ROTATION PERIOD OF KORONIS FAMILY MEMBER (1497) TAMPERE

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Observations of (1497) Tampere during its 2022 apparition yield a determination of its synodic rotation period 3.30237 ± 0.00015 h assuming a doubly-periodic lightcurve.

Published rotation period determinations of Koronis family member (1497) Tampere fall within two significantly different ranges. The longer-period range near 3.6 h includes one result based on dense lightcurves (Brines et al., 2017) and a second result that is based on ATLAS survey data sparsely sampled in time (Erasmus et al., 2020), while both of the periods within the shorter-period range near 3.3 h are derived from survey "sparse data" (Chang et al., 2015; Waszczak et al., 2015). New observations reported here resolve that ambiguity in the rotation period, and also record complete coverage of the lightcurve at a previously unobserved viewing aspect. The published periods assume that the lightcurve is doubly-periodic in a single rotation; that same assumption is made here for the present work, subject to future verification by determining a corresponding sidereal period that can rule out a result twice as long.

Tampere was observed in 2022 from two sites. Lightcurves were recorded on seven nights prior to the asteroid reaching its eastern stationary point, using telescopes at the MIT Wallace Astrophysical Observatory (WAO) in Westford, MA; an additional longer lightcurve span deliberately covering more than two rotations was recorded about a month after opposition. Lightcurves also were recorded at the Union College Observatory (UCO) in Schenectady, NY on two nights near opposition and one more night about a month later, and likewise include a long span covering two rotations. Both sites imaged using Cousins *R* filters; nightly observing information is summarized in Table I and the instrumentation is detailed in Table II. Processing and measurement of the WAO images was as described by Slivan et al. (2008), except that for the observations made using the smaller 0.36-m telescopes the choices of synthetic aperture sizes for the on-chip relative photometry were guided by the experience of Howell (1989). The UCO images were measured using the *AstroImageJ* application.

The new data yield a self-consistent doubly-periodic folded composite lightcurve for a derived synodic period of 3.30237 ± 0.00015 h (Fig. 1), with the high precision resulting from the combination of Tampere's relatively short period with the 124-day interval spanned by the observations to count 952 rotations. The period result is consistent with both published periods comprising the shorter-period range (Chang et al., 2015; Waszczak et al., 2015).

In the longer-period range, the Erasmus et al. (2020) result corresponds to an alias period that undercounts rotations by 0.5 rotation per day, and composites of the new data folded at the Brines et al. (2017) result are not self-consistent.

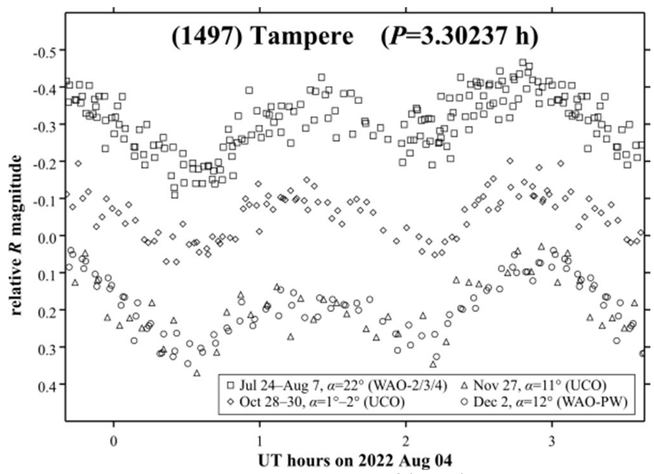

Figure 1. Folded composite lightcurves of (1497) Tampere during its 2022 apparition, light-time corrected, showing one rotation period plus the earliest and latest 10% repeated. The three lunations of composited data have been offset from each other in brightness for presentation. The legend gives UT dates, solar phase angles, and telescope ID (Table II).

UT date 2022	α (°)	Tel. ID	Data Span (h)	Integration time (s)
Jul 24.3	21.8	WAO-4	1.2	240
Jul 26.3	21.8	WAO-3	1.9	240
Jul 27.3	21.8	WAO-3	2.1	240
Jul 31.3	21.9	WAO-3	2.5	300
Aug 03.3	21.8	WAO-3	0.8	300
Aug 04.3	21.8	WAO-3	2.6	240
Aug 07.3	21.8	WAO-2	3.0	180
Oct 28.2	1.6	UCO	2.5	240
Oct 30.2	0.8	UCO	6.7	240
Nov 27.1	10.6	UCO	3.2	240
Dec 02.1	12.3	WAO-PW	7.6	300

Table I: Nightly observing information, with rows grouped by lunation. Columns are: UT date at lightcurve mid-time, solar phase angle *α*, telescope ID (Table II), lightcurve duration, and image integration time.

Number	Name	yyyy mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.
1497	Tampere	2022 07/24-12/02	*21.8,12.3	37	1	3.30237	0.00015	0.23	0.04

Table III. Observing circumstances and results. Solar phase angle is given for the first and last dates; the asterisk indicates that the phase angle reached a minimum during the period. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range.

Tel. ID	Dia. (m)	CCD camera	FOV (′)	Bin	Scale ("/pix)
UCO	0.51	SBIG SXTL-11002	30×20	2×2	0.93
WAO-2	0.36	FLI ML1001	22×22	1×1	1.26
WAO-3	0.36	FLI ML1001	20×20	1×1	1.18
WAO-4	0.36	SBIG STL-1001	21×21	1×1	1.25
WAO-PW	0.61	FLI PL16803	32×32	1×1	0.46

Table II: Telescopes and cameras information. Columns are: telescope ID (UCO, OGS RC20; WAO-2, shed pier #2 Celestron C14; WAO-3, shed pier #3 Celestron C14; WAO-4, shed pier #4 Celestron C14; WAO-PW, Elliot PlaneWave 24-in CDK), telescope diameter, CCD camera, detector field of view, image binning used, and binned image scale.

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LIGHTCURVE ANALYSIS OF TWO NEAR-EARTH ASTEROIDS

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We report photometric analysis of two near-Earth asteroids observed during close approaches in 2022 October. For 2022 TG1 we found P = 0.1951 ± 0.0001 h, A = 0.46 mag; and for 2022 UR4 P = 0.0282 ± 0.0001 h, A = 1.08 mag.

CCD observations of two near-Earth asteroids were made in 2022 October using the instrumentation described in Table I. Lightcurve analysis was performed with *MPO Canopus* (Warner, 2022). All the images were calibrated with dark and flat frames and converted to R magnitudes using solar-colored field stars from CMC15 catalogue distributed with *MPO Canopus*. Table II shows the observing circumstances and results.

No previously reported results were found in the Asteroid Lightcurve Database (LCDB; Warner et al., 2009), The size estimates are calculated using *H* values from the Small-Body Database Lookup (JPL, 2022). Both asteroids are small in size and have a rotation period above the spin-barrier, they are probably monolithic objects.

2022 TG1 is an NEA Apollo; it was discovered by ATLAS-MLO, Mauna Loa, on 2022 October 4 (Bacci et al., 2022a). *H* =25.62 and the Minimum Orbit Intersection Distance (MOID) from Earth of 0.0011 au. Observations were made while the object was still on the NEOCP page of the Minor Planet Center, at V ~ 16.8. It was observed for 46 minutes starting at 2022 October 4, 19:10 UT, and for 55 minutes starting at 2022 October 5, 19:10 UT. We found a synodic period of $P = 0.1951 \pm 0.0001$ h with amplitude $A = 0.46 \pm 0.10$ mag. and ratio a/b = 1.5 ± 0.1 based on the amplitude and an assumed triaxial ellipsoid viewed equatorially (Zappala et al., 1990).