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PRELIMINARY SPIN-SHAPE MODEL FOR 755 QUINTILLA

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We present a preliminary shape and spin axis model for main-belt asteroid 755 Quintilla. The model was derived using lightcurve inversion that combined dense photometric data acquired from three apparitions between 2004 and 2020 and sparse data from USNO Flagstaff. Analysis of the resulting data found a sidereal period P = 4.55204 ± 0.00001 h and two mirrored pole solutions at (λ, β) = (109°, –12°) and (288°, –3°) with an uncertainty of ± 20°.

The minor planet 755 Quintilla was observed by the authors during three oppositions from 2004 to 2020. In order to cov several apparition geometries we used sparse data from the USNO Flagstaff Station (MPC Code 689) that were downloaded from the Asteroids Dynamic Site (AstDyS-2, 2020).

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

Reference	Mid date	# LC	L_{PAB}°	B_{PAB}°
Buchheim, Pray (2005)	2004-04-16	3	207	2
Fauerbach (2019)	2018-11-02	2	54	-3
Franco et al. (2020)	2020-01-28	6	116	-3

Table I. Observational details for the data used in the lightcurve inversion process for 755 Quintilla.

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).

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

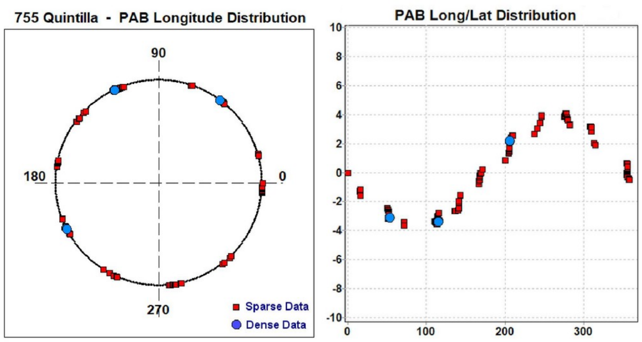

Figure 1: PAB longitude and latitude distribution of the data used for the lightcurve inversion model.

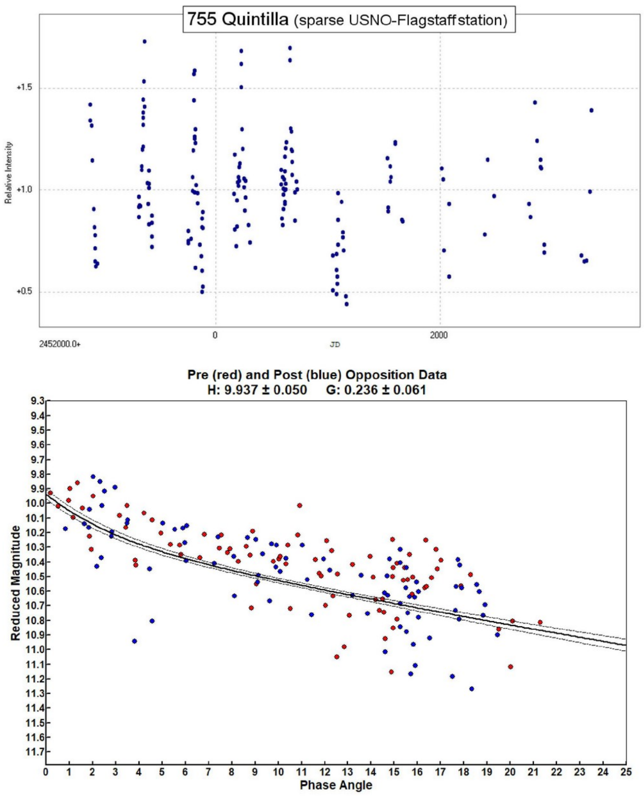

Figure. 2: Top: sparse photometric data point distribution from (689) USNO Flagstaff station (relative intensity vs Julian Day). Bottom: phase curve obtained from sparse data (reduced magnitude vs. phase angle).

In the analysis, the processing weighting factor was set to 1.0 for dense and 0.3 for sparse data. The "dark facet" weighting factor was set to 0.5 to keep the dark facet area below 1% of total area and the number of iterations was set to 50.

The sidereal period search was started around the average of the synodic periods found in the asteroid lightcurve database (LCDB; Warner et al., 2009). We found a group of five sidereal per with Chi-Sq values within 10% of the lowest value, one of them more isolated and with the lowest Chi-Sq (Figure 3).

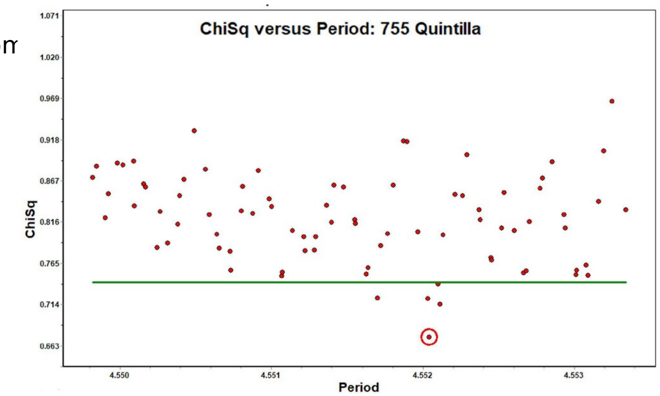

Figure 3: The period search for 755 Quintilla shows five sidereal periods with Chi-Sq values within 10% of the lowest value. The circled period was used in the initial pole search.

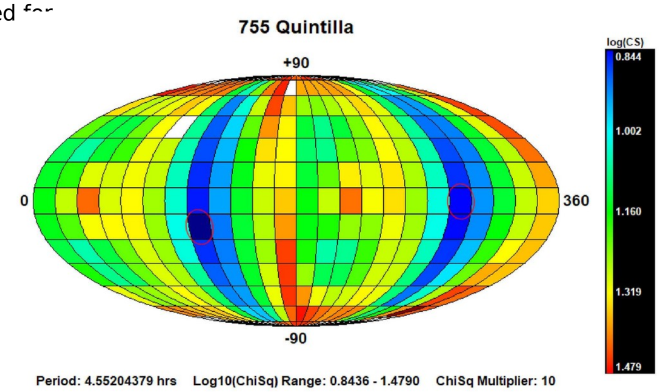

Figure 1: Pole search distribution. The dark blue region indicates the smallest Chi-Sq value while the dark red region indicates the largest.

The pole search was started using the "medium" search opt (312 fixed pole positions with 15° longitude-latitude steps) and th sidereal period with the lowest Chi-Sq set to "float". From t step we found two roughly mirrored lower Chi-Sq solutions (Figure 4) separated by about 180° in longitude at ecliptic longitude-latitude pairs (λ, β) = (105°, –15°) and (285°, –3°).

λ °	β °	Sidereal Period (hours)	Chi-Sq	RMS
109	-12	4.55204 ± 0.00001	0.67488	0.0274
288	-3		0.67616	0.0274

Table II. The two spin axis solutions for 755 Quintilla (ecliptic coordinates) with an uncertainty of ± 20 degrees. The sidereal period is the average of the two solutions found in the pole search.

The two best solutions (lower Chi-Sq) are reported in Table The sidereal period was obtained by averaging the two solutions found in the pole search. Typical errors in the pole solution ± 20° and the uncertainty in sidereal period has been evaluated a rotational error of 40° over the total time span of the data set. Figure 5 shows the shape model (first solution with a lower Chi-Sq) while Figure 6 shows the fit between the model (black line) and some observed lightcurves (red points).

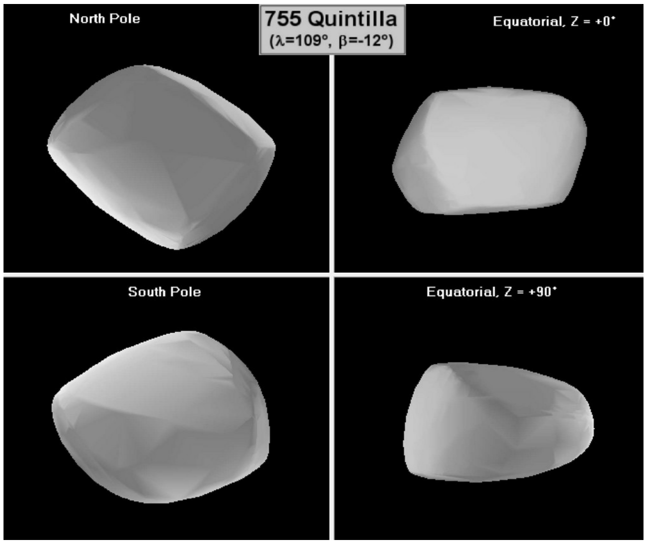

Figure 5: The shape model for 755 Quintilla (λ = 109°, β = -12°).

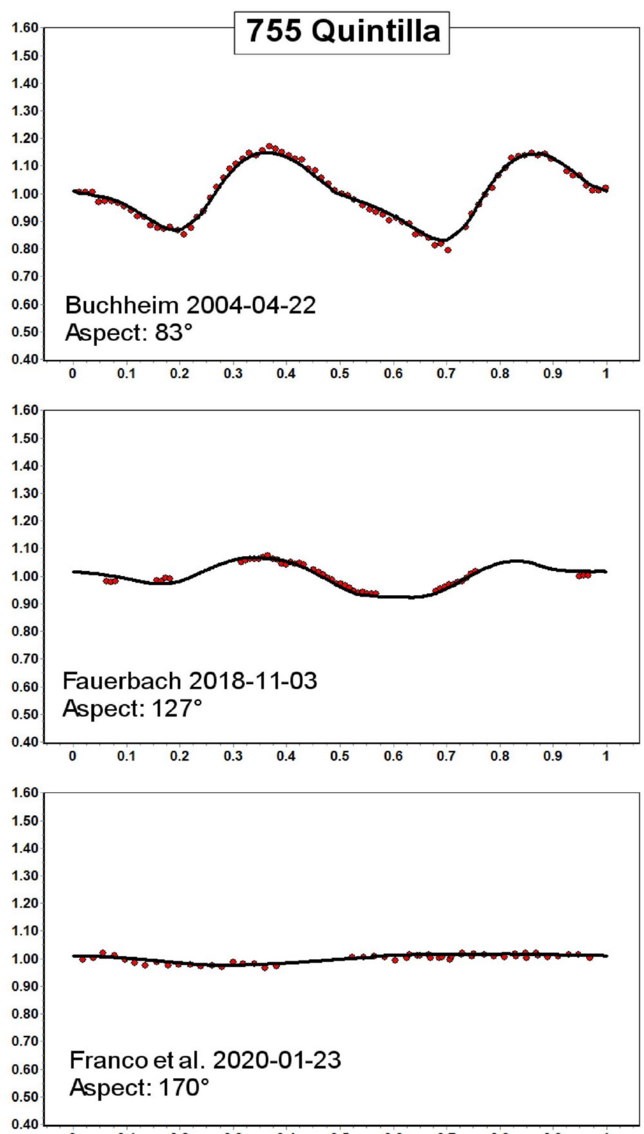

Figure 6: Model fit (black line) versus observed lightcurves (red points) for (λ = 109°, β = –12°) solution.

The analysis did not identify a unique solution (Durech et al 2009), so we consider this to be a preliminary solution. Indeed, th pole search distribution is poorly constrained, especially along th ecliptic latitude. However, a check of the other four probabl sidereal periods produced similar solutions with higher Chi-Sq an RMS values. We invite more observations of 755 Quintilla during the future oppositions, especially at large phase angles, in order t find a more robust solution.

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CORRIGENDUM

Franco, L.; Marchini, A.; Saya, L.-F.; Galli, G.; Baj, G.; Ruocco, N.; Mannucci, M.; Montigiani, N.; Tinelli, L.; Scarfi, G.; Aceti, P.; Banfi, M.; Bacci, P.; Maestripieri, M.; Papini, R.; Salvaggio F.; Mortari, F.; Bachini, M.; Casalnuovo, G.B.; Chinaglia, B. (2020). "Collaborative Asteroid Photometry from UAI: 2020 January - March." *Minor Planet Bulletin* **47**, 242-246.

Incorrect values were given for the lower limit of the secondary-to-primary mean diameter ratio Ds/Dp for the asteroids 1052 Belgica and 7132 Casulli. The correct values are: 1052 Belgica, 0.39 ± 0.02; 7132 Casulli, 0.33 ± 0.02.

COLLABORATIVE ASTEROID PHOTOMETRY FROM UAI: 2020 APRIL-JUNE

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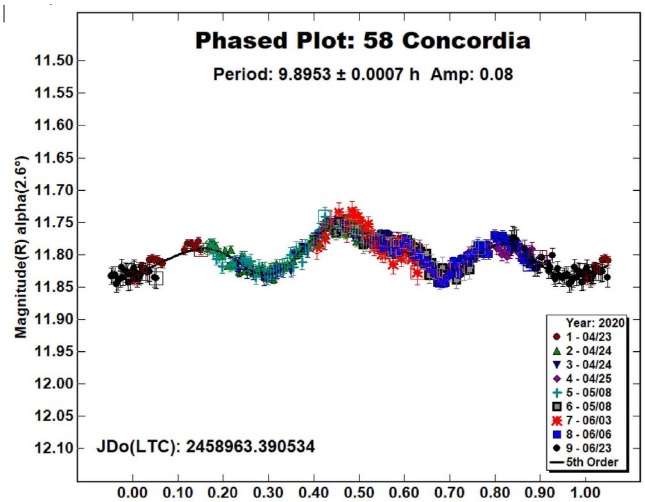
Photometric observations of five asteroids were made in order to acquire lightcurves for shape/spin axis modeling. The synodic period and lightcurve amplitude were found for 58 Concordia: 9.8953 ± 0.0007 h, 0.08 mag; 781 Kartvelia: 19.050 ± 0.005 h, 0.22 mag; 913 Otila: 4.8717 ± 0.0007 h, 0.18 mag; 3317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

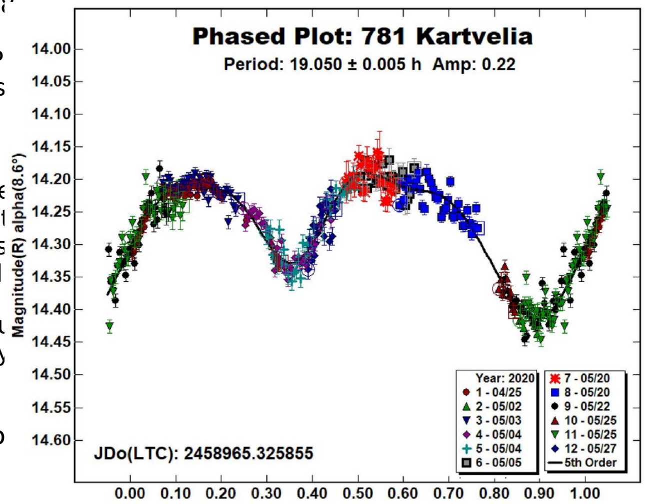
Collaborative asteroid photometry was done inside the Amateur Astronomers Union (UAI; 2020) group. The target selected mainly in order to acquire lightcurves for shape/s modeling. Table I shows the observing circumstances and

The CCD observations were made in 2020 April-June u instrumentation described in the Table II. Lightcurve analy performed at the Balzaretto Observatory with *MPO Canopus* (Warner, 2016). All the images were calibrated with dark frames and converted to R magnitudes using solar-co 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 perioc analysis shows a synodic period of P = 9.8953 ± 0.0007 h with ar amplitude A = 0.08 ± 0.02 mag. The period is close to the previously published results in the asteroid lightcurve databa (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 foun a synodic period of P = 19.050 ± 0.005 h and amplitude A = 0.22 ± 0.03 mag. The period is close to the previously published resul in the LCDB (Warner et al., 2009).



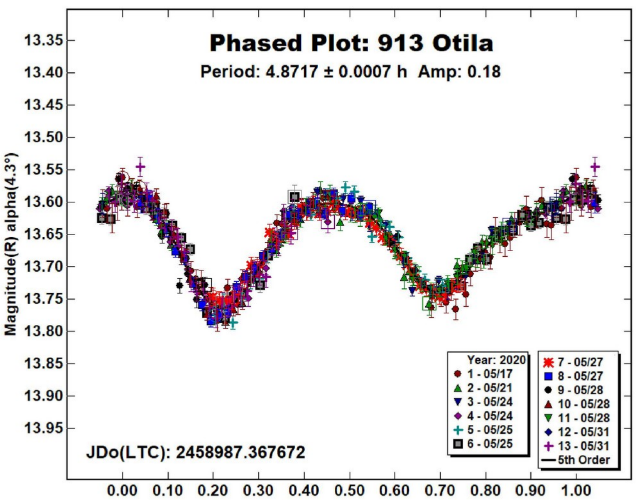
Number	Name	2020 mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
58	Concordia	04/23-06/23	2.5,20.8	213	5	9.8953	0.0007	0.08	0.02	MB-M
781	Kartvelia	04/25-05/27	8.6,13.0	216	23	19.050	0.005	0.22	0.03	MB-O
913	Otila	05/17-05/31	4.1,10.3	236	5	4.8717	0.0007	0.18	0.03	FLOR
3317	Paris	04/25-06/14	*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

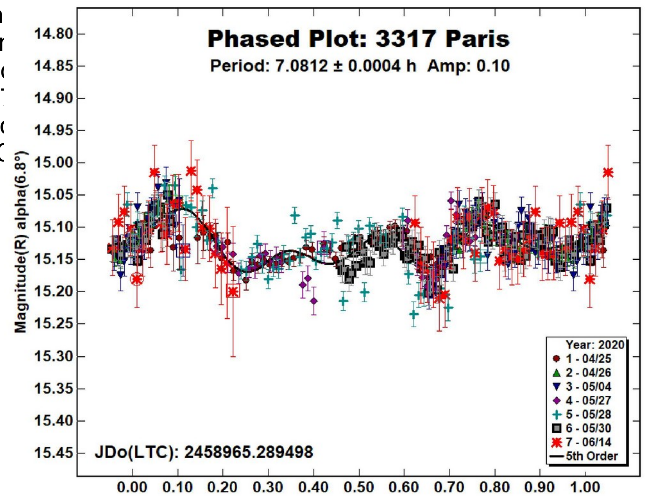
Table I. Observing circumstances and results. The first line gives the results for the primary of a binary system. The second line gives the orbital period of the satellite and the maximum attenuation. The phase angle is given for the first and last date. If preceded by an asteris the phase angle reached 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)

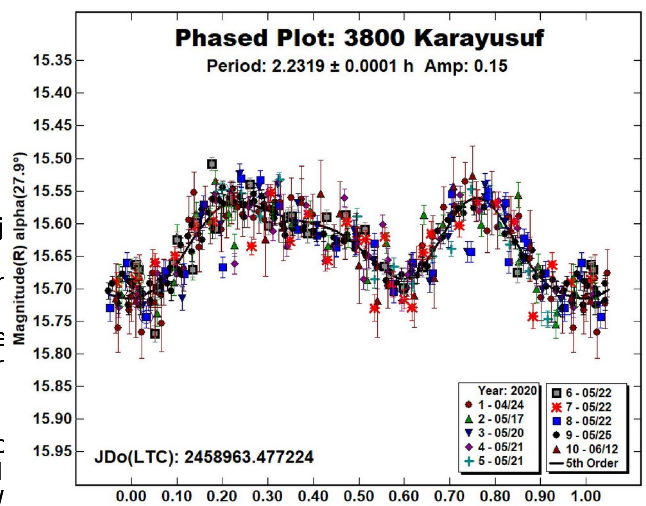
Table II. Instrumentation. MCT: Maksutov -Cassegrain, NRT: Newtonian Reflector, RCT: Ritchey -Chretien, SCT: Schmidt-Cassegrain.

913 Otila is an Sa-type (Bus & Binzel, 2002) member of th group/family; it was discovered on 1919 May 19 by K. Reir at Heidelberg. Collaborative observations were made nights. We found a synodic period of P = 4.8717 ± 0.000 an amplitude A = 0.18 ± 0.03 mag. The period is cl previously published results in the LCDB (Warner et al., 20





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



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