

# **ASTEROID PHOTOMETRY OF EIGHT ASTEROIDS**

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Synodic rotation periods and amplitudes are reported for:  
343 Ostara, 366 Vincentina, 892 Seeligeria, 914 Palisana,  
1112 Polonia, 1237 Genevieve, 1332 Marconia, and 1496  
Turku.

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.

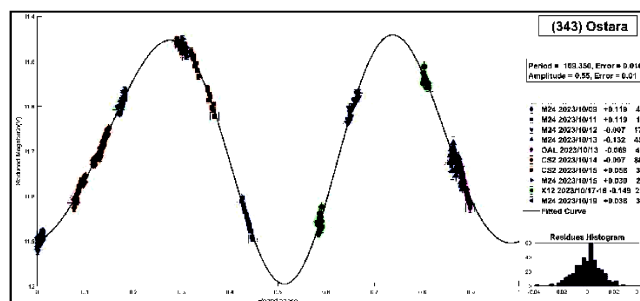
The image acquisition was performed without filters and with exposure times of a few minutes. All images used were corrected using dark frames and, in some cases, bias and flat-field corrections were also used. Photometry measurements were performed using *FotoDif* software and for the analysis, we employed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

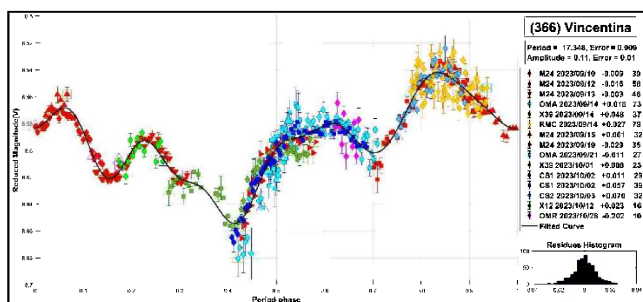
Targets were selected based on the following criteria: 1) those asteroids with magnitudes accessible to the equipment of all participants, 2) those with favorable observation conditions from Argentina or Spain, i.e., with negative or positive declinations  $\delta$ , respectively, and 3) objects with 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 light curves display improved results and are part of a new long-term project that we are initiating.

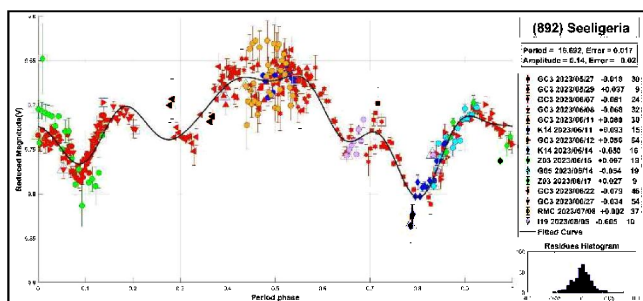
**343 Ostara.** This asteroid was discovered in 1892 by M. Wolf. In the literature, we found two rather different periods calculated for this object:  $P = 6.42$  h (Binzel, 1987) and  $P = 110.027 \pm 0.001$  h (Martikanien et al., 2021). The results we obtained,  $P = 109.35 \pm 0.01$  h with  $\Delta m = 0.55 \pm 0.01$  mag, are consistent with the longer period proposed by Martikanien.



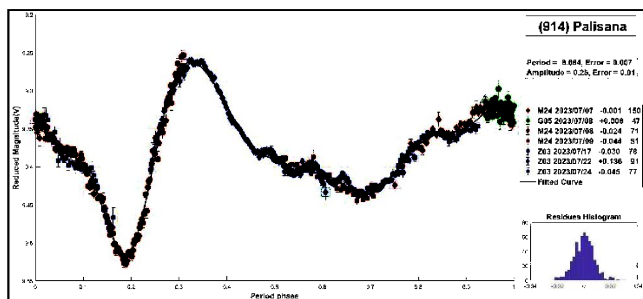
**366 Vincentina.** This asteroid was discovered in 1893 by A. Charlois. Two different periods were reported in the literature. Robinson (2002) found a period of  $15.5 \pm 0.1$  h, whereas Benishek (2013) measured a period of  $P = 12.7365 \pm 0.0005$  h. In this work, we provide similar results and propose  $P = 17.348 \pm 0.0009$  h and  $\Delta m = 0.11 \pm 0.01$  mag. This diagram validates our previous result (Colazo et al., 2021).



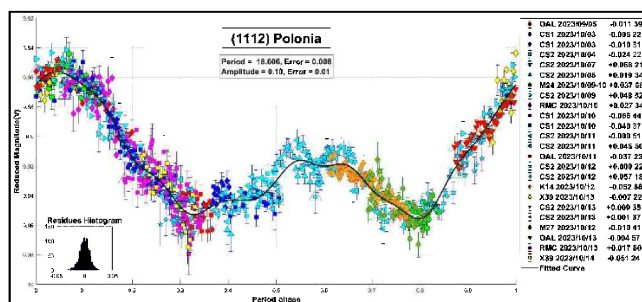
**892 Seeligeria.** This asteroid was discovered in 1918 by M. Wolf. Several periods were measured for this asteroid with the following results:  $P = 41.40 \pm 0.02$  h (Behrend, 2007web),  $P = 15.78 \pm 0.04$  h (Shipley et al., 2008), and  $P = 16.693 \pm 0.008$  h (Colazo et al., 2023). We have determined a period of  $16.692 \pm 0.017$  h with  $\Delta m = 0.14 \pm 0.02$  mag, which is consistent with our previous result.



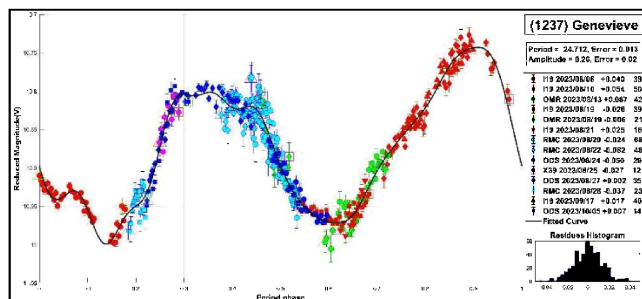
**914 Palisana.** This asteroid was discovered in 1919 by M. Wolf. The more recent period published in the literature corresponds to  $P = 8.681 \pm 0.010$  h (Colazo et al., 2022). We have determined a period of  $8.684 \pm 0.007$  h with  $\Delta m = 0.25 \pm 0.01$  mag, which is consistent with our previous result. This diagram was derived from high-quality curves, and the ephemerides were covered as expected.



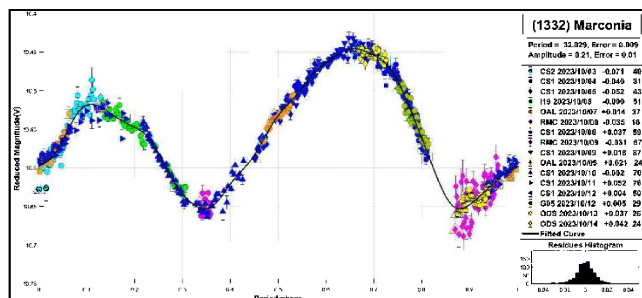
**1112 Polonia.** This asteroid was discovered in 1928 by P. Shajn. We found in the literature two rather different periods calculated for this object:  $P = 82.5 \pm 0.5$  h (Warner, 2008) and  $P = 18.71 \pm 0.04$  h (Polakis, 2020). The results we obtained are  $P = 18.606 \pm 0.008$  h and  $\Delta m = 0.10 \pm 0.01$  mag. Our period well agrees with the one measured by Polakis.



**1237 Genevieve.** This asteroid was discovered in 1931 by G. Reiss. The two more recent periods published in the literature correspond to  $P = 24.82 \pm 0.07$  h (Behrend, 2005web) and  $P = 16.31 \pm 0.04$  h (Polakis, 2022). We have determined a period of  $24.712 \pm 0.013$  h, which is consistent with the longer period proposed by Behrend.



**1332 Marconia.** This asteroid was discovered in 1934 by L. Vorta. The more recent period published in the literature corresponds to  $P = 19.16 \pm 0.01$  h (Stephens, 2013). In this work, we provide rather different results and propose a longer period of  $P = 32.029 \pm 0.009$  h and  $\Delta m = 0.21 \pm 0.01$  mag.



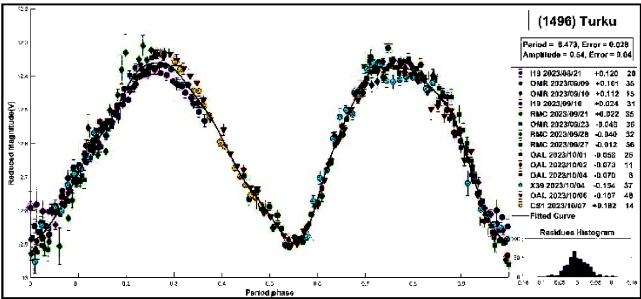
**1496 Turku.** This asteroid was discovered in 1938 by Y. Vaisala. The more recent period published in the literature corresponds to  $P = 6.47375 \pm 0.00001$  h (Durech et al., 2016). We have determined a period of  $6.473 \pm 0.028$  h with  $\Delta m = 0.54 \pm 0.04$  mag, which is consistent with the one proposed by Durech.

| Number | Name       | yy/ mm/dd- yy/ mm/dd | Phase      | L <sub>PAB</sub> | B <sub>PAB</sub> | Period(h) | P.E.  | Amp  | A.E. | Grp  |
|--------|------------|----------------------|------------|------------------|------------------|-----------|-------|------|------|------|
| 343    | Ostara     | 23/10/09-23/10/27    | 13.3,02.4  | 35               | -1               | 109.270   | 0.012 | 0.52 | 0.02 | MB-I |
| 366    | Vincentina | 23/09/10-23/10/29    | 01.4,16.3  | 343              | 1                | 17.348    | 0.009 | 0.11 | 0.01 | MB-O |
| 892    | Seeligeria | 23/05/27-23/08/06    | *08.7,15.1 | 257              | 25               | 16.692    | 0.017 | 0.14 | 0.02 | MB-O |
| 914    | Palisana   | 23/07/07-23/07/27    | 22.4,20.4  | 310              | 29               | 8.684     | 0.007 | 0.25 | 0.01 | MB-I |
| 1112   | Polonia    | 23/09/05-23/10/14    | *13.7,05.6 | 14               | 11               | 18.606    | 0.008 | 0.10 | 0.01 | Eos  |
| 1237   | Genevieve  | 23/08/06-23/10/05    | 06.5,22.2  | 311              | -12              | 24.712    | 0.013 | 0.26 | 0.02 | MB-M |
| 1332   | Marconia   | 23/10/03-23/10/12    | 07.0,03.1  | 25               | 0                | 32.029    | 0.009 | 0.21 | 0.01 | Marc |
| 1496   | Turku      | 23/08/21-23/10/07    | *03.8,21.5 | 334              | 3                | 6.473     | 0.028 | 0.54 | 0.04 | MB-I |

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. LPAB and BPAB 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-I: main-belt inner; MB-O: main-belt outer; Eos: 221 Eos; MB-M: main-belt middle; Marc: 1332 Marconia.

| 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       |
| M27 Elijah Observatory                    | RCT (D250mm; f=6.0)         | CCD QSI 683         |
| 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    |
| CS1 CapoSudObservatory                    | RCT (D=400mm; f=5.7)        | CCD Atik 383L+Mono  |
| CS2 CapoSudObservatory                    | Newtonian (D=254mm; f=4.7)  | CCD Atik 420 Mono   |
| GC3 Specola Giuseppe Pustorino 3          | RCT (D=400mm; f=5.7)        | CCD Atik 383L+Mono  |
| OAL Osservatorio Astronomico di Orciatice | SCT (D=355mm; f=7.4)        | CCD SBIG ST10XME    |
| ODS Obs.Astr.de Damián Scotta 1           | Newtonian (D=300mm; f=4.0)  | CMOS QHY 174M       |
| OMA Obs.Astr.Vuelta por el Universo       | Newtonian (D=150mm; f=5.0)  | CMOS POA Neptune-M  |
| 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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## LIGHTCURVES ANALYSIS OF 1677 TYCHO BRAHE, 1802 ZHANG HENG, AND 18151 LICCHELLI

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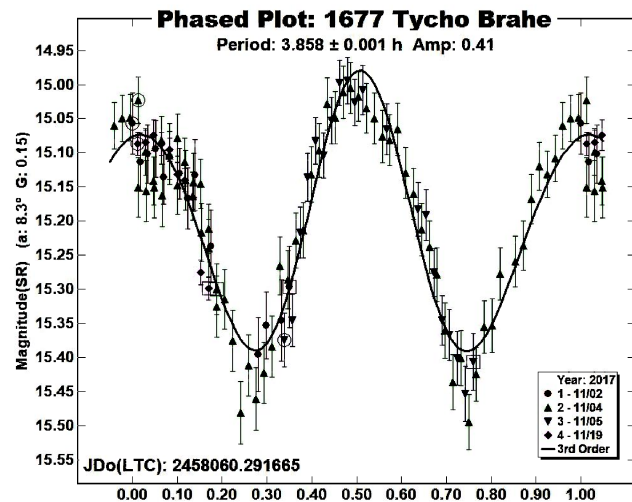
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Photometric observations of three main-belt asteroids were carried out at the R. P. Feynman Observatory on year 2017. The synodic period and lightcurve amplitude were found for 1677 Tycho Brahe, 1802 Zhang Heng, and 18151 Licchelli.

CCD observations of three main-belt asteroids were carried out at the R. P. Feynman Observatory on year 2017 using an Orion 0.30-m newtonian reflector equipped with a CCD Atik 460EX (bin 2×2), as part of an educational project involving high school students. Lightcurves analysis was done by the authors with *MPO Canopus* (Warner, 2023). All the images were calibrated with dark and flat frames and converted to standard magnitudes using solar colored field stars from CMC15 catalogue.

1677 Tycho Brahe is a medium albedo middle main-belt asteroid. Observations were made over four nights using a SR filter. The period analysis shows a synodic period of  $P = 3.858 \pm 0.001$  h with an amplitude  $A = 0.41 \pm 0.05$  mag. The period is close to the previously published results in the asteroid lightcurve database (LCDB; Warner et al., 2009) referred to hereinafter as "LCDB".



| Number | Name        | 2017 mm/dd  | Phase     | $L_{PAB}$ | $B_{PAB}$ | Period(h) | P.E.  | Amp  | A.E. | Grp  |
|--------|-------------|-------------|-----------|-----------|-----------|-----------|-------|------|------|------|
| 1677   | Tycho Brahe | 11/02-11/19 | 8.3, 9.9  | 44        | 18        | 3.858     | 0.001 | 0.41 | 0.05 | MB-M |
| 1802   | Zhang Heng  | 11/01-11/11 | 1.4, 4.6  | 39        | -3        | 3.161     | 0.001 | 0.30 | 0.03 | MB-O |
| 18151  | Licchelli   | 10/08-10/28 | 10.0, 1.5 | 34        | -3        | 10.680    | 0.003 | 0.26 | 0.03 | MB-O |

Table I. Observing circumstances and results. The first line gives the results for the primary of a binary system. The second line gives the orbital period of the satellite and the maximum attenuation. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extrema 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).