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ROTATION PERIODS OF FIVE NEAR-EARTH ASTEROIDS WITH THE TRAPPIST TELESCOPES: (17188) 1999 WC2, (242450) 2004 QY2, (503871) 2000 SL, 2023 DZ2 AND 2023 CM

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Lightcurves of five near-Earth asteroids were obtained with TRAPPIST-North and TRAPPIST-South from December 2022 to May 2023. For all of them the synodic rotation period and amplitude were found to be: (17188) 1999 WC2, (5.064 ± 0.002 h) and (0.35 ± 0.02 mag); (242450) 2004 QY2, (7.072 h ± 0.001 h) and (0.30 ± 0.01 mag); (503871) 2000 SL, (10.6504 h ± 0.0020 h) and (0.32 ± 0.04 mag); 2023 DZ2, (0.104587 ± 0.000083 h) and (0.58 ± 0.02 mag); 2023 CM, (3.6244 ± 0.0004 h) and (0.24 ± 0.02 mag). All data have been submitted to ALCDEF database.
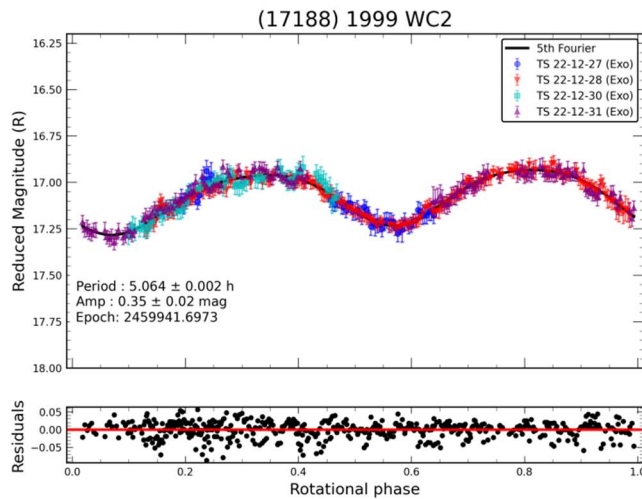
CCD photometric observations of five near-Earth asteroids (NEAs) (17188) 1999 WC2, (242450) 2004 QY2, (503871) 2000 SL, 2023 DZ2 and 2023 CM were made with the telescopes TRAPPIST-North (TN; IAU code Z53) and TRAPPIST-South (TS; IAU code I40) (Jehin et al., 2011), installed at the Oukaïmeden observatory in Morocco and the ESO La Silla observatory in Chile, respectively. Both are 0.6-m Ritchey-Chrétien telescopes operating at *f*/8 on German Equatorial mounts. The TN camera is an Andor IKONL BEX2 DD (0.60 arcsec/pixel), and the TS camera is an FLI ProLine 3041-BB (0.64 arcsec/pixel).

The calibration of the raw images using standard flat fields, dark and bias frames was obtained using the python framework Prose (Garcia et al., 2022). The aperture photometry and lightcurves were obtained with Photometry Pipeline developed by Mommert (2017). This pipeline allows zero-point calibration by matching field stars with online catalogs. The calibrated magnitudes found were corrected to heliocentric and geocentric distances using python script. The rotation periods were then determined using the software Peranso (Paunzen and Vanmunster, 2016), in which we used the FALC (Harris et al., 1989) and the ANOVA (Schwarzenberg-Czerny, 1996) methods. The amplitudes reported are from the Fourier series model curves.
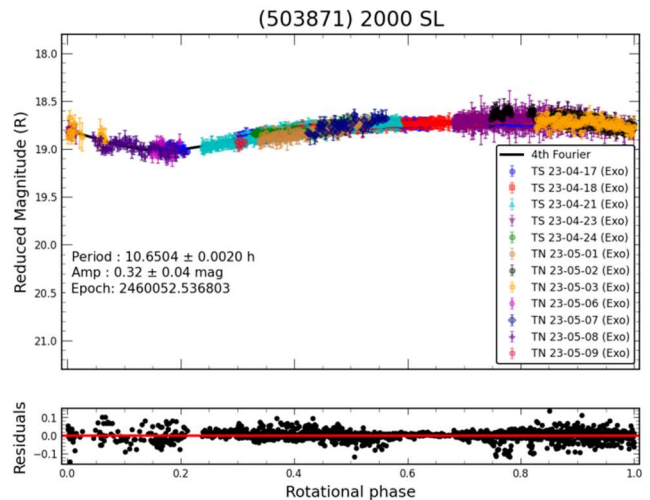
Number	Name	Pts	yyyy	mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.
17188	1999 WC2	563	2022	12/27–12/31	17.9, 19.6	106	−13	5.064	0.002	0.35	0.02
242450	2004 QY2	708	2023	02/05–03/06	76.3, 53.6	165	−56	7.072	0.001	0.30	0.01
503871	2000 SL	1909	2023	04/17–05/09	2.7, 76.6	201	39	10.6504	0.0020	0.32	0.04
	2023 DZ2	633	2023	03/22	60.7, 60.6	150	−0.5	0.104587	0.000083	0.58	0.02
	2023 CM	694	2023	03/07–03/09	22.0, 29.9	165	−12	3.6244	0.0004	0.24	0.02

Table I. Observing circumstances and results. Pts is the number of data points. 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).
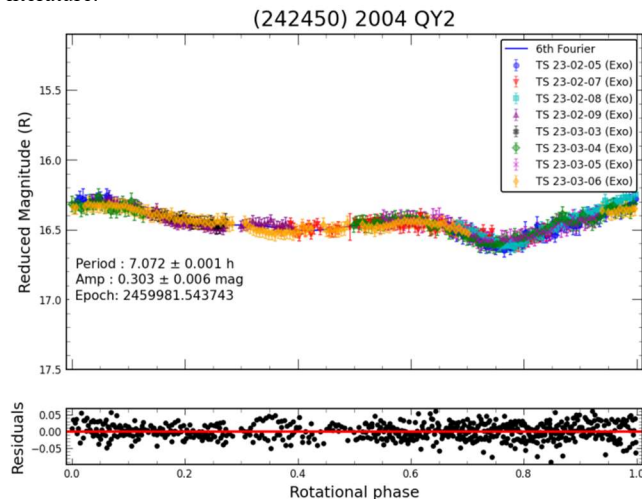
(17188) 1999 WC2 is an S-type NEA (Lin et al., 2018) that belongs to the Apollo family. It was observed for four nights with TS in December 2022 with a total duration of 11.37 h that corresponds roughly to twice its rotation period. All the observations were made using the Exo filter (a broad blue-cutting filter). The best fitting period found is (5.064 ± 0.002) h, which is in agreement with the values reported in ALCDEF (Warner, 2021). An approximate ratio of the a and b axis of 1999 WC2 calculated from the amplitude was found to be 1.38, which with the common bimodal form of the lightcurve suggest an elongated shape.

(242450) 2004 QY2 is a potentially hazardous asteroid. A close approach for this asteroid at a distance of 0.047 au to the Earth is expected in July 2029. We have observed it extensively using the Exo filter for eight nights with TS, four nights in early February and four nights in early March. The best fitting period found is (7.072 h ± 0.001) h. We did not find a rotation period reported in the literature.


(503871) 2000 SL. This NEA was observed extensively for 12 nights in April and May 2023. Five nights with TS in late April and seven nights with TN in early May with a total duration of 36.41 h. All the observations were made using the Exo filter. The best fitting period found is (10.6504 ± 0.0020) h. We did not find a rotation period reported in the literature. In addition, BVRI sequences were acquired with TS on April 27, 2023, yielding B-V = 0.86 ± 0.01, V-R = 0.49 ± 0.01, V-I = 0.89 ± 0.03. These color indices indicate an S-type classification, as already reported by others (e.g., Binzel et al., 2019).

2023 DZ2 is a NEA that approached the Earth at a distance of 0.00117 au in March 2023. During this event, the radar images from Goldstone showed an elongated shape (*https://echo.jpl.nasa.gov/asteroids/2023DZ2/2023DZ2.2023.gold stone.planning.html*). It was observed for one night with both TN and TS at the same time which provided an observing run of 7.82 h. The best period found is (0.104587 ± 0.000083) h (~6 min), which is in agreement with the values reported in ALCDEF (Warner, 2021). We found a large amplitude equals to 0.58 mag. The corresponding axis ratio is 1.70, which suggests an elongated shape, but we note that the phase angle was over 60 degrees.

2023 DZ2

Period : 0.104587 ± 0.000083 h
Amp : 0.58 ± 0.02 mag
Epoch: 2460025.507281
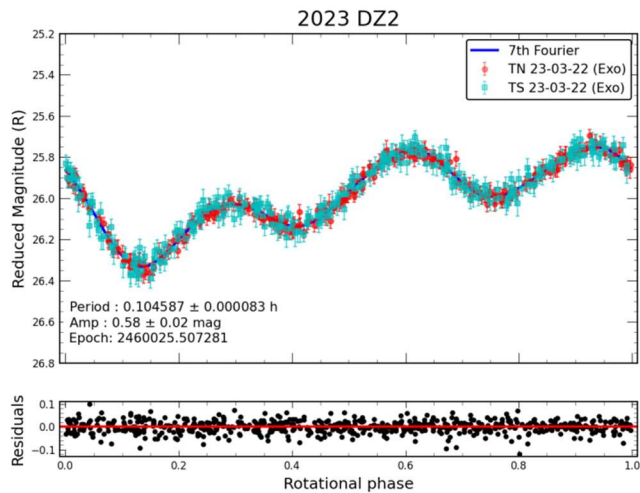
2023 CM is a potentially hazardous asteroid that approached the Earth at a distance of 0.026 au in March 2023. It was observed for three nights in March 2023 with TS using the Exo filter. The best fitting period found is (3.6244 ± 0.0004) h, which is in agreement with the values reported in ALCDEF (Warner, 2021). We also measured the colors of 2023 CM during the last night of observation and found colors indices B - V = 0.83 ± 0.04, V - R = 0.45 ± 0.04, V - I = 0.79 ± 0.06, which suggest a Q-type classification.
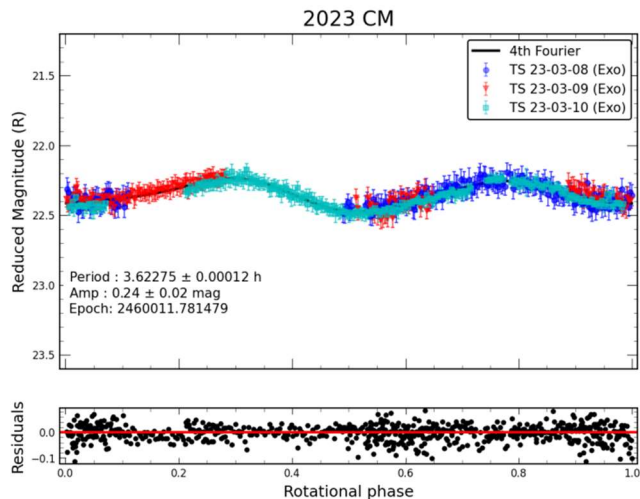
2023 CM

Period : 3.62275 ± 0.00012 h
Amp : 0.24 ± 0.02 mag
Epoch: 2460011.781479

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