Time-series Photometry of Earth Flyby Asteroid 2012 DA_{14}

TERAI, Tsuyoshi, YOSHIDA, Fumi (NAOJ)
URAKAWA, Seitaro (Japan Spaceguard Association)
TAKAHASHI, Jun (University of Hyogo)
OASA, Yumiko, OSHIMA, Goichi, ARATANI, Kenta, HOSHI, Hisaki
SATO, Taiki, USHIODA, Kazutoshi
(Saitama University)

2012 DA_{14}, a near-Earth object in diameter of several ten meters, passed closely to the Earth at a distance of about 27,700 km inside a geosynchronous orbit on February 16, 2013 JST. Such a small asteroid is usually too faint to be observed, The Earth flyby allowed us for precise measurements of 2012 DA_{14} even with a small telescope because the asteroid became brighter than 7th magnitude in the optical. We focused on wide variation of the solar phase angle of 2012 DA_{14} around its closest approach and performed a time-series photometric observation to obtain the phase curve. It provides useful indications of asteroid surface properties, such as geometric albedo and regolith structure. This event was an exciting opportunity to investigate the surface properties of such a small asteroid.

Our observations have been carried out for 2 hours around the closest approach of 2012 DA_{14} using the 0.55-m telescope at Saitama University. Since the asteroid moved on the sky with extremely high speed of ~50 arcmin min^{-1} in maximum, we mounted a CCD camera on the prime focus to cover a wide field of view (32′ × 32′) and took images sequentially with 0.5-sec exposures. The instrument and technique allowed us to keep tracking the asteroid all over this observation. Fortunately, in contrast, the phase angle was constant during the following night. We performed an additional observation on the next night to measure the rotational lightcurve.

Our periodogram analysis determined the rotational period of 11.0 hr and peak-to-peak amplitude of 1.6 mag [1]. The best-fit synthetic model generated from a combination of a given phase curve and the obtained rotational lightcurve shows that the slope of the phase curve is significantly shallower than that of S-type asteroids. 2012 DA_{14} has been classified as an L-type asteroid [2,3] the typical geometric albedo of which is low compared to S-type asteroids. This result is inconsistent with the known inverse correlation between phase curve and geometric albedo, indicating that 2012 DA_{14} is likely to have a different surface property from known L-type asteroids. We suggest that 2012 DA_{14} is coated with a coarse surface that lacks fine regolith particles and/or a high albedo surface.

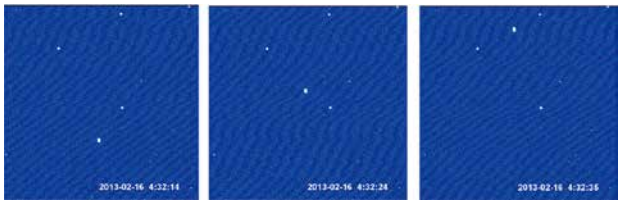

Figure 1: *R*-band images of 2012 DA_{14} at the closest approach with 0.5-sec exposures. Time is shown in JST. The field of view covers 32′ × 32′.

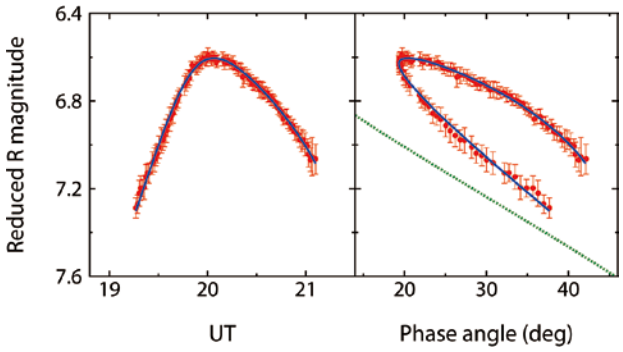

Figure 2: Brightness variation of 2012 DA_{14} around the closest approach. The horizontal axes show time (left) and solar phase angle (right). The circles, solid lines, and dotted line are the data points, best-fit synthetic model, and model phase function, respectively.

References

[1] Terai, T., et al.: 2013, *A&A*, **559**, A106.
[2] de Leon, J., et al.: 2013, *A&A*, **555**, L2.
[3] Urakawa, S., et al.: 2013, *PASJ*, **65**, L9.