

## ASTEROID PHOTOMETRY: LIGHTCURVE RESULTS FOR SIX TARGETS

Milagros Colazo

Astronomical Observatory Institute,  
Faculty of Physics, Adam Mickiewicz University,  
ul. Słoneczna 36, 60-286 Poznań, POLAND

Grupo de Observadores de Rotaciones de Asteroides (GORA),  
ARGENTINA

<https://aoacm.com.ar/gora/index.php>  
milirita.colazovinovo@gmail.com

Raúl Melia

Observatorio de Raúl Melia Carlos Paz (GORA RMC)  
Carlos Paz (Córdoba- ARGENTINA)

Néstor Suárez

Observatorio Antares (MPC X39)  
Pilar (Buenos Aires- ARGENTINA)

Víctor Amelotti

Observatorio Astronómico Naos (GORA NAO)  
Alta Gracia (Córdoba- ARGENTINA)

Ariel Stechina

Observatorio de Ariel Stechina 1 (GORA OAS)  
Reconquista (Santa Fe- ARGENTINA)

Paolo Aldinucci

Osservatorio Astronomico di Orciatto (MPC D41)  
Lajatico (Pisa-ITALIA)

Bruno Monteleone

Osservatorio Astronomico “La Macchina del Tempo” (MPC M24)  
Ardore Marina (Reggio Calabria-ITALIA)

Mario Morales

Observatorio de Sencelles (MPC K14)  
Sencelles (Mallorca-Islas Baleares-ESPAÑA)

Marcos Anzola

Observatorio Astronómico Vuelta por el Universo (GORA OMA)  
Córdoba (Córdoba- ARGENTINA)

Aldo Wilberger

Observatorio Los Cabezones (MPC X12)  
Santa Rosa (La Pampa- ARGENTINA)

Tiago Speranza

Observatorio Astronómico Municipal Reconquista (GORA OMR)  
Reconquista (Santa Fe- ARGENTINA)

Francisco Santos

Observatorio Astronómico Giordano Bruno (MPC G05)  
Piconcillo (Córdoba-ESPAÑA)

Damián Scotta

Observatorio de Damián Scotta 1 (GORA ODS)  
San Carlos Centro (Santa Fe- ARGENTINA)

Giuseppe Ciancia

Specola “Giuseppe Pustorino 1” (GORA GC1)  
Palizzi Marina (Reggio Calabria-ITALIA)

Carlos Colazo

Observatorio Astronómico El Gato Gris (MPC I19)  
Tanti (Córdoba- ARGENTINA)

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Synodic rotation periods and amplitudes are reported for:  
494 Virtus, 866 Fatme, 1075 Helina, 1279 Uganda, 1424  
Sundmania, 1593 Fagnes, (5977) 1992 TH1, (58143)  
1983 VD7.

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.

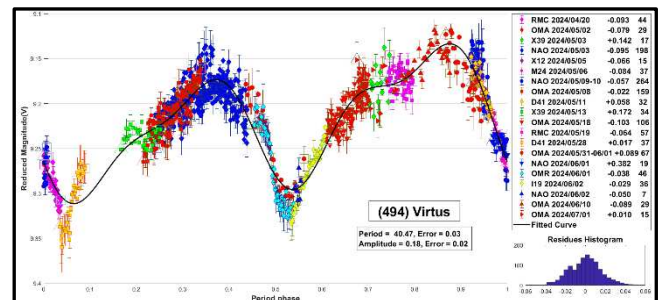
The image acquisition was performed without filters and with exposure times of a few minutes. All images used were corrected using dark frames and, in some cases, bias and flat-field corrections were also used. Photometry measurements were performed using *FotoDif* software and for the analysis, we employed *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  $\delta$ , 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 lightcurves display improved results and are part of a new long-term project that we are initiating.

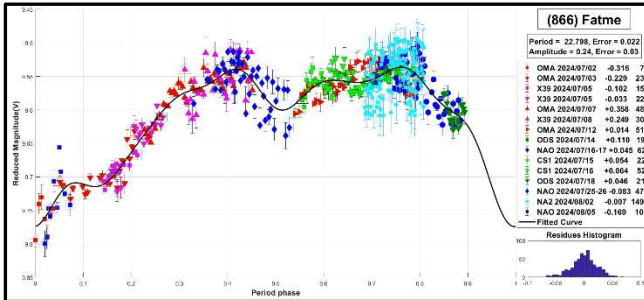
**494 Virtus.** It is a C-type asteroid, discovered in 1902 by M. Wolf (NASA, 2024). Several periods were measured for this asteroid with the following results:  $P = 4.9903$  h (Behrend, 2008web),  $P = 5.570$  h  $\pm$  0.003 h (Hamanowa and Hamanowa, 2009), and more recently  $P = 40.431 \pm 0.004$  h (Dose, 2022). We have determined a  $40.47 \pm 0.03$  h period, which is consistent with the one proposed by Dose.



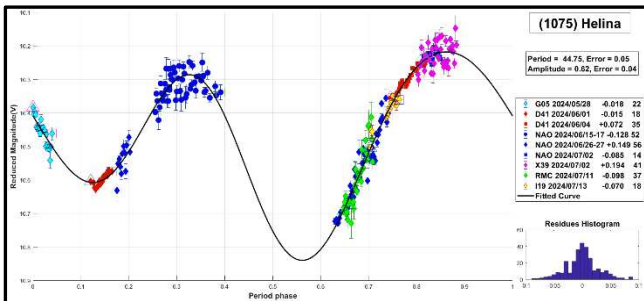
**866 Fatme.** It was discovered in 1917 by M. Wolf (NASA, 2024). Several periods were measured for this asteroid with the following results:  $P = 20.03$  h  $\pm$  0.01 h (Stephens, 2002),  $P = 9.36$  h  $\pm$  0.05 h (Behrend, 2012web), and  $P = 11.600 \pm 0.001$  h (Dose, 2021). The results we obtained,  $P = 22.798 \pm 0.022$  h with  $\Delta m = 0.24 \pm 0.03$  mag, are consistent with the longer period proposed by Stephens.

| Number | Name      | yy/ mm/dd- yy/ mm/dd | Phase      | $L_{PAB}$ | $B_{PAB}$ | Period(h) | P.E.  | Amp  | A.E. | Grp  |
|--------|-----------|----------------------|------------|-----------|-----------|-----------|-------|------|------|------|
| 494    | Virtus    | 24/04/20-24/07/01    | *2.1,19.9  | 215       | -1        | 40.47     | 0.03  | 0.18 | 0.02 | MB-O |
| 866    | Fatme     | 24/07/02-24/08/05    | *4.7,08.3  | 292       | -4        | 22.798    | 0.022 | 0.24 | 0.03 | MB-O |
| 1075   | Helina    | 24/05/28-24/07/14    | 5.0,16.9   | 238       | 8         | 44.75     | 0.05  | 0.62 | 0.04 | EOS  |
| 1279   | Uganda    | 24/05/18-24/07/03    | 16.7,30.5  | 216       | -7        | 11.172    | 0.043 | 0.21 | 0.06 | MB-I |
| 1424   | Sundmania | 24/05/09-24/07/05    | *3.5,16.2  | 237       | 4         | 93.3      | 0.2   | 0.44 | 0.02 | MB-O |
| 1593   | Fagnes    | 24/05/25-24/07/13    | 10.3,29.1  | 247       | 12        | 25.310    | 0.015 | 0.45 | 0.02 | MARS |
| 5977   | 1992 TH1  | 24/06/30-24/07/11    | 12.2,08.0  | 302       | 9         | 42.5      | 0.2   | 0.63 | 0.03 | MAR  |
| 58143  | 1983 VD7  | 24/07/07-24/08/06    | *16.0,04.6 | 303       | -18       | 79.1      | 0.2   | 0.57 | 0.03 | MB-I |

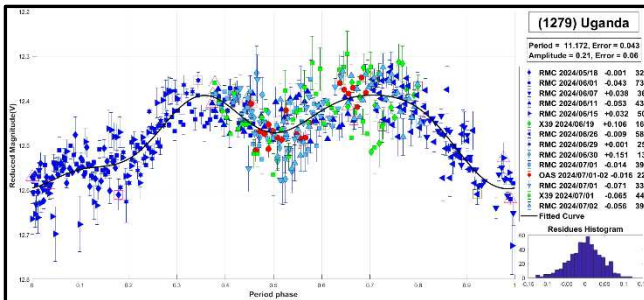
Table I. Observing circumstances and results. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extremum during the period.  $L_{PAB}$  and  $B_{PAB}$  are the approximate phase angle bisector longitude/latitude at mid-date range (see Harris et al., 1984). Grp is the asteroid family/group (Warner et al., 2009). MB-I: main-belt inner; MAR: 170 Maria; MB-O: main-belt outer; MARS: Mars-crosser; EOS: 221 Eos.



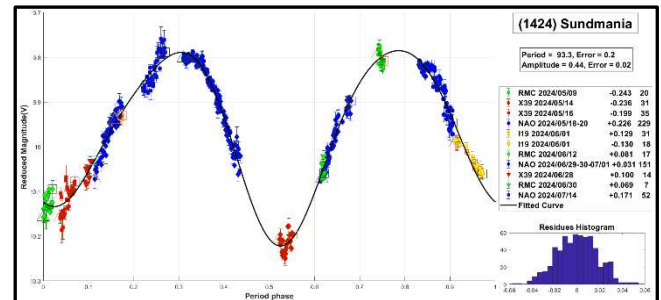
**1075 Helina.** It was discovered in 1926 by G. Neujmin (NASA, 2024). The more recent period published in the literature corresponds to  $P = 44.9$  h (Martikainen et al., 2021). Our period  $P = 44.75 \pm 0.05$  h agrees with the one measured by Martikainen et al.



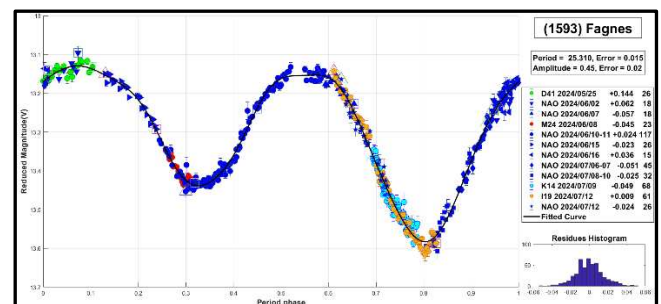
**1279 Uganda.** It was discovered in 1933 by C. Jackson (NASA, 2024). In the literature, we found only one period reported for this asteroid:  $P = 11.6$  h (Binzel, 1987). Our study supports the aforementioned period and yielded the following data:  $P = 11.172 \pm 0.043$  h with  $\Delta m = 0.21 \pm 0.06$  mag. The previously reported period, derived from fragmentary lightcurves, may be subject to significant uncertainty, according to JPL.



**1424 Sundmania.** It was discovered in 1937 by Y. Vaisala (NASA, 2024). The more recent period published in the literature corresponds to  $P = 93.73$  h (Martikainen et al., 2021). The results we obtained are  $P = 93.3 \pm 0.2$  h and  $\Delta m = 0.44 \pm 0.02$  mag. Our period agrees well with the one measured by Martikainen et al.



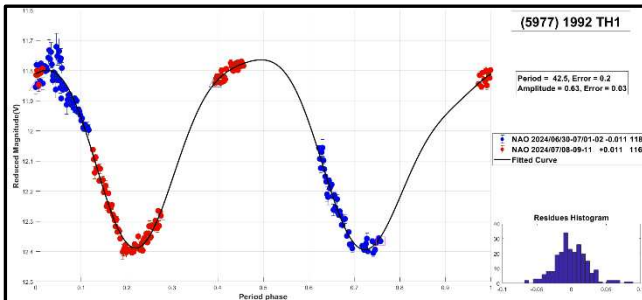
**1593 Fagnes.** It was discovered in 1951 by S. Arend (NASA, 2024). We found in the literature two rather different periods calculated for this object:  $P = 16.45 \pm 0.03$  h (Harris et al., 1992), and  $P = 25.25$  h (Behrend, 2021web). The results we obtained are  $P = 25.310 \pm 0.015$  h. Our period well agrees with the one measured by Behrend.



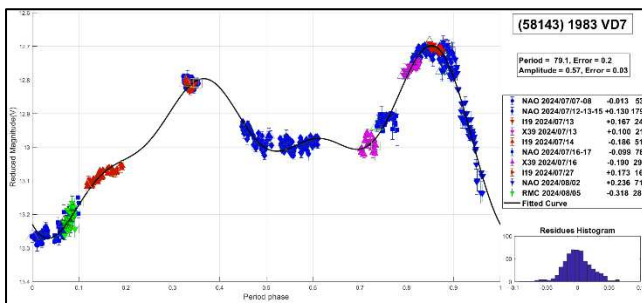
**(5977) 1992 TH1.** It was discovered in 1992 by H.E. Holt (NASA, 2024). Interestingly, we couldn't find a reported period for this object in the literature. According to our observations and after a thorough analysis, we propose a period of  $P = 42.5 \pm 0.2$  h and  $\Delta m = 0.63 \pm 0.03$  mag.

| Observatory                               | Telescope                   | Camera              |
|-------------------------------------------|-----------------------------|---------------------|
| D41 Osservatorio Astronomico di Orciatice | SCT (D=355mm; f=7.4)        | CCD SBIG ST10XME    |
| 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       |
| X39 Obs.Astr.Antares                      | Newtonian (D=250mm; f=4.72) | CCD QHY9 Mono       |
| NAO Obs.Astr.Naos                         | Newtonian (D=250mm; f=4.0)  | CMOS QHY 163M       |
| OAS Obs.Astr.de Ariel Stechina 1          | Newtonian (D=254mm; f=4.7)  | CCD SBIG STF-402    |
| 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.



(58143) 1983 VD7. It was discovered in 1983 by Cavriana (NASA, 2024). For this asteroid, we could not find published periods in the literature either. In this work, we propose a period of  $P = 79.1 \pm 0.2$  h with  $\Delta m = 0.57 \pm 0.03$  mag.



#### Acknowledgements

We want to thank Julio Castellano as we used his *FotoDif* program for preliminary analyses, Fernando Mazzone for his *Períodos* 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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