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References

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A PHOTOMETRIC STUDY OF 1144 ODA

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Minor planet 1144 Oda is a tumbling asteroid with periods probably near 648 hours and 553 hours, maximum amplitude 0.55 ± 0.05 magnitudes

Minor planet 1144 Oda, $a = 3.754$ AU, $e = 0.096$, $i = 9.74^\circ$, is the only large diameter asteroid ($D \sim 55$ km) with an orbit lying between the outer edge of the Cybele zone near 3.65 AU and the inner edge of the Hilda 3:2 Jupiter resonators near 3.88 AU.

Previously published rotation periods for 1144 Oda are 14.4 hours from a very sparse lightcurve (Behrend, 2006) and by Waszczak et al. (2015) who made 1 to 4 measurements on each of 11 nights from 2011 May 11 through June 20 for a total of 26 data points to derive a period of 44.023 hours and amplitude 0.41 magnitudes.

A more comprehensive survey was made at the Organ Mesa Observatory with a 0.35-meter Meade LX200 GPS Schmidt-Cassegrain (SCT) and SBIG STL-1001E CCD. Exposures were 120 seconds, unguided, with a clear filter. All measurements were calibrated from CMC15 Sloan r' values converted to Cousins R magnitudes using $R = r' - 0.22$ for solar-colored field stars. Photometric measurement was with *MPO Canopus* software.

Sixty sessions were obtained from 2018 Feb 8 through May 21. A raw lightcurve prepared by *MPO Canopus* including data from all sessions features a quasi-periodic variation with the usual two maxima and minima per cycle in a period near 615 hours, but with an amplitude varying from near zero to a maximum of about 0.55 magnitudes. To reduce the number of points on this lightcurve and make it easier to read, data points have been binned in sets of 3 with a maximum time difference of 6 minutes between points in each bin.

The author thanks Petr Pravec (personal communication) for the application of simultaneous dual-period software to the complete data set. Tumbling behavior is confirmed. However, a period solution is not very clear. The most likely periods may be about 648 and 553 hours, but other values are also possible. It is not determined which period is rotation and which is precession. There are also signals for periods around 51.8 and 44.1 h, but they appear to be aliases with Earth rotation: Note that $1/51.8 = 1/48 - 1/648$ and $1/44.1 = 1/48 + 1/553$. A lightcurve phased to 648 hours with the dual period software illustrates very different successive cycles.

The raw lightcurve is analogous to beat phenomena of two acoustic signals of slightly unequal frequency or period, in which the tumbling periods of 553 hours and 648 hours combine for an

Number	Name	2018/mm/dd	Pts	Phase	LPAB	BPAB	Period(h)	P.E	Amp	A.E.
1144	Oda	02/08-05/21	3979	9.9, 1.2, 13.2	179	5	648 553	10	0.55	0.05
	P2									

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first date, minimum value, and last date. LPAB and BPAB are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris *et al.*, 1984). P2 is the second period of tumbling.

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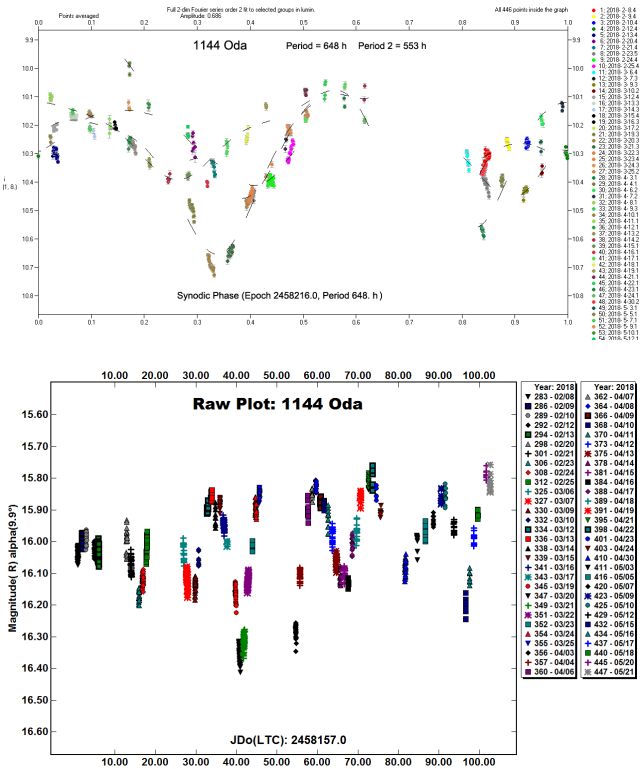
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REDETERMINED ORBITAL PERIOD
FOR THE NEWLY DISCOVERED
NEAR-EARTH BINARY ASTEROID 15745 YULIYA

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A photometric observing campaign conducted in 2018 April and May by Aznar et al. revealed the near-Earth asteroid 15745 Yuliya as a binary system with an orbital period of 15.63 h. Later analysis by Pravec using the dense photometric data obtained in 2018 June by Benishek yielded a different orbital period of 11.735 h, or nearly commensurate with an Earth day.

15745 Yuliya is a relatively large, $D \sim 1$ km, Amor-type near-Earth asteroid discovered at La Silla in 1991 by E.W. Elst. On 2018 June 9, it was announced as being a binary system (Aznar et al., 2018) for which Pravec established a primary period of 3.2486 ± 0.0003 h and an orbital period of 15.63 ± 0.02 h.

Having no information about the possible binary nature of this target, Benishek launched independent photometric observations at Sopot Astronomical Observatory (SAO) on 2018 June 3 using a 0.35-m Schmidt-Cassegrain telescope operating at $f/6.3$ and an SBIG ST-8 XME CCD camera with no filters. A total of eight densely-sampled independent data sets (*sessions*) was obtained by 2018 June 22.

Photometric reduction was performed in *MPO Canopus* software (Warner, 2018) applying differential photometry with up to five field comparison stars of near solar color ($0.5 \leq B-V \leq 0.9$). To ensure satisfactory quality of night-to-night magnitude zero-point calibration, all comparison stars were calibrated using the Cousins R magnitudes derived from the CMC15 Sloan r' magnitudes (VizieR, 2018) by the formula: $R = r' - 0.22$.

Certain deviations closely resembling attenuations typical of binary asteroids were seen in early data sets. A rough preliminary analysis by Benishek found a period of about 11.74 h but it was not possible to distinguish whether it was a rotational period or an orbital period of a possible binary system.

Suspecting that 15745 Yuliya could be a binary system, Benishek sent his data to Pravec for a detailed analysis on 2018 June 23. At that point, the report on 15745 Yuliya as a binary asteroid (Aznar et al., 2018) had already been published. The announced system parameters had been found from the period analysis done by Pravec as part of the discovery team. Nevertheless, he agreed to

Number	Name	2018/mm/dd	Pts	Phase	L _{PAB}	B _{PAB}	Period (h)	P.E.	Amp	A.E.	Grp
15745	Yuliya	06/03-06/21	258	35.6, 35.1	255	29	3.2495	0.0002	0.08	0.02	NEA
	P _{ORB}						11.735	0.003	0.21-0.26		

Table I. Observing circumstances and results. Pts is the number of data points. Phase is the solar phase angle given at the start and end of the date range. L_{PAB} and B_{PAB} are the average phase angle bisector longitude and latitude (see Harris et al., 1984). Grp is the asteroid family/group (Warner et al., 2009): NEA = near-Earth asteroid

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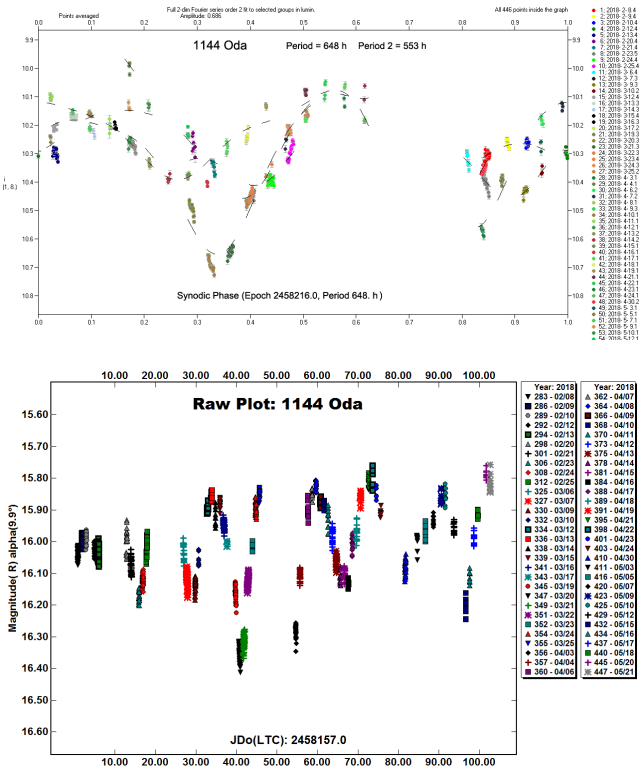
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