

BROAD-BAND MONITORING OF 797 MONTANA

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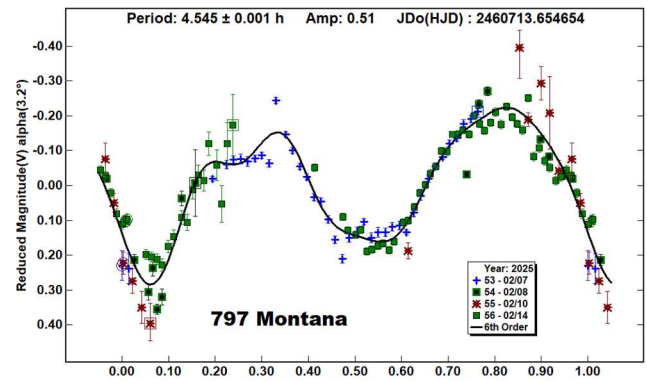
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Broad-band monitoring of asteroid 797 Montana was conducted over the course of four nights in 2025 February. Observations from the first three nights were obtained through a Johnson V filter, while the fourth night was collected as unfiltered observations. We find a best-fit rotation period of 4.545 ± 0.001 h, which agrees with previous measurements, and an amplitude of variability of $\Delta V = 0.50 \pm 0.03$ mag, which agrees with an early measurement but is somewhat larger than most studies have reported.

Asteroid 797 Montana was discovered in 1914 by Holger Thiele at Hamburg-Bergedorf Observatory. A main-belt asteroid, 797 Montana is listed in the JPL Small Body Database with a stony S-type classification (JPL, 2025).

Students enrolled in the *Observational Techniques and Instrumentation* class at Georgia State University collected observations of 797 Montana over the course of four nights between 2024 February 07-14 (UT dates here and throughout). They employed the Miller Telescope, a 24-inch Planewave f/6.5 Corrected Dall-Kirkham Astrograph, at GSU's Hard Labor Creek Observatory in Rutledge, GA.

Multiple equipment failures plagued the class this semester. For the first three nights (February 07, 08, and 10), observations were acquired using our backup CCD, an Apogee Alta with 2048×2048 pixels. These images were acquired through a Johnson V filter, and each image covered a field of view of $26.3 \text{ arcmin} \times 26.3 \text{ arcmin}$ with a pixel scale of 0.77 arcsec . On the evening of February 14, the Apogee Alta suffered an electronic short, so an SBIG camera of unknown heritage was unearthed from a closet and mounted on the telescope. Images acquired with the SBIG camera were unfiltered, since the camera could not be used with our existing filter wheel. The SBIG detector provided 1472×2184 pixels, and plate solving with astrometry.net (Lang et al., 2010) determined that this corresponded to a field of view of $8.6 \text{ arcmin} \times 12.8 \text{ arcmin}$ on the sky with a pixel scale of 0.35 arcsec .



Across the four nights, the weather conditions were mixed, ranging from clear to partly cloudy, and the moon phase ranged from waxing to waning gibbous. Exposure times varied between 150 - 300 s, and all observations were acquired at airmasses < 2.4 .

Images from all nights were reduced in *IRAF*. Reductions of the Apogee Alta images included bias and overscan subtraction, dark subtraction, and flat fielding. A leak in the camera seal allowed moisture to collect and condense on the detector, so additional “droplet masks” were created by medianing together several dithered frames to allow most of the remaining droplet pattern to be divided out. The SBIG camera did not suffer from the condensation problem, but also did not provide an overscan region, so reductions were composed of only bias and dark subtraction and flat fielding.

Aperture photometry was carried out in *IRAF*, with measurements of the asteroid and 3-5 field stars acquired from each reduced image. V-band measurements of field stars were obtained from the AAVSO Photometric All-Sky Survey (Henden et al., 2009) and were used to convert instrumental magnitudes to calibrated Vega magnitudes for the nights of February 07-10. The unfiltered observations collected on February 14 were adjusted by an offset of ~ 2 mag to match the calibrated V-band observations on the other three nights.

The rotation period and amplitude of variability for 797 Montana were determined using *MPO Canopus*, which implements the Fourier Analysis of Light Curves (FALC) algorithm of Harris et al. (1989). We included 137 measurements and explored fitting orders between 4 and 8 for the period search, with a 6th order fitting solution displayed in the folded lightcurve above. We find that the best-fit period is very stable despite the choice of orders, while the amplitude of variability is somewhat sensitive to this choice. From this analysis, we adopt a final rotation period of 4.545 ± 0.001 h and a V-band amplitude of 0.50 ± 0.03 mag.

Our results agree with previous determinations of the rotation period, which include 4.5 h (Angeli et al., 2001), 4.55 ± 0.01 h (Ditteon et al., 2004), 4.5463 ± 0.0002 h (Behrend, 2007web), and 4.54619 ± 0.00005 h (Hanuš et al., 2016). The amplitude of variability that we find agrees with that reported by Angeli et al. (2001) of 0.5 mag, but is somewhat larger than the values reported by Ditteon et al. (2004) of 0.32 ± 0.02 mag and Behrend (2007web) of 0.41 ± 0.01 mag. It is possible that the amplitude of variability

Number	Name	yyyy mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
797	Montana	2025 02/07-02/14	1.5, 4.9	135	0	4.545	0.001	0.50	0.03	9104

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).

determined from our lightcurves is slightly inflated by residual noise after attempting to correct for the droplet patterns on the detector. A physical explanation is a more-equatorial aspect for our observations.

Acknowledgements

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LIGHTCURVES AND THE ROTATION PERIOD OF THE AMOR-TYPE ASTEROID 887 ALINDA

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We find for the Amor-type asteroid 887 Alinda at its close approach to Earth in 2024-2025 a rotation period of 74.21 ± 0.01 hours, amplitude 0.28 ± 0.02 mag.

The Amor-type asteroid 887 Alinda has orbital elements $a=2.479$, $e=0.567$, $i=9.353$. Prior to the year 2025, the most recent very close approach to Earth was 1974 January at a minimum geocentric distance 0.137 AU. From photometric observations at this occasion, Dunlap and Taylor (1979) published a rotation period of 73h 58m based on incomplete phase coverage. At a moderately close approach to 0.836 AU in 2020 September, Behrend (2020) published an incomplete lightcurve phased to 28.4 hours.

On 2025 January 8, minor planet 887 Alinda passed even closer to Earth, 0.082 AU, than in 1974, and was brighter than magnitude 15 from 2024 October through 2025 March. We present two separate lightcurves and rotation periods that were acquired, respectively, after and before closest approach.

The observations by Pilcher 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, 60 to 120 second exposures, unguided, clear filter. Observations by Delgado are with an 11-inch Celestron Schmidt-Cassegrain, Atik 4.14 EX CCD, 60 to 120 second exposures. Observations by Stone are with a 0.51m f/8 Ritchey-Chretien mounted on a Paramount ME-II mount, SBIG AC4040 CMOS camera, Johnson-Cousins R filter, unguided.

For image measurement and lightcurve construction, authors Pilcher and Delgado used *MPO Canopus* software with calibration star magnitudes for solar colored stars from the CMC15 catalog reduced to the Cousins R band. Author Stone used Tycho-Tracker software with near solar colored stars chosen from the ATLAS Refcat 2 with Sloan r' magnitudes. Zero-point magnitudes were adjusted for best fit in the 2025 Feb. 6 - Apr. 1 session set. 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.

A dense lightcurve and robust period were acquired after closest approach. Between 2025 Feb. 6 and Apr. 1, authors Pilcher, Delgado, and Stone acquired data sets on 22 nights, with observing runs seven hours or longer. Their data can be plotted on a dense bimodal phased lightcurve with complete phase coverage and period 74.21 ± 0.01 hours, amplitude 0.28 ± 0.02 magnitudes.