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LIGHTCURVE ANALYSIS OF 918 ITHA AND 2008 KONSTITUTSIYA

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Photometric studies of 918 Itha and 2008 Konstitutsiya were made in collaboration with observers in Australia and Argentina. The large geographic longitudinal differences between the two locations helped provide a unique solution for the synodic period for both asteroids: 918 Itha, 3.47393 ± 0.00006 h; 2008 Konstitutsiya 11.2692 ± 0.0004 h.

918 Itha was selected from the "Potential Lightcurve Targets" list on the Collaborative Asteroid Lightcurve Link (CALL) site (Warner 2011) as a favorable target for observation. Mazzone and Chapman worked on this target independently from Oey. When each learned of the other's work, a collaboration was formed. The combined data were used to derive a synodic period of 3.37393 ± 0.00006 h and amplitude of 0.30 ± 0.03 mag.

2008 Konstitutsiya. Observations of this asteroid were started when Oey selected this target from in the CALL website (Warner 2011). A request for collaboration was placed on that website. Mazzone and Colazo, who had each independently observed the asteroid target for a number of nights, responded.

We could find no previously reported lightcurve parameters for 2008 Konstitutsiya. Initial observations showed that the lightcurve was very shallow with a relatively long period that was nearly-commensurate to an Earth day. Mazzone used his *Matlab* language script software to initially reduce his and Colazo's data. These scripts incorporate a Fourier algorithm and simultaneously adjust any off-set among sessions. He found a period of 11.2688 h. However when the data were pooled with those from Oey, two periods emerged: 9.7520 ± 0.0003 h and 11.2694 ± 0.0004 h.

The Mazzone group's data were also reduced in *MPO Canopus* v10.4.0.2 using differential photometry to facilitate easy exportation. Oey used *MPO Canopus* v10.4.0.2 software for data reduction and period analysis, the latter based on the Fourier algorithm developed by Harris (Harris *et al.* 1989). Internal calibration was done using the Comp Star Selector feature in *MPO Canopus*. This uses 2MASS JK magnitudes converted to Johnson-Cousins BVRI magnitudes (Warner 2007) to allow an estimated calibration error of ± 0.03 mag in the R band. Oey imported the data from Mazzone and adjusted the off-set manually to fit into his derived magnitude lightcurve. The low amplitude of the lightcurve made the collaborative work with Oey mandatory, otherwise a unique period could not be determined.

Both groups of reduced data were exchanged between Oey and Mazzone for independent period analysis. From this process, we determined the period to be 11.2694 ± 0.0004 h with an RMS value of 0.018 mag and amplitude of 0.07 ± 0.02 mag. The period spectrum shows the relationship of the respective periods.

Name	Obs	MPC	Telescope	″/pix	Exp (s)	Sessions
Oey	Kingsgrove	E19	SCT 0.25 f/11	1.45	300	(918) 1-4
	Leura	E17	SCT 0.35 f/7	1.54	300	(2008) 11-24
Colazo	El Gato Gris	I19	SCT 0.35 f/3.2	1.54	100	(918) 8
				1.54	120	(2008) 2-10
Mazzone	Río Cuarto	I20	Schmidt-Newtonian 0.20 f/4	1.9	120	(918) 5-6
				1.9	120	(2008) 1
Chapman	Cruz del Sur	I39	Newtonian 0.20 f/4	2.43x1.9	40	(918) 7

Table I. List of observers and equipment.

All images for these projects were unfiltered and processed with library dark, bias, and flat field frames.

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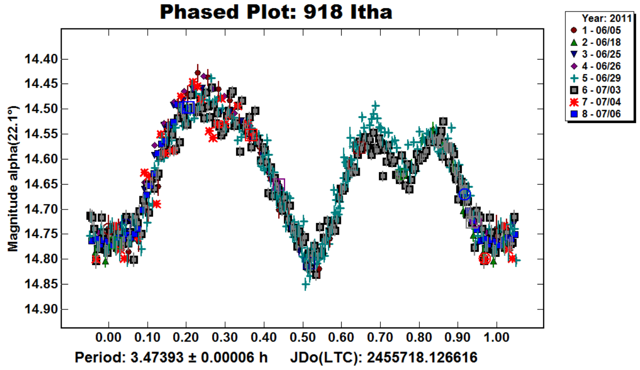

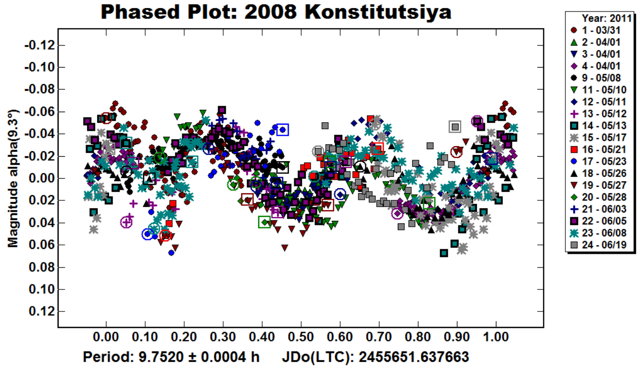

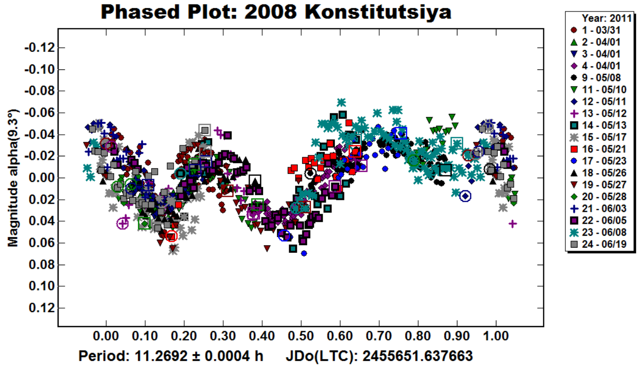

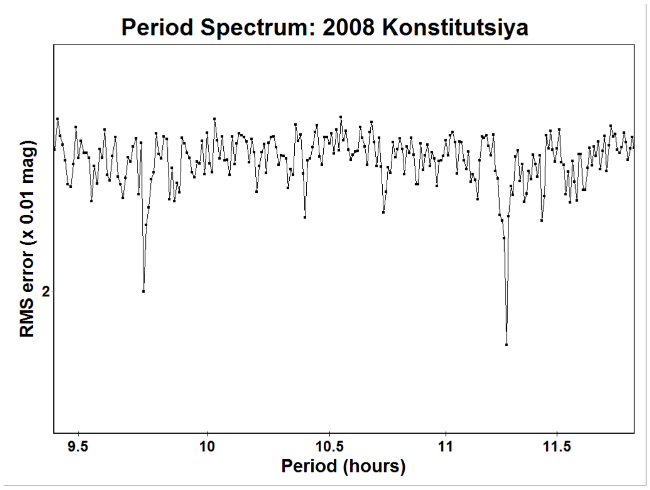

A SHAPE MODEL OF THE MAIN-BELT ASTEROID 27 EUTERPE

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We obtained dense rotational lightcurves for the main-belt asteroid 27 Euterpe during four apparitions in 2000, 2009, 2010 and 2011. The analysis indicates retrograde rotation and suggests, but does not confirm, that Euterpe has albedo features making the determination of an unambiguous spin vector and model shape difficult. Euterpe's apparent nearly spherical shape, low inclination, and pole within about 35 degrees of the plane of the solar system, caused two pole and shape solutions to be present, differing by about 180° in longitude. We found solutions of (83°, -39°, 10.40825 ± 0.00003 h) and (261°, -30°, 10.40818 ± 0.00003 h). The approximate error in the pole solutions is ± 10 degrees.

The main-belt asteroid 27 Euterpe has long been an enigma to observers. Its apparent nearly non-elongated shape and low amplitude frustrated the attempts of many observers to determine a rotational period. It wasn't until 2000 that Stephens (Stephens *et al.* 2001) published an accurate period for Euterpe. Euterpe has also been suspected of having albedo features. Bus (Bus and Binzel, 2002) reports disparities in spectra and ECAS reported colors for Euterpe.

Mostly unfiltered observations were obtained by the authors using small telescopes (0.30 to 0.35 m) with SBIG or FLI CCD cameras. Processing, lightcurve analysis, and lightcurve inversion were done using *MPO Canopus*, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (Harris *et al.*, 1989), and *MPO LCInvert*.

In our analysis, we use the dense lightcurve data from apparitions in 2000, 2009, 2010 and 2011 to find a probable period. Figures 1 – 3 show previously unpublished lightcurves from 2009, 2010 and 2011. Figures 4 and 5 shows the PAB longitude and latitude Distributions of the dense (blue) and sparse (red) data used to form the final model. We started with the synodic periods from the dense lightcurves to find a sidereal period using *LCInvert*. This was then applied in a pole search that generated 264 solutions using discrete, fixed longitude-latitude pairs but allowing the sidereal period to "float."

The results of this initial search are shown in Figure 7. Dark blue indicates the lower values of log(chi-square) in the range of solutions. Colors progress towards bright red with increasing log(chi-square) with the highest value indicated by maroon (dark red). From Figure 7, two general solutions near B = -30° are easily seen (see Hanus and Durech, 2011, for a discussion of guidelines to determine the validity of the "best solution" within a given solution set).

The two intermediate solutions where then refined by running the search again using one of the two solutions as a starting point and allowing the longitude and latitude as well as the sidereal period to float. For final modeling, we included a sparse data set of USNO-Flagstaff to complement the dense lightcurve data sets, but giving a much smaller weighting to the USNO data.

The modeling was complicated by initial "dark facet" sizes exceeding 1%, which can indicate the possibility of albedo variations (Durech *et al.*, 2009). When the weighting was raised to 2.0 before modeling, the final dark facet size fell well below 1%. This leaves the issue of albedo variations somewhat in question.

Our final results show two possible solutions, both with retrograde rotation. The preferred solution is (83°, -39°, 10.40825 h) with an alternate solution of (261°, -30°, 10.40818 h). Given the low orbital inclination (1.6°) and the nature of the lightcurve inversion process, it is common to find a double solution with the two usually differing by 180° in longitude. The error for the poles is ±10° while the period solutions have errors on the order of 2-3 units in the last decimal place.

Further supporting our preference for the (83°, -39°) solution is that the derived shape (Figure 8) is a close match to the 1993 occultation profile obtained by Dunham (1996), when nine observed chords yielded a 124 x 75 km ellipse. In order to reconcile radar observations with the occultation profile, Magri *et al.* (1998) modeled Euterpe as a triaxial ellipsoid of a/b = 1.15 ± 0.15 and b/c = 1.3 ± 0.3, or 127 x 110 x 85 km.

In 2011 August, we obtained observations through standard V and R filters to determine if any color changes to the rotational phase could be found. Figure 10 shows that no color variations were detected within V-R 0.02 mag.

The dense lightcurve data from all apparitions have been uploaded to the ALCDEF database (see Warner *et al.*, 2011) on the Minor Planet Center's web site (*http://minorplanetcenter.net/light_curve*).

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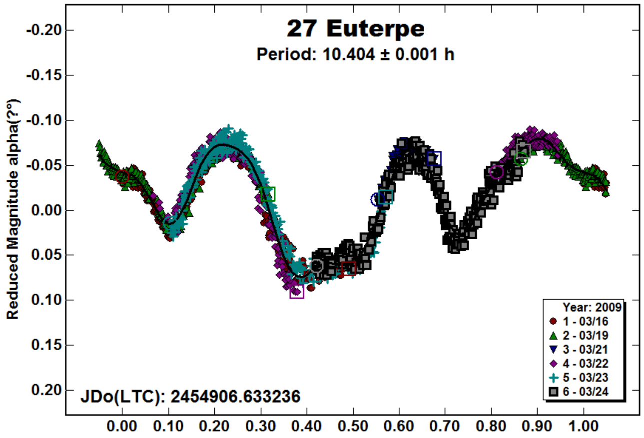

Figure 1: Lightcurve from 2009 March.

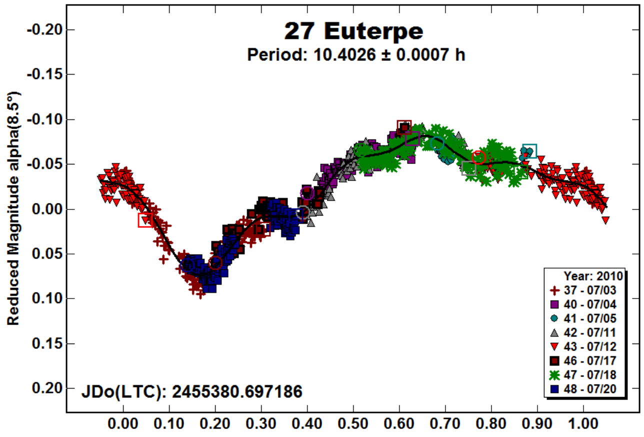

Figure 2: Lightcurve from 2010 July.

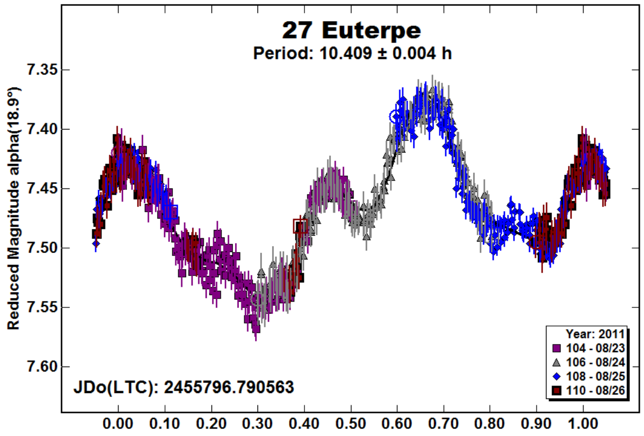

Figure 3: Lightcurve from 2011 August.

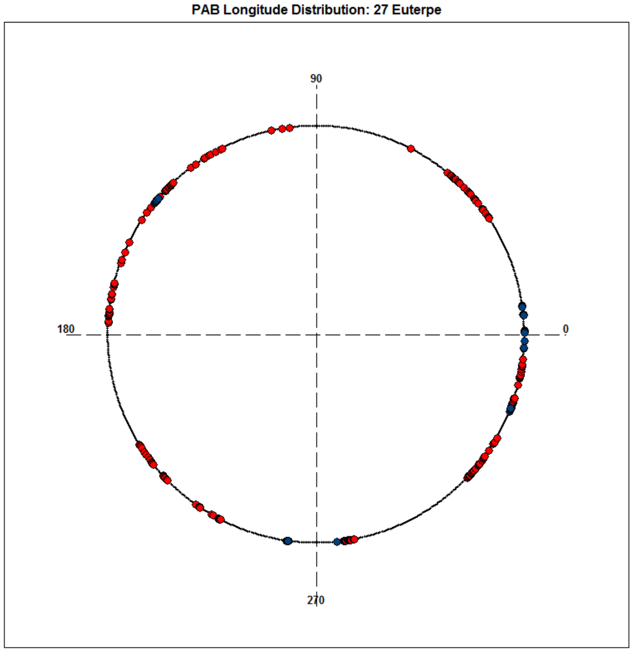

Figure 4: PAB Longitude Distribution of the dense (blue) and sparse (red) data used in the model.

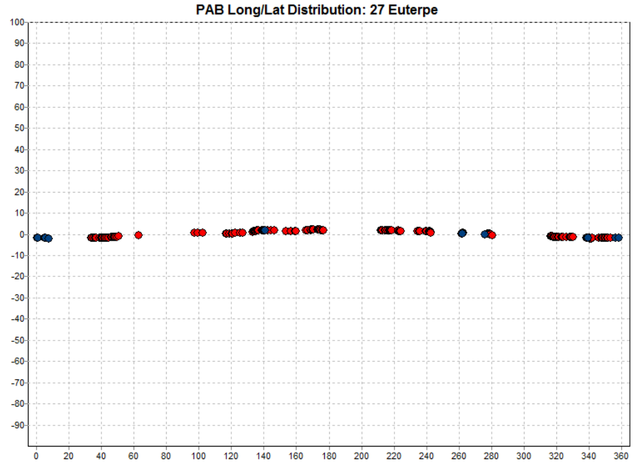

Figure 5: PAB Latitude Distribution of the dense (blue) and sparse (red) data used in the model.

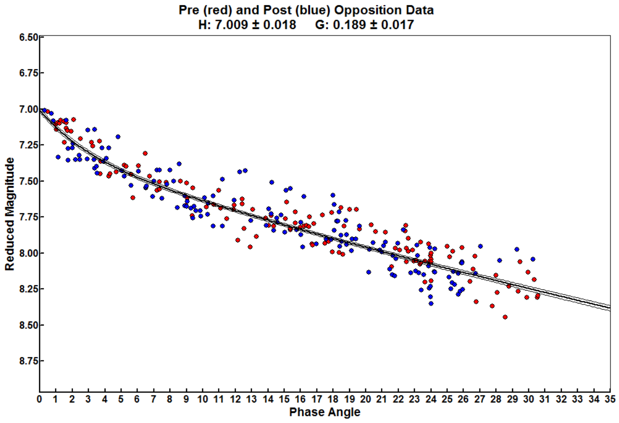

Figure 6: Phase curve of the sparse data from USNO of the Pre- (red) and Post- (blue) Opposition Data.

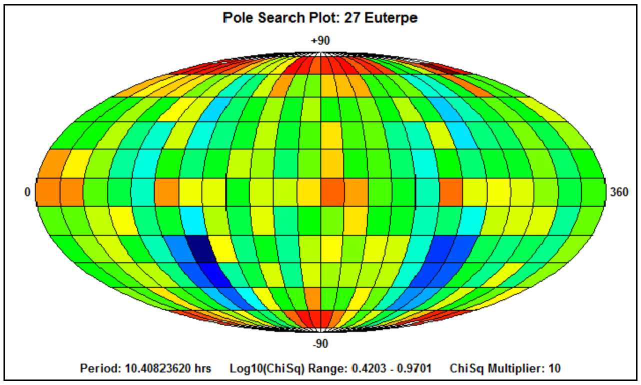

Figure 7: Plot of the log (chi-square) values. Dark blue represents the lowest chi-square value.

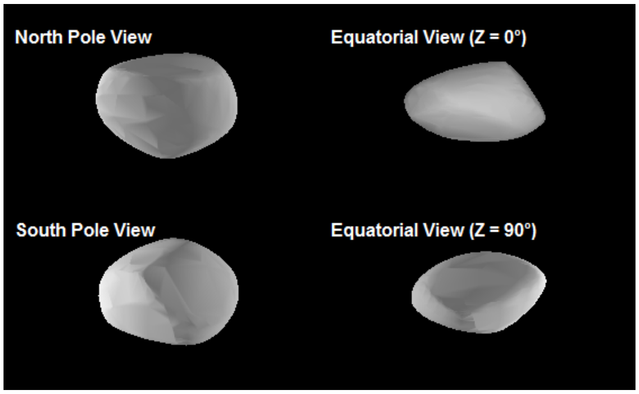

Figure 8: The shape model with the lowest chi-square value.

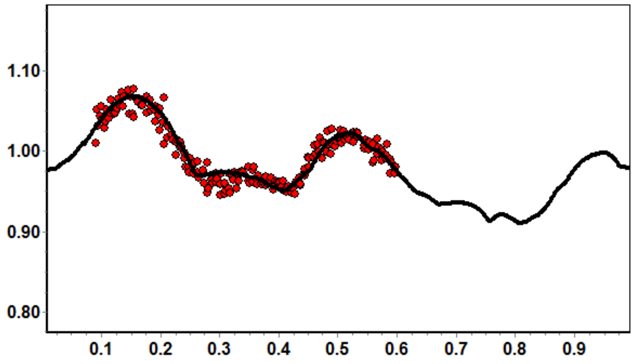

Figure 9: Fit of the data points vs. the model for 2011 August 25.

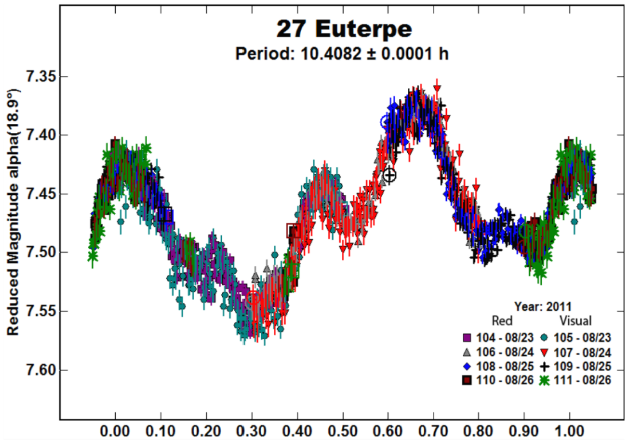

Figure 10: Plot of Cousins V and R observations with V observations zero point shifted 0.47 mag to see if any color changes due to rotational phase could be detected. None were seen to the limit of the noise.

PHOTOMETRIC OBSERVATIONS OF 596 SCHEILA, 1990 BG, 1990 TG1, 1999 CU3, 2000 DM8, 2001 PT9, 2001 SN263, 2002 NP1, 2002 JP9, 2003 UV11, 2006 AL8, 2008 SR1, 2009 BH81, 2009 QC, P/2010 A2 (LINEAR), 2010 JK33, 2010 LY63, 2010 RF12, 2010 UD, P/2010 R2 (LA SAGRA), 2010 YS, 2011 AN16, AND 2011 EZ78

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Twenty-three solar system minor bodies were measured photometrically between 2005 February and 2011 July using robotic telescopes in North America, Europe, and Australia. From the data obtained we determine for these objects their basic physical proprieties, such as Johnson-Cousins BVRI colors, H-G parameters, diameters, and a Tholen taxonomic classification. We found that 70% of our near-Earth asteroid sample belong to S-, Q-, X-, and C-complexes; 2009 BH81 may be a candidate to a new A type asteroid; 2010 RF12 is an S-type and it has absolute magnitude H = 28.46 ± 0.05, G = 0.31 ± 0.06 and D = 6 ± 1 m; the possible dust envelope around (596) Scheila and P/2010 A2 have similar colors.

The near-Earth asteroids 1990 BG, 1990 TG1, 1999 CU3, 2000 DM8, 2001 PT9, 2002 NP1, 2002 JP9, 2003 UV11, 2006 AL8, 2008 SR1, 2009 BH81, 2009 LE, 2009 QC, 2010 JK33, 2010 LY63, 2010 RF12, 2010 UD, 2010 YS, 2011 AN16, 2011 EZ78 and main belt objects 596 Scheila, P/2010 A2 (LINEAR), and P/2010 R2 (La Sagra) were observed between 2005 February and 2011 June at Australia, Spain and USA. Instrumental characteristics of telescopes used in the three observation sites are defined in Table I. Our goal in this work was to estimate, if possible, the BVRI color indices and *H* and *G* parameters. Using the asteroid’s colors, we then attempted to assign a taxonomic class based on the Tholen system.

Details about our photometric reduction and calibration procedure can be found in Betzler *et al*. (2010). An evaluation of the efficiency of our correlating color index to Tholen taxonomy was described by Ye (2011). When there is an ambiguity in the taxonomical classification, we chose the taxonomic class that is most compatible with the mean of Tholen’s class colors. Color compatibility was determined using the L1 norm, which is most robust method. Object colors and classifications are show in Table II. The *H* and/or *G* parameters were determined using an object’s mean V magnitudes taken from photometric data published in the MPEC and the FAZ routine available in *MPO Canopus*.

(596) Scheila. Dahlgren and Lagerkvist (1995) classified this main belt asteroid as an X-complex member. Larson (2010) reported a comet-like structure in observations taken at 2010 December 11.44-11.47 UT. Jewitt *et al*. (2011), based on Hubble Space Telescope (HST) observations, suggest that the observed cometary activity was the effect of a collision of Scheila with a previously unknown 35-m main belt asteroid. We observed Scheila at Mayhill (G2) at 2010 December 15.49 UT. 16 images of 30-s exposure in B, V, R, and I filters were obtained. Our colors do not agree with the colors for any Tholen taxonomic type.

1990 BG. 1999 BG was classified as S type in the SMASS II taxonomic system by Binzel *et al*. (2004). We observed this object at Mayhill (G1) at 2010 January 26.50 UT, obtaining 16 images of 60-s exposure in B, V, R and I filters. Our colors matched with a SQ type supported the previous classification.

1990 TG1. 1999 TG1 was observed at Haleakala (FTN) at 2005 February 09.36 and 16.44 UT; 12 images were obtained in B, V, and R filters. Our mean colors matched with a SQ type. Using our V magnitudes 14.85 ± 0.07 and 14.50 ± 0.01, $G = 0.2 \pm 0.1$ and $p_v = 0.20 \pm 0.07$, typical of S type asteroids (Warner *et al.*, 2009), we found $H = 14.44 \pm 0.02$ and a diameter $D = 2.43 \pm 0.02$ km. Our H is ~ 0.3 mag brighter than the $H = 14.7$ reported on the JPL Small-Body Database Browser.

1999 CU3. This object was classified as type Sl by Binzel *et al.* (2004). The asteroid has a synodic rotation period of 3.7817 h and lightcurve amplitude of 0.81-1.25 mag (Pravec *et al.*, 2005). Radar observations in 2001 revealed that 1999 CU3 is a highly-elongated and irregularly-shaped object (Benner, 2003). This asteroid was observed at Haleakala (FTN) at 2005 February 16.41 and 19.44 UT, obtaining 12 images in B, V, and R filters. Our mean colors matched with an S type. The error in V-R is greater than 10%. This could suggest a problem with the color index determination. However, our two color indexes and V magnitudes corresponding to rotational phase $\Phi = 0.27$ and 0.52 match those of Pravec *et al.* (2005). Therefore, the V-R error may mean a color variation with rotational phase. There is a reasonable hypothesis because the object has an irregular shape. Using our V magnitudes, we found $H = 16.8 \pm 0.2$ and $D = 1.28 \pm 0.09$ km. Our H value is consistent with the $H = 17.0$ reported on the JPL web site.

2000 DM8. 2000 DM8 was classified as Sq type by Binzel *et al.* (2004). We observed this object at Nerpio (G7) at 2011 February 12.97 UT. We obtained 9 images of 44-s exposure in V, R, and I filters. Our colors match a QR type supported the previous classification.

2001 PT9. We observed this object at Moorook (G9) at 2010 February 25.59 UT, obtaining 16 images of 20-s exposure in B, V, R, and I filters. Our colors match a C type.

2001 SN263. We refined our previous results (Betzler, Brum and Celedon, 2008) and found a rotation period $P = 3.202 \pm 0.003$ h and lightcurve amplitude $A = 0.19 \pm 0.03$ (Figure 1). The analysis also confirmed detections of mutual events for this trinary asteroid and the previous orbital period estimate of one of the system's components.

2002 JB9. We observed this object at Officer (G9) at 2011 June 02.50 UT and obtained 12 images of 40-s exposure in B, V, and R filters. Our colors match a B type.

2002 NP1. This object was observed at Haleakala (FTN) at 2009 July 29.48 UT. Three images in B, V, and R filters were obtained. Our colors match an RS type. Trilling *et al*. (2010) reported an albedo of $p_v = 0.25$ and $D = 0.81$ km for this object. Combining this value with our previous result, an S type classification is more appropriate for this object.

2003 UV11. 2003 UV11 was classified as Xk type by M. D. Hicks and T. Trong (see Benner, 2011a). We observed this object at Nerpio (G7) at 2010 October 27.02 and 28.89 UT and obtained 32 images of 18-s exposure in B, V, R, and I filters. Our mean colors agree with an FB type.

2006 AL6. This object was observed at 2006 February 18.50 UT at Haleakala (FTN). Three images in B, V, and R filters were obtained. Our colors do not allow us to distinguish between a C or X-complex member. We classified this object as an FX type. Also, we found V = 20.32 ± 0.01 at the time of observation. This is about 0.8 mag fainter than predicted by the Minor Planet Center (MPC) ephemerides. This result may suggest that this object has a large amplitude lightcurve or low albedo.

2008 SR1. 2008 SR1 was observed at Haleakala (FTN) at 2008 October 10.53 UT. We obtained two images in B and V filters. We found B-V = 0.739 ± 0.003 and V = 18.77 ± 0.04. This magnitude nearly agrees with the V = 18.9 from the MPC ephemerides.

2009 BH81. 2009 BH81 was observed at Haleakala (FTN) at 2009 February 27.58 UT. Three images in B, V, and R filters were obtained. Our colors match an A type.

2009 QC. The object was observed at Haleakala (FTN) at 2009 August 24.47 UT, when we obtained three images in B, V, and R filters. Our colors match an AR type.

2010 JK33. 2010 JK33 was observed at Haleakala (FTN) at 2010 June 03.36 UT, when we obtained three images in B, V, and R filters. We classify this object as an AQ type.

2010 LY63. The object was observed at Moorook (G9) at 2010 September 12.52 UT. We obtained 18 images in V, R, and I filters. Our colors match an Xc type.

2010 RF12. 2010 RF12 was observed at Siding Spring (FTS) at 2010 September 07.61 UT, when we obtained six images, divided in two consecutives sequences, using Sloan g, r, and i filters. We converted the Sloan colors (Table III) to the Johnson-Cousins photometric system using the transformation equations from Chonis and Gaskell (2008). The asteroid's mean colors matched with a SR type. Using our V magnitude estimate and mean MPC magnitudes, we found $H = 28.46 \pm 0.05$ and $G = 0.31 \pm 0.06$ (Figure 2). The G value suggests an S-type classification for this object (see Warner *et al.*, 2009). The H magnitude, combined with the S-complex typical albedo, implies $D = 6 \pm 1$ m.

2010 UD. The object was observed at Haleakala (FTN) at 2010 September 07.61 UT. Three images in B, V, and R filters were obtained. Our colors match a QV type.

2010 YS. 2010 YS was observed at Haleakala (FTN) at 2011 January 04.58 and 05.52 UT. Six images in B, V, and R filters were obtained. We classify this object as a VQ type. Assuming a Q-type, we found $D = 77 \pm 9$ m and $H = 23.1 \pm 0.3$, which agrees with JPL's $H = 22.5 \pm 0.6$.

P/2010 A2 (LINEAR). P/2010 A2 was discovery by the LINEAR survey on 2010 January 06. It was classified as a short-period comet based on the orbit and diffuse appearance (Birtwhistle *et al.*, 2010). Observations of this object revealed near nucleus structures never seen before in a comet (Jewitt and Soares-Santos, 2010; Licandro *et al.*, 2010). Jewitt *et al.* (2010), based on HST observations, suggest that observed structures are the effect of a disruption through high velocity collisions or rotational spin-up under the action of radiation torques. P/2010 A2 was observed at Haleakala (FTN) at 2010 January 22.43 UT. Three images were taken in B, V, and R filters. The object's colors are very similar to those found for 596 Scheila. We postulate that the similarity in colors is due to a similar nature of a possible dust coma around these objects.

P/2010 R2 (La Sagra). This main belt comet was observed at Haleakala (FTN) at 2010 September 19.26 UT. Two images in V and R filters were obtained. We found V-R = 0.395 ± 0.003 and V = 18.30 ± 0.06, which is close to the V = 18.4 predicted from MPC ephemerides.

2011 AN16. The object was observed at Siding Spring (FTS) at 2011 February 09.50 UT. Two images in B and V filters were obtained. We found B-V = 0.638 ± 0.002.

2011 EZ78. This object was classified as S type by M. D. Hicks (see Benner, 2011b). We observed this object at Nerpio (G7) at 2011 July 09.10 UT, obtaining 16 images of 20-s exposure in B, V, R, and I filters. Our colors match an S type, which agrees with the previous classification.

Acknowledgments

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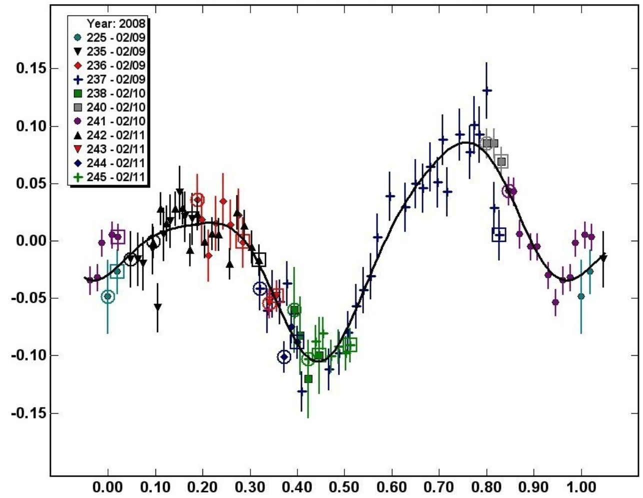

Figure 1. 2001 SN263 lightcurve adjusted in a period of 3.202h. Zero phase corresponds to HJD (LTC) 2454505.509637.

Site	Telescope	Camera
Mayhill NM,USA (GRAS G1)	12" f/11.9 Takahashi	FLI IMG1024
Mayhill NM, USA (GRAS G2)	12" f/11.9 Takahashi	SBIG ST8E
Nerpio (Spain) (GRAS G7)	CDK17 17" f/6.8	SBIG STL1100M
Moorook/Officer (Australia) (GRAS G9)	RCOS 12.5" f/6.3	SBIG ST10
Haleakala HI, USA (FTN)	2m f/10 TTL	DillCam/EM01
Siding Spring (Australia)(FTS)	2m f/10 TTL	EM03

Table I. Equipment used for observations.

Object	B-V	V-R	R-I	Tholen
1990 BG	0.8 ± 0.1	0.409 ± 0.002	0.41 ± 0.01	SQ
1990 TG1	0.82 ± 0.01	0.54 ± 0.03		SQ
1999 CU3	0.82 ± 0.05	0.49 ± 0.07		S
2000 DM8		0.430 ± 0.006	0.35 ± 0.01	QR
2001 PT9	0.70 ± 0.02	0.37 ± 0.02	0.386 ± 0.009	C
2002 JB9	0.673 ± 0.004	0.35 ± 0.01		B
2002 NP1	0.9 ± 0.1	0.54 ± 0.02		S
2003 UV11	0.63 ± 0.03	0.38 ± 0.07	0.28 ± 0.05	FB
2006 AL8	0.63 ± 0.01	0.41 ± 0.02		FX
2008 SR1	0.739 ± 0.003			
2009 BH81	1.0 ± 0.1	0.54 ± 0.02		A
2009 QC	1.03 ± 0.01	0.40 ± 0.03		AR
2010 JK33	1.24 ± 0.05	0.43 ± 0.03		AQ
2010 LY63		0.401 ± 0.005	0.380 ± 0.006	XC
2010 RF12	0.84 ± 0.04	0.46 ± 0.02	0.36 ± 0.01	S
2010 UD	0.85 ± 0.01	0.42 ± 0.03		QV
2010 YS	0.96 ± 0.05	0.38 ± 0.06		VQ
2011 AN16	0.638 ± 0.002			
2011 EZ78	0.87 ± 0.02	0.494 ± 0.003	0.428 ± 0.002	S
596 Scheila	0.520 ± 0.004	0.488 ± 0.006	0.385 ± 0.009	
P/2010 A2 (LINEAR)	0.58 ± 0.01	0.427 ± 0.008		
P/2010 R2 (La Sagra)		0.395 ± 0.003		

Table II. Summary of color indexes and taxonomic classifications

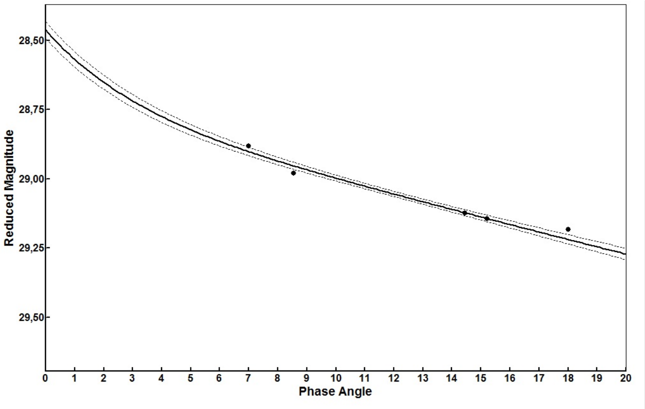

Figure 2. Plot of the reduced magnitude of 2010 RF12 versus the phase angle. The solid black line is corresponding to a curve with H= 28.46±0.05 and G=0.31±0.06.

Seq	g-r	r-i	g
1	0.63 ± 0.01	0.15 ± 0.01	17.70 ± 0.02
2	0.721 ± 0.001	0.13 ± 0.04	17.5 ± 0.1
Mean	0.68 ± 0.05	0.14 ± 0.01	X

Table III. Sloan colors and g magnitudes of 2010 RF12

MINOR PLANETS AT UNUSUALLY FAVORABLE ELONGATIONS IN 2012

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A list is presented of minor planets that are much brighter than usual at their 2012 apparitions.

The minor planets in the lists which follow will be much brighter at their 2012 apparitions than at their average distances at maximum elongation. Many years may pass before these planets will be again as bright as in 2012. Observers are encouraged to give special attention to those which lie near the limit of their equipment.

These lists have been prepared by an examination of the maximum elongation circumstances of minor planets computed by the author for all years through 2060 with a full perturbation program written by Dr. John Reed, and to whom he expresses his thanks. Elements are from *Ephemerides of Minor Planets* (1992), except that for all planets for which new or improved elements have been published subsequently in the *Minor Planet Circulars* or in electronic form, the newer elements have been used. Planetary positions are from the JPL DE-200 ephemeris, courtesy of Dr. E. Myles Standish.

Any planets whose brightest magnitudes near the time of maximum elongation vary by at least 2.0 in this interval and in 2012 will be within 0.3 of the brightest occurring, or vary by at least 3.0 and in 2012 will be within 0.5 of the brightest occurring; and which are visual magnitude 14.5 or brighter, are included. For planets brighter than visual magnitude 13.5, which are within the range of a large number of observers, these standards have been relaxed somewhat to include a larger number of planets. Magnitudes have been computed from the updated magnitude parameters published in MPC28104-28116, on 1996 Nov. 25, or more recently in the *Minor Planet Circulars*.

Oppositions may be in right ascension or in celestial longitude. Here we use still a third representation, maximum elongation from the Sun, instead of opposition. Though unconventional, it has the advantage that many close approaches do not involve actual opposition to the Sun near the time of minimum distance and greatest brightness and are missed by an opposition-based program. Other data are also provided according to the following tabular listings: minor planet number, date of maximum elongation from the Sun in format yyyy/mm/dd, maximum elongation in degrees, right ascension on date of maximum elongation, declination on date of maximum elongation, both in J2000 coordinates, date of brightest magnitude in format yyyy/mm/dd, brightest magnitude, date of minimum distance in format yyyy/mm/dd, and minimum distance in AU.

Users should note that when the maximum elongation is about 177° or greater, the brightest magnitude is sharply peaked due to enhanced brightening near zero phase angle. Even as near as 10 days before or after minimum magnitude the magnitude is generally about 0.4 greater. This effect takes place in greater time interval for smaller maximum elongations. There is some interest in very small minimum phase angles. For maximum elongations E near 180° at Earth distance Δ, an approximate formula for the minimum phase angle ϕ is $\phi = (180° - E)/(\Delta + 1)$.

Six numbered Earth approachers will be making approaches within 0.122 AU to Earth or closer. Their numbers and names, dates of brightest magnitude in the year 2012, and brightest magnitude are: 4179 Toutatis 12/16 10.5; 4183 Cuno 05/31 12.2; (136993) 1998 ST49 10/15 13.6; (153958) 2002 AM31 07/18 13.7; (162421) 2000 ET70 02/20 13.3; and (214869) 2007 PA8 11/02 11.5. For 4179 Toutatis this is the last of a series of close approaches beginning with discovery in 1989. The next will not occur until 2069 Nov. 6 at 0.020 AU.

Table I. Numerical Sequence of Favorable Elongations

Planet	Max Elon D	Max E	RA	Dec	Br Mag D	Br Mag	Min Dist D	Min Dist
1	2012/12/18	178.1°	5h45m	+25°	2012/12/18	6.7	2012/12/20	1.684
5	2012/03/11	174.9°	11h37m	+ 7°	2012/03/11	9.0	2012/03/08	1.141
11	2012/09/03	175.1°	22h57m	-11°	2012/09/03	8.9	2012/08/31	1.215
17	2012/08/05	178.5°	21h 6m	-18°	2012/08/05	10.1	2012/07/31	1.225
59	2012/09/30	175.4°	0h36m	- 0°	2012/09/30	10.8	2012/09/30	1.402
67	2012/07/21	167.8°	19h53m	- 8°	2012/07/21	10.2	2012/07/22	0.976
85	2012/10/11	178.1°	1h 4m	+ 8°	2012/10/11	10.1	2012/10/04	1.284
95	2012/10/29	170.1°	1h57m	+22°	2012/10/29	11.3	2012/10/28	1.620
96	2012/02/10	179.4°	9h32m	+15°	2012/02/10	11.0	2012/02/13	1.684
116	2012/04/08	175.7°	13h15m	- 3°	2012/04/08	10.8	2012/04/05	1.447
138	2012/06/13	177.2°	17h26m	-26°	2012/06/13	10.9	2012/06/19	1.150
141	2012/08/17	177.7°	21h44m	-11°	2012/08/17	10.6	2012/08/23	1.234
162	2012/02/12	170.4°	9h54m	+22°	2012/02/12	12.1	2012/02/14	1.506
183	2012/12/19	134.6°	5h16m	-21°	2012/12/08	12.2	2012/12/04	1.050
234	2012/08/12	176.9°	21h22m	-12°	2012/08/12	10.1	2012/08/15	0.807
236	2012/09/20	178.0°	23h49m	+ 0°	2012/09/20	10.7	2012/09/20	1.272
295	2012/10/23	175.7°	1h47m	+15°	2012/10/23	13.0	2012/10/26	1.379
347	2012/02/27	159.9°	11h13m	+26°	2012/02/28	11.7	2012/02/29	1.229
352	2012/12/02	179.5°	4h37m	+21°	2012/12/02	11.4	2012/11/27	0.933
359	2012/10/03	179.1°	0h36m	+ 4°	2012/10/03	11.4	2012/09/29	1.339
360	2012/01/12	173.0°	7h25m	+14°	2012/01/11	11.9	2012/01/07	1.624
368	2012/08/30	167.6°	22h15m	+ 2°	2012/08/29	13.2	2012/08/26	1.478
430	2012/11/25	177.1°	4h 3m	+23°	2012/11/25	12.4	2012/11/26	1.131
431	2012/07/13	179.6°	19h30m	-21°	2012/07/13	12.0	2012/07/17	1.671
433	2012/02/10	148.3°	10h19m	-15°	2012/02/03	8.5	2012/01/31	0.179
492	2012/10/01	178.3°	0h35m	+ 2°	2012/10/01	13.1	2012/09/27	1.626
499	2012/11/05	178.3°	2h39m	+17°	2012/11/05	13.8	2012/11/07	2.245
518	2012/10/20	179.0°	1h44m	+10°	2012/10/20	13.2	2012/10/11	1.199
521	2012/12/15	177.9°	5h33m	+21°	2012/12/15	10.2	2012/12/08	1.068
544	2012/08/02	176.6°	20h50m	-14°	2012/08/02	12.3	2012/07/29	1.217
555	2012/01/09	178.4°	7h18m	+20°	2012/01/09	14.1	2012/01/11	1.743
585	2012/02/15	172.0°	9h41m	+ 5°	2012/02/15	12.7	2012/02/16	1.137
596	2012/05/31	179.5°	16h32m	-21°	2012/05/31	11.7	2012/05/31	1.432
597	2012/10/09	172.0°	1h10m	- 1°	2012/10/09	12.2	2012/10/05	1.339
601	2012/09/09	178.8°	23h10m	- 3°	2012/09/09	13.3	2012/09/07	1.824
602	2012/08/30	177.2°	22h33m	- 6°	2012/08/30	11.2	2012/09/04	1.431
612	2012/09/18	161.9°	23h 6m	+13°	2012/09/16	14.4	2012/09/12	1.422
620	2012/08/24	172.8°	22h23m	-17°	2012/08/24	13.5	2012/08/24	1.105
625	2012/08/31	167.6°	23h 4m	-19°	2012/08/30	12.2	2012/08/28	1.062
629	2012/01/21	171.6°	8h22m	+28°	2012/01/21	13.5	2012/01/22	1.677
704	2012/11/15	159.6°	2h54m	+37°	2012/11/14	9.9	2012/11/11	1.709
711	2012/06/26	166.5°	18h22m	-36°	2012/06/27	13.3	2012/06/30	0.817
748	2012/11/11	178.0°	3h 7m	+19°	2012/11/12	13.5	2012/11/14	2.316
756	2012/05/12	166.2°	15h36m	- 5°	2012/05/11	13.4	2012/05/11	1.755
760	2012/03/28	167.2°	12h11m	-15°	2012/03/27	11.2	2012/03/26	1.459
767	2012/08/31	176.1°	22h47m	-11°	2012/08/31	13.2	2012/08/31	1.574
787	2012/09/17	175.6°	23h33m	+ 1°	2012/09/17	12.5	2012/09/13	1.283
882	2012/11/22	177.0°	3h47m	+22°	2012/11/21	13.3	2012/11/15	1.405
889	2012/10/26	163.9°	2h28m	- 2°	2012/10/27	13.1	2012/10/28	0.987
923	2012/09/24	172.1°	23h49m	+ 7°	2012/09/24	13.9	2012/09/28	1.179
930	2012/08/25	175.1°	22h20m	-15°	2012/08/25	13.5	2012/08/22	1.093
960	2012/10/08	175.0°	0h49m	+10°	2012/10/08	14.5	2012/10/02	0.935
999	2012/10/23	178.2°	1h48m	+12°	2012/10/22	13.3	2012/10/15	1.171
1013	2012/01/20	158.2°	8h28m	+41°	2012/01/20	12.8	2012/01/21	1.184
1052	2012/12/07	176.2°	5h 0m	+18°	2012/12/07	13.6	2012/12/03	0.983
1060	2012/08/10	166.6°	21h 3m	- 2°	2012/08/09	14.0	2012/08/06	0.792
1083	2012/12/02	178.2°	4h36m	+20°	2012/12/02	14.2	2012/12/07	0.996
1088	2012/11/27	177.0°	4h11m	+24°	2012/11/26	12.7	2012/11/18	0.892
1096	2012/08/05	165.7°	21h23m	-30°	2012/08/05	12.7	2012/08/06	1.117
1116	2012/12/29	152.0°	6h41m	+51°	2012/12/28	12.8	2012/12/26	1.351
1130	2012/07/21	175.2°	20h 1m	-15°	2012/07/22	13.3	2012/07/26	0.815
1131	2012/07/18	177.9°	19h52m	-22°	2012/07/18	13.7	2012/07/31	0.713
1180	2012/07/22	174.5°	20h14m	-25°	2012/07/22	13.8	2012/07/22	2.343
1198	2012/08/12	173.0°	21h21m	- 8°	2012/08/13	14.5	2012/08/21	0.514
1240	2012/08/25	177.2°	22h15m	- 7°	2012/08/25	12.5	2012/08/26	1.381
1267	2012/08/31	173.4°	22h50m	-14°	2012/08/31	14.3	2012/08/24	1.116
1299	2012/09/15	178.2°	23h38m	- 4°	2012/09/16	14.5	2012/09/21	1.550
1301	2012/02/19	162.1°	9h26m	- 3°	2012/02/17	13.4	2012/02/13	1.167
1310	2012/09/26	174.9°	0h 6m	+ 6°	2012/09/27	13.2	2012/10/10	0.959
1319	2012/06/18	179.1°	17h48m	-22°	2012/06/18	14.2	2012/06/12	1.532
1346	2012/09/06	178.9°	22h58m	- 5°	2012/09/06	14.0	2012/09/12	1.404
1360	2012/08/12	170.5°	21h35m	-24°	2012/08/11	13.6	2012/08/04	1.243
1369	2012/10/03	176.1°	0h46m	+ 0°	2012/10/03	14.3	2012/09/25	1.725
1456	2012/09/14	163.9°	23h 3m	+11°	2012/09/13	14.4	2012/09/12	1.551
1473	2012/08/21	154.7°	21h24m	+11°	2012/08/23	14.1	2012/08/24	1.026

Planet	Max Elon D	Max E	RA	Dec	Br Mag D	Br Mag	Min Dist D	Min Dist
1474	2012/09/02	147.2°	23h 8m	+24°	2012/09/16	13.8	2012/09/25	0.646
1508	2012/11/03	143.8°	2h42m	+51°	2012/11/15	14.2	2012/11/21	0.926
1527	2012/09/27	177.6°	0h18m	- 0°	2012/09/26	13.4	2012/09/18	0.863
1545	2012/03/10	175.2°	11h31m	+ 8°	2012/03/10	14.1	2012/03/06	1.169
1554	2012/09/12	162.5°	22h47m	+11°	2012/09/11	14.3	2012/09/11	1.114
1560	2012/09/11	169.9°	23h 3m	+ 4°	2012/09/12	14.0	2012/09/15	1.183
1606	2012/10/14	177.2°	1h22m	+ 5°	2012/10/13	13.9	2012/10/02	0.992
1650	2012/04/24	178.5°	14h13m	-11°	2012/04/25	13.5	2012/05/01	1.100
1660	2012/01/29	134.9°	7h52m	-25°	2012/01/30	13.7	2012/01/31	0.827
1694	2012/10/24	172.1°	1h49m	+19°	2012/10/23	12.7	2012/10/18	0.810
1789	2012/08/13	177.2°	21h37m	-17°	2012/08/13	14.0	2012/08/11	0.786
1817	2012/06/07	165.5°	16h50m	- 8°	2012/06/06	13.7	2012/06/04	0.941
1928	2012/08/20	174.9°	21h50m	- 7°	2012/08/20	14.4	2012/08/21	0.976
1945	2012/10/02	174.3°	0h42m	- 1°	2012/10/01	14.4	2012/09/26	1.146
2006	2012/10/14	176.2°	1h15m	+11°	2012/10/14	13.9	2012/10/14	0.880
2093	2012/05/26	167.2°	16h22m	- 8°	2012/05/27	14.3	2012/05/31	0.913
2341	2012/10/31	176.6°	2h27m	+10°	2012/10/31	13.8	2012/10/31	0.889
2374	2012/09/07	178.7°	23h 5m	- 7°	2012/09/07	14.4	2012/09/08	1.465
2393	2012/08/24	164.1°	21h51m	+ 3°	2012/08/24	14.1	2012/08/24	1.628
2397	2012/11/23	163.4°	4h 9m	+ 4°	2012/11/24	14.4	2012/11/25	1.595
2467	2012/08/10	178.0°	21h17m	-13°	2012/08/10	14.2	2012/08/10	0.850
2583	2012/10/20	174.7°	1h46m	+ 5°	2012/10/19	14.2	2012/10/13	0.822
2763	2012/10/08	173.3°	0h44m	+12°	2012/10/07	14.2	2012/10/01	0.934
2820	2012/10/06	177.5°	0h45m	+ 7°	2012/10/06	14.1	2012/10/05	0.870
2890	2012/10/16	173.7°	1h19m	+15°	2012/10/16	14.5	2012/10/18	0.926
2950	2012/01/12	179.6°	7h34m	+21°	2012/01/12	14.4	2012/01/03	1.322
3178	2012/02/06	164.6°	8h59m	+ 0°	2012/02/04	13.0	2012/02/02	0.733
3322	2012/12/01	178.4°	4h27m	+23°	2012/12/01	14.0	2012/12/06	0.990
3554	2012/03/27	151.1°	12h47m	-31°	2012/03/29	14.4	2012/04/01	0.258
3712	2012/01/03	171.8°	6h46m	+30°	2012/01/03	13.8	2012/01/07	1.112
3813	2012/08/23	178.2°	22h 6m	- 9°	2012/08/22	14.3	2012/08/18	0.812
3879	2012/09/19	168.3°	23h32m	+ 9°	2012/09/18	14.4	2012/09/16	0.754
3920	2012/09/02	163.7°	23h21m	-21°	2012/09/03	14.0	2012/09/05	0.658
3998	2012/12/02	167.4°	4h26m	+34°	2012/12/02	14.4	2012/12/03	0.864
4179	2012/12/30	171.3°	6h 1m	+21°	2012/12/16	10.5	2012/12/12	0.046
4183	2012/06/24	168.7°	17h55m	-33°	2012/05/31	12.3	2012/05/20	0.122
4201	2012/05/07	177.1°	14h54m	-19°	2012/05/07	14.1	2012/05/12	1.469
4222	2012/10/31	178.2°	2h26m	+12°	2012/10/31	13.0	2012/11/06	0.711
4332	2012/09/01	174.2°	22h30m	- 3°	2012/09/02	13.1	2012/09/07	0.809
4352	2012/11/21	176.7°	3h51m	+16°	2012/11/21	14.1	2012/11/20	1.224
4460	2012/08/09	170.9°	21h21m	-24°	2012/08/09	14.2	2012/08/12	1.491
4608	2012/09/29	175.5°	0h15m	+ 6°	2012/09/29	14.4	2012/10/05	0.921
4613	2012/11/11	165.9°	3h24m	+ 4°	2012/11/11	13.4	2012/11/08	0.881
4724	2012/06/07	173.9°	17h 0m	-16°	2012/06/07	14.4	2012/06/13	0.823
4769	2012/08/07	169.5°	21h17m	-26°	2012/08/16	14.1	2012/08/28	0.114
4842	2012/07/28	174.8°	20h25m	-13°	2012/07/28	14.5	2012/07/27	0.886
5133	2012/08/22	160.3°	22h42m	-29°	2012/08/24	14.2	2012/08/27	1.207
5234	2012/11/01	173.9°	2h14m	+19°	2012/11/01	14.1	2012/11/01	1.318
5275	2012/09/28	168.2°	23h58m	+12°	2012/09/27	14.3	2012/09/21	0.664
5391	2012/06/30	175.2°	18h41m	-27°	2012/07/01	14.3	2012/07/10	0.781
5559	2012/06/07	172.7°	16h59m	-15°	2012/06/07	13.9	2012/06/10	0.832
5619	2012/09/09	170.5°	22h49m	+ 2°	2012/09/08	14.4	2012/09/04	1.101
5646	2012/11/23	163.7°	3h40m	+36°	2012/11/09	14.4	2012/10/07	0.444
6000	2012/09/23	158.4°	0h30m	-20°	2012/09/23	14.1	2012/09/23	1.161
6113	2012/08/04	179.6°	21h 0m	-17°	2012/08/04	14.5	2012/08/03	1.115
6193	2012/06/23	169.3°	18h 8m	-34°	2012/06/23	14.1	2012/06/20	0.889
6455	2012/10/23	127.4°	23h36m	-29°	2012/10/07	14.2	2012/10/02	0.437
7534	2012/08/21	169.6°	22h22m	-21°	2012/08/20	14.5	2012/08/14	0.754
8278	2012/05/29	177.3°	16h25m	-24°	2012/05/29	14.3	2012/05/28	1.273
16403	2012/10/05	170.9°	0h54m	- 3°	2012/10/05	14.1	2012/10/06	0.861
19774	2012/04/28	160.7°	13h49m	-31°	2012/04/28	14.5	2012/04/29	1.049
20789	2012/12/14	174.1°	5h31m	+29°	2012/12/14	14.5	2012/12/13	0.954
27174	2012/02/03	171.5°	9h14m	+24°	2012/02/02	14.5	2012/01/27	1.068
28913	2012/02/03	179.5°	9h 3m	+16°	2012/02/03	14.2	2012/02/05	0.949
47035	2012/02/15	128.3°	9h42m	+64°	2012/01/31	14.5	2012/01/29	0.852
136993	2012/10/10	151.6°	23h59m	-16°	2012/10/15	13.6	2012/10/18	0.074
153958	2012/06/14	156.6°	18h10m	- 1°	2012/07/18	13.7	2012/07/22	0.035
162421	2012/02/21	137.5°	11h57m	-23°	2012/02/20	13.3	2012/02/19	0.046
214869	2012/10/02	172.1°	0h55m	- 2°	2012/11/02	11.5	2012/11/05	0.043

Table II. Temporal Sequence of Favorable Elongations

Planet	Max Elon D	Max E	RA	Dec	Br Mag D	Br Mag	Min Dist D	Min Dist
3712	2012/01/03	171.8°	6h46m	+30°	2012/01/03	13.8	2012/01/07	1.112
555	2012/01/09	178.4°	7h18m	+20°	2012/01/09	14.1	2012/01/11	1.743
360	2012/01/12	173.0°	7h25m	+14°	2012/01/11	11.9	2012/01/07	1.624
2950	2012/01/12	179.6°	7h34m	+21°	2012/01/12	14.4	2012/01/03	1.322
1013	2012/01/20	158.2°	8h28m	+41°	2012/01/20	12.8	2012/01/21	1.184
629	2012/01/21	171.6°	8h22m	+28°	2012/01/21	13.5	2012/01/22	1.677
1660	2012/01/29	134.9°	7h52m	-25°	2012/01/30	13.7	2012/01/31	0.827
27174	2012/02/03	171.5°	9h14m	+24°	2012/02/02	14.5	2012/01/27	1.068
28913	2012/02/03	179.5°	9h 3m	+16°	2012/02/03	14.2	2012/02/05	0.949
3178	2012/02/06	164.6°	8h59m	+ 0°	2012/02/04	13.0	2012/02/02	0.733
96	2012/02/10	179.4°	9h32m	+15°	2012/02/10	11.0	2012/02/13	1.684
433	2012/02/10	148.3°	10h19m	-15°	2012/02/03	8.5	2012/01/31	0.179
162	2012/02/12	170.4°	9h54m	+22°	2012/02/12	12.1	2012/02/14	1.506
585	2012/02/15	172.0°	9h41m	+ 5°	2012/02/15	12.7	2012/02/16	1.137
47035	2012/02/15	128.3°	9h42m	+64°	2012/01/31	14.5	2012/01/29	0.852
1301	2012/02/19	162.1°	9h26m	- 3°	2012/02/17	13.4	2012/02/13	1.167
162421	2012/02/21	137.5°	11h57m	-23°	2012/02/20	13.3	2012/02/19	0.046
347	2012/02/27	159.9°	11h13m	+26°	2012/02/28	11.7	2012/02/29	1.229
1545	2012/03/10	175.2°	11h31m	+ 8°	2012/03/10	14.1	2012/03/06	1.169
5	2012/03/11	174.9°	11h37m	+ 7°	2012/03/11	9.0	2012/03/08	1.141
3554	2012/03/27	151.1°	12h47m	-31°	2012/03/29	14.4	2012/04/01	0.258
760	2012/03/28	167.2°	12h11m	-15°	2012/03/27	11.2	2012/03/26	1.459
116	2012/04/08	175.7°	13h15m	- 3°	2012/04/08	10.8	2012/04/05	1.447
1650	2012/04/24	178.5°	14h13m	-11°	2012/04/25	13.5	2012/05/01	1.100
19774	2012/04/28	160.7°	13h49m	-31°	2012/04/28	14.5	2012/04/29	1.049
4201	2012/05/07	177.1°	14h54m	-19°	2012/05/07	14.1	2012/05/12	1.469
756	2012/05/12	166.2°	15h36m	- 5°	2012/05/11	13.4	2012/05/11	1.755
2093	2012/05/26	167.2°	16h22m	- 8°	2012/05/27	14.3	2012/05/31	0.913
8278	2012/05/29	177.3°	16h25m	-24°	2012/05/29	14.3	2012/05/28	1.273
596	2012/05/31	179.5°	16h32m	-21°	2012/05/31	11.7	2012/05/31	1.432
1817	2012/06/07	165.5°	16h50m	- 8°	2012/06/06	13.7	2012/06/04	0.941
4724	2012/06/07	173.9°	17h 0m	-16°	2012/06/07	14.4	2012/06/13	0.823
5559	2012/06/07	172.7°	16h59m	-15°	2012/06/07	13.9	2012/06/10	0.832
138	2012/06/13	177.2°	17h26m	-26°	2012/06/13	10.9	2012/06/19	1.150
153958	2012/06/14	156.6°	18h10m	- 1°	2012/07/18	13.7	2012/07/22	0.035
1319	2012/06/18	179.1°	17h48m	-22°	2012/06/18	14.2	2012/06/12	1.532
6193	2012/06/23	169.3°	18h 8m	-34°	2012/06/23	14.1	2012/06/20	0.889
4183	2012/06/24	168.7°	17h55m	-33°	2012/05/31	12.3	2012/05/20	0.122
711	2012/06/26	166.5°	18h22m	-36°	2012/06/27	13.3	2012/06/30	0.817
5391	2012/06/30	175.2°	18h41m	-27°	2012/07/01	14.3	2012/07/10	0.781
431	2012/07/13	179.6°	19h30m	-21°	2012/07/13	12.0	2012/07/17	1.671
1131	2012/07/18	177.9°	19h52m	-22°	2012/07/18	13.7	2012/07/31	0.713
67	2012/07/21	167.8°	19h53m	- 8°	2012/07/21	10.2	2012/07/22	0.976
1130	2012/07/21	175.2°	20h 1m	-15°	2012/07/22	13.3	2012/07/26	0.815
1180	2012/07/22	174.5°	20h14m	-25°	2012/07/22	13.8	2012/07/22	2.343
4842	2012/07/28	174.8°	20h25m	-13°	2012/07/28	14.5	2012/07/27	0.886
544	2012/08/02	176.6°	20h50m	-14°	2012/08/02	12.3	2012/07/29	1.217
6113	2012/08/04	179.6°	21h 0m	-17°	2012/08/04	14.5	2012/08/03	1.115
17	2012/08/05	178.5°	21h 6m	-18°	2012/08/05	10.1	2012/07/31	1.225
1096	2012/08/05	165.7°	21h23m	-30°	2012/08/05	12.7	2012/08/06	1.117
4769	2012/08/07	169.5°	21h17m	-26°	2012/08/16	14.1	2012/08/28	0.114
4460	2012/08/09	170.9°	21h21m	-24°	2012/08/09	14.2	2012/08/12	1.491
1060	2012/08/10	166.6°	21h 3m	- 2°	2012/08/09	14.0	2012/08/06	0.792
2467	2012/08/10	178.0°	21h17m	-13°	2012/08/10	14.2	2012/08/10	0.850
234	2012/08/12	176.9°	21h22m	-12°	2012/08/12	10.1	2012/08/15	0.807
1198	2012/08/12	173.0°	21h21m	- 8°	2012/08/13	14.5	2012/08/21	0.514
1360	2012/08/12	170.5°	21h35m	-24°	2012/08/11	13.6	2012/08/04	1.243
1789	2012/08/13	177.2°	21h37m	-17°	2012/08/13	14.0	2012/08/11	0.786
141	2012/08/17	177.7°	21h44m	-11°	2012/08/17	10.6	2012/08/23	1.234
1928	2012/08/20	174.9°	21h50m	- 7°	2012/08/20	14.4	2012/08/21	0.976
1473	2012/08/21	154.7°	21h24m	+11°	2012/08/23	14.1	2012/08/24	1.026
7534	2012/08/21	169.6°	22h22m	-21°	2012/08/20	14.5	2012/08/14	0.754
5133	2012/08/22	160.3°	22h42m	-29°	2012/08/24	14.2	2012/08/27	1.207
3813	2012/08/23	178.2°	22h 6m	- 9°	2012/08/22	14.3	2012/08/18	0.812
620	2012/08/24	172.8°	22h23m	-17°	2012/08/24	13.5	2012/08/24	1.105
2393	2012/08/24	164.1°	21h51m	+ 3°	2012/08/24	14.1	2012/08/24	1.628
930	2012/08/25	175.1°	22h20m	-15°	2012/08/25	13.5	2012/08/22	1.093
1240	2012/08/25	177.2°	22h15m	- 7°	2012/08/25	12.5	2012/08/26	1.381
368	2012/08/30	167.6°	22h15m	+ 2°	2012/08/29	13.2	2012/08/26	1.478
602	2012/08/30	177.2°	22h33m	- 6°	2012/08/30	11.2	2012/09/04	1.431
625	2012/08/31	167.6°	23h 4m	-19°	2012/08/30	12.2	2012/08/28	1.062
767	2012/08/31	176.1°	22h47m	-11°	2012/08/31	13.2	2012/08/31	1.574
1267	2012/08/31	173.4°	22h50m	-14°	2012/08/31	14.3	2012/08/24	1.116
4332	2012/09/01	174.2°	22h30m	- 3°	2012/09/02	13.1	2012/09/07	0.809
1474	2012/09/02	147.2°	23h 8m	+24°	2012/09/16	13.8	2012/09/25	0.646
3920	2012/09/02	163.7°	23h21m	-21°	2012/09/03	14.0	2012/09/05	0.658
11	2012/09/03	175.1°	22h57m	-11°	2012/09/03	8.9	2012/08/31	1.215
1346	2012/09/06	178.9°	22h58m	- 5°	2012/09/06	14.0	2012/09/12	1.404
2374	2012/09/07	178.7°	23h 5m	- 7°	2012/09/07	14.4	2012/09/08	1.465
601	2012/09/09	178.8°	23h10m	- 3°	2012/09/09	13.3	2012/09/07	1.824
5619	2012/09/09	170.5°	22h49m	+ 2°	2012/09/08	14.4	2012/09/04	1.101
1560	2012/09/11	169.9°	23h 3m	+ 4°	2012/09/12	14.0	2012/09/15	1.183
1554	2012/09/12	162.5°	22h47m	+11°	2012/09/11	14.3	2012/09/11	1.114
1456	2012/09/14	163.9°	23h 3m	+11°	2012/09/13	14.4	2012/09/12	1.551
1299	2012/09/15	178.2°	23h38m	- 4°	2012/09/16	14.5	2012/09/21	1.550
787	2012/09/17	175.6°	23h33m	+ 1°	2012/09/17	12.5	2012/09/13	1.283
612	2012/09/18	161.9°	23h 6m	+13°	2012/09/16	14.4	2012/09/12	1.422
3879	2012/09/19	168.3°	23h32m	+ 9°	2012/09/18	14.4	2012/09/16	0.754
236	2012/09/20	178.0°	23h49m	+ 0°	2012/09/20	10.7	2012/09/20	1.272
6000	2012/09/23	158.4°	0h30m	-20°	2012/09/23	14.1	2012/09/23	1.161
923	2012/09/24	172.1°	23h49m	+ 7°	2012/09/24	13.9	2012/09/28	1.179
1310	2012/09/26	174.9°	0h 6m	+ 6°	2012/09/27	13.2	2012/10/10	0.959
1527	2012/09/27	177.6°	0h18m	- 0°	2012/09/26	13.4	2012/09/18	0.863
5275	2012/09/28	168.2°	23h58m	+12°	2012/09/27	14.3	2012/09/21	0.664
4608	2012/09/29	175.5°	0h15m	+ 6°	2012/09/29	14.4	2012/10/05	0.921
59	2012/09/30	175.4°	0h36m	- 0°	2012/09/30	10.8	2012/09/30	1.402
492	2012/10/01	178.3°	0h35m	+ 2°	2012/10/01	13.1	2012/09/27	1.626
1945	2012/10/02	174.3°	0h42m	- 1°	2012/10/01	14.4	2012/09/26	1.146
214869	2012/10/02	172.1°	0h55m	- 2°	2012/11/02	11.5	2012/11/05	0.043
359	2012/10/03	179.1°	0h36m	+ 4°	2012/10/03	11.4	2012/09/29	1.339
1369	2012/10/03	176.1°	0h46m	+ 0°	2012/10/03	14.3	2012/09/25	1.725
16403	2012/10/05	170.9°	0h54m	- 3°	2012/10/05	14.1	2012/10/06	0.861
2820	2012/10/06	177.5°	0h45m	+ 7°	2012/10/06	14.1	2012/10/05	0.870
960	2012/10/08	175.0°	0h49m	+10°	2012/10/08	14.5	2012/10/02	0.935
2763	2012/10/08	173.3°	0h44m	+12°	2012/10/07	14.2	2012/10/01	0.934
597	2012/10/09	172.0°	1h10m	- 1°	2012/10/09	12.2	2012/10/05	1.339
136993	2012/10/10	151.6°	23h59m	-16°	2012/10/15	13.6	2012/10/18	0.074
85	2012/10/11	178.1°	1h 4m	+ 8°	2012/10/11	10.1	2012/10/04	1.284
1606	2012/10/14	177.2°	1h22m	+ 5°	2012/10/13	13.9	2012/10/02	0.992
2006	2012/10/14	176.2°	1h15m	+11°	2012/10/14	13.9	2012/10/14	0.880
2890	2012/10/16	173.7°	1h19m	+15°	2012/10/16	14.5	2012/10/18	0.926
518	2012/10/20	179.0°	1h44m	+10°	2012/10/20	13.2	2012/10/11	1.199
2583	2012/10/20	174.7°	1h46m	+ 5°	2012/10/19	14.2	2012/10/13	0.822
295	2012/10/23	175.7°	1h47m	+15°	2012/10/23	13.0	2012/10/26	1.379
999	2012/10/23	178.2°	1h48m	+12°	2012/10/22	13.3	2012/10/15	1.171

Planet	Max Elon	D Max E	RA	Dec	Br Mag	D Br Mag	Min Dist	D Min Dist
6455	2012/10/23	127.4°	23h36m	-29°	2012/10/07	14.2	2012/10/02	0.437
1694	2012/10/24	172.1°	1h49m	+19°	2012/10/23	12.7	2012/10/18	0.810
889	2012/10/26	163.9°	2h28m	- 2°	2012/10/27	13.1	2012/10/28	0.987
95	2012/10/29	170.1°	1h57m	+22°	2012/10/29	11.3	2012/10/28	1.620
2341	2012/10/31	176.6°	2h27m	+10°	2012/10/31	13.8	2012/10/31	0.889
4222	2012/10/31	178.2°	2h26m	+12°	2012/10/31	13.0	2012/11/06	0.711
5234	2012/11/01	173.9°	2h14m	+19°	2012/11/01	14.1	2012/11/01	1.318
1508	2012/11/03	143.8°	2h42m	+51°	2012/11/15	14.2	2012/11/21	0.926
499	2012/11/05	178.3°	2h39m	+17°	2012/11/05	13.8	2012/11/07	2.245
748	2012/11/11	178.0°	3h 7m	+19°	2012/11/12	13.5	2012/11/14	2.316
4613	2012/11/11	165.9°	3h24m	+ 4°	2012/11/11	13.4	2012/11/08	0.881
704	2012/11/15	159.6°	2h54m	+37°	2012/11/14	9.9	2012/11/11	1.709
4352	2012/11/21	176.7°	3h51m	+16°	2012/11/21	14.1	2012/11/20	1.224
882	2012/11/22	177.0°	3h47m	+22°	2012/11/21	13.3	2012/11/15	1.405
2397	2012/11/23	163.4°	4h 9m	+ 4°	2012/11/24	14.4	2012/11/25	1.595
5646	2012/11/23	163.7°	3h40m	+36°	2012/11/09	14.4	2012/10/07	0.444
430	2012/11/25	177.1°	4h 3m	+23°	2012/11/25	12.4	2012/11/26	1.131
1088	2012/11/27	177.0°	4h11m	+24°	2012/11/26	12.7	2012/11/18	0.892
3322	2012/12/01	178.4°	4h27m	+23°	2012/12/01	14.0	2012/12/06	0.990
352	2012/12/02	179.5°	4h37m	+21°	2012/12/02	11.4	2012/11/27	0.933
1083	2012/12/02	178.2°	4h36m	+20°	2012/12/02	14.2	2012/12/07	0.996
3998	2012/12/02	167.4°	4h26m	+34°	2012/12/02	14.4	2012/12/03	0.864
1052	2012/12/07	176.2°	5h 0m	+18°	2012/12/07	13.6	2012/12/03	0.983
20789	2012/12/14	174.1°	5h31m	+29°	2012/12/14	14.5	2012/12/13	0.954
521	2012/12/15	177.9°	5h33m	+21°	2012/12/15	10.2	2012/12/08	1.068
1	2012/12/18	178.1°	5h45m	+25°	2012/12/18	6.7	2012/12/20	1.684
183	2012/12/19	134.6°	5h16m	-21°	2012/12/08	12.2	2012/12/04	1.050
1116	2012/12/29	152.0°	6h41m	+51°	2012/12/28	12.8	2012/12/26	1.351
4179	2012/12/30	171.3°	6h 1m	+21°	2012/12/16	10.5	2012/12/12	0.046

ROTATION PERIOD DETERMINATION FOR 668 DORA

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For previously unstudied 668 Dora a rotation period of 22.914 ± 0.001 hours and amplitude 0.19 ± 0.02 magnitude have been found.

Minor planet 668 Dora was selected for observation because Harris et al. (2011) show no previous photometric observations and because at its 2011 August opposition it was considerably brighter than at any time for the next several years. Authors Pilcher and Durkee began observations independently. Author Martinez kindly offered to collaborate with Pilcher beginning in late August after Pilcher had lost many nights due to clouds and was having difficulty finding the period. Martinez offered helpful advice to find a definitive period and contributed several additional lightcurves to provide full phase coverage. When Pilcher and Durkee learned of each other's work, they agreed to share data and publish jointly.

Observations by Pilcher were made at the Organ Mesa Observatory with a Meade 35 cm LX200 GPS S-C, SBIG STL-1001E CCD, unguided exposures. Those by Durkee at the Shed of Science Observatory used a 0.35 m Schmidt-Cassegrain, SBIG ST-10XE CCD working at a scale of 0.94 arcsec/pixel, Celestron UHC LPR filter. Martinez used a Celestron CPC 1100 28 cm Schmidt Cassegrain, SBIG ST8XME CCD, clear filter. All observers used differential photometry only.

MPO Canopus software was used by all observers to measure the images photometrically, share data, adjust instrumental magnitudes up or down to produce the best fit, and prepare the lightcurve. Due to the large number of data points acquired the lightcurve has been binned in sets of three data points with a maximum of five minutes between points.

Five sessions were obtained 2011 July 31 – Aug. 8 by Pilcher, with 18 additional sessions by all three authors 2011 Aug. 20 – Sept. 7.

When all data for all 23 sessions were combined they produced a very well defined asymmetric bimodal lightcurve with period 22.914 ± 0.001 hours, amplitude 0.19 ± 0.02 magnitudes.

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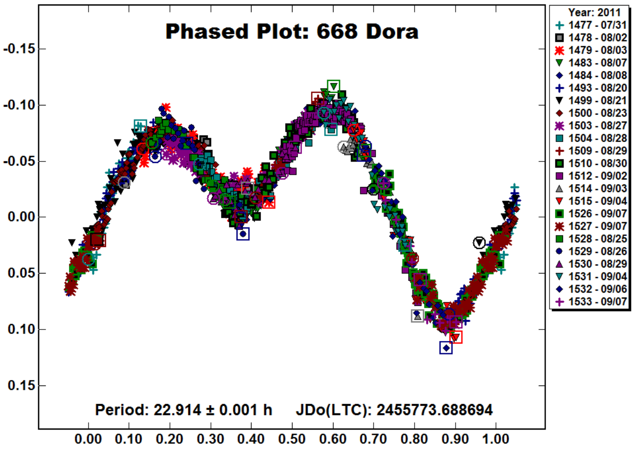

ASTEROIDS OBSERVED FROM GMARS AND SANTANA OBSERVATORIES: 2011 JULY - SEPTEMBER

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Lightcurves of three asteroids were obtained from Santana Observatory and Goat Mountain Astronomical Research Station (GMARS) from 2011 July to September: 688 Melanie, 1077 Campanula, and (42265) 2001 QL69.

Observations at Santana Observatory (MPC Code 646) were made with a 0.30-m Schmidt-Cassegrain (SCT) with a SBIG STL-1001E. All images were unguided and unbinned with no filter. Observations at GMARS (MPC Code G79) were made with a 0.4-m Schmidt-Cassegrain (SCT) with a SBIG STL-1001E. Measurements were made using *MPO Canopus*, which employs differential aperture photometry to produce the raw data. Period analysis was done using *Canopus*, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (Harris et al. 1989). The asteroids were selected from the list of asteroid photometry opportunities published on the Collaborative Asteroid Lightcurve Link (CALL) website (Warner et al. 2011).

The results are summarized in the table below, as are individual plots. Night-to-night calibration of the data (generally < ±0.05 mag) was done using field stars converted to approximate Cousins R magnitudes based on 2MASS J-K colors (Warner 2007 and Stephens 2008).

688 Melanie. All images were acquired at Santana Observatory. Melanie was observed (Binzel 1987) in 1984 June on two nights when it was at a similar longitude to 2011. He did not report a period since neither night showed more than a few hundredths of a magnitude of amplitude. Behrend (2011) reports a period of 19.968 h based upon three nights of observations in 2011 March covering about 90 percent of the lightcurve. That period is in fair agreement with this result.

1077 Campanula. All images were acquired at Santana Observatory. There is no previously reported period in the Lightcurve Database (LCDB) (Warner et al. 2010).

(42265) 2001 QL69. All observations were acquired at GMARS with the 0.4-m SCT. 42265 does not have a previously reported period in the LCDB (Warner et al. 2010). It was a dim target found in the field of view of the primary target, 9023 Mnesthus. Observations of 42265 could not be obtained afterwards.

The data for each of these asteroids were uploaded to the ALCDEF database (see Warner et al. 2011) on the Minor Planet Center's web site (MPC 2011).

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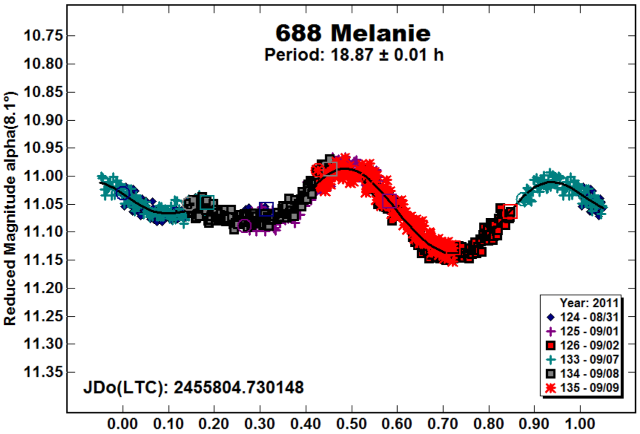

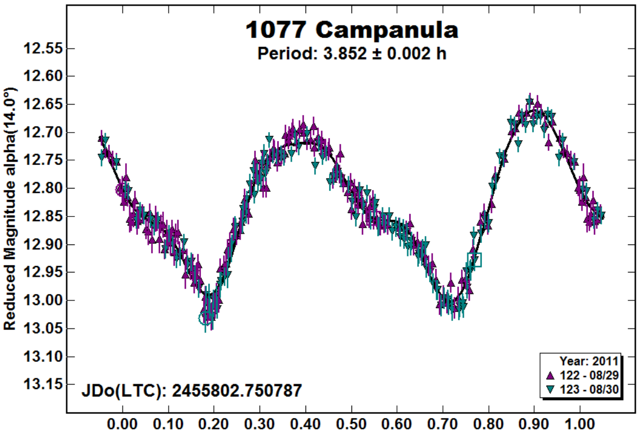

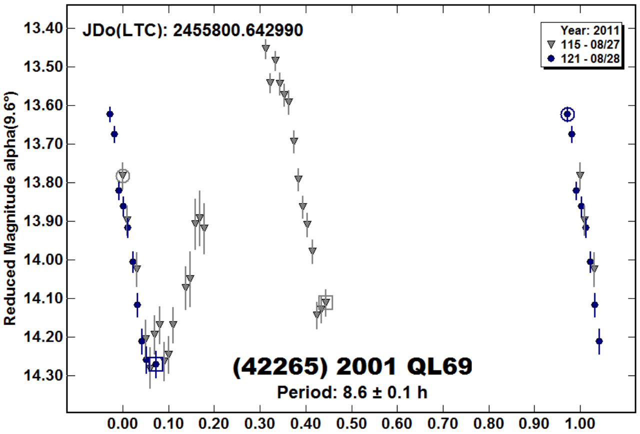

#	Name	mm/dd 2011	Data Pts	α	L_{PAB}	B_{PAB}	Per (h)	PE	Amp (mag)	AE
688	Melanie	08/31 - 09/09	857	8.2, 3.8	353	0	18.87	0.01	0.14	0.03
1077	Campanula	08/29 - 08/30	301	14.2, 13.6	356	0	3.852	0.002	0.33	0.03
42265	2001 QL69	08/27 - 08/28	39	9.4, 9.7	313	11	8.6	0.1	0.85	0.05

ROTATION PERIOD DETERMINATION FOR 185 EUNIKE

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Previous attempts at rotation period determination for 185 Eunike have yielded values of 10.83, 11.02, 14.56, and 21.807 hours, respectively. An aliasing situation appears in which the shorter periods are very near 1/2 and 2/3 of the 21.8 hour period. New observations show a period of 21.797 ± 0.001 hours, amplitude 0.15 ± 0.02 magnitudes, and rule out all of the shorter periods.

Determining the rotation period of asteroid 185 Eunike has been problematic. Debehogne et al. (1978) published a period of 10.83 hours. No further photometric observations were made until Ruthroff (2010) published a lightcurve consistent with an 11.20 hour period. Ruthroff (2011) reevaluated his 2010 data and found them consistent also with 14.56 hours. Based also on data from the 2010 apparition Behrend (2011) obtained a lightcurve with full phase coverage and phased to 21.807 hours. First author Pilcher noted that periods of 11.20 hours, 14.56 hours, and 21.807 hours were all obtained based on year 2010 observations, and that these are very close to a ratio 3:4:6.

To resolve this ambiguity first author Pilcher made observations on 8 nights 2011 June 21 – July 21 at the Organ Mesa Observatory. Equipment consists of a 35 cm Meade LX200 GPS Schmidt-Cassegrain, SBIG STL-1001E CCD, 60 second exposures with R filter, unguided, differential photometry only. These indicated a period near 21.80 hours, and definitively ruled out all of the shorter periods. An examination of the lightcurve by Debehogne et al. (1978) suggested that their data are also compatible with twice their 10.83 hour period. Given these findings Pilcher contacted John Ruthroff, author of the suggested 11.20 hour and 14.56 hour periods. Ruthroff obtained a good fit of all of his year 2010 observations to a 21.80 hour period, but with only 65% phase coverage. Ruthroff, with a 0.3 m Schmidt-Cassegrain operating at f/6.1, SBIG ST9 CCD with image scale 2.2 arcseconds/pixel, SBIG AO-8 adaptive optics unit, unfiltered, 20 second exposures, then obtained data on 5 more nights 2011 Aug. 1 – 10 which confirm a period near 21.8 hours.

Conclusions. We present here lightcurves of the Ruthroff 2010 data phased to a period of 21.80 hours, and of the combined new data by both observers. The 2011 data show a period 21.797 ± 0.001 hours, amplitude 0.15± 0.02 magnitudes, and an irregular lightcurve with one principal maximum and minimum per cycle. It can be stated definitively that all data obtained to date are consistent with the 21.797 hour period of the most dense data set, and that all shorter periods can be ruled out.

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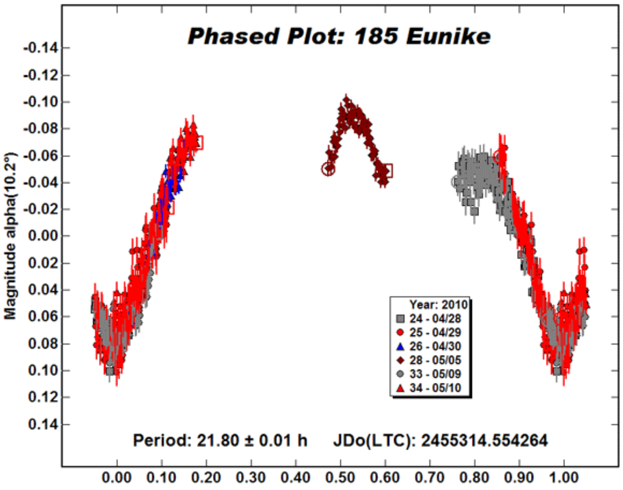

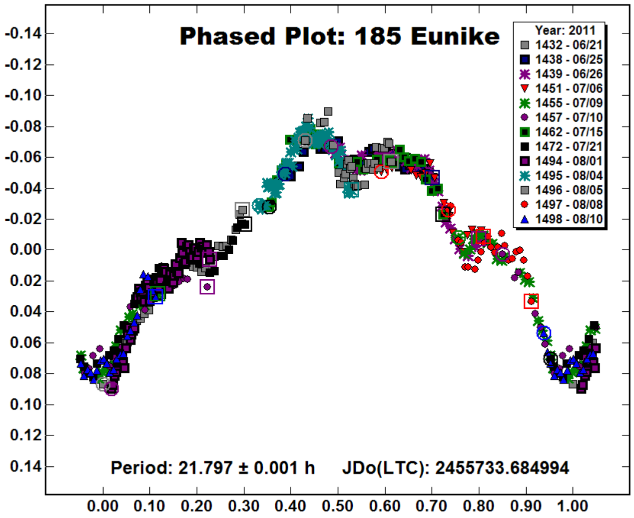

5088 TANCREDI: ROTATION PERIOD AND PHASE COEFFICIENTS

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The main-belt asteroid 5088 Tancredi was observed during a period of 42 days close to the 2009 opposition. The data were collected with a clear filter on 15 different nights. R-magnitudes were calculated using the MPOSC3 Catalog. The observations covered a range of phase angles from 0.35° to 16°. The phase coefficients in the H-G system (R-mag) are: HR = 12.36 HR = 12.36 [12.30, 12.43]; G = 0.058 [–0.036, 0.153], with 95% confidence range presented within the brackets. Based on the low value of G, the asteroid can be tentatively classified as a C-type asteroid. A precise estimate of the rotation period is computed as P = 5.05909 ± 0.00014 h. The amplitude is A = 0.31 mag.

The main-belt asteroid 5088 Tancredi was observed during the 2009 opposition, one of the more favorable in recent years. Perihelion passage and opposition occurred in 2008 Oct. 12 and 2009 Jan 15, respectively. The asteroid reached a minimum apparent magnitude of R~15.5, allowing us to obtain an acceptable lightcurve with our 35-cm telescope. We could find no photometric data of this asteroid published in the literature.

The observations were done at the Observatorio Astronómico Los Molinos (IAU code 844), in the north of Montevideo, the capital of Uruguay, and so under moderately-strong light pollution conditions. Images were taken on 15 different nights from 2009 Jan 15–Feb 26, spanning a period of 42 days. The observational details are given in Table I. We used a 0.35-m f/5.08 Newtonian (modified Cassegrain) with an SBIG ST-7 CCD camera and clear filter. The field of view was 16.5x11 arcminutes with a scale of 1.29 arcsec/pixel. The images were acquired with *Maxim DL*. Bias and dark frames were collected every night, but dome flat fields were collected on only a few nights. The images were calibrated using the *Maxim DL*. The photometric reduction was done with *MPO Canopus* V10. The photometric reference catalog was MPOSC3, provided with MPO software, which includes a large subset of the Carlsberg Meridian Catalog (CMC-14) as well as the Sloan Digital Sky Survey (SDSS). Only stars that are about the same color as the Sun were used as comparison stars. The values of the R-mag were used for reference.

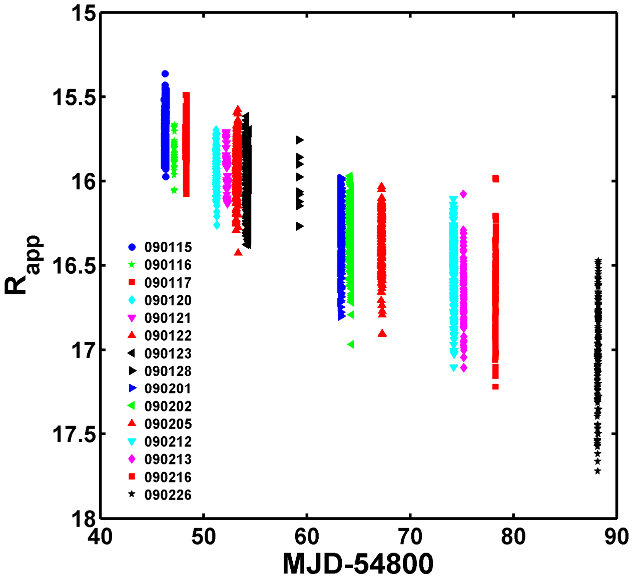

Figure 1. The apparent R magnitude as a function of date (Modified Julian Date – 54800).

Figure 1 shows the apparent R magnitude plotted as a function of date. As seen in Table I, the phase angle was increasing over the span of observations. This and the increasing distance from Earth explain the decline in apparent brightness over time. We computed the median value of the apparent R magnitude each night. These values were corrected for heliocentric and geocentric distance to obtain the reduced magnitude R(1,1,α). The results are listed in Table I and plotted as a function of the phase angle (α) in Figure 2. The phase function adopted by the IAU (Bowell *et al.*, 1989) was fitted to the R(1,1,α) magnitudes using the nonlinear least-squares *fit* function in *Matlab R2008b*.

UT Date	R.A.	Dec.	r	Δ	α	δT	N	R(1,1,α)	σ_R	δR
2009 Jan 15	07 47	+22 02	2.655	1.672	0.33	4.4	257	15.71	0.004	0.36
2009 Jan 16	07 46	+22 04	2.656	1.673	0.60	0.7	34	15.83	0.024	0.24
2009 Jan 17	07 45	+22 06	2.657	1.674	1.01	3.3	205	15.79	0.008	0.35
2009 Jan 20	07 43	+22 12	2.658	1.678	2.34	3.2	171	15.89	0.008	0.29
2009 Jan 21	07 42	+22 14	2.659	1.680	2.79	3.4	39	15.91	0.018	0.35
2009 Jan 22	07 41	+22 16	2.660	1.683	3.23	5.5	252	15.90	0.006	0.38
2009 Jan 23	07 40	+22 18	2.660	1.686	3.68	6.1	327	16.01	0.007	0.46
2009 Jan 28	07 36	+22 26	2.664	1.703	5.86	0.2	10	16.06	0.081	0.40
2009 Feb 01	07 33	+22 33	2.666	1.722	7.54	3.2	203	16.30	0.012	0.46
2009 Feb 02	07 32	+22 34	2.667	1.728	7.95	4.7	248	16.29	0.010	0.41
2009 Feb 05	07 30	+22 38	2.669	1.746	9.15	2.2	152	16.34	0.015	0.42
2009 Feb 12	07 26	+22 44	2.675	1.796	11.75	1.8	185	16.48	0.020	0.53
2009 Feb 13	07 25	+22 45	2.675	1.804	12.10	1.1	122	16.67	0.027	0.48
2009 Feb 16	07 24	+22 47	2.678	1.829	13.11	1.4	122	16.68	0.035	0.65
2009 Feb 26	07 22	+22 48	2.686	1.926	16.04	2.9	144	16.99	0.027	0.80

Table I - Observation details. The ephemerides are computed at 03h UT of the corresponding day. r - heliocentric distance (AU), Δ - geocentric distance (AU), α - phase angle (°), δT - time interval of the observation (hr), N - number of data points, R(1,1, α) - median value of the distance reduced R-mag. for the night, σ_R - error of the mean value (computed as the square root of the sum squares of the individual errors divided by N), δR - magnitude range during the night (computed as the difference between the magnitude in the 90% percentile minus the one in the 10% percentile of the sorted R-mag).

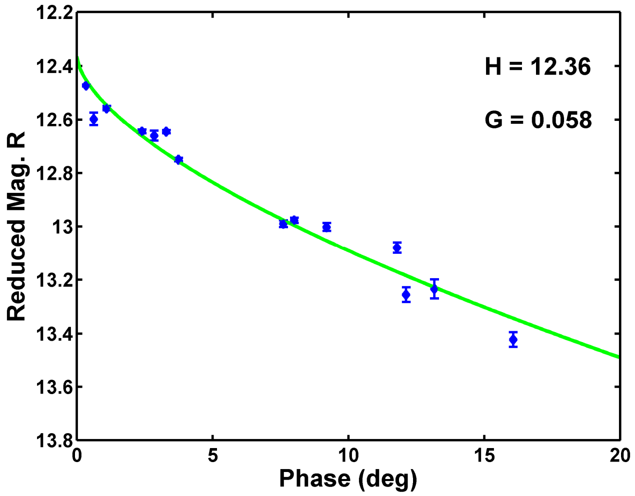

Figure 2. Reduced magnitude R(1,1,α) vs. phase angle (α). The green line is the least-squares fit to the data.

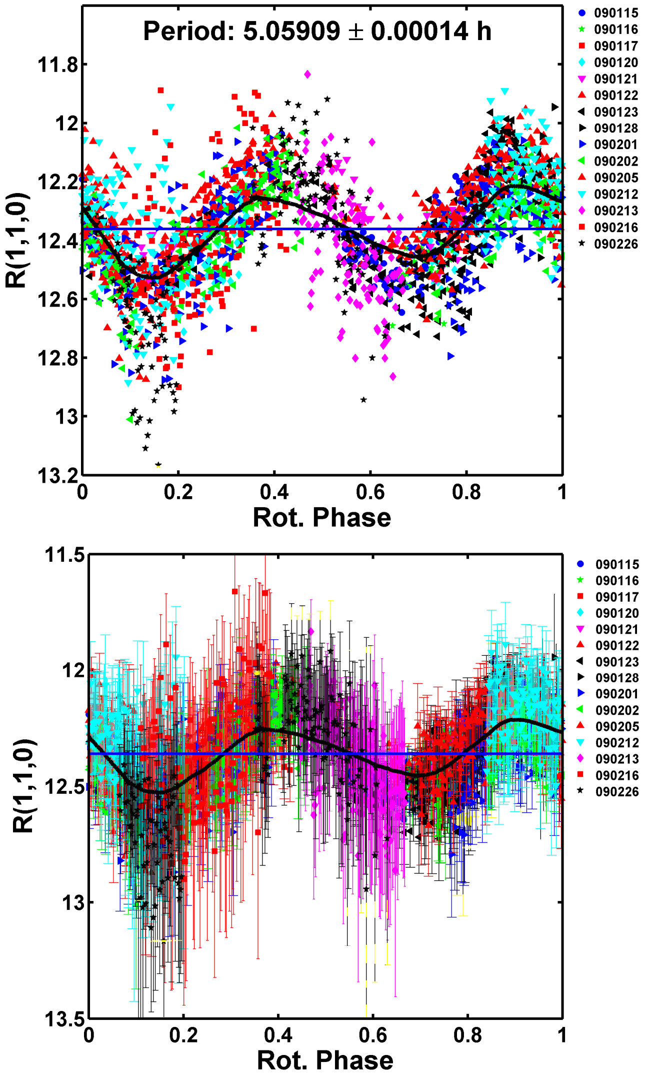

Figure 3a (top) shows the data phased to a period of 5.05909 h without error bars. Figure 3b (bottom) includes the error bars.

From our analysis, we derived values of $H_R = 12.36$ [12.30, 12.43]; $G = 0.058$ [–0.036, 0.153]. The lower and upper 95% confidence bounds are presented between brackets. Note that the lower bound of *G* is an unrealistic negative value. A value of $G = 0.058$ is typical of a low-albedo C-type asteroid (Lagerkvist and Magnusson 1990). 5088 Tancredi has a semimajor axis $a = 3.1$ AU and a low eccentricity, $e = 0.16$. This tentative classification of 5088 Tancredi as a C-type asteroid is in agreement with the fact that, in the outer region of the main belt where the object is located, C-type asteroids prevail (Gradie and Tedesco 1982, Pieters and McFadden, 1994).

Period analysis was performed using *MPO Canopus*, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (Harris *et al.*, 1989). We corrected each observation for the phase effect using the value of *G* we obtained. We then combined the data of the 15 nights to obtain a rotation period of 5.05909 ± 0.00014 h and a time of minimum of JD 2452846.6867. The phased plot is presented in Figures 3a and 3b without and with magnitude error bars, respectively. A mean curve is computed as the running mean with a window of 251 points. In order to compute the mean values at the edge of the plot, the data points are recycled before rotational phase 0 and after 1. A horizontal line at R(1,1,0) = 12.36 is drawn in each plot. The maximum amplitude of the mean curve is $A = 0.31$ mag.

Acknowledgements

We thank the technical personnel of the OALM for the support with the maintenance of the equipments. The colleagues of the Observatorio Kappa Crucis (Montevideo, Uruguay) are also thanked for lending us the CCD camera employed for these observations, since our equipment was out of order at that time.

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ASTEROID LIGHTCURVE ANALYSIS AT THE PALMER DIVIDE OBSERVATORY: 2011 JUNE - SEPTEMBER

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Lightcurves for 28 asteroids were obtained at the Palmer Divide Observatory (PDO) from 2011 June to September: 903 Nealley, 1103 Sequoia, 2052 Tamriko, 2083 Smither, 2150 Nyctimene, 2272 Montezuma, 2306 Bauschinger, 4125 Lew Allen, 5571 Lesliegreen, (7660) 1993 VM1, 7933 Magritte, (16256) 2000 JM2, (16959) 1998 QE17, (17822) 1998 FM135, (18890) 2000 EV26, (27568) 2000 PT6, (31898) 2000 GC1, (32953) 1996 GF19, (32928) 1995 QZ, (33356) 1999 AM3, (35055) 1984 RB, (54234) 2000 JD16, (60365) 2000 AT109, (62117) 2000 RC102, (67404) 2000 PG26, 70030 Margaretmiller, (140428) 2001 TT94, (282081) 2000 NG. Observations of 70030 Margaretmiller indicate that the asteroid is a probable binary with a secondary period being detected but no mutual events.

CCD photometric observations of 28 asteroids were made at the Palmer Divide Observatory (PDO) from 2011 June to September. See the introduction in Warner (2010a) for a discussion of equipment, analysis software and methods, and overview of the plot scaling. The “Reduced Magnitude” in the plots uses Cousins R magnitudes corrected to unity distance by applying –5*log (Rr) with R and r being, respectively, the Sun-asteroid and Earth-asteroid distances in AU. The magnitudes were normalized to the phase angle given in parentheses, e.g., alpha(6.5°), using $G = 0.15$ unless otherwise stated.

903 Nealley. Warner (2004) observed this asteroid in mid-2004 and found a period of 21.60 h using a data set without internal calibration. The internally-standardized data from 2011 fit periods of 19.72 or 21.52 h about equally well. As shown in the plot for 2004, by adjusting nightly zero points, the data from the earlier apparition fit a period of 19.58 h. The two apparitions differed in phase angle bisector longitude by about 90°. Given the low amplitude and roughly similar lightcurve shape for both apparitions, this favors the conclusion that the spin axis latitude is relatively high and the object somewhat spheroidal in shape.

1103 Sequoia. This well-studied Hungaria (e.g., see Wisniewski 1997; LeCrone *et al.* 2004; Behrend 2006; and Hanus *et al.* 2011) was observed at PDO in 2011 August. The period derived from the latest data is in good agreement with the previous findings.

2083 Smither. Warner (2007a, 2010b) observed this asteroid at two previous apparitions. The 2009 apparition showed possible signs of the asteroid being binary (mutual events) but this could not be confirmed. The observations in 2011 found no definitive evidence of events or a secondary period. The asteroid remains a strong target of interest for future observations.

2150 Nycteimene. Warner (2007a, 2008) previously determined the period for this Hungaria to be approximately 6.12 h. The 2011 observations confirm this and should help find a spin axis and shape model using lightcurve inversion techniques (see Hanus *et al.* 2011 and references therein).

2306 Bauschinger. Behrend (2007) reported a period of 21.64 h. Analysis of the 2011 PDO observations confirm that result.

4125 Lew Allen. This was the third apparition of observations at PDO for this Hungaria (Warner 2007b, 2010b). The most recent period is in close agreement with previous findings.

(7660) 1993 VM1. This Mars-crossing asteroid was observed by Pravec *et al.* (2005) in 2005 April, who reported a period of 5.916 h and amplitude of 0.32 mag. The PDO data analysis gave P = 5.92 h and A = 0.86 mag.

(16959) 1998 QE17. Initial observations indicated the possibility of a second period. However, the full data set, with some minor zero point adjustments, shows a single-periodic curve (Petr Pravec, private communications).

(31898) 2000 GC1. The period of 17.2 h reported here is just one of many that fit the data and should be considered unreliable.

(33356) 1999 AM3. The amplitude of 0.56 mag is based on the Fourier curve, i.e., it’s assumed that the second minimum, for which there was no coverage, was not deeper than the first, double-covered, minimum.

(35055) 1984 RB. Warner *et al.* (2010) observed this asteroid in 2010 February and reported a period of 3.658 h with an amplitude range of 0.35-0.44 mag due to observations covering phase angles from 7° to 22°. The 2011 observations at PDO found the same synodic period (to 0.001 h) and, since they were confined to a relatively short time, a fixed amplitude of 0.44 mag.

(60365) 2000 AT109. This Flora member was a “target of opportunity,” i.e., in the same field as a planned target. Follow up was not possible. The data show a steady decline over almost 5 h, with a lightcurve amplitude of >0.2 mag. This favors a period of at least 16 h and probably in the range of 1-2 days.

70030 Margaretmiller. Named after the author’s wife, this asteroid was previously observed in 2003 (Warner 2005) and 2010 (Warner 2010). The original analysis of the 2003 data found a period of 3.98 h. The images were remeasured and data placed on an internal standard system. A revised period of 4.35 h was found (Warner 2010) despite the somewhat noisy data. The 2010 observations (when the asteroid was brighter) found a period of 4.329 h (Warner 2010). There were no signs of a secondary period or mutual events due to a satellite in either of the two apparitions.

The 2011 observations told a different story. While the data could be fit to a period of about 4.329 h, this required removing a secondary period of either 15.8 h or 11.8 h. This secondary period was confirmed with independent observations by Audrey Thirouin at Cala Alto fitted into the PDO data set and analyzed by Petr Pravec and Peter Kušnirak at the Astronomical Institute, Czech Republic (Petr Pravec, private communications). Since there were no mutual events (occultations and/or eclipses) observed, the asteroid can be said to be only a probable and not confirmed binary. Follow-up photometric observations and, possibly, imaging with adaptive optics at future apparitions will be required to confirm the true nature of the asteroid.

Acknowledgements

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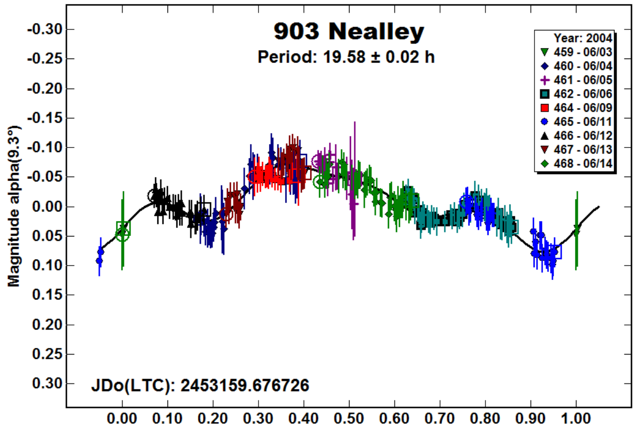
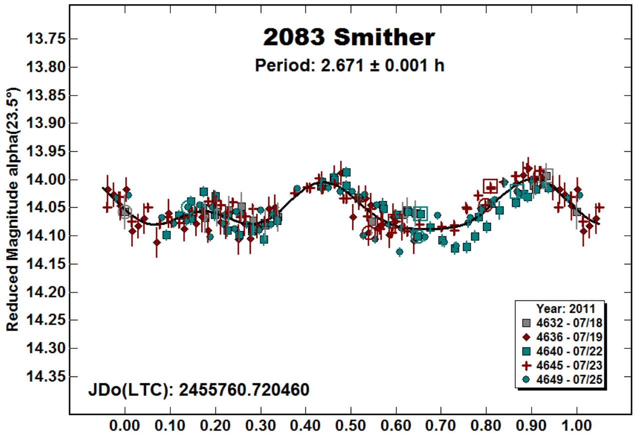
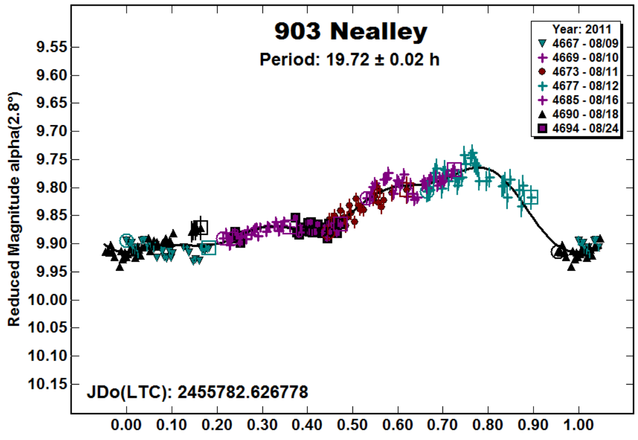
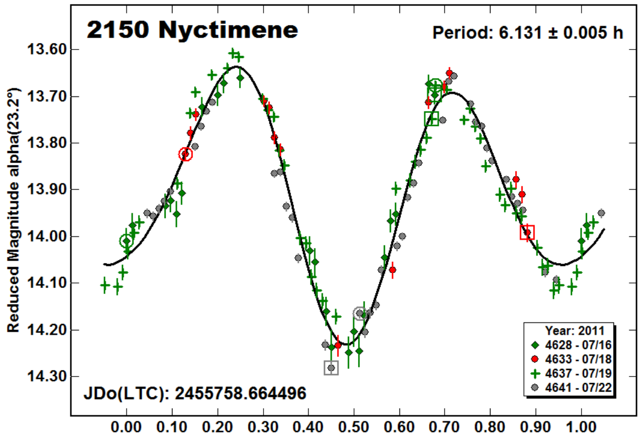
#	Name	mm/dd 2011	Data Pts	α	L_{PAB}	B_{PAB}	Per (h)	PE	Amp (mag)	AE
903	Nealley	06/06-06/14[1]	239	9.9,11.8	228	13	19.58/21.52	0.02	0.15	0.02
903	Nealley	08/09-09/12	160	2.7,12.1	312	6	19.72	0.02	0.15	0.01
1103	Sequoia (H)	08/12-08/13	102	17.3	311	21	3.044	0.005	0.35	0.02
2052	Tamriko	09/11-09/23	148	6.7,10.4	334	9	7.470	0.002	0.15	0.02
2083	Smither (H)	07/18-07/25	203	23.5,21.7	328	23	2.671	0.001	0.10	0.01
2150	Nyctimene (H)	07/16-07/22	124	23.1,22.4	311	35	6.131	0.005	0.61	0.02
2272	Montezuma (H)	08/11-08/16	188	14.4,13.5	323	21	8.183	0.005	1.08	0.02
2306	Bauschinger	08/01-08/24	240	4.1,2.7,7.6	314	5	21.66	0.01	0.69	0.02
4125	Lew Allen (H)	07/16-07/19	121	28.0,27.3	326	20	4.629	0.005	0.45	0.02
5571	Lesliegreen	09/01-09/05	137	4.6,4.1	345	11	6.953	0.005	0.16	0.02
7660	1993 VM1 (H)	07/03-07/18	118	19.9,16.4	305	26	5.92	0.02	0.86	0.03
7933	Magritte	08/01	52	5.8	313	9	3.26	0.05	0.38	0.02
16256	2000 JM2 (H)	06/16-07/16	260	24.3,22.8,23.1	281	33	63.5	0.3	0.98	0.03
16959	1998 QE17	09/11-09/25	340	13.2,7.2	8	7	3.2266	0.0001	0.36	0.02
17822	1998 FM135	08/01-08/05	99	3.8,2.7	315	5	4.613	0.002	0.28	0.02
18890	2000 EV26 (H)	06/28-07/04	87	20.1,20.9	264	32	10.53	0.05	0.20	0.02
27568	2000 PT6 (H)	08/01-08/09	125	17.0,14.0	325	19	3.624	0.002	0.13	0.01
31898	2000 GC1 (H)	08/01-08/10	135	7.6,5.2	313	7	17.2	0.2	0.07	0.01
32928	1995 QZ (H)	08/01-08/24	183	6.0,13.1	315	7	38.9	0.1	0.56	0.03
32953	1996 GF19	09/05-09/23	112	4.0,12.0	339	5	4.329	0.001	0.13	0.01
33356	1999 AM3 (H)	08/25-09/04	347	17.0,16.1	344	22	37.59	0.05	0.92	0.02
35055	1984 RB (H)	07/22-07/25	145	17.9,16.6	327	10	3.659	0.005	0.41	0.02
54234	2000 JD16 (H)	07/22-08/01	112	20.5,19.2	316	28	6.058	0.005	0.39	0.03
60365	2000 AT109	09/20	34	13.9	336	9	>16		>0.2	
62117	2000 RC102	08/30-09/02	164	9.9,9.6	345	25	13.5	0.1	0.09	0.01
67404	2000 PG26 (H)	08/25-09/01	176	15.7,14.7	344	23	5.398	0.001	0.70	0.02
70030	Margaretmiller (H)	08/25-09/22	311	9.6,6.5,11.0	344	10	4.3292	0.0002	0.45	0.02
140428	2001 TT94	08/30-08/31	51	5.5,5.2	345	10	2.5	0.1	0.46	0.03
282081	2000 NG	07/22-07/25	81	22.3,21.1	325	10	6.59	0.02	0.33	0.02
(1)=2004										

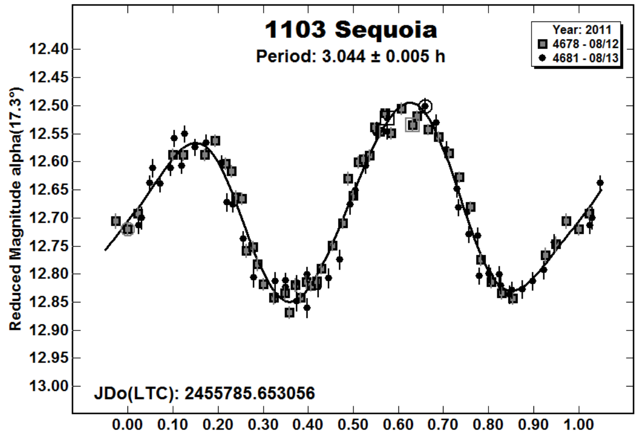
Table I. Observing circumstances. Asteroids with "(H)" after the name are members of the Hungaria group/family. The phase angle (α) is given at the start and end of each date range, unless it reached a minimum, which is then the second of three values. If a single value is given, the phase angle did not change significantly and the average value is given. L_{PAB} and B_{PAB} are each the average phase angle bisector longitude and latitude, unless two values are given (first/last date in range).

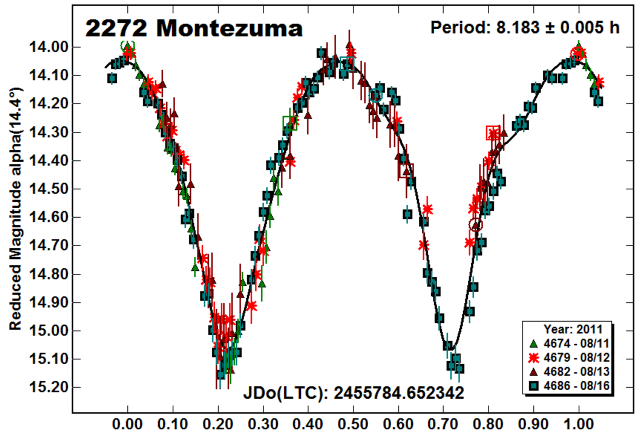

903 Nealley
Period: 19.58 ± 0.02 h
Year: 2004
459 - 06/03
460 - 06/04
461 - 06/05
462 - 06/06
464 - 06/09
465 - 06/11
466 - 06/12
467 - 06/13
468 - 06/14
Magnitude alpha(9.3°)
-0.30 -0.25 -0.20 -0.15 -0.10 -0.05 0.00 0.05 0.10 0.15 0.20 0.25 0.30
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2453159.676726

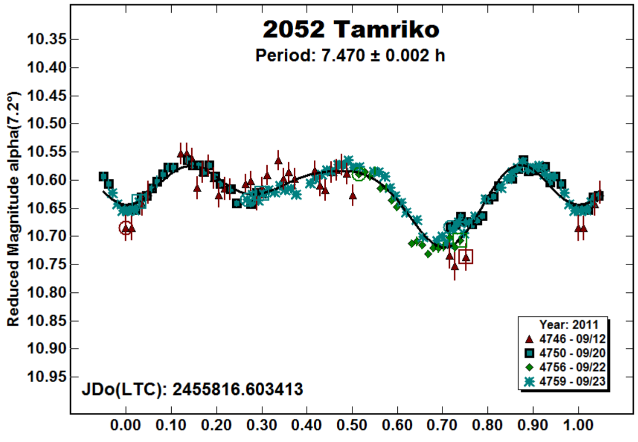

2083 Smither
Period: 2.671 ± 0.001 h
Year: 2011
4632 - 07/18
4636 - 07/19
4640 - 07/22
4645 - 07/23
4649 - 07/25
Reduced Magnitude alpha(23.5°)
13.75 13.80 13.85 13.90 13.95 14.00 14.05 14.10 14.15 14.20 14.25 14.30 14.35
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2455760.720460

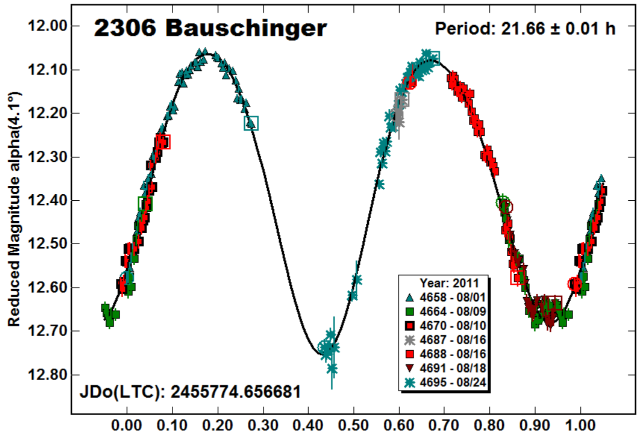

903 Nealley
Period: 19.72 ± 0.02 h
Year: 2011
4667 - 08/09
4669 - 08/10
4673 - 08/11
4677 - 08/12
4685 - 08/16
4690 - 08/18
4694 - 08/24
Reduced Magnitude alpha(2.8°)
9.55 9.60 9.65 9.70 9.75 9.80 9.85 9.90 9.95 10.00 10.05 10.10 10.15
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2455782.626778

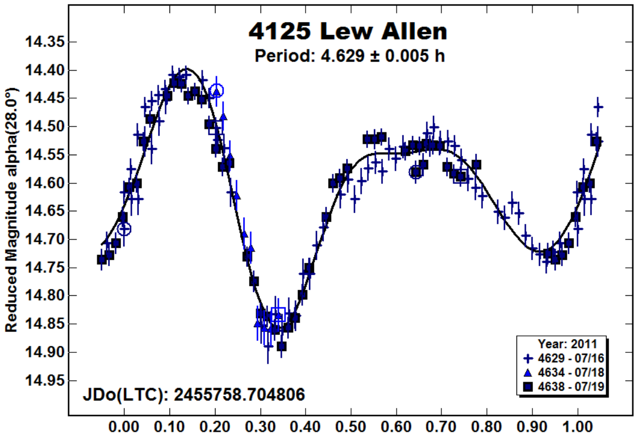

2150 Nyctimene
Period: 6.131 ± 0.005 h
Year: 2011
4628 - 07/16
4633 - 07/18
4637 - 07/19
4641 - 07/22
Reduced Magnitude alpha(23.2°)
13.60 13.70 13.80 13.90 14.00 14.10 14.20 14.30
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2455758.664496

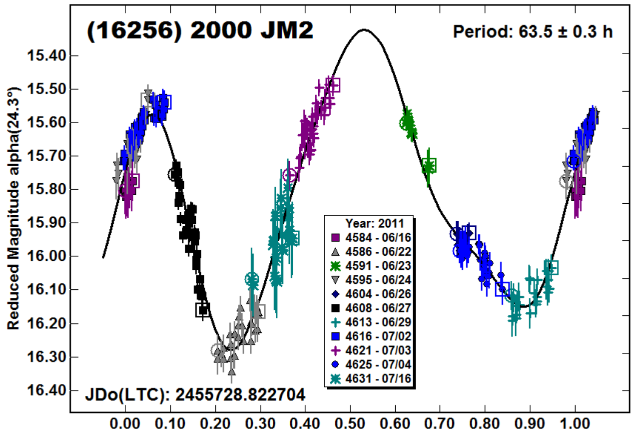

1103 Sequoia
Period: 3.044 ± 0.005 h
Year: 2011
4678 - 08/12
4681 - 08/13
Reduced Magnitude alpha(17.3°)
12.40 12.45 12.50 12.55 12.60 12.65 12.70 12.75 12.80 12.85 12.90 12.95 13.00
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2455785.653056

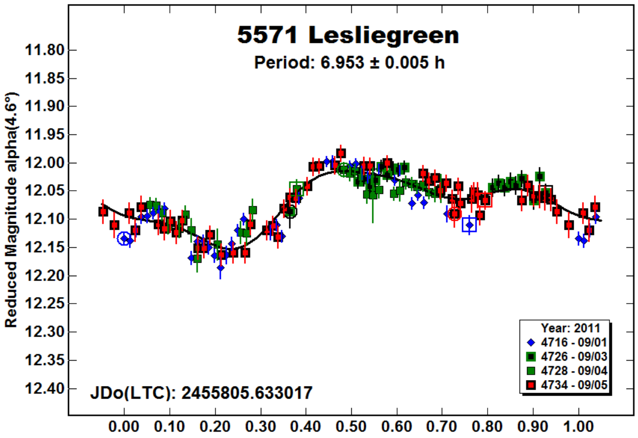

2272 Montezuma
Period: 8.183 ± 0.005 h
Year: 2011
4674 - 08/11
4679 - 08/12
4682 - 08/13
4686 - 08/16
Reduced Magnitude alpha(14.4°)
14.00 14.10 14.20 14.30 14.40 14.50 14.60 14.70 14.80 14.90 15.00 15.10 15.20
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2455784.652342

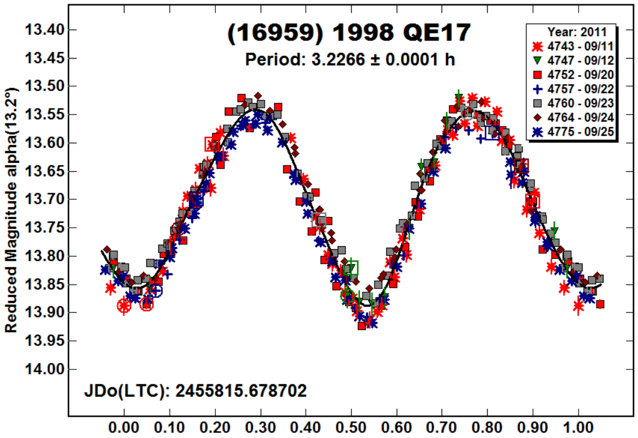

2052 Tamriko
Period: 7.470 ± 0.002 h
Year: 2011
4746 - 09/12
4750 - 09/20
4756 - 09/22
4759 - 09/23
Reduced Magnitude alpha(7.2°)
10.35 10.40 10.45 10.50 10.55 10.60 10.65 10.70 10.75 10.80 10.85 10.90 10.95
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2455816.603413

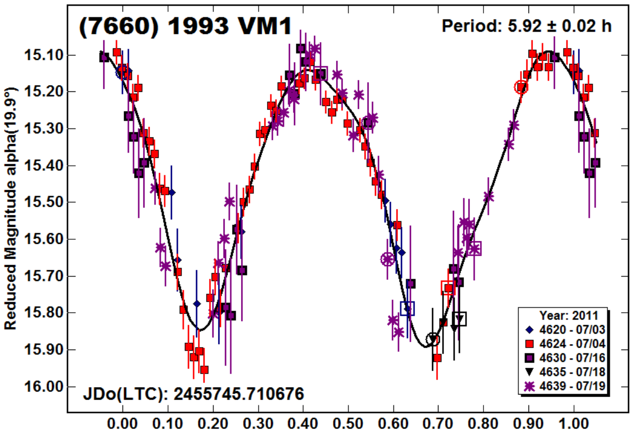

2306 Bauschinger
Period: 21.66 ± 0.01 h
Year: 2011
4658 - 08/01
4664 - 08/09
4670 - 08/10
4687 - 08/16
4688 - 08/16
4691 - 08/18
4695 - 08/24
Reduced Magnitude alpha(4.1°)
12.00 12.10 12.20 12.30 12.40 12.50 12.60 12.70 12.80
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
JDo(LTC): 2455774.656681

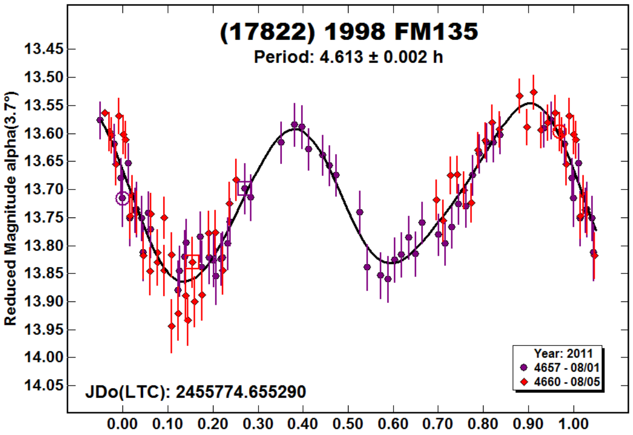

4125 Lew Allen
Period: 4.629 ± 0.005 h
Reduced Magnitude alpha(28.0°)
14.35
14.40
14.45
14.50
14.55
14.60
14.65
14.70
14.75
14.80
14.85
14.90
14.95
JDo(LTC): 2455758.704806
Year: 2011
4629 - 07/16
4634 - 07/18
4638 - 07/19
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

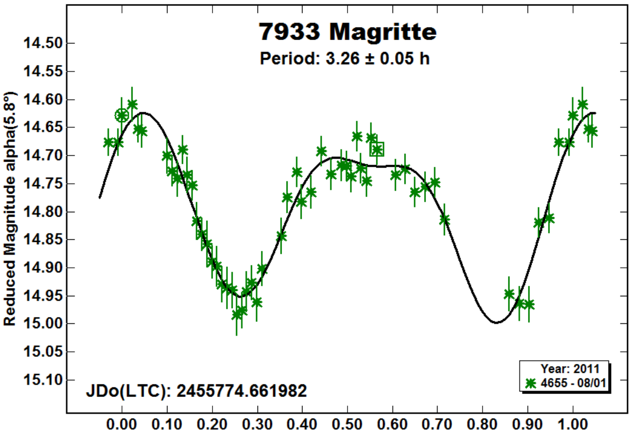

(16256) 2000 JM2
Period: 63.5 ± 0.3 h
Reduced Magnitude alpha(24.3°)
15.40
15.50
15.60
15.70
15.80
15.90
16.00
16.10
16.20
16.30
16.40
JDo(LTC): 2455728.822704
Year: 2011
4584 - 06/16
4586 - 06/22
4591 - 06/23
4595 - 06/24
4604 - 06/26
4608 - 06/27
4613 - 06/29
4616 - 07/02
4621 - 07/03
4625 - 07/04
4631 - 07/16
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

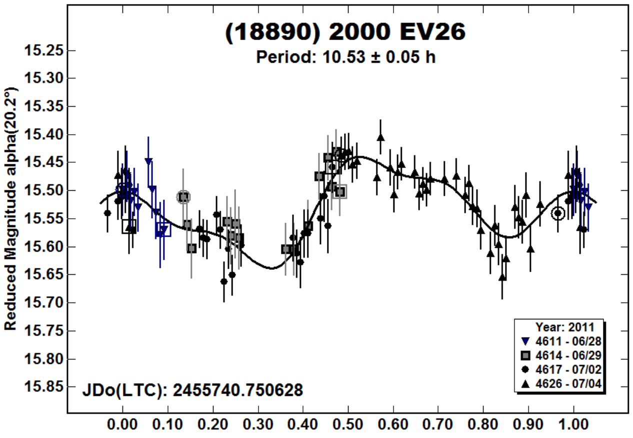

5571 Lesliegreen
Period: 6.953 ± 0.005 h
Reduced Magnitude alpha(4.6°)
11.80
11.85
11.90
11.95
12.00
12.05
12.10
12.15
12.20
12.25
12.30
12.35
12.40
JDo(LTC): 2455805.633017
Year: 2011
4716 - 09/01
4726 - 09/03
4728 - 09/04
4734 - 09/05
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

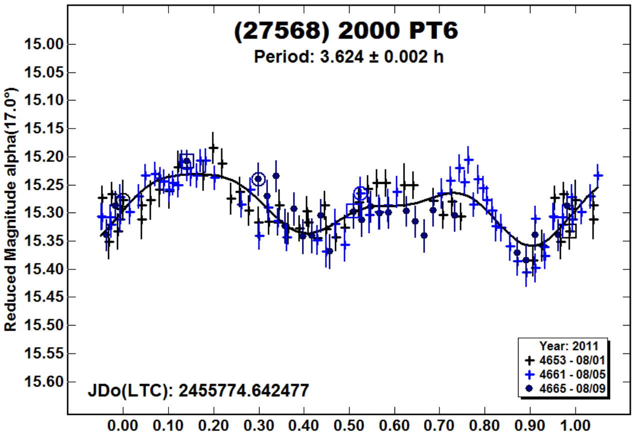

(16959) 1998 QE17
Period: 3.2266 ± 0.0001 h
Reduced Magnitude alpha(13.2°)
13.40
13.45
13.50
13.55
13.60
13.65
13.70
13.75
13.80
13.85
13.90
13.95
14.00
JDo(LTC): 2455815.678702
Year: 2011
4743 - 09/11
4747 - 09/12
4752 - 09/20
4757 - 09/22
4760 - 09/23
4764 - 09/24
4775 - 09/25
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

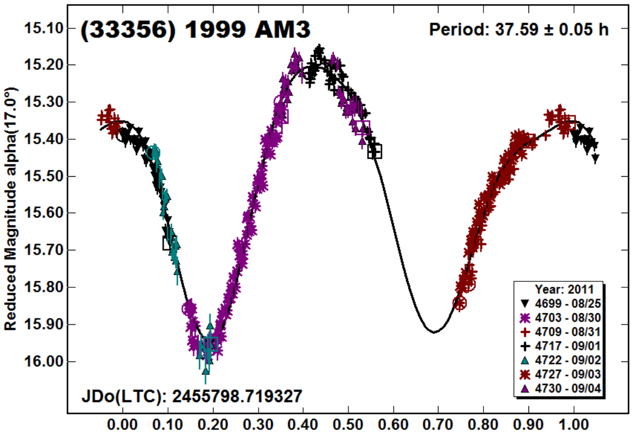

(7660) 1993 VM1
Period: 5.92 ± 0.02 h
Reduced Magnitude alpha(19.9°)
15.10
15.20
15.30
15.40
15.50
15.60
15.70
15.80
15.90
16.00
JDo(LTC): 2455745.710676
Year: 2011
4620 - 07/03
4624 - 07/04
4630 - 07/16
4635 - 07/18
4639 - 07/19
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

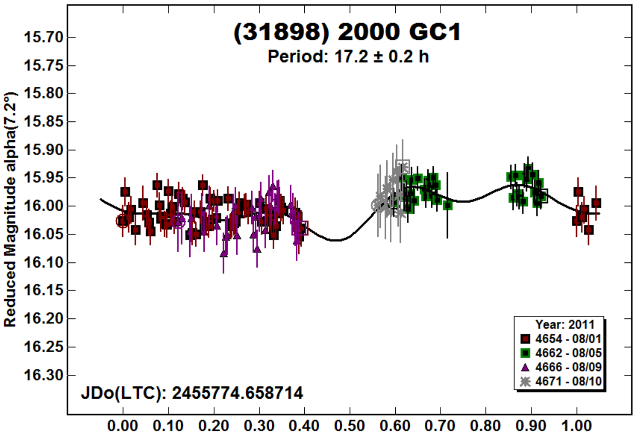

(17822) 1998 FM135
Period: 4.613 ± 0.002 h
Reduced Magnitude alpha(3.7°)
13.45
13.50
13.55
13.60
13.65
13.70
13.75
13.80
13.85
13.90
13.95
14.00
14.05
JDo(LTC): 2455774.655290
Year: 2011
4657 - 08/01
4660 - 08/05
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

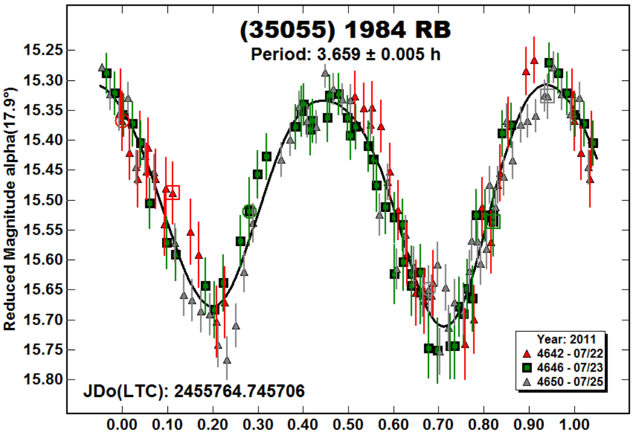

7933 Magritte
Period: 3.26 ± 0.05 h
Reduced Magnitude alpha(5.8°)
14.50
14.55
14.60
14.65
14.70
14.75
14.80
14.85
14.90
14.95
15.00
15.05
15.10
JDo(LTC): 2455774.661982
Year: 2011
4655 - 08/01
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

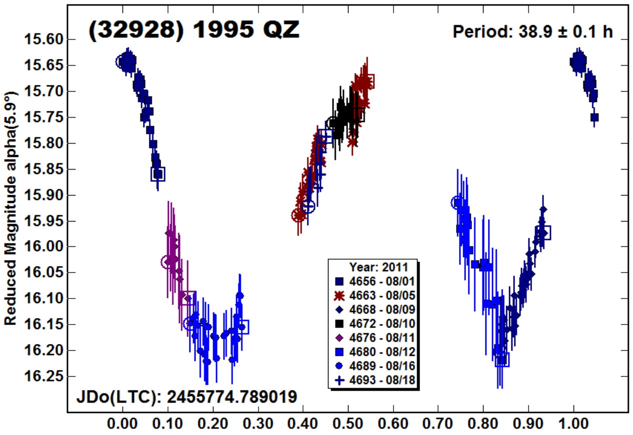

(18890) 2000 EV26
Period: 10.53 ± 0.05 h
Reduced Magnitude alpha(20.2°)
15.25
15.30
15.35
15.40
15.45
15.50
15.55
15.60
15.65
15.70
15.75
15.80
15.85
JDo(LTC): 2455740.750628
Year: 2011
4611 - 06/28
4614 - 06/29
4617 - 07/02
4626 - 07/04
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00


(27568) 2000 PT6
Period: 3.624 ± 0.002 h
Reduced Magnitude alpha(17.0°)
15.00
15.05
15.10
15.15
15.20
15.25
15.30
15.35
15.40
15.45
15.50
15.55
15.60
JDo(LTC): 2455774.642477
Year: 2011
4653 - 08/01
4661 - 08/05
4665 - 08/09
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00


(33356) 1999 AM3
Period: 37.59 ± 0.05 h
Reduced Magnitude alpha(17.0°)
15.10
15.20
15.30
15.40
15.50
15.60
15.70
15.80
15.90
16.00
JDo(LTC): 2455798.719327
Year: 2011
4699 - 08/25
4703 - 08/30
4709 - 08/31
4717 - 09/01
4722 - 09/02
4727 - 09/03
4730 - 09/04
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00


(31898) 2000 GC1
Period: 17.2 ± 0.2 h
Reduced Magnitude alpha(7.2°)
15.70
15.75
15.80
15.85
15.90
15.95
16.00
16.05
16.10
16.15
16.20
16.25
16.30
JDo(LTC): 2455774.658714
Year: 2011
4654 - 08/01
4662 - 08/05
4666 - 08/09
4671 - 08/10
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00


(35055) 1984 RB
Period: 3.659 ± 0.005 h
Reduced Magnitude alpha(17.9°)
15.25
15.30
15.35
15.40
15.45
15.50
15.55
15.60
15.65
15.70
15.75
15.80
JDo(LTC): 2455764.745706
Year: 2011
4642 - 07/22
4646 - 07/23
4650 - 07/25
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00


(32928) 1995 QZ
Period: 38.9 ± 0.1 h
Reduced Magnitude alpha(5.9°)
15.60
15.65
15.70
15.75
15.80
15.85
15.90
15.95
16.00
16.05
16.10
16.15
16.20
16.25
JDo(LTC): 2455774.789019
Year: 2011
4656 - 08/01
4663 - 08/05
4668 - 08/09
4672 - 08/10
4676 - 08/11
4680 - 08/12
4689 - 08/16
4693 - 08/18
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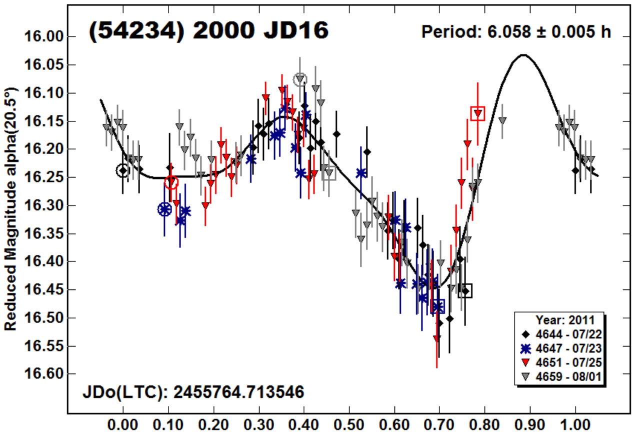
0.40
0.50
0.60
0.70
0.80
0.90
1.00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16.25
16.30
16.35
16.40
16.45
16.50
16.55
16.60
JDo(LTC): 2455764.713546
Year: 2011
4644 - 07/22
4647 - 07/23
4651 - 07/25
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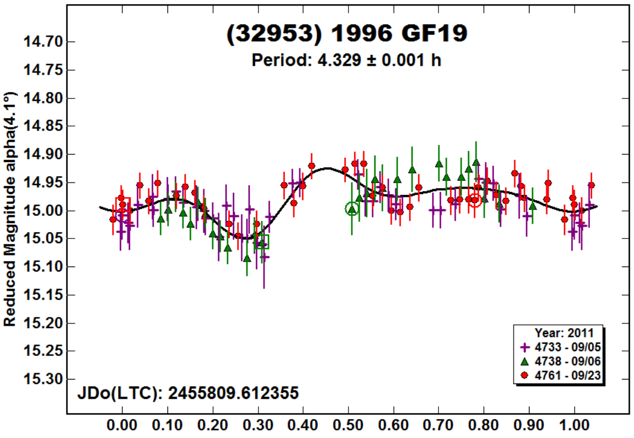
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14.95
15.00
15.05
15.10
15.15
15.20
15.25
15.30
JDo(LTC): 2455809.612355
Year: 2011
4733 - 09/05
4738 - 09/06
4761 - 09/23
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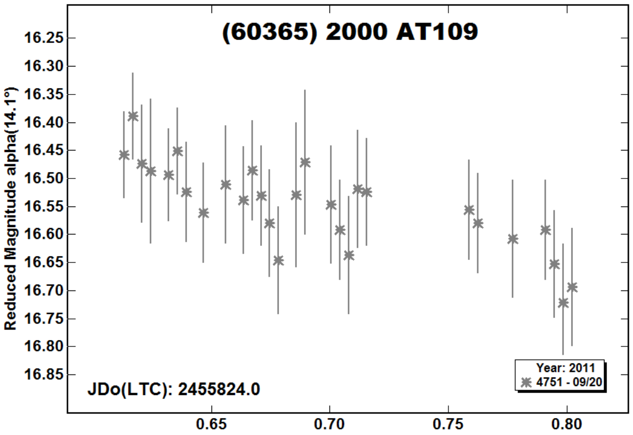
0.90
1.00


(60365) 2000 AT109
Reduced Magnitude alpha(14.1°)
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16.30
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16.40
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16.50
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16.65
16.70
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16.85
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Year: 2011
4751 - 09/20
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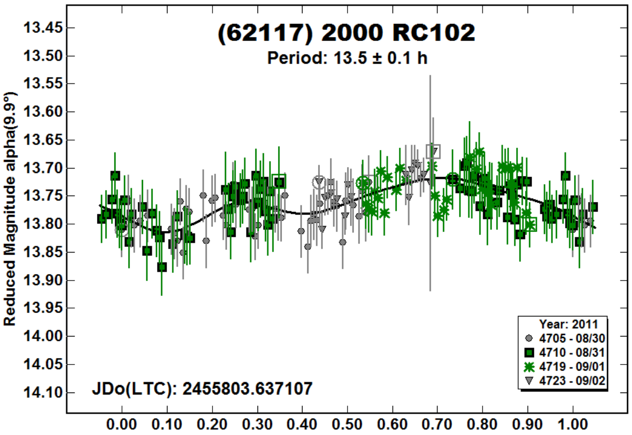
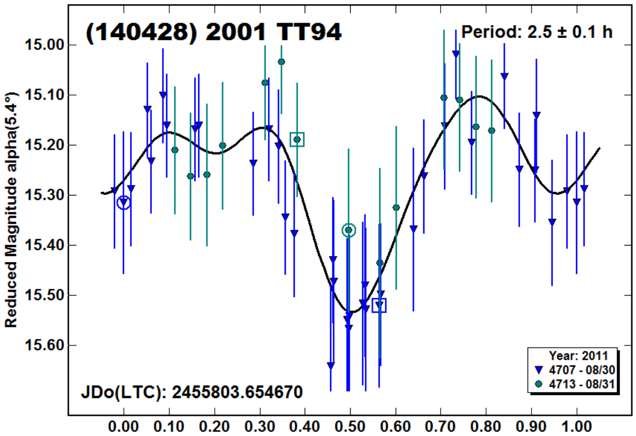
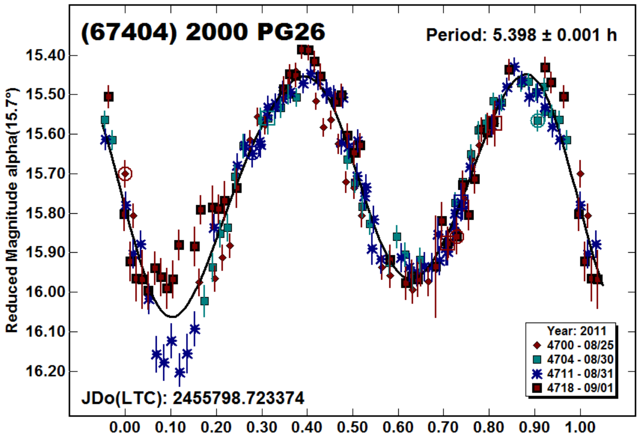
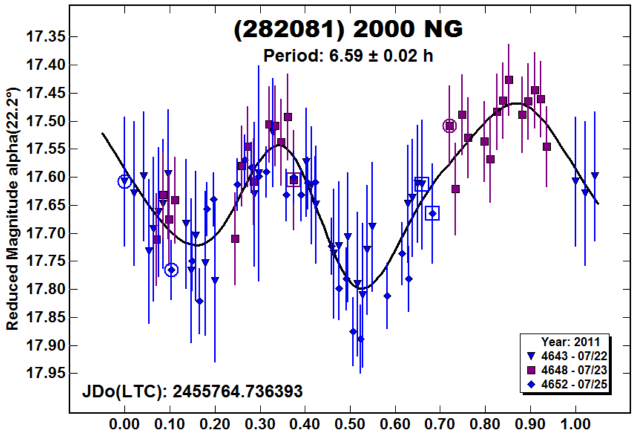
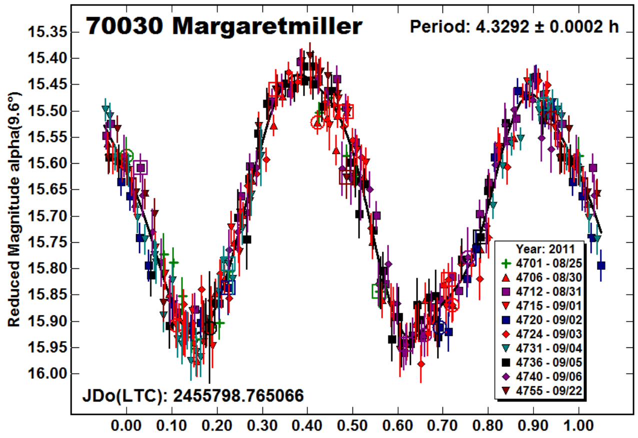
0.75
0.80

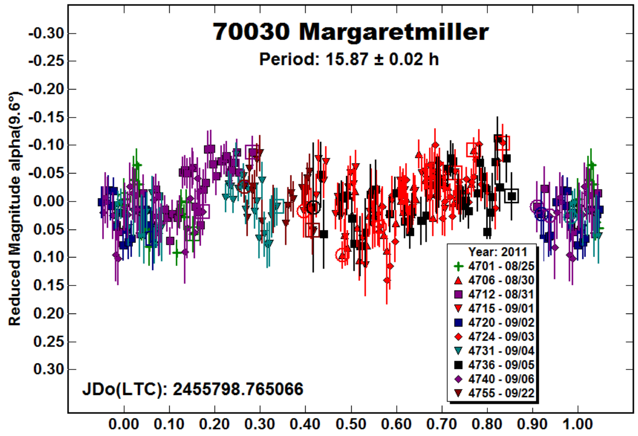












PERIOD DETERMINATION FOR 414 LIRIOPE

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Lightcurve analysis for 414 Liriope was performed from observations obtained during its 2011 opposition. The synodic rotation period was found to be 7.353 ± 0.002 h and the lightcurve amplitude was 0.13 ± 0.05 mag.

As of late 2011 August, only 5 of the first 500 numbered asteroids appeared to have no previously reported rotation periods. This implied a modest improvement (just one asteroid less) compared to the situation prevailing one year before (Alvarez, 2011). One of those elusive 5 asteroids, 414 Liriope, was chosen for observations from CALL web-site (Warner 2011) since it would be favorably placed for a few weeks during its 2011 opposition.

Unfiltered CCD photometric images of 414 Liriope were taken at Observatorio Los Algarrobos, Salto, Uruguay (MPC Code I38) from 2011 August 30 to September 07 using a 0.3-m Meade LX-200R working at ~*f*/6.3 with a focal reducer. The CCD imager was a QSI 516wsg NABG with a 1536 x 1024 array of 9-micron pixels. 2x2 binning was used, yielding an image scale of 1.9 arcseconds per pixel. Exposures were 60 s working at –10C, unguided (except for the last session, when a Lodestar camera and *PHD Guiding* software were applied). All images were dark and flat field corrected and then measured using *MPO Canopus* (Bdw Publishing) v10.2.0.2 with a differential photometry technique. The data were light-time corrected. Period analysis was also done with *MPO Canopus*, which incorporates the Fourier analysis algorithm developed by Harris (Harris *et al.* 1989).

Nearly 1,900 data points were obtained during six sessions. Each session was longer than 5.5 h, giving a total of more than 33 h of observations. Over the span of observations, the phase angle varied from 2.9º to 4.5º. Analysis of the data found a rotation period for 414 Liriope of P = 7.353 ± 0.002 h along with a peak-to-peak amplitude of A = 0.13 ± 0.05 mag.

This leaves only four asteroids numbered below 500 for which no rotation parameters could be found. They are, in ascending order, 330 Adalberta, 398 Admete, 457 Alleghenia, and 473 Nolli. With respect to the following 500 asteroids (numbered from 501 to 1000) such status currently contains 37 cases, thus totaling 41 the number of the first 1000 numbered asteroids that still appear to have no previously reported rotation periods.

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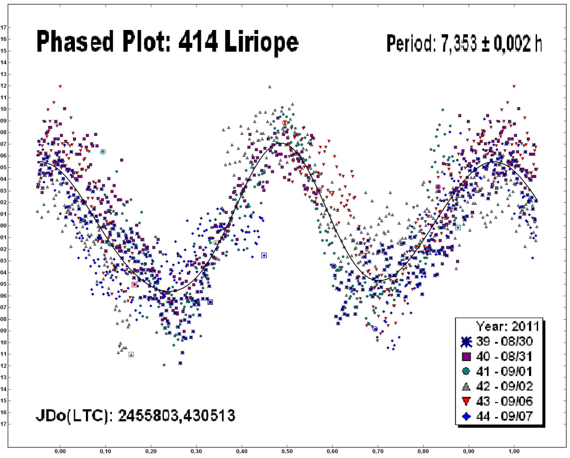

LIGHTCURVES FOR 2567 ELBA, 2573 HANNU OLAVI, 2731 CUCULA, 4930 REPHILTIM, 6952 NICCOLO, AND 7750 MCEWEN

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Lightcurve observations have yielded period determinations for the following asteroids: 2567 Elba, 9.7794 ± 0.0008 h; 2573 Hannu Olavi, 4.9326 ± 0.0003 h; 2731 Cucula, 26.886 ± 0.003 h; 4930 Rephiltim, 5.2423 ± 0.0001 h; 6952 Niccolo, 12.532 ± 0.001 h; and 7750 McEwen, 27.8182 ± 0.0009 h.

Photometric data for six asteroids were obtained at Barnes Ridge Observatory located in northern California, USA, using a 0.43-m PlaneWave f/6.8 corrected Dall-Kirkham astrograph and Apogee U9 camera. The camera was binned 2x2 with a resulting image scale of 1.26 arc-seconds per pixel. All image exposures were 210 seconds taken through a photometric C filter with the imager cooled to –25°C. All images were obtained with *MaxIm DL* V5 driven by *ACP* V6 and analyzed using *MPO Canopus* v10.4 (Warner, 2011). All comparison stars and asteroid targets had an SNR at least 200.

2567 Elba. Data were collected from 2011 July 23 through August 04 resulting in 9 data sets totaling 443 data points. 2567 Elba was tracked through 29.58 revolutions. A period of 9.7785 ± 0.0007 h was determined with a peak-to-peak amplitude of 0.25 mag.

2573 Hannu Olavi. Data were collected from 2011 May 4 through May 13 resulting in 4 data sets totaling 307 data points. 2573 Hannu Olavi was tracked through 44.87 revolutions. A period of 4.9326 ± 0.0003 h was determined with a peak-to-peak amplitude of 0.35 mag.

2731 Cucula. Data were collected from 2011 August 5 through September 7 resulting in 17 data sets totaling 688 data points. 2731 Cucula was tracked through 29.51 revolutions. A period of 26.886 ± 0.003 h was determined with a peak-to-peak amplitude of approximately 0.3 mag.

4930 Rephiltim. Data were collected from 2011 February 10 through April 11 resulting in 6 data sets totaling 436 data points. 4930 Rephiltim was tracked through 275.35 revolutions. A period of 5.2423 ± 0.0001 h was determined with a peak-to-peak amplitude of 0.32 mag.

6952 Niccolo. Data were collected from 2011 July 1 through August 1 resulting in 14 data sets totaling 458 data points. 6952 Niccolo was tracked through 59.32 revolutions. A period of 12.5326 ± 0.0008 h was determined with a peak-to-peak amplitude of approximately 1.0 mag.

7750 McEwen. Data were collected from 2011 August 30 through September 29 resulting in 18 data sets totaling 1085 data points. 7750 McEwen was tracked through 25.91 revolutions. A period of 27.8182 ± 0.0009 h was determined with a peak-to-peak amplitude of 0.44 mag.

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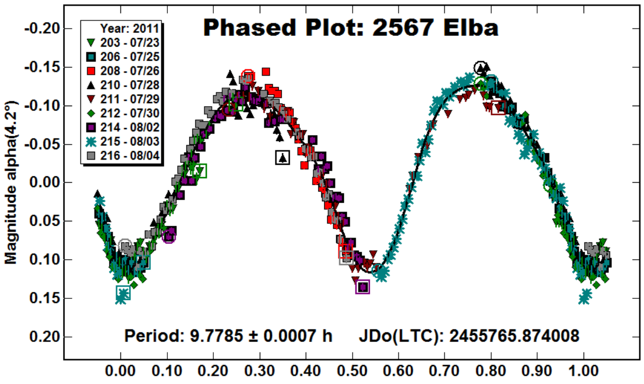

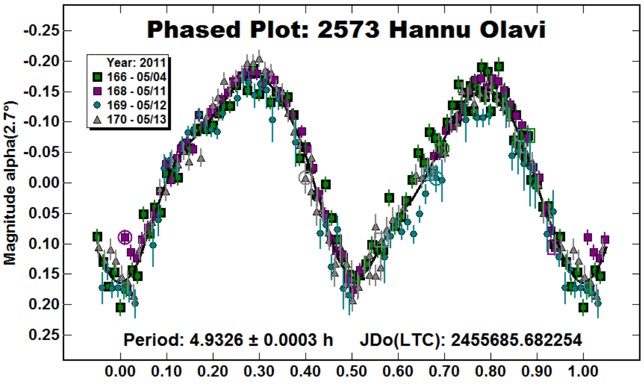

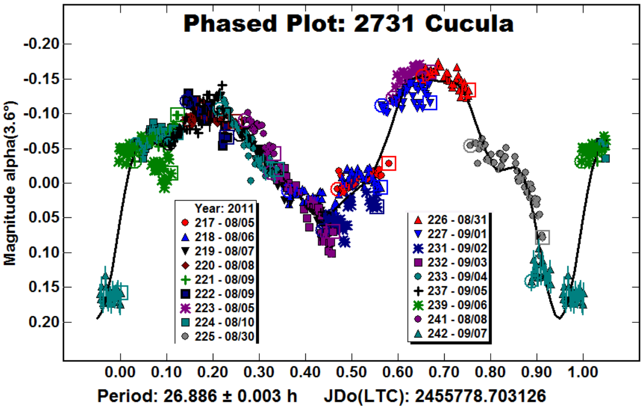

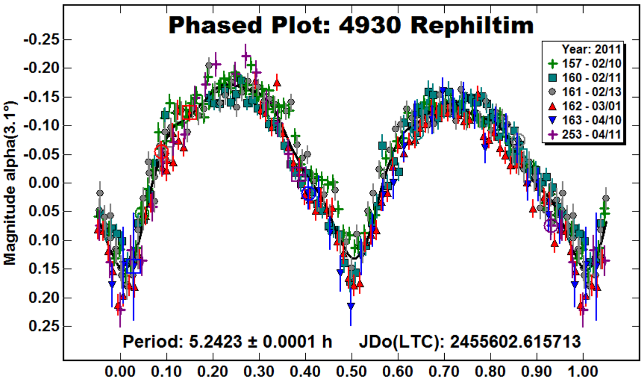

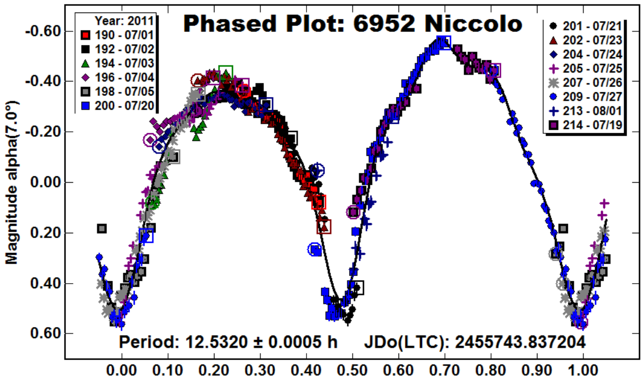

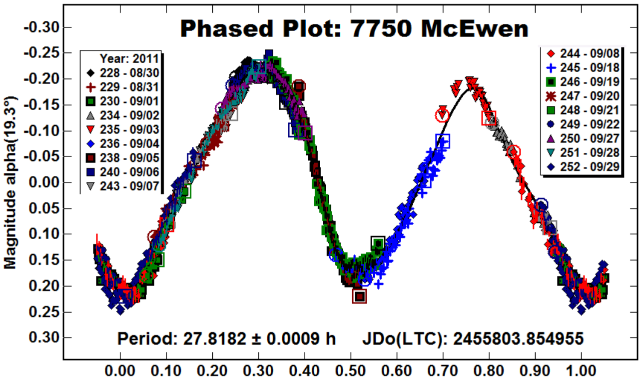

ASTEROID LIGHTCURVE ANALYSIS AT THE DANHENGE OBSERVATORY APR – AUG 2011

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(Received: 15 October)

The lightcurves for three main-belt asteroids, 1413 Roucarie, 3385 Bronnina, and 39890 Bobstephens. All observations were taken from the DanHenge Observatory, one of 13 observatories at Goat Mountain Astronomical Research Station (GMARS - MPC G79).

Observations of asteroids 1413 Roucarie, 3385 Bronnina, and 39890 Bobstephens were made during the timeframe from 2011 April through 2011 August. The asteroids were selected from the list of asteroid photometry opportunities published on the Collaborative Asteroid Lightcurve Link (CALL) website (Warner et al. 2010), as well as a personal decision to work 39890 Bobstephens. A search of the Asteroid Lightcurve Database did not reveal previously reported results, hence all data and analysis is provided by the author.

All images for asteroids 1413 Roucarie and 3385 Bronnina were taken using a Meade 14-inch f/10 ACF OTA mounted on a Mathis Instruments MI-500F fork and an SBIG ST-9XE. All exposures were unbinned and unfiltered. Images for asteroid 39890 Bobstephens were taken with an SBIG ST-10XE on the same mount and OTA noted above. These exposures were binned 3x3 and unfiltered. Measurements and analysis were made using *MPO Canopus*, which employs differential aperture photometry to produce the raw data and incorporates the Fourier analysis algorithm (FALC) (Harris et al. 1989). Night-to-night calibration of the zero points was done using 2MASS magnitudes of five comparison stars of similar color to an asteroid. See Warner (2007) and Stephens (2008) for further discussion of this process that provides calibration of nightly zero points typically good to within ± 0.05 mag.

<u>1413 Roucaurie</u>. The findings for 1413 Roucaurie, comprised of 2 nights of observations on April 10th and April 30th with 124 data points, show the synodic period to be 6.357 ± .001 h and an amplitude of 0.50 ± 0.02 mag.

<u>3385 Bronnina</u>. For 3385 Bronnina, I had 3 nights of observations on April 10th, April 30th, and May 30th with 221 data points, resulting in a synodic period finding of 2.996 ± .001 h and an amplitude of 0.25 ± .01 mag.

<u>39890 Bobstephens</u>. The choice to work 39890 Bobstephens was a personal decision because Mr. Bob Stephens has been my mentor these past few years and has been instrumental in my success in the realm of astronomical science and the contributions that amateurs can make to the international community, and the inclusion of the results of my efforts on his asteroid in this edition is a proud moment in my early experiences in the field of asteroid photometry.

Also of note, this asteroid brightened to 18.6 mag during the timeframe the observations were made, which in and of itself, presented quite a challenge for a 14 inch OTA. In an effort to minimize the streaking effect during capture, exposures were limited to 5 minutes on an SBIG ST-10XE binned 3x3 and unfiltered. The findings, comprised of 5 nights of observations from July 29th through August 8th and consisting of 129 data points, show that the synodic period for 39890 Bobstephens is 9.55 ± 0.01 h with an amplitude of 0.20 ± 0.05 mag. These results were presented to Bob upon his return from Chile at the end of August. It was a great day!

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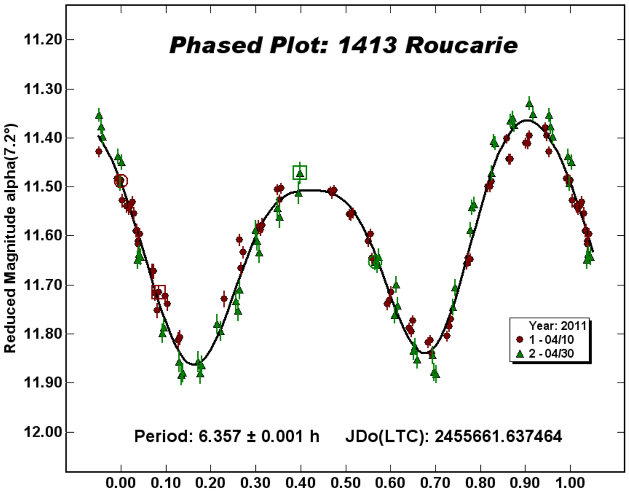

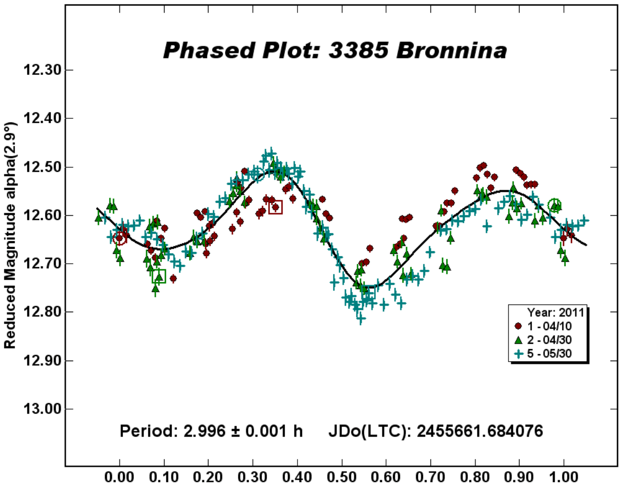

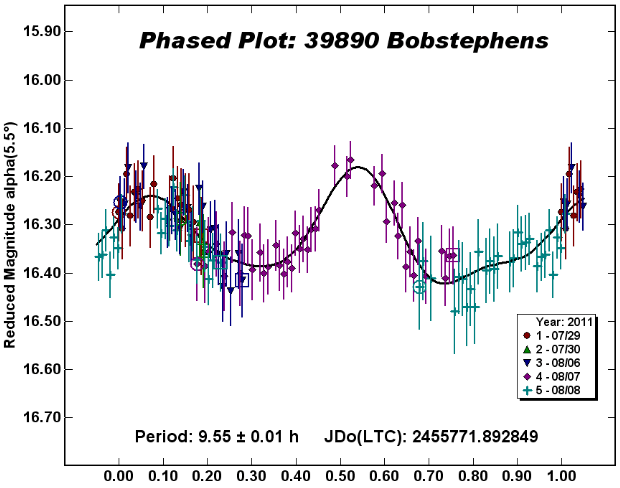

THE ROTATIONAL PERIOD OF 1406 KOMPPA

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(Received: 7 October)

Our observations of main-belt asteroid 1406 Komppa indicate a synodic period of P = 3.508 ± 0.002 h, A = 0.16 ± 0.05 mag.

Observations of 1406 Komppa were taken over 7 nights in 2011 August and September. The Shed of Science used a 0.35-m Schmidt Cassegrain (SCT) with an SBIG ST-10XE CCD camera working at f/8.5, resulting in a scale of 0.94 arcsec/pixel. Exposures were made through a Celestron UHC LPR filter. The Etscorn Campus Observatory of New Mexico Institute of Mining and Technology has two identical 0.35-m SCT operating at f/11 with SBIG STL-1001E CCD cameras resulting in an image scale of 1.25 arcsec/pixel. HUT Observatory has a 16-inch f/8 Ritchey-Chretien reflector by DFM Engineering. For these observations we used an Apogee Alta model U47 CCD with a Bessell R filter. The exposures were binned 2x2 for an effective image scale of 1.65 arcsec/pixel.

All images were dark and flat field corrected. Images were measured using *MPO Canopus* (Bdw Publishing) with a differential photometry technique. The *MPO Canopus* Comp Star Selector was used to link sessions. The data were light-time corrected. Period analysis was also done with *MPO Canopus*, incorporating the Fourier analysis algorithm developed by Harris (Harris *et al.* 1989).

Behrend (2011) reported a period near 7.0 h, or twice the period we are reporting here. Our current results are in close agreement with earlier work on this object by Polishook (2009).

Acknowledgements

Partial funding for work at the Shed of Science is provided by Gene Shoemaker NEO Grants from the Planetary Society. Work at the HUT Observatory is supported by the Mittelman Foundation.

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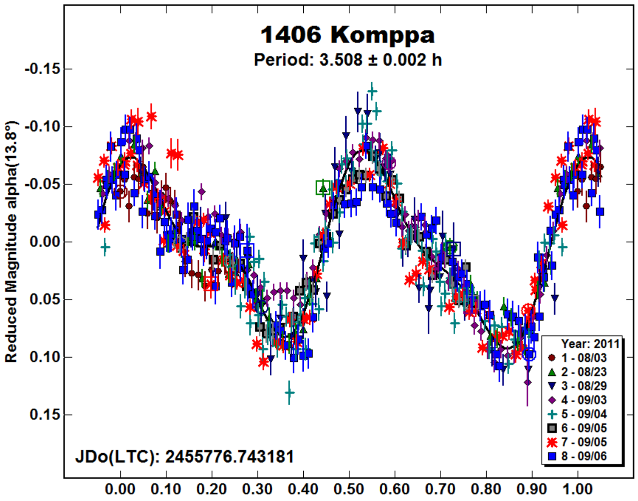

ROTATIONAL PERIOD DETERMINATION FOR 1820 LOHMANN

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Observations of main-belt minor planet 1820 Lohmann were undertaken by Lenomiya Observatory during 2011 August-September. Data analysis found a period of 14.048 ± 0.001 h with amplitude 0.48 ± 0.01 mag.

1820 Lohmann is a main-belt asteroid, discovered in 1949 by K. Reinmuth in Heidelberg and named in honor of Werber Lohmann (1911-1983), an astronomer at Heidelberg (Schmadel, 2003). The asteroid was selected from Collaborative Asteroid Lightcurve Link (CALL) site's Lightcurve Targets list (Warner, 2011). A search of the Asteroid Lightcurve Database and other sources does not reveal any previously reported lightcurve results for 1820 Lohmann.

Observations of the asteroid were made at the Lenomiya Observatory with a Celestron CPC-1100 0.28-m Schmidt-Cassegrain (SCT) working at f/6.3 using a focal reducer. Images were guided and unfiltered using a Santa Barbara Instruments Group ST8XME CCD camera operating at –12° C. The images were binned 2x2, which resulted in an effective array of 765x510 18-micron pixels and scale of 1.92 arcseconds/pixel. The 1,442 images were exposed in the range of 60 s to 100 s, depending on atmospheric conditions, in order to maximize SNR. They were calibrated using *CCDSoft* version 5.00.205 and measured using *MPO Canopus* version 10.4.0.4 (Warner, 2011).

Analysis of the data disclosed a bimodal lightcurve with a period of 14.048 ± 0.001 h with an amplitude of 0.48 ± 0.01 mag.

Individual sessions spanned the complex section of the curve ruling out any trimodal or monomodal fit. Due to weather problems, only about 85% phase coverage could be obtained. However, I believe this period to be secure because the only shape that can produce a lightcurve with an amplitude as large as 0.40 magnitudes is an elongated body that features two maxima and minima per cycle that are nearly symmetrically placed.

Acknowledgments

The author wishes to express gratitude to Frederick Pilcher for his support and helpful suggestions on the *MPO Canopus* software and period determination.

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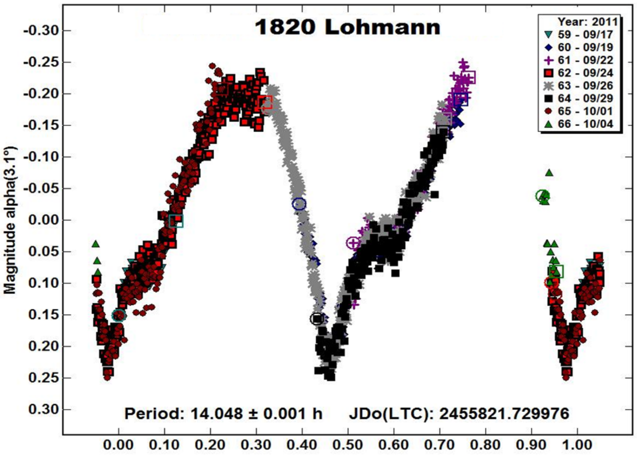

ASTEROID LIGHTCURVE ANALYSIS AT THE OAKLEY SOUTHERN SKY OBSERVATORY: 2011 APRIL–MAY

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(Received: 15 October)

Photometric data for 19 asteroids were collected over 21 nights during 2011 April and May at the Oakley Southern Sky Observatory. The asteroids observed included: 518 Halawe, 828 Lindemannia, 999 Zachia, 1305 Pongola, 1359 Prieska, 1858 Lobachevskij, 2008 Konstitutsiya, 2141 Simferopol, 2271 Kiso, 2691 Sersic, 2776 Baikal, 2841 Puijo, 2931 Mayakovsky, 3031 Houston, 3044 Saltykov, 3181 Ahnert, 3248 Farinella, 4362 Carlisle, and 5092 Manara.

Nineteen asteroids were observed from the Oakley Southern Sky Observatory near Coonabarabran, New South Wales, Australia on the nights of 2011 April 22-30, May 1, May 3-7, May 9-10, and May 25-28. From these images, we were able to find lightcurves for eight asteroids. Of those eight, six were previously unrecorded results. Our result for one asteroid was reasonably close to the already published period, but the other was significantly different.

The selection of asteroids was based on their sky position approximately one hour after sunset. Asteroids without previously published lightcurves were given higher priority than asteroids with known periods. Asteroids with uncertain periods were also selected with the hope that we would be able to improve earlier results. We used an RC Optical, 20-inch Ritchey-Chretien optical tube assembly mounted on a Paramount ME. The camera was a Santa Barbara Instrument Group STL-1001E with a clear filter. The image scale was 1.2 arcseconds per pixel at f/8.3. Calibration of the images was done using master twilight flats, darks, and bias frames. All calibration frames were created using *CCDSoft*. *MPO Canopus* was used to measure the processed images and complete the period analysis of the asteroids' lightcurves.

As far as we are aware, these are the first reported lightcurve and period determinations for asteroids 518 Halawe, 2008 Konstitutsiya, 2141 Simferopol, 2931 Mayakovsky, 3031 Houston, and 3248 Farinella. Our data for 828 Lindemannia, 999 Zachia, 1359 Prieska, 2271 Kiso, 2691 Sersic, 2776 Baikal, 2841 Puijo, 3044 Saltykov, 3181 Ahnert, 4362 Carlisle, and 5092 Manara were too noisy to determine their periods. Supporting lightcurve plots are included. Results from all of the asteroids are listed in the table below. Additional comments have been included as needed.

<u>999 Zachia.</u> We were unable to confirm the period of 22.77 ± 0.03 h found by Warner (2000).

<u>1305 Pongola.</u> Our results are within experimental uncertainty of the period of 8.03 ± 0.10 h found by Binzel (1987).

<u>1858 Lobachevskij.</u> Our current results are not compatible with the period of 7.00 ± 0.01 h reported by Ditteon (2002). However, the data from 2002 were reexamined and found to fit a period of 5.435 ± 0.009 h, which is close to our new value. In addition to the plot of the current data, a plot of the reexamined data is also included.

<u>2841 Puijo.</u> We were unable to confirm the period of 3.545 ± 0.005 h found by Warner (2004).

Number	Name	Dates (mm/dd 2011)	Data Points	Period (h)	Error (h)	Amp (mag)	Err (mag)
518	Halawe	5/1, 5/3 - 5/6, 5/9, 5/10	141	14.310	0.002	0.50	0.03
828	Lindemannia	5/1, 5/3 - 5/7, 5/9, 5/10	139			0.08	0.04
999	Zachia	5/25 - 5/28	65			0.04	0.04
1305	Pongola	5/25 - 5/28	82	8.06	0.02	0.14	0.04
1359	Prieska	5/25 - 5/28	74			0.04	0.04
1858	Lobachevskij	5/25 - 5/28	73	5.413	0.003	0.30	0.03
2008	Konstitutsiya	4/22 - 4/30	178	11.279	0.009	0.06	0.02
2141	Simferopol	4/22 - 4/30	200	14.956	0.003	0.48	0.03
2271	Kiso	5/1, 5/3 - 5/7, 5/9, 5/10	102			0.12	0.04
2691	Sersic	5/25 - 5/28	93			0.20	0.04
2776	Baikal	5/1, 5/3 - 5/6, 5/9, 5/10	141			0.04	0.04
2841	Puijo	5/25 - 5/28	74			0.10	0.04
2931	Mayakovsky	4/22 - 4/23, 4/25 - 4/30	149	37.38	0.05	0.14	0.02
3031	Houston	4/22 - 4/23, 4/25 - 4/30	186	11.218	0.006	0.11	0.04
3044	Saltykov	5/25 - 5/28	77			0.04	0.04
3181	Ahnert	5/1, 5/3 - 5/7, 5/9, 5/10	137			0.08	0.04
3248	Farinella	4/22 - 4/23, 4/25 - 4/30	147	6.676	0.002	0.20	0.04
4362	Carlisle	4/22 - 4/30	186			0.10	0.04
5092	Manara	5/1, 5/3 - 5/7, 5/9, 5/10	101			0.10	0.04

Table I. Observing circumstances.

Acknowledgements

We would like to thank Rose-Hulman's Operation Catapult for making it possible for us to work together on this project (*http://www.rose-hulman.edu/catapult/*).

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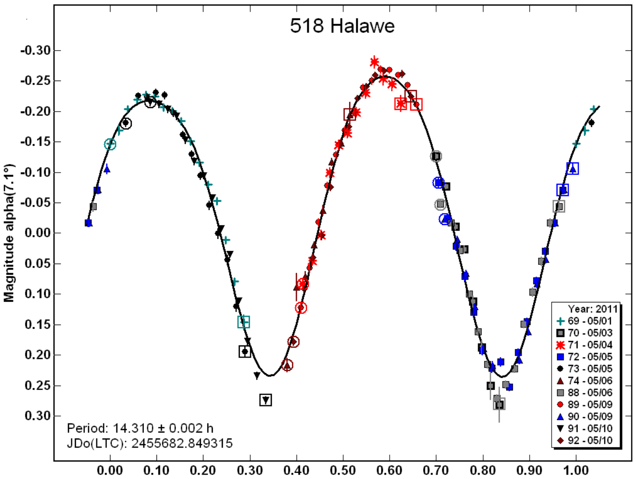
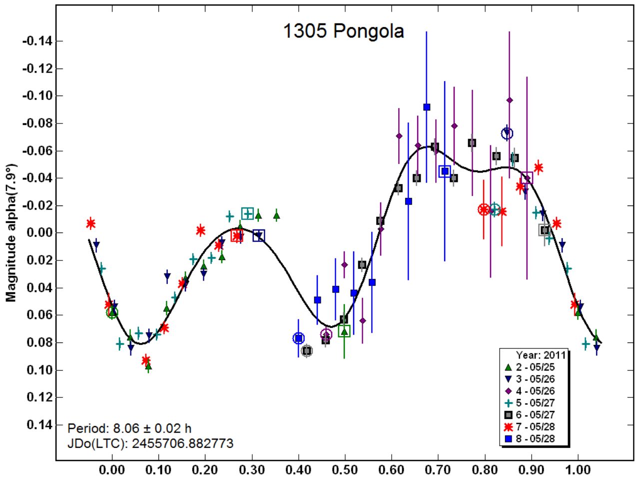
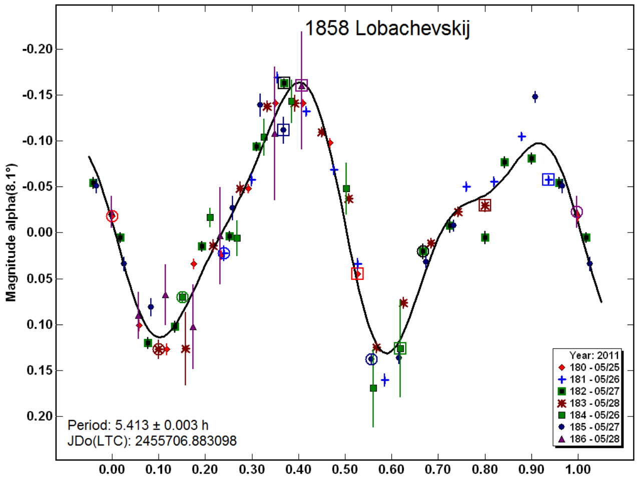
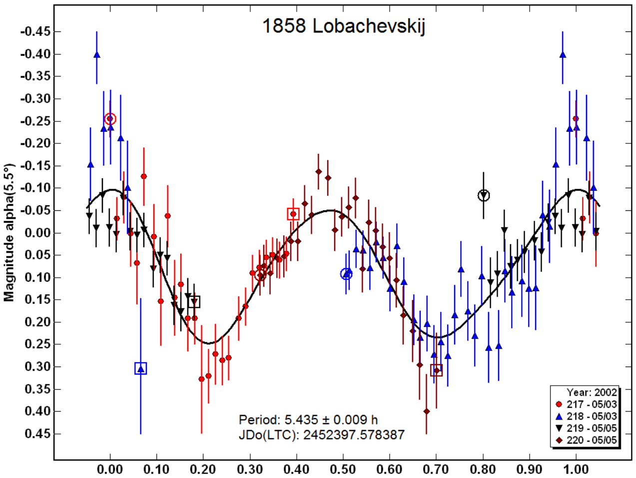
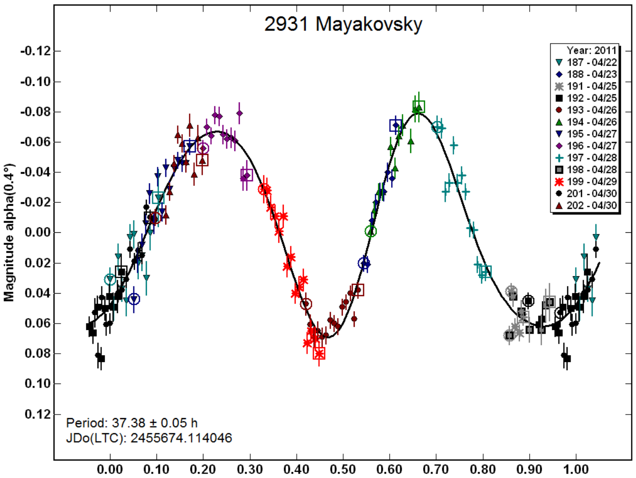
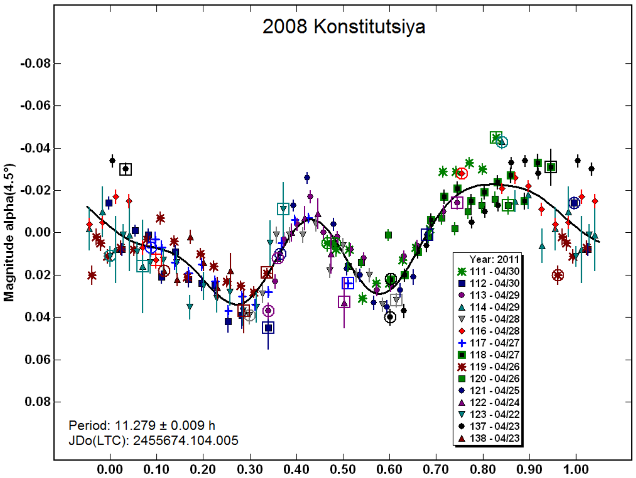


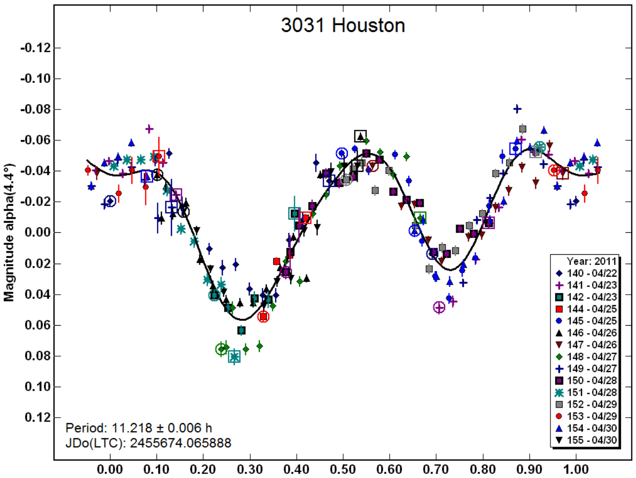


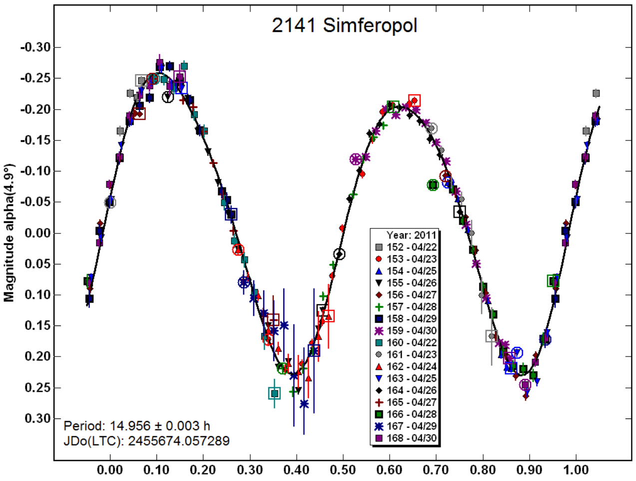


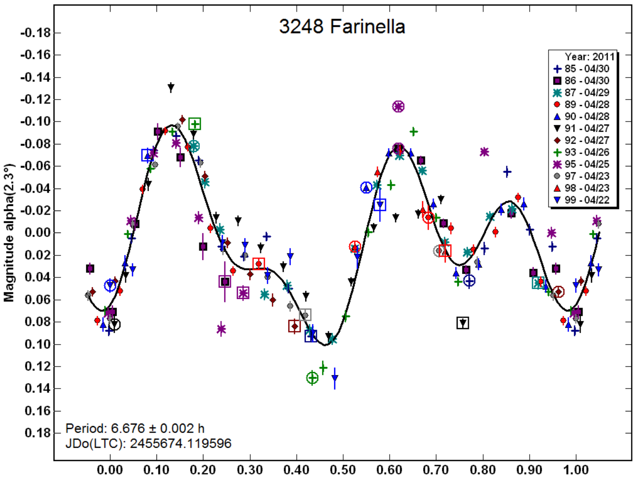

1858 Lobachevskij
Magnitude alpha(5.5°)
-0.45
-0.40
-0.35
-0.30
-0.25
-0.20
-0.15
-0.10
-0.05
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Year: 2002
217 - 05/03
218 - 05/03
219 - 05/05
220 - 05/05
Period: 5.435 ± 0.009 h
JDo(LTC): 2452397.578387


2931 Mayakovsky
Magnitude alpha(0.4°)
-0.12
-0.10
-0.08
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Year: 2011
187 - 04/22
188 - 04/23
191 - 04/25
192 - 04/25
193 - 04/26
194 - 04/26
195 - 04/27
196 - 04/27
197 - 04/28
198 - 04/28
199 - 04/29
201 - 04/30
202 - 04/30
Period: 37.38 ± 0.05 h
JDo(LTC): 2455674.114046


2008 Konstitutsiya
Magnitude alpha(4.5°)
-0.08
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
0.08
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Year: 2011
111 - 04/30
112 - 04/30
113 - 04/29
114 - 04/29
115 - 04/28
116 - 04/28
117 - 04/27
118 - 04/27
119 - 04/26
120 - 04/26
121 - 04/25
122 - 04/24
123 - 04/22
137 - 04/23
138 - 04/23
Period: 11.279 ± 0.009 h
JDo(LTC): 2455674.104.005


3031 Houston
Magnitude alpha(4.4°)
-0.12
-0.10
-0.08
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Year: 2011
140 - 04/22
141 - 04/23
142 - 04/23
144 - 04/25
145 - 04/25
146 - 04/26
147 - 04/26
148 - 04/27
149 - 04/27
150 - 04/28
151 - 04/28
152 - 04/29
153 - 04/29
154 - 04/30
155 - 04/30
Period: 11.218 ± 0.006 h
JDo(LTC): 2455674.065888


2141 Simferopol
Magnitude alpha(4.9°)
-0.30
-0.25
-0.20
-0.15
-0.10
-0.05
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Year: 2011
152 - 04/22
153 - 04/23
154 - 04/25
155 - 04/26
156 - 04/27
157 - 04/28
158 - 04/29
159 - 04/30
160 - 04/22
161 - 04/23
162 - 04/24
163 - 04/25
164 - 04/26
165 - 04/27
166 - 04/28
167 - 04/29
168 - 04/30
Period: 14.956 ± 0.003 h
JDo(LTC): 2455674.057289


3248 Farinella
Magnitude alpha(2.3°)
-0.18
-0.16
-0.14
-0.12
-0.10
-0.08
-0.06
-0.04
-0.02
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Year: 2011
85 - 04/30
86 - 04/30
87 - 04/29
89 - 04/28
90 - 04/28
91 - 04/27
92 - 04/27
93 - 04/26
95 - 04/25
97 - 04/23
98 - 04/23
99 - 04/22
Period: 6.676 ± 0.002 h
JDo(LTC): 2455674.119596

CCD PHOTOMETRY AND LIGHTCURVE ANALYSIS OF MAIN BELT ASTEROIDS 1077 CAMPANULA AND 1151 ITHAKA FROM OBSERVATORI CARMELITA

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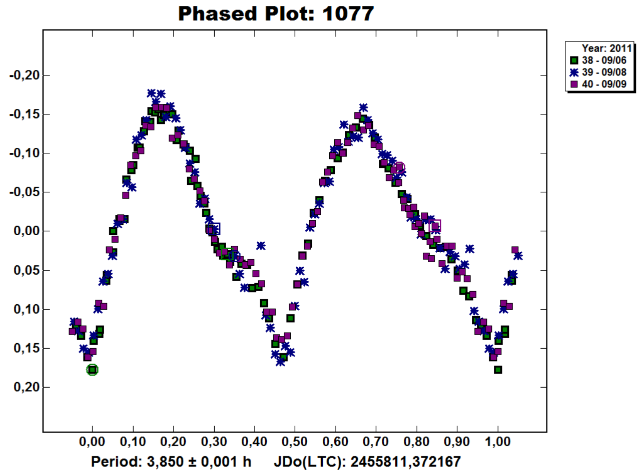
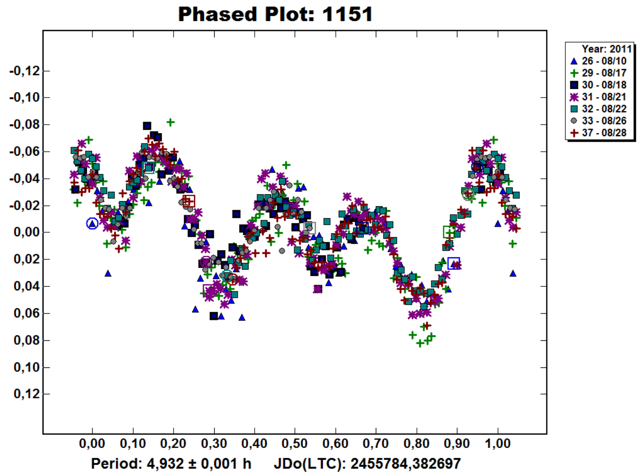
Observations carried out in 2011 August and September allowed us to determine the synodic periods of 1077 Campanula and 1151 Ithaka. For 1077 Campanula, a period of 3.850 ± 0.001 h and amplitude of 0.36 mag were found. 1151 Ithaka exhibited an irregularly-shaped lightcurve with a period of 4.932 ± 0.001 h and amplitude of 0.15 mag.

The *Carmelita Observatory* (MPC B20) is situated in Tiana, in the southernmost part of the *Serra de Marina*, a moderately light-polluted suburban park 15 km north of Barcelona, Spain. The Observatory is equipped with an Astro-Physics AP900 German Equatorial Mount on top of a fixed pier, a 25-cm Schmidt-Cassegrain telescope with a focal reducer, and a dual-chip SBIG ST8-XME CCD camera with filter wheel. This gives a 34.0' x 22.7' field of view and an effective resolution of 1.33 arc sec/pixel.

<ins>1077 Campanula (1926 TK)</ins> is a main-belt asteroid (e = 0.1982780, a = 2.3920617 AU) that was discovered by Karl Wilhelm Reinmuth at Heidelberg Observatory (024) in 1926. Before our work, no lightcurve parameters had been reported in the lightcurve database (Warner *et al.* 2011). From 2011 September 6–9, we collected 266 images of 150-s exposure through a C (clear) filter using *Maxim DL* acquisition software. The CCD camera was operated at –6º C. All images were calibrated with master bias, dark, and flat frames. According to *Astrometrica* (Raab 2011), the asteroid brightness as measured against the CMC-14 catalogue in R band was mag 13.8-14.9. We performed real-time differential photometry of the asteroid with *Fotodif* as the images were being downloaded. Using *MPO Canopus*, we derived a lightcurve showing a period of 3.850 h ± 0.001 h and amplitude of 0.36 ± 0.02 mag.



<ins>1151 Ithaka</ins> (1929 RK, e = 0.2771086, a = 2.4054447 AU) was also discovered at Heidelberg by Reinmuth (1929). It was chosen for observations from the "Lightcurve Photometry Opportunities" list in the *Minor Planet Bulletin* (Warner *et al.*, 2011). A total of 677 calibrated images were obtained during ten nights from 2011 August 10-28 using *Maxim DL*. Exposures were 150 s using a C (clear) filter with the CCD working at –6º C. Three sessions were discarded due to high-altitude clouds. The asteroid brightness was measured against the CMC-14 catalogue in R band at mag 14.0-14.3. With *MPO Canopus* we produced a rather unusual lightcurve of four minimum/maximum pairs with a synodic period of 4.932 ± 0.001 h and maximum amplitude of 0.15 ± 0.01 mag.



Acknowledgements

Special thanks are due to Ramón Bosque, a member of the Grup d'Astronomia de Tiana (G.A.T.) for revising this paper, and to Julio Castellano for his contribution with free software tools for the astronomical community. The Grup d'Astronomia de Tiana (G.A.T.) granted access to *MPO Canopus* so that we could derive the lightcurves appearing in this paper.

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ASTEROID-DEEPSKY APPULSES IN 2012

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(Received: 15 October)

The following list is a very small subset of the results of a search for asteroid-deepsky appulses for 2012, presenting only the highlights for the year based on close approaches of brighter asteroids to brighter DSOs. The complete set of predictions is available at

http://www.minorplanet.info/ObsGuides/Appulses/DSOAppulses.htm

For any event not covered, the Minor Planet Center's web site at *http://scully.harvard.edu/~cgi/CheckMP* allows you to enter the location of a suspected asteroid or supernova and check if there are any known targets in the area.

The table gives the following data, with potentially attractive astrophotography appulses indicated in **bold**:

Date/Time	Universal Date (MM DD) and Time of closest approach
#/Asteroid	The number and name of the asteroid
RA/Dec	The J2000 position of the asteroid
AM	The approximate visual magnitude of the asteroid
Sep/PA	The separation in arcseconds and the position angle from the DSO to the asteroid
DSO	The DSO name or catalog designation
DM	The approximate total magnitude of the DSO
DT	The type of DSO: OC = Open Cluster; GC = Globular Cluster; G = Galaxy
SE/ME	The elongation in degrees from the sun and moon respectively
MP	The phase of the moon: 0 = New, 1.0 = Full. Positive = waxing; Negative = waning

Date	UT	#	Name	RA	Dec	AM	Sep	PA	DSO	DM	DT	SE	ME	MP
01 19	07:13	31	Euphrosyne	01:50.27	+27 11.4	11.6	258	148	Cr 21	8.2	OC	97	146	-0.19
01 30	08:14	387	Aquitania	10:54.30	+17 14.8	12.2	216	233	NGC 3455	12.0	G	150	126	0.42
02 21	00:14	144	Vibilia	11:00.24	+13 52.1	12.4	125	205	NGC 3489	10.3	G	168	157	-0.01
02 26	14:01	387	Aquitania	10:34.94	+21 41.5	11.8	191	38	NGC 3287	12.3	G	167	121	0.20
02 26	21:39	423	Diotima	15:00.79	-07 29.6	12.5	99	184	NGC 5812	11.2	G	112	163	0.22
03 16	11:40	416	Vaticana	10:51.28	+27 57.3	12.0	105	187	NGC 3414	11.0	G	151	127	-0.34
03 19	06:30	432	Pythia	12:36.13	+19 18.3	11.8	116	209	NGC 4561	12.5	G	159	133	-0.11
03 21	19:09	97	Klotho	12:20.59	+05 27.7	11.4	279	37	NGC 4281	11.3	G	173	164	-0.01
03 22	09:25	97	Klotho	12:20.10	+05 33.1	11.4	305	36	NGC 4270	12.2	G	173	168	0.00
03 23	18:02	5	Astraea	11:28.46	+09 25.4	9.4	100	33	NGC 3692	12.1	G	165	151	0.01
04 16	19:00	127	Johanna	15:17.39	-20 58.6	12.4	144	357	NGC 5897	8.6	GC	154	105	-0.18
04 18	01:08	374	Burgundia	12:51.59	-10 31.8	12.2	292	219	NGC 4742	11.3	G	167	157	-0.10
04 21	03:22	374	Burgundia	12:49.48	-10 05.6	12.3	111	41	AN 3	11.6	G	164	166	0.00
04 25	**07:15**	**326**	**Tamara**	**12:58.10**	**+01 34.9**	**11.9**	**9**	**158**	**NGC 4845**	**11.2**	**G**	**156**	**114**	**0.14**
05 23	00:13	5	Astraea	11:30.24	+09 20.9	10.9	265	27	NGC 3705	11.1	G	107	85	0.04
06 14	17:09	37	Fides	12:39.97	-05 52.3	12.5	282	205	NGC 4597	12.1	G	108	161	-0.20
06 17	**03:23**	**596**	**Scheila**	**16:17.05**	**-23 00.6**	**12.2**	**102**	**158**	**M80**	**7.2**	**GC**	**160**	**173**	**-0.05**
06 18	13:59	42	Isis	12:49.17	+03 23.7	12.2	30	232	NGC 4701	12.4	G	102	114	-0.01
06 19	**10:30**	**216**	**Kleopatra**	**18:10.72**	**-07 10.4**	**11.7**	**97**	**11**	**IC 1276**	**10.3**	**GC**	**163**	**164**	**0.00**
07 11	17:14	804	Hispania	20:48.64	-38 03.7	11.4	223	173	NGC 6958	11.4	G	156	84	-0.43
07 17	05:03	89	Julia	13:41.39	-29 51.1	11.7	306	343	NGC 5264	12.0	G	99	120	-0.04
07 18	22:37	196	Philomela	18:12.84	-28 23.7	11.1	224	172	PK 3-4.9	12.0	PN	156	157	0.00
07 20	16:23	196	Philomela	18:11.64	-28 25.8	11.2	228	173	PK 3-4.7	11.0	PN	154	135	0.03
07 24	21:30	11	Parthenope	23:18.77	-07 35.0	9.9	120	271	NGC 7600	11.9	G	135	154	0.34
08 12	**11:18**	**138**	**Tolosa**	**17:02.60**	**-26 16.7**	**12.3**	**44**	**184**	**M19**	**7.2**	**GC**	**117**	**175**	**-0.25**
09 13	07:27	18	Melpomene	17:56.19	-16 33.7	10.4	242	204	PK 11+4.1	12.0	PN	98	134	-0.09
09 21	22:36	287	Nephthys	01:04.89	-06 09.4	11.4	287	319	New 1	11.8	G	162	115	0.40
12 09	**19:39**	**488**	**Kreusa**	**08:27.09**	**+25 58.0**	**12.4**	**9**	**254**	**NGC 2592**	**12.3**	**G**	**135**	**86**	**-0.17**
12 12	15:30	704	Interamnia	02:37.00	+33 18.1	10.3	160	109	NGC 987	12.4	G	143	151	-0.01
12 18	02:18	9	Metis	07:07.07	+27 17.1	8.8	259	204	NGC 2331	8.5	OC	161	133	0.29

LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2012 JANUARY–MARCH

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We present lists of asteroid photometry opportunities for objects reaching a favorable apparition and have no or poorly-defined lightcurve parameters. Additional data on these objects will help with shape and spin axis modeling 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 four lists of "targets of opportunity" for the period 2012 January-March. For background on the program details for each of the opportunity lists, refer to previous issues, e.g., *Minor Planet Bulletin* **36**, 188. 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:

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

Objects with U = 1 should be given higher priority when possible. *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. Note that the lightcurve amplitude in the tables could be more or less than what's given. Use the listing only as a guide.

The first list is an *abbreviated list* of those asteroids reaching V < 15.0 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. A more complete list as well as one including objects V < 16.0 can be found on the CALL web site.

http://www.minorplanet.info/CALL/targets_2012_Q1.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 spin axis and/or shape modeling. Those doing work for modeling should contact Josef Ďurech at the email address above and/or 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 to determine the lightcurve period, amplitude, and shape are needed to supplement the radar data. *High-precision work, 0.01-0.02 mag, is preferred, especially if the object is a known or potential binary*. 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

As always, we encourage observations of asteroids even if they have well-established lightcurve parameters and especially if they are lacking good spin axis and/or shape model solutions. Every lightcurve of sufficient quality supports efforts to resolve a number of questions about the evolution of individual asteroids and the general population. For example, pole directions are known for only about 30 NEAs out of a population of 8000. This is hardly sufficient to make even the most general of statements about NEA pole alignments, including whether or not the thermal YORP effect is forcing pole orientations into a limited number of preferred directions (see La Spina *et al.*, 2004, *Nature* **428**, 400-401). Data from many apparitions can help determine if an asteroid's rotation rate is being affected by YORP, which can also cause the rotation rate of a smaller, irregularly-shaped asteroid to increase or decrease. See Lowry *et al.* (2007) *Science* **316**, 272-274 and Kaasalainen *et al.* (2007) *Nature* **446**, 420-422.

The ephemeris listings for the optical-radar listings include lunar elongation and phase. Phase values range from 0.0 (new) to 1.0 (full). If the value is positive, the moon is waxing – between new and full. If the value is negative, the moon is waning – between full and new. The listing also includes the galactic latitude. When this value is near 0°, the asteroid is likely in rich star fields and so may be difficult to work. It is important to emphasize that the ephemerides that we provide are only guides for when you might observe a given asteroid. Obviously, you should use your discretion and experience to make your observing program as effective as possible.

Once you've 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.

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Lightcurve Opportunities

		Brightest				LCDB Data	
#	Name	Date	Mag	Dec	U	Period	Amp
621	Werdandi	1 02.9	13.9	+25	2	9.39	0.58
5435	Kameoka	1 05.7	14.9	+20			
8882	Sakaetamura	1 07.4	15.0	-10	2	2.83	0.66
3115	Baily	1 08.5	13.6	+13	2+	16.22	0.08-0.14
555	Norma	1 09.5	14.1	+21	2	30.6	0.20
3063	Makhaon	1 12.0	15.0	+21	2	8.64	0.03-0.15
3017	Petrovic	1 13.7	14.1	+ 9	2	4.06	0.40
4801	Ohre	1 14.8	14.8	+24			
1373	Cincinnati	1 15.1	15.0	+25	2	5.28	0.14
9780	Bandersnatch	1 16.8	14.6	+21	2+	8.23	0.16
5297	Schinkel	1 16.9	15.0	+14			
1311	Knopfia	1 20.6	15.0	+16	1+	9.65	1.3
2464	Nordenskiold	1 21.7	14.7	+21			
2026	Cottrell	1 22.3	15.0	+21			
6972	Helvetius	1 26.5	14.8	+ 8			
1660	Wood	1 30.6	13.7	-25			
4700	Carusi	1 30.2	14.7	+25			
47035	1998 WS	1 31.7	14.6	+69			
4874	Burke	2 01.6	14.7	+19			
27174	1999 BB2	2 02.9	14.4	+25			
28913	2000 OT	2 03.2	14.0	+16	2	15.30	0.35
3141	Buchar	2 04.8	14.7	+18	2+	11.41	0.47
1724	Vladimir	2 06.9	14.7	+ 7	2	12.57	0.14
2965	Surikov	2 09.2	14.3	+25	2	9.07	0.29
1985	Hopmann	2 09.3	14.4	+ 8			
585	Bilkis	2 15.8	12.6	+ 5	2+	8.57	0.41
3580	Avery	2 17.1	14.6	+14			
2842	Unsold	2 19.6	14.8	+ 5			
4350	Shibecha	2 19.9	14.8	+32			
162421	2000 ET70	2 20.6	13.2	-21			
6618	1936 SO	2 20.1	14.4	+16	2+	8.29	0.20
3397	Leyla	2 22.1	15.0	+48			
3764	Holmesacourt	2 22.0	15.0	+11			
8045	Kamiyama	3 03.0	14.6	- 8			
192642	1999 RD32	3 04.5	14.6	+ 2			
1502	Arenda	3 06.3	14.7	+ 2	2	45.8	0.4
1841	Masaryk	3 07.6	15.0	+ 8	2+	7.53	0.52
2635	Huggins	3 15.5	14.5	- 5			
1228	Scabiosa	3 17.0	14.8	- 2			
4892	Chrispollas	3 18.0	14.9	- 7			
18243	Gunn	3 20.4	14.8	+ 1			
2846	Ylppo	3 26.5	15.0	+ 8	2-	> 12.	0.25
1465	Autonoma	3 27.6	14.8	+ 2	2	4.88	0.13

Low Phase Angle Opportunities

#	Name	Date	α	V	Dec	Period	Amp	U
158	Koronis	01 01.6	0.16	12.8	+23	14.218	0.28-0.43	3
621	Werdandi	01 02.9	0.76	13.9	+25	9.396	0.58	2
316	Goberta	01 15.4	0.24	13.4	+21	8.605	0.20-0.27	3
1017	Jacqueline	01 15.9	0.37	13.9	+20	7.87	0.6	3
370	Modestia	01 18.9	0.67	13.5	+19	22.5299	0.24-0.40	3
165	Loreley	01 20.1	0.27	12.3	+21	7.226	0.05-0.17	3
213	Lilaea	01 22.9	0.07	12.8	+20	8.045	0.07-0.20	3
240	Vanadis	01 23.2	0.23	11.6	+20	10.64	0.34	3
817	Annika	02 02.4	0.98	13.7	+19	10.56	0.27	3
586	Thekla	02 05.1	0.85	13.0	+14	13.670	0.30	3
140	Siwa	02 09.6	0.74	12.9	+17	34.407	0.05-0.15	3-
96	Aegle	02 10.1	0.19	11.0	+15	13.82	0.05-0.29	3
243	Ida	02 16.7	0.14	13.6	+12	4.634	0.45-0.86	3
461	Saskia	02 16.8	0.18	14.0	+12	7.348	0.25-0.36	3
924	Toni	02 16.9	0.22	13.7	+12	21.	0.1	1
606	Brangane	02 17.0	0.70	14.0	+10	12.2950	0.21	3-
1182	Ilona	02 23.6	0.31	13.9	+11	29.8	1.2	2
46	Hestia	02 23.8	0.55	12.2	+08	21.04	0.11	3
147	Protogeneia	02 25.2	0.85	13.1	+07	7.853	0.28	3
297	Caecilia	02 26.0	0.23	14.0	+08	4.163	0.15-0.27	3
16	Psyche	03 02.8	0.29	10.3	+08	4.196	0.03-0.42	3
325	Heidelberga	03 03.2	0.15	13.1	+07	6.737	0.20	3
33	Polyhymnia	03 03.5	0.29	13.8	+08	18.608	0.14-0.21	3
327	Columbia	03 07.1	0.53	13.9	+07	5.9320	0.16-0.42	3
332	Siri	03 08.3	0.97	13.6	+07	8.0074	0.10-0.15	3
36	Atalante	03 15.8	0.50	12.6	+03	9.93	0.12-0.17	3

Low Phase Angle Opportunities (continued)

#	Name	Date	α	V	Dec	Period	Amp	U
257	Silesia	03 19.9	0.92	13.9	+03	15.7095	0.31	3
93	Minerva	03 21.6	0.28	11.2	+00	5.982	0.04-0.10	3
1269	Rollandia	03 21.6	0.78	13.7	+02			
55	Pandora	03 24.3	0.39	12.0	+00	4.8040	0.07-0.40	3
720	Bohlinia	03 27.5	0.62	13.3	-01	8.919	0.17-0.46	3
373	Melusina	03 30.0	0.62	14.0	-06	12.97	0.25	3
379	Huenna	03 30.1	0.19	13.9	-03	7.022	0.09	2-
150	Nuwa	03 30.2	0.27	12.8	-05	8.135	0.08-0.31	3

Shape/Spin Modeling Opportunities

There are two lists here. The first is for objects for which good occultation profiles are available. These are used to constrain the models obtained from lightcurve inversion, eliminating ambiguous solutions and fixing the size of asteroid. Lightcurves are needed for modeling and/or to establish the rotation phase angle at the time the profile was obtained. The second list is of those objects for which another set of lightcurves from one more apparitions will allow either an initial or a refined solution.

Occultation Profiles Available

		Brightest			LCDB DATA		
#	Name	Date	Mag	Dec	Period	Amp	U
200	Dynamene	1 01.	12.4	+22	19.	0.10	2
40	Harmonia	1 01.	10.6	+13	8.910	0.13 0.36	3
230	Athamantis	1 01.	11.3	+12	24.0055	0.1 0.26	3
420	Bertholda	1 01.	13.5	+19	11.04	0.29	3
27	Euterpe	1 01.	11.0	+03	10.410	0.15 0.21	3
466	Tisiphone	1 03.4	12.9	+27	8.824	0.16	3
153	Hilda	1 06.4	13.6	+14	5.9587	0.05 0.20	3
204	Kallisto	1 06.5	13.3	+11	19.489	0.09 0.26	3
790	Pretoria	1 15.1	13.7	+03	10.37	0.08 0.16	3
70	Panopaea	1 17.3	12.6	+36	15.797	0.06 0.12	3
757	Portlandia	1 27.0	12.9	+32	6.5837	0.24 0.45	3
490	Veritas	1 27.8	13.0	+08	7.930	0.33 0.58	3
578	Happelia	1 29.2	13.8	+27	10.061	0.11 0.20	3
25	Phocaea	2 03.8	12.4	-13	9.9341	0.03 0.25	3
1437	Diomedes	2 08.2	14.9	+14	24.49	0.22 0.70	3-
530	Turandot	2 11.8	14.6	+17	19.947	0.10 0.16	2+
375	Ursula	2 14.8	12.2	+17	16.83	0.17	2
386	Siegena	2 16.6	11.7	+03	9.763	0.11 0.18	3
498	Tokio	2 19.5	13.5	+21	20.	>0.36	1+
144	Vibilia	2 28.1	12.3	+15	13.819	0.15	3
559	Nanon	3 08.6	13.0	+16	10.059	0.08 0.26	3
791	Ani	3 17.0	14.5	+17	16.72	0.32	2
106	Dione	3 17.9	12.4	+06	16.26	0.08	3
93	Minerva	3 21.7	11.1	+00	5.982	0.04 0.10	3
334	Chicago	3 22.7	13.0	+04	7.361	0.15 0.67	3
49	Pales	3 25.9	12.9	-06	10.42	0.18	3

Inversion Modeling Candidates

		Brightest			LCDB Data		
#	Name	Date	Mag	Dec	Period	Amp	U
281	Lucretia	1 01.	14.9	+18	4.348	0.38	3
270	Anahita	1 01.	12.2	+16	15.06	0.25-0.34	3
966	Muschi	1 01.	14.3	+31	5.355	0.31	3
622	Esther	1 01.	13.2	+01	47.5	0.57	2
446	Aeternitas	1 01.	13.6	+23	15.7413	0.48	3
852	Wladilena	1 01.	14.2	+04	4.6134	0.30-0.32	3
336	Lacadiera	1 01.	12.8	+17	13.70	0.27-0.34	3
1243	Pamela	1 01.	14.2	+14	26.017	0.42-0.71	2
1188	Gothlandia	1 01.	15.0	+10	3.493	0.68	3
1665	Gaby	1 01.	14.8	+10	66.	0.27	2
1282	Utopia	1 01.	14.7	+37	13.623	0.28-0.36	3
391	Ingeborg	1 02.3	13.6	-15	26.391	0.22-0.79	3
1185	Nikko	1 17.4	14.1	+28	3.79	0.27-0.50	3
235	Carolina	1 17.5	13.1	+31	17.610	0.38	3
233	Asterope	1 19.5	12.1	+09	19.70	0.25-0.55	3
1013	Tombecka	1 20.7	12.7	+42	6.053	0.44	3
629	Bernardina	1 21.8	13.4	+28	3.763	0.23-0.39	3
399	Persephone	1 26.8	13.1	+32	9.136	0.40	3
540	Rosamunde	1 27.2	13.0	+09	9.336	0.40-0.66	3-
573	Recha	1 30.9	14.0	+25	7.16633	0.22-0.34	3
1687	Glarona	2 04.4	14.3	+19	6.3	0.75	3
753	Tiflis	2 05.9	13.7	+31	9.85	0.35-0.8	3
784	Pickeringia	2 06.7	13.8	+31	13.17	0.20-0.40	2
1379	Lomonosowa	2 14.3	13.9	+03	24.488	0.63	3

Inversion Modeling Candidates (continued)

		Brightest			LCDB Data		
#	Name	Date	Mag	Dec	Period	Amp	U
1301	Yvonne	2 17.5	13.3	-04	7.320	0.52-0.90	3
553	Kundry	2 18.7	14.6	+20	12.605	0.52	3
605	Juvisia	2 21.2	14.7	+16	15.93	0.25	2
746	Marlu	3 10.1	15.0	+09	7.787	0.23	2
510	Mabella	3 10.9	13.5	-03	19.4	0.25	3
1889	Pakhmutova	3 19.6	15.0	+16	17.490	0.50	3-
706	Hirundo	3 23.1	14.9	-13	22.027	0.75-0.9	3
823	Sisigambis	3 28.2	13.4	-09	21.0	0.08-0.6	2-

Radar-Optical Opportunities

Use the ephemerides below to judge your best chances for observing. Some of the targets may be too faint to do accurate photometry with backyard telescopes. However, accurate astrometry using techniques such as "stack and track" is still possible and can be helpful for those asteroids where the position uncertainties are significant. Note that the intervals in the ephemerides are not always the same and that *geocentric* positions are given. Use these web sites to generate updated and *topocentric* positions:

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

The first two objects are repeats from the previous issues since they can be observed sometime during the first quarter of 2012.

(24475) 2000 VN2 (2012 Jan-Feb, H = 16.5)

2002 VN2 is a 1.6 km NEA. There are no known lightcurve parameters. It will linger around for the final two months of 2011 and be within relatively easy reach for modest instruments the entire time. Well-linked observations (those on a common system with only small adjustments to nightly zero points required) over the entire span of the ephemeris could show how the amplitude varies with phase angle. Because the asteroid never reaches below 7° phase angle, let alone close to 0°, finding an accurate value for the absolute magnitude (*H*) and phase slope parameter (*G*) won't be likely.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/01	02 37.3	+39 17	0.21	1.12	14.6	45.3	126	72	+0.48	-19
01/06	02 36.5	+45 42	0.21	1.11	14.8	48.9	122	76	+0.89	-13
01/11	02 38.9	+51 39	0.22	1.10	14.9	51.7	118	81	-0.97	-8
01/16	02 45.3	+57 05	0.23	1.10	15.1	53.7	115	86	-0.54	-2
01/21	02 56.9	+61 56	0.24	1.10	15.3	55.0	113	91	-0.06	+3
01/26	03 15.4	+66 11	0.26	1.11	15.4	55.6	112	97	+0.08	+7
01/31	03 43.0	+69 45	0.27	1.11	15.5	55.7	111	103	+0.48	+12
02/05	04 22.0	+72 31	0.29	1.12	15.7	55.3	111	108	+0.90	+16

2001 YE4 (2011 Dec-2012 Jan, H = 20.6, PHA)

There are no known lightcurve parameters for this NEA coming in at only 200 m diameter. Fast rotation and/or tumbling are a possibility, so try to get as high-precision data as possible.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
12/25	07 33.9	+68 40	0.07	1.03	16.7	44.3	133	132	+0.00	+29
12/26	06 37.3	+70 38	0.06	1.03	16.7	44.8	133	128	+0.02	+24
12/27	05 28.2	+71 16	0.06	1.02	16.6	46.0	131	119	+0.06	+19
12/28	04 17.1	+70 12	0.06	1.02	16.6	47.9	130	106	+0.13	+14
12/29	03 16.1	+67 29	0.06	1.02	16.7	50.6	127	92	+0.20	+8
12/30	02 29.7	+63 38	0.06	1.02	16.8	53.8	123	77	+0.29	+3
12/31	01 55.9	+59 09	0.06	1.01	16.9	57.4	120	63	+0.38	-3
01/01	01 31.2	+54 25	0.06	1.01	17.0	61.3	116	49	+0.48	-8

(29075) 1950 DA (2011 Dec-2012 Feb, H = 17.3, PHA)

This 1200 m NEA will pass Earth by about 5.4 million km in 2105 March. Busch *et al.* (2007) used radar observations to determine an accurate rotation period of 2.1216 h as well as a shape and spin axis model. Lightcurve observations this time around will help remove the two-fold ambiguity between the two poles found by Busch *et al.* One of those poles yields a model that has a small but non-zero chance of impacting the Earth in 2880. The other does not. The models also differ in diameter and, therefore, different optical and radar albedos. If the pole direction can be resolved by new lightcurves, they'll also provide the right shape model, albedos, and constraints on the composition, which may be metallic. For a list of close approaches by asteroids, see *http://www.minorplanetcenter.net/iau/lists/PHACloseApp.html*

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
12/20	08 13.5	+45 48	0.83	1.73	18.8	19.9	143	107	-0.28	+33
12/25	08 08.0	+47 05	0.78	1.69	18.6	18.5	147	107	+0.00	+32
12/30	08 00.1	+48 22	0.73	1.66	18.3	17.5	150	107	+0.29	+31
01/04	07 49.7	+49 35	0.69	1.62	18.2	16.9	151	108	+0.75	+29
01/09	07 36.8	+50 39	0.66	1.59	18.0	17.3	151	107	+1.00	+28
01/14	07 21.6	+51 27	0.62	1.55	17.9	18.6	150	107	-0.76	+25
01/19	07 04.7	+51 56	0.60	1.52	17.8	20.8	147	107	-0.22	+23
01/24	06 46.8	+52 01	0.57	1.48	17.8	23.9	142	107	+0.01	+20
01/29	06 29.1	+51 39	0.55	1.44	17.7	27.5	137	107	+0.30	+18
02/03	06 12.7	+50 52	0.54	1.40	17.7	31.5	132	107	+0.76	+15
02/08	05 58.3	+49 44	0.53	1.37	17.8	35.6	126	107	+1.00	+12
02/13	05 46.5	+48 18	0.52	1.33	17.8	39.8	120	108	-0.69	+10

(192642) 1999 RD32 (2012 Jan-Mar, H = 16.4)

There are no known lightcurve parameters for this NEA, which has an effective diameter of about 1.6 km (assuming an albedo of p_V = 0.2). It may actually be a little larger since Masi et *al.* report it to be a type C (darker) object based on SDSS colors. A well-designed collaboration over the first two months of the year should be able to find an accurate set of H-G parameters. A good set of dense lightcurves over the entire apparition could lead to a reasonable shape and spin axis model from lightcurve inversion alone, although photometric *and* radar data would be even better.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/20	10 12.0	+10 24	0.73	1.65	17.8	18.4	148	142	-0.13	+49
01/25	10 08.9	+10 01	0.65	1.59	17.4	15.9	154	143	+0.03	+48
01/30	10 04.0	+09 39	0.57	1.54	16.9	12.9	160	143	+0.39	+47
02/04	09 56.8	+09 15	0.50	1.48	16.4	9.3	166	144	+0.84	+45
02/09	09 46.8	+08 47	0.43	1.42	15.8	5.4	172	144	-0.98	+43
02/14	09 32.9	+08 13	0.37	1.36	15.3	4.5	174	143	-0.58	+39
02/19	09 13.9	+07 28	0.31	1.29	15.1	10.4	166	143	-0.09	+35
02/24	08 47.7	+06 23	0.26	1.23	14.9	19.5	155	141	+0.04	+29
02/29	08 11.5	+04 45	0.22	1.17	14.7	31.6	142	139	+0.40	+20
03/05	07 21.6	+02 15	0.18	1.10	14.7	47.7	125	135	+0.86	+8

(141018) 2000 WC47 (2012 Jan-Mar, H = 18.7)

The estimated diameter for this NEA is 0.6 km. It will remain relatively bright throughout the first quarter of 2012. Radar observations are planned for April at Arecibo. There are no known lightcurve parameters.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
01/10	09 18.4	+20 44	0.30	1.25	17.6	20.9	153	20	-0.99	+41
01/20	09 22.2	+23 04	0.24	1.22	16.9	14.5	162	121	-0.13	+43
01/30	09 22.2	+26 21	0.20	1.19	16.3	9.7	168	107	+0.39	+44
02/09	09 19.5	+30 20	0.17	1.15	16.0	13.2	165	28	-0.98	+44
02/19	09 16.0	+34 34	0.15	1.13	15.9	22.3	154	153	-0.09	+44
02/29	09 15.4	+38 24	0.14	1.10	16.0	32.3	144	72	+0.40	+44
03/10	09 22.5	+41 17	0.13	1.08	16.0	41.0	134	67	-0.96	+45

2011 CP4 (2012 Feb, H = 21.0)

This NEA has an estimated size of about 200 meters. There are no known lightcurve parameters as of this writing. Telescopes of 0.5-m or larger will have a better chance of obtaining sufficiently accurate photometry. Given the size, the chances of this have a rotation of 3 hours or less are fairly good. It may even have a much shorter period. Keep this in mind when doing period analysis.

This object has large plane-of-sky pointing uncertainties, so it's crucial that accurate astrometry be obtained as soon as possible. Otherwise, it won't be possible to get photometric or radar observations.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
02/15	12 47.1	-00 56	0.15	1.10	18.7	40.1	134	171	-0.47	+62
02/16	12 51.1	-00 20	0.14	1.09	18.4	40.4	134	172	-0.35	+63
02/17	12 56.1	+00 28	0.12	1.07	18.1	41.0	135	172	-0.25	+63
02/18	13 02.9	+01 33	0.10	1.06	17.8	41.9	134	173	-0.16	+64
02/19	13 12.2	+03 04	0.08	1.05	17.4	43.4	133	174	-0.09	+65
02/20	13 26.2	+05 22	0.07	1.03	17.0	45.9	131	175	-0.04	+67
02/21	13 49.3	+09 05	0.05	1.02	16.5	50.6	127	177	-0.01	+67
02/22	14 33.7	+15 45	0.04	1.01	16.0	60.4	118	180	+0.00	+64

(263976) 2009 KD5 (2012 Feb-Apr, H = 18.4, PHA)

Hicks *et al.* (2010) found a rotation period of 2.664 h for this 600-m NEA. The amplitude at that time (L_{PAB} ~ 250°) was only 0.15 mag. L_{PAB} is ~200° for this apparition. Depending on the spin axis orientation, this may result in a larger amplitude lightcurve. Foster *et al.* (2010) raised the possibility that this is a binary asteroid. Given that about 2/3 the NEAs with comparable periods are binary, there's a chance that 2009 KD5 may be as well. Accurate photometry will be required to help decide the matter – assuming that mutual events or a strong secondary period are there to be found.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
02/10	14 57.6	+37 08	0.22	1.07	17.5	63.0	105	169	-0.94	+62
02/20	14 43.0	+44 45	0.24	1.11	17.6	54.9	113	170	-0.04	+62
03/01	14 17.3	+50 32	0.27	1.15	17.7	48.9	119	170	+0.50	+61
03/11	13 41.3	+53 56	0.30	1.18	17.9	45.0	123	171	-0.90	+62
03/21	13 01.2	+54 41	0.34	1.21	18.1	43.0	124	172	-0.03	+62
03/31	12 26.3	+53 00	0.37	1.24	18.4	42.5	123	173	+0.52	+64
04/10	12 02.3	+49 37	0.42	1.27	18.7	43.1	120	176	-0.85	+66

(162421) 2000 ET70 (2012 Feb-Mar, H = 18.1, PHA)

This modest-sized NEA (650 m) has no known lightcurve parameters. In general, objects with sizes of about 140 meters or less, are more likely to be superfast rotators – those with periods <2.1 h. Therefore, this asteroid is more likely to have a period of 2 hours or more. It will be moving quickly across the sky, so take lots of short exposures. Don't stack them, but use the high density of data points to "beat down the noise" due to shorter exposures. If possible, keep exposures at least 10 second so that scintillation is not the dominant noise.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
02/15	14 13.3	+12 14	0.06	1.01	14.2	60.9	116	176	-0.47	+66
02/17	13 39.5	+02 45	0.05	1.02	13.7	53.1	125	176	-0.25	+63
02/19	12 58.3	-08 54	0.05	1.02	13.4	45.4	133	174	-0.09	+54
02/21	12 10.6	-20 59	0.05	1.02	13.3	41.0	137	172	-0.01	+41
02/23	11 19.9	-31 07	0.05	1.03	13.5	41.6	136	168	+0.01	+28
02/25	10 31.1	-38 07	0.06	1.03	13.9	45.2	132	165	+0.09	+17
02/27	09 48.3	-42 22	0.07	1.03	14.3	49.4	128	163	+0.23	+9
02/29	09 13.0	-44 44	0.08	1.03	14.7	53.1	123	161	+0.40	+3
03/02	08 45.0	-45 59	0.09	1.04	15.1	56.1	120	160	+0.59	-2
03/04	08 22.9	-46 35	0.10	1.04	15.5	58.5	117	159	+0.78	-5

(7341) 1991 VK (2012 Mar-Apr, H = 16.7, PHA)

Pravec *et al.* (1998) found a period of 4.2096 h for this 1.2 km NEA. Their observations covered a wide range of phased angles, which was demonstrated by the amplitude ranging from 0.28 to 0.70 mag. The high phase angles during this apparition could produce not only large amplitudes but somewhat unusual lightcurves as shadowing comes into play. New lightcurves could constrain the pole direction.

DATE	RA	Dec	ED	SD	V	α	SE	ME	MP	GB
03/10	13 04.1	-35 59	0.21	1.15	15.2	39.0	133	192	-0.96	+27
03/15	12 52.5	-33 49	0.23	1.18	15.3	32.5	140	192	-0.50	+29
03/20	12 42.4	-31 37	0.26	1.22	15.4	26.8	147	193	-0.07	+31
03/25	12 33.9	-29 25	0.28	1.25	15.5	21.8	152	194	+0.05	+33
03/30	12 27.0	-27 17	0.31	1.29	15.7	18.0	156	194	+0.42	+35
04/04	12 21.7	-25 15	0.35	1.33	15.9	15.6	159	195	+0.89	+37
04/09	12 17.9	-23 22	0.38	1.37	16.1	14.8	160	196	-0.93	+39
04/14	12 15.4	-21 39	0.42	1.40	16.4	15.3	158	197	-0.44	+40
04/19	12 14.2	-20 08	0.46	1.44	16.7	16.7	156	198	-0.05	+42
04/24	12 14.1	-18 49	0.51	1.48	17.0	18.5	152	199	+0.06	+43

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* * * * *

The deadline for the next issue (39-2) is January 15, 2012. The deadline for issue 39-3 is April 15, 2012.