Visible Spectroscopic Observations of a Near-Earth Object, 2012 DA_{14}

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The observations of near-earth objects (NEO) are suitable for the elucidation of taxonomy of sub-km-sized asteroids because the brightness increases when a NEO is close to the Earth. Most asteroids smaller than 100 m are monolithic asteroids. The constructions are different from the rubble-pile of sub-km-sized asteroids. To solve the collisional processes and mineral compositions for small asteroids, it is important to investigate whether the taxonomy has correlation between the construction and the diameter by examining gradual but steady observational data accumulations. This study's purpose is to obtain the taxonomy for 2012 DA_{14} at the time when the object moves fast on the sky after its closest approach to the Earth. 2012 DA_{14} came close to the surface of the Earth on February 15, 2013 at a distance of 27,700 km. Its estimated diameter is around 45 m. The spectroscopic observations for such a small asteroid require a large-aperture telescope, generally. However, the close distance after its closest approach to the Earth assists us in conducting the spectroscopic observations using a small-aperture telescope if we have a skillful observational technique corresponding to the fast sky motion.

We conducted the spectroscopic observation of 2012 DA_{14} at the Fujii Kurosaki Observatory (Longitude = 133.6478° E, Latitude = 34.5100° N) with the Meade 0.4 m/f10 telescope on February 15, 2013. We used a FBSPEC-III spectroscope of our own construction. The FBSPEC-III is equipped with FLI ML6303E CCD with 3072 × 2048 pixels. The slit width and the provided spectral resolution are 5″ and $R \sim 500$, respectively. This configuration permits the spectral range from 0.354 μm to 0.965 μm. Though we set an exposure time of six minutes, the fast sky motion of 2012 DA_{14} made it difficult to hold the image within the slit width for the six-minute duration. Thus, we continued manual reintroduction of 2012 DA_{14} into the slit every eight seconds for six minutes. By this procedure, we achieved the effective exposure time of around nine seconds for one frame. Since we obtained four frames, the total effective exposure time is around 36 seconds.

The relative reflectance for 2012 DA_{14} is shown in Figure 1. Though a typical error for relative reflectance of 2012 DA_{14} is around 0.02, the data with a lower integration time have the errors of over 0.10 in a wavelength region of shorter than 0.41 μm and longer than 0.78 μm. The legend of "DA_{14} error" in Figure 1 indicates the error at the representative wavelength. The error at 0.85 μm is calculated by stacking the data from 0.83 μm to 0.87 μm. The taxonomy is determined by following the flow chart of Bus [1]. We conclude that taxonomy of 2012 DA_{14} is an L-type because the relative reflectance at 0.75 μm and the overall slope satisfy the requirements for L-type [2]. The legend of "L-type" in Figure 1 shows the range of relative reflectance for L-type asteroids. The observational results are included within the range of L-type. Our results are consistent with the observational results by using 10.4 m Gran Telescopio Canarias [3]. The consistency indicates that 2012 DA_{14} has not shown the apparent rotational color variation.

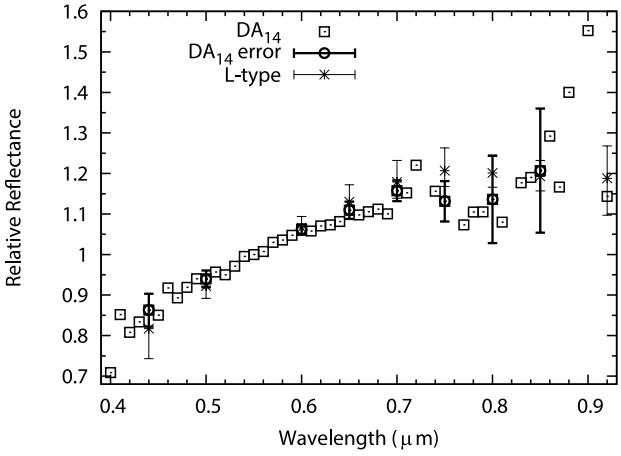

Figure 1: Relative reflectance for 2012 DA_{14}.

References

[1] Bus, S. J.: 1999, *PhD thesis, Massachusetts Institute of Technology*.
[2] Urakawa, S., et al.: 2013, *PASJ*, **65**, L9.
[3] de León, J., et al.: 2013, *A&A*, **555**, L2.