ASTEROID PHOTOMETRY AND LIGHTCURVE ANALYSIS FOR EIGHT ASTEROIDS

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Synodic rotation periods and amplitudes are reported for 244 Sita, 329 Svea, 421 Zahringia, 904 Rockefellia, 2479 Sodankyla, 4373 Crespo, (143947) 2003 YQ117, and 2015 RN35.

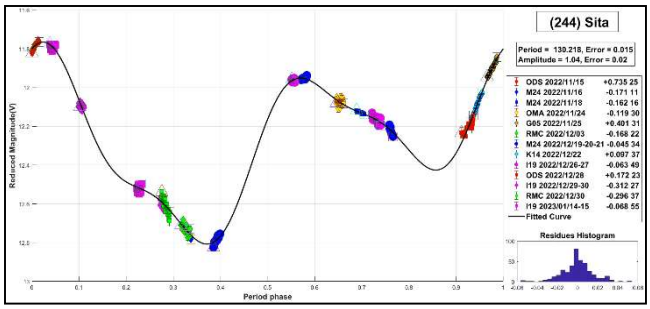
The periods and amplitudes of asteroid lightcurves presented here are the product of collaborative work by GORA (Grupo de Observadores de Rotaciones de Asteroides). In all the studies, we have applied relative photometry assigning V magnitudes to the calibration stars.

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-fields were also used. Photometry measurements were performed using *FotoDif* software We employed *Períodos* software (Mazzone, 2012) for analysis.

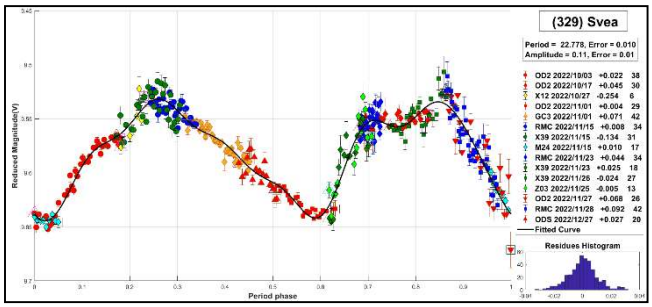
Below, we present the results for each asteroid under study. The lightcurve figures contain the following information: the estimated period and period error and the estimated amplitude and amplitude error. In the reference boxes, the columns represent, respectively, the marker, observatory MPC code, 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 Asteroid Lightcurve Database (LCDB; Warner et al., 2009) quality codes U < 3.

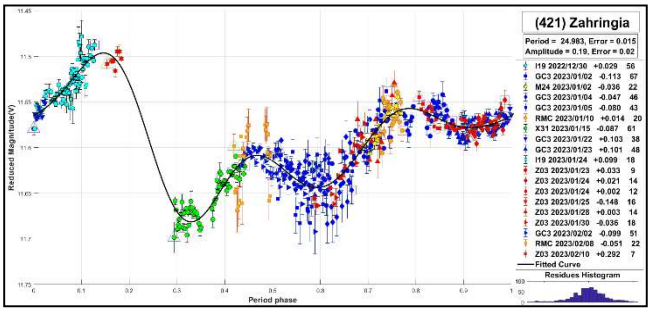
244 Sita was discovered in 1844 by J. Palisa. The most recent period published in the literature is P = 129.06 ± 0.02 h with A = 0.80 ± 0.05 mag (Vander Haagen, 2010). In this work, we provide similar results and propose P = 130.218 ± 0.015 h and A = 1.04 ± 0.02 mag.



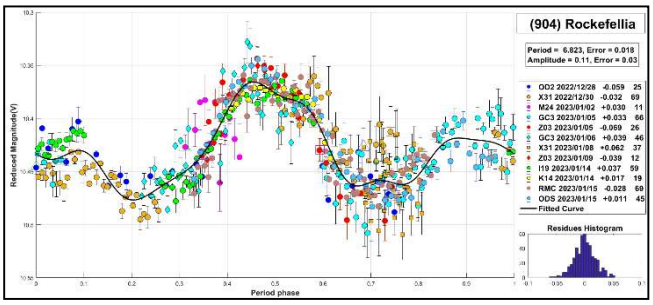
329 Svea is a C-type asteroid discovered in 1892 by M. Wolf. Several periods have been reported for this asteroid: P = 15 h (Weidenschilling et al., 1990), P = 15.201 ± 0.005 h (Pray, 2006), P = 22.6 ± 0.01 h (Menke et al., 2008), and P = 22.778 ± 0.006 h (Marciniak et al., 2015). We have determined a period of 22.778 ± 0.010 h with A = 0.11 ± 0.01 mag. This is consistent with the one proposed by Marciniak et al.



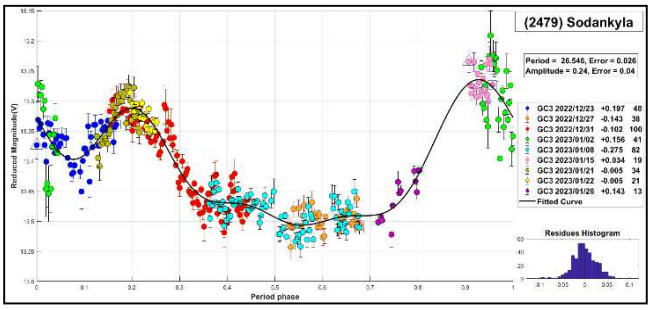
421 Zahringia is an S-type asteroid discovered in 1896 by M. Wolf. Several periods were previously measured for this asteroid: P = 15.5 h ± 0.1 h (Robinson, 2002), P = 17.49 ± 0.02 h (Behrend, 2005web), P = 6.42 ± 0.01 h (Warner, 2010), and P = 25.4891 ± 0.0376 h (Waszczak et al., 2015). The results we obtained, P = 24.983 ± 0.015 h with A = 0.19 ± 0.02 mag, are consistent with the longer period proposed by Waszczak et al.



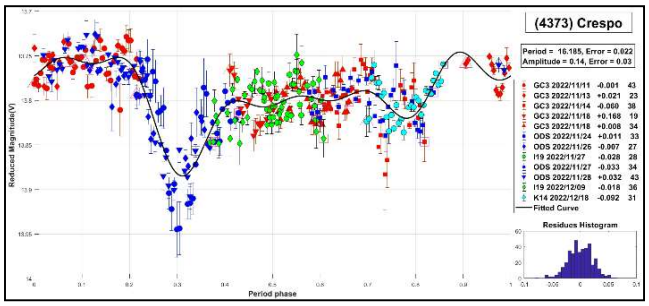
904 Rockefellia was discovered in 1918 by M. Wolf. We found in the literature three rather different periods for this object: P = 4.93 h (CALL, 2011web), P = 5.82 ± 0.01 h (Fauvaud and Fauvaud, 2013), and P = 12.72 ± 0.05 h (Behrend, 2014web). Our analysis suggests a period that is consistent with the one proposed by Fauvaud and Fauvaud, i.e., P = 6.823 ± 0.018 h and A = 0.11 ± 0.03 mag.



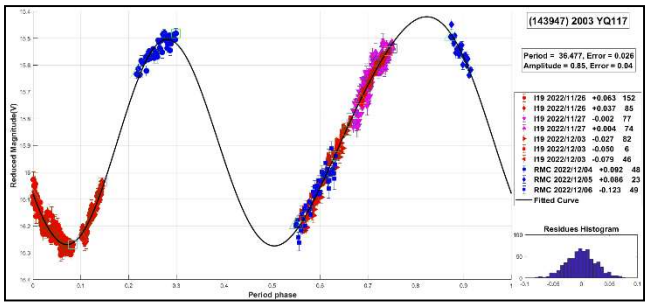
2479 Sodankyla was discovered in 1942 by Y. Vaisala. We couldn't find published periods in the literature for the asteroid. In this work, we propose a long-term period of P = 26.546 ± 0.026 h with A = 0.24 ± 0.04 mag.



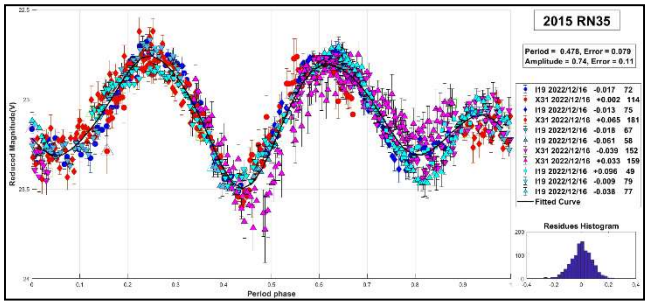
4373 Crespo was discovered in 1985 by E. Bowell. Interestingly, we couldn't find a reported period for this object in the literature. According to a thorough analysis of our observations, we propose a period of P = 16.185 ± 0.022 h and A = 0.14 ± 0.03 mag.



(143947) 2003 YQ117 was discovered in 2003 by NEAT. It is a poorly studied object. Here we propose a tentative period of P = 36.477 ± 0.026 h with A = 0.85 ± 0.04 mag.



2015 RN35. This hazardous asteroid was discovered in 2015 by Pan-STARRS. A great number of probable encounters of asteroid 2015 RN35 with the Earth have been predicted (Petrov et al., 2018; Sokolov et al., 2020). We couldn't find a reported period for this object in the literature. In this paper, we present full lightcurve coverage with observations made by overlapping different nights and telescopes, thus giving confidence to our result. We measured a period of 0.478 ± 0.008 h with A = 0.74 ± 0.11 mag.



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Number	Name	20yy/ mm/dd- yy/ mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
244	Sita	22/11/15-23/01/15	*5.6,24.7	62	-2	130.218	0.015	1.04	0.02	MB-I
329	Svea	22/10/03-22/12/27	2.0,22.8	10	-7	22.778	0.010	0.11	0.01	416
421	Zahringia	22/12/30-23/02/11	*15.0,9.1	125	-10	24.983	0.015	0.19	0.02	MB-I
904	Rockefellia	22/12/28-23/01/15	9.5,14.2	82	-18	6.823	0.018	0.11	0.03	MB-O
2479	Sodankyla	22/12/23-23/01/26	7.4,23.6	82	3	26.546	0.026	0.24	0.04	MB-I
4373	Crespo	22/11/11-22/12/18	*5.5,20.3	52	-7	16.185	0.022	0.14	0.03	MB-I
143947	2003 YQ117	22/11/26-22/12/06	67.5,50.2	70	-40	36.477	0.026	0.85	0.04	NEA
	2015 RN35	22/12/16-22/12/16	44.1,38.9	83	-20	0.478	0.079	0.74	0.11	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., 2009). 416: 329 Svea, MB-I: main-belt inner, MB-O: main-belt outer.

MPC	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
ODS	Obs.Astr.de Damián Scotta 1	Newtonian (D=300mm; f=4.0)	CMOS QHY 174M
OD2	Obs.Astr.de Damián Scotta 2	Newtonian (D=250mm; f=4.0)	CCD SBIG STF-8300M
OMA	Obs.Astr.Vuelta por el 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.

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