COLLABORATIVE ASTEROID PHOTOMETRY FROM UAI: 2022 APRIL-JUNE

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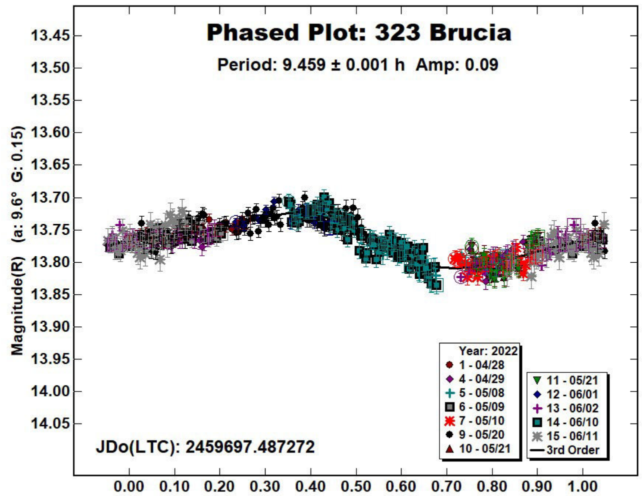
Photometric observations of ten asteroids were made in order to acquire lightcurves for shape/spin axis modeling. The synodic period and lightcurve amplitude were found for 323 Brucia, 342 Endymion, 542 Susanna, 578 Happelia, 1656 Suomi, 4221 Picasso, (5693) 1993 EA, (7335) 1989 JA, 2022 BT and 2022 MP. We also found color indices for 323 Brucia and (7335) 1989 JA.

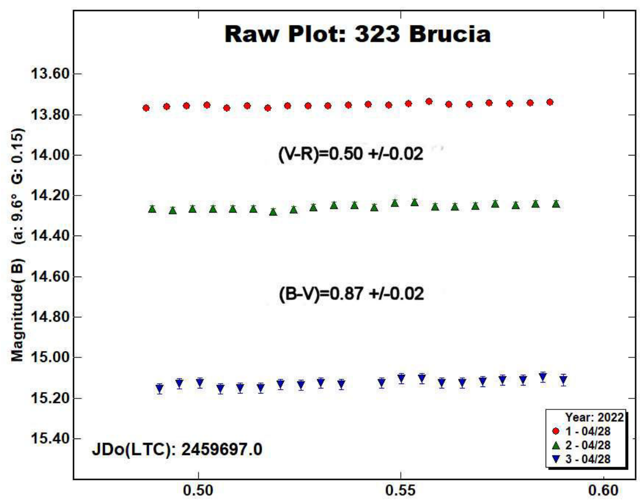
Collaborative asteroid photometry was done inside the Italian Amateur Astronomers Union (UAI; 2022) group. The targets were selected mainly in order to acquire lightcurves for shape/spin axis modeling. Table I shows the observing circumstances and results.

The CCD observations of ten asteroids were made in 2022 April-June using the instrumentation described in the Table II. Lightcurve analysis was performed at the Balzaretto Observatory with *MPO Canopus* (Warner, 2021). All the images were calibrated with dark and flat frames and converted to R magnitudes using solar colored field stars from CMC15 catalogue, distributed with *MPO Canopus*. For brevity, the following citations to the asteroid lightcurve database (LCDB; Warner et al., 2009) will be summarized only as "LCDB".

323 Brucia is an S-type (Tholen, 1984) inner main-belt asteroid. Collaborative observations were made over ten nights. The period analysis shows a synodic period of P = 9.459 ± 0.001 h with an amplitude A = 0.09 ± 0.02 mag. The period is close to the previously published results in the LCDB.

Multiband photometry was made by P. Bacci and M. Maestripieri (104) on 2022 April 28. We found the color indices (B-V) = 0.87 ± 0.02 and (V-R) = 0.50 ± 0.02, both are consistent with a S-type asteroid (Shevchenko and Lupishko, 1998).





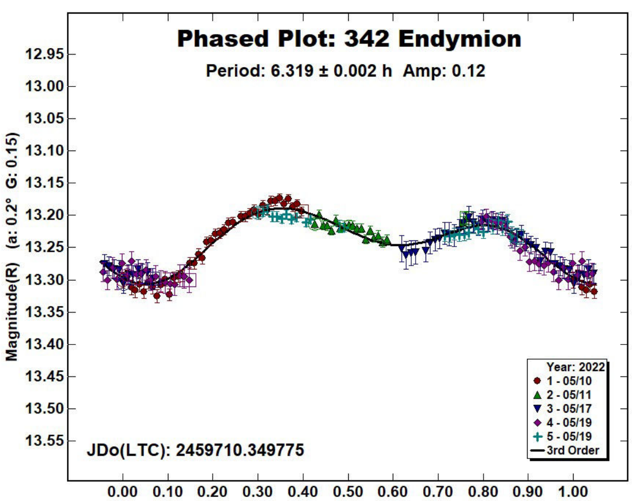
342 Endymion is a Ch-type (Bus and Binzel, 2002) middle main-belt asteroid. Collaborative observations were made over four nights. The period analysis shows a synodic period of P = 6.319 ± 0.002 h with an amplitude A = 0.12 ± 0.02 mag. The period is close to the previously published results in the LCDB.

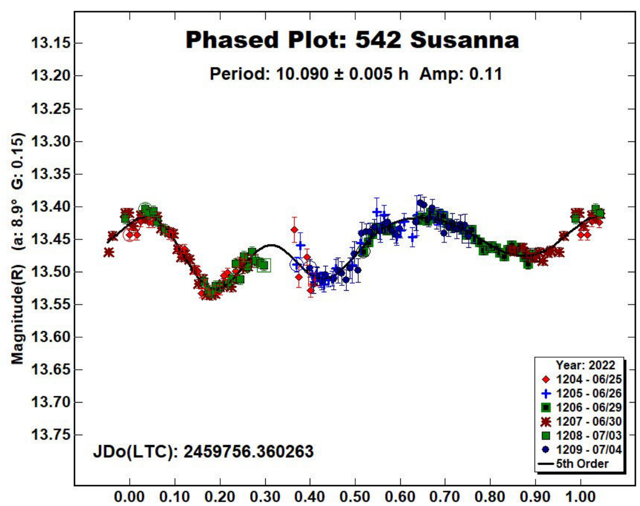
Number	Name	2022 mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
323	Brucia	04/28-06/11	*9.4,14.8	224	24	9.459	0.001	0.09	0.02	MB-I
342	Endymion	05/10-05/19	0.2,3.8	230	0	6.319	0.002	0.12	0.02	MB-M
542	Susanna	06/25-07/04	8.8,11.3	256	14	10.090	0.005	0.11	0.02	MB-O
578	Happelia	04/26-05/18	8.4,16.5	198	1	10.066	0.002	0.15	0.02	MB-M
1656	Suomi	04/26-05/21	16.8,21.2	219	27	2.589	0.001	0.11	0.06	H
4221	Picasso	04/28-05/10	9.4,14.6	203	9	3.3270	0.001	0.18	0.06	MB-M
5693	1993 EA	05/20-05/22	48.5,55.7	265	17	2.493	0.002	0.11	0.07	NEA
7335	1989 JA	05/20-05/24	26.4,34.8	227	3	2.588	0.001	0.21	0.05	NEA
	2022 BT	01/23-01/23	107.7,105.5	78	32	0.0366	0.0001	0.76	0.20	NEA
	2022 MP	06/25-06/26	*38.4,38.5	259	12	0.015678	0.000001	0.52	0.20	NEA

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).

Observatory (MPC code)	Telescope	CCD	Filter	Asteroids Observed (#Sessions)
Astronomical Observatory of the University of Siena(K54)	0.30-m MCT f/5.6	SBIG STL-6303e (2x2)	C,Rc	323(1), 342(1), 542(6), 578(4), 1656(2), 5693(3)
GAMP (104)	0.60-m NRT f/4.0	Apogee Alta	C,B, V,Rc	323(1), 342(3), 7335(3), 2022 BT(1), 2022 MP(2)
Osservatorio Astronomico Nastro Verde (C82)	0.35-m SCT f/6.3	SBIG ST10XME (2x2)	C	1656(4), 4221(1), 7335(2)
Iota Scorpii(K78)	0.40-m RCT f/8.0	SBIG STXL-6303e (2x2)	Rc	323(2), 1656(2)
HOB Astronomical Observatory (L63)	0.20-m SCT f/6.8	ATIK 383L+	C,Rc	323(2), 578(2)
Osservatorio Astronomico Margherita Hack (A57)	0.35-m SCT f/8.3	SBIG ST10XME (2x2)	Rc	1656(1), 4221(3)
M57 (K38)	0.35-m RCT f/5.5	SBIG STT1603ME	Rc	323(4)
ALMO Observatory (G18)	0.30-m NRT f/4.0	Moravian G2-1600	Rc	323(1), 7335(1)
GiaGa Observatory (203)	0.36-m SCT f/5.8	Moravian G2-3200	C	5693(1)
Schiaparelli Observatory (204)	0.80-m RCT f/8.0	SBIG STX-16803	C	2022 BT(1)

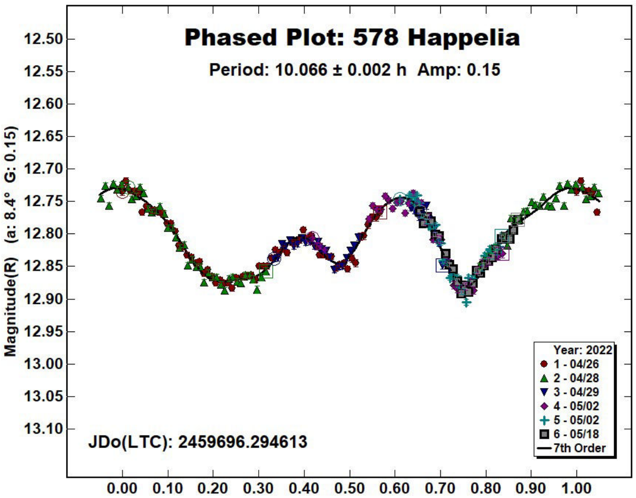
Table II. Observing Instrumentations. MCT: Maksutov-Cassegrain, NRT: Newtonian Reflector, RCT: Ritchey-Chretien, SCT: Schmidt-Cassegrain.



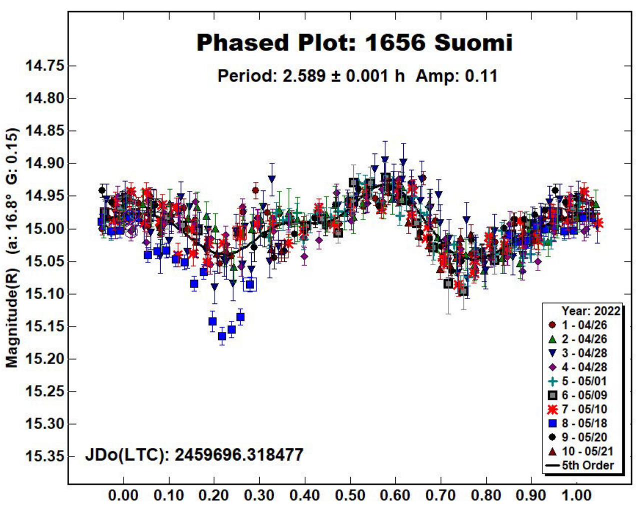


542 Susanna is an S-type (Tholen, 1984) outer main-belt asteroid. Observations were made over six nights by A. Marchini (K54). The period analysis shows a synodic period of $P = 10.090 \pm 0.005$ h with an amplitude $A = 0.11 \pm 0.02$ mag. The period is close to the previously published results in the LCDB.

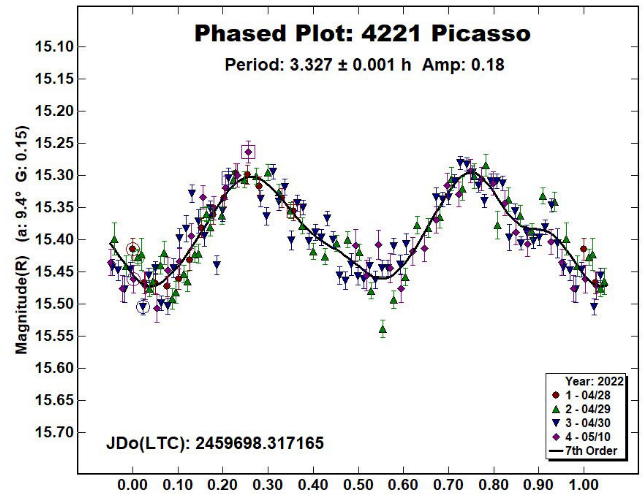
578 Happelia is an Xc-type (Bus & Binzel, 2002) middle main-belt asteroid. Collaborative observations were made over five nights. We found a synodic period of $P = 10.066 \pm 0.002$ h with an amplitude $A = 0.15 \pm 0.02$ mag. The period is close to the previously published results in the LCDB.



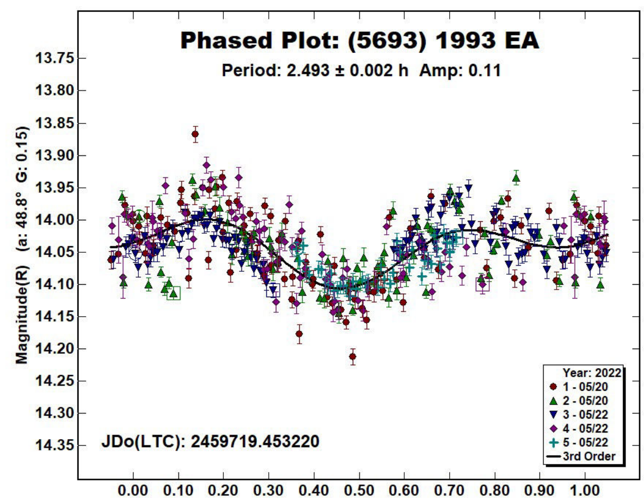
1656 Suomi is an S-type (Tholen, 1984) a binary asteroid (Warner et al., 2020) member of the Hungaria group. Collaborative observations were made over seven nights. We found a synodic period of P = 2.589 ± 0.001 h with an amplitude A = 0.11 ± 0.06 mag. Noteworthy is the attenuation event observed by N. Ruocco (C82) on 2022 May 18. The period is close to the previously published results in the LCDB.



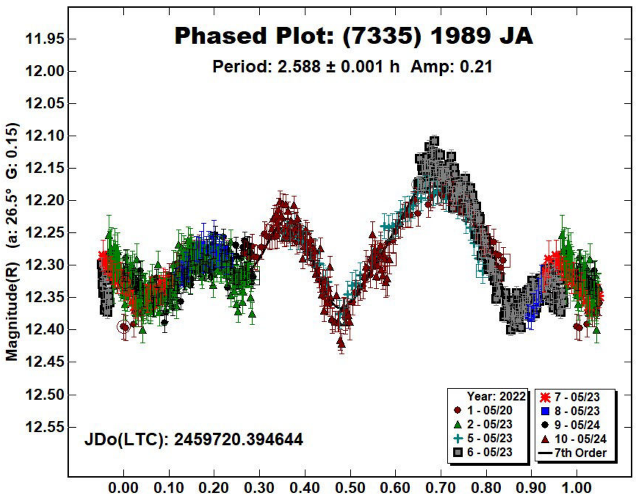
4221 Picasso is a medium albedo middle main-belt asteroid. Collaborative observations were made over four nights. We found a synodic period of P = 3.327 ± 0.001 h with an amplitude A = 0.18 ± 0.06 mag. The period agrees with that published by Clark (2019).

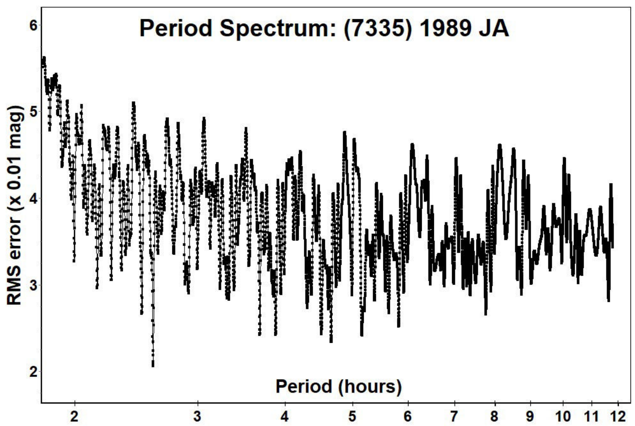


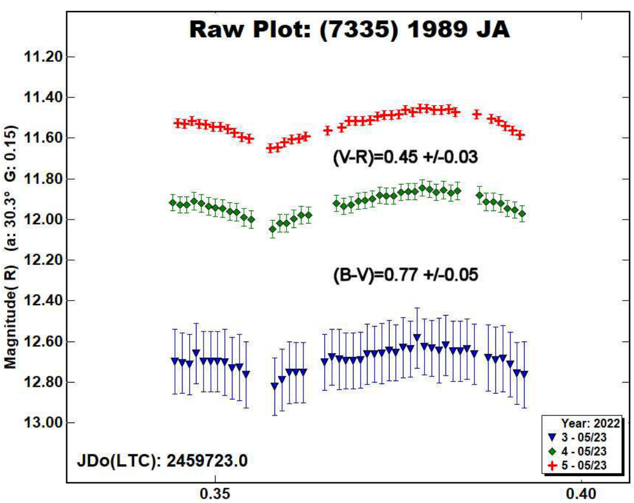
(5693) 1993 EA is an Apollo Near-Earth asteroid classified as Potentially Hazardous Asteroid (PHA). Collaborative observations were made over three nights. We found a synodic period of P = 2.493 ± 0.002 h with an amplitude A = 0.11 ± 0.07 mag. The period is close to the previously published results in the LCDB.



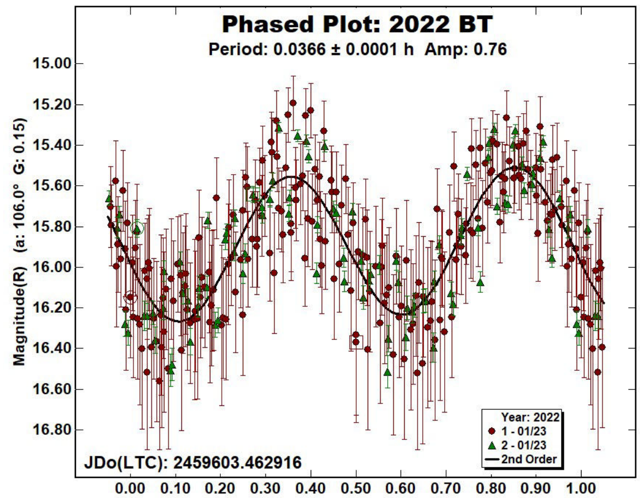
(7335) 1989 JA is an Apollo Near-Earth asteroid classified as Potentially Hazardous Asteroid (PHA). Collaborative observations were made over three nights. We found a quadrimodal lightcurve with a synodic period of P = 2.588 ± 0.001 h with an amplitude A = 0.21 ± 0.05 mag. This result differs from the upper limit of 12 hours reported in the LCDB. Multiband photometry was made by P. Bacci and M. Maestripieri (104) on 2022 May 23. We found the color indices (B-V) = 0.77 ± 0.05 and (V-R) = 0.45 ± 0.03, both consistent with an M-type asteroid (Shevchenko and Lupishko, 1998).

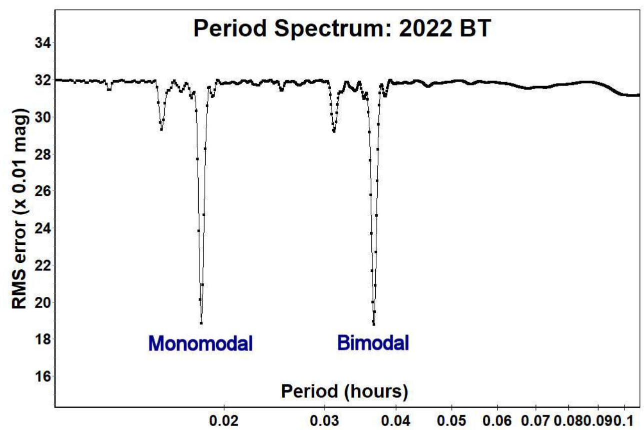




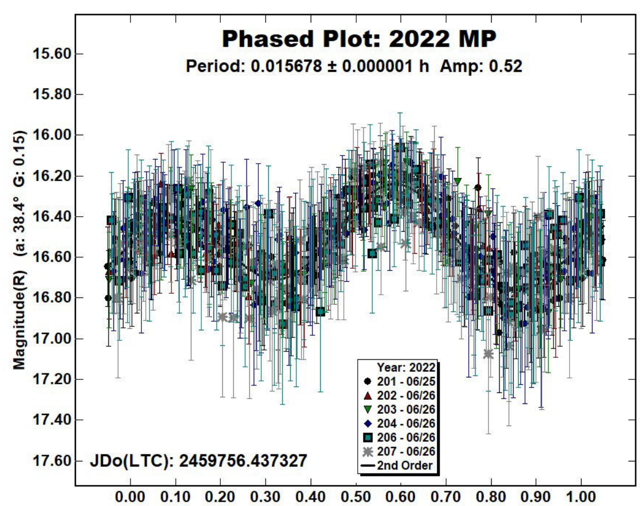


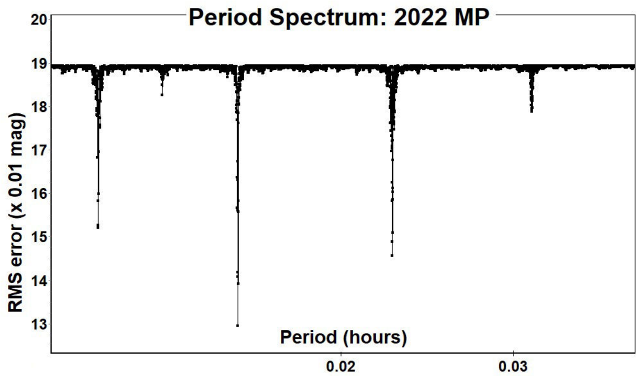
2022 BT is an Apollo Near-Earth asteroid, observed on 2022 January 23 by P. Bacci, M. Maestripieri (104) and L. Buzzi (204) during its close approach to the Earth. We found a synodic period of P = 0.0366 ± 0.0001 h (2.2 minutes) with an amplitude A = 0.76 ± 0.20 mag. There were no previously published results in the LCDB.





2022 MP is an Aten Near-Earth asteroid, observed on 2022 June 25 and 26 by P. Bacci, M. Maestripieri (104), during its close approach to the Earth. We found an ultra-fast synodic period of P = 0.015678 ± 0.000001 h (56.4 seconds) with an amplitude A = 0.52 ± 0.20 mag. No previously published results were found in the LCDB.





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LIGHTCURVES AND ROTATION PERIODS OF 233 ASTEROPE, 240 VANADIS, 275 SAPIENTIA, 282 CLORINDE, 414 LIRIOPE, AND 542 SUSANNA

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Synodic rotation periods and amplitudes are found for 233 Asterope 19.694 ± 0.001 h, 0.41 ± 0.02 mag; 240 Vanadis 10.565 ± 0.002 h, 0.07 ± 0.01 mag; 275 Sapientia 14.933 ± 0.001 h, 0.10 ± 0.01 mag; 282 Clorinde 49.350 ± 0.003 h, 0.19 ± 0.02 mag; 414 Liriope 11.009 ± 0.002 h, 0.14 ± 0.01 mag with 3 unsymmetrical maxima and minima per rotational cycle; 542 Susanna 10.089 ± 0.001 h, 0.09 ± 0.01 mag with 3 unsymmetrical maxima and minima per rotational cycle.

Observations to produce the results reported in this paper were made at the Organ Mesa Observatory with a Meade 35-cm LX200 GPS Schmidt-Cassegrain, SBIG STL-1001E CCD, 60 second exposures, unguided, R filter for 275 Sapientia, clear filter for all other targets. Image measurement and lightcurve construction were with *MPO Canopus* software with all calibration star magnitudes from the CMC15 catalog reduced to the Cousins R band. Zero-point adjustments of a few ×0.01 magnitude were made for best fit. To reduce the number of data points on the lightcurves and make them easier to read, data points have been binned in sets of 3 with maximum time difference 5 minutes.

233 Asterope. Previously published periods are by Harris and Young (1983), 19.7 hours; Behrend (2012web), >10 hours; Piironen et al. (1998), 19.743 hours, all with moderately sparse lightcurves. New observations on six nights 2022 May 10 - June 6 provide an excellent fit to a period of 19.694 ± 0.001 hours, amplitude 0.41 ± 0.02 magnitudes (Fig. 1). This period is consistent with all previously published periods and with improved accuracy due to being based upon a much denser lightcurve.

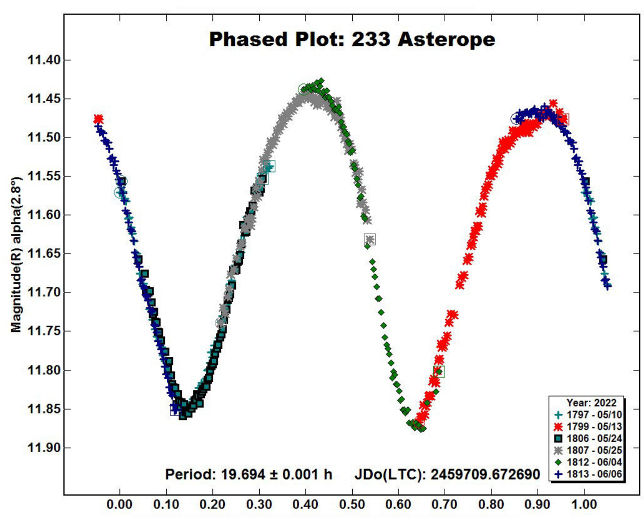

Figure. 1. Lightcurve of 233 Asterope phased to 19.694 hours.