LIGHTCURVE ANALYSIS OF NEA (192642) 1999 RD32

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CCD photometry observations of the near-Earth asteroid (192642) 1999 RD32 were made in support of radar observations during a close approach in 2012 March. Analysis of the data indicates a period of 17.08 ± 0.03 with an amplitude of 0.28 mag. The possibility that the asteroid is in non-principal axis rotation (tumbling) cannot be formally excluded.

In 2012 March, the near-Earth asteroid (192642) 1999 RD32 made a fly-by of Earth at ~0.15 AU. Radar observers made a call for astrometric and photometric data to help with their observations. The authors collaborated to obtain photometric data a few days before closest approach.

Initial radar observations at Arecibo in Puerto Rico indicated a potentially long period, $P > 100$ h (Nolan, private communications). However, an extended run at the Goldstone facility in California revised this estimate (Benner, private communications), indicating that the viewing aspect was nearly pole-on. This lead to a period estimate in the range of 10-30 h, which made it it more likely that the photometric observations would be able to find a period despite having only a few days when the asteroid was both bright enough and far enough from the sun in the sky to get sufficient data.

Warner (PDO) used a 0.3-m Schmit-Cassegrain with ST-9XE CCD camera at the Palmer Divide Observatory. Megna used 0.35-m SCT and SBIG ST-9 camera at the Center for Solar System Studies. Both sets of data were unfiltered. However, they were placed approximately onto the Johnson V system by using a feature in *MPO Canopus* that uses version DR5 of the APASS catalog (Henden, private communications). In cases where the two observatories were observing at the same time, the data could be overlaid with no or only small adjustments (< 0.03 mag) to the internal zero points.

Warner did the period analysis of the combined data in *MPO Canopus*, find a period of 17.08 ± 0.03 h with an amplitude of 0.28 ± 0.03 mag. However, the data show some deviations from the solution that may indicate tumbling, i.e., non-principal axis rotation (see Pravec *et al.*, 2005). The asteroid makes a return appearance in 2012 November, when it will be brighter and have a slower sky motion. At which time it's hoped to refine the period and look for more outward signs of tumbling.

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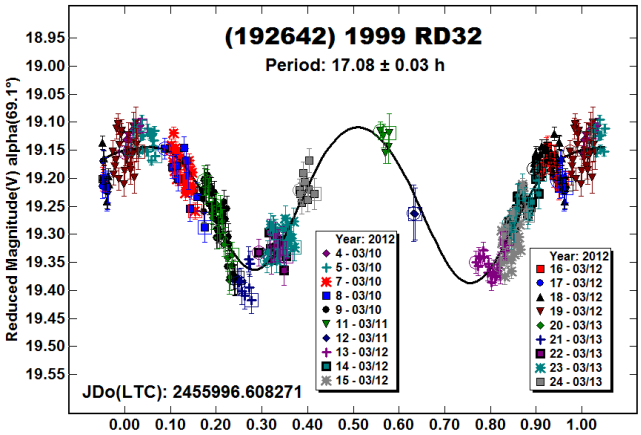

LIGHTCURVE ANALYSIS COLLABORATION FOR 561 INGWELDE AND 621 WERDANDI

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Lightcurves of 621 Werdandi and 561 Ingwelde were obtained by a collaboration between Bassano Bresciano Observatory and Organ Mesa Observatory. Thanks to this collaboration, it was possible to cover the full rotation cycle for both objects, both of which had periods close to half of an Earth day. For 561 Ingwelde we found P = 12.012 ± 0.001 h and for 621 Werdandi, P = 11.776 ± 0.001 h.

561 Ingwelde was started by Pilcher at Organ Mesa Observatory because the Asteroid Lightcurve Data file (Warner *et al.* 2011) showed no previous observations. Observations on 2012 Feb 25 and 26 suggested a period very near 12 hours, for which observations from a greatly different longitude would be required to get full lightcurve coverage. Strabla kindly responded to Pilcher's request and obtained lightcurves on Feb 29 and Mar 14. These, along with five nights by Pilcher from Feb 25 to Mar 21, enabled full lightcurve coverage. Our analysis found a period of 12.012 ± 0.001 h and an amplitude of 0.38 mag.

621 Werdandi was selected for observations by Bassano Bresciano Observatory (565) from "Lightcurve Photometry Opportunities: 2012 January-March" (Warner *et al.* 2012). The asteroid was reported a period 9.396 h and amplitude 0.58 mag with quality code U = 2 (see Almedia *et al.* 2004; Sauppe *et al.* 2007). The asteroid was observed at Bassano Bresciano Observatory for 5 nights covering an 8-day span. The observations were made with a 0.32-m *f*/3.1 Schmidt and Starlight HX-516 CCD camera at prime focus. The 120-second exposures, unfiltered and unguided, were at 2x2 binning and taken when the target's altitude was more than 30°. *Polypus* software (Bassano Bresciano Observatory, 2010) was used for telescope and camera control. All raw images were processed with dark and flat field frames before being measured.

MPO Canopus (Bdw Publishing, 2010) was used to perform differential photometry on the reduced images. It incorporates the Fourier analysis algorithm developed by Harris (Harris *et al.*, 1989). Comparison stars were selected with the Comp Star Selector in *MPO Canopus* and restricted to near solar-color in order to match the approximate color of the asteroid. Preliminary analysis showed the same lightcurve phase every night. The longest session (8.5 hours) showed only one minimum and one maximum, suggesting a period longer than 9 hours with the most probable solution near 12 hours. A collaboration request was posted on CALL web site in order to have observations from a significantly different longitude.

Frederick Pilcher at Organ Mesa Observatory responded to this request with four more sessions, 2012 Feb. 14-19. He used a 0.35-m Meade LX-200 GPS Schmidt-Cassegrain with SBIG STL-1001E CCD camera. Exposures, also unfiltered and unguided, were 60 seconds. The large longitude span between observatories made it possible to obtain full coverage of the lightcurve. The individual observing sessions were adjusted to an internal zero point by adjusting the DeltaComp value in *MPO Canopus*. Based on a solution with the lowest RMS error, we found P = 11.776 ± 0.001 h with an amplitude A = 0.80 mag.

Acknowledgements

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Observatory	Date	Phase Angle	Time h.	Num. Obs	Filter
561 Ingwelde					
Organ Mesa	2012-02-25	7.2	7.9	361	C
Organ Mesa	2012-02-26	6.8	8.1	338	C
Organ Mesa	2012-02-29	5.7	7.9	323	C
Bassano Br.	2012-02-29	5.5	6.0	140	C
Bassano Br.	2012-03-14	0.2	6.7	102	C
Organ Mesa	2012-03-17	1.1	8.5	395	C
Organ Mesa	2012-03-21	2.6	3.6	187	C
621 Werdandi					
Bassano Br.	2012-01-23	9.0	6.0	86	C
Bassano Br.	2012-01-25	7.1	8.5	194	C
Bassano Br.	2012-01-26	10.2	1.0	34	C
Bassano Br.	2012-01-29	11.3	2.0	55	C
Bassano Br.	2012-01-30	11.6	2.5	62	C
Organ Mesa	2012-02-14	15.9	3.5	158	C
Organ Mesa	2012-02-15	16.2	3.8	153	C
Organ Mesa	2012-02-18	16.9	7.1	270	C
Organ Mesa	2012-02-19	17.1	5.2	237	C

Table I. Observation circumstances.