

ASTEROID PHOTOMETRY FOR THIRTEEN MAIN BELT ASTEROIDS

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>
mlirita.colazovinovo@gmail.com

Víctor Amelotti
Observatorio Astronómico Naos (GORA NAO)
Observatorio Astronómico Naos 2 (GORA NA2)
Observatorio Astronómico Naos 4 (GORA NA4)
Alta Gracia (Córdoba - ARGENTINA)
Estación Astrofísica Bosque Alegre (MPC 821)
Departamento Punilla (Córdoba - ARGENTINA)

Gerard Tàrtalo
Dark Energy Observatory (DEO)
Dark Energy Observatory 2 (DE2)
Àger (Lleida - ESPAÑA)

Nicola Montecchiari
Elijah Observatory (MPC M27)
Lajatico (Pisa - ITALIA)

Giuliat Navas
Observatorio Astronómico Nacional Llano del Hato (MPC 303)
Observatorio Astronómico Nacional Llano del Hato (OAN)
Centro de Investigaciones de Astronomía Francisco J. Duarte
(CIDA) - Apartaderos (Mérida - VENEZUELA)

Carlos Ambrosioni
Observatorio Astronómico de Carlos Ambrosioni 3 (GORA OC3)
Cañuelas (Buenos Aires - ARGENTINA)

Martín Leiva
Estación Astrofísica Bosque Alegre (MPC 821)
Departamento Punilla (Córdoba - ARGENTINA)

Paolo Aldinucci
Osservatorio Astronomico di Orciatto (MPC D41)
Lajatico (Pisa - ITALIA)
Osservatorio Astronomico Piero Angela (MPC D42)
Scandicci (Firenze - ITALIA)

Zlatko Orbanic
Osservatorio Explorer (MPC M19) - Pula (Istria - CROACIA)
Observatorios Remotos Nuevo México
Pie Town - (Nuevo México - USA)

José Álvarez
Observatorio Astronómico Corgas (MPC Z65)
Corgas-Taboadela-Ourense (Galicia - ESPAÑA)

Raúl Melia
Observatorio de Raúl Melia Carlos Paz (GORA RMC)
Carlos Paz (Córdoba - ARGENTINA)
Estación Astrofísica Bosque Alegre (MPC 821)
Departamento Punilla (Córdoba - ARGENTINA)

Marcos Anzola
Observatorio Astronómico Vuelta por el Universo 2
(GORA OM2) - Córdoba (Córdoba - ARGENTINA)
Estación Astrofísica Bosque Alegre (MPC 821)
Departamento Punilla (Córdoba - ARGENTINA)

Mario Morales
Observatorio de Sencelles (MPC K14)
Sencelles (Mallorca-Islands Baleares - ESPAÑA)

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

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

Carlos Colazo
Observatorio Astronómico El Gato Gris (MPC I19)
Tanti (Córdoba - ARGENTINA)
Observatorios Remotos Nuevo México
Pie Town - (Nuevo México - USA)

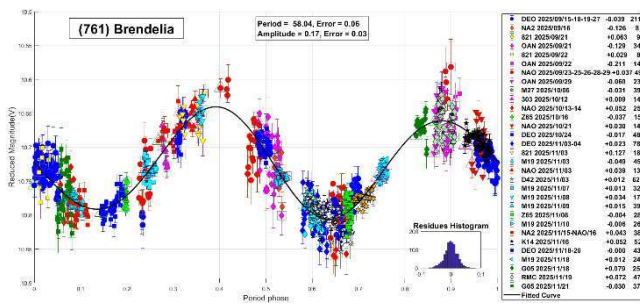
(Received: 14 April 2026 Revised: 4 May 2026)

Synodic rotation periods and amplitudes are reported for:
761 Brendelia, 923 Herluga, 1118 Hansky, 1549 Mikko,
1579 Herrick, 1586 Thiele, 1844 Susilva, 1912 Anubis,
2068 Dangreen, 2362 Mark Twain, 4382 Stravinsky,
6514 Torahiko, 8730 Iidesan.

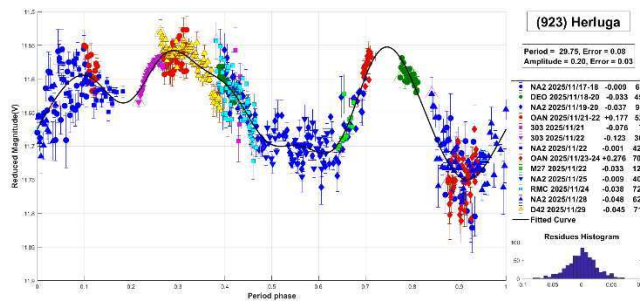
The periods and amplitudes of asteroid lightcurves presented in this paper are the product of collaborative work by the GORA (Grupo de Observadores de Rotaciones de Asteroides) group. In all the studies, we have applied relative photometry assigning V magnitudes to the calibration stars. The image acquisition 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, Venezuela, Spain, Italy, or Croatia, i.e. with negative or positive declinations δ , 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.

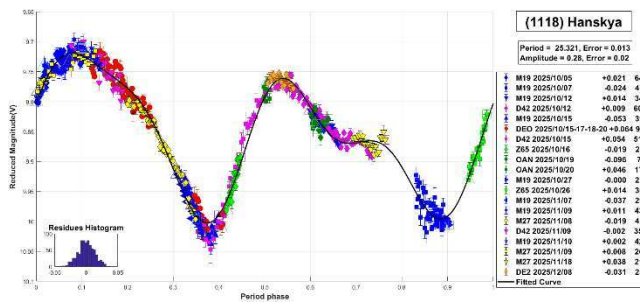
761 Brendelia: It is a binary main-belt asteroid discovered in 1913 by F. Kaiser, while its companion was identified in 2024 by GORA (Colazo et al., 2024). A previously reported rotation period for this asteroid is $P = 57.96$ h (Durech et al., 2018). During our observations in 2024, when the binarity was discovered, we measured a period of 57.98 h. In this work, we observed Brendelia again and determined a period of $P = 58.04 \pm 0.06$ h, with an amplitude of $\Delta m = 0.17 \pm 0.03$ mag.



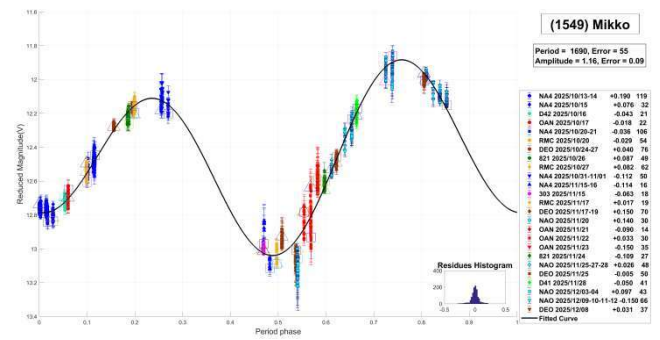
923 Herluga: This main-belt asteroid was discovered in 1919 by K. Reinmuth, with a diameter of 34.553 km. The reported rotation period for this asteroid is $P = 30.61$ h (Polakis, 2022). In this work, we propose a shorter period of $P = 29.75 \pm 0.08$ h with $\Delta m = 0.20 \pm 0.03$ mag.



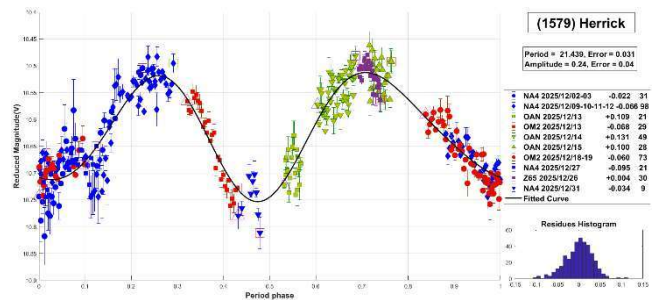
1118 Hanskya: It is an outer main-belt asteroid discovered in 1987 by S. Belyavskij and N. Ivanov, with an estimated diameter of 70.954 km. The most recent period published in the literature corresponds to $P = 25.31$ h (Dose, 2021). Our measured period $P = 25.321 \pm 0.013$ h agrees with the one measured by Dose.



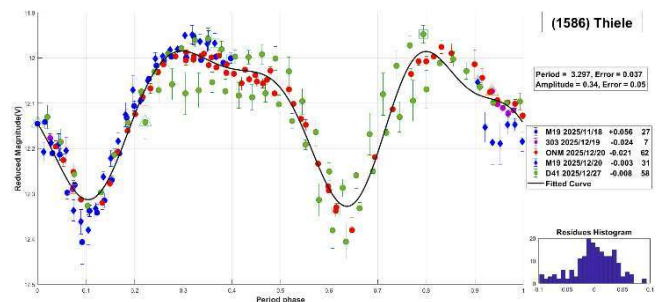
1549 Mikko: It is a main-belt asteroid with an estimated diameter of 10.376 km, discovered in 1937 by Y. Vaisala. Based on the SMASS II taxonomy (Xu et al., 1995; Bus and Binzel, 2002), it is classified as an S-type and belongs to the Flora family (Nesvorný et al., 2015). The reported rotation period for this asteroid is $P = 8.74$ h (Fauerbach, 2019). Our observations suggest a longer period, yielding a value of $P = 1690 \pm 55$ h with $\Delta m = 1.16 \pm 0.09$.



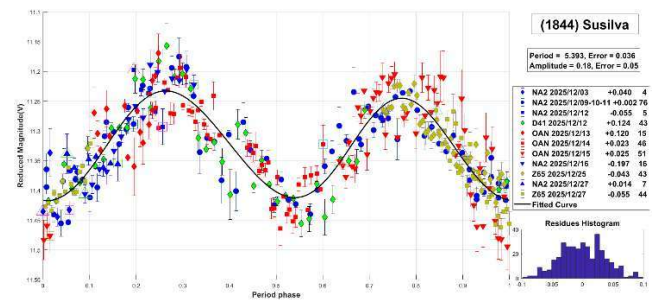
1579 Herrick: It is an outer main-belt asteroid with a diameter of 46.925 km, discovered in 1948 by S. Arend. The reported rotation period for this asteroid is 21.33 h (Polakis, 2020). We also measured a period of $P = 21.439 \pm 0.031$ h, with $\Delta m = 0.24 \pm 0.04$ mag.



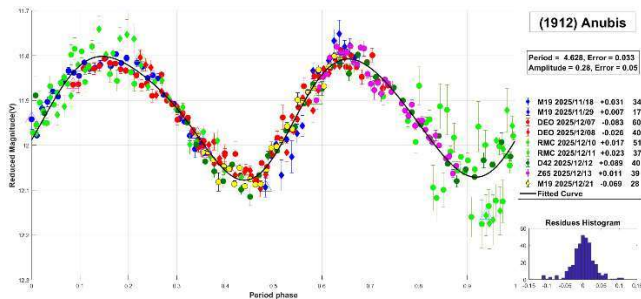
1586 Thiele: It is a main-belt asteroid discovered in 1939 by A. Wachmann and has an estimated diameter of 11.415 km. A rotation period of $P = 3.086$ h was previously reported for this asteroid (Childers and Church, 2007). Our results are consistent with this rotation period, giving a value of $P = 3.297 \pm 0.037$ h.



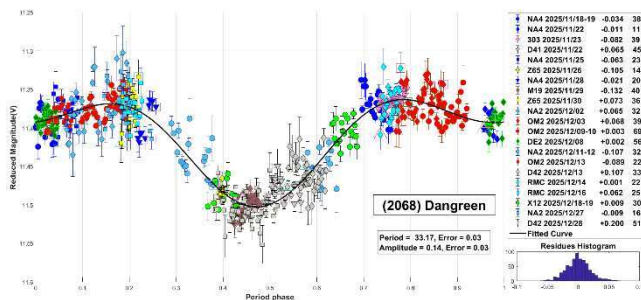
1844 Susilva: It is a main-belt asteroid discovered in 1972 by P. Wild. It is a member of the Eos family (Nesvorný et al., 2015), with a diameter of 26.8 km. A previously reported rotation period for this asteroid is $P = 5.423$ h (Polakis, 2021). In this work, we propose a period of $P = 5.393 \pm 0.036$ h.



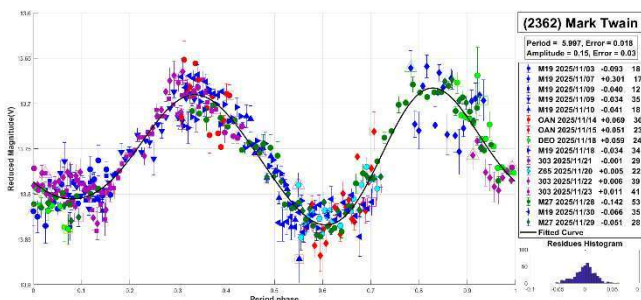
1912 Anubis: It is a main-belt asteroid discovered in 1960 by C.J. van Houten and I. van Houten-Groenveld. It is a member of the Koronis family (Nesvorný et al., 2015), with a diameter of 10.407 km. A previously reported rotation period for this asteroid is $P = 4.626$ h (Đurech et al., 2019). In this work, we measured a period of $P = 4.628 \pm 0.033$ h.



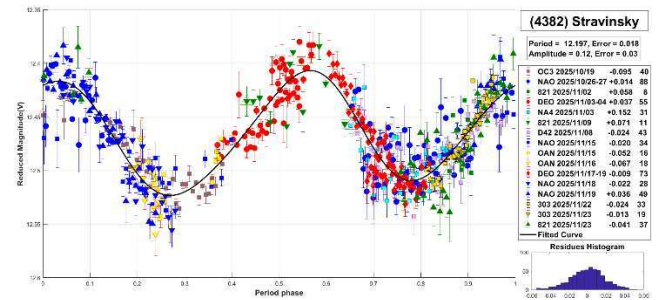
2068 Dangreen: It is a main-belt asteroid with an estimated diameter of 34.32 km. It was discovered in 1948 by M. Laugier. It is classified as a C-type asteroid according to the SDSS taxonomy (Hasselmann et al., 2012). We couldn't find a reported period for this object in the literature. We propose a period of 33.17 ± 0.03 h with $\Delta m = 0.14 \pm 0.03$ mag.



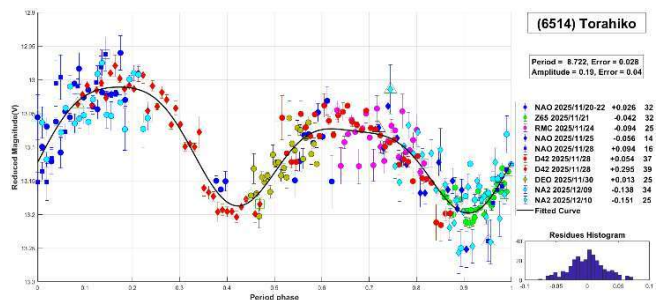
2362 Mark Twain: This is a main-belt asteroid, discovered in 1976 by N. Chernykh, with an estimated diameter of 4.331 km. For this asteroid, we could not find published periods in the literature, either. In this work, we propose a short period of $P = 5.997 \pm 0.018$ h with $\Delta m = 0.15 \pm 0.03$ mag.



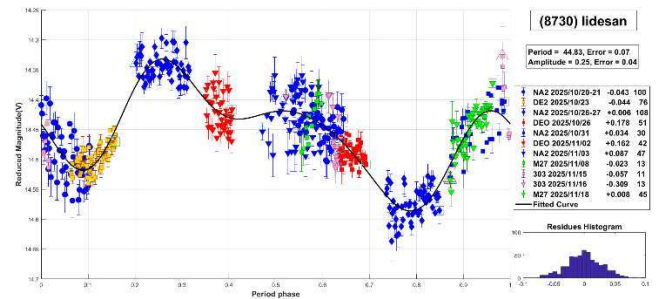
4382 Stravinsky: is a main-belt asteroid with a diameter of 8.746 km, discovered in 1989 by F. Borngen. It is classified as an Sa-type asteroid according to the SMASSII spectral type scheme (Xu et al., 1995; Bus and Binzel, 2002). For this asteroid, we couldn't find published periods in the literature either. Based on our observations and thorough analysis, we propose a period of $P = 12.197 \pm 0.018$ h and $\Delta m = 0.12 \pm 0.03$ mag.



6514 Torahiko: It is a main-belt asteroid with a diameter of 7.555 km, discovered in 1987 by T. Seki. The most recent period published in the literature corresponds to $P = 8.7207$ h (Pál et al., 2020). Our period $P = 8.722 \pm 0.028$ h agrees with the one measured by Pál and collaborators.



8730 Iidesan: It is a main-belt asteroid discovered in 1996 by T. Okwi with an estimated diameter of 3.443 km. It is a member of the Nysa-Polana family (Nesvorný et al., 2015). For this asteroid, we could not find any published rotation periods in the literature. In this work, we propose a long period of $P = 44.83 \pm 0.07$ h with $\Delta m = 0.25 \pm 0.04$ mag.



Acknowledgements

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. We also used *Seqplot* (<https://www.aavso.org/seqplot>), which proved very effective for checking the magnitudes of the calibration stars. 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.

Number	Name	yy/ mm/dd- yy/ mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
761	Brendelia	15/09/25-21/11/25	*19.5,01.7	54	1	58.04	0.06	0.17	0.03	Kor
923	Herluga	17/11/25-29/11/25	*8.4,09.4	59	-14	29.75	0.08	0.20	0.03	MB-M
1118	Hanskya	05/10/25-08/12/25	*9.5,13.5	34	16	25.321	0.013	0.28	0.02	2013
1549	Mikko	13/10/25-12/12/25	7.1,26.5	12	-6	1690	55	1.16	0.09	Flor
1579	Herrick	02/12/25-31/12/25	*10.5,04.3	96	-10	21.439	0.031	0.24	0.04	MB-O
1586	Thiele	18/11/25-28/12/25	22.6,08.5	110	-2	3.297	0.037	0.34	0.05	MB-I
1844	Susilva	03/12/25-27/12/25	*7.1,02.8	89	-3	5.393	0.036	0.18	0.05	Eos
1912	Anubis	18/11/25-21/12/25	*8.5,06.0	75	-0	4.628	0.033	0.28	0.05	Kor
2068	Dangreen	18/11/25-28/12/25	*7.1,13.0	67	-8	33.17	0.03	0.14	0.03	MB-O
2362	Mark Twain	03/11/25-30/11/25	*12.3,06.3	59	5	5.997	0.018	0.15	0.03	MB-I
4382	Stravinsky	19/10/25-23/11/25	*10.7,11.4	42	-9	12.197	0.018	0.12	0.03	MB-I
6514	Torahiko	20/11/25-10/12/25	1.2,11.8	57	-3	8.722	0.028	0.19	0.04	MB-M
8730	Iidesan	20/10/25-18/11/25	*4.1,14.1	33	1	44.83	0.07	0.25	0.04	Her

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). Kor: 158 Koronis, MB-M: main-belt middle, 2013 = 1118 Hanskya, Flor: 8 Flora, MB-O: main-belt outer, MB-I: main-belt inner, Eos: 221 Eos, Her: 135 Hertha.

Observatory	Telescope	Camera
303 Obs.Astr.Nacional Llano del Hato	Newtonian (D=1000mm; f=5.5)	CCD FLI PL4240
821 Est.Astrof.Bosque Alegre	Newtonian (D=1540mm; f=4.9)	CCD APOGEE Alta U9
D41 OsservatorioAstronomico di Orciatico	SCT (D=355mm; f=7.4)	CCD SBIG ST10XME
D42 OsservatorioAstronomico Piero Angela	SCT (D=300mm; f=6.2)	CMOS Touptek 2600 KMA
G05 Obs.Astr.Giordano Bruno	SCT (D=203mm; f=6.3)	CCD Atik 420 m
K14 Obs.Astr.de Sencelles	Newtonian (D=250mm; f=4.0)	CCD SBIG ST-7XME
M19 Osservatorio Explorer	RCT (D=304 mm; f=6,5)	CMOS Player One-Poseidon
M27 Elijah Observatory	RCT (D=250mm; f=8.0)	CCD QSI 683
Z65 Obs.Astr.Corgas	Newtonian (D=310mm; f=4.8)	CMOS ZWO ASI 294 MM
DE0 Dark Energy Observatory	Refractor (D=115mm; f=7.0)	CMOS QHY 294M pro
DE2 Dark Energy Observatory 2	RCT (D=200mm; f=5.4)	CMOS Player One Ares-M
NAO Obs.Astr.Naos	Newtonian (D=250mm; f=4.0)	CMOS ZWO 183
NA2 Obs.Astr.Naos 2	Newtonian (D=200mm; f=5.0)	CMOS ZWO ASI 174
NA4 Obs.Astr.Naos 4	Newtonian (D=200mm; f=5.0)	CMOS ZWO ASI 174
OAN Obs.Astr.Nacional Llano del Hato	Cámara Schmidt (D=1000mm; f=3.0)	CMOS Fujifilm GFX 50R
OC3 Obs.Astr.de Carlos Ambrosioni	SCT (D=279mm; f=7)	CCD SBIG ST8XME
OM2 Obs.Astr.Vuelta por el Universo 2	Newtonian (D=200mm; f=5.0)	CMOS POA Neptune-M
ONM Obs. Remotos Nuevo México	Newtonian (D=300mm; f=3.8)	CMOS Zwo 2600MM
RMC Obs.Astr.de Raúl Melia Carlos Paz	Newtonian (D=254mm; f=4.7)	CMOS QHY 174M
X12 Obs.Astr.Los Cabezones	Newtonian (D=200mm; f=5.0)	CMOS QHY 174M

Table II. List of observatories and equipment.

References

- Bus, S.J.; Binzel, R.P. (2002). "Phase II of the small main-belt asteroid spectroscopic survey: A feature-based taxonomy." *Icarus* **158**, 146-177.
- Childers, D.; Church, A. (2007). "High-speed Photometric Analysis for Minor Planets 1586 Thiele, 4246 Telemann, (10662) 32-1 T-2, and (49880) 1999 XP 135." *Minor Planet Bulletin* **34**, 124-125.
- Colazo, M.; Colazo, C.; Ameloti, V.; Melia, R.; Suarez, N.; Santos, F.; Monteleone, B.; Ciancia, G.; Wilberger, A.; Morales, M.; Anzola, M. (2024). "(761) Brendelia." Central Bureau Electronic Telegrams (CBET) #5435.
- Dose, E.V. (2021). "Lightcurves of Twelve Asteroids." *Minor Planet Bulletin* **48**, 375-380.
- Đurech, J.; Hanus, J.; Ali-Lagoa, V. (2018). "Asteroid models reconstructed from the Lowell Photometric Database and WISE data." *Astron.Astrophys.* **617**, A57.
- Đurech, J.; Hanuš, J.; Vančo, R. (2019). "Inversion of asteroid photometry from Gaia DR2 and the Lowell Observatory photometric database." *Astronomy & Astrophysics* **631**, A2.
- Fauerbach, M. (2019). "Photometric Observations for 8 Main-belt Asteroids: 2017 April-May." *Minor Planet Bulletin* **46**, 15-19.
- Harris, A.W.; Young, J.W.; Scaltriti, F.; Zappala, V. (1984). "Lightcurves and phase relations of the asteroids 82 Alkmene and 444 Gyptis." *Icarus* **57**, 251-258.
- Hasselmann, P.H.; Carvano, J.M.; Lazzaro, D. (2012). SDSS-based Asteroid Taxonomy V1.1. EAR-A-I0035-5-SDSSTAX-V1.1. NASA Planetary Data System.
- Mazzone, F.D. (2012). Periodos software, version 1.0. <http://www.astrosurf.com/salvador/Programas.html>
- Nesvorný, D.; Brož, M.; Carruba, V. (2015). Identification and dynamical properties of asteroid families. En P. Michel, F.E. DeMeo, & W. F. Bottke (Eds.), *Asteroids IV* (pp. 297-321). University of Arizona Press.
- Pál, A.; Szakáta, R.; Kiss, C.; Bódi, A.; Bognár, Z.; Kalup, C.; Kiss, L.; Marton, G.; Molnár, L.; Plachy, E.; Sárneczky, K.; Szabó, G.; Szabó, R. (2020). "Solar System Objects Observed with TESS - First Data Release: Bright Main-belt and Trojan Asteroids from the Southern Survey." *The Astrophysical Journal Supplement Series* **247**, 26-34.

Polakis, T. (2020). "Photometric Observations of Thirty Minor Planets." *Minor Planet Bulletin* **47**, 177-186.

Polakis, T. (2021). "Period Determinations for Twenty Asteroids." *Minor Planet Bulletin* **48**, 239-245.

Polakis, T. (2022). "Lightcurves for Fifteen Minor Planets." *Minor Planet Bulletin* **49**, 179-184.

Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The asteroid lightcurve database." *Icarus* **202**, 134-146.

Xu, S.; Binzel, R.P.; Burbine, T.H.; Bus, S.J. (1995). "Small main-belt asteroid spectroscopic survey: Initial results." *Icarus* **115**, 1-35.
