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ANALYSIS AND LIGHTCURVES OF ELEVEN ASTEROIDS

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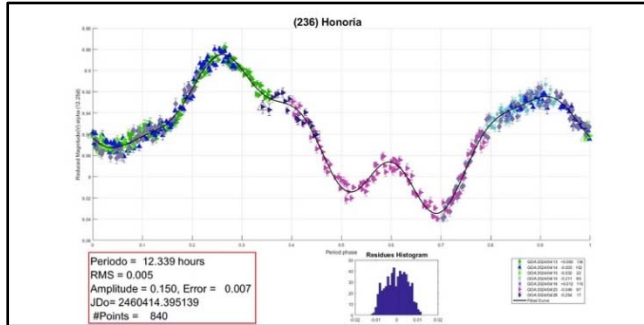
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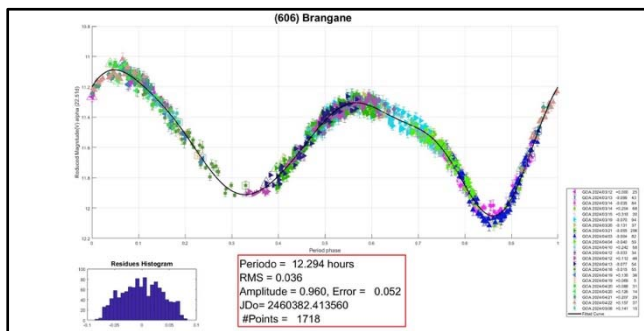
The analysis, observation, and results of the lightcurves of the eleven asteroids presented here were mostly performed during the months of 2024 March to July, while the others were observed in 2021 and 2023. In some cases, we obtained rotation periods somewhat different from those previously published. For others, we could not find a period in the literature. The eleven asteroids studied and the derived rotation periods were: 236 Honoria (12.339 h), 606 Brangane (12.294 h), 737 Arequipa (14.067 h), 1509 Esclangona (3.252 h), 2383 Bradley (5.870 h), 4897 Tomhamilton (18.213 h), 5515 Naderi (5.230 h), 6012 Williammurdoch (2.891 h), 6859 Datemasamune (8.905 h), 7304 Namiki (8.873 h), and 8648 Salix (30.267 h).

We made photometric observations of a total of eleven asteroids, mostly in 2024 but some in 2021 or 2023. In all cases, the images obtained were calibrated in the conventional mode, without photometric filter, and with the application of darks, bias and flats. Data analysis and processing were performed using *FotoDif* (2021), *Tycho Tracker* (2023), and *Periodos* (2020) software. In addition, all data were light-time corrected. Individual lightcurve plots along additional comments as required are presented below.

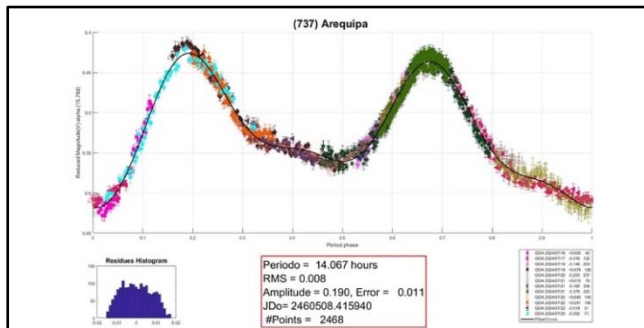
236 Honoria. The asteroid lightcurve database (LCDB from here on; Warner et al., 2009) gives numerous references to rotation periods of this almost 80-km main-belt asteroid. One of the most recent is due to Colazo et al. (2022). Our independent observations took place two years later, in 2024 April. The analysis confirmed a synodic rotation period $P = 12.339 \pm 0.005$ hours, closely matching Colazo et al. (2022), and lightcurve amplitude of 0.15 ± 0.01 mag.



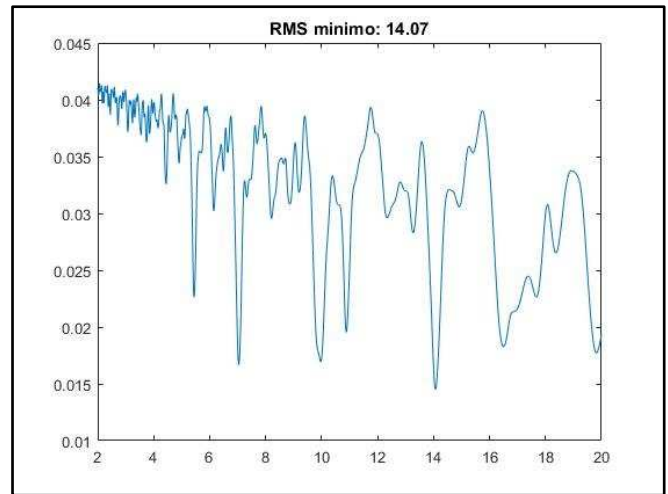
606 Brangane. Behrend (2006web) found a period 12. 2050 hours for Brangane. Hanus et al. (2011) reported a sidereal rotation period 12.29067 h. The results of our observations in 2024 March to May are $P = 12.294 \pm 0.036$ hours and $A = 0.96 \pm 0.05$ mag.



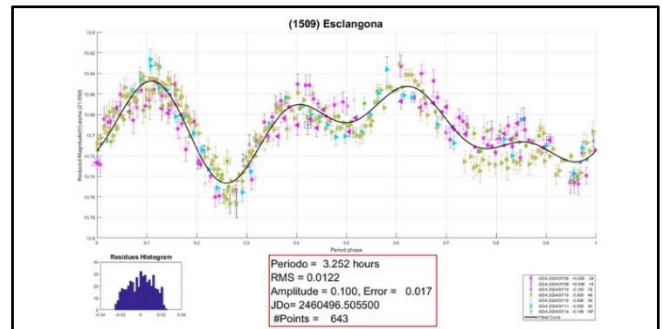
737 Arequipa. The LCDB lists numerous results for this main-belt asteroid that was discovered in 1912. Among those results are from Behrend (2005web; 7.03 h) and Franco et al. (2022; 7.024 h). Many of the previous results report a rotation period of slightly more than 7 hours. Marciniak et al. (2014) reported a period of 14.03 h, but they later revised this to the half-period (Marciniak et al., 2015). Based on our observations in 2024 July, we obtained $P = 14.067 \pm 0.008$ hours and an amplitude $A = 0.19 \pm 0.01$ mag.



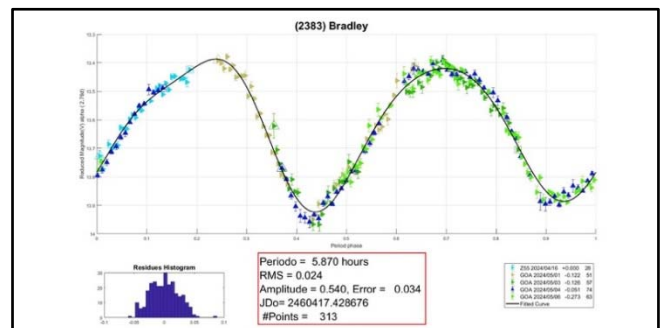
The asymmetry of the lightcurve, non-symmetrical maximums of different amplitudes, and the period spectrum led us to rule out the possibility that our results are a harmonic of the many previous results near 7 hours.



1509 Esclangona. This asteroid is located in the inner part of the main-belt and belongs to the Hungaria group. Warner (2013), reported a synodic rotation period that is in perfect agreement with the one derived from our observations made in 2024 July, $P = 3.252 \pm 0.012$ hours. The lightcurve amplitude is 0.10 ± 0.02 mag.

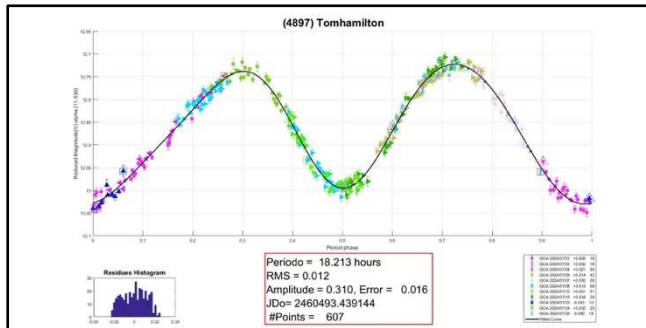


2383 Bradley. The only previous period found in the LCDB was from Warell (2017). The $U = 2$ rating indicates that the rotation period could be off by 30 %. In the case for Warell, the two sets of observations were separated by almost a month, thus introducing the chance of a rotational alias, i.e., an uncertain number of rotations over the date range of the observations.

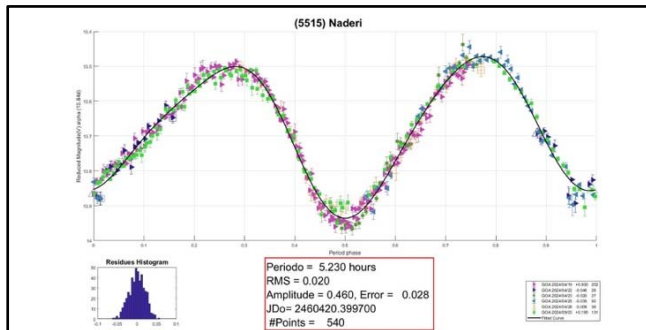


The uncertainty in the period prompted us to observe the asteroid in 2024 April and May. The data set of almost 500 points allowed us to find a period of 5.870 ± 0.024 hours, which is close to the one from Warell (2017). The lightcurve amplitude is $A = 0.54 \pm 0.03$ mag.

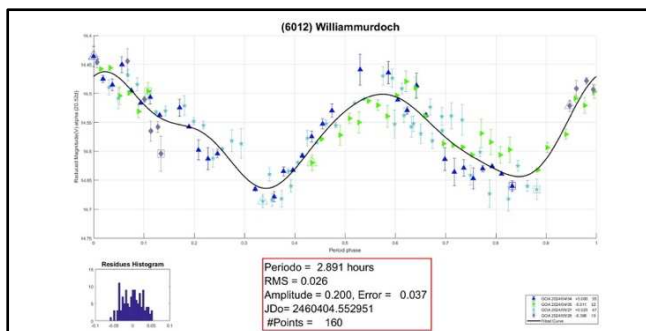
4897 Thomhamilton. Behrend (2024web) reported a synodic rotation period of 18.201 h and amplitude of 0.28 mag. Our observations were carried out during 2024 July and provided more than 600 data points. From these, we found a rotation period of $P = 18.213 \pm 0.012$ hours and an amplitude $A = 0.31 \pm 0.02$ mag.



5515 Naderi is a 7-km asteroid (JPL, 2024) that was discovered in 1989. In 2024 April and May, we were able to obtain a lightcurve and determine a rotation period. Pal et al. (2020) reported a period of 5.22997 ± 0.00005 h based on dense data from the TESS survey. Other periods reported in the LCDB are also close to 5.25 hours. We found $P = 5.23 \pm 0.02$ hours and a lightcurve amplitude of $A = 0.46 \pm 0.03$. The period is in good agreement with previous results.



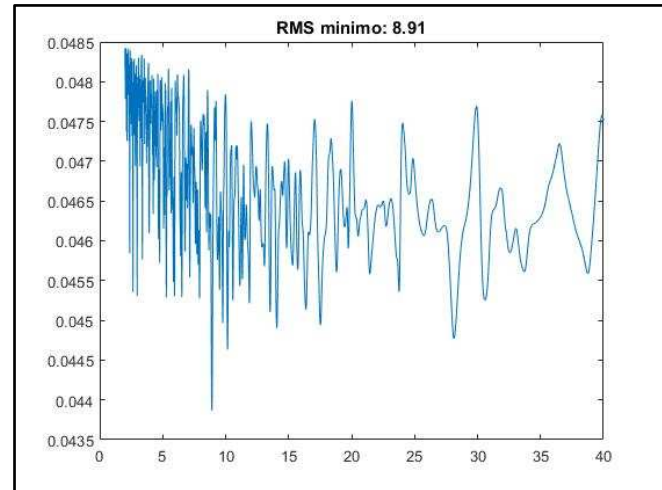
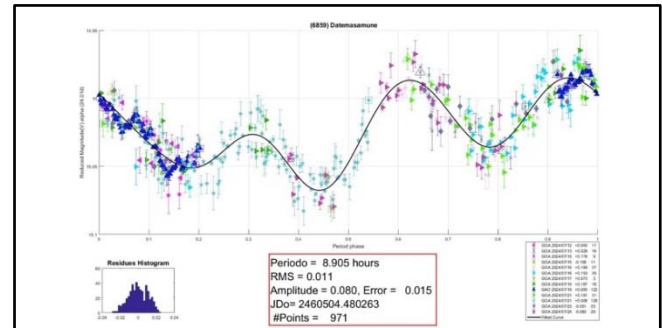
6012 Williammurdoch. Skiff et al. (2019) reported a period of 2.890 hours based on data obtained in 2011. There were no other periods reported in the LCDB. Our team worked on this asteroid during 2024 April and was able to obtain a lightcurve of about 160 points. This allowed us to deduce a rotation period $P = 2.891 \pm 0.026$ hours, in agreement with Skiff et al. (2019), and lightcurve amplitude $A = 0.20 \pm 0.04$ mag.



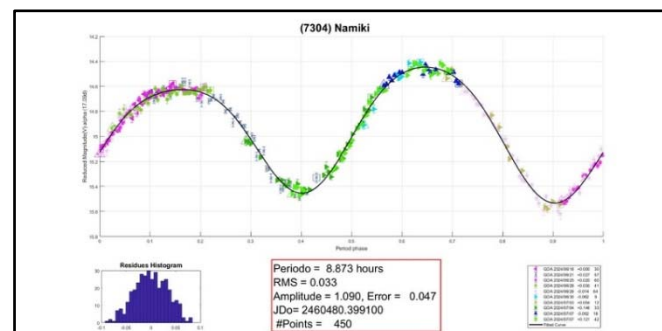
6859 Datemasamune. Stephens et al. (2021) reported a period of 5.94 hours. Many other results in the LCDB for this main-belt asteroid are in close agreement. However, all are rated $U = 2$, or worse, indicating a need of additional observations to verify and refine the period.

The lightcurve amplitude has never been reported to be more than 0.12 mag. With low amplitudes, despite dense data sets, there can be ambiguities in the solution since it is not safe to assume that the lightcurve is monomodal or bimodal (Harris et al., 2014).

Our group worked on this asteroid in 2024 July, obtaining a large data set of almost 1,000 points. The deduced rotation period was $P = 8.905 \pm 0.01$ hours with an amplitude $A = 0.08 \pm 0.02$ mag. The periodogram we obtained seems to favor clearly our result.



7304 Namiki. Durech et al. (2018) reported a sidereal period of 8.87383 h for this Mars-crosser discovered in 1994 (JPL, 2024). Numerous other synodic periods found in the LCDB are in close agreement at about 8.87 hours.

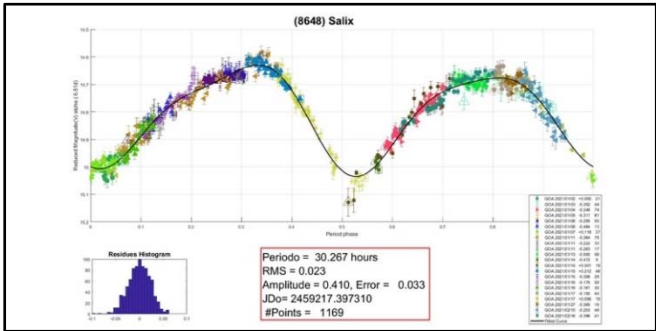


Number	Asteroid	20yy mm/dd	Phase	Period(h)	P.E.	Amp	A.E.
236	Honorina	24/04/13–24/04/28	12.2–15.2	12.339	0.005	0.150	0.007
606	Brangane	24/03/13–24/05/08	22.5–17.0	12.294	0.036	0.960	0.052
737	Arequipa	24/07/16–24/07/23	15.9–13.4	14.067	0.008	0.190	0.011
1509	Esclangona	24/07/04–24/07/14	21.8–18.0	3.252	0.012	0.100	0.017
2383	Bradley	24/04/16–24/05/08	2.8–15.2	5.870	0.024	0.540	0.030
4897	Tomhamilton	24/07/01–24/07/24	11.7– 6.1	18.213	0.012	0.310	0.016
5515	Naderi	24/04/21–24/01/27	10.4– 9.5	5.230	0.020	0.460	0.028
6012	Williammurdoch	24/04/03–24/04/05	20.6–20.2	2.891	0.026	0.200	0.037
6859	Datemasamune	24/07/13–24/07/25	23.8–17.8	8.905	0.011	0.080	0.015
7304	Namiki	24/06/21–24/07/07	18.1–23.7	8.873	0.009	1.090	0.047
8648	Salix	21/01/02–21/02/16	6.7–20.9	30.267	0.023	0.410	0.033

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.

Our group observed this asteroid in 2024 June and July. The analysis of our data lead to $P = 8.873 \pm 0.033$ hours, in good agreement with previous results, and a lightcurve amplitude $A = 1.09 \pm 0.05$ mag.

8648 Salix. The LCDB listed no rotation periods for Salix. There is one night of observations for 2011 March 13 submitted by Skiff reported in the ALCDEF database (<https://alcdef.org>). Analysis of our data, obtained in 2021 January and February, led to a lightcurve that fit a period of $P = 30.267 \pm 0.023$ hours with an $A = 0.41 \pm 0.03$ mag.



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