

ASTEROID PHOTOMETRY AT SOPOT ASTRONOMICAL OBSERVATORY: 2019 JUNE-OCTOBER

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A summary on the lightcurve and synodic rotation period determinations for 29 asteroids observed at Sopot Astronomical Observatory from 2019 June-October is presented in this paper.

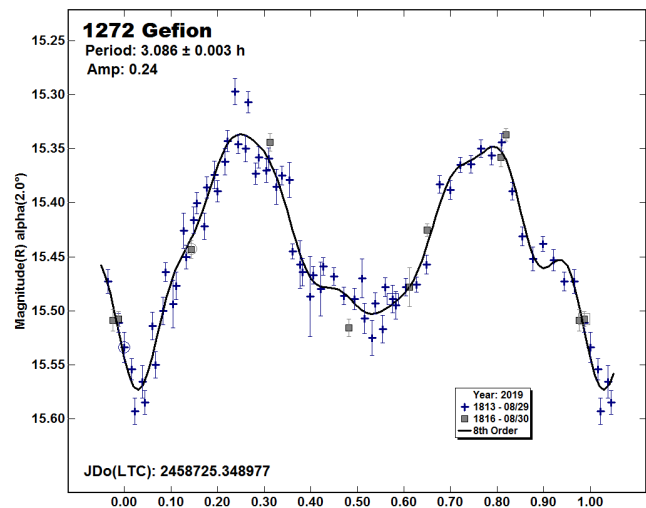
Photometric observations of 29 asteroids were conducted at Sopot Astronomical Observatory (SAO) between 2019 June-October in order to determine their synodic rotation period. For this purpose, two 0.35-m *f*/6.3 Meade LX200GPS Schmidt-Cassegrain telescopes were employed. The telescopes are equipped with a SBIG ST-8 XME or a SBIG ST-10 XME CCD camera. The exposures were unfiltered and unguided for all targets. Both cameras were operated in 2x2 binning mode, which produces image scales, respectively, of 1.66 arcsec/pixel and 1.25 arcsec/pixel for the ST-8 XME and ST-10 XME cameras. Prior to measurements, all images were corrected using dark and flat field frames.

Photometric reduction, lightcurve construction, and period analysis were conducted using *MPO Canopus* (Warner, 2018). Differential photometry with up to five comparison stars of near solar color ($0.5 \leq B-V \leq 0.9$) was performed using the Comparison Star Selector (CSS) utility. This helped ensure a satisfactory quality level of night-to-night zero point calibrations and correlation of the measurements within the standard magnitude framework. Field comparison stars were calibrated using standard Cousins R magnitudes derived from the Carlsberg Meridian Catalog 15 (VizieR, 2019) Sloan *r'* magnitudes using the formula $R = r' - 0.22$ in all cases presented in this paper. In some instances, small zero-point adjustments were necessary in order to achieve the best match between individual data sets in terms of minimum RMS residual of a Fourier fit.

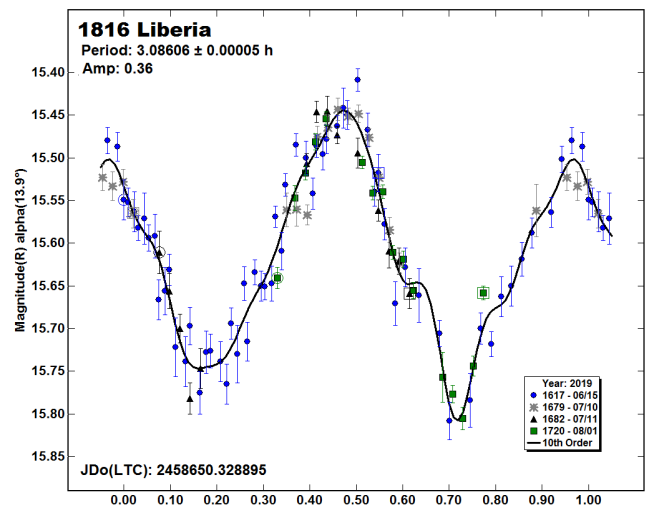
Some of the targets presented in this paper were observed within the Photometric Survey for Asynchronous Binary Asteroids (BinAstPhot Survey) under the leadership of Petr Pravec from Ondřejov Observatory, Czech Republic.

Table 1 gives the observing circumstances and results.

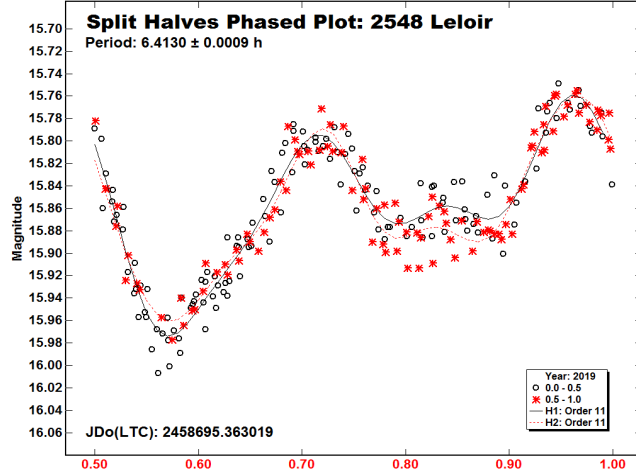
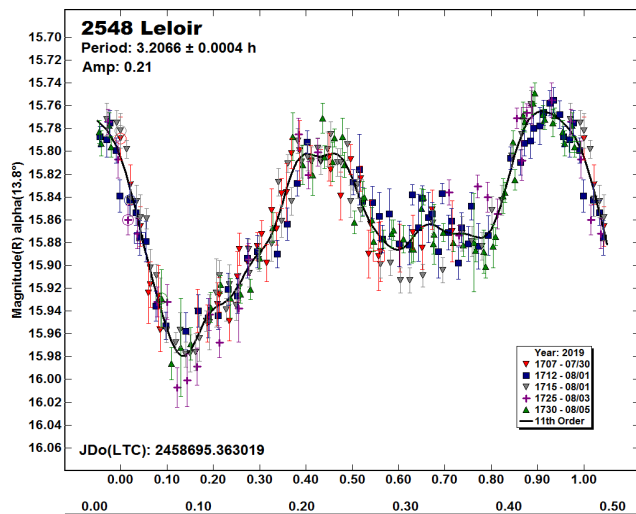
1272 Gefion. Two similar rotational periods were previously determined by Waszczak et al. (2015): 2.900 h and 3.087 h. An uncertainty flag of $U = 2$ was assigned to both of these results in the lightcurve database (LCDB; Warner et al., 2019). The SAO photometric observations were performed over two consecutive nights in late 2019 August. Period analysis indicates an equivocal bimodal solution of $P = 3.086 \pm 0.003$ h, which is consistent with one of the results determined by Waszczak et al (2015).



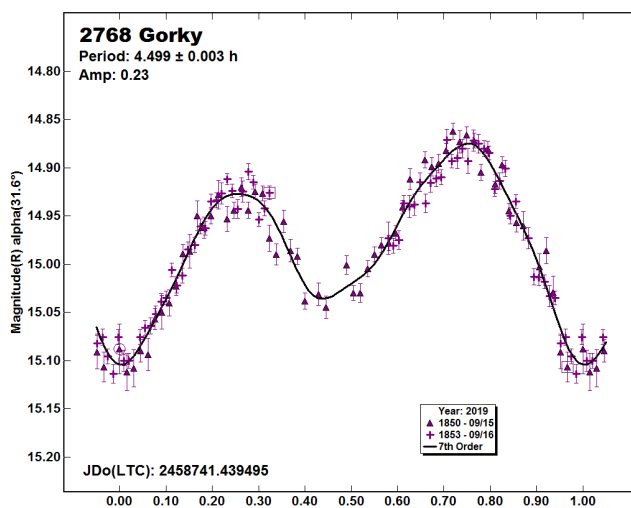
1816 Liberia. A search of the LCDB finds the following previously determined synodic rotation periods: 3.0861 h (Willis, 2004) and 3.02 h (Behrend, 2008), as well as the result for sidereal period by Hanus et al. (2016) of 3.086156 h. The SAO result of $P = 3.08606 \pm 0.00005$ h, determined from the observations carried out from 2019 June 15 through August 1, is in complete agreement with the previously determined period results.



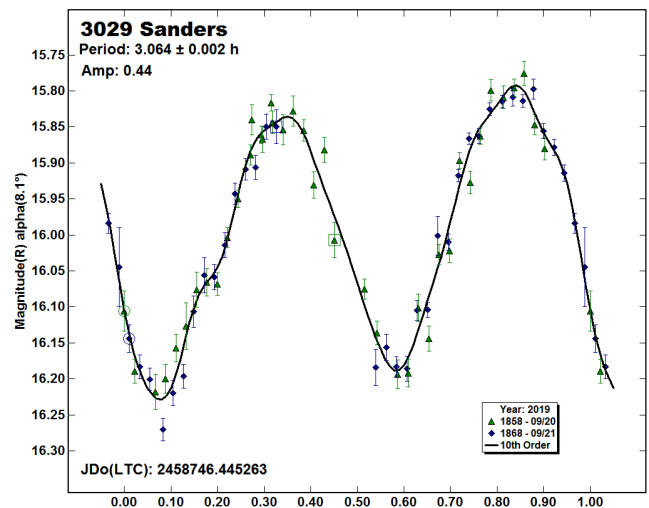
2548 Leloir. No previous period determinations were found in the LCDB. The data collected at SAO in 2019 from late July and early August indicate $P = 3.2066 \pm 0.0004$ h as the most likely value for period. Still, it should be noted that due to the slightly higher noise level in some individual lightcurves obtained on some nights with less favorable observing conditions, a double period of $P = 6.4130$ h cannot be formally ruled out. This is supported by the fact that the two halves of the lightcurve at the longer period are somewhat different and the amplitude of 0.21 mag still allows for different solutions besides a bimodal one (Harris et al., 2014). Based on the available data, it was difficult to discern whether such a double period is just a consequence of unstable observational conditions or is the correct solution.



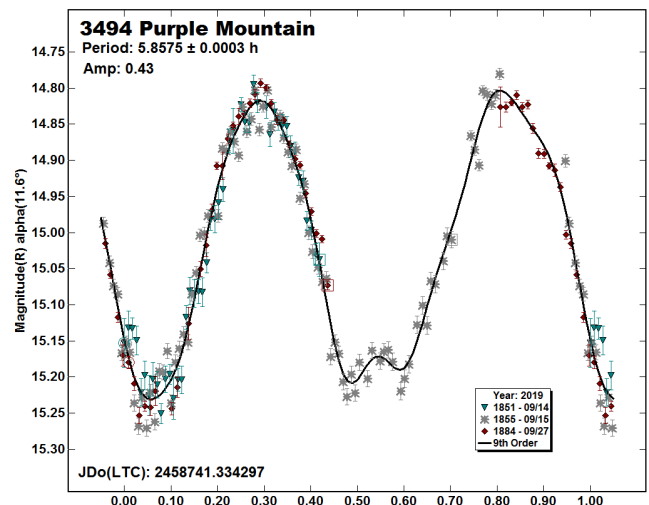
2768 Gorky. Pray et al. (2008) found a synodic period of 4.507 h. The SAO data obtained in 2019 September point to a bimodal solution of $P = 4.449 \pm 0.003$ h, which is only slightly different from the one found previously.



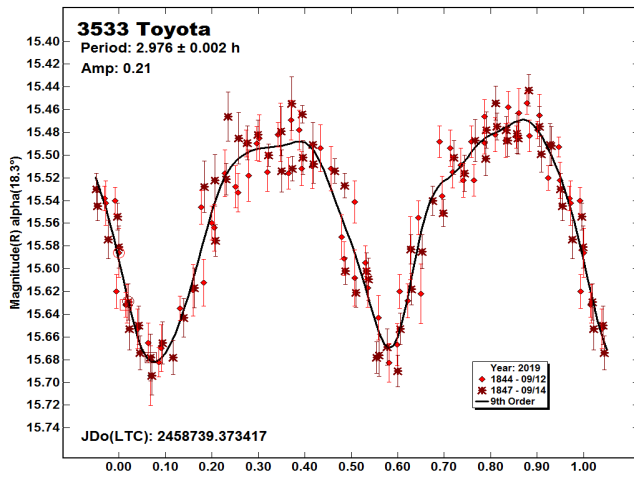
3029 Sanders. No records on previous period determinations were found prior to the SAO observations of this target. Period analysis conducted upon the SAO observations over two consecutive nights in 2019 September show an unambiguous bimodal period solution of $P = 3.064 \pm 0.002$ h.



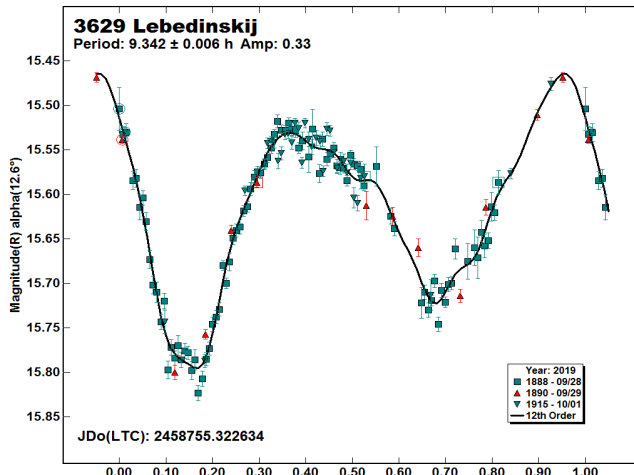
3494 Purple Mountain. Cantu et al. (2016) and Kosiarek et al. (2017) found rotation periods of, respectively, 5.857 h and 2.928 h. The SAO data collected over three nights in 2019 September over a range of relatively low phase angles yields an equivocal bimodal solution of $P = 5.8575 \pm 0.0003$ h. The fairly large amplitude (0.43 mag) of the corresponding lightcurve strongly supports such a result (Harris et al., 2014).



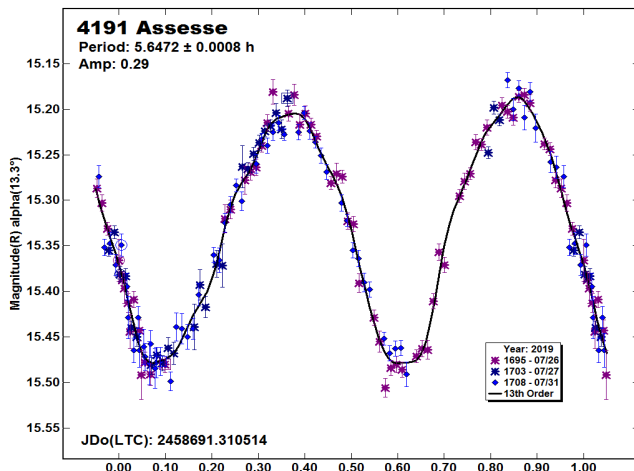
3533 Toyota. Several synodic rotation period determinations were known for this asteroid prior to the SAO observations in on two nights in 2019 September. These include Behrend (2006; 2.9814 h), Pray et al. (2007; 2.9807 h), and Pravec (2009; 2.98156 h). Analysis of the SAO data gave $P = 2.976 \pm 0.002$ h.



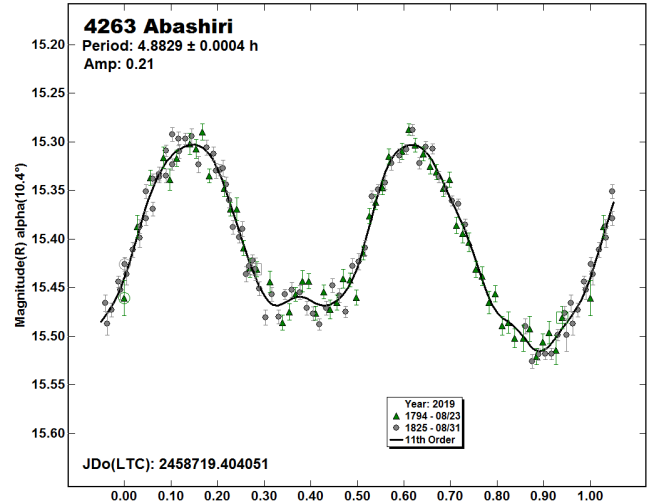
3629 Lebedinskij is a Vestoid type asteroid without a previously known rotation period. Observations undertaken over three nights from 2019 September 28 to October 1 revealed a bimodal lightcurve with a synodic rotation period of $P = 9.342 \pm 0.006$ h and amplitude of 0.33 mag.



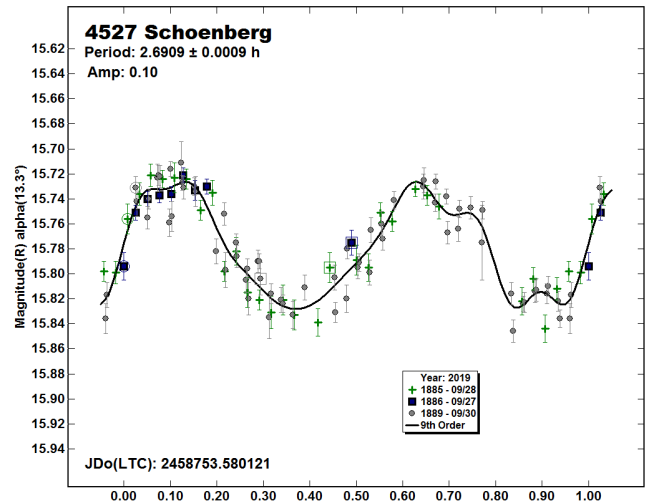
4191 Assesse. Previous rotation period determinations include Angeli et al. (2001; 5.4 h), Alvarez (2010; 5.6489 h), and Waszczak et al. (2015; 5.649 h). The bimodal solution for period of $P = 5.6472 \pm 0.0008$ h based on the data taken at SAO over three nights in 2019 July is consistent with the earlier results.



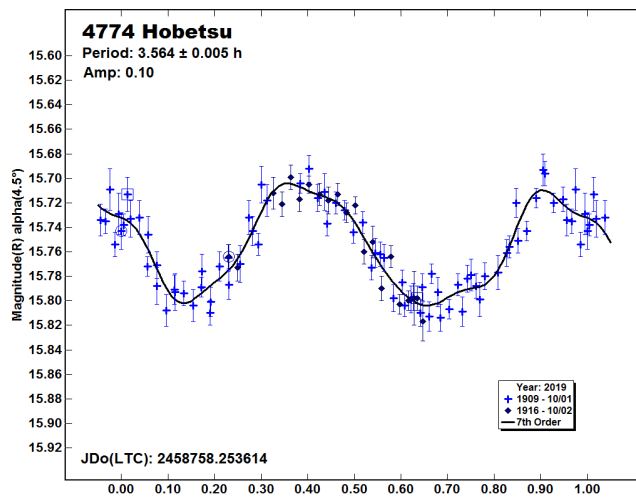
4263 Abashiri. This is a Binastphot Survey target that had been monitored three times previously within this Survey in 2008, 2012, and 2016. Those observations found periods of 4.8820 h (Pravec, 2008), 4.8817 h (Pravec, 2012), and 4.88230 h (Pravec, 2016). No other rotation period results were found. Observations at SAO made in 2019 under the same Survey led to an almost identical result of $P = 4.8829 \pm 0.0004$ h.



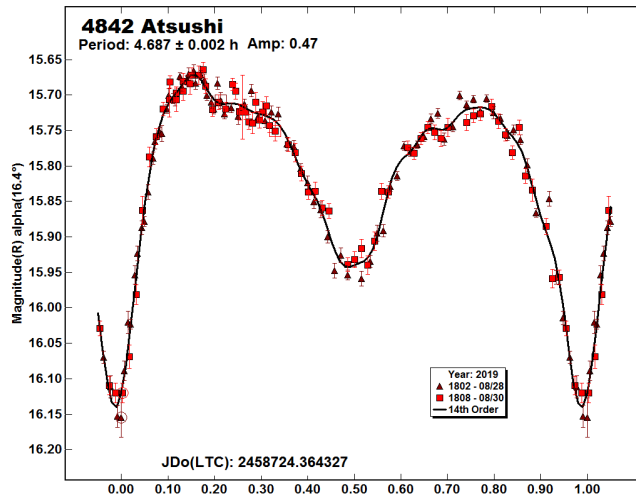
4527 Schoenberg. The rotational period of $P = 2.6909 \pm 0.0009$ h found on the basis of SAO data obtained in 2019 September confirms the only previous result (Burkhonov et al., 2013; 2.69 h).



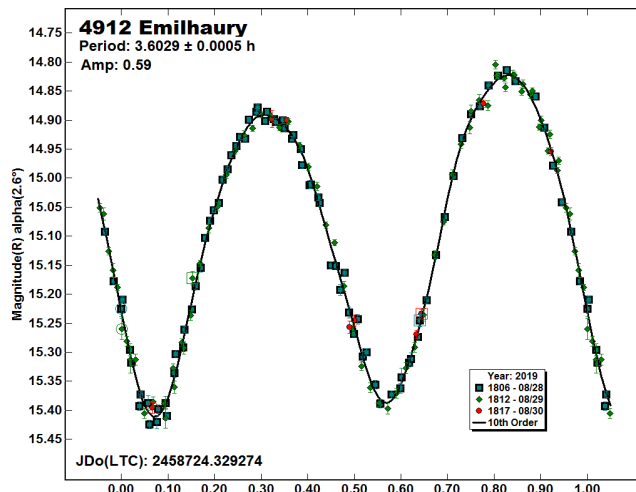
4774 Hobetsu. An analysis of SAO data taken on two consecutive nights in early 2019 October corroborate the only previous period result of 3.577 h (Pray, 2005), indicating the close result of $P = 3.564 \pm 0.005$ h as the most favorable one.



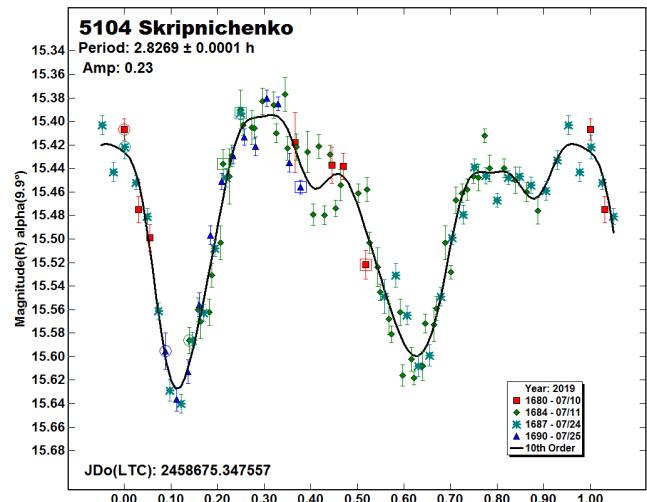
4842 Atsushi. No previous rotation period determinations have been reported. A large amplitude (0.47 mag) bimodal lightcurve phased to a period of $P = 4.687 \pm 0.002$ h is based on SAO data obtained on two nights in 2019 August.



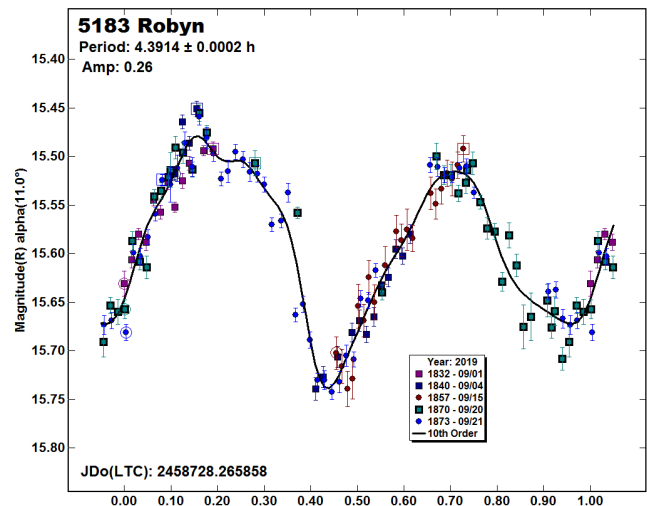
4912 Emilhaury. This is another asteroid without previously known rotation period. The low phase angle observations carried out at SAO over three nights in 2019 August show an unambiguous bimodal solution at $P = 3.6029 \pm 0.0005$ h.



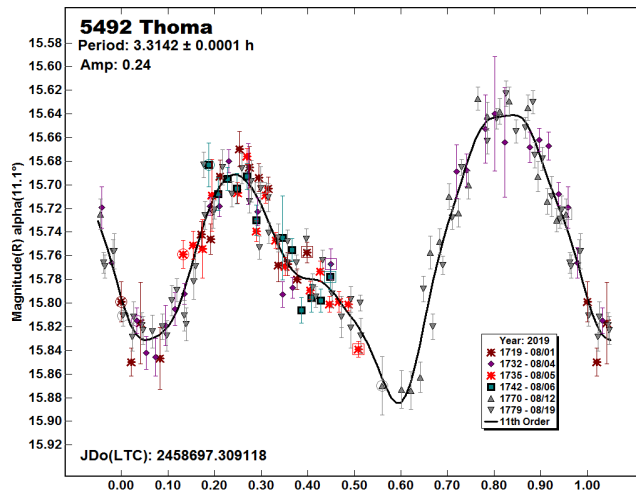
5104 Skripnichenko. Previous rotation period determinations for this Eunomia family asteroid are by Angeli and Barucci (1996, 6.14 h) and Behrend (2006, 2.82708 h; 2011, 2.8266 h; 2014, 2.83 h). The SAO data from 2019 July led to a period of $P = 2.8269 \pm 0.0001$ h, which is fully consistent with the results reported by Behrend.



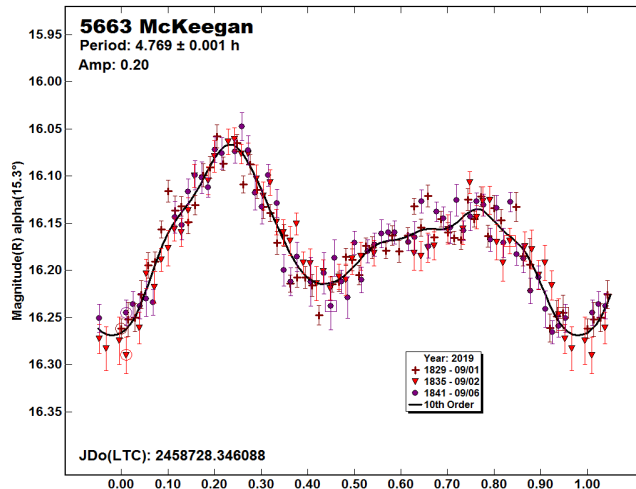
5183 Robyn. This seems to be the first rotation period determination for this Eunomia family asteroid. The observations were conducted on five nights in 2019 September. Period analysis yielded a bimodal lightcurve phased to a period of $P = 4.3914 \pm 0.0002$ h.



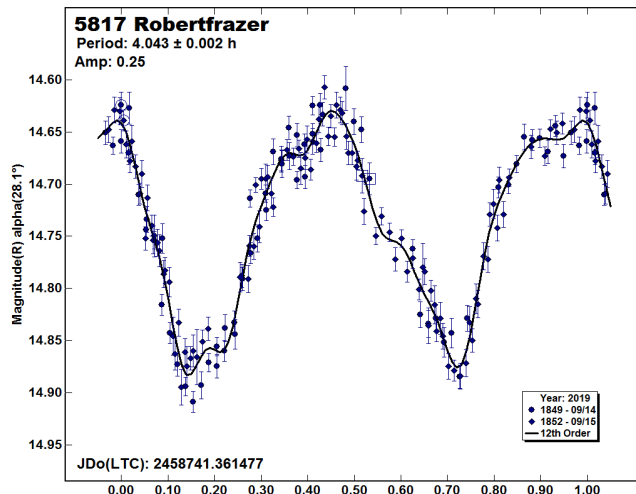
5492 Thoma. Klinglesmith et al. (2015) and Waszczak et al. (2015) found identical synodic rotation periods of 3.315 h. Period analysis of SAO data shows an almost identical result: $P = 3.3142 \pm 0.0001$ h.



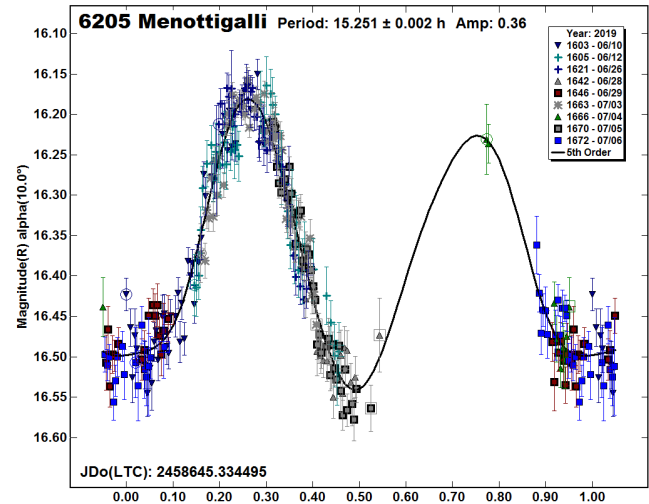
5663 McKeegan. This is another BinAstPhot Survey target with no previously known rotation period. The 2019 September SAO observations carried out as part of this Survey on three nights led to an unambiguous rotation period of $P = 4.769 \pm 0.001$ h.



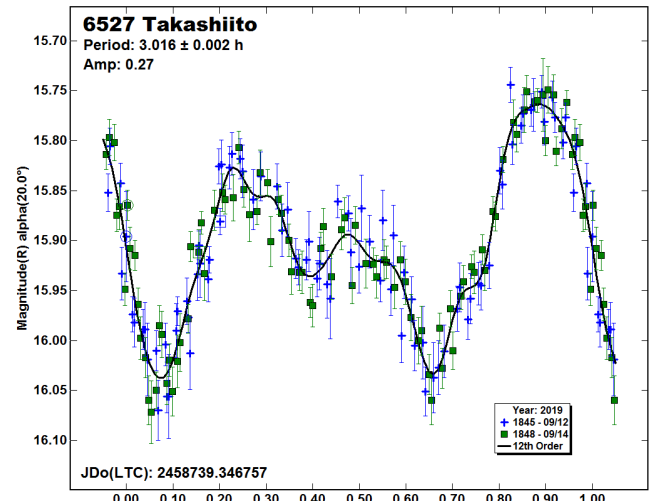
5817 Robertfrazier. Consistent period values were determined previously by Behrend (2004, 4.0511 h) and Koff (2005, 4.051 h). There is no significant difference based on the SAO 2019 September data that led to $P = 4.043 \pm 0.002$ h.



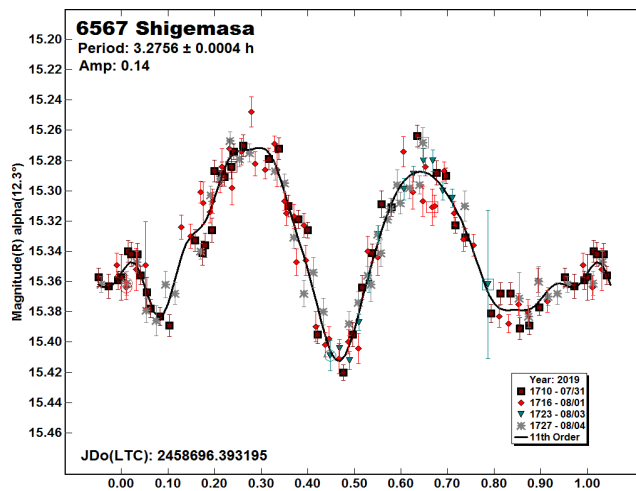
6205 Menottigalli. This is another BinAstPhot Survey program target with no previously known rotation period. Period analyses performed independently by Pravec and Benishek using the SAO observations indicate periods of 15.252 h (Pravec, 2019) and 15.251 h (this work) as the most favorable solutions despite the extremely scarce coverage of most of the second half of the rotational cycle. The advantage of such a bimodal solution over other possibilities is supported by the rather high amplitude of the bimodal lightcurve of 0.36 mag (Harris et al, 2014).



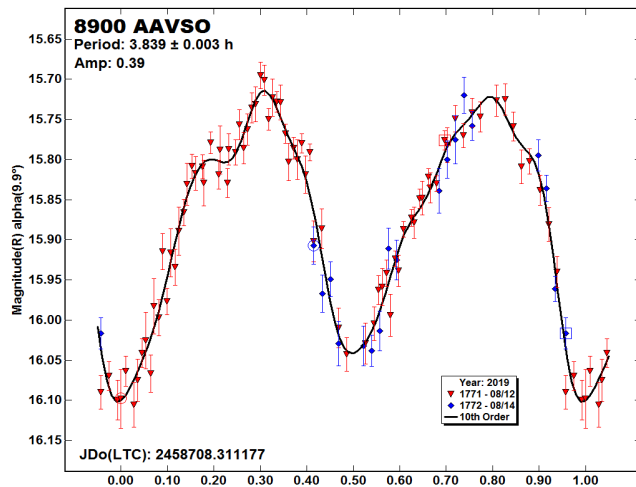
6527 Takashiito. A search of the LCDB found no previous rotation period results on this Flora family asteroid. A secure period of $P = 3.016 \pm 0.002$ h was found based two dense photometric data sets obtained in 2019 September.



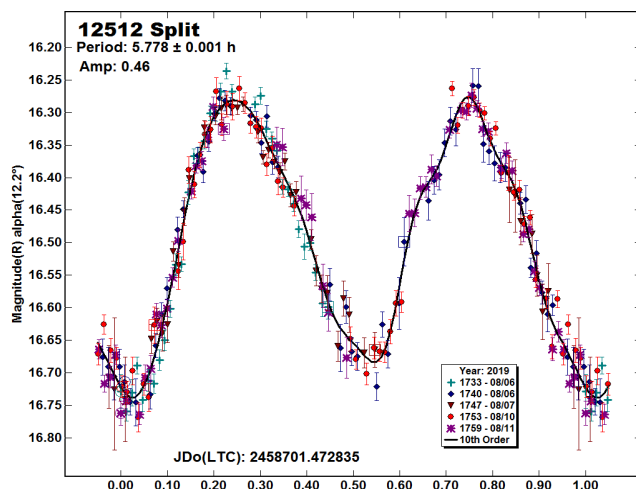
6567 Shigemasa. This was a BinAstPhot Survey target with no previously known rotation period. Period analyses conducted independently by Pravec and Benishek on SAO data from four nights in 2019 July-August converge to statistically equal periods of 3.2752 ± 0.0005 h (Pravec, 2019) and 3.2756 ± 0.0004 h (this work).



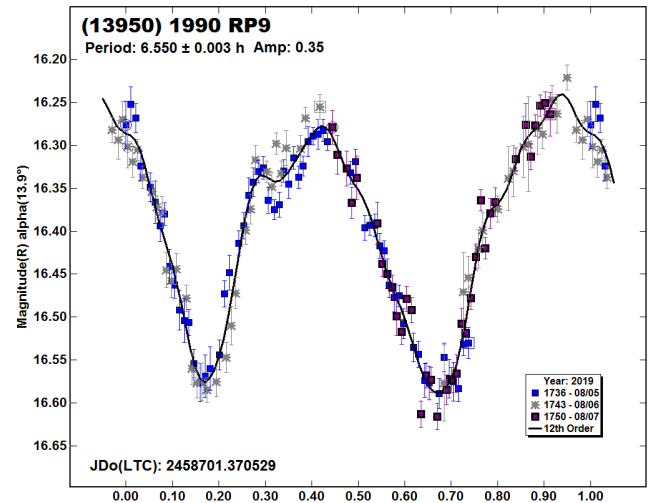
8900 AAVSO. The only previous result for a rotation period is by Waszczak (2015, 3.837 h). A bimodal lightcurve with an amplitude of 0.39 mag, phased to a period $P = 3.839 \pm 0.003$ h, was found based on data from two nights in 2019 August.



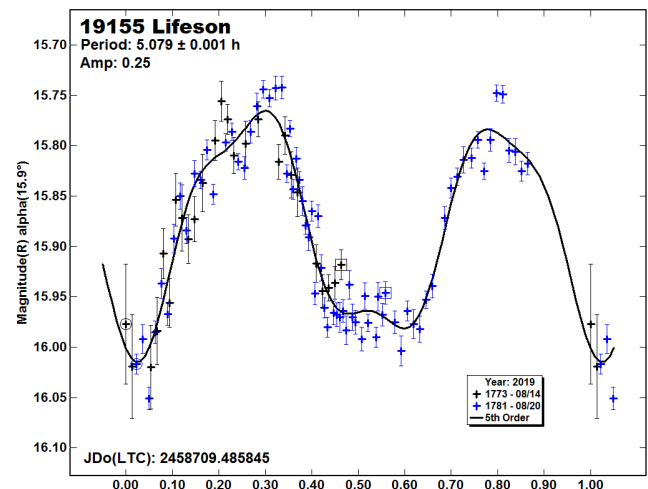
12512 Split. This Baptistina family asteroid was observed within the BinAstPhot Survey at SAO on five nights in 2019 August. Analysis found a large amplitude (0.46 mag.) bimodal lightcurve with a period of $P = 5.778 \pm 0.001$ h. Pravec (2019) used the same data independently to find $P = 5.7781 \pm 0.0006$ h



(13950) 1990 RP9. No previous period determinations were known for this Vestoid asteroid. A unique bimodal solution with $P = 6.550 \pm 0.003$ h was found using SAO data obtained on three nights in 2019 August.

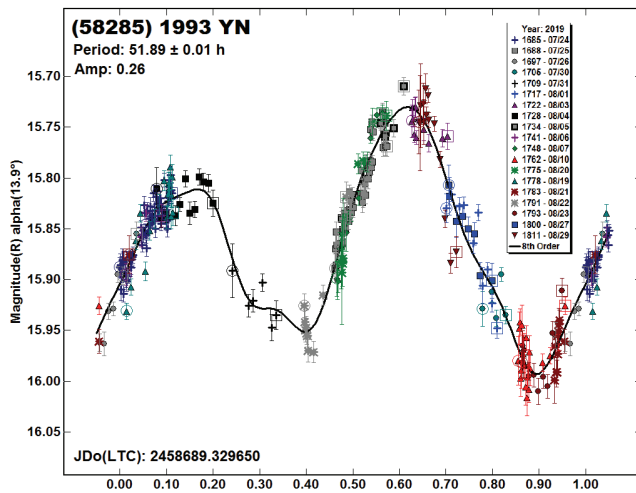


19155 Lifeson. No records on past period determinations were found prior to observations done at SAO in 2019 August. The rotation period of $P = 5.079 \pm 0.001$ h reported here, even though based on an incomplete bimodal lightcurve, represents the most likely solution, especially given the amplitude and relatively low phase angle (Harris et al., 2014). Future observations could increase the certainty of the result given here.



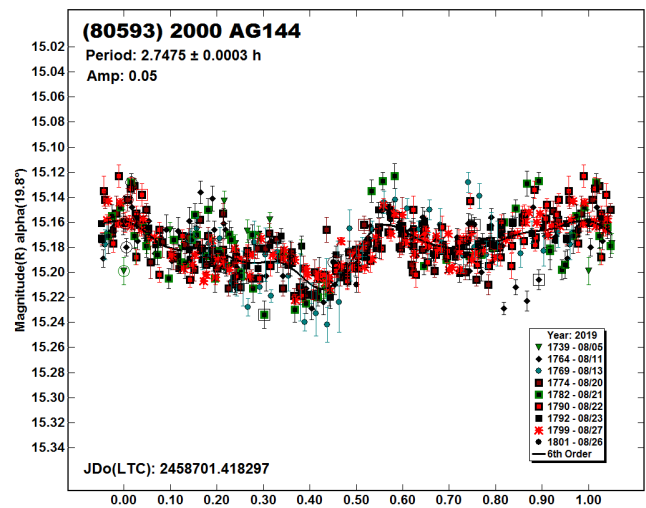
(58285) 1993 YN. This is a Mars-crossing BinAstPhot Survey asteroid with no previously known rotation period. Initial observations indicated a slow-spinning asteroid. The target was monitored systematically for more than a month (2019 late July - late August) on 19 nights.

A sparse photometric data set was created by obtaining several separate groups of a few data points on each night. A bimodal lightcurve with an amplitude of 0.26 mag phased to a period of $P = 51.89 \pm 0.01$ h was found as a result of period analysis. Pravec (2019), independently using the same data set, found 51.92 h for the period



(80593) 2000 AG144. This Mars-crossing asteroid was included in the BinAstPhot Survey observing program. No prior rotation period determinations were known. The photometric observations within the survey were made in 2019 August at SAO on nine nights, as well as on two nights by V. Chiorny using a 0.7-m telescope of the Kharkiv University Observatory, Ukraine.

Despite a low lightcurve amplitude, Pravec used the full data set to find a nearly unambiguous solution of $P = 2.7476$ h and assign an uncertainty flag on the LCDB system of $U = 2+$ (Pravec, 2019). In an independent period analysis based solely on the SAO data, an almost identical result of $P = 2.7475 \pm 0.0003$ h was found.



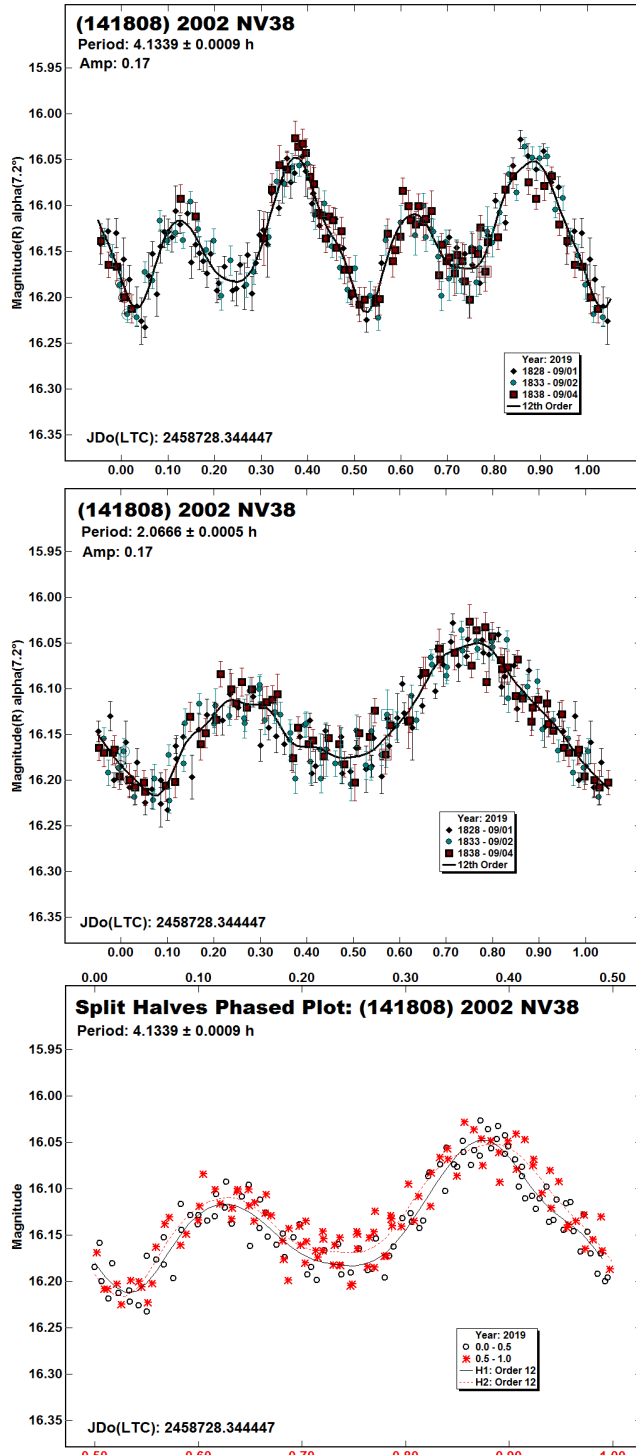
(141808) 2002 NV38. This Mars-crossing asteroid was a BinAstPhot Survey program target without a known prior rotation period determination. Analysis of the dense photometric data acquired at SAO on three nights in early 2019 September shows two distinctly pronounced, harmonically related solutions: the longer period is exactly twice the shorter one (4.133 h vs. 2.066 h).

The possibility of a shorter period below the 2.2 h “spin-barrier” for “rubble-pile” asteroids could indicate either a small monolithic asteroid ($D < \sim 200$ m) or a strongly cohesive “rubble-pile” structure. Given that the absolute magnitude is estimated to be $H = 16.0$ (JPL, 2019), it is more likely not a small-sized asteroid, which would require $H > 22$ (Pravec and Harris, 2000).

Number	Name	2019/mm/dd	Phase	L _{PAB}	B _{PAB}	Period (h)	P.E.	Amp	A.E.	Grp
1272	Gefion	08/29-08/31	2.0, 1.8	338	3	3.086	0.003	0.24	0.02	MB-O
1816	Liberia	06/15-08/01	13.9, 17.8	271	29	3.08606	0.00005	0.36	0.02	PHO
2548	Leloir	07/30-08/05	13.8, 12.2	337	12	3.2066	0.0004	0.21	0.03	MB-M
2768	Gorky	09/14-09/16	31.6, 31.5	51	-2	4.499	0.003	0.23	0.01	FLOR
3029	Sanders	09/19-09/21	8.1, 7.6	12	4	3.064	0.002	0.44	0.01	FLOR
3494	Purple Mountain	09/14-09/27	11.5, 17.0	335	8	5.8575	0.0003	0.43	0.01	FLOR
3533	Toyota	09/12-09/14	18.4, 17.9	21	1	2.976	0.002	0.21	0.02	FLOR
3629	Lebedinskiy	09/28-10/02	12.7, 11.1	27	4	9.342	0.006	0.33	0.01	V
4191	Assesse	07/26-07/31	13.4, 12.0	323	16	5.6472	0.0008	0.29	0.01	EUN
4263	Abashiri	08/23-09/01	10.5, 6.6	348	6	4.8829	0.0004	0.21	0.01	FLOR
4527	Schoenberg	09/27-09/30	13.8, 12.1	23	-5	2.6909	0.0009	0.10	0.02	FLOR
4774	Hobetsu	10/01-10/02	4.5, 5.0	1	5	3.564	0.005	0.10	0.02	FLOR
4842	Atsushi	08/28-08/30	16.5, 15.9	1	3	4.687	0.002	0.47	0.01	FLOR
4912	Emilhaury	08/28-08/31	2.7, 2.0	338	3	3.6029	0.0005	0.59	0.01	FLOR
5104	Skripnichenko	07/10-07/25	9.9, 13.1	281	19	2.8269	0.0001	0.23	0.02	EUN
5183	Robyn	09/01-09/21	*11.0, 10.2	350	20	4.3914	0.0002	0.26	0.02	EUN
5492	Thoma	08/01-08/20	11.1, 8.1	325	17	3.3142	0.0001	0.24	0.02	MB-O
5663	McKeegan	09/01-09/06	15.3, 13.2	356	10	4.769	0.001	0.20	0.02	MB-I
5817	Robertfrazier	09/14-09/16	28.1, 27.9	28	18	4.043	0.002	0.25	0.02	MC
6205	Menottigalli	06/10-07/06	9.9, 18.3	253	15	15.251	0.002	0.36	0.03	MB-I
6527	Takashiito	09/12-09/14	20.1, 19.5	20	7	3.016	0.002	0.27	0.03	FLOR
6567	Shigemasa	07/31-08/05	12.3, 10.3	324	7	3.2756	0.0004	0.14	0.02	BAP
8900	AAVSO	08/12-08/14	9.9, 9.5	331	12	3.839	0.003	0.39	0.02	MB-I
12512	Split	08/05-08/11	12.2, 9.6	328	8	5.778	0.001	0.46	0.02	BAP
13950	1990 RP9	08/05-08/08	13.9, 13.0	335	8	6.550	0.003	0.35	0.02	V
19155	Lifeson	08/13-08/21	15.9, 13.1	346	9	5.079	0.001	0.25	0.03	EUN
58285	1993 YN	07/24-08/29	*14.0, 16.9	316	12	51.89	0.01	0.26	0.02	MC
80593	2000 AG144	08/05-08/26	19.8, 13.0	339	9	2.7475	0.0003	0.05	0.02	MC
141808	2002 NV38	09/01-09/05	7.2, 6.6	343	7	4.1339	0.0009	0.17	0.02	MC

Table I. Observing circumstances and results. Phase is the solar phase angle given at the start and end of the date range. If preceded by an asterisk, the phase angle reached an extrema during the period. LPAB and BPAB are the average phase angle bisector longitude and latitude. Grp is the asteroid family/group (Warner et al., 2009): BAP = Baptistina, EUN = Eunomia, FLOR = Flora, MB-I/M/O = main-belt inner/middle/outer, MC = Mars Crosser, PHO = Phocaea, V = Vestoid.

On the other hand, the “split halves” at the double period shows noticeable differences in the two halves of the lightcurve. This favors the longer period solution and a gravity-dominated “rubble-pile” structure for this asteroid. The solution of $P = 4.1339 \pm 0.0009$ h is adopted here as being more likely correct. An independent period analysis by Pravec (2019) resulted in a period of 4.1333 ± 0.0008 h. Given the unknown basic physical parameters for this asteroid, a conclusive period cannot be given. Further study of other physical parameters is highly desirable as it would likely lead to the true rotation period.



Acknowledgements

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References

- Alvarez, E.M. (2010). “Period Determination for 4191 Assesse.” *Minor Planet Bull.* **37**, 142-143.
- Angeli, C.A.; Barucci, M.A. (1996). “CCD observations: rotational properties of 13 small asteroids.” *Planetary and Space Science* **44**, 181-186.
- Angeli, C.A.; Guimaraes, T.A.; Lazzaro, D.; Duffard, R.; Fernandez, S.; Florczak, M.; Mothe-Diniz, T.; Carvano, J.M.; Betzler, A.S. (2001). “Rotation Periods for Small Main-Belt Asteroids From CCD Photometry.” *Astron. J.* **121**, 2245-2252.
- Behrend, R. (2004, 2006, 2008, 2011, 2014). CdL Observatoire de Geneve web site: http://obswww.unige.ch/~behrend/page_cou.html
- Burkhonov, O.A.; Ehgamberdiev, Sh.A.; Ergashev, K.E.; Yoshida, F. (2013). “Period Determination for 4527 Schoenberg.” *Minor Planet Bull.* **40**, 190.
- Cantu, S.A.; Kozdon, J.; Montgomery, K.; Lyons, V. (2016). “Lightcurves and Rotational Periods of Three Main-belt Asteroids.” *Minor Planet Bull.* **43**, 210-212.
- Hanus, J.; Durech, J.; Oszkiewicz, D.A.; Behrend, R.; Carry, B.; Delbo, M.; Adam, O.; Afonina, V.; Anquetin, R.; Antonini, P.; Arnold, L.; Audejean, M.; Aurard, P.; Bachschmidt, M.; Baduel, B.; and 154 coauthors. (2016). “New and updated convex shape models of asteroids based on optical data from a large collaboration network.” *Astron. Astrophys.* **586**, A108.
- Harris, A.W.; Pravec, P.; Galad, A.; Skiff, B.A.; Warner, B.D.; Vilagi, J.; Gajdos, S.; Carbognani, A.; Hornoch, K.; Kusnirak, P.; Cooney, W.R.; Gross, J.; Terrell, D.; Higgins, D.; Bowell, E.; Koehn, B.W. (2014). “On the maximum amplitude of harmonics on an asteroid lightcurve.” *Icarus* **235**, 55-59.
- JPL (2019). Small Body Database Browser. <http://ssd.jpl.nasa.gov/sbdb.cgi>
- Klinglesmith, D.A., III.; DeHart, A.; Hanowell, J.; Warrern, C.A. (2015). “Asteroids at Etscom: 490 Veritas, 3039 Yangel, 5492 Thoma.” *Minor Planet Bull.* **42**, 12-13.
- Koff, R.A. (2005). “Lightcurve photometry of asteroids 212 Medea, 517 Edith, 3581 Alvarez 5682 Beresford, and 5817 Robertfraser.” *Minor Planet Bull.* **32**, 32-34.
- Kosiarek, M.; Nisley, I.; Patra, K.; Hatano, R.; Bates, H.; Chavez, E.; Kosiarek, J.L.; Kumari, S. (2017). “Rotation Period of Asteroid 3494 Purple Mountain.” *Minor Planet Bull.* **44**, 171-172.
- Pravec, P.; Harris, A.W. (2000). “Fast and Slow Rotations of Asteroids.” *Icarus* **148**, 12-20.
- Pravec, P. (2008, 2009, 2012, 2016, 2019). Photometric Survey for Asynchronous Binary Asteroids web site. <http://www.asu.cas.cz/~ppravec/newres.txt>

Pray, D.P. (2005). "Lightcurve analysis of asteroids 276, 539, 1014, 1067, 3693 and 4774." *Minor Planet Bull.* **32**, 8-9.

Pray, D.P.; Kusnirak, P.; Galad, A.; Vilagi, J.; Kornos, L.; Gajdos, S.; Pikler, M.; Cervak, G.; Husarik, M.; Oey, J.; Cooney, W.; Gross, J.; Terrell, D.; Stephens, R.D.; Higgins, D. (2007). "Lightcurve Analysis of Asteroids 2006 BQ6, 2942, 2943 3402, 3533, 6497, 6815, 7033, 12336, and 14211." *Minor Planet Bull.* **34**, 44-46.

Pray, D.P.; Galad, A.; Husarik, M.; Oey, J. (2008). "Lightcurve Analysis of Fourteen Asteroids." *Minor Planet Bull.* **35**, 34-36.

VizieR (2019). <http://vizier.u-strasbg.fr/viz-bin/VizieR>.

Warner, B.D. (2018). *MPO Canopus* software, version 10.7.11.3. <http://www.bdwpublishing.com>

Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The Asteroid Lightcurve Database." *Icarus* **202**, 134-146. Updated 2019 August. <http://www.minorplanet.info/lightcurvedatabase.html>

Waszczak, A.; Chang, C.-K.; Ofek, E.O.; Laher, R.; Masci, F.; Levitan, D.; Surace, J.; Cheng, Y.-C.; Ip, W.-H.; Kinoshita, D.; Helou, G.; Prince, T.A.; Kulkarni, S. (2015). "Asteroid Light Curves from the Palomar Transient Factory Survey: Rotation Periods and Phase Functions from Sparse Photometry." *Astron. J.* **150**, A75.

Willis, S. (2004). "CCD observations and period determination of six minor planets." *Minor Planet Bull.* **31**, 82-83.

LIGHTCURVE PHOTOMETRY OPPORTUNITIES: 2020 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 using lightcurve inversion. We also include lists of objects that will or might be radar targets. Lightcurves for these objects can help constrain pole solutions and/or remove rotation period ambiguities that might not come from using radar data alone.

We present several lists of asteroids that are prime targets for photometry during the period 2020 January-March

In the first three sets of tables, "Dec" is the declination and "U" is the quality code of the lightcurve. See the latest asteroid lightcurve data base (LCDB; Warner et al., 2009; *Icarus* **202**, 134-146.) documentation for an explanation of the U code:

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

The ephemeris generator on the CALL web site allows you to create custom lists for objects reaching $V \leq 18.0$ during any month in the current year and up to five years in the future, e.g., limiting the results by magnitude and declination, family, and more.

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

We refer you to past articles, e.g., *Minor Planet Bulletin* **36**, 188, for more detailed discussions about the individual lists and points of advice regarding observations for objects in each list.

Once you've obtained and analyzed your data, it's important to publish your results. Papers appearing in the *Minor Planet Bulletin* are indexed in the Astrophysical Data System (ADS) and so can be referenced by others in subsequent papers. It's also important to make the data available at least on a personal website or upon request. We urge you to consider submitting your raw data to the ALCDEF database. This can be accessed for uploading and downloading data at

<http://www.alcdef.org>