

**PHOTOMETRY OF 39 ASTEROIDS AT Sopot
ASTRONOMICAL OBSERVATORY:
2019 SEPTEMBER - 2020 MARCH**

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CCD photometric observations of 39 asteroids were conducted at Sopot Astronomical Observatory (SAO) from 2019 September through 2020 March. A review of the results obtained for synodic rotation periods as well as the established lightcurves is presented here.

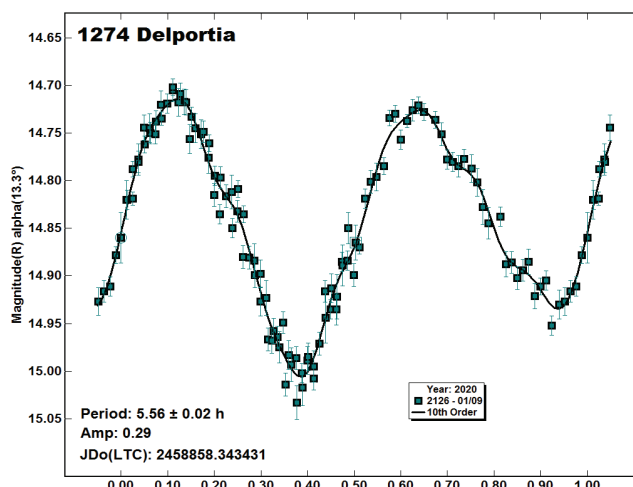
Photometric observations of 39 asteroids were conducted at Sopot Astronomical Observatory (SAO) between 2019 September - 2020 March in order to determine their synodic rotation periods. For this purpose, two 0.35-m $f/6.3$ Meade LX200GPS Schmidt-Cassegrain telescopes were employed. The telescopes are equipped with SBIG ST-8 XME and SBIG ST-10 XME CCD cameras. The exposures were unfiltered and unguided for all targets. Both cameras were operated in 2×2 binning mode, which produces image scales of 1.66 arcsec/pixel and 1.25 arcsec/pixel for ST-8 XME and ST-10 XME cameras, respectively. 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 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.

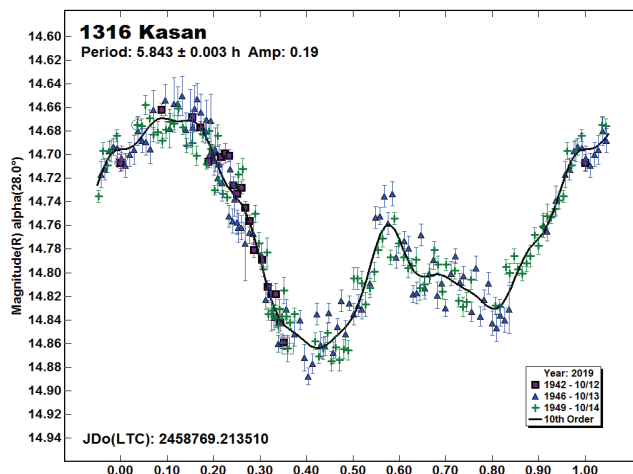
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Table I gives the observing circumstances and results.

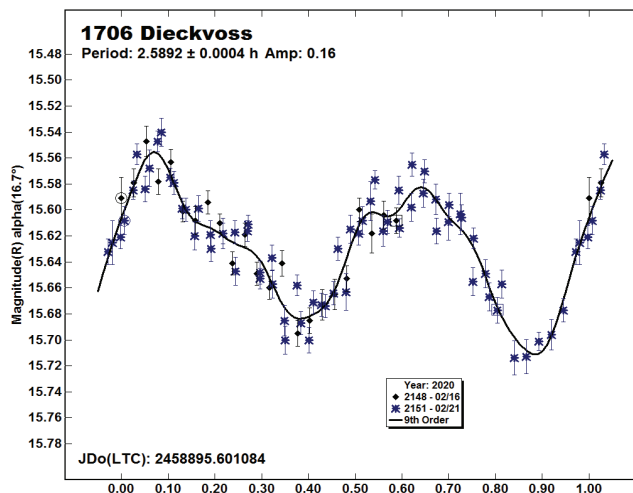
1274 Delportia. A search for previous rotation periods in the LCDB (Warner et al., 2009) finds the following results: 5.5 h (Behrend, 2005web), 5.615 h (Sheridan, 2011), and 5.620 h (Waszczak et al., 2015). The dense photometric observations obtained at SAO over a single night in 2020 January led to a synodic period of $P = 5.56 \pm 0.02$ h, which is in good agreement with the previously established periods.



1316 Kasan. Observations made over three consecutive nights in 2019 October yielded a bimodal lightcurve phased to a period of $P = 5.843 \pm 0.003$ h as the most favorable period solution for this Mars-crossing asteroid. This is quite consistent with the results by Warner (2005, 5.83 h) and Stephens (2009, 5.82 h).



1706 Dieckvoss. Oey (2016) found a rotation period of 2.58944 h for this inner main-belt asteroid. The SAO observations conducted over two nights in 2020 February show a similar result: $P = 2.5892 \pm 0.0004$ h.



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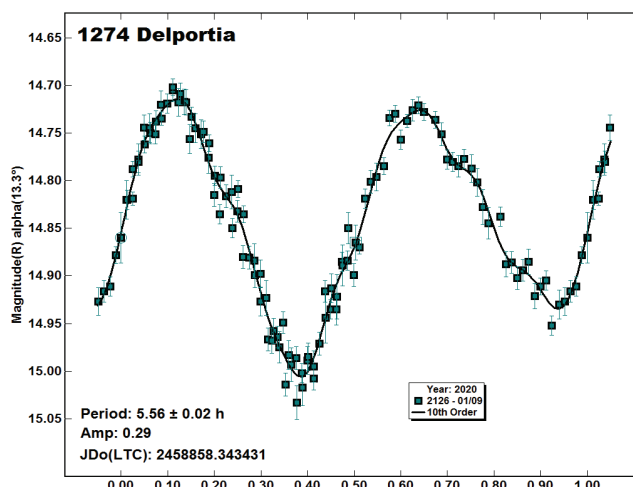
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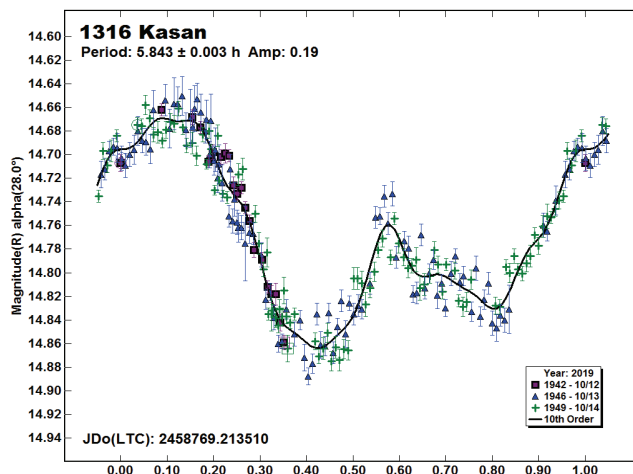
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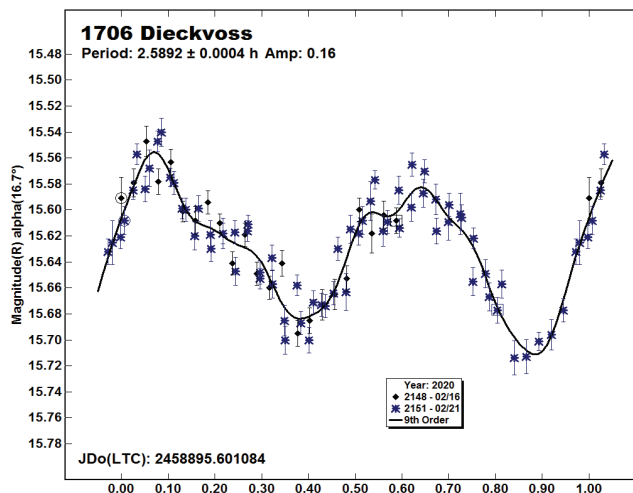
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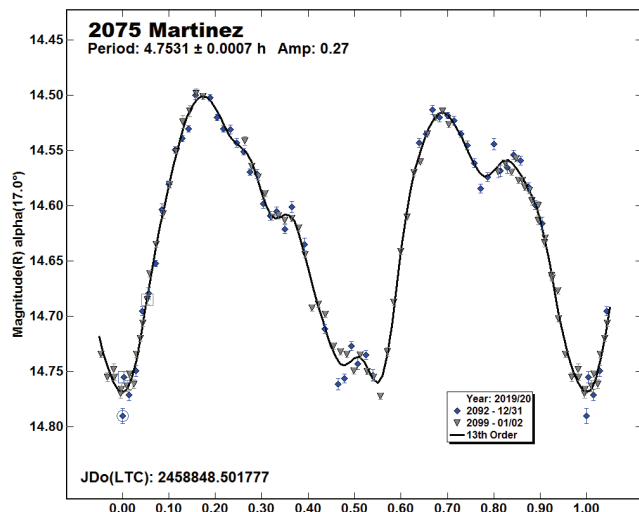
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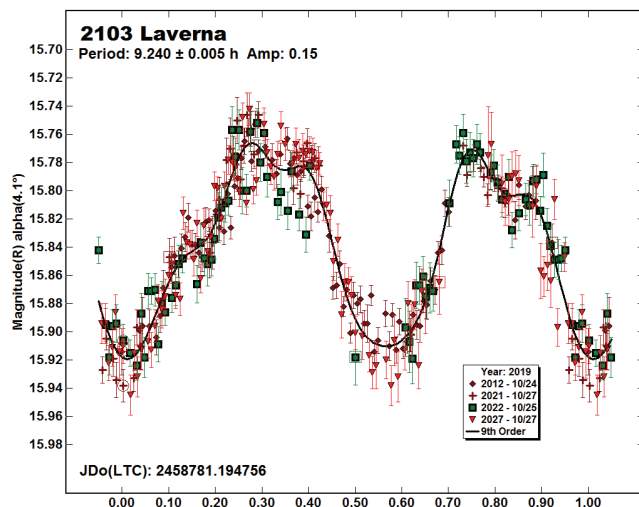


2075 Martinez. The only previous rotation period determination is by Menke et al. (2008, 4.755 h). Period analysis of the SAO data obtained in 2019 December - 2020 January on two nights shows the favored solution to be a bimodal lightcurve with a period of $P = 4.7531 \pm 0.0007$ h and amplitude of 0.27 mag.

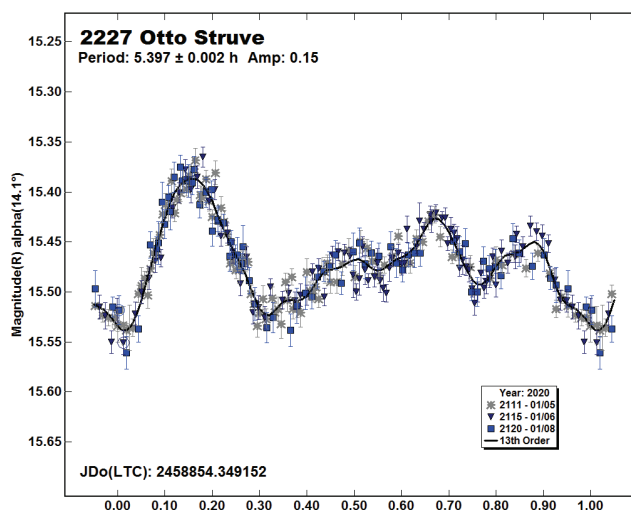


2103 Laverna. Two previous period determinations indicate completely different results: 9.249 h (Klinglesmith et al., 2005) and 11.0 h (Behrend, 2016web), of which the latter is an estimate based on an incomplete lightcurve obtained over a single night.

The SAO observations from 2019 October point to a bimodal period of $P = 9.240 \pm 0.005$ h, which is in a full agreement with that found by Klinglesmith et al. (2005).

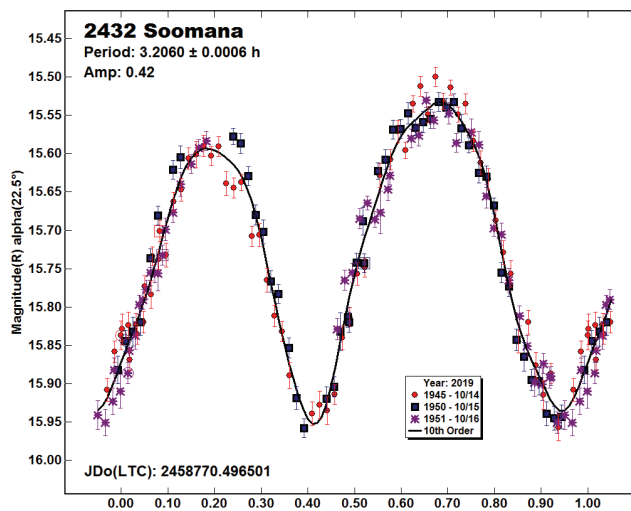


2227 Otto Struve. This was a BinAstPhot Survey target with no previously known rotation period. It was observed solely at SAO on three nights in 2020 January. A unique rotation period solution of $P = 5.397 \pm 0.002$ h was found.

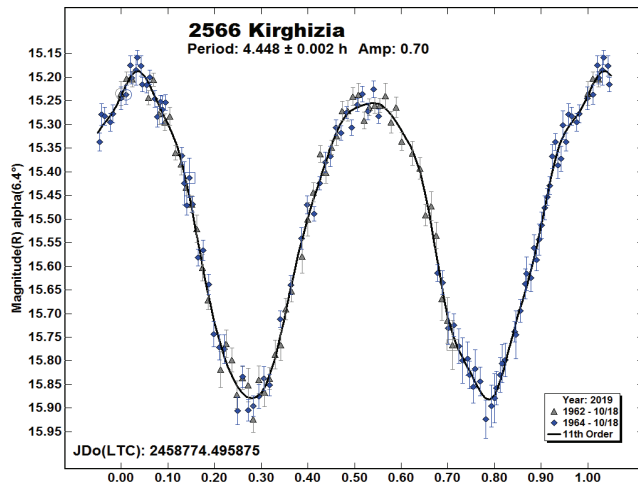


2432 Soomana. The SAO data gathered on three consecutive nights on this Vestoid asteroid in 2019 October show an unambiguous rotation period of $P = 3.2060 \pm 0.0006$ h, associated with a large amplitude (0.42 mag.) bimodal lightcurve.

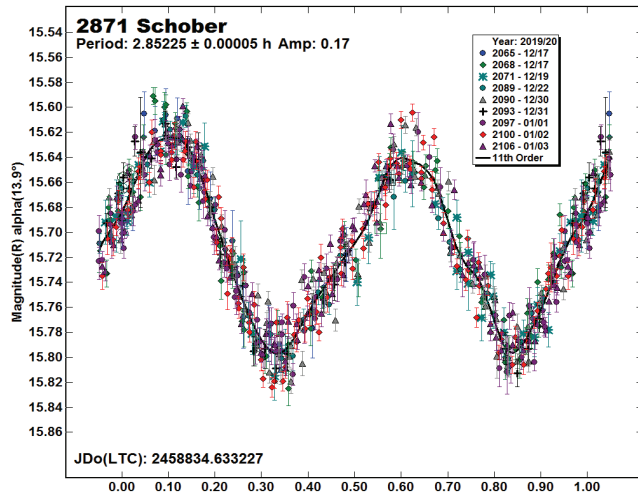
This period result is fully consistent with two previous results: 3.206 h (Klinglesmith et al., 2013) and 3.207 h (Waszczak et al., 2015).



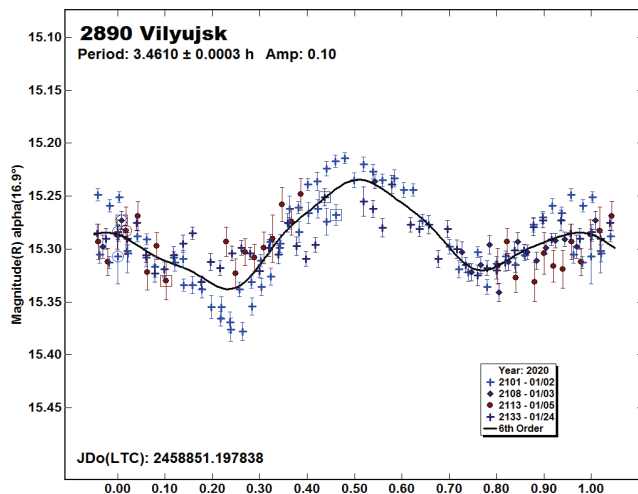
2566 Kirghizia. Montgomery et al. (2013) found the only previously known rotation period, 4.451 h. Photometric data taken on two consecutive nights at SAO yielded a unique bimodal solution of $P = 4.448 \pm 0.002$ h associated with a large amplitude (0.70 mag.) lightcurve.



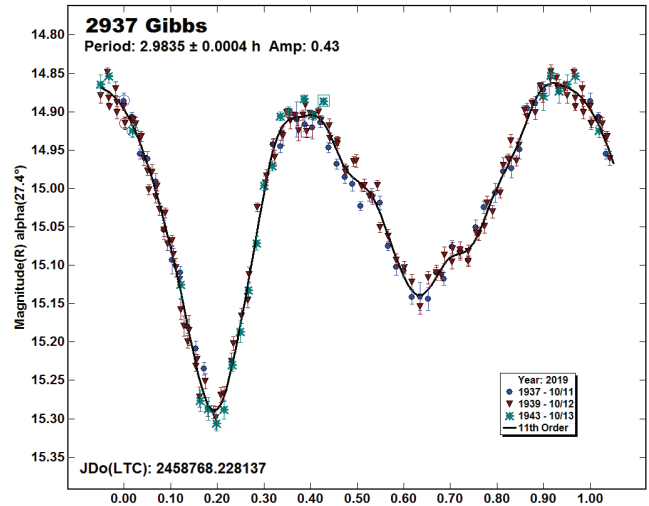
2871 Schober. Yankov and Dittion (2009) found a synodic rotation period of 2.8674 h. The SAO data collected over nine nights in 2019 December and 2020 January indicate $P = 2.85225 \pm 0.00005$ h, differing slightly from the previous result.



2890 Vilyujsk. Previous period determinations are those of Koff (2003, 3.45 h), Ruthroff (2013, 3.45 h) and Waller (2013, 3.42 h). The SAO observations carried out in 2020 January show a value very close to those earlier ones: $P = 3.4610 \pm 0.0003$ h.



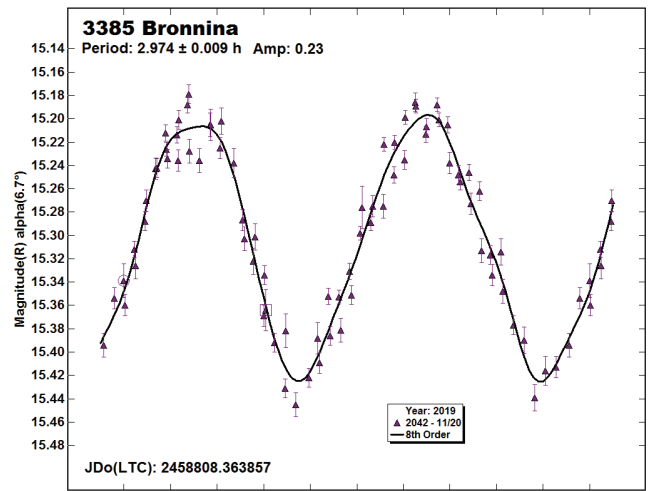
2937 Gibbs. Several rotation period determinations were known for this Mars-crossing asteroid prior to the SAO observations in 2019 October. These include Behrend (2005web; 3.06153 h) and Stephens (2017; 3.189 h). In addition, the most recent results came from the 2019 apparition: Warner and Stephens (2019; 2.982 h) and Benishek (2019; 2.9820 h).

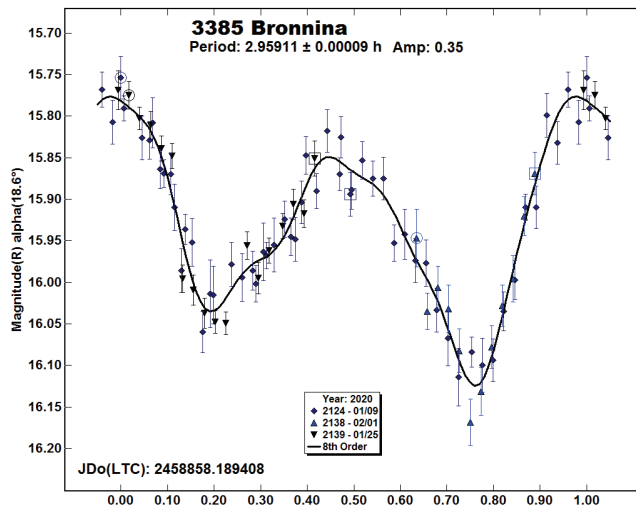


The SAO photometric observations carried out on three consecutive nights resulted in a moderately large amplitude (0.43 mag.) bimodal lightcurve phased to a unique period of $P = 2.9835 \pm 0.0004$ h.

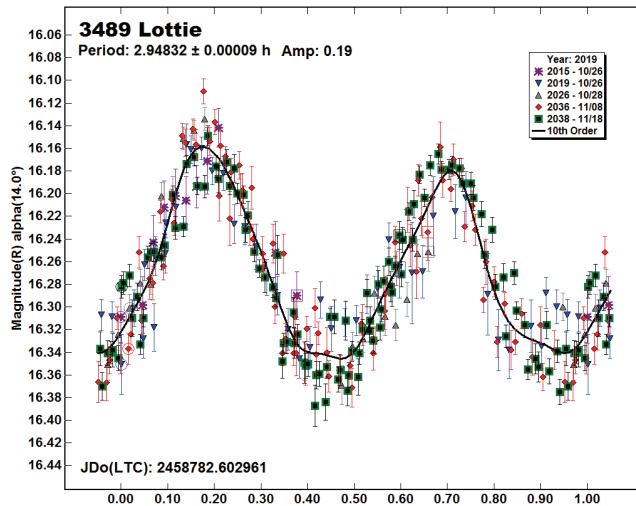
3385 Bronnina. The LCDB records indicate several previously known rotation periods, e.g. by Coley (2012, 2.996 h), Behrend (2014web, 2.93 h) and Dykhuis et al. (2016, 2.95897 h).

This target was observed at two different viewing geometries, first in late 2019 November over a single night and then 2019 January to February 1 on three nights. Hence two, independent lightcurves different in shape were obtained. The single-night 2019 November SAO data indicate a rotation period of 2.974 ± 0.009 h, whilst period analysis of the 2020 January-February data gives a secure period value of 2.95911 ± 0.00009 h.

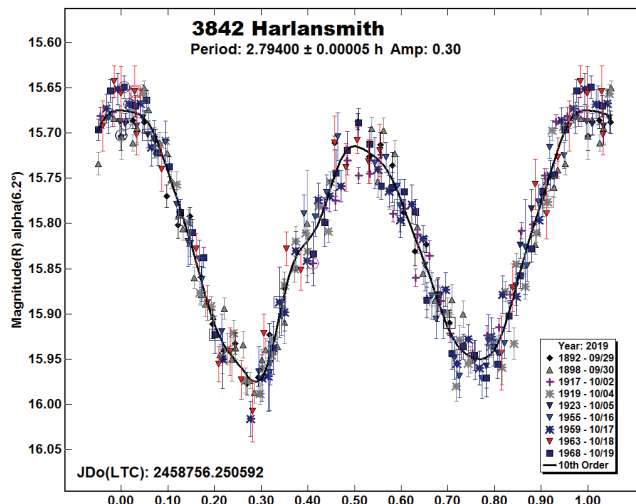




3489 Lottie is a Vestoid type asteroid with no previously known rotation period. Observed over five nights in 2019 October–November at SAO, analysis found an unambiguous bimodal solution of $P = 2.94832 \pm 0.00009$ h.

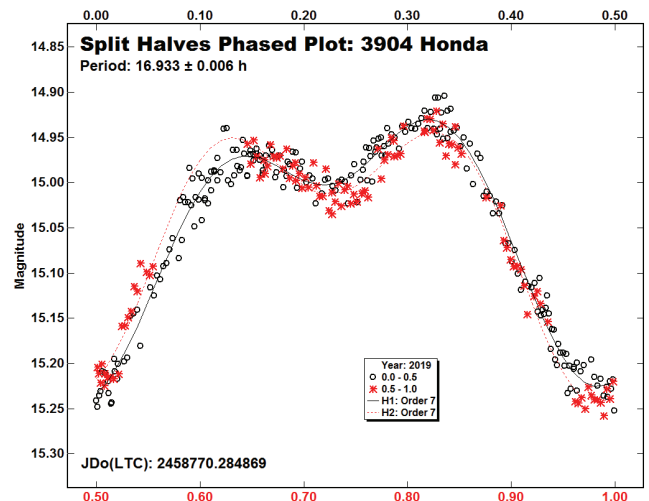
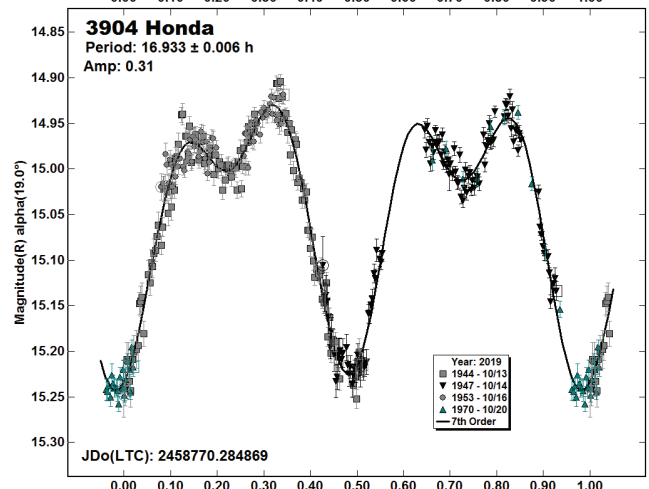
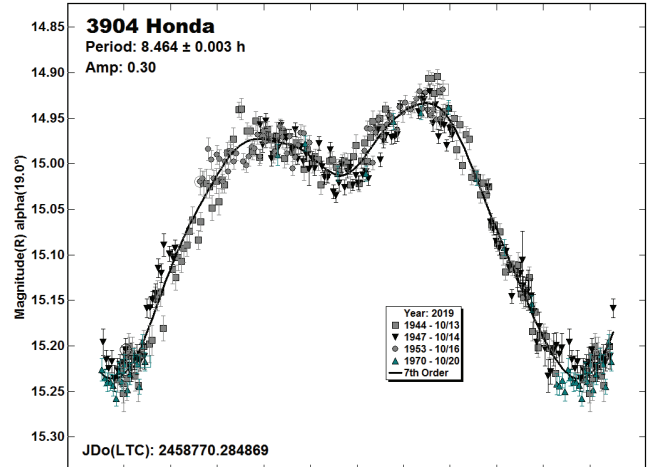


3842 Harlansmith. The only previously determined rotation period was by Han et al. (2013, 2.7938 h).



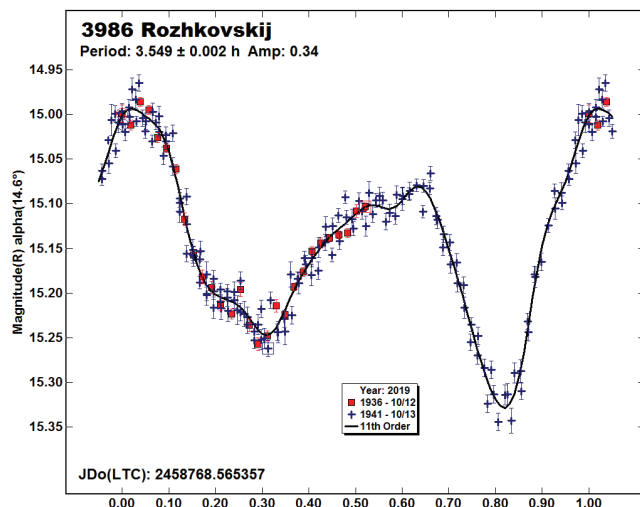
Based on data obtained over nine nights in 2019 September–October at SAO, the most likely solution was a 0.30 mag. amplitude bimodal lightcurve phased to a period of $P = 2.79400 \pm 0.00005$ h

3904 Honda. There were no previously reported rotation period results for this Eunomia family asteroid. Five datasets taken in 2019 October led to a period solution of $P = 8.464 \pm 0.003$ h.



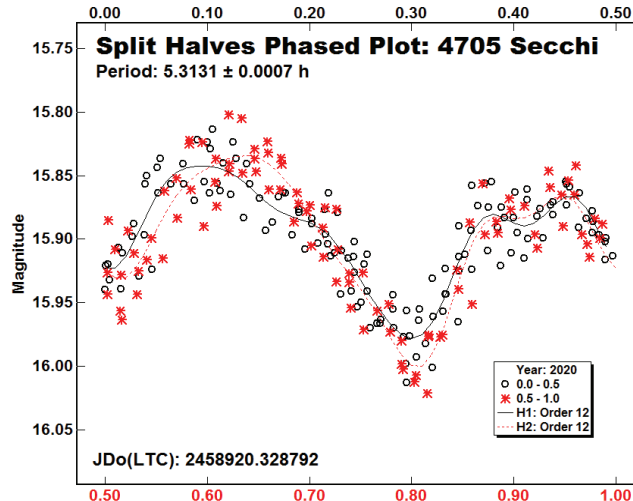
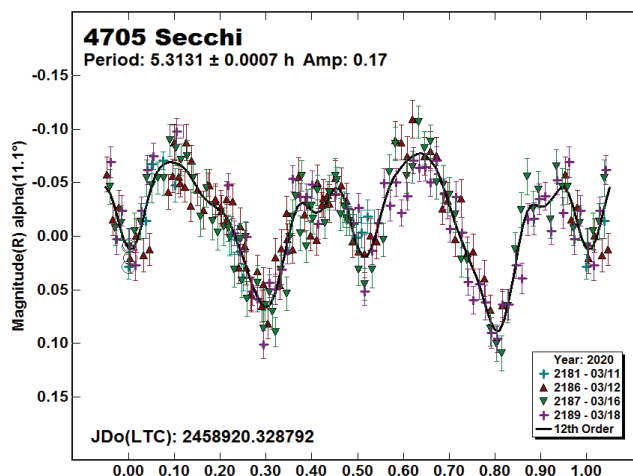
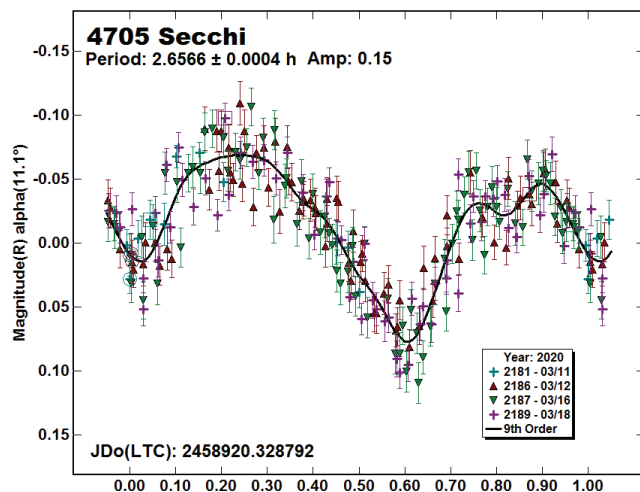
Aside from this solution, a period twice as long of 16.933 h appears in the period spectrum as a possible result, which should not be ruled out given the negligible differences between the two halves of the corresponding lightcurve. Since it is possible that those differences come from a slightly higher noise level in the current data, it would be desirable to observe this target in the future to securely determine which of the two periods is the correct one.

3986 Rozhkovskij. Several earlier rotation period determinations were found in the LCDB: Birlan et al. (1996, 4.26 h) and Warner (2010, 3.548 h). Period analysis of the SAO data taken on two consecutive nights in 2019 October show a unique bimodal solution for a period of $P = 3.549 \pm 0.002$ h.

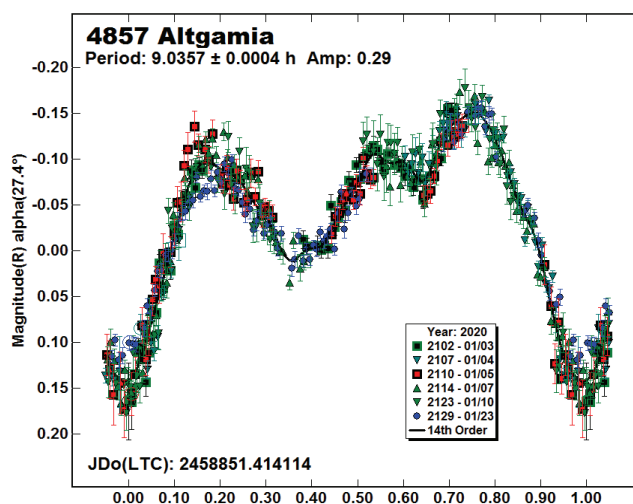


4705 Secchi. No rotation periods were found in the LCDB. The observations were performed over four nights in 2020 March. Due to slightly higher noise level in the obtained data and a relatively low amplitude (0.17 mag.), it is not easy to distinguish between a period of $P = 2.6566 \pm 0.0004$ h and a harmonically related double period of 5.3131 ± 0.0007 h.

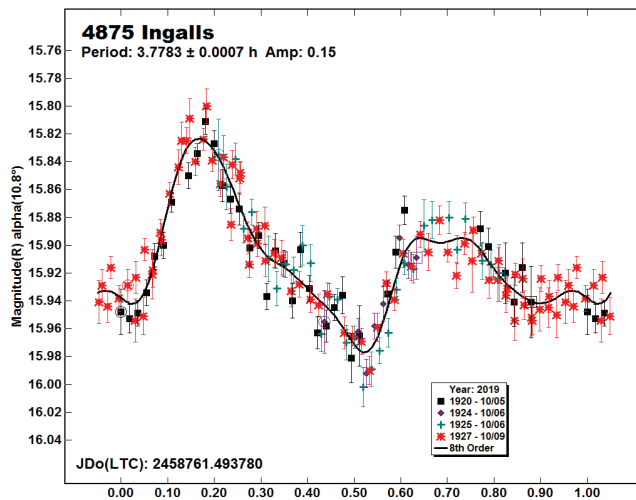
The two halves of the lightcurve for the longer period do not fully match, which could be due to higher noise and means that the longer period cannot be formally excluded. The shorter found period is adopted here as more likely. As in other similar cases, only high-quality future observations can give a definitive answer.



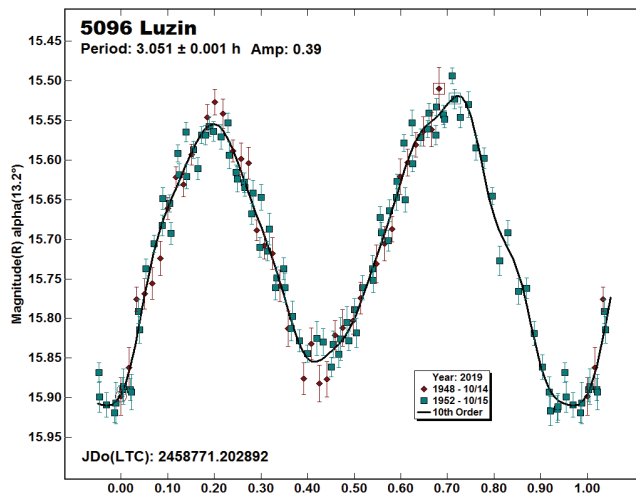
4857 Altgamia. This was a BinAstPhot Survey target with no previously known rotation period. The observations taken at SAO throughout 2020 January revealed a 0.29 mag. lightcurve phased to a period of $P = 9.0357 \pm 0.0004$ h as a most plausible solution.



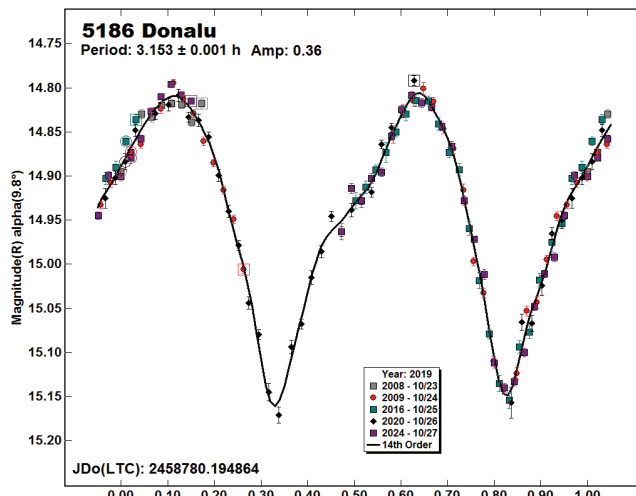
4875 Ingalls. Garceran et al. (2016) found a synodic rotation period of 3.78 h based a somewhat noisy data set (rated U = 2+ in the LCDB). Analysis of the 2019 October SAO observations nevertheless confirm the previous result, showing a unique period of $P = 3.7783 \pm 0.0007$ h.



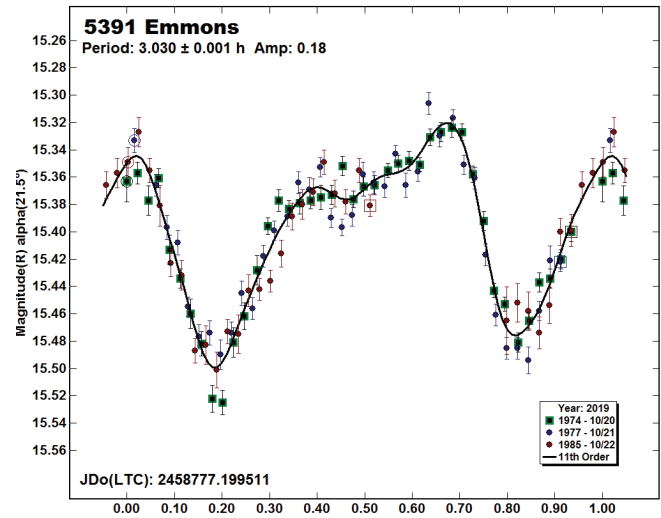
5096 Luzin. The synodic rotation period by Klinglesmith et al. (2013; 3.054 h) was the only one found in the LCDB. Two consecutive nights of observations at SAO in 2019 October resulted in a rather large amplitude (0.39 mag.) bimodal lightcurve with a unique period of $P = 3.051 \pm 0.001$ h.



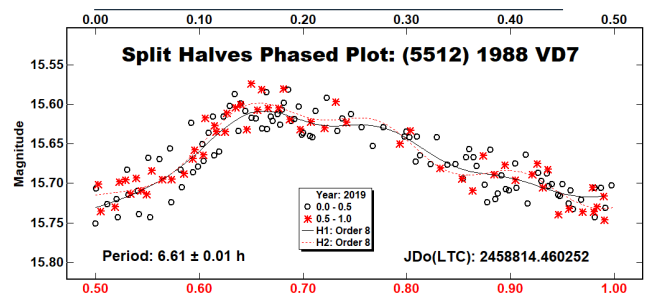
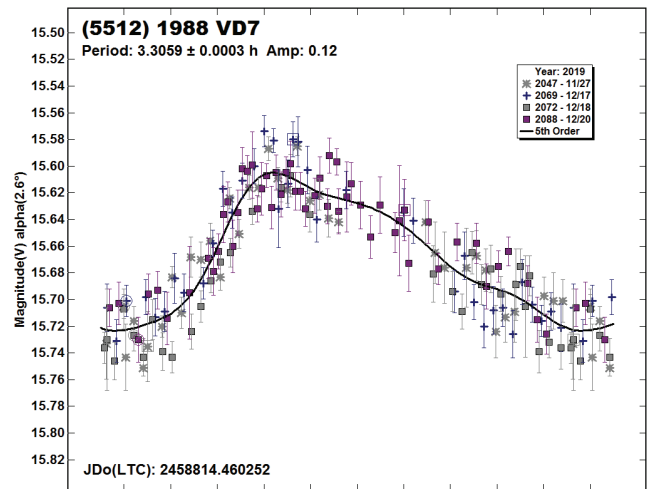
5186 Donalu. Casalnuovo (2016) reported a rotation period of 3.15 h. The period found from the 2019 October SAO data, $P = 3.153 \pm 0.001$ h, is consistent with this Casalnuovo (2016).



5391 Emmons. Clark and Joyce (2003) found a synodic rotation period of 3.028 h for this inner main-belt asteroid. The 2019 October SAO data obtained on three nights led to an almost identical result of $P = 3.030 \pm 0.001$ h.

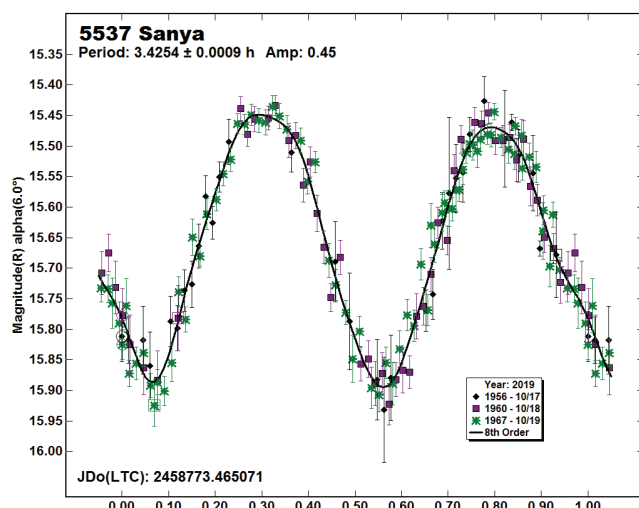


(5512) 1988 VD7. No prior rotation period results on this Flora asteroid exist. Observations were conducted in second half of 2019 December in the course of four nights. Out of the many possible period solutions, the most prominent are the monomodal one at $P = 3.3059 \pm 0.0003$ h and a bimodal lightcurve at the double period of 6.61 h.

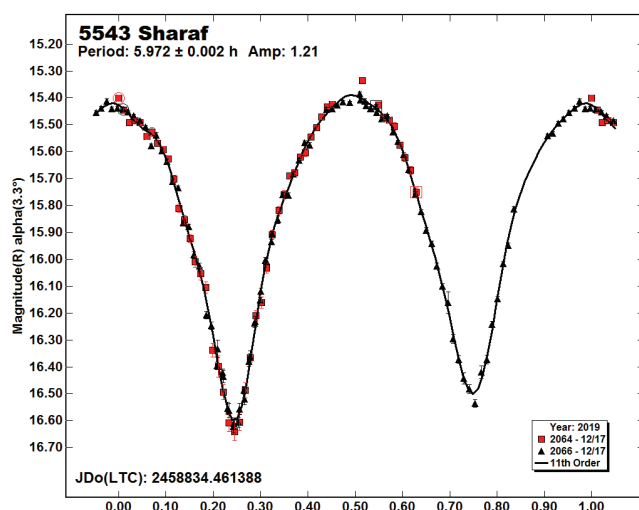


The two halves of the bimodal lightcurve are almost exactly identical, within the boundaries of the data scatter. This fact supports the shorter period as a solution although the possibility of a bimodal period should not be entirely ruled since the minimal differences in the two halves could be concealed in the noise. As in other similar cases, resolving this kind of period ambiguity requires intensive gathering of better-quality data at future apparitions.

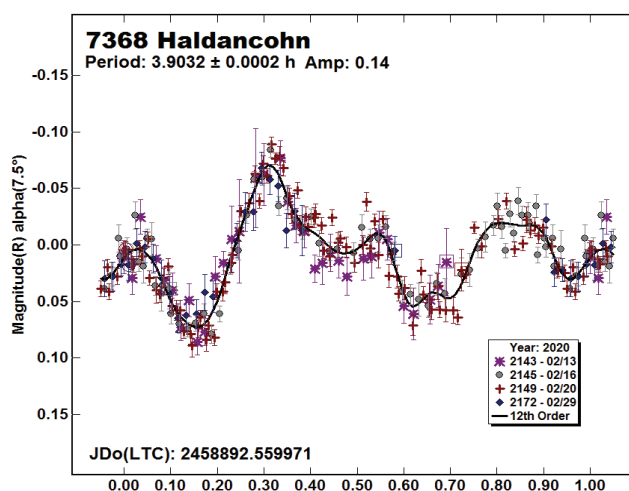
5537 Sanya. The only previous rotation period result by Waszczak et al. (2015; 3.427 h) is almost identical to the result derived from the SAO data acquired in 2019 October on three consecutive nights, $P = 3.4254 \pm 0.0009$ h.



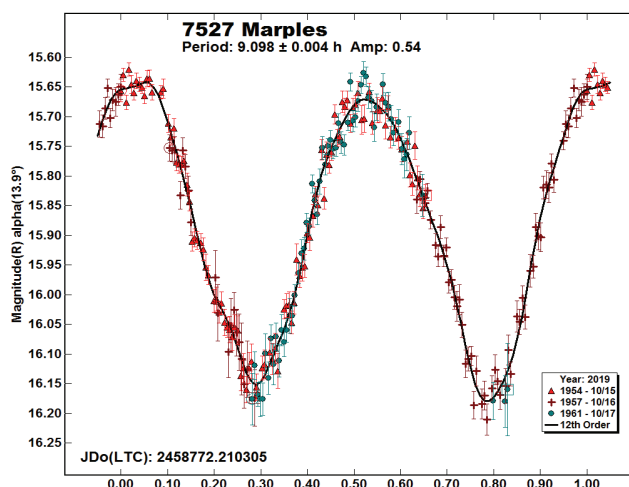
5543 Sharaf. No previous rotation period determinations were found for this Flora family asteroid. Data obtained on two consecutive 2019 December nights reveal an extremely large amplitude (1.21 mag.) bimodal lightcurve phased to a period of $P = 5.972 \pm 0.002$ h, indicating a very elongated shape.



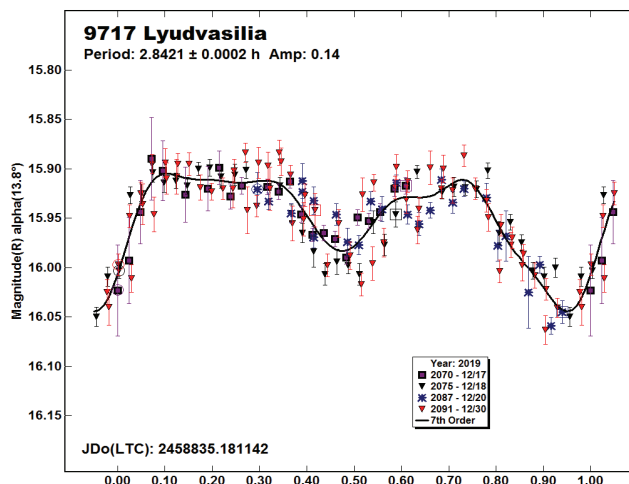
7368 Haldancohn was another BinAstPhot Survey program target observed solely at Sopot Observatory during the 2020 apparition. Data taken on four nights in 2019 February confirm the period result found, also within the BinAstPhot Survey, at the 2017 apparition (Pravec, 2017web; 3.90337 h). The newly established value is $P = 3.9032 \pm 0.0002$ h.



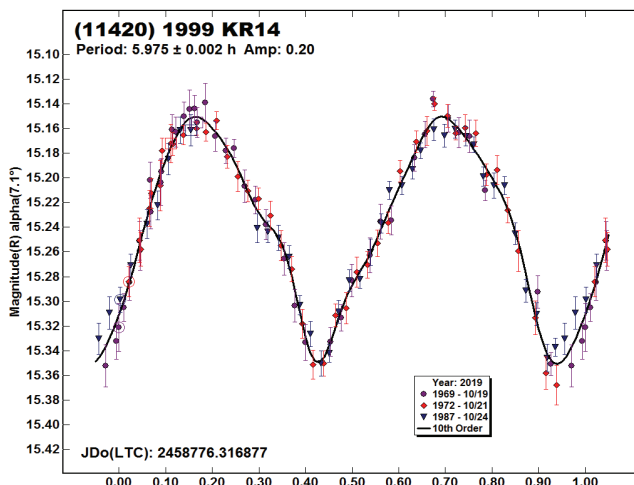
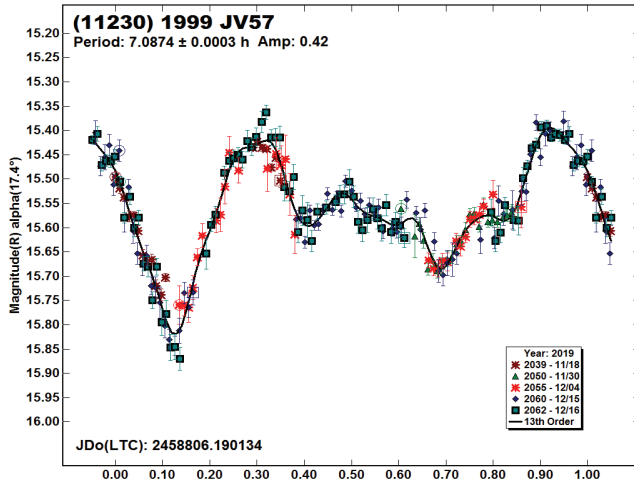
7527 Marples. Behrend (2018web) states 7.85 h for a synodic rotation period. This result is based on a single night data and a provisional lightcurve. The newly established unique bimodal results based on the 2019 October SAO data collected on three consecutive nights are $P = 9.098 \pm 0.004$ h, $A = 0.54$ mag.



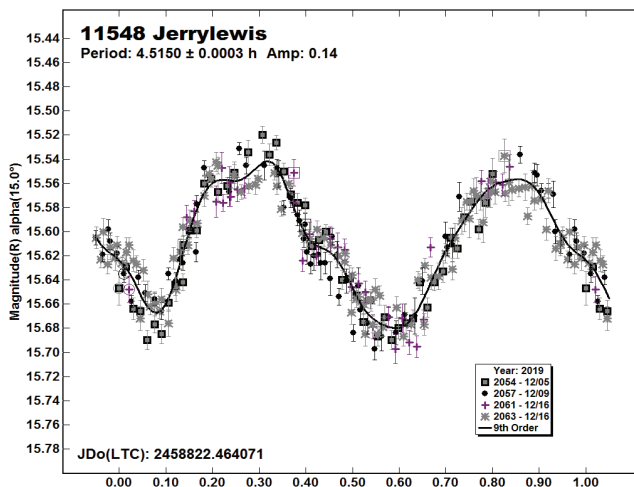
9717 Lyudvasilia. No reports on rotation period determinations were found in the LCDB. The asteroid was observed at Sopot Observatory in the second half of 2019 December over four nights. Period analysis shows a solution of $P = 2.8421 \pm 0.0002$ h.



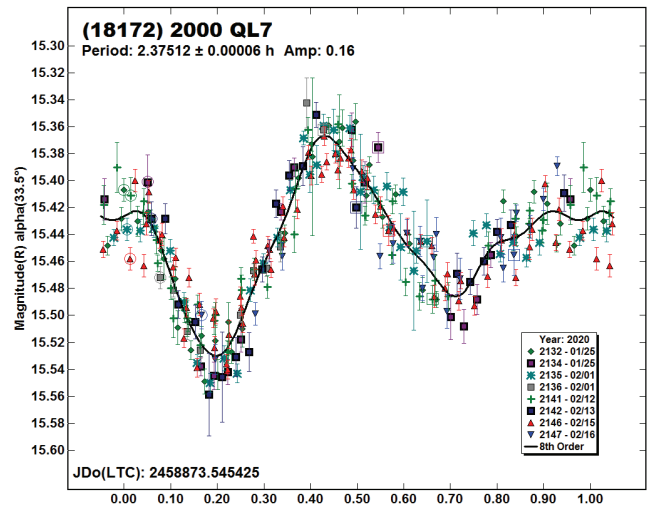
(11230) 1999 JV57, (11420) 1999 KR14 are Flora family members with no previously known rotation periods. The 2019 November-December SAO observations of 1999 JV57 reveal an unequivocal solution of $P = 7.0874 \pm 0.0003$ h and 0.42 mag amplitude. Period analysis of the 2019 October SAO photometric data for 1999 KR14 yields an unambiguous bimodal solution $P = 5.975 \pm 0.002$ h.



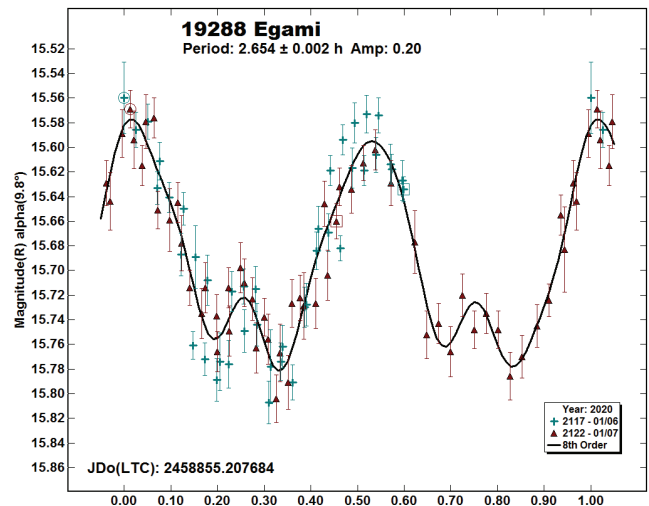
11548 JerryLewis. The observations conducted solely at SAO for the BinAstPhot Survey show a bimodal lightcurve phased to a period $P = 4.5150 \pm 0.0003$ h as the most favorable solution.



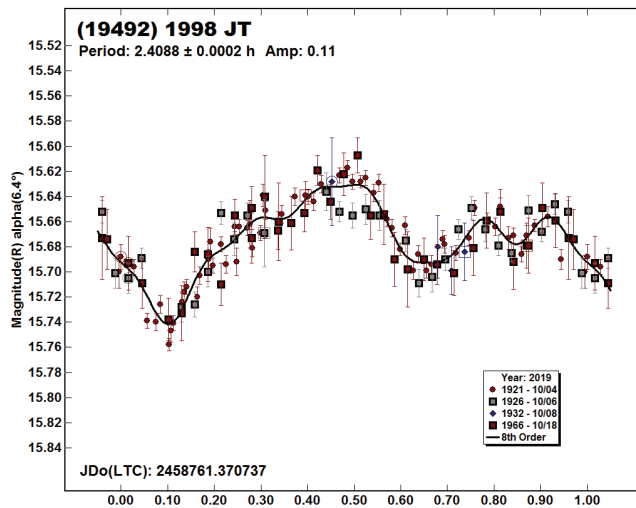
(18172) 2000 QL7 was a BinAstPhot Survey NEA target observed solely at Sopot Observatory from late 2020 January to mid-February, resulting in a total of 8 datasets. An unambiguous rotation period of $P = 2.37512 \pm 0.00006$ h was found by the period analysis.



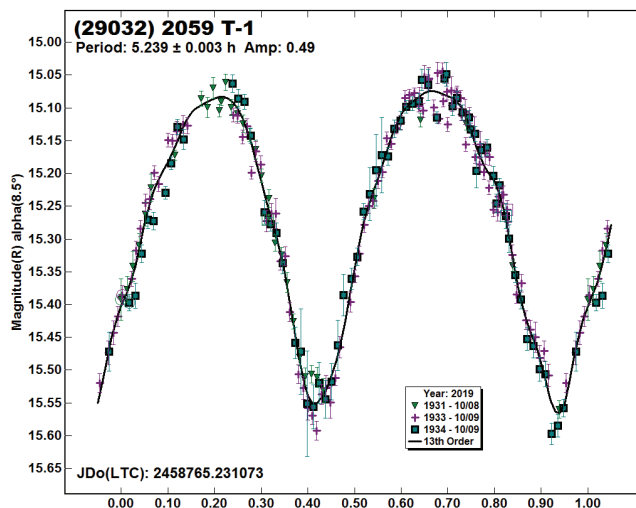
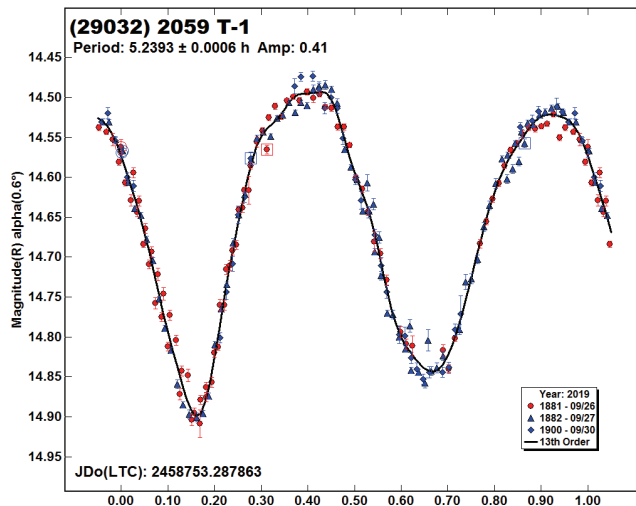
19288 Egami. Warner (2011web; 2.6590 h) is the only previously reported period in the LCDB. Analysis of two consecutive nights of observations in 2020 January confirm that period, $P = 2.654 \pm 0.002$ h.



(19492) 1998 JT. The LCDB had no previous period results. Four photometric datasets obtained at SAO in 2019 October show a unique rotation period of $P = 2.4088 \pm 0.0002$ h.



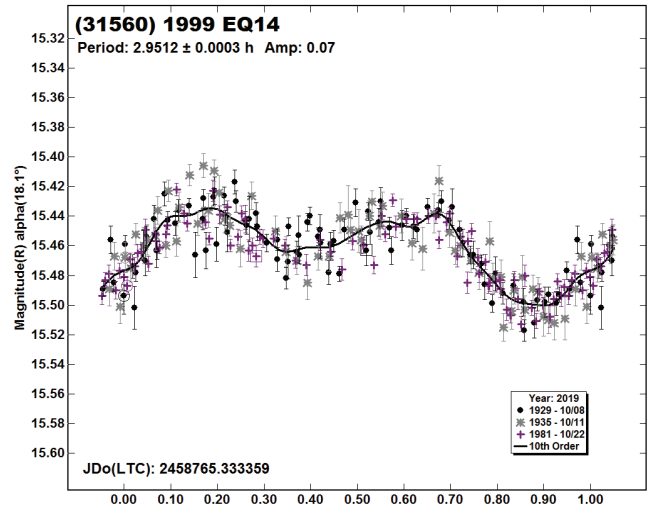
(29032) 2059 T-1. This is a Phocaea family asteroid with no previous rotation period reported. It was observed in late 2019 September and first half of 2019 October, resulting in a total of 6 datasets.



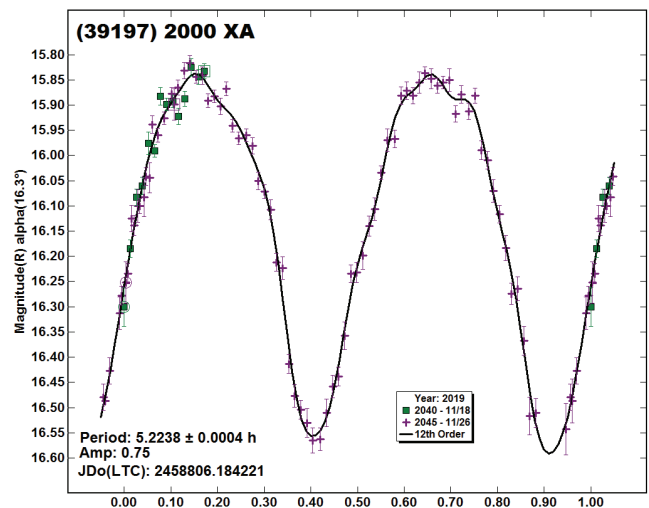
Since the lightcurve shape changed somewhat over the observation period, two separate lightcurves were constructed from well-matched datasets. The first one is formed of 3 datasets

obtained in 2019 late September and the second one from the data collected in 2019 October. Both bimodal lightcurves have rather large amplitudes and nearly identical period values of $P = 5.2393 \pm 0.0006$ h and $P = 5.239 \pm 0.003$ h, respectively.

(31560) 1999 EQ14. Waszczak et al. (2015) found a period of 2.950 h. The 2019 October SAO data show a similar value $P = 2.9512 \pm 0.0003$ h.

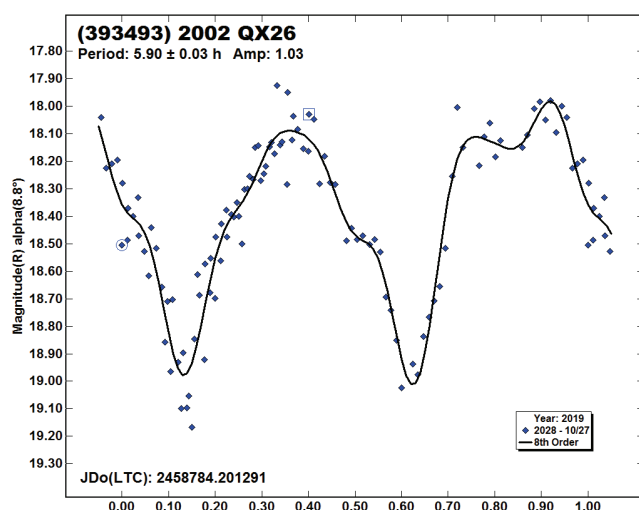


(39197) 2000 XA. Waszczak et al. (2015) found 5.221 h for a rotation period of this Hungaria asteroid. Period analysis conducted on two datasets obtained at SAO in 2019 November at relatively low phase angles indicate a high-amplitude (0.75 mag.) bimodal lightcurve phased to a period of $P = 5.2238 \pm 0.0004$ h as the most plausible solution.

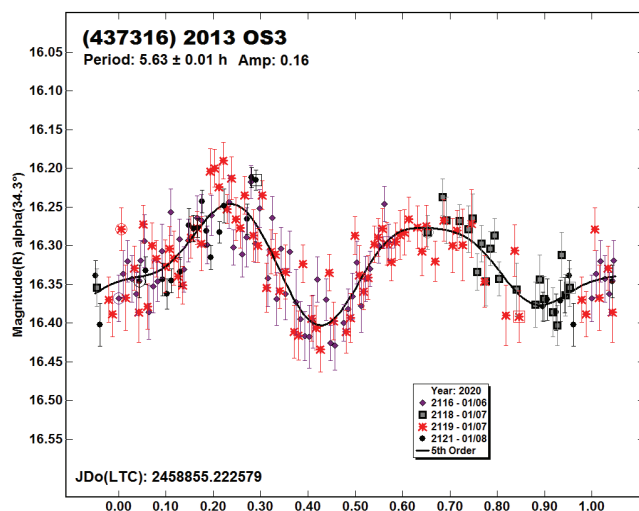


(393493) 2002 QX26. No prior period results were found in the LCDB. Since there were no favorable conditions for multi-night follow-up observing, conclusions on the possible value of rotation period were drawn on the basis of a single night data (2019 October 27-28) with more than one rotational cycle data coverage.

The lightcurve was found to be bimodal and of very large amplitude (1.03 mag.) at a low phase angle. This indicates the unambiguity of the rotation period of $P = 5.90 \pm 0.03$ h (Harris et al., 2014).



(437316) 2013 OS₃. No rotation period has been established for this near-Earth asteroid prior to this determination. An unequivocal synodic rotation period of $P = 5.63 \pm 0.01$ h was found analyzing the 2020 January SAO data taken on four consecutive nights.



Acknowledgements

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Number	Name	20yy/mm/dd	Phase	L _{PAB}	B _{PAB}	Period (h)	P.E.	Amp	A.E.	Grp
1274	Delportia	20/01/09-20/01/10	13.4,13.2	133	2	5.56	0.02	0.29	0.02	FLOR
1316	Kasan	19/10/12-19/10/14	28.0,28.4	354	30	5.843	0.003	0.19	0.02	MC
1706	Dieckvoss	20/02/16-20/02/21	16.7,14.5	176	-2	2.5892	0.0004	0.16	0.02	MB-I
2075	Martinez	19/12/31-20/01/02	17.0,15.8	123	2	4.7531	0.0007	0.27	0.02	PHO
2103	Laverna	19/10/24-19/10/28	4.1,4.9	21	9	9.240	0.005	0.15	0.03	MB-O
2227	Otto Struve	20/01/05-20/01/08	14.2,12.9	126	-6	5.397	0.002	0.15	0.02	FLOR
2432	Soomana	19/10/14-19/10/16	22.5,22.0	64	6	3.2060	0.0006	0.42	0.02	V
2566	Kirghizia	19/10/18-19/10/19	6.4,5.9	37	-2	4.448	0.002	0.70	0.02	V
2871	Schober	19/12/17-20/01/04	13.9,6.0	111	8	2.85225	0.00005	0.17	0.03	FLOR
2890	Vilyujsk	20/01/02-20/01/24	16.8,24.4	79	9	3.4610	0.0003	0.10	0.04	BAP
2937	Gibbs	19/10/11-19/10/13	27.4,27.5	3	34	2.9835	0.0004	0.43	0.02	BAP
3385	Bronnina	19/11/20-19/11/21	6.7,6.6	68	-7	2.974	0.009	0.23	0.02	FLOR
3385	Bronnina	20/01/09-20/01/25	18.5,22.5	71	-8	2.95911	0.00009	0.35	0.03	FLOR
3489	Lottie	19/10/26-19/11/19	14.0,3.5	57	5	2.94832	0.00009	0.19	0.03	V
3842	Harlansmith	19/09/29-19/10/19	6.2,15.2	355	1	2.79400	0.00005	0.30	0.03	MB-I
3904	Honda	19/10/13-19/10/20	19.0,17.4	56	19	8.464	0.003	0.30	0.03	EUN
3986	Rozhkovskij	19/10/12-19/10/13	14.6,14.1	41	7	3.549	0.002	0.34	0.02	FLOR
4705	Secchi	20/03/11-20/03/18	11.0,14.3	152	-2	2.6566	0.0004	0.15	0.03	MB-I
4857	Altgamia	20/01/02-20/01/24	27.5,24.6	145	33	9.0357	0.0004	0.29	0.02	PHO
4875	Ingalls	19/10/05-19/10/09	10.9,8.9	30	-7	3.7783	0.0007	0.15	0.02	FLOR
5096	Luzin	19/10/14-19/10/15	13.2,13.7	359	7	3.051	0.001	0.39	0.02	V
5186	Donalu	19/10/23-19/10/27	9.8,11.2	17	15	3.153	0.001	0.36	0.02	EUN
5391	Emmons	19/10/20-19/10/22	21.5,22.3	356	2	3.030	0.001	0.18	0.02	MB-I
5512	1988 VD7	19/11/26-19/12/20	*2.7,10.4	69	0	3.3059	0.0003	0.12	0.02	FLOR
5537	Sanya	19/10/16-19/10/19	6.0,5.3	29	7	3.4254	0.0009	0.45	0.02	FLOR
5543	Sharaf	19/12/16-19/12/18	3.3,2.8	89	-3	5.972	0.002	1.21	0.02	FLOR
7368	Haldancohn	20/02/13-20/03/01	*7.5,4.5	155	4	3.9032	0.0002	0.14	0.02	FLOR
7527	Marples	19/10/15-19/10/17	13.9,15.0	3	6	9.098	0.004	0.54	0.02	FLOR
9717	Lyudvasilia	19/12/17-19/12/31	13.8,19.4	63	6	2.8421	0.0002	0.14	0.03	FLOR
11230	1999 JV57	19/11/18-19/12/16	17.4,26.8	33	2	7.0874	0.0003	0.42	0.02	FLOR
11420	1999 KR14	19/10/19-19/10/24	7.1,5.5	33	-7	5.975	0.002	0.20	0.02	FLOR
11548	JerryLewis	19/12/04-19/12/17	15.1,11.4	88	19	4.5150	0.0003	0.14	0.02	PHO
18172	2000 QL7	20/01/25-20/02/16	33.5,27.9	118	21	2.37512	0.00006	0.16	0.02	NEA
19288	Egami	20/01/06-20/01/07	9.9,9.8	108	20	2.654	0.002	0.20	0.03	EUN
19492	1998 JT	19/10/04-19/10/18	6.5,9.8	13	8	2.4088	0.0002	0.11	0.02	FLOR
29032	2059 T-1	19/09/26-19/10/01	0.5,3.1	3	1	5.2393	0.0006	0.41	0.02	PHO
29032	2059 T-1	19/10/08-19/10/10	8.4,9.3	4	4	5.239	0.003	0.49	0.02	PHO
31560	1999 EQ14	19/10/08-19/10/22	18.1,11.9	43	8	2.9512	0.0003	0.07	0.02	MB-I
39197	2000 XA	19/11/18-19/11/26	16.3,20.9	34	4	5.2238	0.0004	0.75	0.02	H
393493	2002 QX26	19/10/27-19/10/28	8.7,8.8	23	8	5.90	0.03	1.03	0.03	MB-M
437316	2013 OS3	20/01/06-20/01/08	34.4,33.3	105	24	5.63	0.01	0.16	0.03	NEA

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. L_{PAB} and B_{PAB} 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, H = Hungaria, MB-I/M/O = main-belt inner/middle/outer, MC = Mars Crosser, NEA = near-Earth asteroid, PHO = Phocaea, V = Vestoid.

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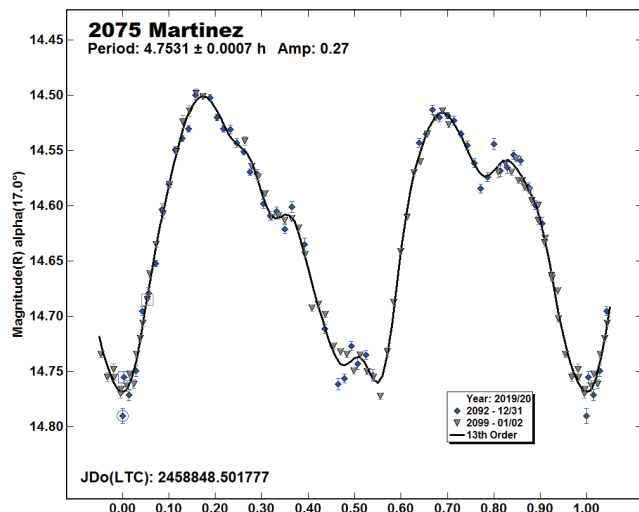
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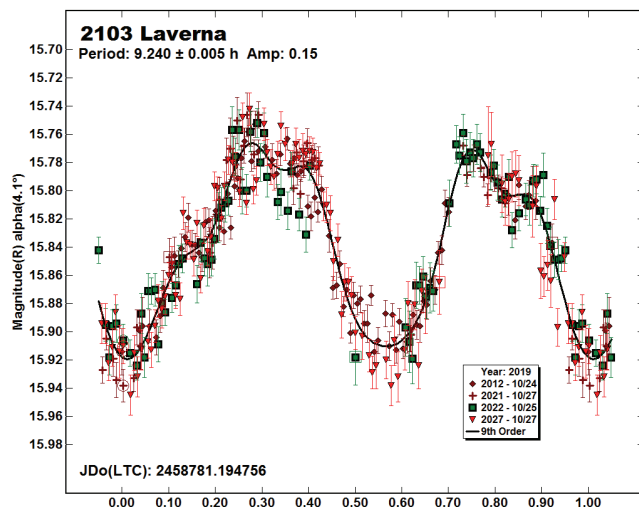
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2075 Martinez. The only previous rotation period determination is by Menke et al. (2008, 4.755 h). Period analysis of the SAO data obtained in 2019 December - 2020 January on two nights shows the favored solution to be a bimodal lightcurve with a period of $P = 4.7531 \pm 0.0007$ h and amplitude of 0.27 mag.

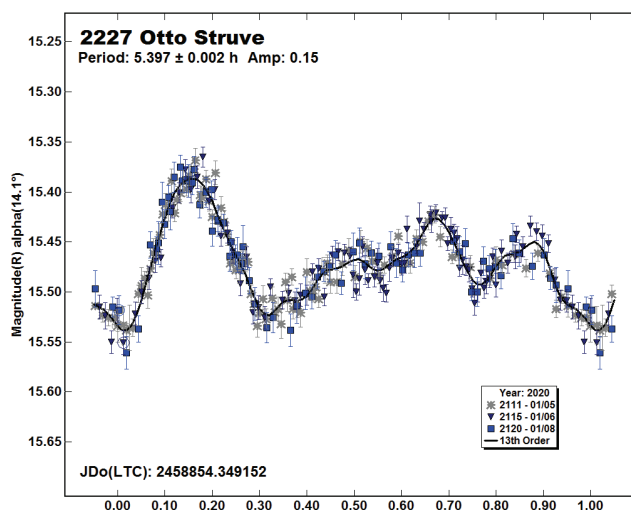


2103 Laverna. Two previous period determinations indicate completely different results: 9.249 h (Klinglesmith et al., 2005) and 11.0 h (Behrend, 2016web), of which the latter is an estimate based on an incomplete lightcurve obtained over a single night.

The SAO observations from 2019 October point to a bimodal period of $P = 9.240 \pm 0.005$ h, which is in a full agreement with that found by Klinglesmith et al. (2005).

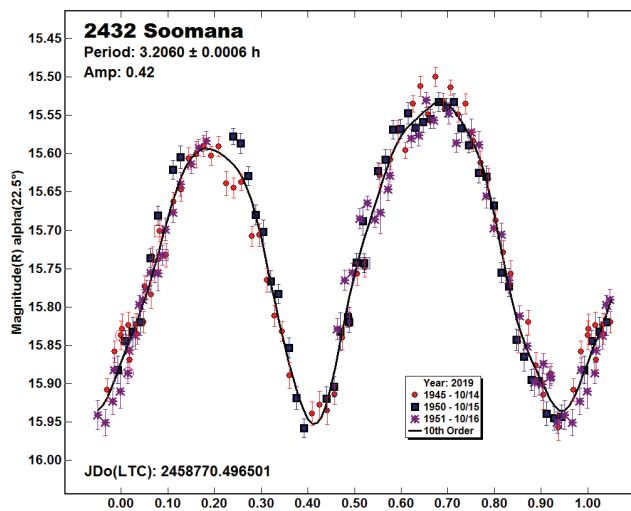


2227 Otto Struve. This was a BinAstPhot Survey target with no previously known rotation period. It was observed solely at SAO on three nights in 2020 January. A unique rotation period solution of $P = 5.397 \pm 0.002$ h was found.

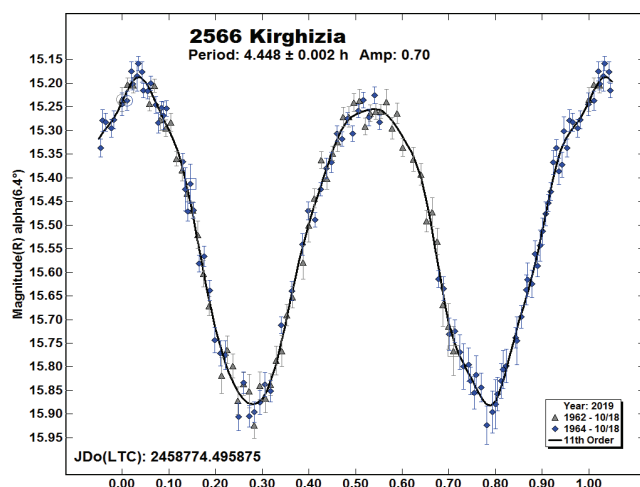


2432 Soomana. The SAO data gathered on three consecutive nights on this Vestoid asteroid in 2019 October show an unambiguous rotation period of $P = 3.2060 \pm 0.0006$ h, associated with a large amplitude (0.42 mag.) bimodal lightcurve.

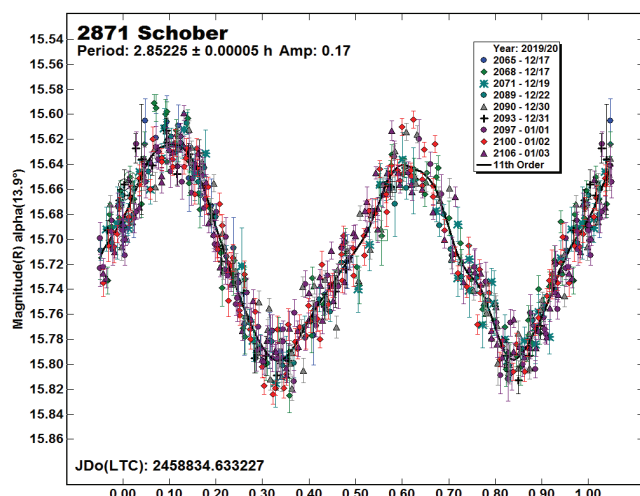
This period result is fully consistent with two previous results: 3.206 h (Klinglesmith et al., 2013) and 3.207 h (Waszczak et al., 2015).



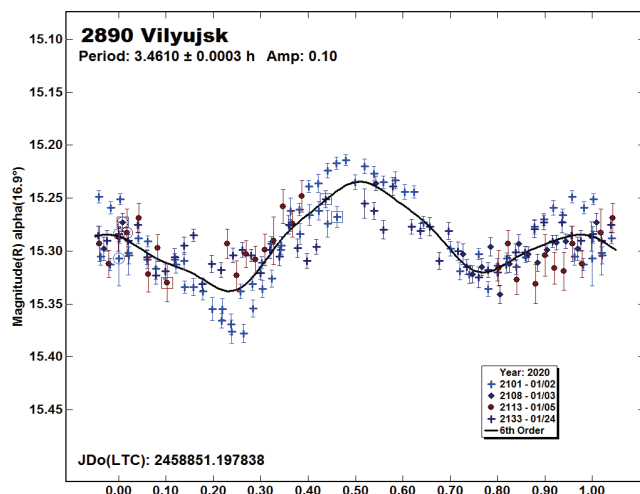
2566 Kirghizia. Montgomery et al. (2013) found the only previously known rotation period, 4.451 h. Photometric data taken on two consecutive nights at SAO yielded a unique bimodal solution of $P = 4.448 \pm 0.002$ h associated with a large amplitude (0.70 mag.) lightcurve.



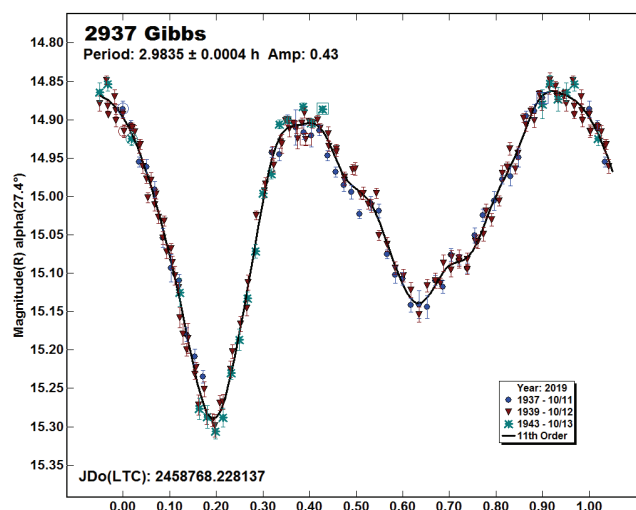
2871 Schober. Yankov and Dittion (2009) found a synodic rotation period of 2.8674 h. The SAO data collected over nine nights in 2019 December and 2020 January indicate $P = 2.85225 \pm 0.00005$ h, differing slightly from the previous result.



2890 Vilyujsk. Previous period determinations are those of Koff (2003, 3.45 h), Ruthroff (2013, 3.45 h) and Waller (2013, 3.42 h). The SAO observations carried out in 2020 January show a value very close to those earlier ones: $P = 3.4610 \pm 0.0003$ h.



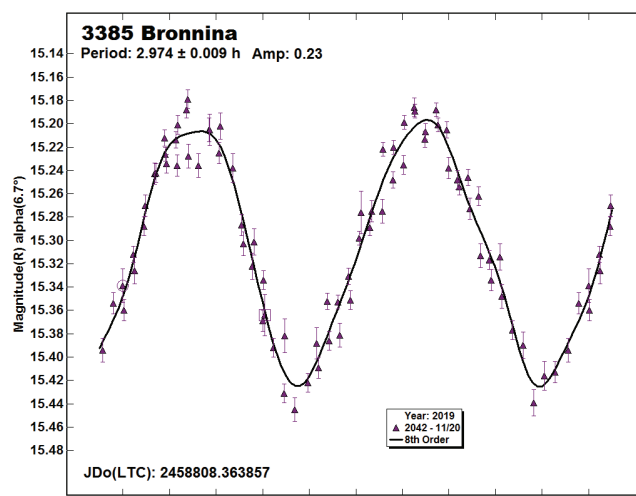
2937 Gibbs. Several rotation period determinations were known for this Mars-crossing asteroid prior to the SAO observations in 2019 October. These include Behrend (2005web; 3.06153 h) and Stephens (2017; 3.189 h). In addition, the most recent results came from the 2019 apparition: Warner and Stephens (2019; 2.982 h) and Benishek (2019; 2.9820 h).



The SAO photometric observations carried out on three consecutive nights resulted in a moderately large amplitude (0.43 mag.) bimodal lightcurve phased to a unique period of $P = 2.9835 \pm 0.0004$ h.

3385 Bronnina. The LCDB records indicate several previously known rotation periods, e.g. by Coley (2012, 2.996 h), Behrend (2014web, 2.93 h) and Dykhuis et al. (2016, 2.95897 h).

This target was observed at two different viewing geometries, first in late 2019 November over a single night and then 2019 January to February 1 on three nights. Hence two, independent lightcurves different in shape were obtained. The single-night 2019 November SAO data indicate a rotation period of 2.974 ± 0.009 h, whilst period analysis of the 2020 January-February data gives a secure period value of 2.95911 ± 0.00009 h.



3489 Lottie
 Period: 2.94832 ± 0.00009 h Amp: 0.19

Y-axis: Magnitude(R) $\alpha(14.0'')$
 X-axis: JDO(LTC): 2458782.602961

Legend:

- Year: 2019
- 2015 - 10/26
- 2019 - 10/26
- 2026 - 10/28
- 2036 - 11/08
- 2038 - 11/18
- 10th Order

3842 Harlansmith
 Period: 2.7940 ± 0.00005 h Amp: 0.30

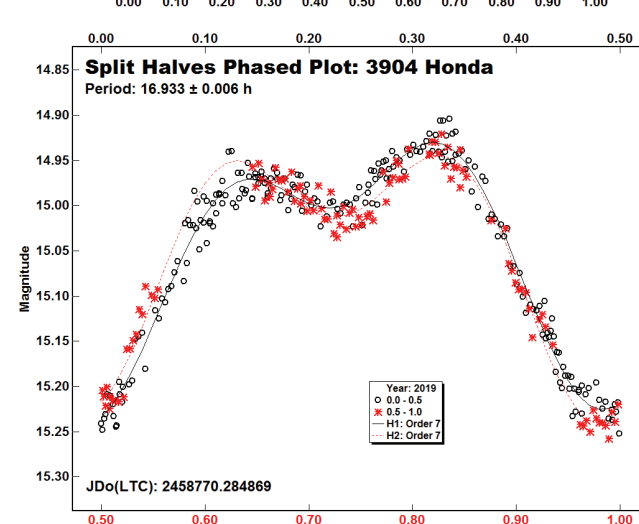
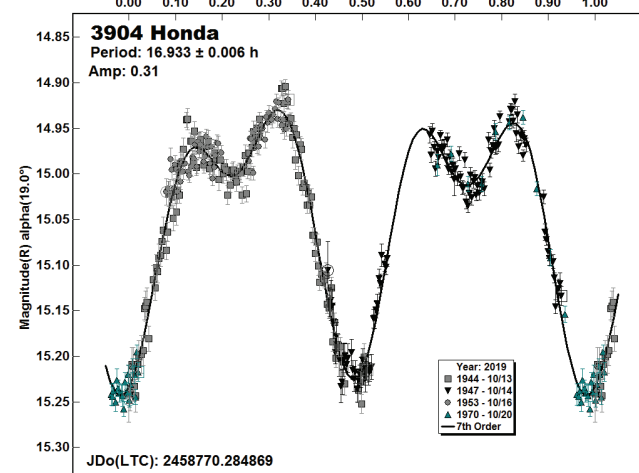
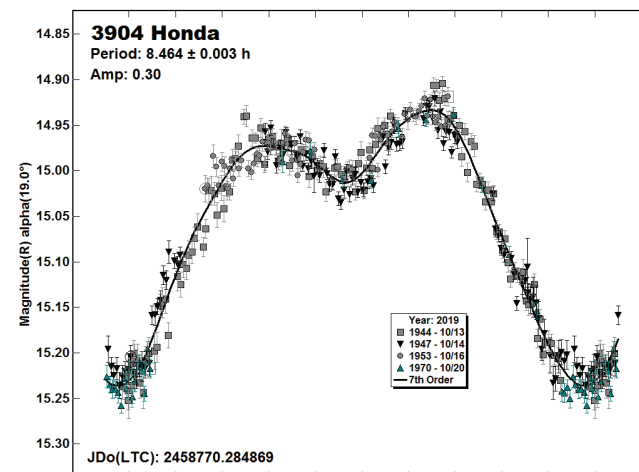
Magnitude(R) $\alpha(6.2^\circ)$

JD(LTC): 2458756.250592

Legend:

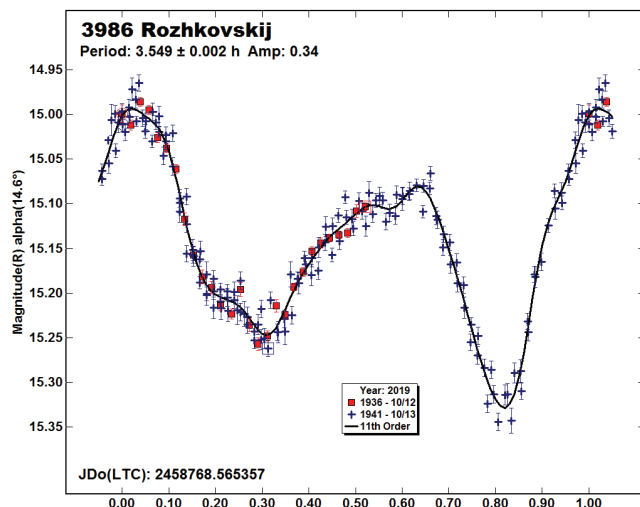
- Year: 2019 (black diamonds)
- 1898 - 09/30 (grey triangles)
- 1917 - 10/02 (purple pluses)
- 1919 - 10/04 (black crosses)
- 1923 - 10/05 (dark blue inverted triangles)
- 1955 - 10/18 (dark blue triangles)
- 1959 - 10/17 (dark blue crosses)
- 1963 - 10/18 (dark blue inverted triangles)
- 1968 - 10/19 (dark blue squares)
- 10th Order (solid black line)

3904 Honda. There were no previously reported rotation period results for this Eunomia family asteroid. Five datasets taken in 2019 October led to a period solution of $P = 8.464 \pm 0.003$ h.



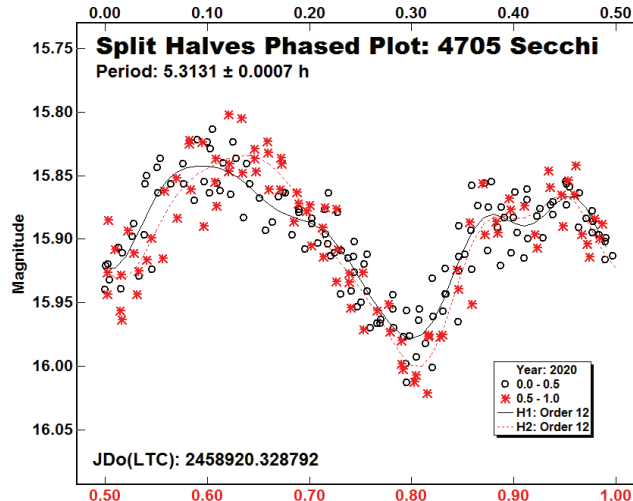
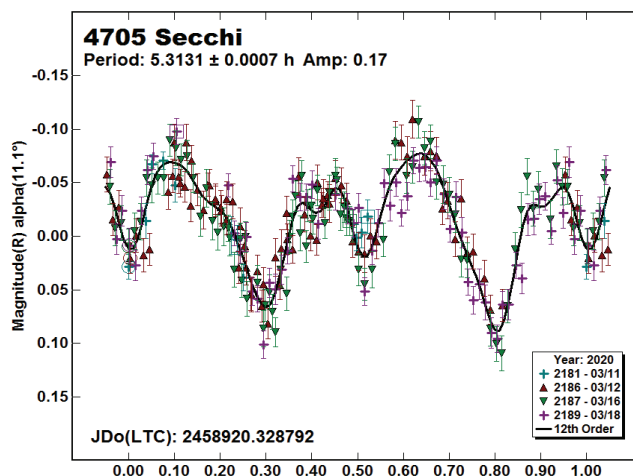
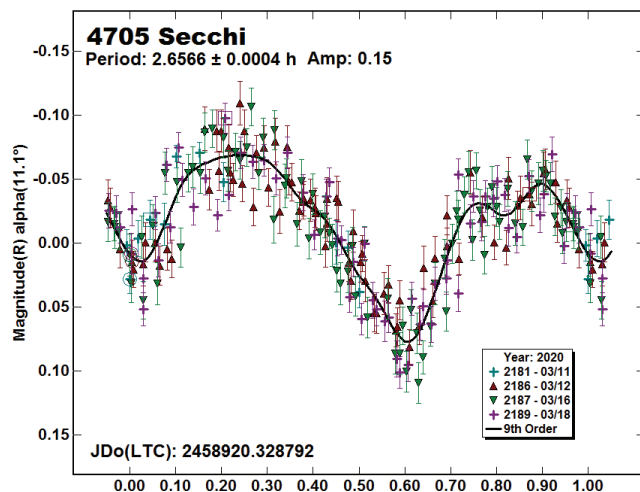
Aside from this solution, a period twice as long of 16.933 h appears in the period spectrum as a possible result, which should not be ruled out given the negligible differences between the two halves of the corresponding lightcurve. Since it is possible that those differences come from a slightly higher noise level in the current data, it would be desirable to observe this target in the future to securely determine which of the two periods is the correct one.

3986 Rozhkovskij. Several earlier rotation period determinations were found in the LCDB: Birlan et al. (1996, 4.26 h) and Warner (2010, 3.548 h). Period analysis of the SAO data taken on two consecutive nights in 2019 October show a unique bimodal solution for a period of $P = 3.549 \pm 0.002$ h.

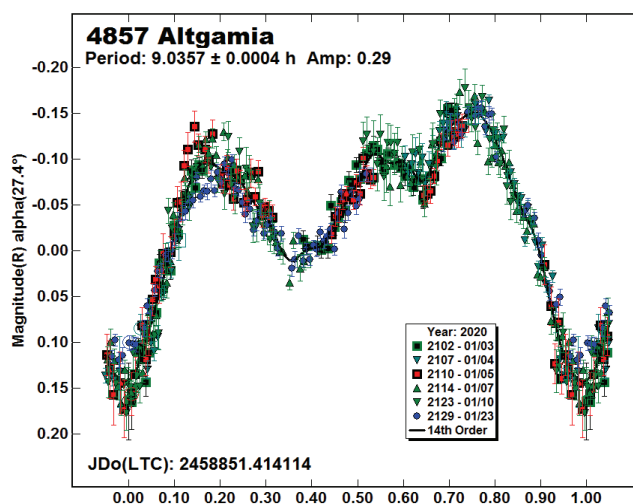


4705 Secchi. No rotation periods were found in the LCDB. The observations were performed over four nights in 2020 March. Due to slightly higher noise level in the obtained data and a relatively low amplitude (0.17 mag.), it is not easy to distinguish between a period of $P = 2.6566 \pm 0.0004$ h and a harmonically related double period of 5.3131 ± 0.0007 h.

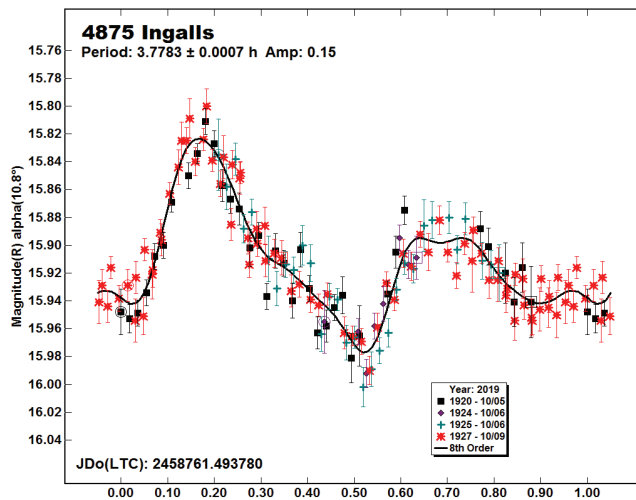
The two halves of the lightcurve for the longer period do not fully match, which could be due to higher noise and means that the longer period cannot be formally excluded. The shorter found period is adopted here as more likely. As in other similar cases, only high-quality future observations can give a definitive answer.



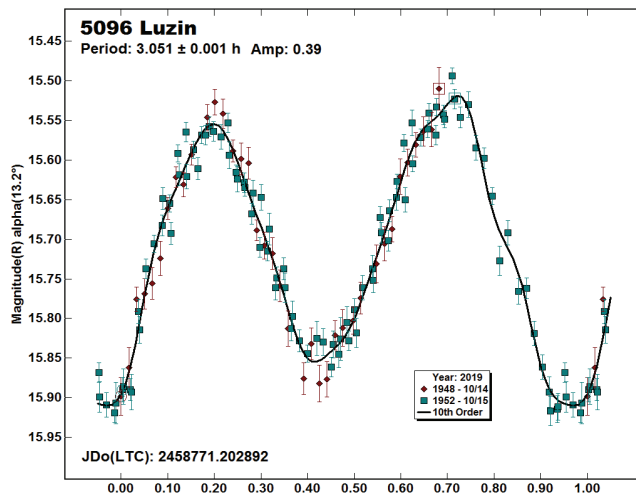
4857 Altgamia. This was a BinAstPhot Survey target with no previously known rotation period. The observations taken at SAO throughout 2020 January revealed a 0.29 mag. lightcurve phased to a period of $P = 9.0357 \pm 0.0004$ h as a most plausible solution.



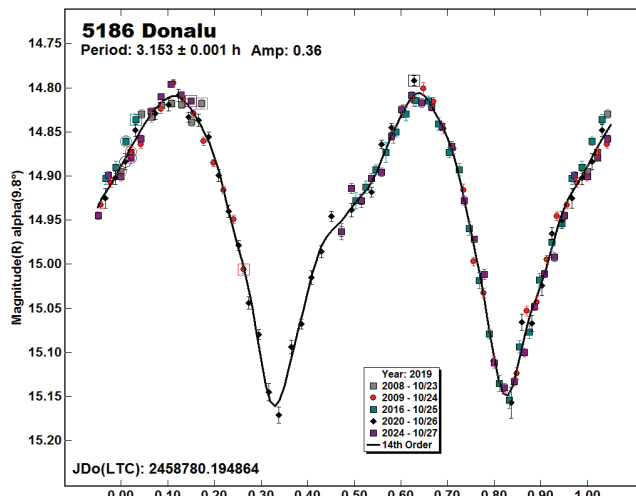
4875 Ingalls. Garceran et al. (2016) found a synodic rotation period of 3.78 h based a somewhat noisy data set (rated U = 2+ in the LCDB). Analysis of the 2019 October SAO observations nevertheless confirm the previous result, showing a unique period of $P = 3.7783 \pm 0.0007$ h.



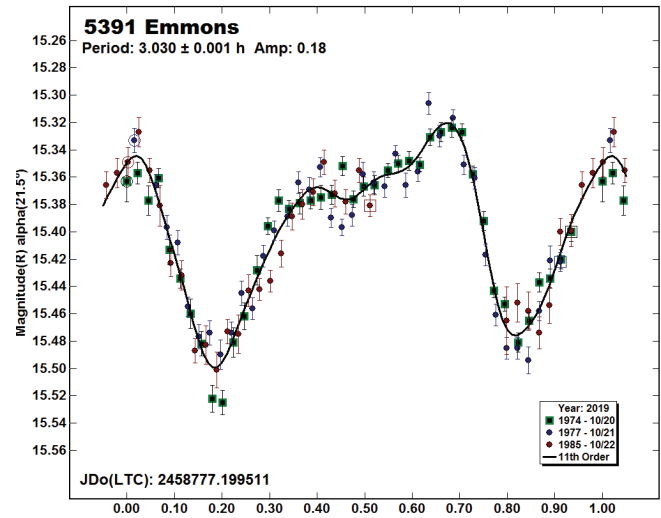
5096 Lulin. The synodic rotation period by Klinglesmith et al. (2013; 3.054 h) was the only one found in the LCDB. Two consecutive nights of observations at SAO in 2019 October resulted in a rather large amplitude (0.39 mag.) bimodal lightcurve with a unique period of $P = 3.051 \pm 0.001$ h.



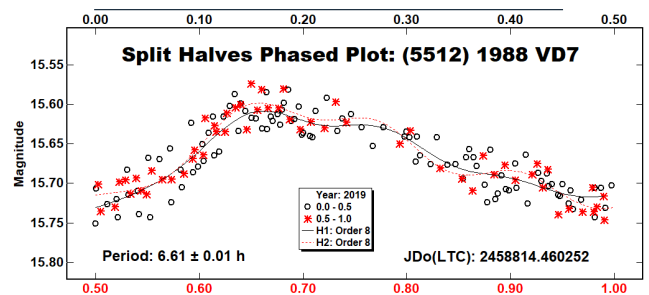
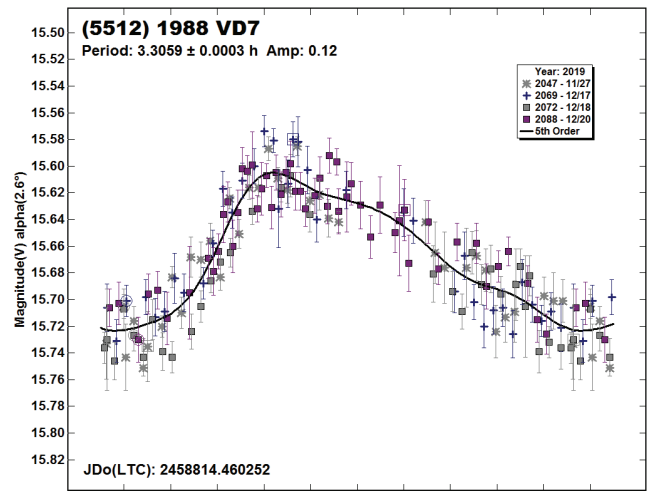
5186 Donalu. Casalnuovo (2016) reported a rotation period of 3.15 h. The period found from the 2019 October SAO data, $P = 3.153 \pm 0.001$ h, is consistent with this Casalnuovo (2016).



5391 Emmons. Clark and Joyce (2003) found a synodic rotation period of 3.028 h for this inner main-belt asteroid. The 2019 October SAO data obtained on three nights led to an almost identical result of $P = 3.030 \pm 0.001$ h.

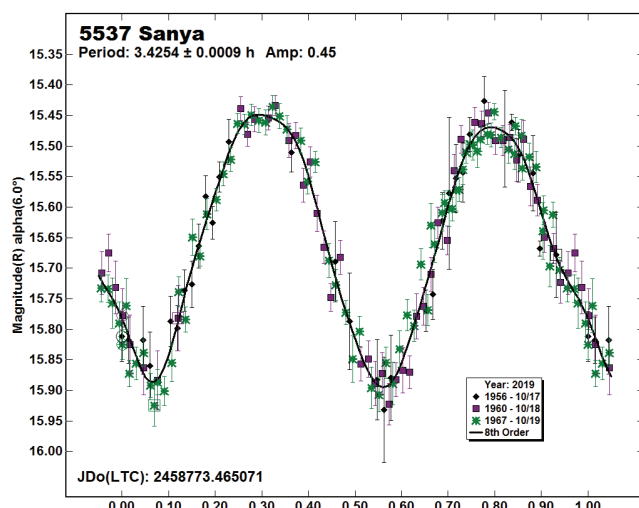


(5512) 1988 VD7. No prior rotation period results on this Flora asteroid exist. Observations were conducted in second half of 2019 December in the course of four nights. Out of the many possible period solutions, the most prominent are the monomodal one at $P = 3.3059 \pm 0.0003$ h and a bimodal lightcurve at the double period of 6.61 h.

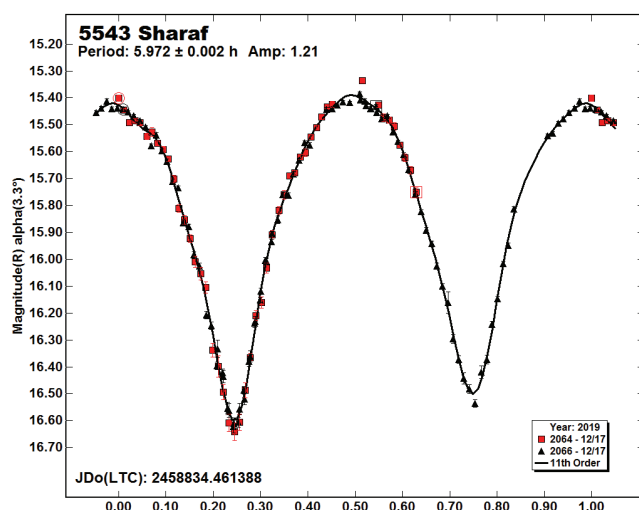


The two halves of the bimodal lightcurve are almost exactly identical, within the boundaries of the data scatter. This fact supports the shorter period as a solution although the possibility of a bimodal period should not be entirely ruled since the minimal differences in the two halves could be concealed in the noise. As in other similar cases, resolving this kind of period ambiguity requires intensive gathering of better-quality data at future apparitions.

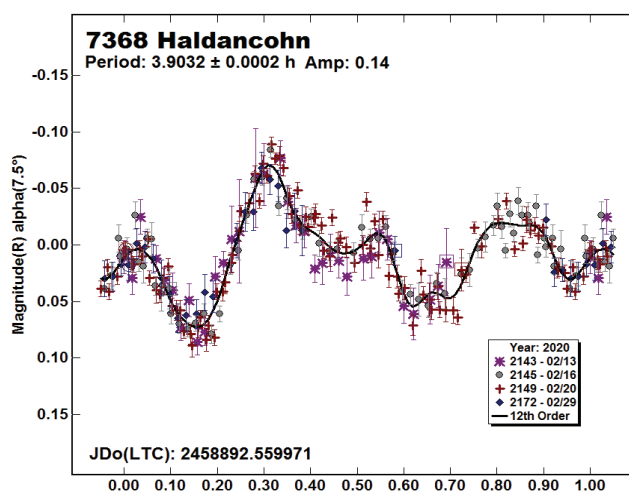
5537 Sanya. The only previous rotation period result by Waszczak et al. (2015; 3.427 h) is almost identical to the result derived from the SAO data acquired in 2019 October on three consecutive nights, $P = 3.4254 \pm 0.0009$ h.



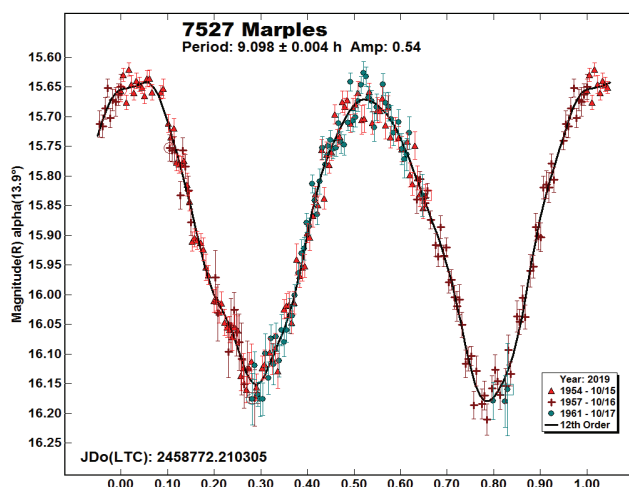
5543 Sharaf. No previous rotation period determinations were found for this Flora family asteroid. Data obtained on two consecutive 2019 December nights reveal an extremely large amplitude (1.21 mag.) bimodal lightcurve phased to a period of $P = 5.972 \pm 0.002$ h, indicating a very elongated shape.



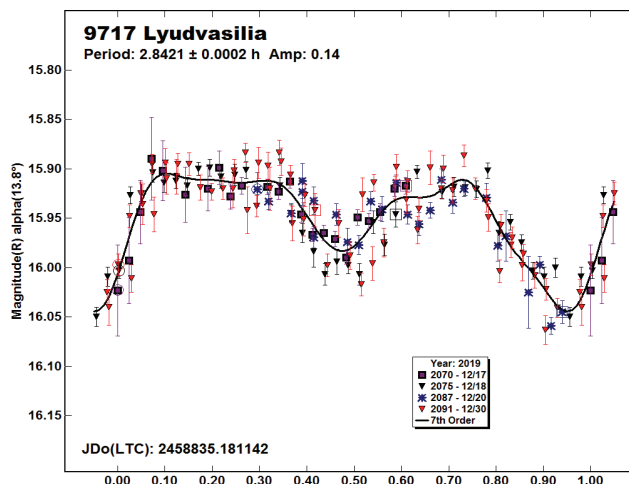
7368 Haldancohn was another BinAstPhot Survey program target observed solely at Sopot Observatory during the 2020 apparition. Data taken on four nights in 2019 February confirm the period result found, also within the BinAstPhot Survey, at the 2017 apparition (Pravec, 2017web; 3.90337 h). The newly established value is $P = 3.9032 \pm 0.0002$ h.



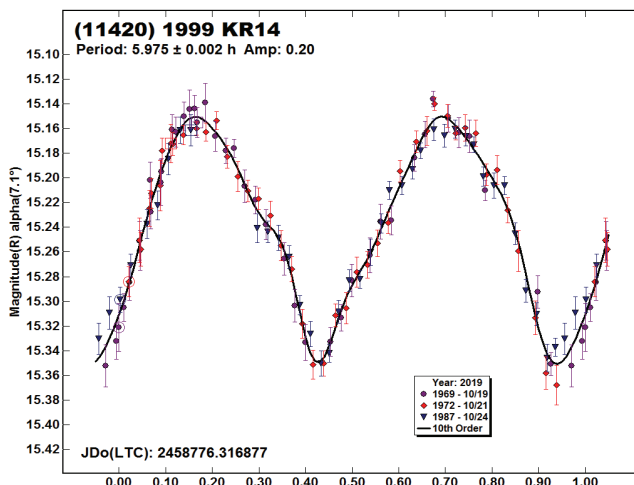
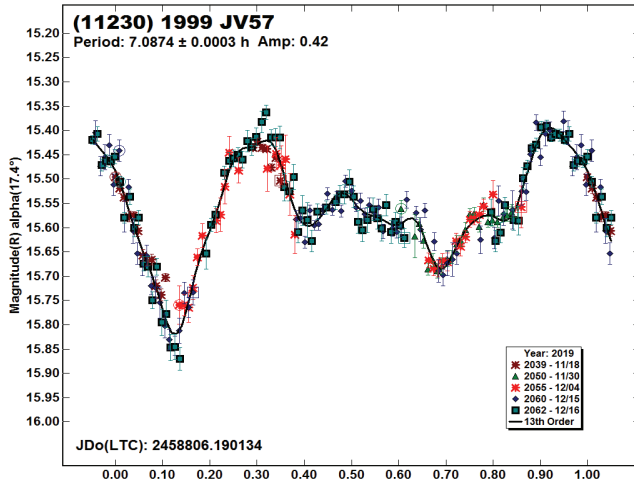
7527 Marples. Behrend (2018web) states 7.85 h for a synodic rotation period. This result is based on a single night data and a provisional lightcurve. The newly established unique bimodal results based on the 2019 October SAO data collected on three consecutive nights are $P = 9.098 \pm 0.004$ h, $A = 0.54$ mag.



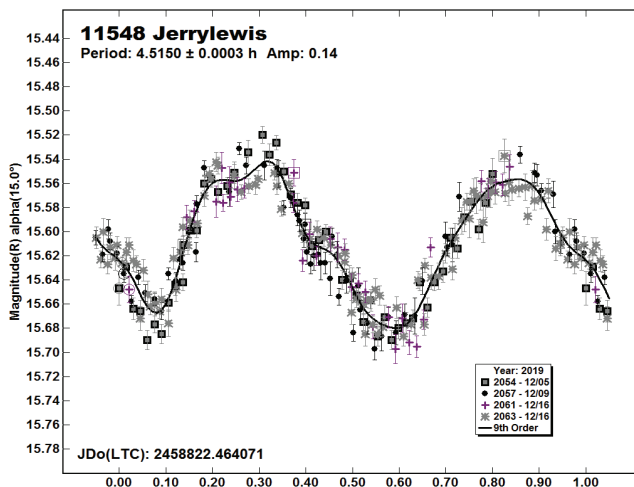
9717 Lyudvasilia. No reports on rotation period determinations were found in the LCDB. The asteroid was observed at Sopot Observatory in the second half of 2019 December over four nights. Period analysis shows a solution of $P = 2.8421 \pm 0.0002$ h.



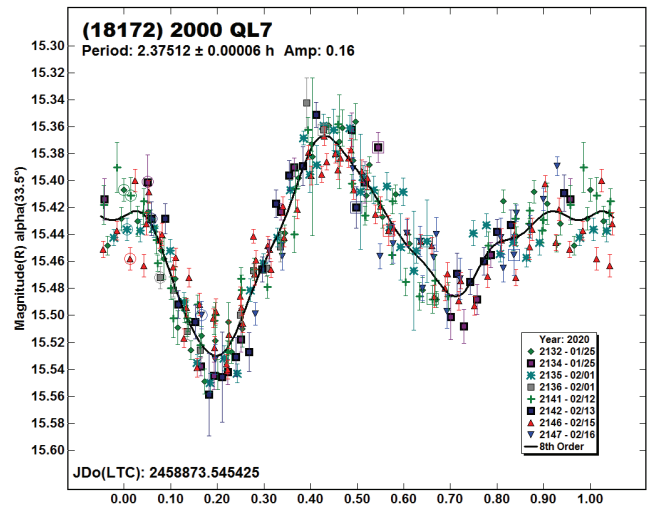
(11230) 1999 JV57, (11420) 1999 KR14 are Flora family members with no previously known rotation periods. The 2019 November-December SAO observations of 1999 JV57 reveal an unequivocal solution of $P = 7.0874 \pm 0.0003$ h and 0.42 mag amplitude. Period analysis of the 2019 October SAO photometric data for 1999 KR14 yields an unambiguous bimodal solution $P = 5.975 \pm 0.002$ h.



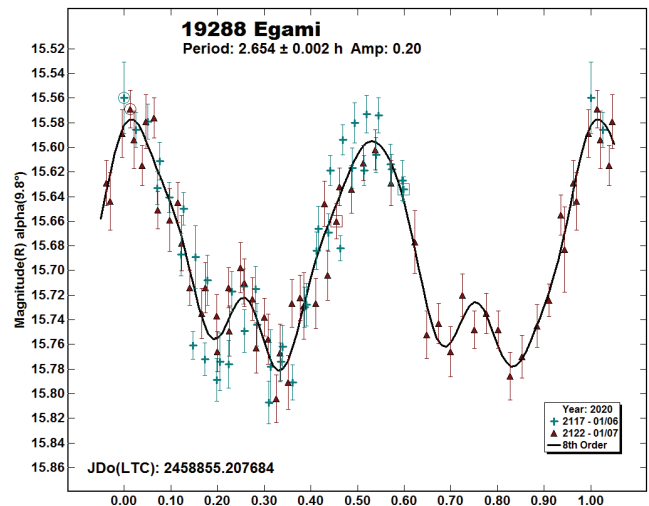
11548 JerryLewis. The observations conducted solely at SAO for the BinAstPhot Survey show a bimodal lightcurve phased to a period $P = 4.5150 \pm 0.0003$ h as the most favorable solution.



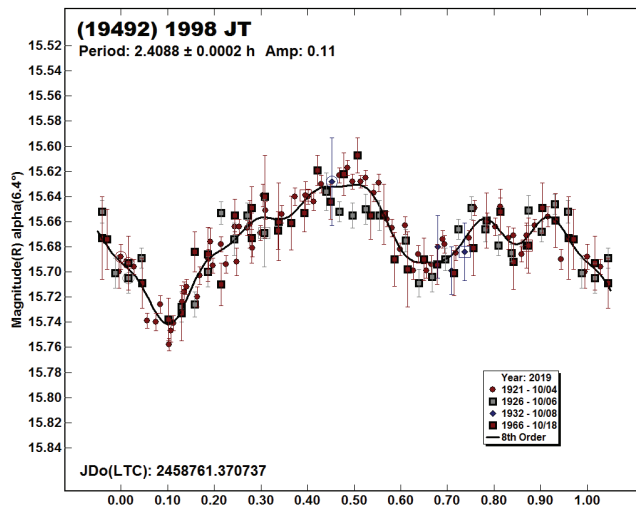
(18172) 2000 QL7 was a BinAstPhot Survey NEA target observed solely at Sopot Observatory from late 2020 January to mid-February, resulting in a total of 8 datasets. An unambiguous rotation period of $P = 2.37512 \pm 0.00006$ h was found by the period analysis.



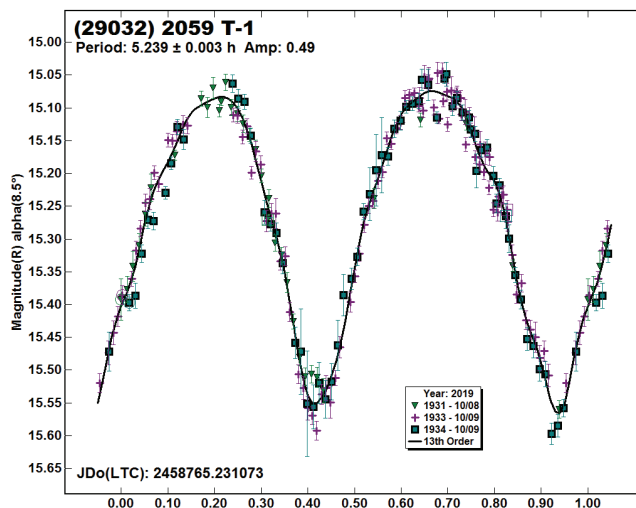
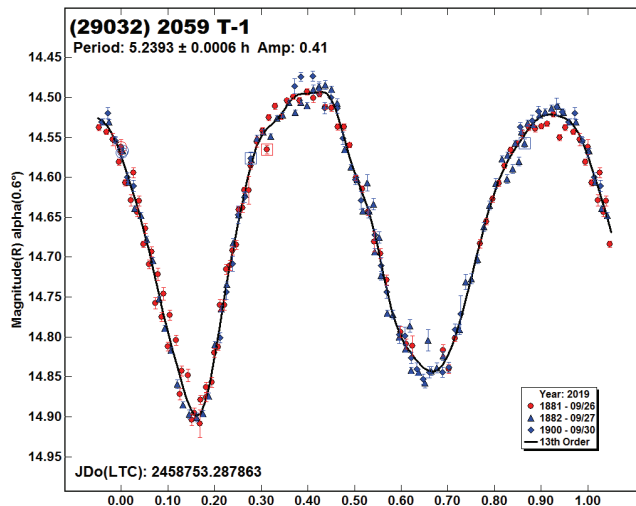
19288 Egami. Warner (2011web; 2.6590 h) is the only previously reported period in the LCDB. Analysis of two consecutive nights of observations in 2020 January confirm that period, $P = 2.654 \pm 0.002$ h.



(19492) 1998 JT. The LCDB had no previous period results. Four photometric datasets obtained at SAO in 2019 October show a unique rotation period of $P = 2.4088 \pm 0.0002$ h.



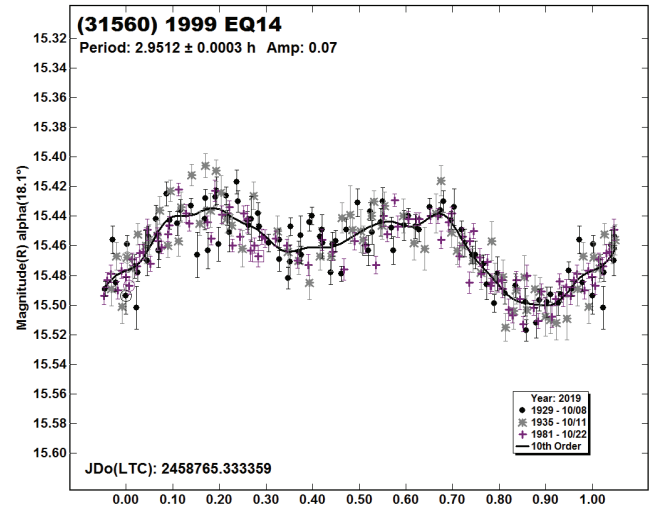
(29032) 2059 T-1. This is a Phocaea family asteroid with no previous rotation period reported. It was observed in late 2019 September and first half of 2019 October, resulting in a total of 6 datasets.



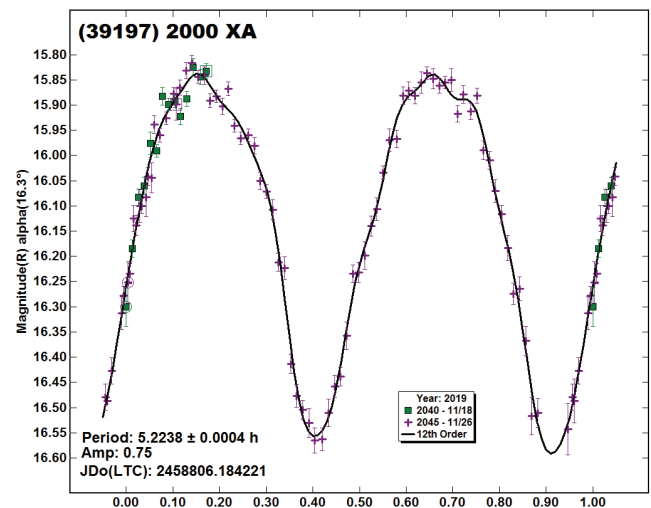
Since the lightcurve shape changed somewhat over the observation period, two separate lightcurves were constructed from well-matched datasets. The first one is formed of 3 datasets

obtained in 2019 late September and the second one from the data collected in 2019 October. Both bimodal lightcurves have rather large amplitudes and nearly identical period values of $P = 5.2393 \pm 0.0006$ h and $P = 5.239 \pm 0.003$ h, respectively.

(31560) 1999 EQ14. Waszczak et al. (2015) found a period of 2.950 h. The 2019 October SAO data show a similar value $P = 2.9512 \pm 0.0003$ h.

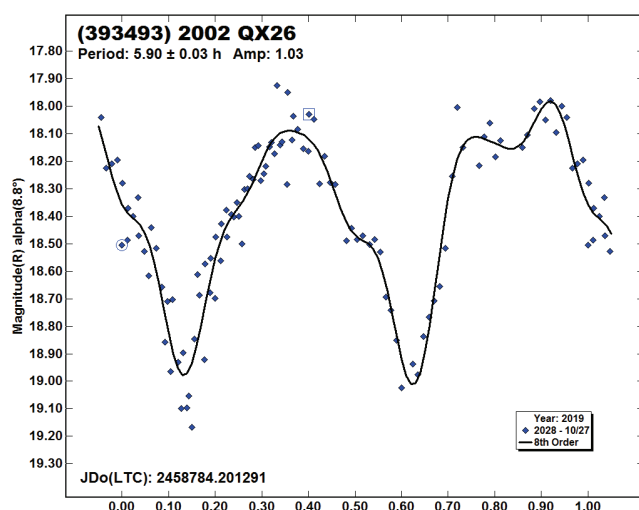


(39197) 2000 XA. Waszczak et al. (2015) found 5.221 h for a rotation period of this Hungaria asteroid. Period analysis conducted on two datasets obtained at SAO in 2019 November at relatively low phase angles indicate a high-amplitude (0.75 mag.) bimodal lightcurve phased to a period of $P = 5.2238 \pm 0.0004$ h as the most plausible solution.

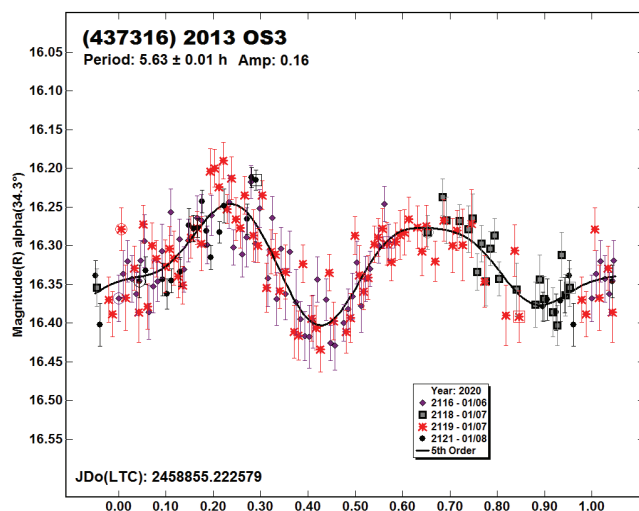


(393493) 2002 QX26. No prior period results were found in the LCDB. Since there were no favorable conditions for multi-night follow-up observing, conclusions on the possible value of rotation period were drawn on the basis of a single night data (2019 October 27-28) with more than one rotational cycle data coverage.

The lightcurve was found to be bimodal and of very large amplitude (1.03 mag.) at a low phase angle. This indicates the unambiguity of the rotation period of $P = 5.90 \pm 0.03$ h (Harris et al., 2014).



(437316) 2013 OS₃. No rotation period has been established for this near-Earth asteroid prior to this determination. An unequivocal synodic rotation period of $P = 5.63 \pm 0.01$ h was found analyzing the 2020 January SAO data taken on four consecutive nights.



Acknowledgements

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