Observation campaign for the near-Earth object 2012 DA_{14} in Japan

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We present the observation campaign for the near-Earth object 2012 DA_{14} (hereafter, DA_{14}). The asteroid DA_{14} came close to the Earth's surface on 2013 February 15, 19:33 UT, at a distance of 27,700 km. DA_{14}'s altitude from the horizon in Japan was $\sim 30^\circ$ at the closest approach time. The estimated diameter of DA_{14} is $\sim$50 m. The close encounter and the horizontal altitude made it possible to conduct a variety of observations for this tiny asteroid using small- and medium-sized telescopes. There have been few detailed observations, including spectroscopy, of asteroids smaller than 100 m in diameter. Moreover, the close encounter might results in a change for the rotational period and the surface spectrum due to the tidal forces. The observations around the closest approach are useful to investigate such physical changes. We performed visible spectroscopy, near-infrared photometry, and time-series photometry in the visible wavelength region. The visible spectroscopy was conducted using the 0.4-m $F/10$ telescope at the Fujii Kurosaki Observatory. The observations aimed to deduce the taxonomy of DA_{14}. The near-infrared photometry was made by Nishi-harima Infrared Camera (NIC) attached to the 2.0-m Nayuta telescope at the Nishi-Harima Astronomical Observatory. The NIC achieves three-band (i.e., J, H, and K_s) simultaneous observations, which allowed us to reliably deduce the colors of this fast-moving object. The time-series photometry was carried out using the 0.55-m telescope at Saitama University. The solar phase angle of DA_{14} had varied widely around its closest approach but was almost constant during the following night. The R-band images were obtained continuously over 2 h at the closest approach and for about 5 h on the subsequent night. Those two nights of observations allow us to determine the rotational properties and the phase effect.

We found, from the visible spectroscopy [1], that DA_{14} is an L-type asteroid. The flatness of the derived relative reflectance in the near-infrared wavelength region support the conclusion [2]. Moreover, the consistency of taxonomy with the observations in Spain[3], which are conducted 10 h after our near-infrared observations, suggests no rotational color variation. The lightcurve data from the second night indicates a rotational period of $11.0^{+1.8}_{-0.6}$ h and a peak-to-peak amplitude of 1.59 ± 0.02 mag [4]. The brightness variation before and after the closest approach was separated into two components that are derived from the rotation and phase effect. We found that the phase curve slope of DA_{14} is significantly shallower than those of other L-type asteroids. It suggests that DA_{14} is coated with a coarse surface that lacks fine regolith particles and/or a high-albedo surface.

References: [1] Urakawa, S., et al. 2013, PASJ, 65, L9. [2] Takahashi, J., et al. 2014, PASJ, in press. [3] de León, J., et al. 2013, A&A, 555, L2. [4] Terai, T., et al., 2013, A&A, 559, A106.