ROTATION PERIOD DETERMINATION FOR 299 THORA

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This is the first comprehensive photometric investigation ever made of 299 Thora. We find a synodic rotation period 273.6 ± 0.2 hours, amplitude 0.39 magnitudes. Inaccuracies in calibration star magnitudes and possible changes in the shape of the lightcurve through the two months of observation prevent finding any possible tumbling behavior.

Warner et al. (2014) state no previous photometric observations of 299 Thora. First author Pilcher on the first nights found very slow magnitude changes and invited second author Alvarez to collaborate. Author Pilcher used a 35 cm f/10 Meade LX200 GPS S-C, SBIG STL-1001E CCD, unguided, clear filter with infrared blocker. Author Alvarez used a 30 cm f/6.9 Meade LX200 ACF S-C, QSI 516 wsg NABG CCD, off axis guiding, clear filter with no infrared blocker. Both authors used *MPO Canopus v.10* software to measure the images photometrically and share data. Each night the instrumental magnitudes were calibrated with up to five comparison stars with near solar colors. The calibration star magnitudes were improved by finding their Sloan r' magnitudes on the Carlsbad Meridian Circle (CMC15) catalog on the VizieR web site (2014), and then subtracting 0.22 to convert to Johnson-Cousins R magnitudes where R = r' – 0.22.

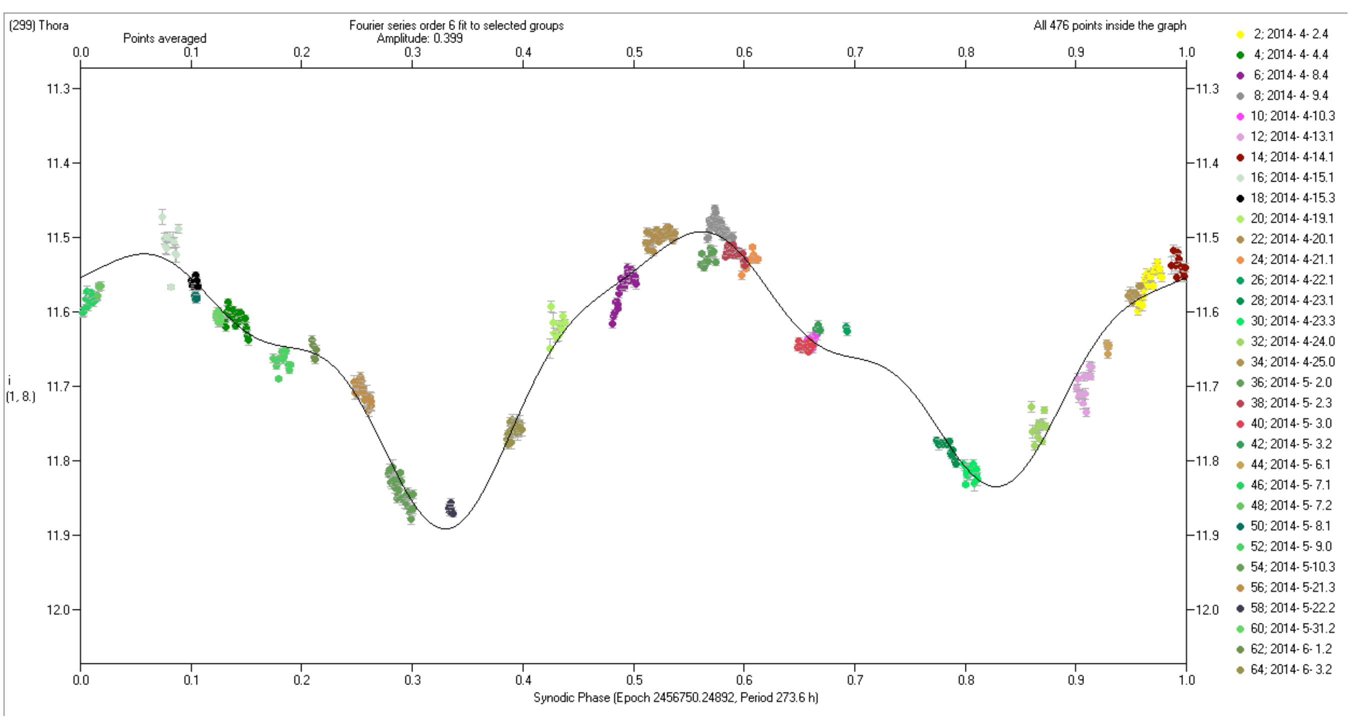
Observations obtained on 32 nights 2014 Apr. 2 – June 3 are summarized on table 1. On three of these nights observer Alvarez ended his session no more than three hours before observer Pilcher started his session and some or all of the same calibration stars could be used. These allowed a precise comparison of calibrated magnitudes by the two equipment sets. In each case Pilcher's data were 0.12 to 0.18 magnitudes brighter than the extrapolation of Alvarez's data. A systematic difference near 0.15 magnitude we attribute to different responses of the CCD sensors and to the clear filters being IR blocked and non IR blocked, respectively. An additional random difference of a few x 0.01 magnitudes also appears. These differences prevent precise calibration of comparison star magnitudes.

The period of 273.6 hours is well established by the data, with a formal error ± 0.2 hours, with amplitude 0.39 ± 0.04 magnitudes. A real uncertainly may be greater, perhaps on an order one hour, due to possible systematic errors in the calibrations and the assumption of principal axis rotation. A possible second frequency, which would be presumably due to tumbling, is not detectable with the given quality of data calibrations. The data fit reasonably well with the 273.6 hour period, there are a few small deviations apparent, but they could be due to calibration uncertainties and/or lightcurve evolution during the two month long observational interval. Thus, we cannot tell from the available data whether the asteroid is in principal axis rotation or if there may be some tumbling. In the composite lightcurve nearby points are averaged (taken over an interval not longer than 1% of the main period with averaging of more than 13 points was suppressed.)

References

VizieR (2014). *http://vizier.u-strasbg.fr/viz-bin/VizieR*

Warner, B. D., Harris, A. W., Pravec, P., "Asteroid Lightcurve Data Base, Revised 2014 March 1." *http://minorplanet.info.lightcurvedatabase.html*



Session	Observer	Session Data 2014	UT	Data Pts
2	FP	Apr 2	06:09 – 12:11	273
4	FP	Apr 4	05:56 – 12:00	270
6	FP	Apr 8	05:35 – 11:45	267
8	FP	Apr 9	05:13 – 11:45	328
10	FP	Apr 10	05:40 – 08:34	115
12	EMA	Apr 13	00:23 – 04:31	114
14	EMA	Apr 13-14	23:46 – 03:45	87
16	EMA	Apr 14-15	23:54 – 04:02	109
18	FP	Apr 15	07:12 – 08:58	89
20	EMA	Apr 18-19	23:54 – 03:47	96
22	EMA	Apr 19-20	23:27 – 07:05	200
24	EMA	Apr 20-21	23:12 – 03:36	113
26	EMA	Apr 22	01:03 – 01:41	20
28	EMA	Apr 22-23	23:22 – 04:29	120
30	FP	Apr 23	06:12 – 10:02	139
32	EMA	Apr 23-24	22:54 – 02:55	113
34	EMA	Apr 24-25	22:58 – 02:04	91
36	EMA	May 1-2	22:42 – 02:43	106
38	FP	May 2	04:57 – 10:00	250
40	EMA	May 2-3	22:40 – 02:44	109
42	FP	May 3	03:20 – 04:28	49
44	FP	May 6	03:12 – 03:50	33
46	EMA	May 6-7	23:14 – 03:09	113
48	FP	May 7	03:10 – 04:05	46
50	FP	May 8	03:10 – 03:57	42
52	EMA	May 8-9	22:36 – 03:00	115
54	FP	May 10	03:11 – 09:26	296
56	FP	May 21	04:08 – 08:48	195
58	FP	May 22	03:36 – 04:45	60
60	FP	May 31	03:36 – 05:00	68
62	FP	June 1	03:27 – 04:41	46
64	FP	June 3	03:40 – 07:31	190

Table 1. Observing Circumstances. In the observer column EMA is Alvarez at OLASU and FP is Pilcher at Organ Mesa.

TROJAN ASTEROIDS OBSERVED FROM CS3: 2014 JANUARY - MAY

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Lightcurves for eight Jupiter Trojan asteroids were obtained from the Center for Solar System Studies from 2014 January to May.

The Jovian Trojan asteroids are found in orbits near the stable L4 and L5 Langrange points of Jupiter's orbit. They are thought to have formed further from the Sun and their composition and collisional history appears to be different from main-belt asteroids. The rotation properties of Trojan asteroids are poorly known compared to those of main-belt asteroids. The lower albedo and greater distance of the Trojans makes them more difficult to observe. Here we report lightcurve data for 8 Trojans. Most are in the 50 – 100 km diameter size range, many of which were observed to collect data for future pole solutions and shape models.

All images were made with a 0.4-m or two 0.35-m SCTs with a FLI-1001e, a SBIG STL-1001E or a SBIG ST-9E CCD camera. Images were unbinned with no filter and had Master flats and darks applied to the science frames prior to measurement. Measurements were made using MPO Canopus, which employs differential aperture photometry to produce the raw data. Period analysis was done using MPO Canopus, which incorporates the Fourier analysis algorithm (FALC) developed by Harris (1989). Night-to-night calibration of the data (generally < ±0.05 mag) was done using field stars converted to approximate Cousins V magnitudes based on 2MASS J-K colors (Warner 2007). The Comp Star Selector feature in MPO Canopus was used to limit the comparison stars to near solar color.

624 Hektor. As one of the brightest Trojans, Hektor has been observed a number of times. All reported results have a synodic rotational period of around 6.92 h. This year it was undertaken as a "Full Moon" project and the period found is consistent with those results. Marchis (2006) reports that Hektor is a binary and the primary is an ellipse with major and minor axes of approximately 350 km by 210 km. It has a satellite about 10 km in diameter orbiting about 600 km distant (Marchis 2014).

911 Agamemnon. The authors observed Agamemnon twice before (French 2012, Stephens 2009) and undertook observations this year in hope of getting sufficient data for a shape model in the future. This year's results are similar to those past results and that obtained by Mottola (2011).

1143 Odysseus. Also undertaken as a "Full Moon" project, Odysseus has been previously observed several times. Molnar