LIGHTCURVE AND PERIOD OF THE NEA 2010 WA9

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The authors report on the results of photometric observations of near-Earth asteroid (NEA) 2010 WA9. The synodic rotation period is 0.097 ± 0.002 h, with an amplitude of 1.4 ± 0.2 mag.

The asteroid 2010 WA9 was discovered by Andrea Boattini, Mt. Lemmon Survey, on 2010 Nov. 30.27 and announced on MPEC 2010-X05. Astrometric observations continued until 2010 Dec. 10.96, with one of us (LB) supplying the last observations. From the analysis of its orbital parameters (a = 1.225 AU, q = 0.839 AU), the asteroid belongs to the Apollo class of near-Earth asteroids (NEA). From its absolute magnitude (H) of 25.6 taken from JPL Small-Body Database Browser, we can derive a diameter ranging from 20 to 50 meters, depending on its albedo.

Here we present a lightcurve obtained from Dec.10.9567 to 10.9650 at G.V. Schiaparelli Astronomical Observatory and analyzed at OAVdA. One hundred images, each of 5 seconds exposure, were obtained with the 0.60-m f/4.64 reflector and CCD SBIG ST10-XME (2184×1672 pixels, 6.8 microns). No filter was used and the camera was binned 3×3. This gave a field-of-view of 18.4×12.3 arcminutes and a pixel scale of 1.51 arcsec/pixel. At the time of the observations, the asteroid was 0.014 AU from Earth and 0.995 AU from the Sun, at phase angle α = 41°, and travelling at an average rate of 26.68 arcsec/minute.

One of us (AC), used *MPO Canopus* v10.2 (Warner, 2009) to measure the images and do the period analysis of the lightcurve. For a first reduction, all 88 images were used. The raw lightcurve (Fig. 1) shows an obvious oscillation centered at about R = 17.8. The errors are larger near the minima, when the SNR was very low. In order to increase the SNR, the images were summed 4 at a time to create a new set of 22 images with higher SNR. The images were stacked with a drift velocity intermediate between the sidereal tracking and the asteroid's tracking and with the same PA of the target. In this way, the elongation of the target and reference stars is the same. We used elliptical aperture in *MPO Canopus*, with the semi-axes proportional to those of the elongated star images and with the major axis parallel to the motion direction. Fig. 2 shows the result after measuring the stacked images.

Our analysis of the revised data set found a period of 0.097 ± 0.002 h (349 ± 7 s). The amplitude of second lightcurve was more easily determined than by using Fig. 1. Adopting the method outlined in Carbognani (2010) with a polynomial interpolation of fifth degree, the amplitude is A(41°) = 1.4 ± 0.2 mag. If we correct the amplitude to zero phase angle using the empirical formula by Zappala *et al.* (1990) m = 0.03/deg, the mean value for S-type asteroids and common among NEAs, we have A(0°) = 0.6 ± 0.2 mag. Assuming a triaxial ellipsoid (semi-major axis a, b, c), then we found a lower limit for the ratio (a/b) using $a/b = 10^{(A/2.5)}$ = 1.8 ± 0.3 (Warner, 2006).

The rotation period of this asteroid is under the spin barrier value of about 2.2 h, which is consistent with its small size (Pravec and Harris, 2000). The period and the lower limit for the a/b ratio provide constraints on the internal structure of the asteroid, i.e., it is most likely an elongated body that is strength-bound (e.g., monolithic) rather than gravity-bound (a so-called "rubble pile").

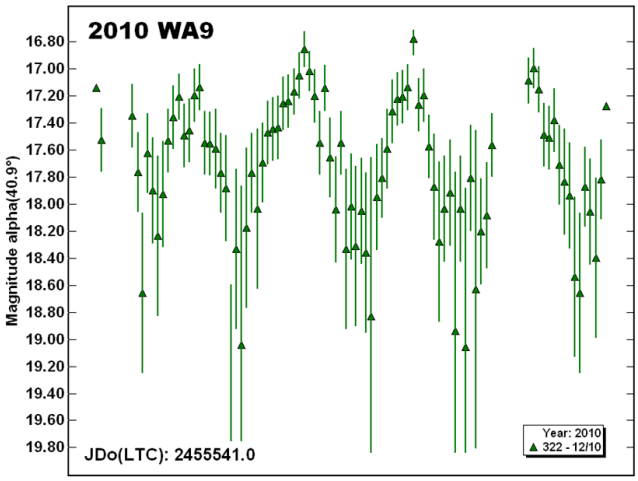

Figure 1. The raw lightcurve of 2010 WA9 with all 88 data points.

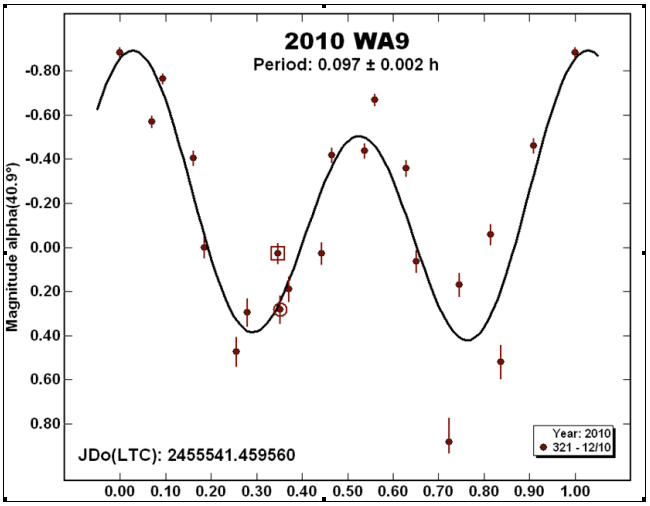

Figure 2. The full lightcurve and period of 2010 WA9 using 22 binned images (see text).

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