

ANALYSIS AND REVIEW OF ROTATION CURVES AND PERIODS OF 12 ASTEROIDS

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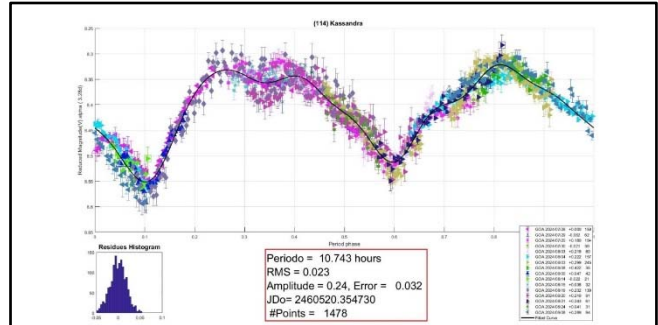
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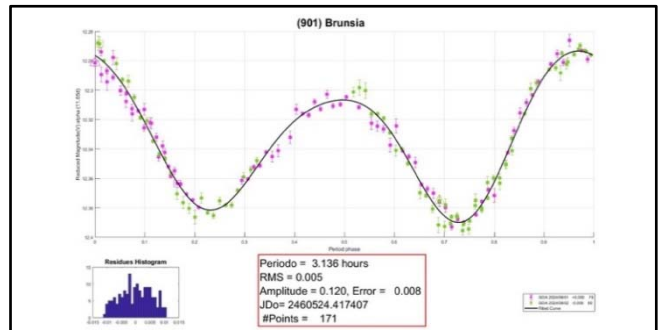
The twelve asteroids presented here were observed from 2024 May to September. Analysis of the resulting data lead to generating lightcurves, finding rotation periods, and drawing some conclusions from the results. The asteroids studied and the derived periods are: 114 *Kassandra* (10.734 h), 901 *Brunsia* (3.136 h), 924 *Toni* (19.436 h), 1065 *Amundsenia* (7.758 h), 2168 *Swope* (7.354 h), 2555 *Thomas* (2.858 h), 2801 *Huygens* (4.378 h), 2994 *Flynn* (9.750 h), 3735 *Trebon* (8.472 h), 5749 *Urduja* (2.813 h), 21088 *Chelyabinsk* (11.272 h), and (66251) 1999 GJ2 (2.463 h). In some cases, the results were almost identical to those previously published but there were several for which we found no previously reported lightcurves or periods.

Observations of twelve asteroids were made by the authors between 2024 May and September. 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 with additional comments as required are presented below.

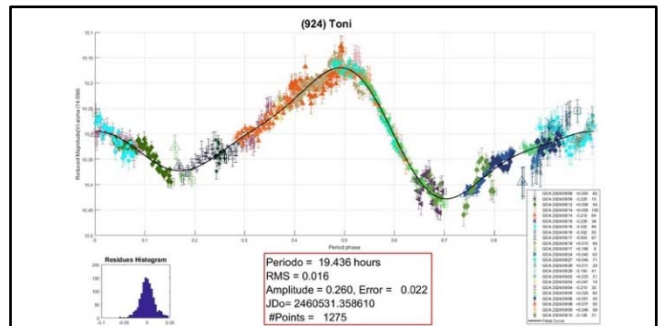
114 *Kassandra*. Part of the main asteroid belt and discovered in July 1871, we had the opportunity to observe this asteroid (incompletely) in September 2020 and February 2023. However, it was not until July and August 2024 that we were able to plot a complete and updated lightcurve. This allowed us to obtain a rotation period of 10.743 ± 0.023 hours and an amplitude of 0.240 ± 0.032 mag.



901 *Brunsia*. We were able to observe this asteroid in early 2024 August. Our lightcurve allowed us to deduce a rotation period of 3.136 ± 0.005 hours and an amplitude of 0.12 ± 0.01 mag. The period is in good agreement with Franco et al. (2022).



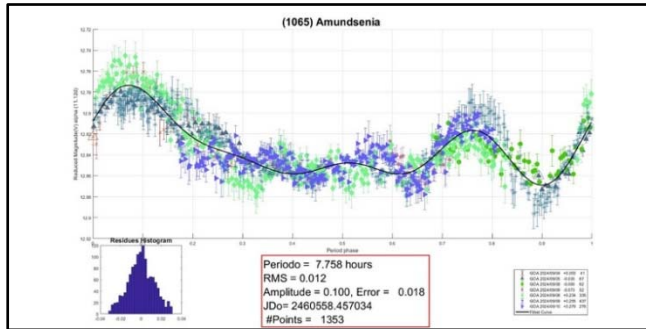
924 *Toni*. Several periods have been reported since 1998. For example, Behrend (2006web; 2007web) reported a period near 21 hours. However, our data obtained in 2024 July to September allowed us to propose a result of 19.436 ± 0.016 hours and an amplitude of 0.26 ± 0.02 mag, which seems to be more in line with those published by Pilcher (2015).



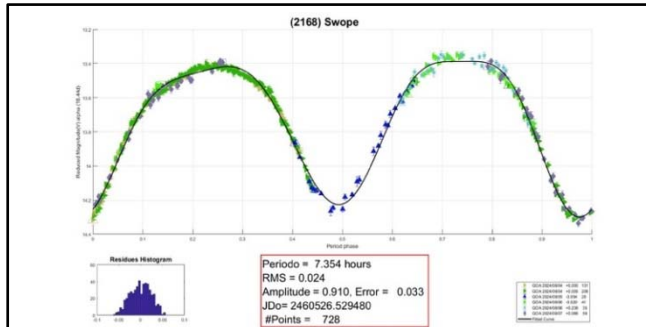
1065 *Amundsenia*. There are subtle differences in the results for the rotation period in the literature. For example, Pravec et al. (2006web) published a result of 7.759 h while Stephens (2018) found 7.790 h, and Behrend (2020web) reported 7.740h. The amplitudes varied between 0.08 and 0.16 mag. Our work for this asteroid, carried out in 2024 September, led to a rotation period of 7.758 ± 0.012 hours and an amplitude of 0.10 ± 0.02 mag.

Number	Asteroid	2024 mm/dd	Phase	Period(h)	P.E.	Amp	A.E.
114	Kassandra	07/25-24/08/04	2.4, 12.3	10.743	0.023	0.24	0.03
901	Brunsia	08/01-24/08/02	11.7, 12.3	3.136	0.005	0.12	0.01
924	Toni	07/08-24/09/10	4.5, 13.4	19.436	0.016	0.26	0.02
1065	Amundsenia	09/05-24/09/11	10.5, 7.3	7.758	0.012	0.10	0.02
2168	Swope	08/04-24/08/07	18.1, 16.8	7.354	0.024	0.91	0.03
2555	Thomas	09/23-24/09/28	0.6, 2.6	2.858	0.017	0.25	0.02
2801	Huygens	08/11-24/09/15	21.6, 9.5	4.378	0.026	0.08	0.03
2994	Flynn	08/13-24/08/28	17.5, 9.3	9.750	0.029	0.38	0.04
3735	Trebon	05/27-24/06/13	12.5, 17.4	8.472	0.033	0.68	0.05
5749	Urduja	08/19-24/08/26	5.0, 4.9	2.813	0.046	0.10	0.07
21088	Chelyabinsk	07/27-24/08/04	30.0, 35.3	11.272	0.017	0.31	0.02
66251	1999 GJ2	08/08-24/08/11	39.0, 38.0	2.463	0.018	0.10	0.03

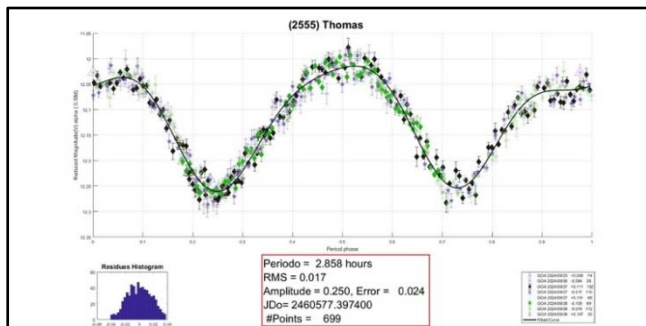
Table I. Observing circumstances and results. Phase is the solar phase angle given at the start and end of the date range.



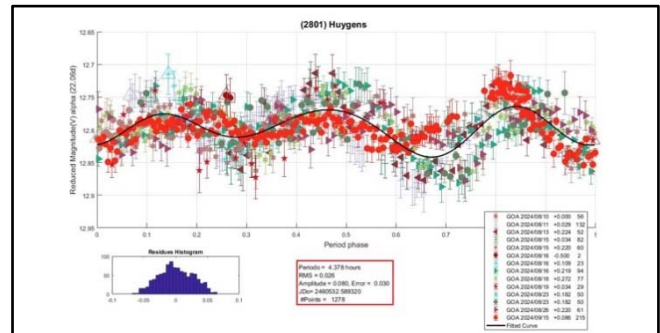
2168 Swope. The only previous result we found was a 3D model in DAMIT (Durech et al., 2023) that gave a sidereal rotation period of 7.352 hours. Our observations, carried out in 2024 August, allowed us to plot a lightcurve with an amplitude of 0.91 ± 0.03 mag and a similar period of 7.354 ± 0.024 hours.



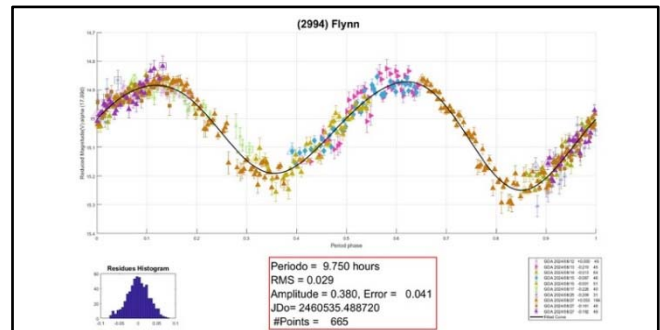
2555 Thomas. During 2024 September, we made observations of this asteroid, which allowed us to plot a lightcurve of more than 700 points and then deduce a rotation period of 2.858 ± 0.017 hours with an amplitude of 0.25 ± 0.03 mag.



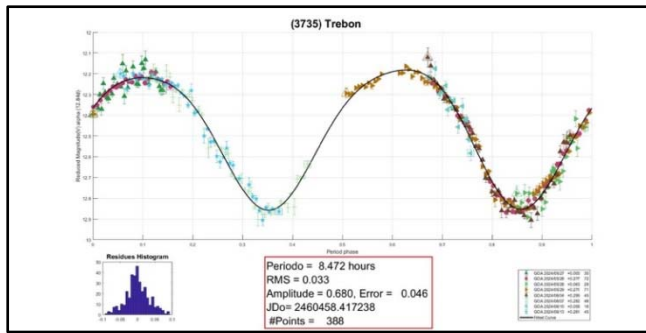
2801 Huygens. We did not find any lightcurves or rotation periods in the literature. Analysis of the data from our observations made in 2024 August and September led to a lightcurve with a small amplitude of 0.08 ± 0.03 mag that was fit to a rotation period of 4.378 ± 0.026 hours. Given the low amplitude, we recommend more observations at future apparitions to confirm our results.



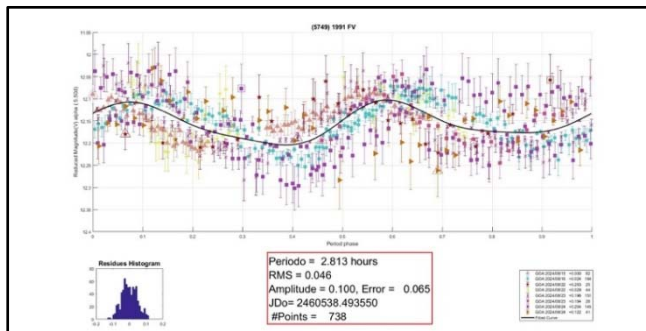
2994 Flynn. The rotational period published by JPL (2024) for this asteroid is 9.747 hours, although JPL points out that this is based on very few observations. This is almost a 3:2 ratio with the period found by Erasmus et al. (2020), suggesting that the two periods are harmonically related. Our observations from 2024 August are more in line with the first result. We obtained a lightcurve with more than 660 points. This allowed us to deduce a rotation period of 9.750 ± 0.029 hours and an amplitude of 0.38 ± 0.04 mag.



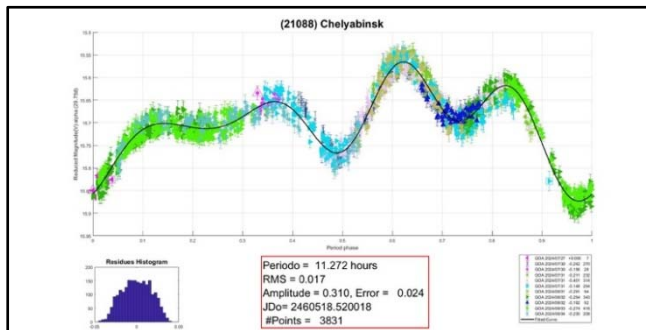
3735 Trebon. The ALCDEF database (<https://alcdef.org>) has observations going back to 2010. The rotation period given in the LCDB (Warner et al., 2009) is 8.471 hours. Data from our observations carried out in 2024 May and June allowed us to plot a lightcurve that fit a period of 8.472 ± 0.033 hours, close to the LCDB value, and an amplitude of 0.68 ± 0.05 mag.



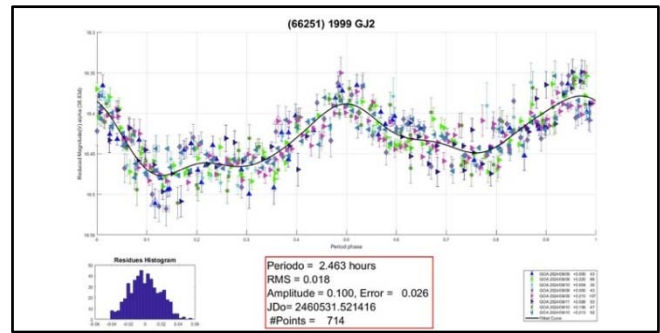
5749 Urduja (1991 FV). We found no published lightcurve or rotation period for this asteroid in the literature, so we decided that it would be a good target for study. The observations took place during 2024 June and allowed us to plot a curve of more than 700 points. From this, we were able to deduce a rotation period of 2.813 ± 0.046 hours and an amplitude of 0.10 ± 0.07 mag.



21088 Chelyabinsk. The data obtained by our team allowed us to deduce a rotation period very similar to that of Warner and Stephens (2021; 11.23 hours). Our lightcurve, with more than 3800 points, best fits a period $P = 11.272 \pm 0.017$ hours and has an amplitude of 0.31 ± 0.03 mag.



(66251) 1999 GJ2. There are numerous observations of this asteroid uploaded to the ALCDEF site since 2005. Most of them suggest a rotation period of about 2.5 hours. During the month of 2024 August, we were able to construct a lightcurve of more than 700 points. The synodic rotation period was found to be $P = 2.463 \pm 0.018$ hours and an amplitude of 0.10 ± 0.03 mag. The period is in agreement with previously published results.



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