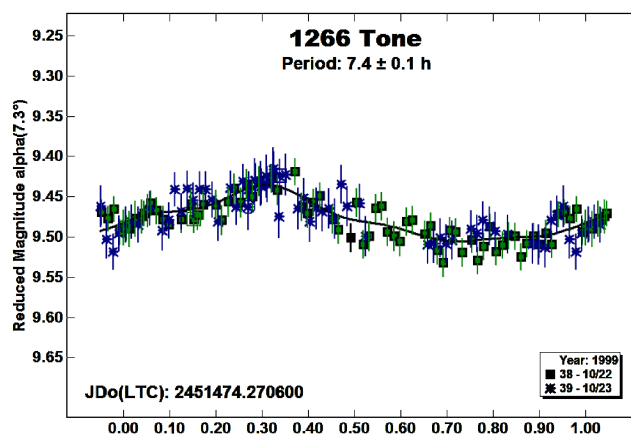
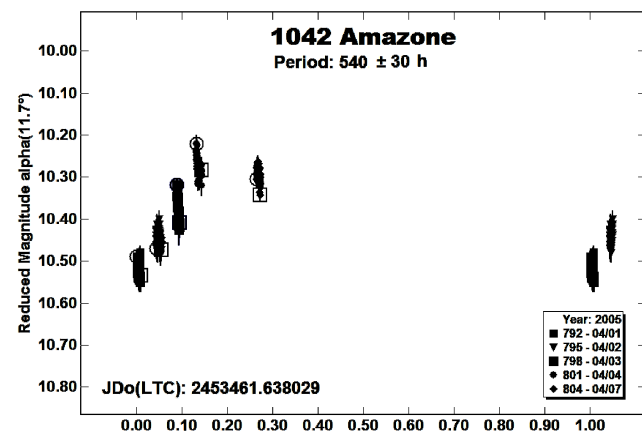
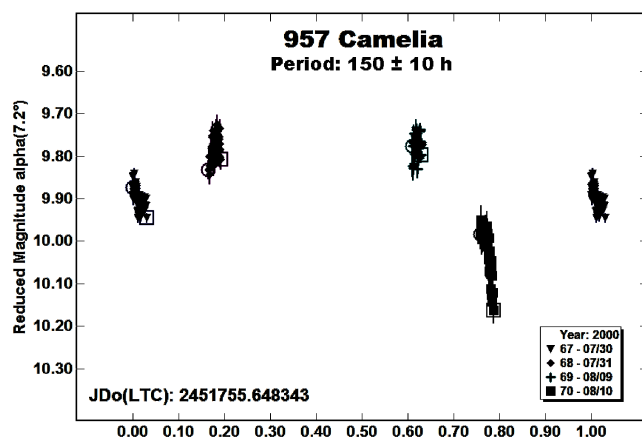
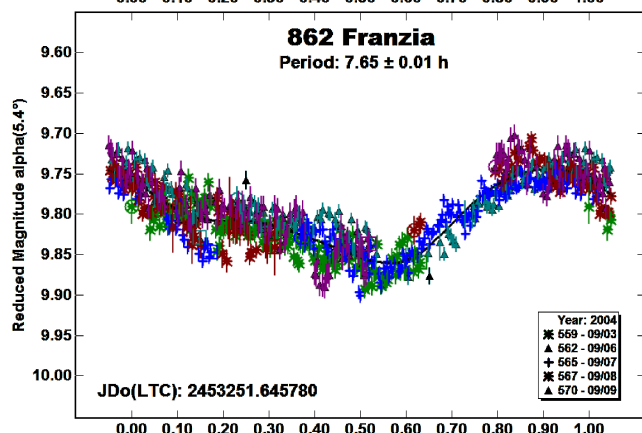
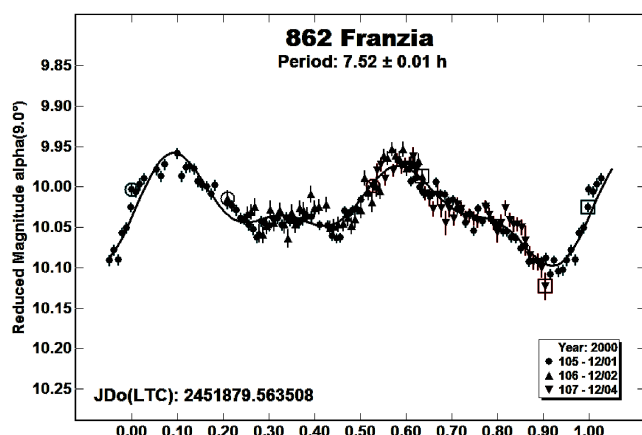




LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2010 JULY - SEPTEMBER

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This time we feature several NEAs for radar support that may present some challenges given their fast sky motion, faintness, and/or proximity to the Sun. For more background on the program details for each of the opportunity lists, refer to previous issues, e.g., *Minor Planet Bulletin* **36**, 188.

As always, we urge observations of asteroids even if they have well-established lightcurve parameters, especially if they do not yet have good spin axis or shape models. Every lightcurve of sufficient quality provides valuable information in support of such efforts, which are needed to resolve a number of questions about the evolution of individual asteroids and the general population. Furthermore, data over many apparitions can help determine if an asteroid's rotation rate is being affected by the YORP effect, a thermal effect that can cause a smaller, irregularly-shaped asteroid to speed up or slow down. This is done by seeing if a constant sidereal period fits all the data equally well or if a small linear change in the period produces better results. See Lowry et al. (2007) *Science* **316**, 272-274 and Kaasalainen et al. (2007) *Nature* **446**, 420-422.

Lightcurves, new or repeats, of NEAs are also important for solving spin axis models, specifically the orientation of the asteroid's axis of rotation. Pole directions are known for only about 30 NEAs out of a population of 6800. This is hardly sufficient to make even the most general of statements about pole alignments, including whether or not YORP is forcing pole orientations into a limited number of preferred directions (see La Spina et al. (2004), *Nature* **428**, 400-401).

The Opportunities Lists

We present four lists of "targets of opportunity" for the period 2010 July-September. In the first three sets of tables, Dec is the declination, U is the quality code of the lightcurve, and α is the solar phase angle. See the asteroid lightcurve data base (LCDB) documentation for an explanation of the U code:

www.minorplanetobserver.com/astlc/LightcurveParameters.htm

Note that the lightcurve amplitude in the tables could be more, or less, than what's given. Use the listing only as a guide.

Objects with no U rating or $U = 1$ should be given higher priority when possible. *We urge that you do not overlook asteroids with $U = 2$ 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.

The first list is an *abbreviated list* of those asteroids reaching $V < 14.5$ at brightest during the period and have either no or poorly constrained lightcurve parameters. The goal for these asteroids is to find a well-determined rotation rate. More completed lists, including objects $V < 16.0$ can be found on the CALL web site.

http://www.minorplanetobserver.com/astlc/targets_3q_2010.htm

The Low Phase Angle list includes asteroids that reach very low phase angles. 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."

The third list is of those asteroids needing only a small number of lightcurves to allow shape and spin axis modeling. Those doing work for modeling should contact Josef Durech at the email address above and visit the Database of Asteroid Models from Inversion Techniques (DAMIT) web site for existing data and models: <http://astro.troja.mff.cuni.cz/projects/asteroids3D>.

The fourth list gives a brief ephemeris for planned radar targets. Supporting optical observations made to determine the lightcurve period, amplitude, and shape are needed to supplement the radar data. High-precision work, 0.01-0.03 mag, is preferred. Those obtaining lightcurves in support of radar observations should contact Dr. Benner directly at the email given above.

Future radar targets:

<http://echo.jpl.nasa.gov/~lance/future.radar.nea.periods.html>

Past radar targets:

<http://echo.jpl.nasa.gov/~lance/radar.nea.periods.html>

Arecibo targets:

<http://www.naic.edu/~pradar/sched.shtml>

Goldstone targets:

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

Once you have analyzed your data, it's important that you 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.

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Lightcurve Opportunities

#	Name	Brightest Date Mag	Dec U	LCDB Data Period Amp
1211	Bressole	7 02.6 14.2	-13	
1329	Eliane	7 04.6 13.4	- 9 2-	106.
1850	Kohoutek	7 07.8 14.5	-27	
19261	1995 MB	7 09.5 13.9	-13	
10487	Danpeterson	7 11.6 14.1	-33	
11277	Ballard	7 11.7 14.9	+10	
664	Judith	7 12.5 13.3	- 9 2	10.76
2575	Bulgaria	7 13.0 14.4	-27	
1867	Deiphobus	7 13.3 14.8	-17 2	> 24.
1780	Kippes	7 13.7 14.3	-22 2	18.0
2407	Haug	7 13.6 13.8	-25	
15491	1999 CW85	7 15.7 14.4	-29	
3145	Walter Adams	7 17.9 15.0	-19 2	2.7
953	Painleva	7 18.8 13.1	-36 1	10.
2880	Nihondaira	7 21.5 14.0	-32 2	17.97
5430	Luu	7 22.6 14.2	-17 2	13.55
4297	Eichhorn	7 23.0 13.8	-20	
1594	Danjon	7 30.7 13.7	-34 1	> 12.
4331	Hubbard	8 01.6 14.4	-28	
1266	Tone	8 06.4 13.9	-20 2	7.40
370	Modestia	8 06.5 12.9	-11 2-	> 24.
21632	Suwanasri	8 07.5 14.7	-12	
4691	Toyen	8 09.0 14.7	-29	
7178	Ikuookamoto	8 10.6 14.7	-17	
14425	1991 TJ2	8 11.6 14.4	-28	
1353	Maartje	8 12.4 14.2	- 2 2	22.98
3173	McNaught	8 15.3 14.5	-28	
1746	Brouwer	8 16.1 14.4	-14 2	19.8
2607	Yakutia	8 17.9 14.5	-16	
3053	Dresden	8 18.2 14.3	-20	
3662	Dezhnev	8 19.1 14.5	-24	
3833	Calingasta	8 23.4 14.5	+ 1	
2025	Nortia	8 24.7 14.5	-11	
504	Cora	8 24.1 11.9	-27 2	7.59
1701	Okavango	8 26.4 14.3	-34 2	13.20
3104	Durer	8 27.8 14.4	- 5	
1699	Honkasalo	9 01.4 13.7	- 5 2	12.30
448	Natalie	9 01.1 13.8	-25	
154029	2002 CY46	9 04.5 14.5	+29	
103	Hera	9 04.1 10.7	-11 2	23.74
938	Chlosinde	9 05.1 13.9	-10	
3184	Raab	9 05.7 14.0	-20	
672	Astarte	9 05.9 13.5	- 7 2	19.8
1730	Marceline	9 06.6 14.0	- 4	
1811	Bruwer	9 09.2 14.4	- 5	
2715	Mielikki	9 14.6 14.5	+ 2	
10452	Zuev	9 16.1 14.4	+ 2	
3921	Klement'ev	9 16.9 14.2	-10	
10357	1993 SL3	9 17.3 14.5	-21	
3408	Shalamov	9 18.5 14.2	- 6	
1519	Kajaani	9 18.5 14.2	- 9	
3295	Murakami	9 19.1 14.5	- 4	
3883	Verbano	9 20.1 14.4	- 4	
19288	1996 FJ5	9 21.0 14.9	- 8 2	2.65
1493	Sigrid	9 21.7 13.5	+ 2 2	43.29
1619	Ueta	9 27.7 13.7	- 9 2	2.94
2550	Houssay	9 28.7 14.8	- 5	
2650	Elinor	9 29.0 13.9	+17 2	9.08

Low Phase Angle Opportunities

#	Name	Date	α	V	Dec	Period	Amp	U
2264	Sabrina	7 03.5	0.17	13.8	-23	43.41	0.30	2
678	Fredogundis	7 04.2	0.13	12.5	-23	11.61624	0.27	3
184	Dejopeja	7 07.7	0.39	12.7	-24	6.455	0.25-0.3	3
1107	Lictoria	7 08.1	0.26	14.0	-22	8.5616	0.16-0.30	3
758	Mancunia	7 08.2	0.07	12.9	-22	12.724	0.15-0.26	3
177	Irma	7 09.0	0.73	12.9	-24	14.208	0.37	2
512	Taurinensis	7 09.8	0.19	11.8	-22	5.585	0.14-0.35	3

Low Phase Angle Opportunities (continued)

#	Name	Date	α	V	Dec	Period	Amp	U
371	Bohemia	7 11.4	0.45	11.8	-21	10.739	0.13-0.18	3
122	Gerda	7 12.5	0.67	12.4	-20	10.685	0.11-0.26	3
24	Themis	7 20.1	0.31	11.8	-22	8.374	0.09-0.14	3
300	Geraldina	7 20.1	0.34	13.8	-22	6.8423	0.15-0.32	3
696	Leonora	7 20.5	0.26	13.3	-21	17.988	0.10	2
4297	Eichhorn	7 23.0	0.24	13.8	-20			
551	Ortrud	7 29.1	0.17	13.8	-19	13.05	0.16	3
2217	Eltigen	8 04.0	0.09	14.0	-18			
206	Hersilia	8 09.1	0.34	12.3	-15	11.11	0.08-0.14	3
240	Vanadis	8 11.0	0.52	12.2	-17	10.64	0.34	3
215	Oenone	8 18.2	0.89	13.0	-15	20.	0.1	2
954	Li	8 19.1	0.22	13.1	-12	7.207	0.11-0.25	3
1182	Ilona	8 23.5	0.95	13.4	-13	29.8	1.2	2
469	Argentina	8 24.4	0.29	13.5	-12	17.573	0.12	3
1187	Afra	8 27.0	0.89	13.8	-08	14.0701	0.38	3
203	Pompeja	8 29.2	0.42	12.1	-10	46.6	0.10	2
77	Frigga	8 31.0	0.63	11.7	-10	9.012	0.07-0.20	3
82	Alkmene	9 05.9	0.85	12.9	-09	12.999	0.18-0.54	3
672	Astarte	9 05.9	0.15	13.5	-07	19.8	0.10	2
808	Merxia	9 09.3	0.67	13.4	-04	30.631	0.70	3
1247	Memoria	9 16.8	0.22	14.0	-03			
158	Koronis	9 19.0	0.55	12.9	+00	14.218	0.28-0.43	3
108	Hecuba	9 24.5	0.34	12.8	+02	17.859	0.05-0.2	3
604	Tekmessa	9 26.3	0.45	12.4	+00	5.5596	0.52	3
417	Suevia	9 28.7	0.76	13.7	+04	7.034	0.22	3
585	Bilkis	9 29.2	0.45	13.7	+01	6.442	0.38	2
5567	Durisen	9 29.2	0.68	13.6	+01			

Shape/Spin Modeling Opportunities

#	Name	Date	Brightest Mag	Dec	Per (h)	Amp	U
288	Glauke	7 12.9	13.0	-21	1200.	0.58-0.9	3
451	Patientia	7 14.8	11.1	-30	9.727	0.05-0.10	3
24	Themis	7 20.1	11.8	-22	8.374	0.09-0.14	3
190	Ismene	7 23.3	13.7	-14	6.52	0.10-0.15	3
372	Palma	8 03.8	12.3	-28	8.567	0.10-0.17	3
146	Lucina	8 07.4	12.0	-31	18.557	0.08-0.17	3
291	Alice	8 11.8	14.2	-14	4.313	0.14-0.28	3
31	Euphrosyne	8 20.0	12.2	-46	5.530	0.08-0.13	3
14	Irene	8 22.1	10.4	-23	15.028	0.08-0.16	3
83	Beatrix	8 22.9	11.9	-18	10.16	0.06-0.27	3
77	Frigga	8 31.1	11.6	-10	9.012	0.07-0.20	3
369	Aeria	8 31.9	11.7	-26	4.787	0.08	2
441	Bathilde	9 06.5	12.5	+05	10.446	0.18	3
100	Hekate	9 24.7	11.3	-07	27.066	0.11-0.23	3
233	Asterope	9 28.1	11.1	+09	19.70	0.25-0.55	3

Radar-Optical Opportunities

Use the ephemerides to judge your best chances for observing. Note that the intervals in the ephemerides are not always the same and that *geocentric* positions are given. Use the web sites below to generate updated and *topocentric* positions. In the ephemerides, E.D. and S.D. are, respectively, the Earth and Sun distances (AU), V is the V magnitude, and α is the phase angle.

Minor Planet Center: <http://cfa-www.harvard.edu/iau/mpc.html>
JPL Horizons: <http://ssd.jpl.nasa.gov/?horizons>

Some objects are best seen outside July-September. We present them now to give you ample time for planning.

2002 BF25 (2010 July, H = 22.3)

The estimated size for this NEA is 100 meters. There are no lightcurve parameters in the LCDB. The apparition favors Southern Hemisphere observers with larger instruments.

DATE	RA(2000)	DC(2000)	E.D.	S.D.	Mag	α
07/10	23 46.43	-54 43.0	0.046	1.041	17.78	56.9
07/11	00 09.81	-54 01.4	0.043	1.037	17.68	59.9
07/12	00 35.93	-52 51.8	0.039	1.034	17.61	63.4
07/13	01 04.55	-51 04.2	0.036	1.030	17.55	67.6
07/14	01 35.11	-48 27.1	0.034	1.026	17.52	72.6
07/15	02 06.70	-44 49.4	0.031	1.022	17.55	78.4
07/16	02 38.20	-40 03.1	0.029	1.019	17.64	85.1
07/17	03 08.53	-34 08.3	0.028	1.015	17.83	92.6

(85989) 1996 JD6 (2010 July, H = 17.1)

This NEA has a well-established period of 7.66 h. It also tends to have a large amplitude, ~ 1.0 mag, which should make it an interesting study. Lightcurve observations here can help determine the rotational phase at the time of radar observations and be used to see if the YORP effect has changed the rotation period.

DATE	RA(2000)	DC(2000)	E.D.	S.D.	Mag	α
07/05	19 45.74	+14 55.8	0.265	1.232	16.02	31.8
07/10	19 17.00	+16 00.4	0.221	1.198	15.57	31.7
07/15	18 35.12	+16 35.3	0.184	1.162	15.19	35.1
07/20	17 36.17	+15 59.6	0.156	1.122	15.01	44.2
07/25	16 21.26	+13 20.6	0.140	1.079	15.14	59.8
07/30	15 02.21	+08 41.7	0.141	1.033	15.67	78.8
08/04	13 53.91	+03 39.4	0.157	0.984	16.52	96.9

2005 ED318 (2010 July, H = 20.8)

Radar observations are available but unpublished for this ~ 200 -meter NEA. It does have established lightcurve parameters, $P = 17.157$ h and $A = 0.22-0.48$ mag, but additional lightcurves can serve to constrain pole and shape models. This object is fainter than we usually include but with access to 1 to 2-meter telescopes not out of the question these days, it's hoped that some Southern Hemisphere observers can make a project of it.

DATE	RA(2000)	DC(2000)	E.D.	S.D.	Mag	α
07/01	14 57.56	-25 57.7	0.071	1.063	16.96	47.1
07/03	15 29.17	-28 58.5	0.073	1.070	16.90	41.8
07/05	16 00.24	-31 19.3	0.077	1.077	16.89	37.0
07/07	16 29.67	-33 00.2	0.082	1.084	16.91	32.9
07/09	16 56.71	-34 06.0	0.087	1.092	16.98	29.4
07/11	17 20.96	-34 43.5	0.094	1.100	17.07	26.5

3122 Florence (2010 July-September, H = 14.2)

While not a radar target until later this decade, lightcurve data obtained during this apparition can help with future modeling (see the opening section above). The period is well established, 2.358 h, which makes a prime candidate for being a binary. Careful and high-precision observations should be made to check for this possibility.

DATE	RA(2000)	DC(2000)	E.D.	S.D.	Mag	α
07/01	0 44.04	-29 58.7	0.538	1.232	15.29	54.3
07/11	1 17.39	-22 13.8	0.463	1.180	14.99	58.4
07/21	1 51.41	-11 48.7	0.401	1.132	14.73	63.2
07/31	2 27.49	+01 36.3	0.357	1.090	14.56	68.5
08/10	3 07.47	+17 08.5	0.339	1.057	14.54	73.4
08/20	3 53.38	+32 20.8	0.348	1.034	14.66	76.6
08/30	4 46.93	+44 39.7	0.381	1.022	14.85	77.4
09/09	5 47.65	+53 04.0	0.427	1.022	15.05	76.0
09/19	6 51.21	+57 55.2	0.478	1.034	15.23	73.1
09/29	7 51.11	+60 10.0	0.528	1.056	15.37	69.5

(4034) 1986 PA (2010 July-September, H = 18.4)

This NEA will be a stretch even for those with access to larger instruments. However, lightcurve data of sufficient quality on the 620-meter asteroid could refine bounds for the pole-dimensions and optical albedo that were found with previous radar observations.

DATE	RA (2000)	DC (2000)	E.D.	S.D.	Mag	α
07/01	21 12.77	+05 20.9	0.575	1.469	19.35	30.5
07/11	21 00.83	+05 37.1	0.492	1.440	18.81	25.2
07/21	20 40.58	+04 48.1	0.422	1.405	18.24	19.3
07/31	20 11.85	+02 28.5	0.369	1.364	17.78	16.2
08/10	19 36.94	-01 32.6	0.335	1.317	17.67	21.7
08/20	19 01.18	-06 49.3	0.320	1.264	17.83	33.4
08/30	18 30.01	-12 29.6	0.322	1.205	18.10	46.2
09/09	18 05.91	-17 55.1	0.331	1.140	18.39	58.5
09/19	17 48.21	-22 54.5	0.341	1.069	18.67	69.9
09/29	17 33.70	-27 34.3	0.348	0.993	18.93	81.3

6239 Minos (2010 August-September, H = 18.2)

Pravec determined a period of 3.5558 h based observations in 2004 for this NEA. Data this apparition can see if the amplitude (0.08 mag in 2004) is different. If so, that will help with spin axis modeling. Radar observations show a near-spheroid with D ~ 500 m.

DATE	RA (2000)	DC (2000)	E.D.	S.D.	Mag	α
08/10	3 23.90	+02 32.7	0.099	1.015	16.24	86.5
08/15	2 16.85	+00 23.8	0.101	1.051	15.65	65.4
08/20	1 16.42	-01 37.1	0.112	1.086	15.38	46.3
08/25	0 27.30	-03 13.9	0.129	1.120	15.30	30.2
08/30	23 49.63	-04 25.5	0.152	1.154	15.32	17.2
09/04	23 21.47	-05 16.6	0.179	1.186	15.34	6.7
09/09	23 00.72	-05 52.3	0.211	1.218	15.46	1.7
09/14	22 45.67	-06 16.2	0.246	1.248	16.22	8.5

(154029) 2002 CY46 (2010 August-September, H = 16.4)

There are no known lightcurve parameters for this NEA of about 1.6 km size. Mid- to late September may be the best chance to work the asteroid, when its sky motion is considerably slower.

DATE	RA (2000)	DC (2000)	E.D.	S.D.	Mag	α
08/20	4 03.79	-21 56.4	0.246	1.053	16.04	73.6
08/25	3 34.43	-10 55.1	0.201	1.070	15.45	67.7
08/30	2 53.49	+05 19.0	0.171	1.089	14.85	58.3
09/04	1 57.32	+24 49.9	0.165	1.110	14.54	48.6
09/09	0 47.44	+40 45.8	0.188	1.134	14.73	44.1
09/14	23 35.77	+49 26.6	0.230	1.159	15.22	43.9
09/19	22 36.54	+52 49.7	0.283	1.185	15.75	44.9
09/24	21 54.24	+53 36.4	0.343	1.213	16.23	45.5

(137032) 1998 UO1 (2010 October, H = 16.7)

Periods ranging from ~3 to 4 h have been reported for this NEA. Radar observations show D ~ 1.2 km and a nearly spheroidal shape. There were hints of a companion in the radar but nothing conclusive. High-precision observations will be needed to have any chance of detecting a satellite, if it exists. Note that ephemeris has 1-day intervals.

DATE	RA (2000)	DC (2000)	E.D.	S.D.	Mag	α
10/01	16 25.13	+11 06.4	0.082	0.964	15.69	115.0
10/02	17 12.73	+14 35.2	0.084	0.978	15.07	103.4
10/03	17 58.13	+17 16.0	0.089	0.993	14.71	92.6
10/04	18 38.41	+19 03.8	0.097	1.007	14.55	83.2
10/05	19 12.43	+20 08.1	0.107	1.022	14.52	75.4
10/06	19 40.42	+20 42.2	0.119	1.036	14.58	69.2
10/07	20 03.26	+20 57.3	0.132	1.050	14.68	64.1
10/08	20 21.93	+21 01.1	0.146	1.064	14.80	60.0
10/09	20 37.33	+20 58.4	0.160	1.078	14.94	56.7
10/10	20 50.17	+20 52.2	0.176	1.092	15.09	54.0

(153814) 2001 WN5 (2010 October, H = 18.3)

There are no known lightcurve parameters for this NEA. Its estimate size is about 650 meters. The somewhat fast sky motion and estimated magnitude favors larger telescopes so that exposure times can be kept to a minimum. In 2028, the asteroid passes at 0.6 lunar distances, the closest known approach by an object of this size for the next two centuries.

DATE	RA (2000)	DC (2000)	E.D.	S.D.	Mag	α
10/01	17 36.01	-08 24.8	0.127	0.980	17.21	96.0
10/06	18 41.50	-05 32.6	0.112	1.003	16.54	85.2
10/11	19 58.70	-01 34.3	0.107	1.029	16.00	70.9
10/16	21 14.43	+02 29.6	0.115	1.056	15.78	56.5
10/21	22 16.64	+05 36.7	0.134	1.085	15.85	45.4
10/26	23 03.11	+07 39.4	0.161	1.116	16.11	38.1
10/31	23 37.20	+08 57.2	0.194	1.148	16.45	33.9
11/05	0 02.79	+09 48.9	0.231	1.181	16.83	31.6

(162269) 1999 VO6 (2010 October, H = 17.0)

This NEA has an estimated size of 1.2 km. There are no known lightcurve parameters. It's decidedly a Northern Hemisphere target as it rides near the north celestial pole during October.

DATE	RA (2000)	DC (2000)	E.D.	S.D.	Mag	α
10/01	3 32.88	+64 26.1	0.254	1.115	16.34	57.5
10/03	3 53.35	+67 04.1	0.221	1.090	16.08	60.7
10/05	4 27.82	+70 14.4	0.189	1.065	15.82	65.0
10/07	5 34.33	+73 40.3	0.158	1.040	15.57	71.1
10/09	7 47.01	+75 13.4	0.130	1.014	15.39	79.9
10/11	10 26.57	+69 09.9	0.106	0.987	15.42	93.2
10/13	11 58.40	+53 15.5	0.091	0.960	16.03	112.3

IN THIS ISSUE

This list gives those asteroids in this issue for which physical observations (excluding astrometric only) were made. This includes lightcurves, color index, and H-G determinations, etc. In some cases, no specific results are reported due to a lack of or poor quality data. The page number is for the first page of the paper mentioning the asteroid. EP is the "go to page" value in the electronic version.

Number	Name	Page	EP
11	Parthenope	119	39
35	Leukothea	119	39
38	Leda	119	39

Number	Name	Page	EP
71	Niobe	98	18
111	Ate	119	39
112	Iphigenia	107	27
180	Garumna	89	9
194	Prokne	119	39
205	Martha	112	32
221	Lucia	127	47
262	Valda	119	39
292	Ludovica	102	22
331	Etheridgea	127	47
347	Pariana	107	27
379	Huenna	112	32
421	Zahringia	127	47
456	Abnoba	112	32
479	Caprera	112	32
506	Marion	127	47
581	Tauntonia	122	42
586	Thekla	127	47
616	Elly	112	32
616	Elly	125	45
728	Leonisis	119	39
747	Winchester	119	39
756	Lilliana	127	47
766	Moguntia	112	32
776	Berbericia	122	42
862	Franzia	127	47
957	Camelia	127	47
968	Petunia	122	42
1001	Gaussia	93	13
1042	Amazone	127	47
1060	Magnolia	93	13
1069	Planckia	112	32
1266	Tone	127	47
1311	Knopfia	89	9