ROTATION PERIOD DETERMINATION FOR (7335) 1989 JA

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Unistellar Citizen Astronomers

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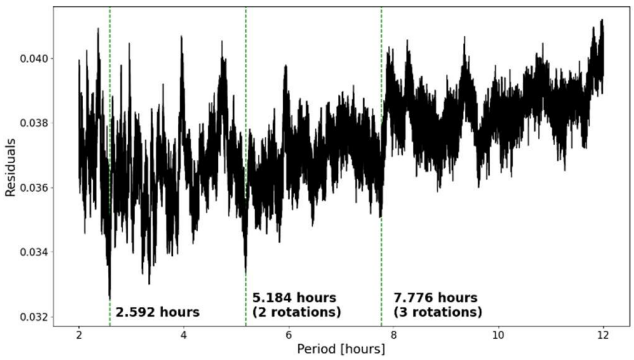
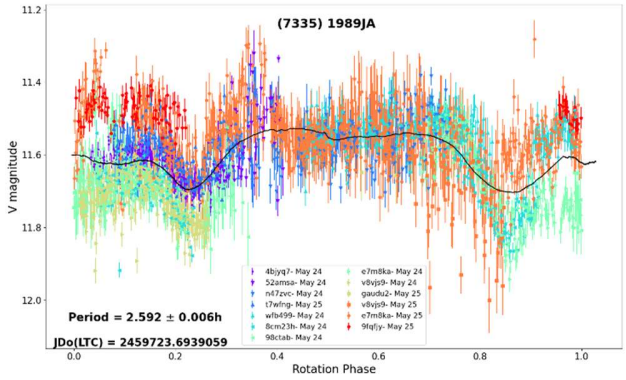
We present the results of an observational study of the near-Earth asteroid (7335) 1989 JA conducted during its May 2022 close approach. Using data collected from participating Unistellar citizen astronomers, we report a best-fitting synodic rotation period of 2.592 ± 0.006 hours with a corresponding amplitude of 0.09 ± 0.01 magnitudes for (7335) 1989 JA.

Beginning on 2022 May 5, the Unistellar citizen science network (Marchis et al., 2020) began a campaign to observe the near-Earth asteroid, (7335) 1989 JA during its close approach on 2022 May 27. The campaign ran from 2022 May 5 to Jun 2 and resulted in 75 observations from 35 different citizen astronomers. Observations were taken using Unistellar digital telescopes, named eVscope, eQuinox, and eVscope 2. These telescopes are 114mm *f*/4 reflectors and use a Sony Exmor IMX224 (eVscope, eQuinox) and Sony Exmor IMX347 CMOS (eVscope 2) detector. Before 2022 May 22, observations were performed as a series of consecutive, unfiltered 4-second exposures with a gain of 25dB. Exposures were taken for 40 minutes before the eVscope was realigned onto the target. On 2022 May 22, the proper motion of 1989 JA was great enough that the observation procedures were updated to realign every 20 minutes to avoid the asteroid leaving the field of view. Observations were then uploaded to the Unistellar server where the images were dark subtracted, plate-solved, and stacked according to the proper motion of (7335) 1989 JA at the time of observation.

(7335) 1989 JA was discovered in 1989 May by Eleanor Helin at the Palomar observatory. It is a potentially hazardous near-Earth asteroid with a semi-major axis of 1.772 au, eccentricity of 0.485, inclination of 15.17°, and orbital period of 2.36 years. The diameter has been estimated to be 0.932 ± 0.153 km from the NEOWISE survey (Mainzer et al.; 2019) using an absolute magnitude $H = 17$. Radar observations taken by Mahapatra et al. (2002) constrained the synodic rotation period to <12 hours but no further attempts to constrain the rotation period appear on the asteroid lightcurve database (LCDB; Warner et al., 2009).

To determine the synodic rotation period, a subsample of 13 observations that occurred between 2022 May 24-25 were selected. Since (7335) 1989 JA was in the midst of a close approach, this two-day window was chosen to minimize the change in magnitude that would occur across observations due to the changing distance and phase angle. Analysis of the periodogram created from the lightcurves of these 13 observations reveals a best fitting synodic rotation period of 2.592 hours with other high-probability signals occurring at the integer aliases of this rotation period. We assumed an uncertainty corresponding to a 10% rotation phase offset, resulting in a synodic rotation period of 2.592 ± 0.006 hours. In the second figure, we present a rotation phase plot of our 13-observation subsample. Each observation has been labeled by the 6-character serial number of the eVscope that took the observation along with the date the observation was taken. To more easily identify features in the lightcurve, a black line has been added to the plot that is the rolling weighted average magnitude of 200 subsequent magnitude measurements. We estimate the amplitude as half of the difference between the highest and lowest magnitude across the weighted rolling average. Using this method, we find an amplitude of $A = 0.09 \pm 0.01$ mag.





Number	Name	20yy mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.	Exp	Grp
7335	1989JA	22 05/24-05/25	30.7,35.5	226	-1	2.592	0.006	0.09	0.01	4200	PHA

Table I. Observing circumstances and results. The phase angle is given for the first and last date. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris et al., 1984). Exp is the exposure (sec) or average if a range of exposures was used. Grp is the asteroid family/group (Warner et al., 2009).

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ROTATION PERIOD DETERMINATION FOR ASTEROID 12919 TOMJOHNSON

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Photometric observations of the main-belt asteroid 12919 Tomjohnson were conducted in order to determine its synodic rotation period. We found P = 8.147 ± 0.001 h, A = 0.51 ± 0.03 mag.

CCD photometric observations of the main-belt asteroid 12919 Tomjohnson were carried out in July 2022 at the Astronomical Observatory of the University of Siena (K54), a facility inside the Department of Physical Sciences, Earth and Environment (DSFTA, 2022). 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 result may be the first reported lightcurve observations and results for this asteroid.

12919 Tomjohnson (1998 VB6) was discovered on 1998 November 11 at Catalina by the Catalina Sky Survey and named in honor of Thomas J. Johnson who developed a technique for creating Schmidt telescope correctors that allowed the mass production of Schmidt-Cassegrain telescopes. It is an inner main-belt asteroid with a semi-major axis of 2.274 AU, eccentricity 0.218, inclination 6.368°, and an orbital period of 3.43 years. Its absolute magnitude is H = 14.02 (JPL, 2022). The WISE/NEOWISE satellite infrared radiometry survey (Masiero et al., 2011) found a diameter D = 4.882 ± 0.468 km using an absolute magnitude H = 13.7.

Observations were conducted over four nights and collected 191 data points. The period analysis shows a bimodal solution for the rotational period of P = 8.147 ± 0.001 h with an amplitude A = 0.51 ± 0.03 mag. This target was observed within the Photometric Survey for Asynchronous Binary Asteroids under the leadership of Petr Pravec from Ondřejov Observatory, Czech Republic (Pravec et al., 2006; Pravec, 2022web) and their independent analysis confirmed our results.