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MAIN-BELT AND TROJAN ASTEROIDS OBSERVED FROM CS3: 2022 OCTOBER-NOVEMBER

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CCD photometric observations of three main-belt asteroids and four Jovian Trojans from the L4 cloud were obtained at the Center for Solar System Studies (CS3) from 2022 October-November. Revised periods for 4060 Deipylos from previous oppositions are also reported.

The Center for Solar System Studies (CS3) has nine telescopes which are normally used in program asteroid family studies. The focus is on near-Earth asteroids, Jovian Trojans and Hildas. When it is not the season to study a family, or when a nearly full moon is too close to the family targets being studied, targets of opportunity amongst the main-belt families were selected.

Table I lists the telescopes and CCD cameras that were used to make the observations. Images were unbinned with no filter and had master flats and darks applied. The exposures depended upon various factors including magnitude of the target, sky motion, and Moon illumination.

Telescope	Camera
0.40-m f/10 Schmidt-Cass	FLI Proline 1001E
0.50-m F/8.1 R-C	FLI Proline 1001E

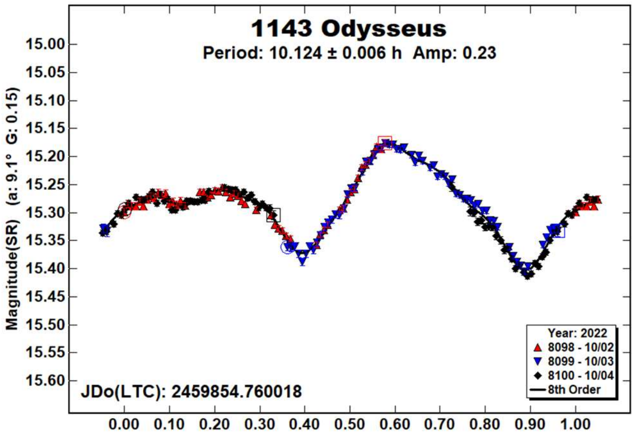
Table I: List of CS3 telescope/CCD camera.

Image processing, measurement, and period analysis were done using *MPO Canopus* (Bdw Publishing), which incorporates the Fourier analysis algorithm (FALC) developed by Harris (Harris et al., 1989). The Comp Star Selector feature in *MPO Canopus* was used to limit the comparison stars to near solar color. Night-to-night calibration was done using field stars from the ATLAS catalog (Tonry et al., 2018), which has Sloan *griz* magnitudes that were derived from the GAIA and Pan-STARR catalogs and are “native” magnitudes of the catalog. Those adjustments are usually ≤ ±0.03 mag. The rare greater corrections may have been related in part to using unfiltered observations, poor centroiding of the reference stars, and not correcting for second-order extinction.

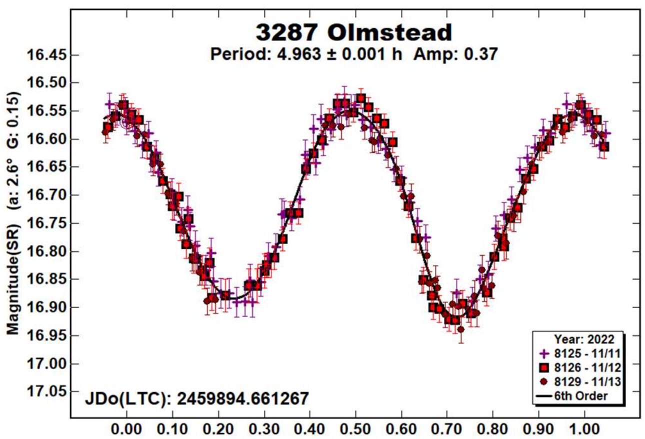
The Y-axis values are ATLAS SR “sky” magnitudes. The two values in the parentheses are the phase angle (a) and the value of *G* used to normalize the data to the comparison stars used in the earliest session. This, in effect, made all the observations seem to be made at a single fixed date/time and phase angle, leaving any variations due only to the asteroid’s rotation and/or albedo changes. The X-axis shows rotational phase from -0.05 to 1.05. If the plot includes the amplitude, e.g., “Amp: 0.65”, this is the amplitude of the Fourier model curve and *not necessarily the adopted amplitude for the lightcurve*.

For brevity, only some of the previously reported rotational periods may be referenced. A complete list is available at the asteroid lightcurve database (LCDB; Warner et al., 2009).

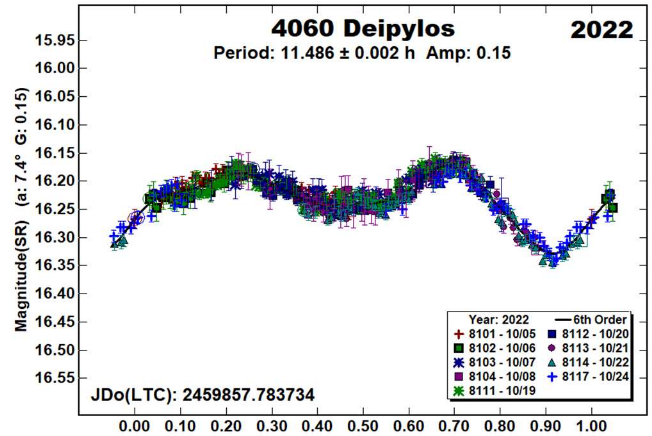
1143 Odysseus. Odysseus has been observed many times in the past (Stephens and Warner, 2022 and references therein) with most reported periods in the LCDB near 10.1 h. Our period this year is in good agreement with those prior results.

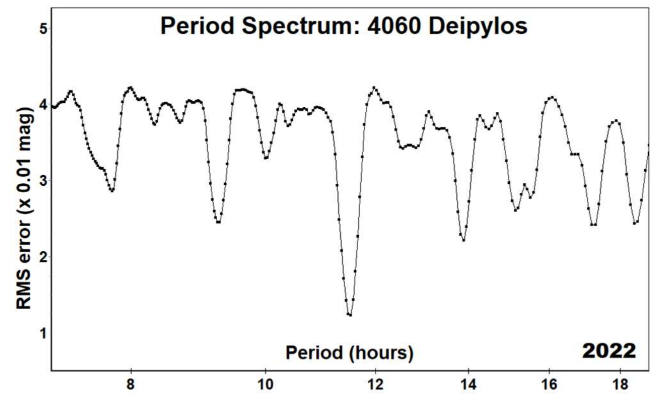


3287 Olmstead. This Mars-crosser has been observed three times in the past. Wisniewski et al. (1997) reported a period of 4.80 h, Warner (2018) reported a period of 4.963 h, and Benishek (2019) reported a period of 4.954 h. Our period this year is in good agreement with the Warner and Benishek results.

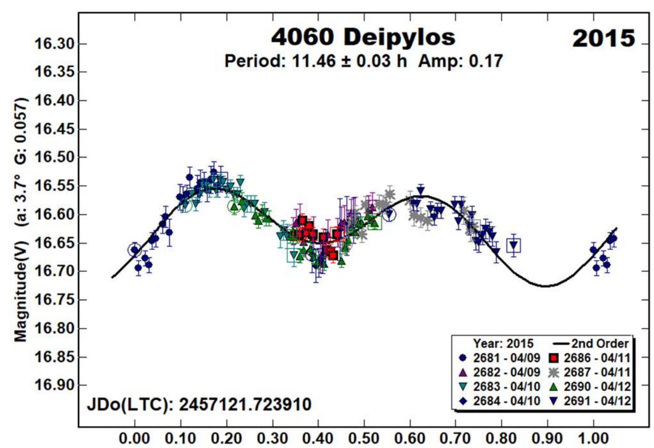


4060 Deipylos. This L_4 Trojan has been observed many times in the past (Stephens and Warner, 2020 and references therein), with most reported periods near 9.3 h. However, that period would not fit the dataset we got this year. The asymmetric lightcurve was a much better fit to a period of 11.486 h. The period spectrum shows a secondary peak near 9.3 h, which is a 5:4 alias of the 11.487 h period.



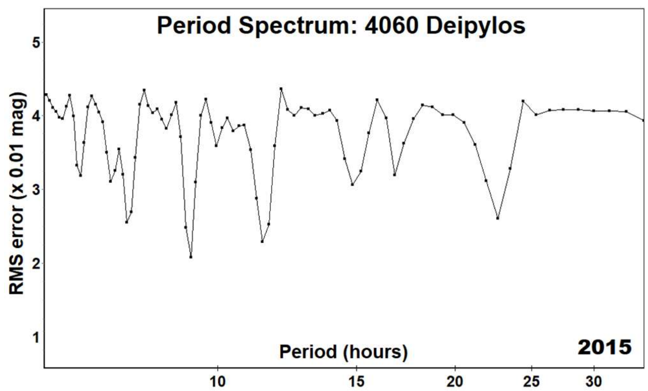


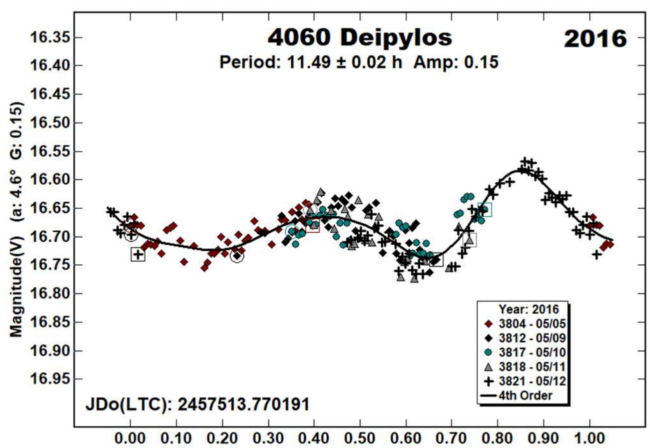
We rephased the periods we found in previous years, many of which showed the 9.3 h period as the dominant period, with a secondary peak near 11.5 h. With the 11.5 h period being nearly commensurate with an Earth's Day, it takes observations spanning two weeks to completely cover a lightcurve. Most of those prior datasets spanned only a week leaving gaps in the lightcurve assuming the 11.5 h period. This is particularly true for the 2017 dataset which has a 40% gap in the lightcurve. Because the 2022 dataset eliminates the possibility of a 9.3 h period, we favor the 11.5 h period for all of the datasets.

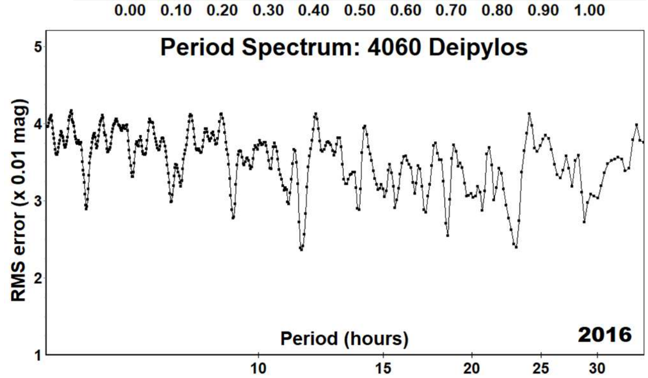


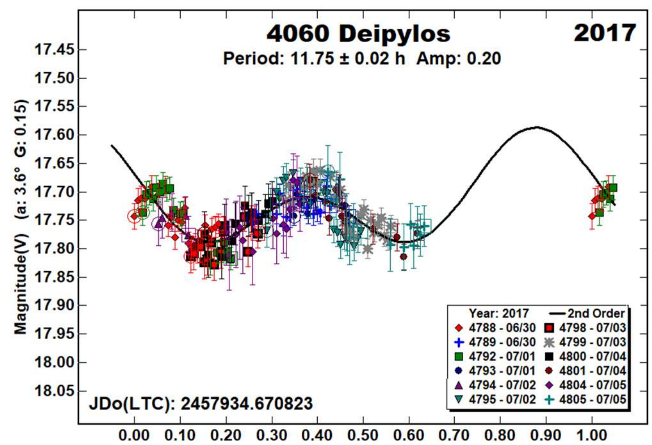
Number	Name	2022/mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.
1143	Odysseus	10/02-10/03	9.1,8.9	55	-1	10.124	0.006	0.23	0.01
3287	Olmstead	11/11-11/13	2.6,3.4	46	-4	4.963	0.001	0.37	0.01
4060	Deipylos	10/06-10/24	7.3,4.5	44	-15	11.486	0.002	0.15	0.01
		2015/04/09-04/12	3.7,3.3	212	12	^{R}11.46	0.03	0.17	0.04
		2016/05/09-05/12	4.1,3.8	242	17	^{R}11.49	0.02	0.15	0.05
		2017/06/30-07/05	3.6,4.1	269	17	^{R}11.75	0.02	0.10	0.05
		2018/08/13-08/19	5.2,6.0	293	14	^{R}11.38	0.03	0.12	0.02
		2019/08/17-08/22	2.0,2.6	318	9	^{R}11.62	0.02	0.13	0.02
4489	Dracius	11/14-11/19	3.9,4.1	45	-17	12.599	0.006	0.22	0.02
5123	Cynus	11/14-11/17	1.1,0.9	55	-4	9.903	0.002	0.49	0.01
7445	Trajanus	11/11-11/13	7.3,8.6	38	0	6.108	0.002	0.79	0.02
10182	Junkobiwaki	10/23-10/31	*1.0,2.8	32	1	4.318	0.003	0.07	0.02

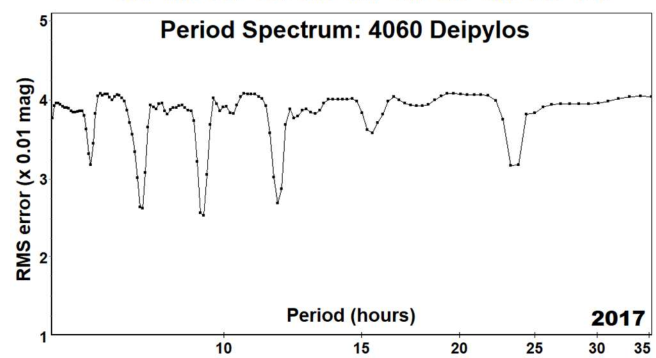
Table II. Observing circumstances and results. ^{R}Revised period. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extremum during the period. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range (see Harris et al., 1984). If more than one line for an asteroid, the first line gives the dominant solution and has a ^{T} superscript. Subsequent lines are additional, not alternate, periods. See the text for more details.

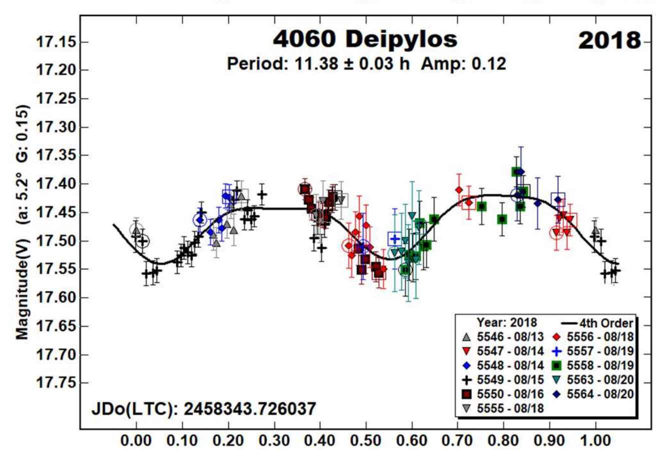


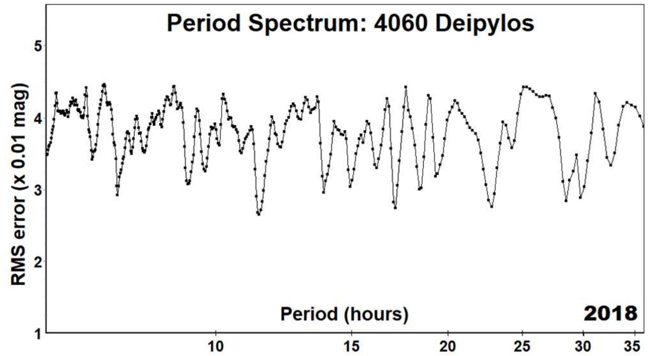


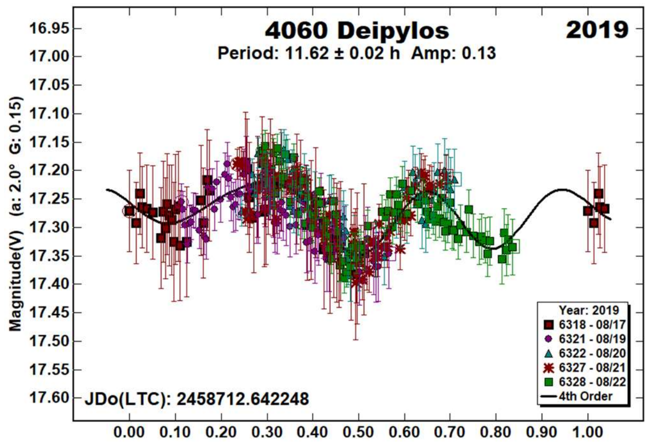


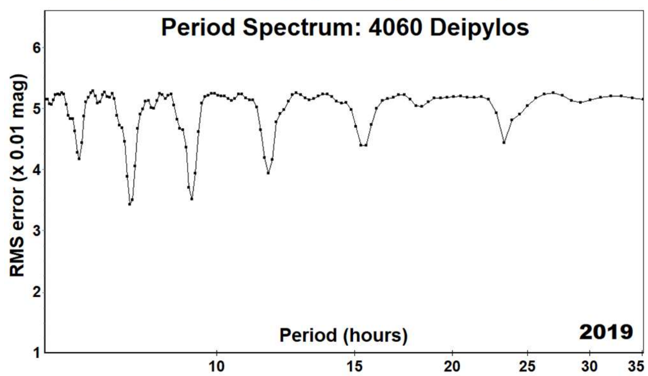




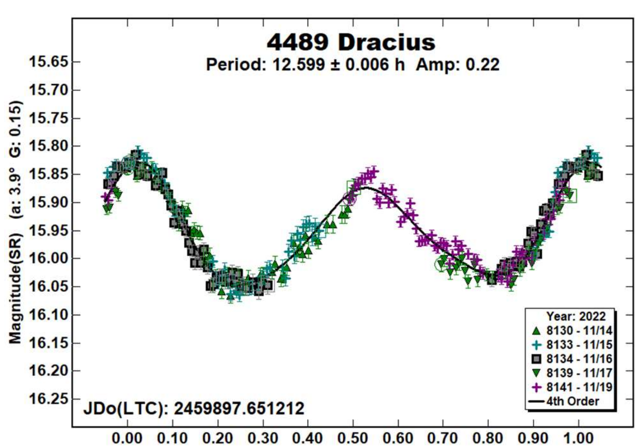




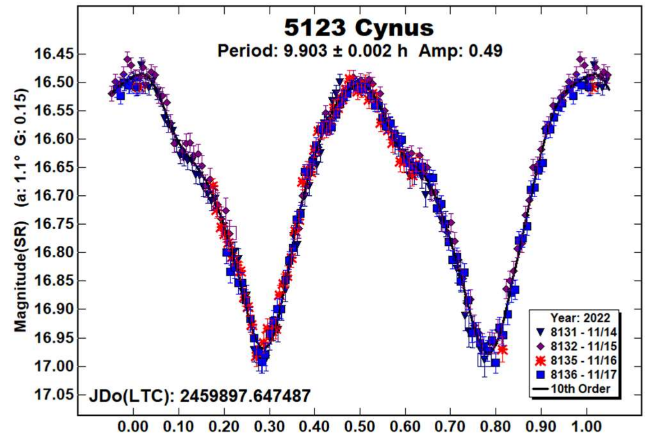




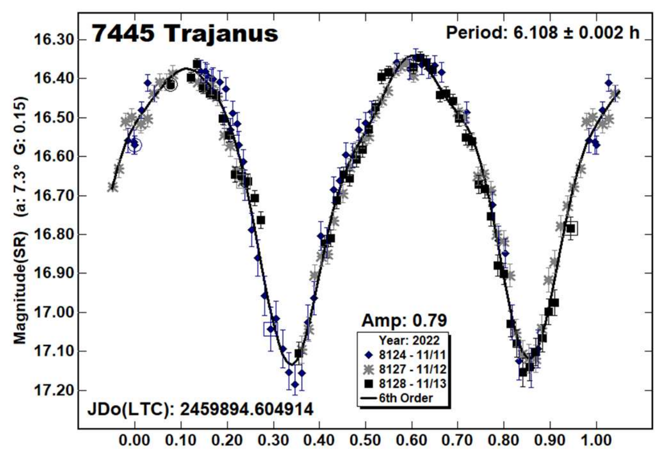
4489 Dracius. Rotational periods for this L_4 Trojan have been found many times in the past (Stephens et al., 2016 and references therein), each time finding a period near 12.58 h. In addition, using sparse data, Ďurech et al. (2019) found a sideral period of 12.58423 h. The result this year is in good agreement with the prior findings.



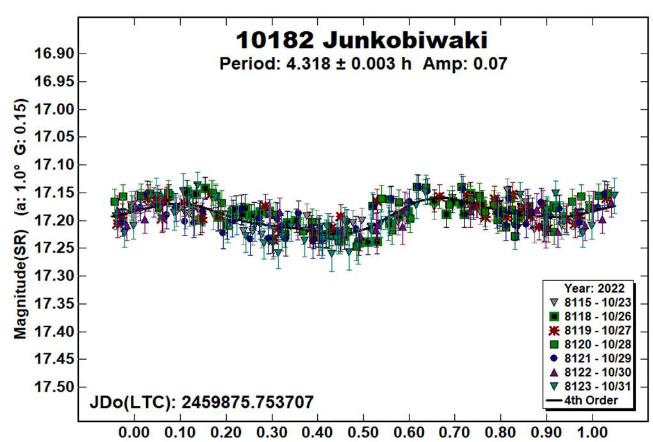
5123 Cynus. A period for this L_4 Trojan has been reported several times in the past. French et al. (2013), Ryan et al. (2017), and Szabó et al. (2017) all found periods near 9.9 h. The result this year is in good agreement with those prior findings.



7445 Trajanus. The only previous period reported on the LCDB for this Mars-crosser has been by Durech et al. (2018), who used data from the Lowell Photometric Database and WISE data to find a sidereal period of 6.10802 h. Our period this year is in good agreement with that prior result.



10182 Junkobiwaki. This inner Main-belt asteroid has been observed twice in the past. Pravec et al. (2017web) observed it finding a period of 4.3081 h. Using data from the TESS spacecraft, Pál et al. (2020) found a period of 4.30884 h. Our result this year is in good agreement with those prior results. In none of the results does the amplitude exceed 0.08 mag.



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