LIGHTCURVES AND ROTATION PERIODS OF 57 MNEMOSYNE AND 58 CONCORDIA

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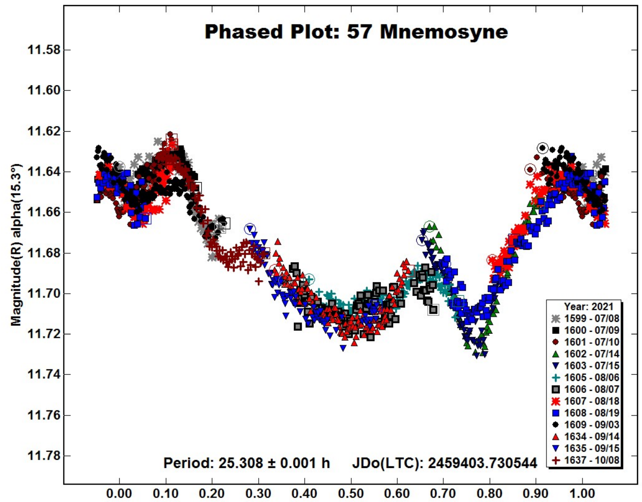
(Received: 2021 October 8)

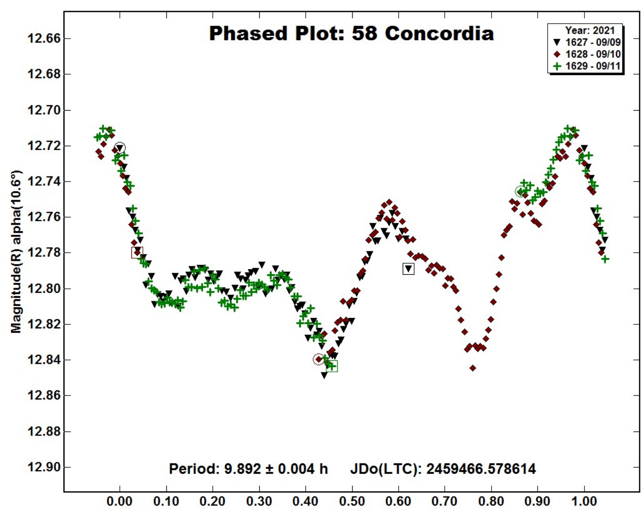
Synodic rotation periods and amplitudes are found for 57 Mnemosyne: 25.308 +/- 0.001 h, 0.08 +/- 0.01 mag; 58 Concordia: 9.892 +/- 0.004 h, 0.12 +/- 0.01 mag.

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, 30 second exposures for 57 Mnemosyne, 60 second exposures for 58 Concordia, unguided, clear filter. 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.

57 Mnemosyne. Earlier published periods are by Harris et al. (1992), 12.463 hours; Ditteon and Hawkins (2007), 12.66 hours; Behrend (2016web), 12.92 hours. This author (Pilcher, 2019b) was unable to fit a lightcurve to a period near 12.5 hours and found a synodic period 25.324 hours with one maximum and minimum per cycle near celestial longitude 197 degrees. Pilcher (2020) obtained another set of observations near celestial longitude 258 degrees, finding a synodic period 25.281 hours with a complex lightcurve. New observations on 13 nights 2021 July 8 - Oct. 8 near celestial longitude 331 degrees provide a good fit to a lightcurve with synodic period 25.308 ± 0.001 hours, amplitude 0.08 ± 0.01 magnitudes, again with a complex shape. Misfits in the lightcurve can be attributed to the relevant segments being sampled at greatly different phase angles ranging from -15.3º to 5.9º to 15.0º during the three-month observation campaign. The observations in years 2019, 2020, and 2021, respectively, indicate consistent rotation periods but very different lightcurve shapes. The differing shapes indicate that the observations were made at different asterocentric latitudes and should be helpful toward future LI modeling.



58 Concordia. Previously published periods are by Gil-Hutton (1993), >16. hours; Wang (2002), 9.89 hours; Behrend (2006web), 9.9 hours; Behrend (2010web), 9.905 hours; Behrend (2011web), 9.904 hours; Stephens (2006), 9.895 hours; Pilcher (2016), 9.895 hours; Pilcher (2019a), 9.895 hours, Pilcher (2020), 9.899 hours. New observations on 3 nights 2021 Sept. 9 - 11 provide a good fit to an irregular lightcurve with period 9.892 ± 0.004 hours, amplitude 0.12 ± 0.01 magnitudes, consistent with most of the previously published values.



Number	Name	2021/mm/dd	Phase	LPAB	BPAB	Period(h)	P.E	Amp	A.E.
57	Mnemosyne	07/08-10/08	* 15.3, 15.0	331	14	25.308	0.001	0.08	0.01
58	Concordia	09/09-09/11	10.6, 11.3	321	1	9.892	0.004	0.12	0.01

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first and last date, unless a minimum (second value) was reached. LPAB and BPAB are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris *et al.*, 1984).

References

Behrend, R. (2006web, 2010web, 2011web, 2016web). Observatoire de Geneve web site. *http://*obswww.unige.ch/*~behrend/page_cou.html*.

Ditteon, R.; Hawkins, S. (2007). "Asteroid lightcurve analysis at the Oakley Observatory - November 2006." *Minor Planet Bull.* **34**, 59-64

Gil-Hutton, R. (1993). "Photoelectric photometry of asteroids 58 Concordia, 122 Gerda, 326 Tamara, and 441 Bathilde." *Rev. Mexicana Astron. Astrof.* **25**, 75-77.

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.

Harris, A.W.; Young, J.W.; Dockweiler, T.; Gibson, J.; Poutanen, M.; Bowell, E. (1992). "Asteroid lightcurve observations from 1981." *Icarus* **95**, 115-147.

Pilcher, F. (2016). "Rotation period determinations for 50 Virginia, 58 Concordia, 307 Nike, and 339 Dorothea." *Minor Planet Bull.* **43**, 304-306.

Pilcher, F. (2019a). "Rotation period determinations for 58 Concordia, 384 Burdigala, 464 Megaira, 488 Kreusa, and 491 Carina." *Minor Planet Bull.* **46**, 360-363.

Pilcher, F. (2019b). "New lightcurves of 50 Virginia, 57 Mnemosyne, 59 Elpis, 444 Gyptis, and 997 Priska." *Minor Planet Bull.* **46**, 445-448.

Pilcher, F. (2020). "Lightcurves and rotation periods of 50 Virginia, 57 Mnemosyne, 58 Concordia, 59 Elpis, 78 Diana, and 529 Preziosa." *Minor Planet Bull.* **47**, 344-346.

Stephens, R. D. (2006). "Asteroid lightcurve photometry from Santana and GMARS observatories - winter and spring 2006." *Minor Planet Bull.* **33**, 100-101.

Wang, X.-B. (2002). "CCD photometry of asteroids (58) Concordia, (360) Carlova, and (405) Thia." *Earth, Moon, and Planets* **91**, 25-30

Warner, B.D., Harris, A.W., Pravec, P. (2009). "The Asteroid Lightcurve Database." *Icarus* **202**, 134-146. Updated 2021 June. *https://minplanobs.org/MPInfo/php/lcdb.php*

ROTATION PERIOD DETERMINATION FOR ASTEROIDS 2232 ALTAJ, 3699 MILBOURN, 4101 RUIKOU, (6787) 1991 PF15 AND 8416 OKADA

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(Received: 2021 October 15)

Photometric observations of five main-belt asteroids were conducted in order to determine their synodic rotation periods. For 2232 Altaj we found P = 8.089 ± 0.001 h, A = 0.30 ± 0.02 mag; for 3699 Milbourn we found P = 3.816 ± 0.002 h, A = 0.20 ± 0.02 mag; for 4101 Ruikou we found P = 8.098 ± 0.009 h, A = 0.07 ± 0.03 mag; for (6787) 1991 PF15 we found P = 4.645 ± 0.001 h, A = 0.80 ± 0.01 mag; for 8416 Okada we found P = 2.646 ± 0.001 h, A = 0.04 ± 0.02 mag.

CCD photometric observations of five main-belt asteroids were carried out in 2021 July - October at the Astronomical Observatory of the University of Siena (K54), a facility inside the Department of Physical Sciences, Earth and Environment (DSFTA, 2021). We used a 0.30-m *f*/5.6 Maksutov-Cassegrain telescope, SBIG STL-6303E NABG CCD camera, and clear filter; the pixel scale was 2.30 arcsec when binned at 2×2 pixels and all exposures were 300 seconds.

Data processing and analysis were done with *MPO Canopus* (Warner, 2018). All images were calibrated with dark and flat-field frames and the instrumental magnitudes converted to R magnitudes using solar-colored field stars from a version of the CMC-15 catalogue distributed with *MPO Canopus*. Table I shows the observing circumstances and results.

A search through the asteroid lightcurve database (LCDB; Warner *et al.*, 2009) indicates that our results may be the first reported lightcurve observations and results for these asteroids. For 2232 Altaj we found in literature a previously published period in good agreement with our solution.

2232 Altaj (1969 RD2) was discovered on 1969 September 15 by B. A. Burnasheva at the Crimean Astrophysical Observatory and named after the place of residence of the discoverer's mother, Elena Andreevna Vasil'eva. [Ref: Minor Planet Circ. 5850] It is a main-belt asteroid with a semi-major axis of 2.668 AU, eccentricity 0.143, inclination 3.693°, and an orbital period of 4.36 years. Its absolute magnitude is H = 12.2 (JPL, 2021). The WISE/NEOWISE satellite infrared radiometry survey (Masiero et al., 2011) found a diameter D = 11.780 ± 0.212 km using an absolute magnitude H = 12.0.

Observations were conducted over four nights and collected 179 data points. The period analysis shows a bimodal solution for the rotational period of P = 8.089 ± 0.001 h with an amplitude A = 0.30 ± 0.02 mag. This result is in good agreement with the one recently published by Ďurech et al. (2020) of P = 8.09346 ± 0.00003.