

ROTATION PERIOD DETERMINATION AND LIGHTCURVE ANALYSIS OF ASTEROID 1852 CARPENTER

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We report on photometric observations of the main-belt asteroid 1852 Carpenter that were acquired from 2023 April 13 to April 26. The observations yielded a synodic rotation period of 29.8685 ± 0.0185 h and an amplitude of 0.41 ± 0.06 mag.

During 2023, photometric observations of main-belt asteroid 1852 Carpenter were carried out from two observatories located in Utah, United States and Malta, Europe. Observations were carried out on 5 nights beginning on 2023 April 13 until 2023 April 26.

Observations from the Utah Desert Remote Observatory, MPC code U94, were conducted with telescope 21. T21 is a Deep Field Planewave 17" CDK telescope that uses a FLI-PL6303E CCD. It has a focal length of 1940mm, a pixel size of $9 \mu\text{m}$ square, an array of 3072×2048 pix, and resolution of 0.96 arcsec/pix. The luminance filter was used for all observations.

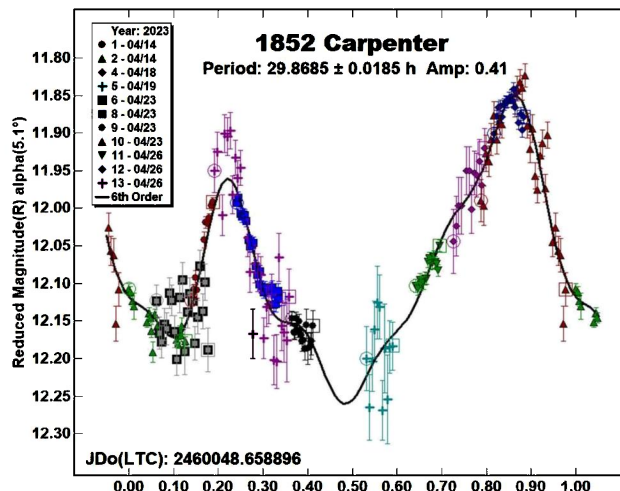
Observations were also obtained from Manikata Observatory, MPC code A40, in Malta using an OTA Meade 8in with a Mount Skywatcher EQ6-R Pro. The telescope utilized a SBIG ST10XME CCD.

Photometric reduction, lightcurve construction, and period analyses were done using *MPO Canopus* software 10.7.12.9 (Warner, 2019). Differential aperture photometry was used and photometric measurements were based on the use of comparison stars of near-solar color that were selected by the Comparison Star Selector (CSS) utility available through *MPO Canopus*. Asteroid magnitudes for all nights except 2023 April 22 were based on the MPOSC3 catalog supplied with *MPO Canopus*. For the observation on the 22nd, we used the APASS catalog due to the dearth of comparison stars in the MPOSC3 catalog.

1852 Carpenter is a main-belt asteroid discovered on 1955 April 1 at the Goethe Link Observatory located in Indiana. This outer main-belt asteroid has a semi-major axis of 3.02 AU, an eccentricity of 0.06, a diameter of 21.38 km, and an absolute magnitude of 11.35

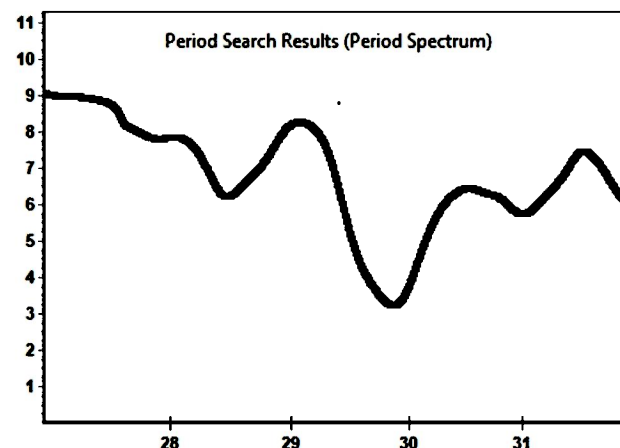
(JPL, 2020). Following a search of the Asteroid Lightcurve Database, we did not find any data previously recorded regarding a rotation period for this asteroid (LCDB, Warner et al., 2009).

Raw light curves were created for each night in *MPO Canopus* for data collected in Utah as well as Malta. In total, 208 images were used for analysis. After combining the individual raw lightcurves, we did Fourier analysis, adjusting the zero points of the magnitude system to find a lightcurve. The phased plot shows a fit with 6 orders, which has a full amplitude of 0.41 ± 0.06 mag and a potential lightcurve showing a period of 29.8685 ± 0.0185 h.



We experienced difficulty collecting data on a few nights due to excessive clouds and other weather conditions. This likely contributed to scatter in our phased plot and variance in uncertainties. Despite the scatter, the majority of data points in the lightcurve follow the reported shape well.

The period spectrum for this 21.38-km main-belt asteroid shows one primary solution. The Fourier analysis finds a pronounced RMS minimum between 29 h to 30 h. Further observations are needed to refine our lightcurve and overall period.



Number	Name	2023/mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
1852	Carpenter	04/13-04/25	5.0, 6.7	202.1	13.3	29.8685	0.0185	0.41	0.06	MB

Table I. Observing circumstances and results. 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).

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PHOTOMETRY AND LIGHTCURVE ANALYSIS OF VESTA FAMILY ASTEROID (14645) 1998 XR9

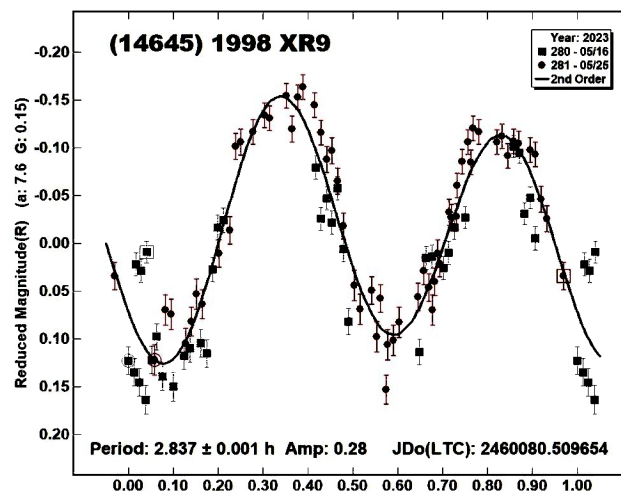
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Photometric observations of the Vesta family asteroid (14645) 1998 XR9 were obtained, and a rotational period of 2.837 ± 0.001 h was determined, with a lightcurve amplitude of 0.28 mag.

Photometric observations of asteroid (14645) 1998 XR9 were obtained with the 0.6m telescope of the Southeastern Association for Research in Astronomy (SARA) consortium at Cerro Tololo Inter-American Observatory. The telescope is coupled with an Andor iKon-L series CCD. A detailed description of the instrumentation and setup can be found in the paper by Keel et al. (2017). The data was calibrated using *MaximDL* and photometric analysis was performed using *MPO Canopus* (Warner, 2021).

(14645) 1998 XR9 is a member of the Vesta family. The asteroid was chosen as only one prior measurement of the rotational period existed. (14645) 1998 XR9 was observed over two nights. The derived rotational period of 2.837 ± 0.001 h with an amplitude of 0.28 mag is in excellent agreement with the result previously obtained by Pál et al. (2020, 2.83685 h).



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Number	Name	yyyy mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.
14645	1998 XR9	2023 05/16,05/25	7.6, 11.9	222	-0.6	2.837	0.001	0.28	0.02

Table I. Observing circumstances and results. 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).