ASTEROID PHOTOMETRY AND LIGHTCURVE ANALYSIS FOR SIX ASTEROIDS

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Synodic rotation periods and amplitudes are reported for: 705 Erminia, 748 Simeisa, 914 Palisana, 983 Gunila, 1043 Beate, and (138971) 2001 CB21

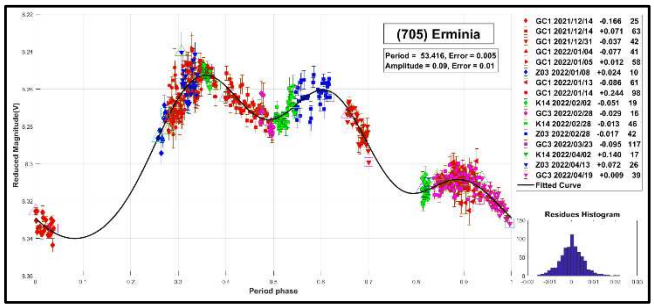
The periods and amplitudes of asteroid lightcurves currently presented are the product of collaborative work by GORA (Grupo de Observadores de Rotaciones de Asteroides) group. In all the studies we have applied relative photometry assigning V magnitudes to the calibration stars.

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 were also used. Photometry measurements were performed using *FotoDif* software and for the analysis, we employed *Periodos* software (Mazzone, 2012).

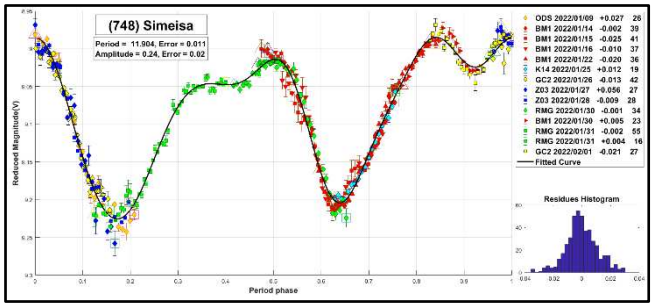
Below, we present the results for each asteroid under study. The lightcurve figures contain the following information: the estimated period and period error and the estimated amplitude and amplitude error. In the reference boxes, the columns represent, respectively, the marker, observatory MPC code, 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 and Italy, i.e., with negative or positive declinations δ, respectively, and 3) objects with few periods reported in the literature and/or with light curve Database (LCDB) (Warner et al., 2009b) quality codes (U) of less than 3.

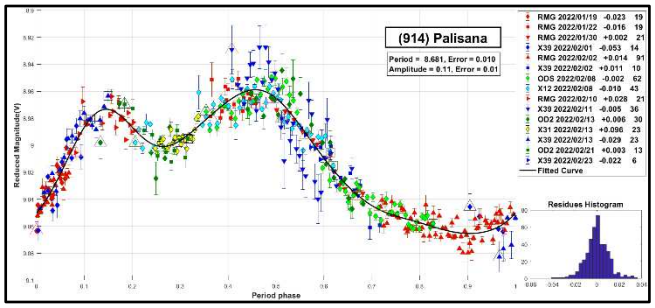
705 Erminia is an X-type asteroid, discovered in 1910 by Ernst Heidelberg. We found in the literature two rather different periods calculated for this object: P = 53.96 ± 0.01 h with Δm = 0.12 ± 0.01 mag (Koff et al., 2006), and P = 7.22 h with Δm = 0.07 mag (Di Martino et al., 1995). The results we obtained are P = 53.416 ± 0.005 h and Δm = 0.09 ± 0.01 mag. Our period well agrees with the one measured by Koff et al. (2006).



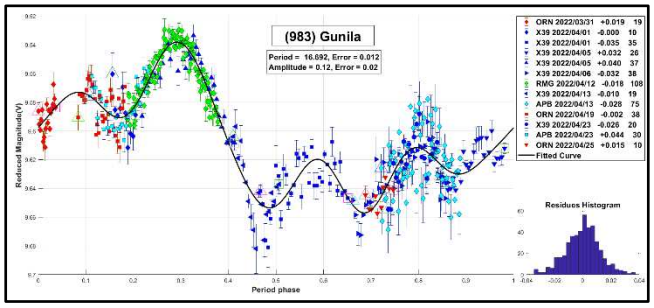
748 Simeisa is a P-type asteroid, discovered in 1913 by G. Neujim. We determined a period of 11.904 ± 0.011 h with Δm = 0.24 ± 0.02 mag. These results well agree with those reported by Dahlgren et al., (1998), P = 11.88 h with Δm = 0.22 mag and Behrend (2011web), P = 11.919 ± 0.002 h with Δm = 0.36 ± 0.03 mag. As a further contribution, our lightcurve provides more coverage on the rotational phase space.



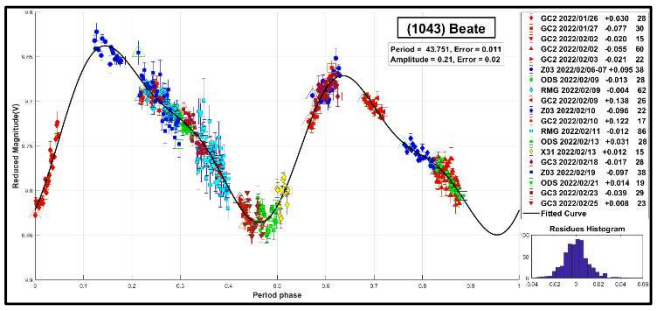
914 Palisana was discovered in 1919 by Wolf, M. We determined a period of 8.681 ± 0.010 h with Δm = 0.11 ± 0.01 mag. However, different authors have reported longer periods: P = 14 h with Δm = 0.02 mag (Tedesco, 1979) and P = 15.922 ± 0.004 h with Δm = 0.04 ± 0.01 mag (Warner, 2009a). In this paper, we present full light curve coverage, with observations made by overlapping different nights and telescopes, thus giving confidence to our result.



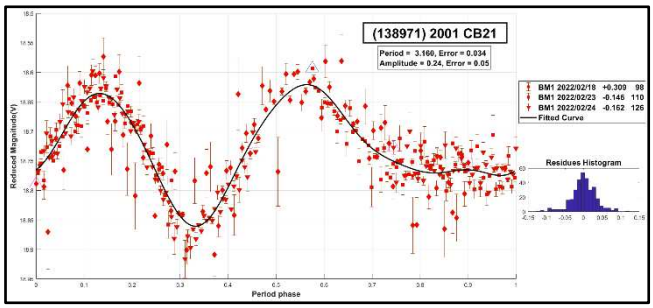
983 Gunila was discovered in 1922 by K. Reinmuth. Different authors attempted to measure the period of this asteroid without success (Warner, 2011; Albers et al., 2010; Shipley et al., 2008). The first reported period for this asteroid was published in 2014 by Hayes-Gehrke et al. (2014), resulting in P = 8.37 ± 0.12 h with Δm = 0.11 ± 0.01 mag. However, years later, Polakis (2019) published a new period, with a value doubling the previous one: P = 16.633 ± 0.023 h with Δm = 0.12 ± 0.02 mag. Our results, P = 16.092 ± 0.012 h with Δm = 0.12 ± 0.02 mag, well agree with those from Polakis (2019).



1043 Beate is an S-type asteroid, discovered in 1925 by K. Reinmuth. In the literature, we found only one reported period for this asteroid: P = 44.1 ± 0.1 h (Warner and Higgins, 2006). However, in the same paper, the authors propose a shorter period corresponding to 22.05 ± 0.10 h, though it was considered less plausible. Our study supports the longer period and yielded the following data: P = 43.751 ± 0.011 h with Δm = 0.21 ± 0.02 mag.



(138971) 2001 CB21 is a near-Earth asteroid, discovered in 2001 by LINEAR. According to the period previously reported, it is a fast rotator, with P = 3.3020 ± 0.0008 h and Δm = 0.12 ± 0.02 mag (Galád et al., 2005). Our observations also support the short-period scenario: P = 3.160 ± 0.034 h with Δm = 0.24 ± 0.05 mag.



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Number	Name	yy/ mm/dd- yy/ mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
705	Erminia	21/12/14-22/04/19	*18.7,20.5	136	23	53.416	0.005	0.09	0.01	MB-O
748	Simeisa	22/01/09-22/02/01	10.5,03.7	143	-02	11.904	0.011	0.24	0.02	HIL
914	Palisana	22/01/19-22/02/23	16.7,12.3	161	-30	8.681	0.010	0.11	0.01	MB-I
983	Gunila	22/03/31-22/04/25	*07.7,07.1	203	-14	16.692	0.012	0.12	0.02	MB-O
1043	Beate	22/01/26-22/02/25	*06.2,05.1	142	-03	43.751	0.011	0.21	0.02	MB-O
138971	2001 CB21	22/02/18-22/02/25	42.6,54.5	172	20	3.160	0.034	0.24	0.05	NEA

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., 2009b). HIL Hilda; MB-O: main-belt outer; MB-I: main-belt inner.

Observatory	Telescope	Camera
K14 Obs.Astr.de Sencelles	Newtoniano (D=250mm; f=4.0)	CCD SBIG ST-7XME
X12 Obs.Astr.Los Cabezones	Newtoniano (D=200mm; f=5.0)	CMOS QHY 174M GPS
X31 Obs.Astr.Galileo Galilei	RCT ap (D=405mm; f=8.0)	CCD SBIG STF8300M
X39 Obs.Astr.Antares	Newtoniano (D=250mm; f=4.7)	CCD QHY9 Mono
Z03 Obs.Astr.Río Cofio	SCT (D=254mm; f=6.3)	CCD SBIG ST8-XME
APB Obs.Astr.AstroPilar	Refractor (D=150mm; f=7.0)	CCD ZWO-ASI183
BM1 Oss.Astr.La Macchina del Tempo	Ritchey-Chretien (D250mm; f=8)	CMOS ZWO ASI 1600 MM
GC1 Specola Giuseppe Pustorino 1	Newtoniano (D=254mm; f=4.7)	CCD Atik 383l+Mono
GC2 Specola Giuseppe Pustorino 2	RC (D=400mm; f=8.0)	CCD Atik 383l+Mono
GC3 Specola Giuseppe Pustorino 3	RC (D=400mm; f=5.7)	CCD Atik 383l+Mono
ODS Obs.Astr.de Damián Scotta 1	Newtoniano (D=300mm; f=4.0)	CMOS QHY 174M
ORN Obs.Astr.de Ricardo Nolte	Newtoniano (D=200mm; f=5.0)	CMOS Neptune-M
RMG Obs.Astr.de Raúl Melia	Newtoniano (D=254mm; f=4.7)	CMOS QHY 174M GPS

Table II. List of observatories and equipment.

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