

COLLABORATIVE ASTEROID PHOTOMETRY FROM UAI: 2020 APRIL-JUNE

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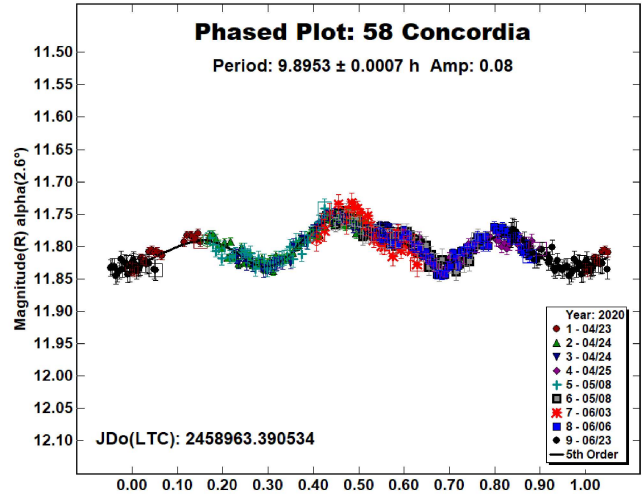
(Received: 2020 July 10)

Photometric observations of five asteroids were made in order to acquire lightcurves for shape/spin axis modeling. The synodic period and lightcurve amplitude were found for 58 Concordia: 9.8953 ± 0.0007 h, 0.08 mag; 781 Kartvelia: 19.050 ± 0.005 h, 0.22 mag; 913 Otila: 4.8717 ± 0.0007 h, 0.18 mag; 3317 Paris: 7.0812 ± 0.0004 h, 0.10 mag; and 3800 Karayusuf: 2.2319 ± 0.0001 h, 0.15 mag.

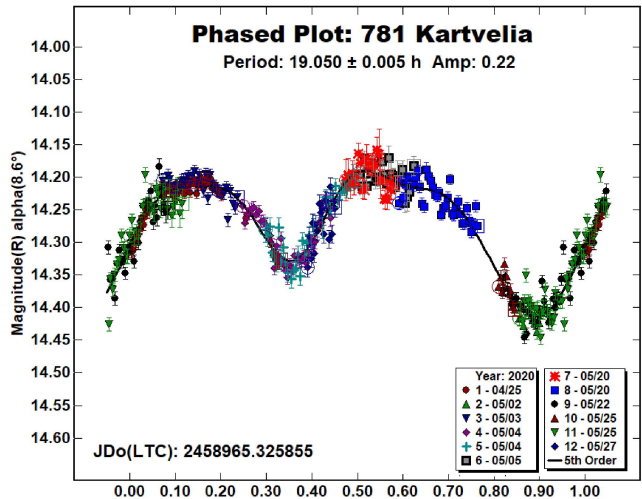
Collaborative asteroid photometry was done inside the Italian Amateur Astronomers Union (UAI; 2020) group. The targets were selected mainly in order to acquire lightcurves for shape/spin axis modeling. Table I shows the observing circumstances and results.

The CCD observations were made in 2020 April-June using the instrumentation described in the Table II. Lightcurve analysis was performed at the Balzaretto Observatory with *MPO Canopus* (Warner, 2016). All the images were calibrated with dark and flat frames and converted to R magnitudes using solar-colored field stars from the CMC15 catalogue as distributed with *MPO Canopus*.

58 Concordia is a Ch-type (Bus & Binzel, 2002) middle main-belt asteroid discovered on 1860 March 24 by R. Luther at Dusseldorf. Collaborative observations were made over six nights. The period analysis shows a synodic period of $P = 9.8953 \pm 0.0007$ h with an amplitude $A = 0.08 \pm 0.02$ mag. The period is close to the previously published results in the asteroid lightcurve database (LCDB; Warner et al., 2009).



781 Kartvelia is an Xc-type (Bus & Binzel, 2002) outer main-belt asteroid discovered on 1914 January 25 by G. Neujmin at Simeis. Collaborative observations were made over eight nights. We found a synodic period of $P = 19.050 \pm 0.005$ h and amplitude $A = 0.22 \pm 0.03$ mag. The period is close to the previously published results in the LCDB (Warner et al., 2009).



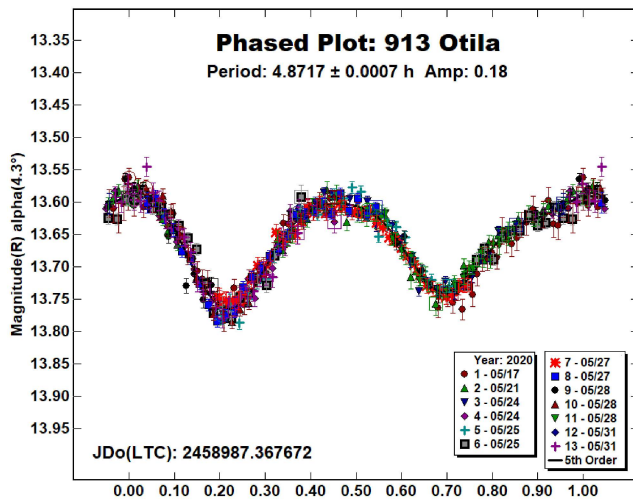
Number	Name	2020 mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
58	Concordia	04/23-06/23	2.5, 20.8	213	5	9.8953	0.0007	0.08	0.02	MB-M
781	Kartvelia	04/25-05/27	8.6, 13.0	216	23	19.050	0.005	0.22	0.03	MB-O
913	Otila	05/17-05/31	4.1, 10.3	236	5	4.8717	0.0007	0.18	0.03	FLOR
3317	Paris	04/25-06/14	*6.8, 9.8	222	31	7.0812	0.0004	0.10	0.04	TR-J
3800	Karayusuf	04/24-06/12	*27.8, 23.4	237	19	2.2319	0.0001	0.15	0.05	MC

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).

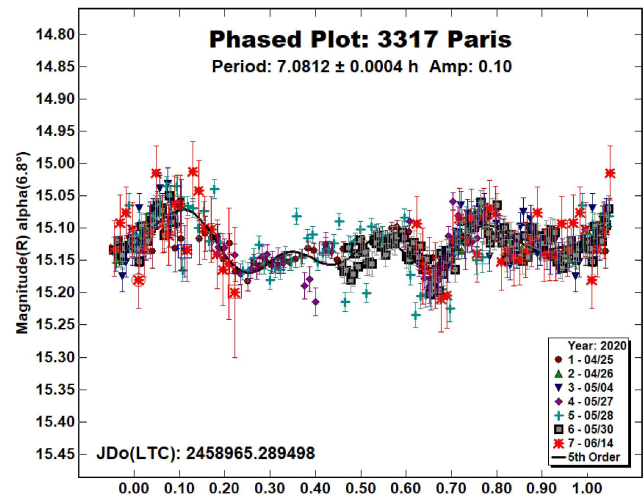
Observatory (MPC code)	Telescope	CCD	Filter	Observed Asteroids (#Sessions)
Astronomical Observatory of the University of Siena (K54)	0.30-m MCT $f/5.6$	SBIG STL-6303e (bin 2×2)	R _c	58 (5), 781 (3), 913 (4), 3317 (2), 3800 (2)
Iota Scorpii (K78)	0.40-m RCT $f/8.0$	SBIG STXL-6303e (bin 2×2)	R _c	781 (1), 913 (2), 3317 (2), 3800 (1)
WBRO (K49)	0.235-m SCT $f/10$	SBIG ST8-XME	C	781 (3), 3800 (3)
M57 (K38)	0.30-m RCT $f/5.5$	SBIG STT-1603	C	58 (1), 3317 (2)
GiaGa Observatory (203)	0.36-m SCT $f/5.8$	Moravian G2-3200	R _c	913 (2)
GAMP (104)	0.60-m NRT $f/4.0$	Apogee Alta	C	3800 (1)
GAV	0.20-m SCT $f/6.3$	SXV-H9	R _c	781 (1)

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

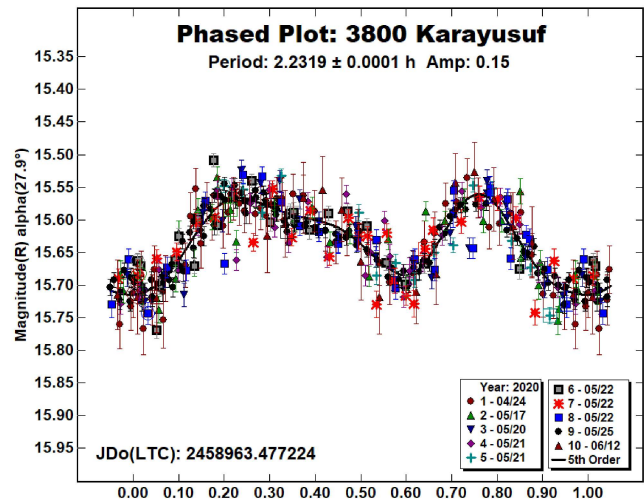
913 Otila is an Sa-type (Bus & Binzel, 2002) member of the Flora group/family; it was discovered on 1919 May 19 by K. Reinmuth at Heidelberg. Collaborative observations were made over seven nights. We found a synodic period of $P = 4.8717 \pm 0.0007$ h with an amplitude $A = 0.18 \pm 0.03$ mag. The period is close to the previously published results in the LCDB (Warner et al., 2009).



3317 Paris is a T-type (Bus & Binzel, 2002) Jupiter Trojan that was discovered on 1984 May 26 by C. Shoemaker and E. Shoemaker at Palomar. Collaborative observations were made over six nights. We found a synodic period of $P = 7.0812 \pm 0.0004$ h with low amplitude $A = 0.10 \pm 0.04$ mag. The period is close to the previously published results in the LCDB (Warner et al., 2009).



3800 Karayusuf is an S-type (Bus & Binzel, 2002) Mars-crosser asteroid discovered on 1984 January 4 by E.F. Helin at Palomar. Collaborative observations were made over seven nights. We found a synodic period of $P = 2.2319 \pm 0.0001$ h with an amplitude $A = 0.15 \pm 0.05$ mag. The period is close to the previously published results in the LCDB (Warner et al., 2009).



Acknowledgements

The authors want to thank a group of high school students from Liceo “Galilei” in Erba (Como) involved in an interesting vocational guidance project about astronomy. Despite the health emergency for Covid-19, they attended some online observing sessions of 58 Concordia and participated remotely in data analysis: M. Canzi, W. Cigardi, M. Colombo, M. Creatini, L. Falato, P. Fava, A. Frigerio, C. Iezzi, V. La Bella, J. Marzullo, N. Paredi, E. Pirovano, S. Ronchetti, S. Jamil, L. Tomba.

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SPIN-SHAPE MODEL FOR 50 VIRGINIA

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We present a shape and spin axis model for main-belt asteroid 50 Virginia. The model was achieved with the lightcurve inversion process, using combined dense photometric data acquired from seven apparitions between 1995-2020 and sparse data from USNO Flagstaff. Analysis of the resulting data found a sidereal period $P = 14.31233 \pm 0.00005$ h and two mirrored pole solutions (ecliptic coordinates) at $(\lambda, \beta) = (112^\circ, 41^\circ)$ and $(295^\circ, 47^\circ)$ with an uncertainty of ± 10 degrees.

The minor planet 50 Virginia was observed for seven oppositions from 1995 to 2020, mainly by co-author Pilcher at Organ Mesa Observatory. The 1995 legacy data was downloaded a few years ago from the Standard Asteroid Photometric Catalogue by Piironen et al. (2001), hosted at the University of Helsinki but no longer available online. Moreover, we used sparse data from the USNO Flagstaff Station (MPC Code 689), downloaded from the Asteroids Dynamic Site (AstDyS-2, 2020).

The observational details of the dense data sets are reported in Table I with the mid-date, number of the lightcurves used for the inversion process, and longitude and latitude of the phase angle bisector (L_{PAB} , B_{PAB}).

Reference	Mid date	# LC	L_{PAB}°	B_{PAB}°
Shevchenko (1997)	1995-09-20	8	352	0
Pilcher (2009)	2008-09-25	9	7	-1
Pilcher (2011) (*)	2011-03-30	1	212	2
Pilcher (2016)	2016-06-16	7	259	4
Pilcher (2018)	2018-01-13	8	90	-4
Pilcher (2019)	2019-04-23	6	175	0
Pilcher (2020)	2020-05-15	5	234	3

Table I. Observational details for the data used in the lightcurve inversion process for 50 Virginia. * Published on alcddef.org web site.

Lightcurve inversion was performed using *MPO LCInvert* v.11.8.2.0 (BDW Publishing, 2016). For a description of the modeling process, see *LCInvert Operating Instructions Manual*, Durech et al. (2010 and references therein). In order to reduce the overall processing time, Pilcher’s dense data were binned at a time interval of 5 minutes.

Figure 1 shows the PAB longitude/latitude distribution for the dense and sparse data used in the lightcurve inversion process. Figure 2 (top panel) shows the sparse photometric data distribution (intensity vs JD) and (bottom panel) the corresponding phase curve (reduced magnitudes vs phase angle).