

SYNODIC ROTATION PERIODS AND LIGHTCURVE AMPLITUDES FOR ELEVEN MAIN BELT ASTEROIDS

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Synodic rotation periods and amplitudes are reported for:
526 Jena, 1033 Simona, 1341 Edmee, 1408 Trusanda,
1926 Demidelaer, 2350 von Lude, 2843 Yeti,
3041 Webb, 3134 Kostinsky, 3774 Megumi,
4725 Milone.

The periods and amplitudes of asteroid lightcurves presented in this paper are the product of collaborative work by the GORA (Grupo de Observadores de Rotaciones de Asteroides) group. In all the studies, we have applied relative photometry assigning V magnitudes to the calibration stars.

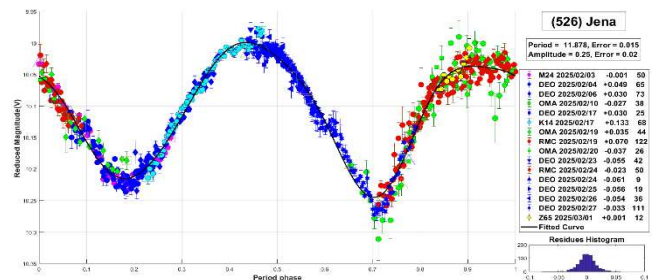
The image acquisition was performed without filters and with exposure times of a few minutes. All images used were corrected using dark frames and, in some cases, bias and flat-field corrections were also used. Photometry measurements were performed using *FotoDif* software and for the analysis, we employed *Periodos* software (Mazzone, 2012).

Below, we present the results for each asteroid studied. The lightcurve figures contain the following information: the estimated period and period error and the estimated amplitude and amplitude error. In the reference boxes, the columns represent, respectively, the marker, observatory MPC code, or - failing that - the GORA internal code, session date, session offset, and several data points.

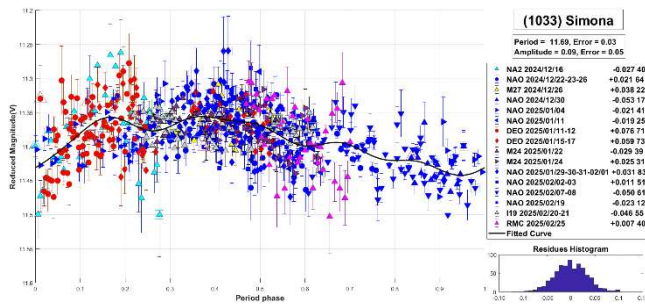
Targets were selected based on the following criteria: 1) those asteroids with magnitudes accessible to the equipment of all participants, 2) those with favorable observation conditions from Argentina or Spain or Italy, i.e. with negative or positive declinations δ , respectively; and 3) objects with few periods reported in the literature and/or with Lightcurve Database (LCDB) (Warner et al., 2009) quality codes (U) of less than 3.

In this work, we present measurements of periods corresponding to asteroids previously analyzed by our team. These lightcurves display improved results and are part of a new long-term project that we are initiating.

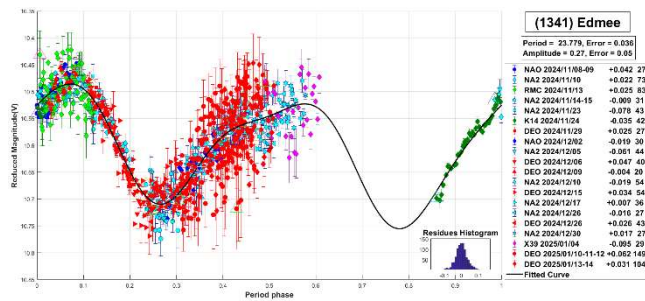
526 Jena. This main-belt asteroid was discovered in 1904 by M. Wolf. Classified as a B-type asteroid according to the Tholen taxonomy, it is a member of the Themis family (Nesvorný et al., 2015). The diameter is 44.84 km. The reported rotational period for this asteroid is 11.877 h (Martkainen et al., 2021). Our measurement of the period, $P = 11.878 \pm 0.015$ h, with $\Delta m = 0.25 \pm 0.02$, agrees well with the value reported by the authors.



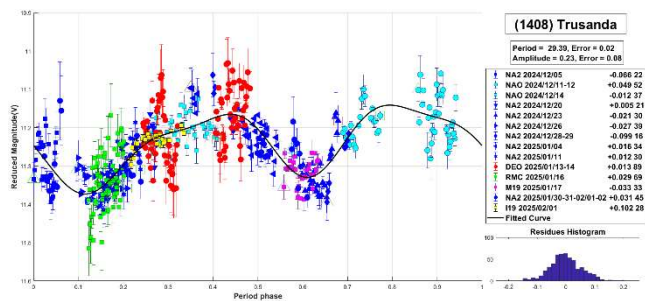
1033 Simona. Simona is a main-belt asteroid discovered in 1924 by G. Van Biesbroeck. It is a member of the Eos family (Nesvorný et al., 2015), with a diameter of 19.195 km. The reported rotational period for this asteroid is $P = 10.07$ h (Shipley et al., 2008). In this work, we propose a period of $P = 11.69 \pm 0.03$ h with $\Delta m = 0.09 \pm 0.05$ mag. The very low amplitude observed may be attributed to a near pole-on viewing geometry.



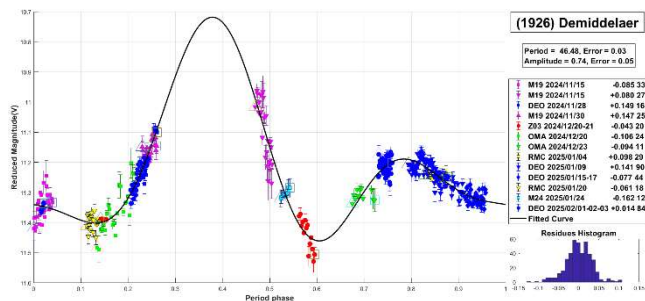
1341 Edmee. Edmee is a main-belt asteroid discovered in 1935 by E. Delporte. It is classified as a XB-type asteroid, with a diameter of 23.859 km. The reported rotational period for this asteroid is 23.745 h (Stephens, 2015). We measured a period of $P = 23.779 \pm 0.036$ h, with $\Delta m = 0.27 \pm 0.05$ mag.



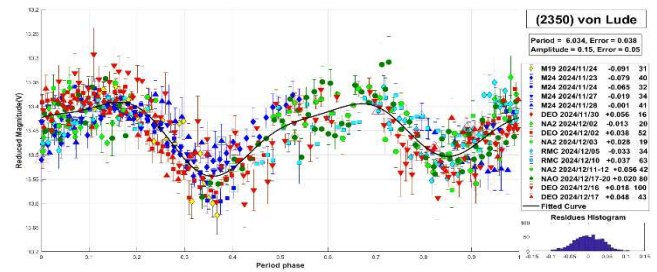
1408 Trusanda. This main-belt asteroid was discovered in 1936 by K. Reinmuth. It is classified as a X-type asteroid according to the Tholen taxonomy, with a diameter of 35.423 km. Interestingly, we could not find a reported rotational period for this object in the literature. Based on our observations and thorough analysis, we propose a period of $P = 29.39 \pm 0.02$ h and $\Delta m = 0.23 \pm 0.08$ mag.



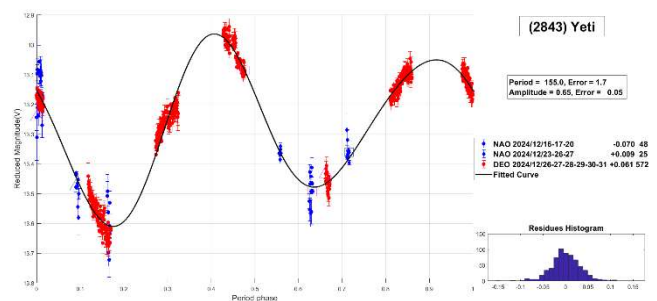
1926 Demidellaer. This main-belt asteroid was discovered in 1935 by E. Delporte. It is a member of the Eunomia family (Nesvorný et al., 2015), with a diameter of 17.752 km. It is classified as an L-type asteroid. The reported rotational period for this asteroid is $P = 32.095$ h (Polakis and Skiff, 2017). Our observations suggest a longer period, yielding a value of $P = 46.48 \pm 0.03$ h with $\Delta m = 0.74 \pm 0.05$ mag.



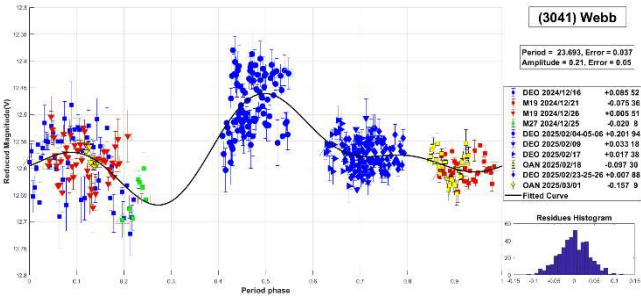
2350 von Lude. This main-belt asteroid is classified as an LS-type and a member of the Flora family, with a diameter of 5.786 km. It was discovered in 1938 by A. Bohmann. No previously published rotational periods were found in the literature. In this work, we propose a period of $P = 6.034 \pm 0.038$ h with an amplitude of $\Delta m = 0.15 \pm 0.05$ mag.



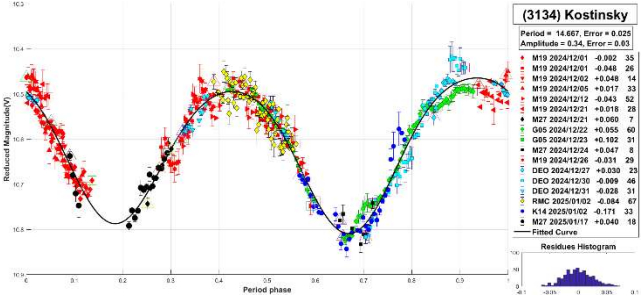
2843 Yeti. This main-belt asteroid has an estimated diameter of 7.587 km, discovered in 1975 by P. Wild. The reported rotational period for this asteroid is $P = 156.718$ h (Durech et al., 2020). Our observations also support the long-period hypothesis, yielding a value of $P = 155.0 \pm 1.7$ h with $\Delta m = 0.65 \pm 0.05$ mag.



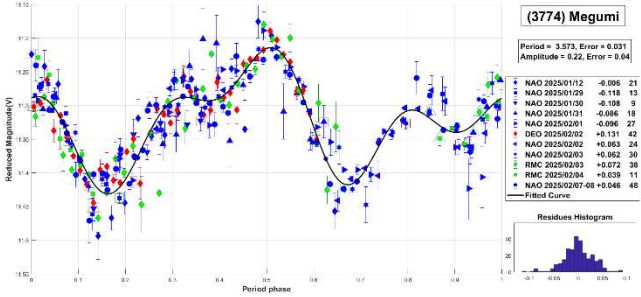
3041 Webb. This main-belt asteroid was discovered in 1980 by E. Bowell. It is a member of the Eunomia family (Nesvorný et al., 2015), with an estimated diameter of 8.221 km. A review of the literature revealed no published rotational periods for this asteroid. In this work, we propose a long period of $P = 23.693 \pm 0.037$ h with $\Delta m = 0.21 \pm 0.05$ mag.



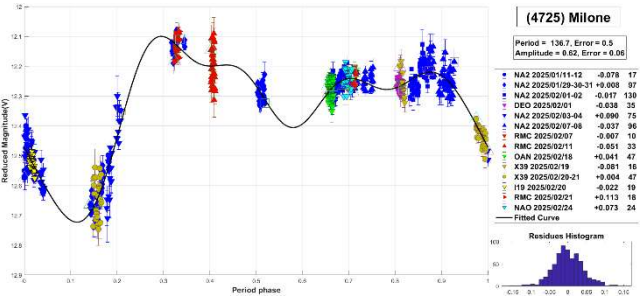
3134 Kostinsky. Kostinsky is an outer main-belt asteroid, discovered in 1921 by S. Belyavskij. It is a member of the Hilda family (Nesvorný et al., 2015), with an estimated diameter of 50.389 km. Pál et al. (2020) reported a rotational period of 14.7 h. Our measurement, $P = 14.667 \pm 0.025$ h with an amplitude of $\Delta m = 0.34 \pm 0.03$ mag, is in good agreement with their result.



3774 Megumi. This main-belt asteroid was discovered in 1987 by T. Kojima. Classified as an L-type asteroid according to the Tholen taxonomy, it is a member of the Eos family (Nesvorný et al., 2015). The diameter is 18.251 km. For this asteroid, we couldn't find published periods in the literature either. In this work, we propose a short period of $P = 3.573 \pm 0.031$ h with $\Delta m = 0.22 \pm 0.04$ mag.



4725 Milone. Milone is a main-belt asteroid with an estimated diameter of 10.47 km, discovered in 1975 by the Felix Aguilar Observatory (El Leoncito). For this asteroid, we couldn't find published periods in the literature. In this work, we propose a long period of $P = 136.7 \pm 0.5$ h with $\Delta m = 0.62 \pm 0.06$ mag.



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We want to thank Julio Castellano as we used his *FotoDif* program for preliminary analyses, Fernando Mazzone for his *Periodos* program, which was used in final analyses, and Matías Martini for his *CalculadorMDE v0.2* used for generating ephemerides used in the planning stage of the observations. This research has made use of the Small Bodies Data Ferret (<https://sbnapps.psi.edu/ferret/>), supported by the NASA Planetary System. This research has made use of data and/or services provided by the International Astronomical Union's Minor Planet Center.

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Observatory	Telescope	Camera
G05 Obs.Astr.Giordano Bruno	SCT (D=203mm; f=6.3)	CCD Atik 420 m
I19 Obs.Astr.El Gato Gris	SCT (D=355mm; f=10.6)	CCD SBIG STF-8300M
K14 Obs.Astr.de Sencelles	Newtonian (D=250mm; f=4.0)	CCD SBIG ST-7XME
M19 Osservatorio Explorer	Newtonian (D=254mm; f=3.8)	CCD Atik 414EX
M24 Oss.Astr.LaMacchina del Tempo	RCT (D250mm; f=8.0)	CMOS ZWO ASI 1600MM
M27 Elijah Observatory	RCT (D250mm; f=8.0)	CCD QSI 683
X39 Obs.Astr.Antares	Newtonian (D=250mm; f=4.72)	CCD QHY9 Mono
Z03 Obs.Astr.RioCofio	SCT (D=254mm; f=6.3)	CCD SBIG ST-8XME
Z65 Obs.Astr.Corgas	Newtonian (D=310mm; f=4.8)	CMOS ZWO ASI 294 MM
DEO Dark Energy Observatory	Refractor (D=115mm; f=7.0)	CMOS QHY 294M pro
NAO Obs.Astr.Naos	Newtonian (D=250mm; f=4.0)	CMOS QHY 163M
NA2 Obs.Astr.Naos 2	Newtonian (D=200mm; f=5.0)	CMOS ZWO ASI 174
OAN Obs.Astr.Nacional Llano del Hato	Cámara Schmidt (D=1000mm; f=3.0)	CMOS Fujifilm GFX 50R
OMA Obs.Astr.Vueltaporel Universo	Newtonian (D=150mm; f=5.0)	CMOS POA Neptune-M
RMC Obs.Astr.de Raúl Melia Carlos Paz	Newtonian (D=254mm; f=4.7)	CMOS QHY 174M

Table II. List of observatories and equipment.

Number	Name	yy/mm/dd-yy/mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
526	Jena	25/02/03-25/03/03	*06.9,04.7	150	1	11.878	0.015	0.25	0.02	Themis
1033	Simona	24/12/16-25/02/26	*13.7,14.3	119	-12	11.69	0.03	0.09	0.05	Eos
1341	Edmee	24/11/08-25/01/14	06.4,19.1	40	-13	23.779	0.036	0.27	0.05	MB-O
1408	Trusanda	24/12/05-25/02/02	*11.2,11.5	102	-10	29.39	0.02	0.23	0.08	Eos
1926	Demidelaer	24/11/15-25/02/03	*14.7,17.3	90	-1	46.48	0.03	0.74	0.05	Euno
2350	von Lude	24/11/23-24/12/20	*09.9,09.2	75	-7	6.034	0.038	0.15	0.05	Flora
2843	Yeti	24/12/16-25/01/01	20.7,14.2	122	-5	155.0	1.7	0.65	0.05	MB-I
3041	Webb	24/12/16-25/03/01	*19.0,17.2	125	13	23.693	0.037	0.21	0.05	Euno
3134	Kostinsky	24/12/01-25/01/17	*07.1,09.4	89	-2	14.667	0.025	0.34	0.03	Hilda
3774	Megumi	25/01/12-25/02/08	14.4,06.2	153	-7	3.573	0.031	0.22	0.04	Eos
4725	Milone	25/01/11-25/02/24	*16.2,07.8	144	-13	136.7	0.5	0.62	0.06	MB-O

Table I. Observing circumstances and results. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extremum during the period. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range (see Harris et al., 1984). Grp is the asteroid family/group (Warner et al., 2009). Themis: 24 Themis; Eos: 221 Eos; MB-O: main-belt outer; Euno: 15 Eunomia; Flora: 8 Flora; MB-I: main-belt inner; Hilda: 153 Hilda.

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