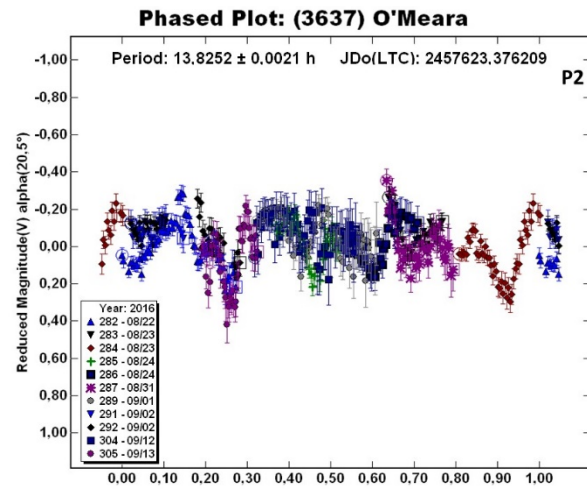


Number	Name	2016 mm/dd	Pts	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.
3637	O'Meara	08/22-09/13	445	20.3,24.2	294	18	4.118	0.025	0.25	0.09

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first and last date. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris *et al.*, 1984). The period is for the presumed primary of a binary system.



Using the shallower event and:

$$D_s/D_p \geq \sqrt{10^{0.4\Delta m} - 1}$$

gives an approximate diameter ratio (D_s/D_p) of 0.55 ± 0.09 .

New observations of this object at future apparitions will be needed in order to improve the analysis and confirm its binary nature.

LIGHTCURVE ANALYSIS FROM APT OBSERVATORY GROUP FOR NINE MAINBELT ASTEROIDS: 2016 JULY-SEPTEMBER. ROTATION PERIOD AND PHYSICAL PARAMETERS.

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Lightcurves of nine main-belt asteroids (MBAs) obtained at APT-Observatory Group from 2016 July-September were analyzed for rotation period, amplitude, and axis ratios.

CCD photometric observations of nine main-belt asteroids (MBAs) were made by APT Observatory Group 2016 July to September. Asteroids were selected based on the U (quality) code given in the asteroid lightcurve database (LCDB; Warner *et al.*, 2009). Most objects had ratings of U = 2 or 3. However, some asteroids were not in the LCDB or had no U rating. Despite being rated U = 3, it can be worthwhile to observe an asteroid since the shape and/or amplitude of the lightcurve often changes from one apparition to another. These changes are important when modeling an asteroid for its actual shape.

Acknowledgements

I would like to express my gratitude to Brian Warner for supporting LCDB as main database for study of asteroids.

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The APT Observatory Group is made up of two observatories. The Isaac Aznar Observatory is located in Centro Astronómico del Alto Turia, Aras de los Olmos, Valencia, Spain. It is 1270 meters above sea level under a very dark and high quality night sky (~ 21.7 magnitudes/arcsec²). The observatory is equipped with a 0.35-m telescope, STL-1001E CCD camera, and adaptive optics system. Pixel resolution is 1.44 arcseconds. The POP-Punto de Observación de Puçol, Puçol, Spain, is an urban observatory equipped with a 0.25-m telescope, SBIG ST-9 CCD camera, and adaptive optics system. Pixel resolution is 1.56 arcseconds. Table I summarizes the telescope/CCD camera combinations.

Observatory	Telescope (m)	CCD + Accessories
OIA Obs. Isaac Aznar	0.35m SCT	SBIG STL1001E+AO
POP Punto Obs. Puçol	0.25m SCT	SBIG ST9XE+AO

Table I. Equipment used for asteroid photometry.

All images were obtained in 1x1 binning mode and were taken without any photometric filter. Dark, bias, and twilight sky flat-field frames were applied to each raw image. The resulting SNR values allowed obtaining lightcurves with low data dispersion.

Data reduction was done using *MPO Canopus*, which implements the FALC algorithm developed by Harris (Harris *et al.*, 1989). The Comp Star Selector utility in *MPO Canopus* found up to five comparison stars of near solar-color for differential photometry. Comparison star magnitudes were taken from the APASS catalog (Henden *et al.*, 2009) or MPOSC3 (Warner, 2007) depending on

Number	Name	2016 mm/dd	Pts	Phase	L_{PAB}	B_{PAB}	Period	P.E.	Amp	A.E.	D	a/b	b/c
565	Marbachia	07/17–07/28	740	10.7, 14.3	275	11	4.588	0.001	0.70	0.09	27.3	1.63	0.62
1293	Sonja	07/09–07/10	99	18.5, 18.0	308	8	2.881	0.02	0.19	0.01	7.9*	1.12	1.02
1346	Gotha	09/06–09/18	158	13.6, 17.3	314	7	2.642	0.001	0.16	0.04	14.2	1.13	1.03
2189	Zaragoza	07/02–07/06	285	14.1, 12.1	301	5	4.927	0.0006	0.86	0.03	6.0	1.75	0.54
3042	Zelinsky	08/08	37	6.6	313	8	4.468	0.094	0.14	0.01	5.7	1.12	1.02
3232	Brest	09/28–10/02	181	5.2, 7.3	352	4	5.288	0.004	0.25	0.04	16.6*	1.24	1.04
4923	Clarke	07/30–08/01	62	17.4, 18.3	288	10	3.143	0.016	0.14	0.04	3.0	1.09	1.01
10306	Pagnol	07/16–08/01	163	5.9, 5.6, 7.7	298	11	4.79	0.01	0.27	0.05	9.1*	1.23	1.04
19516	1998 QF80	07/26–07/30	375	21.4, 19.7	330	8	5.438	0.001	0.33	0.02	16.2	1.26	1.06

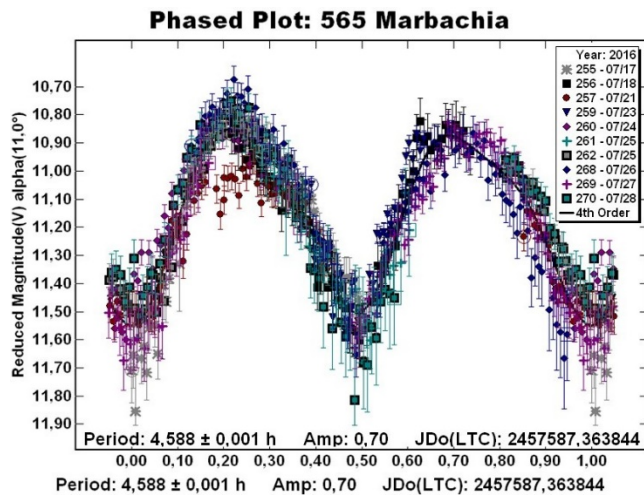
Table II. Observing circumstances and results. Pts is the number of data points used in the analysis. The phase angle values are for the first and last date, unless a minimum (second value) was reached. L_{PAB} and B_{PAB} are the average phase angle bisector longitude and latitude. Period is in hours. Amp is peak-to-peak amplitude in magnitudes. D is the estimated diameter (km). * indicates diameter is from the JPL Small Bodies Node. The other diameters were calculated from the reported H and p_v values. The last two columns give the a/b and b/c ratios for an assumed triaxial ellipsoid viewed equatorially based on the amplitude.

availability of comparison stars. The nightly zero points for both catalogs have been found to be generally consistent to about ± 0.05 mag or better, but on occasion reach 0.1 mag and more.

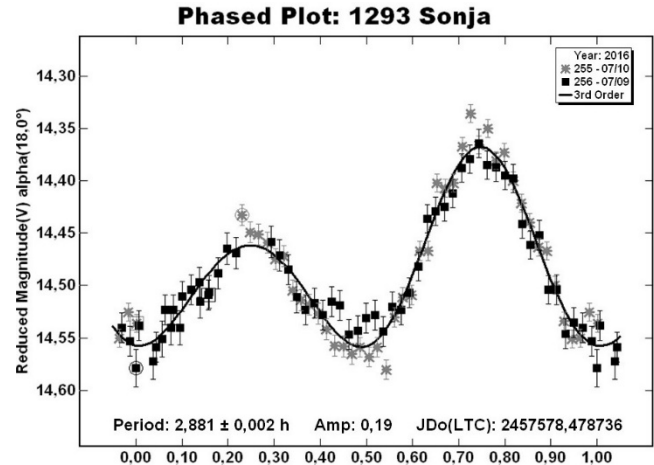
The StarBGone star subtraction feature in *MPO Canopus* was used to remove or reduce the effect of stars located in the asteroid path. This technique is most effective when the star's SNR is equal to or less than asteroid SNR. (Aznar, 2013).

Table II gives the observing circumstances and results for each asteroid. See Aznar (2016) for details concerning the derivation of the asteroid axis ratios as determined by the lightcurve amplitude.

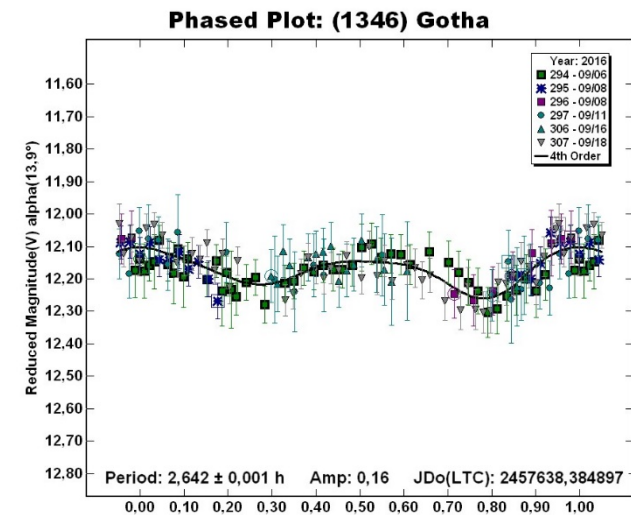
565 Marbachia. The period for Marbachia has been reported on many occasions, all of them being about 4.5 hours. Hanus *et al.*, (2016) found a *sidereal* rotation period of 4.587 h. The *synodic* period found from our analysis using ten sessions is in agreement with those earlier results.



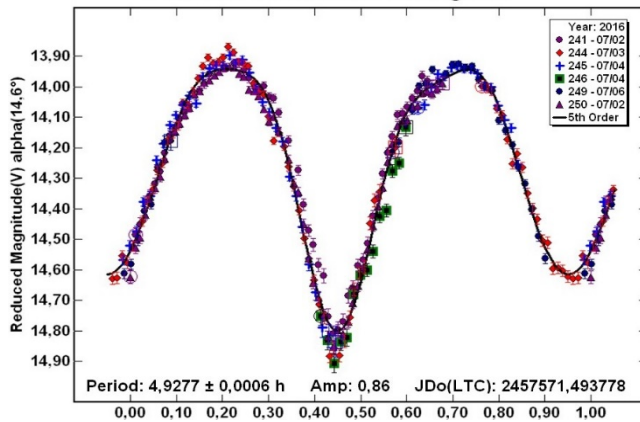
1293 Sonja. Five previously reported periods for this asteroid were all approximately 2.87 h (Warner *et al.*, 2009). Our result is very similar. The lightcurve shows a bimodal shape with a maximum amplitude of 0.19 mag at a phase angle of 18° . As noted by Zappala *et al.* (1990), the amplitude at 0° phase angle would be smaller.



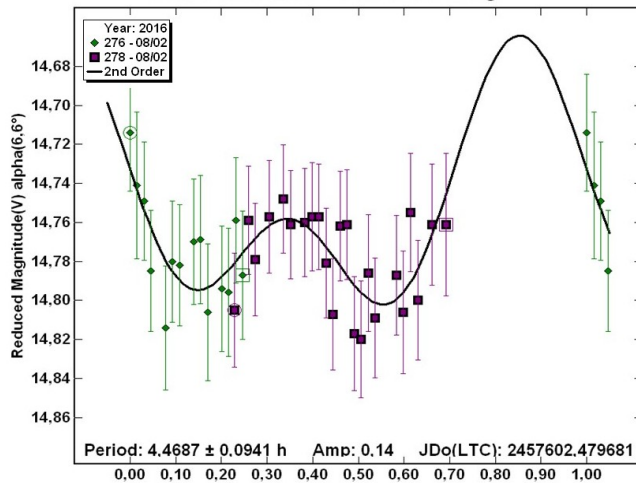
1346 Gotha. Binzel (1987) was the first to report a period for Gotha (11.19 h). Waszczak *et al.* (2015) found a period of 2.6405 h. Our result matches the more recent result. Given the low amplitude of 0.16 mag, this asteroid has an almost spherical form, assuming it was viewed equatorially.



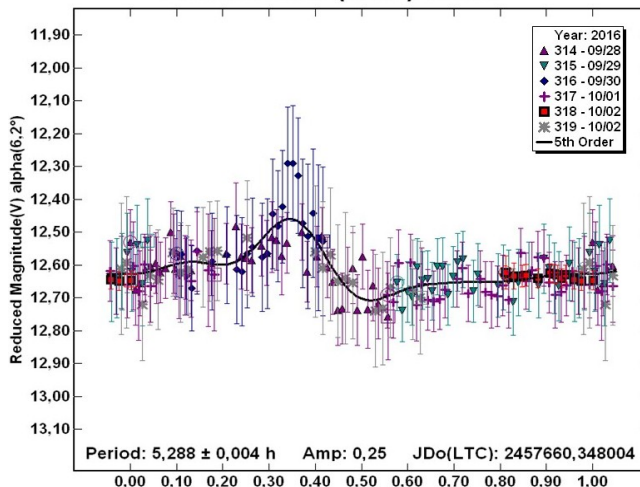
(2189) Zaragoza. Previous reports for the period of this asteroid include Higgins (2011; 4.934 h) and Pravec *et al.* (2016; 4.9282 h). Our period is consistent with those earlier results.

Phased Plot: 2189 Zaragoza

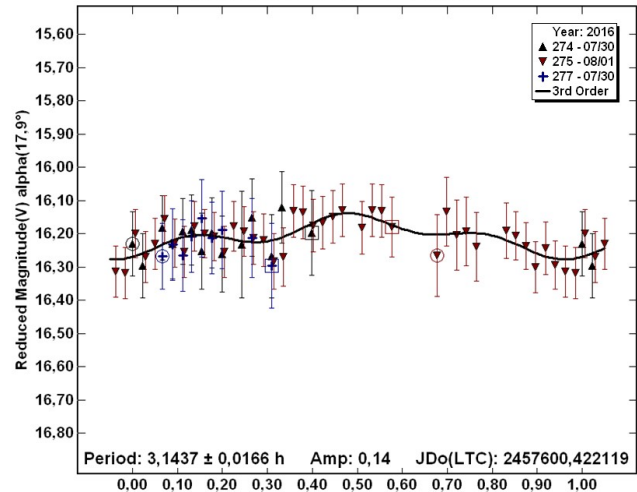
(3042) Zelinsky. Pravec *et al.* (2016) found a period of 5.3248 h for this asteroid. The analysis of our data found 4.468 hours. However, we obtained a small data set due to bad weather and our result also includes a large gap in the lightcurve coverage.

Phased Plot: 3042 Zelinsky

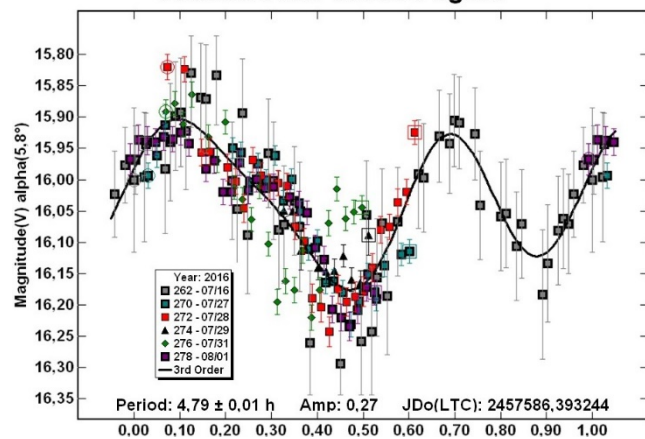
3232 Brest. There were no previous entries in the LCDB (Warner *et al.*, 2009). Our lightcurve, composed by 181 points, shows a mostly flat shape with an amplitude of 0.25 mag and period of 5.288 ± 0.004 h. Although our solution could be right, we suggest observations at future apparitions to confirm this result.

Phased Plot: (3232) Brest

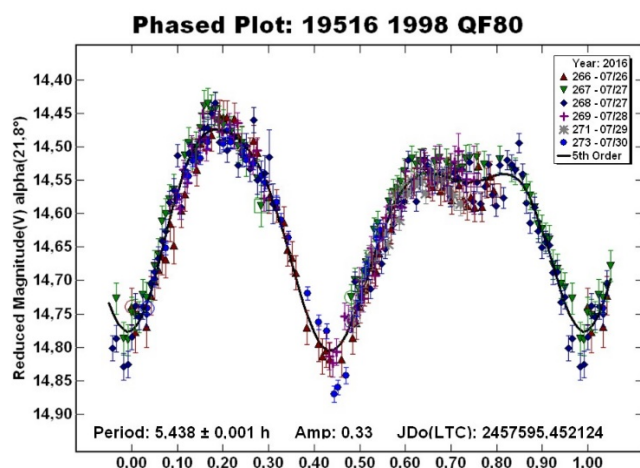
(4923) Clarke. Pravec *et al.* (2013) found a period of 3.1787 h while Waszczak *et al.* (2015) reported a period of 27.2531 h. Our analysis found a rotation period of 3.143 ± 0.016 h, which is in close agreement with Pravec *et al.* Assuming an equatorial viewing aspect, the low amplitude of 0.14 mag indicates a nearly spheroidal shape for the asteroid.

Phased Plot: 4923 Clarke

(10306) Pagnol. There were no entries in the LCDB for this asteroid. We derived a rotation period of 4.79 ± 0.01 h with an amplitude of 0.27 mag. The lightcurve shows a typical bimodal shape; its amplitude suggests a semi-elongated shape.

Phased Plot: 10306 Pagnol

(19516) 1998 QF80. Pravec *et al.* (2016) found a period of about 5.438 h for this asteroid. Analysis of our data found a period of 5.438 ± 0.001 h. The lightcurve shows a bimodal shape with a maximum amplitude of 0.33 magnitudes.



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ROTATION PERIOD DETERMINATION OF ASTEROIDS (8360) 1990 FD1 AND (11386) 1998 TA18

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Photometric observations were made in 2016 April and October of the main-belt asteroids (8360) 1990 FD1 and (11386) 1998 TA18. For 1990 FD1, analysis of the data found a period of 8.094 ± 0.003 h; for 1998 TA18 a likely period of 15.943 ± 0.003 h was found.

Photometric observations of the main-belt asteroids (8360) 1990 FD1 and (11386) 1998 TA18 were taken at the Astronomical Observatory of the University of Siena (K54), Italy, with a 0.30 m f/5.6 Maksutov-Cassegrain telescope equipped with a SBIG STL-6303E NABG CCD camera and clear filter. The pixel scale was 2.26 arcsec in binning 2x2. Exposure time was 300 seconds. Table I gives the observation circumstances and results.

Differential photometry measurements were performed using the Comp Star Selector (CSS) procedure in *MPO Canopus* (Warner, 2012) that allows selecting of up to five comparison stars of near solar color. The magnitudes from the CMC-15 catalog were used for the comparison stars. Period analysis was performed using *MPO Canopus* and its FALC (Fourier Analysis for Lightcurves) algorithm (Harris *et al.*, 1989). Additional adjustments of the magnitude zero-points for each data set were carried out in order to reach the minimum RMS value from the Fourier analysis and so achieve the best alignment among lightcurves.

A search of the Asteroid Lightcurve Database (LCDB; Warner *et al.*, 2009) and literature found no previous entries.

(8360) 1990 FD1 was discovered on 1990 March 26 by Atsushi Sugie, a Japanese astronomer, at the Dynic Astronomical Observatory. It orbits with a semi-major axis of about 2.64 AU, eccentricity 0.12, and a period of 4.3 years (JPL, 2014). Observations were made on three nights from 2016 April 5-10 with a total of 157 useful data points collected over that time. The period analysis yielded a few possible solutions with nearly comparable RMS values. We concluded that the most likely value of the synodic period for (8360) 1990 FD1 is associated with a bimodal lightcurve phased to 8.094 ± 0.003 h with an amplitude of 0.26 ± 0.03 mag.