	Tisiphone	08 20.9	13.8	+3	8.824	0.03-0.16	3
288	Glauke	08 21.8	13.8	-15	170.	0.36- 0.9	3
1829	Dawson	08 21.8	15.1	-6	4.254	0.05-0.28	3
1127	Mimi	08 22.1	13.7	-21	12.749	0.72-0.95	3
5240	Kwasan	08 22.4	15.5	-3	5.675	0.42-0.48	3-
1710	**Gothard**	**08 22.8**	**14.3**	**-22**	**4.939**	**0.31-0.32**	**3**
1777	Gehrels	08 23.9	14.8	-12	2.8355	0.21-0.27	3
963	Iduberga	08 24.0	15.2	-25	3.0341	0.30-0.34	3
273	**Atropos**	**08 24.7**	**12.4**	**-6**	**23.924**	**0.52-0.65**	**3**
1296	Andree	08 24.8	15.1	-5	5.1837	0.23-0.27	3
200	Dynamene	08 25.0	11.5	-10	37.394	0.10	3
1071	Brita	08 26.4	14.2	-18	5.8169	0.18-0.38	3
2951	Perepadin	08 26.6	15.2	-26	4.781	0.54-0.60	3
1082	**Pirola**	**08 27.0**	**13.4**	**-11**	**15.8525**	**0.53-0.60**	**3**
1695	**Walbeck**	**08 27.1**	**14.9**	**+15**	**5.1607**	**0.22-0.34**	**3**
790	Pretoria	08 27.8	12.6	+19	10.37	0.05-0.18	3
2341	Aoluta	08 27.9	14.9	-18	3.	0.25-0.28	3
5817	Robertfrazer	08 28.0	14.9	-16	4.051	0.22-0.33	3

Num	Name	Brightest Date	Mag	Dec	LCDB Data Period	Amp	U
1790	Volkov	08 31.4	15.4	-12	10.7419	0.09-0.14	3
10046	Creighton	09 01.3	15.5	-20	6.566	0.65-0.68	3
98	Ianthe	09 01.7	13.3	-14	16.479	0.27-0.34	3
4490	Bambery	09 01.7	14.9	-31	5.815	0.9-1.16	3
769	Tatjana	09 01.9	12.6	-17	35.08	0.30-0.33	3-
177	Irma	09 02.1	11.8	-9	13.856	0.24-0.37	3
303	**Josephina**	**09 02.4**	**12.8**	**-9**	**12.497**	**0.12-0.15**	**3**
818	Kapteynia	09 03.7	13.5	-30	16.35	0.09-0.12	3
490	**Veritas**	**09 04.1**	**12.2**	**-4**	**7.93**	**0.21-0.58**	**3**
342	Endymion	09 04.3	13.9	+3	6.319	0.15-0.23	3
564	Dudu	09 04.4	13.5	-33	8.882	0.43-0.55	3
6084	**Bascom**	**09 04.4**	**14.7**	**-18**	**2.7454**	**0.14-0.23**	**3**
2478	Tokai	09 05.9	14.7	-1	25.885	0.41-0.78	3
427	Galene	09 06.6	13.5	-1	3.705	0.55-0.68	3
1636	Porter	09 07.2	14.0	-6	2.9658	0.22-0.24	3
4055	***Magellan***	***09 07.2***	***12.2***	***-4***	***7.475***	***0.46-0.76***	***3***
970	Primula	09 07.3	14.3	-2	2.777	0.16-0.30	3
180	Garumna	09 08.9	14.3	-5	23.866	0.42- 0.6	3
472	Roma	09 09.6	12.2	-21	9.8007	0.27-0.45	3
1117	**Reginita**	**09 10.5**	**13.1**	**-8**	**2.946**	**0.13-0.33**	**3**
410	Chloris	09 11.6	11.7	-19	32.5	0.28-0.33	3
223	Rosa	09 12.3	14.1	-7	20.283	0.06-0.13	3
1656	Suomi	09 12.9	14.5	+1	2.583	0.09-0.20	3
109	Felicitas	09 13.1	11.2	-8	13.191	0.06-0.12	3
325	**Heidelberga**	**09 13.4**	**12.5**	**-3**	**6.737**	**0.11-0.20**	**3**
1375	Alfreda	09 14.4	14.5	-12	19.14	0.17	3-
232	Russia	09 15.9	14.1	-6	21.905	0.14-0.31	3
869	Mellena	09 16.0	15.0	-6	6.5155	0.20-0.27	3
361	Bononia	09 16.7	13.7	-10	13.83	0.25	3
463	**Lola**	**09 17.3**	**13.7**	**-22**	**6.206**	**0.20-0.22**	**3**
461	Saskia	09 17.9	14.8	-3	7.348	0.25-0.36	3
806	Gyldenia	09 18.5	15.1	-16	16.846	0.10-0.27	3-
286	Iclea	09 18.8	13.3	-13	15.365	0.13-0.20	3
971	Alsatia	09 18.8	13.8	-23	9.614	0.17-0.29	3
1052	Belgica	09 19.6	13.8	-10	2.7097	0.08-0.10	3
742	**Edisona**	**09 19.7**	**13.3**	**-17**	**18.52**	**0.24-0.30**	**3**
1146	Biarmia	09 20.3	13.6	+14	5.47	0.20-0.32	3
1642	Hill	09 23.2	14.6	+5	6.056	0.21-0.25	3
3724	Annenskij	09 24.2	14.6	+12	3.974	0.28-0.30	3
3447	**Burckhalter**	**09 24.5**	**13.9**	**+0**	**59.8**	**0.30-0.39**	**3**
255	Oppavia	09 25.7	14.3	-2	19.499	0.14-0.19	3
1152	Pawona	09 25.7	14.1	+5	3.4154	0.16-0.26	3
206	Hersilia	09 26.1	12.2	-2	11.128	0.08-0.20	3
1177	Gonnessia	09 26.4	14.4	+19	30.51	0.10-0.25	3-
1847	Stobbe	09 27.9	14.9	-14	5.617	0.27-0.35	3
577	Rhea	09 28.0	13.1	+6	12.249	0.21-0.31	3-
693	Zerbinetta	09 28.2	13.5	+6	11.475	0.14-0.29	3-
1275	**Cimbria**	**09 28.5**	**13.1**	**+3**	**5.65**	**0.40-0.57**	**3**
642	Clara	09 29.1	14.5	+2	8.2308	0.26-0.31	3
3332	Raksha	09 29.1	14.6	-15	4.8065	0.25-0.36	3
2215	Sichuan	09 29.2	14.2	-16	3.975	0.38-0.39	3
2015	Kachuevskaya	09 29.7	15.0	+10	42.532	0.76-1.20	3
2253	**Espinette**	**09 29.8**	**13.7**	**-2**	**7.442**	**0.18-0.48**	**3**
3266	Bernardus	09 30.1	15.0	-44	10.757	0.26-1.14	3
4464	**Vulcano**	**09 30.1**	**14.7**	**-2**	**3.2038**	**0.08-0.22**	**3**
885	**Ulrike**	**09 30.2**	**13.7**	**+0**	**4.9**	**0.55-0.72**	**3**

Radar-Optical Opportunities

There are several resources to help plan observations in support of radar.

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

However, these are based on *known* targets at the time the list was prepared. It is very common for newly discovered objects to move up the list and become radar targets on short notice. We recommend that you keep up with the latest discoveries using the RSS feeds from the Minor Planet Center

http://www.minorplanetcenter.net/iau/rss/mpc_feeds.html

In particular, monitor the NEA feed 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 if you get data (through Dr. Benner's email listed above). They may not always be observing the target but, in some cases, your initial results may change their plans. In all cases, your efforts are greatly appreciated.

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. Note that *geocentric* positions are given. Use these web sites to generate updated and *topocentric* positions:

MPC: *http://www.minorplanetcenter.net/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.

Several of the targets listed here are carry-overs from the previous quarter's photometry opportunities article since they can be followed well into July, and beyond in some cases.

(85989) 1999 JD6 (Jul, H = 17.1, PHA)
1999 JD6 has been studied extensively and many of its physical properties are well known. It has a rotation period of 7.68 h; a lightcurve amplitude of 1.2 mag suggests a very elongated shape. Mainzer *et al.* (2011) used WISE data to estimate a diameter of 1.8 km and an optical albedo of 0.075, which indicates that this is a relatively dark object. Spectroscopic results have been ambiguous, suggesting multiple possible classifications, not all consistent with the low albedo from WISE data.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
07/01	21 27.0	+15 02	0.29	1.20	16.5	44.7	124	64	+0.99	-25
07/05	21 27.9	+17 22	0.24	1.17	16.1	45.3	125	28	-0.88	-24
07/09	21 28.1	+20 33	0.20	1.14	15.6	46.5	126	57	-0.47	-21
07/13	21 27.2	+25 21	0.15	1.11	15.0	49.1	125	101	-0.10	-18
07/17	21 24.1	+33 45	0.11	1.07	14.4	55.1	120	130	+0.01	-12
07/21	21 12.6	+51 57	0.07	1.04	13.8	70.6	106	118	+0.23	+2
07/25	12 20.3	+82 40	0.05	1.00	14.7	110.6	67	96	+0.59	+34
07/29	09 52.5	+39 18	0.07	0.96	19.8	151.3	27	129	+0.93	+51

1566 Icarus (Jul, H = 16.9, PHA)
Somewhat a surprise is the small number of rotation periods recorded in the LCDB for this well-known NEA. The last one has a 1995 reference! The period is about 2.3 hours. It's long past time to get an updated rotation period. The rotation period and size make Icarus a binary candidate, so high-precision observations covering a number of days, the initial group preferably being on consecutive nights, are encouraged.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
07/01	15 01.3	-19 31	0.26	1.20	15.9	40.7	130	37	+0.98	+34
07/03	15 05.0	-20 52	0.29	1.22	16.2	40.3	129	64	-0.99	+32
07/05	15 08.2	-21 56	0.33	1.25	16.5	40.0	128	91	-0.89	+31
07/07	15 11.1	-22 48	0.36	1.27	16.8	39.8	127	119	-0.71	+30
07/09	15 13.8	-23 31	0.40	1.29	17.0	39.7	126	146	-0.48	+29
07/11	15 16.3	-24 08	0.43	1.31	17.2	39.6	125	169	-0.27	+28
07/13	15 18.8	-24 40	0.47	1.33	17.5	39.5	123	158	-0.10	+27
07/15	15 21.1	-25 08	0.51	1.36	17.6	39.4	122	133	-0.01	+27

1685 Toro (Jul-Aug, H = 14.2)

The rotation period for this near-Earth asteroid is well established at 10.20 h. The amplitude of the lightcurve ranges from 0.47 to 1.80 mag. With the phase angle changing significantly during the apparition, it would be a good idea to get blocks of lightcurves separated by a week or so and then analyze each block independently. This can reveal not only a changing synodic period but changes in the shape and amplitude of the lightcurve from block to block. See Warner (2013; *MPB* **40**, 26-29).

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
07/01	15 45.2	-24 19	0.74	1.65	15.7	23.0	141	28	+0.99	+24
07/06	15 38.5	-23 08	0.75	1.63	15.9	26.6	134	99	-0.80	+26
07/11	15 33.4	-22 02	0.76	1.60	16.0	30.0	128	169	-0.26	+27
07/16	15 29.9	-21 02	0.78	1.58	16.1	33.0	122	122	+0.00	+28
07/21	15 27.9	-20 08	0.80	1.55	16.2	35.8	117	60	+0.23	+29
07/26	15 27.4	-19 22	0.82	1.52	16.2	38.2	112	5	+0.69	+30
07/31	15 28.2	-18 43	0.84	1.50	16.3	40.5	107	68	+1.00	+30
08/05	15 30.2	-18 10	0.86	1.47	16.4	42.5	103	141	-0.72	+31

(294739) 2008 CM (Jul-Aug, H = 17.3, PHA)

Warner (2014) found a rotation period of 3.054 h. The amplitude of 0.48 mag at the time suggests an elongated shape. The estimated diameter is about 1 km.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
07/01	20 22.9	-00 47	0.67	1.62	18.5	20.5	146	43	+0.99	-21
07/06	20 12.3	+02 56	0.63	1.59	18.3	19.5	149	36	-0.80	-16
07/11	19 59.8	+06 51	0.60	1.56	18.1	19.4	149	104	-0.26	-12
07/16	19 45.5	+10 53	0.57	1.53	18.0	20.8	148	152	+0.00	-7
07/21	19 29.7	+14 52	0.56	1.50	18.0	23.6	144	116	+0.23	-1
07/26	19 12.9	+18 39	0.55	1.47	18.1	27.2	138	64	+0.69	+4
07/31	18 55.7	+22 05	0.55	1.44	18.1	31.4	132	42	+1.00	+9
08/05	18 38.8	+25 05	0.56	1.41	18.2	35.6	126	93	-0.72	+1

(385186) 1994 AW1 (Jul-Aug, H = 17.5, PHA, Binary)

1994 AW1 is a binary system that has not yet been observed by radar. This was the first candidate binary NEA identified by possible mutual events in lightcurves (Mottola *et al*., 1995; Pravec and Hahn, 1997). The effective diameter of the system, based on the absolute magnitude, is roughly 1 km. The primary has a low lightcurve amplitude of 0.12 mag, suggesting a shape with low elongation. The secondary has an orbital period of 22.3 h. Pravec *et al*. (2006) estimate a secondary/primary diameter ratio of 0.49; if correct, then the secondary could be about 0.5 km in diameter. The lightcurve observations suggest a low elongation for the secondary as well.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
07/01	10 29.0	-71 36	0.12	1.05	15.5	70.9	103	78	+0.99	-12
07/06	12 08.1	-64 19	0.09	1.05	14.9	69.9	105	107	-0.80	-2
07/11	13 27.2	-47 28	0.07	1.04	14.3	68.7	107	141	-0.26	+15
07/16	14 20.9	-19 57	0.07	1.04	14.1	70.1	106	105	+0.00	+38
07/21	14 56.9	+06 50	0.08	1.03	14.6	75.0	101	50	+0.23	+54
07/26	15 22.2	+23 57	0.10	1.03	15.3	79.0	96	39	+0.69	+56
07/31	15 40.8	+33 52	0.13	1.03	15.9	81.0	92	82	+1.00	+53
08/05	15 55.1	+39 57	0.16	1.03	16.4	81.7	89	120	-0.72	+50

2011 UW158 (Jul-Sep, H = 19.4, PHA)

This asteroid will approach within 0.0164 AU on 2015 July 19 and will be one of the strongest radar targets of the year. Its estimated size is about 450 meters, assuming a typical albedo for NEAs. 2011 UW158 will be within range of Goldstone from late June into early August. The window for Arecibo is July 12-17. As far as optical photometry goes, the asteroid is available from July through September. Three ephemerides are given below, one for each month and roughly near new moon but more so when the moon and asteroid are well away from each other in the sky.

Note that the solar phase angle is very high in July and August. Deep shadowing effects could make for some very unusual lightcurve shapes requiring careful analysis. At the very least, it will probably not be practical or wise to try to combine lightcurves from each month because of the significantly different viewing aspects. Treat this asteroid as we suggested for 1685 Toro above.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
07/07	12 40.2	-13 05	0.05	1.02	15.8	87.3	90	155	-0.71	+50
07/08	12 41.1	-11 29	0.04	1.02	15.8	88.9	89	168	-0.60	+51
07/09	12 42.1	-09 36	0.04	1.02	15.7	90.5	87	172	-0.48	+53
07/10	12 43.2	-07 25	0.04	1.01	15.5	92.3	86	160	-0.37	+55
07/11	12 44.5	-04 50	0.03	1.01	15.4	94.1	84	146	-0.27	+58
07/12	12 46.1	-01 46	0.03	1.01	15.3	96.0	82	132	-0.18	+61
07/13	12 47.9	+01 58	0.03	1.01	15.2	98.1	80	117	-0.10	+65
07/14	12 50.2	+06 30	0.03	1.01	15.1	100.4	78	103	-0.05	+69

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
08/10	00 21.4	+44 39	0.07	1.04	16.3	69.5	107	69	-0.20	-18
08/11	00 21.7	+44 03	0.08	1.04	16.3	68.3	108	78	-0.13	-19
08/12	00 21.8	+43 29	0.08	1.04	16.4	67.0	109	88	-0.07	-19
08/13	00 21.9	+42 57	0.08	1.04	16.4	65.8	110	98	-0.03	-20
08/14	00 21.9	+42 27	0.09	1.05	16.5	64.6	111	108	+0.00	-20
08/15	00 21.8	+41 58	0.09	1.05	16.5	63.4	112	117	+0.00	-21
08/16	00 21.7	+41 30	0.09	1.05	16.6	62.1	113	126	+0.02	-21
08/17	00 21.5	+41 04	0.10	1.06	16.6	60.9	114	134	+0.05	-21
09/10	00 07.6	+31 48	0.17	1.15	17.3	33.8	141	114	-0.10	-30

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
09/11	00 06.8	+31 24	0.18	1.15	17.3	32.8	142	125	-0.05	-31
09/12	00 06.0	+31 00	0.18	1.16	17.4	31.8	143	134	-0.01	-31
09/13	00 05.3	+30 36	0.19	1.16	17.4	30.8	144	143	+0.00	-31
09/14	00 04.5	+30 12	0.19	1.17	17.4	29.8	145	149	+0.00	-32
09/15	00 03.8	+29 47	0.19	1.17	17.4	28.8	146	152	+0.03	-32
09/16	00 03.0	+29 23	0.20	1.18	17.5	27.8	147	150	+0.07	-32
09/17	00 02.3	+28 58	0.20	1.18	17.5	26.9	148	144	+0.12	-33

(206378) 2003 RB (Aug, H = 18.7, PHA)

Pravec *et al*. (2003) reported a period of $P > 16$ h and amplitude $A > 0.2$ mag. Given the short observing window for 2003 RB, it may not be possible for a single station to get enough data to find a reliable period. This will make a good target for a collaboration involving observers at well-separated longitudes.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
08/05	21 36.4	-20 22	0.10	1.12	14.6	8.7	170	55	-0.73	-45
08/07	21 43.1	-17 34	0.09	1.11	14.4	8.2	171	81	-0.51	-46
08/09	21 50.8	-14 10	0.09	1.10	14.2	8.5	171	105	-0.30	-46
08/11	21 59.7	-10 01	0.08	1.09	14.0	10.1	169	128	-0.13	-46
08/13	22 10.1	-04 57	0.07	1.08	13.9	13.3	166	149	-0.03	-46
08/15	22 22.5	+01 09	0.06	1.07	13.8	18.1	161	166	+0.00	-44
08/17	22 37.1	+08 24	0.06	1.07	13.8	24.4	154	164	+0.05	-42
08/19	22 54.7	+16 42	0.06	1.06	13.9	31.9	146	149	+0.17	-38

(277475) 2005 WK4 (Aug-Sep, H = 20.2, PHA)

Radar observations of 2005 WK4 (Benner *et al*., 2013) indicated a period of about 2.7 h. Analysis of optical observations by Stephens (2014) found a period of 2.595 h with amplitude of 0.29 mag. The lightcurve was rated U = 2+, so additional observations could prove useful for refining the period.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
08/10	14 00.5	-01 08	0.17	0.97	19.8	98.3	72	124	-0.20	+57
08/15	14 40.2	-09 13	0.17	0.99	19.5	91.5	79	74	+0.00	+45
08/20	15 22.2	-17 11	0.17	1.01	19.2	84.3	86	26	+0.25	+33
08/25	16 05.1	-24 09	0.18	1.03	19.1	77.4	93	26	+0.73	+21
08/30	16 47.2	-29 36	0.19	1.05	19.2	71.6	98	87	-1.00	+10
09/04	17 26.9	-33 29	0.21	1.07	19.3	67.0	102	148	-0.64	+1
09/09	18 03.1	-36 00	0.24	1.09	19.4	63.4	104	146	-0.16	-7
09/14	18 35.6	-37 29	0.26	1.11	19.6	60.7	106	97	+0.01	-1