

COLLABORATIVE ASTEROID PHOTOMETRY FROM UAI: 2022 JANUARY-MARCH

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Photometric observations of eleven asteroids were made to acquire lightcurves for shape/spin axis modeling. The synodic period and lightcurve amplitude were found for 49 Pales, 142 Polana, 206 Hersilia, 737 Arequipa, 1071 Brita, 1120 Cannonia, 1166 Sakuntala, 1736 Floirac, 3103 Eger, 4528 Berg and (7482) 1994 PC1. We also found color indices for 49 Pales, 142 Polana, 206 Hersilia, 1071 Brita, 1120 Cannonia, 3103 Eger and 4528 Berg; along with H-G parameters for 49 Pales, 1071 Brita, and 4528 Berg.

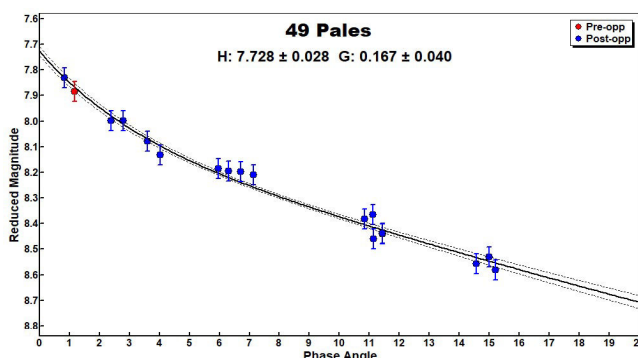
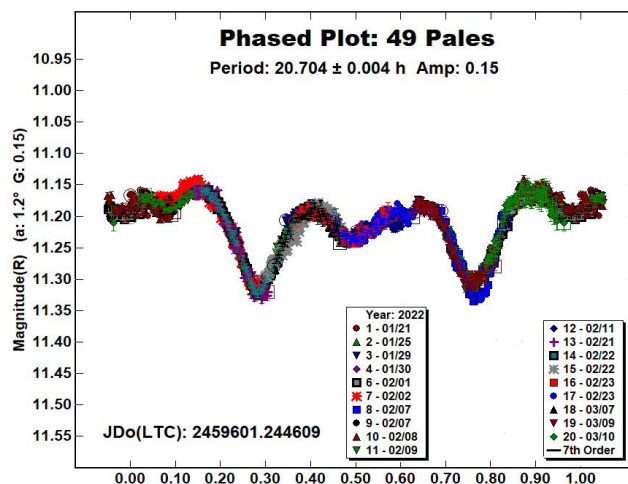
Collaborative asteroid photometry was done inside the Italian Amateur Astronomers Union (UAI; 2022) group. The targets were selected mainly in order to acquire lightcurves for shape/spin axis modeling. Table I shows the observing circumstances and results.

The CCD observations of eleven asteroids were made in 2022 January-March 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*.

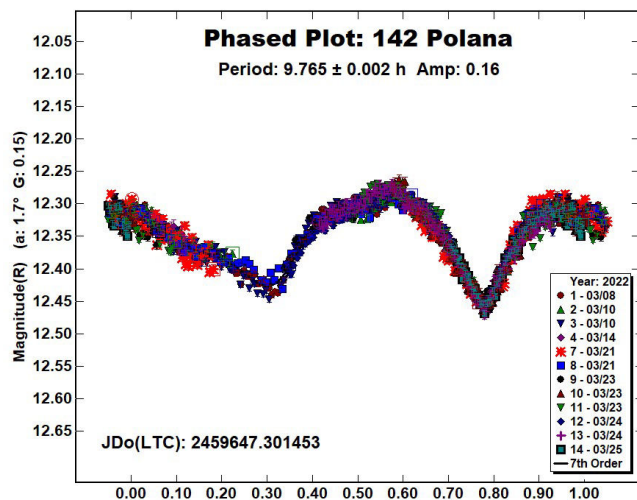
For H-G plots, the R magnitudes were converted to V band adding the color index (V-R) and evaluating the half peak to peak magnitude using a Fourier model of the same order of the lightcurve plot (Buchheim, 2010).

For brevity, the following citations to the asteroid lightcurve database (LCDB; Warner et al., 2009) will be summarized only as “LCDB.”

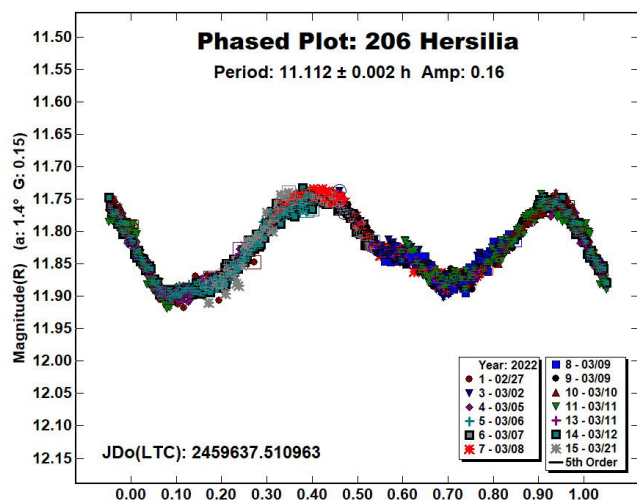
49 Pales is a Ch-type (Bus and Binzel, 2002) outer main-belt asteroid. Collaborative observations were made over sixteen nights. Period analysis shows a synodic period of $P = 20.704 \pm 0.004$ h with an amplitude $A = 0.15 \pm 0.03$ mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by P. Aceti on 2022 Jan 30 deriving a color index (V-R) = 0.36 ± 0.03 . The wide phase angles covered by the observations allowed us to determine the H-G parameters. We found $H = 7.73 \pm 0.03$ and $G = 0.17 \pm 0.04$. Both the color index (V-R) and G value are consistent with a low albedo asteroid (Shevchenko and Lupishko, 1998).



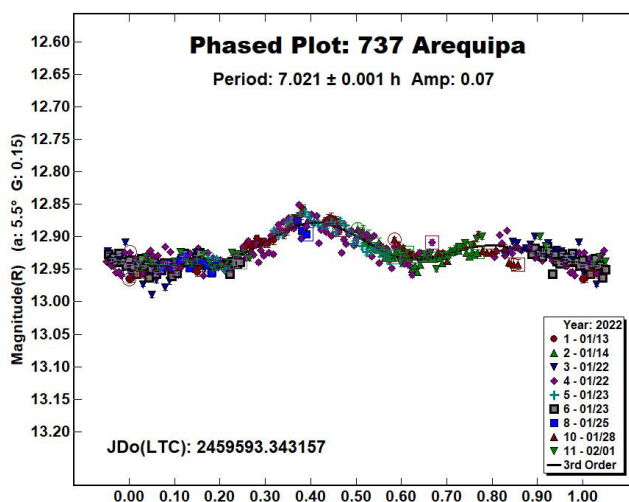
142 Polana is a B-type (Bus and Binzel, 2002) inner main-belt asteroid. Collaborative observations were made over eight nights. The period analysis shows a synodic period of $P = 9.765 \pm 0.002$ h with an amplitude $A = 0.16 \pm 0.02$ mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by P. Bacci and M. Maestripieri on 2022 Mar 14. We found color indices $(B-V) = 0.63 \pm 0.03$; $(V-R) = 0.38 \pm 0.03$, consistent with a low albedo asteroid (Shevchenko and Lupishko, 1998).



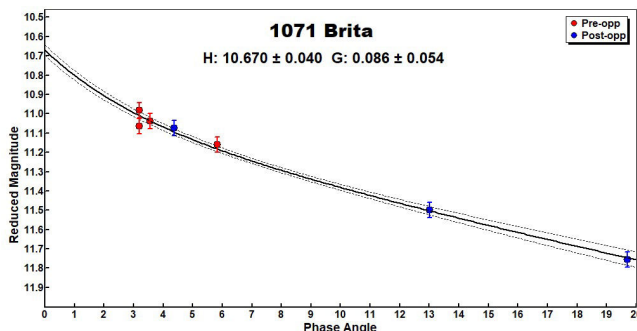
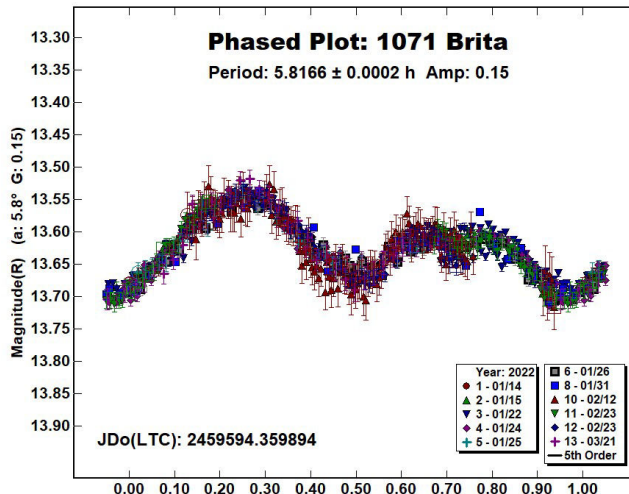
206 Hersilia is a C-type (Bus and Binzel, 2002) middle main-belt asteroid. Collaborative observations were made over ten nights. The period analysis shows a synodic period of $P = 11.112 \pm 0.002$ h with an amplitude $A = 0.16 \pm 0.04$ mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by P. Aceti and M. Banfi on 2022 Feb 27 and by P. Bacci and M. Maestripieri on 2022 Mar 10. We found a color index $(V-R) = 0.41 \pm 0.03$ (average of two independent values), consistent with a low albedo asteroid (Shevchenko and Lupishko, 1998).



737 Arequipa is an S-type (Bus and Binzel, 2002) middle main-belt asteroid. Collaborative observations were made over seven nights. We found a synodic period of $P = 7.021 \pm 0.001$ h with an amplitude $A = 0.07 \pm 0.03$ mag. The period is close to the previously published results in the LCDB.



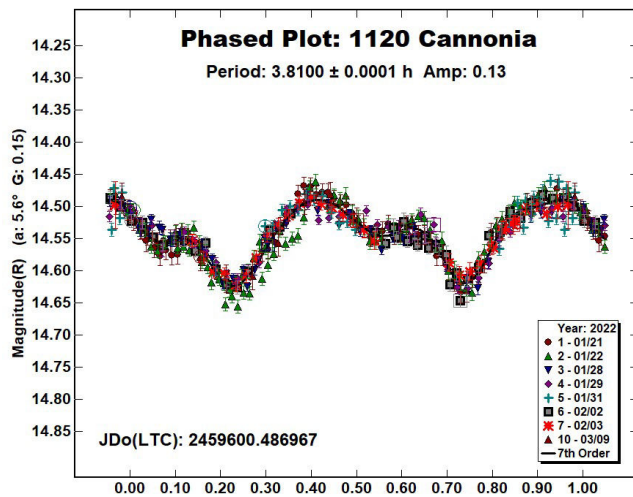
1071 Brita is an Xk-type (Bus and Binzel, 2002) middle main-belt asteroid. Collaborative observations were made over eight nights. We found a synodic period of $P = 5.8166 \pm 0.0002$ h with an amplitude $A = 0.15 \pm 0.03$ mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by P. Aceti on 2022 Jan 31 and by P. Bacci and M. Maestripieri on 2022 Mar 21. We found color indices $(B-V) = 0.70 \pm 0.04$; $(V-R) = 0.43 \pm 0.04$ (average of two independent values). The wide phase angles covered by the observations allowed us to determine the H-G parameters. We found $H = 10.67 \pm 0.04$ and $G = 0.09 \pm 0.05$. Both the color index $(V-R)$ and G value are consistent with a low-medium albedo asteroid (Shevchenko and Lupishko, 1998).



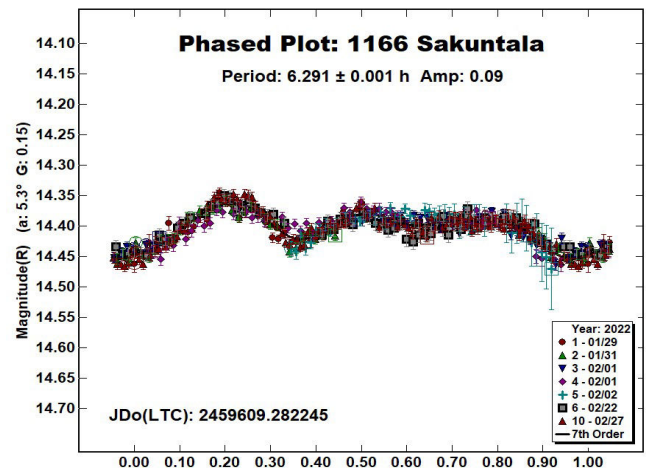
Number	Name	2022 mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
49	Pales	01/21-03/10	*1.1, 15.2	124	-2	20.704	0.004	0.15	0.03	MB-O
142	Polana	03/08-03/25	*1.6, 8.9	169	-3	9.765	0.002	0.16	0.02	MB-I
206	Hersilia	02/27-03/21	*1.1, 8.6	161	2	11.112	0.002	0.16	0.04	MB-M
737	Arequipa	01/13-02/01	5.4, 9.3	110	-14	7.021	0.001	0.07	0.03	MB-M
1071	Brita	01/14-03/21	*5.8, 19.7	126	7	5.8166	0.0002	0.15	0.03	MB-M
1120	Cannonia	01/20-03/09	*5.6, 17.6	131	-2	3.8100	0.0001	0.13	0.04	MB-I
1166	Sakuntala	01/29-02/27	*5.3, 9.8	137	13	6.291	0.001	0.09	0.02	MB-M
1736	Floirac	03/01-03/21	*2.6, 7.9	166	1	6.772	0.001	0.09	0.04	MB-I
3103	Eger	02/07-03/07	*14.4, 20.2	149	14	5.7100	0.0005	0.63	0.05	NEA
4528	Berg	02/05-04/04	*14.4, 14.2	166	1	3.563	0.001	0.24	0.05	MB-M
7482	1994 PC1	01/20-01/23	105.9, 107.2	88	47	2.599	0.001	0.32	0.06	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).

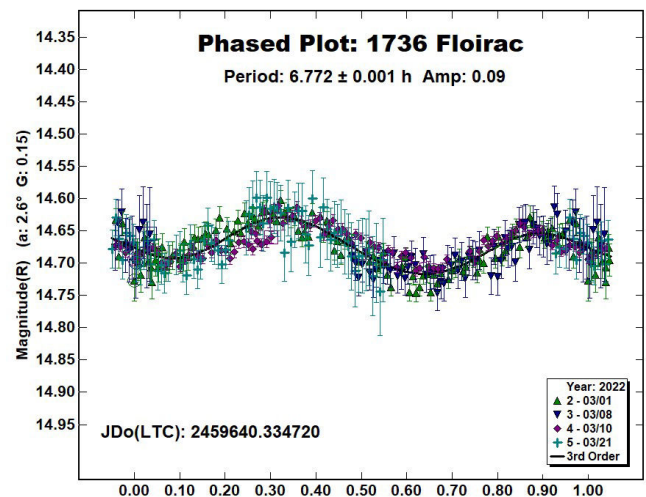
1120 Cannonia is an inner main-belt asteroid. Collaborative observations were made over six nights. We found a synodic period of $P = 3.8100 \pm 0.0001$ h with an amplitude $A = 0.13 \pm 0.04$ mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by P. Bacci and M. Maestripieri on 2022 Mar 09. We found color indices $(B-V) = 0.88 \pm 0.04$ and $(V-R) = 0.50 \pm 0.01$, which are consistent with an S-type medium albedo asteroid (Shevchenko and Lupishko, 1998).



1166 Sakuntala is a medium albedo middle main-belt asteroid. Collaborative observations were made over four nights. We found a synodic period of $P = 6.291 \pm 0.001$ h with an amplitude $A = 0.09 \pm 0.02$ mag. The period is close to the previously published results in the LCDB.



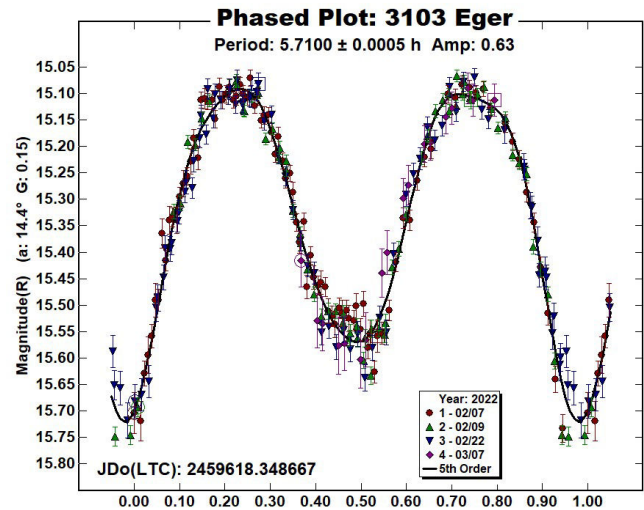
1736 Floirac is a medium albedo inner main-belt asteroid. Collaborative observations were made over four nights. We found a synodic period of $P = 6.772 \pm 0.001$ h with an amplitude $A = 0.09 \pm 0.04$ mag. The period is close to that published by Pravec et al. (2007web).



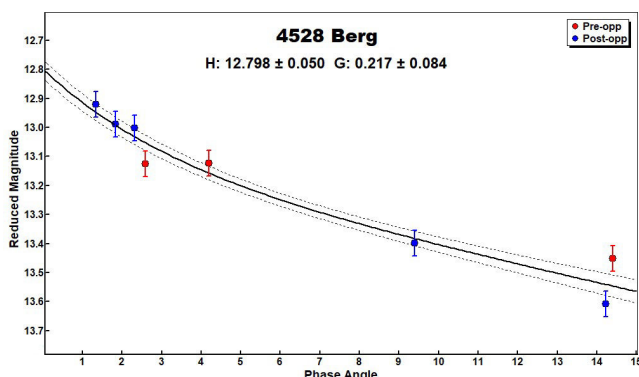
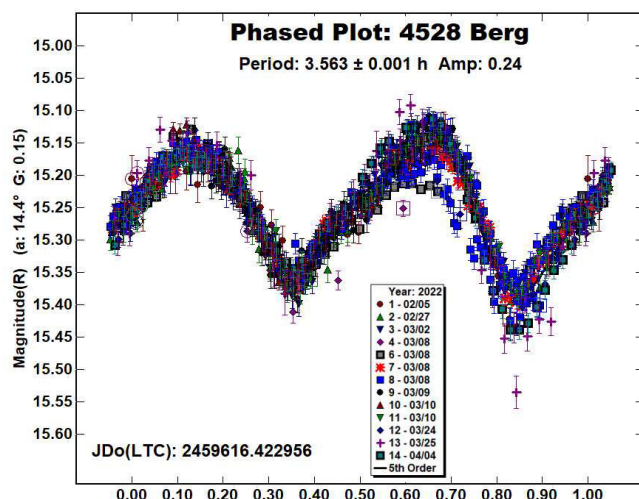
Observatory (MPC code)	Telescope	CCD	Filter	Observed Asteroids (#Sessions)
Astronomical Observatory of the University of Siena(K54)	0.30-m MCT f/5.6	SBIG STL-6303e(bin 2x2)	C,Rc	142(5), 737(1), 1071(2), 1120(2), 1166(2), 3103(3), 4528(2), 7482(4)
HOB Astronomical Observatory (L63)	0.20-m SCT f/6.8	ATIK 383L+	C	49(7), 142(1), 206(5), 737(4)
Iota Scorpis(K78)	0.40-m RCT f/8.0	SBIG STXL-6303e (bin 2x2)	Rc	142(1), 1071(1), 1120(1), 1166(3), 1736(4), 4528(3), 7482(1)
Hypatia Observatory (L62)	0.25-m RCT f/5.3	MORAVIAN G2-8300	C,Rc	49(5), 142(2), 206(3)
GAMP (104)	0.60-m NRT f/4.0	Apogee Alta	C,B,V,Rc	142(1), 206(1), 1071(1), 1120(3), 3103(1), 4528(1)
M57 (K38)	0.35-m RCT f/5.5	SBIG STT1603ME	C,Rc	49(3), 206(2), 1166(1), 4528(1)
GiaGa Observatory (203)	0.36-m SCT f/5.8	Moravian G2-3200	C,Rc	737(1), 1071(2), 7482(2)
Osservatorio Serafino Zani (130)	0.40-m RCT f/8.0	SBIG ST8 XME (bin 2x2)	C	142(2), 1071(1), 4528(2)
Seveso Observatory (C24)	0.30-m SCT f/10	QSI	V,Rc	49(1), 206(1), 1071(1), 4528(1)
GAV	0.20-m SCT f/7.0	SXV-H9	Rc	49(3), 206(1)
Osservatorio Astronomico Margherita Hack (A57)	0.35-m SCT f/8.3	SBIG ST10XME (bin 2x2)	Rc	1736(1), 4528(1)
Osservatorio Salvatore Di Giacomo (L07)	0.50-m RCT f/8.0	FLI Proline	Rc	737(2)
Osservatorio Astronomico Nastro Verde (C82)	0.35-m SCT f/6.3	SBIG ST10XME (bin 2x2)	C	4528(1)
BSCR Observatory (K47)	0.41-m NRT f/3.2	DTA Discovery plus 1600	C	4528(1)
Balzaretto Observatory (A81)	0.20-m SCT f/5.0	SBIG ST7XME	Rc	1071(1)

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

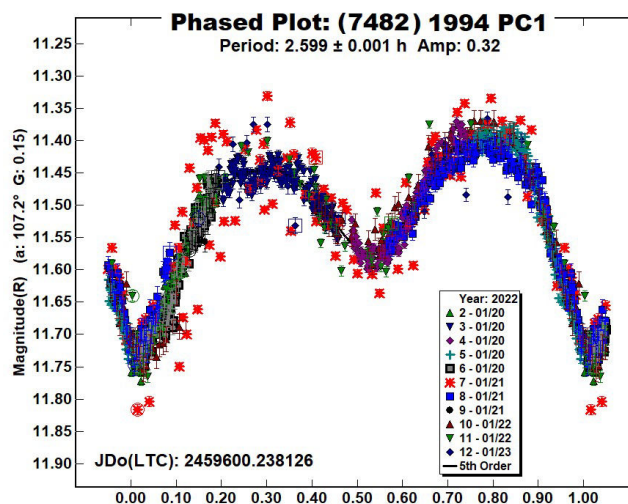
3103 Eger is an Xe-type (Bus and Binzel, 2002) Apollo Near-Earth asteroid. Collaborative observations were made over four nights. We found a synodic period of $P = 5.7100 \pm 0.0005$ h with an amplitude $A = 0.63 \pm 0.05$ mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by P. Bacci and M. Maestripieri on 2022 Mar 7. We found a color index $(V-R) = 0.45 \pm 0.09$, consistent with a medium albedo asteroid (Shevchenko and Lupishko, 1998).



4528 Berg is a middle main-belt asteroid. Collaborative observations were made over nine nights. We found a synodic period of $P = 3.563 \pm 0.001$ h with an amplitude $A = 0.24 \pm 0.05$ mag. The period is close to the previously published results in the LCDB. The lightcurve shows some anomalous attenuations that could possibly be due to a binary nature of this asteroid. Multiband photometry was made by P. Aceti and M. Banfi on 2022 Mar 8. We found a color index $(V-R) = 0.46 \pm 0.07$. The wide phase angle covered by the observations allowed us to determine the H-G parameters. We found $H = 12.80 \pm 0.05$ and $G = 0.22 \pm 0.08$. Both the color index $(V-R)$ and G value are consistent with a medium albedo asteroid (Shevchenko and Lupishko, 1998).



(7482) 1994 PC1 is an S-type (Bus and Binzel, 2002) Apollo Near-Earth asteroid classified as Potentially Hazardous Asteroid (PHA). Collaborative observations were made over four nights. We found a synodic period of $P = 2.599 \pm 0.001$ h with an amplitude $A = 0.32 \pm 0.06$ mag. The period is close to the previously published results in the LCDB.



References

- Buchheim, R.K. (2010). "Methods and Lessons Learned Determining the H-G Parameters of Asteroid Phase Curves." *Society for Astronomical Sciences Annual Symposium* **29**, 101-115.
- 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.
- 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.
- Pravec, P.; Wolf, M.; Sarounova, L. (2007web). <https://www.asu.cas.cz/~asteroid/binastphotsurvey.htm>
- Shevchenko, V.G.; Lupishko, D.F. (1998). "Optical properties of Asteroids from Photometric Data." *Solar System Research* **32**, 220-232.
- UAI (2022), "Unione Astrofili Italiani" web site. <https://www.uai.it>
- Warner, B.D.; Harris, A.W.; Pravec, P. (2009). "The asteroid lightcurve database." *Icarus* **202**, 134-146. Updated 2022 April 12. <https://minplanobs.org/alcdelf/index.php>
- Warner, B.D. (2021). MPO Software, *MPO Canopus* v10.8.5.0. Bdw Publishing. <http://minorplanetobserver.com>