ASTEROID PHOTOMETRY AND LIGHTCURVES FOR TWELVE ASTEROIDS – SEPTEMBER 2023

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Synodic rotation periods and amplitudes are reported for: 830 Petropolitana, 931 Whittemora, 953 Painleva, 1064 Aethusa, 1199 Geldonia, 1465 Autonoma, 1937 Locarno, 4569 Baerbel.

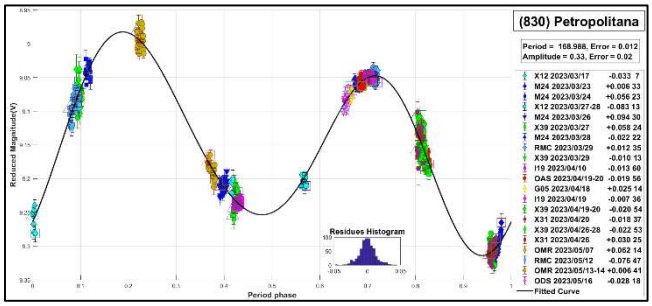
The periods and amplitudes of asteroid lightcurves presented in this paper are the product of collaborative work by the GORA (Grupo de Observadores de Rotaciones de Asteroides) group. In all the studies, we have applied relative photometry assigning V magnitudes to the calibration stars.

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).

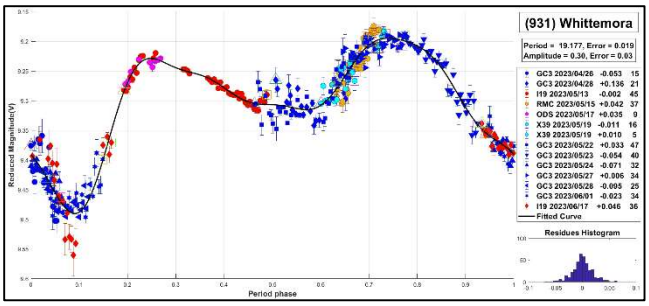
Below, we present the results for each asteroid studied. The lightcurve figures contain the following information: the estimated period and period error and the estimated amplitude and amplitude error. In the reference boxes, the columns represent, respectively, the marker, observatory MPC code, or - 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, 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.

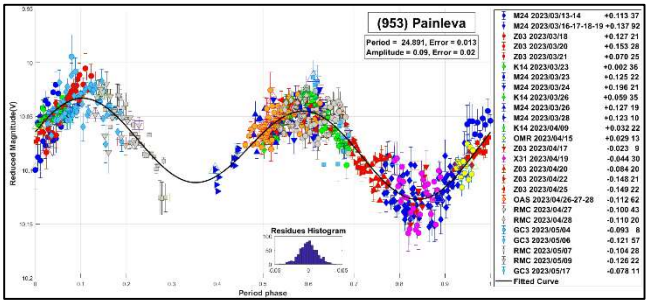
830 Petropolitana. It is an S-type asteroid, discovered in 1916 by G. Neujmin. The two more recent periods published in the literature correspond to P = 39.0 ± 0.5 h (Behrend, 2005web) and P = 37.347 ± 0.005 h (Hanus et al., 2016). In this work, we provide rather different results and propose a longer period of P= 168.988 ± 0.012 h and Δm = 0.33 ± 0.02 mag.



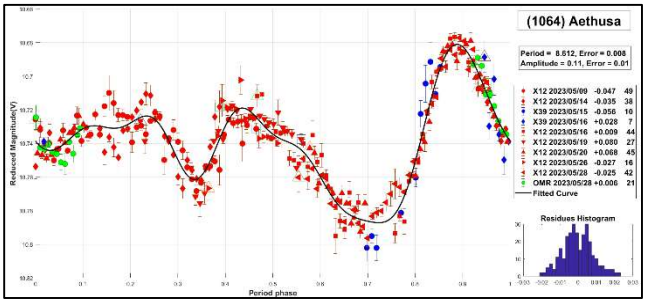
931 Whittemora. It is a M-type asteroid, discovered in 1920 by F. Gonnessiat. In the literature, we found only one reported period for this asteroid: P = 19.20 ± 0.01 h with Δm = 0.20 ± 0.05 mag (Menke, 2005). Our study supports the aforementioned period and yielded the following data: P = 19.177 ± 0.019 h with Δm = 0.30 ± 0.03 mag.



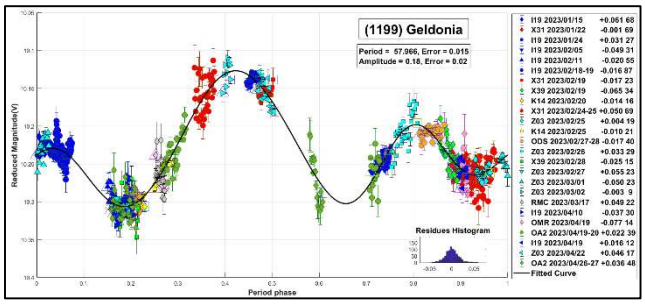
953 Painleva. It was discovered in 1921 by B. Jekhovsky. We found in the literature three rather different periods calculated for this object: P = 10 h (Behrend, 2006 web), P = 7.389 ± 0.004 h (Schmidt, 2015), and P = 24,884 ± 0.002 h (Dose, 2022). The results we obtained are P = 24.891 ± 0.013 h and Δm = 0.09 ± 0.02 mag. Our period well agrees with the one measured by Dose.



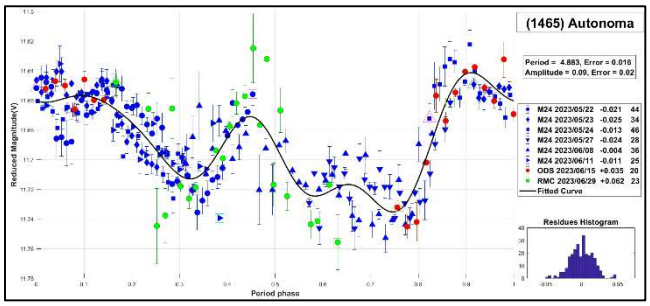
1064 Aethusa. It was discovered in 1926 by K. Reinmuth. We found in the literature two rather different periods calculated for this object: P = 12.916 ± .002 h (Behrend, 2004web) and P = 8.61275 ± 0.00004 h (Ďurech et al., 2020). Our period P = 8.612 ± 0.008 with Δm = 0.11 ± 0.01 mag agrees with the one measured by Durech.



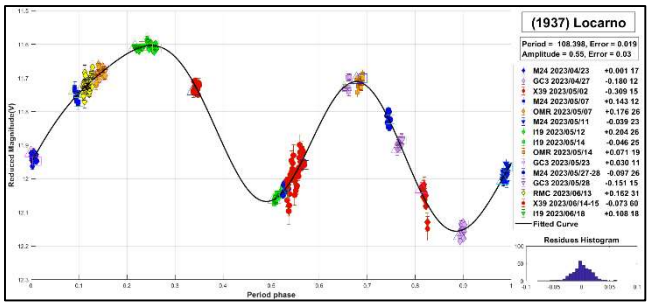
1199 Geldonia. It was discovered in 1931 by E. Delporte. Two different periods were reported in the literature. Behrend (2010web) found a period of 28.3 ± 0.2 h with Δm = 0.11 ± 0.03 mag, whereas Polakis (2019) measured a period of P = 57.82 ± 0.21 h with Δm = 0.20 mag. We have determined a period of 57.966 ± 0.015 h with Δm = 0.18 ± 0.02 mag, which is consistent with the one proposed by Polakis.



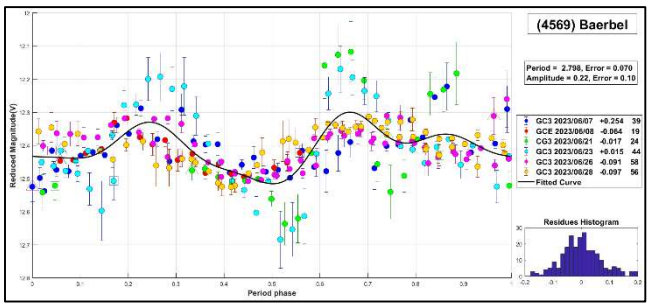
1465 Autonoma. This L-type Asteroid was discovered in 1938 by A. Wachmann. The period more recently reported in the literature is P = 4.882 h (Ditteon et al., 2018). The results we obtained are P = 4.882 ± 0.016 h and Δm = 0.09 ± 0.02 mag. Our period well agrees with the one measured by Ditteon.



1937 Locarno. It is an S-type asteroid, discovered in 1973 by P. Wild. In the literature, we found only one reported period for this asteroid: P = 110 h (Behrend, 2019 web). In this work, we propose a shorter period of P = 108.398 ± 0.019 h with Δm = 0.55 ± 0.03 mag.



4569 Baerbel. It was discovered in 1985 by C. S. Shoemaker. The more recent period published in the literature corresponds to P = 2.790 ± 0.002 h with Δm = 0.14 mag (Stephens and Warner, 2020). In this work, we provide similar results and propose P= 2.708 ± 0.070 h and Δm = 0.22 ± 0.10 mag.



Number	Name	yy/ mm/dd- yy/ mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
830	Petropolitana	23/03/17-23/05/17	*6.0,13.2	193	-3	168.988	0.012	0.33	0.02	MB-O
931	Whittemora	23/04/26-23/06/17	*7.9,07.7	241	10	19.177	0.019	0.30	0.03	MB-O
953	Painleva	23/03/13-23/05/17	*3.3,19.0	176	6	24.891	0.013	0.09	0.02	MB-O
1064	Aethusa	23/05/09-23/05/29	*6.7,08.1	235	-9	8.612	0.008	0.11	0.01	MB-I
1199	Geldonia	23/01/15-23/04/29	*11.5,19.8	144	-10	57.966	0.015	0.18	0.02	Eos
1465	Autonoma	23/05/22-23/06/30	*8.1,12.8	252	13	4.883	0.016	0.09	0.02	MB-O
1937	Locarno	23/04/23-23/06/18	*7.4,22,0	220	9	108.398	0.019	0.55	0.03	MB-I
4569	Baerbel	23/06/07-23/06/29	*11.4,09.3	271	17	2.798	0.070	0.22	0.10	Maria

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). MB-O: main-belt outer; MB-I: main-belt inner; Eos: 221 Eos; Maria: 170 Maria.

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
M24 Oss.Astr.La Macchina del Tempo	RCT (D250mm; f=8.0)	CMOS ZWO ASI 1600MM
X12 Obs.Astr.Los Cabezones	Newtonian (D=200mm; f=5.0)	CMOS QHY 174M
X31 Obs.Astr.Galileo Galilei	RCT ap (D=405mm; f=8.0)	CCD SBIG STF-8300M
X39 Obs.Astr.Antares	Newtonian (D=250mm; f=4.72)	CCD QHY9 Mono
Z03 Obs.Astr.Río Cofio	SCT (D=254mm; f=6.3)	CCD SBIG ST-8XME
GC3 Specola Giuseppe Pustorino 3	RCT (D=400mm; f=5.7)	CCD Atik 383L+Mono
OAS Obs.Astr.de Ariel Stechina 1	Newtonian (D=254mm; f=4.7)	CCD SBIG STF-402
OA2 Obs.Astr.de Ariel Stechina 2	Newtonian (D=305mm; f=5.0)	CMOS QHY 174M
ODS Obs.Astr.de Damián Scotta 1	Newtonian (D=300mm; f=4.0)	CMOS QHY 174M
OMR Obs.Astr.Municipal Reconquista	Newtonian (D=254mm; f=4.0)	Player One Ceres-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.

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We want to thank Julio Castellano as we used his *FotoDif* program for preliminary analyses, Fernando Mazzone for his *Periods* 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 (*http://sbn.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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