

Observations of near-Earth Object 2012 TC₄ -- The high-time resolution lightcurve with the Tomo-e Gozen --

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Explorations of Itokawa by Hayabusa space probe revealed that asteroids can take a rubble pile structure in which numerous pieces of the rock are weakly constrained by gravity. On the other hand, asteroids that are constructed from a piece of rock itself are called monolithic asteroids. The monolithic asteroids can be said to be the smallest unit object constructing rubble pile asteroids. To clarify the structural strength and/or the constituting substance of the monolithic asteroids help us to understand the physics of asteroids more deeply. The size of the almost all the monolithic asteroids is smaller than 200 m. The small size makes us difficult to observe the monolithic asteroids. The observation opportunity limits to the time when the monolithic asteroids approaches to the Earth.

A near-Earth object 2012 TC4 (hereafter TC4) was approached to the Earth at the distance of about 95,000 km in 2012. The estimated diameter was 12 –27 m and the rotation period indicated to be 12.24 min. Asteroids, rotating shorter than 2.2 hr, cannot take a rubble pile structure due to the strong centrifugal force. Therefore, TC4 is a monolithic asteroid.

The observation opportunity of TC4 had come again in October 2017. The closest distance between the Earth and TC4 was about 50,000 km. This apparition was a very good observation opportunity to investigate the surface of monolithic asteroid that was not covered with the regolith layer. We conducted the observation campaign of TC4 at the Kiso Observatory, the Bisei Spaceguard Center (BSGC), the Nishi-Harima Astronomical Observatory, the Nayoro City Astronomical Observatory, and the Anan City Astronomical Observatory. In particular, we succeed to obtain the high-time resolution lightcurve of TC4 with the Tomo-e Gozen camera. The Tomo-e Gozen camera is the world's first wide-field CMOS camera mounted on the 1.05 m Schmidt telescope at the Kiso Observatory, the University of Tokyo. The power spectrum from the period analysis shows the rotation period of 12.2449 min, and the precession period of 8.4731 min. Thus, TC4 is a tumbling asteroid. We made the shape model of TC4 from the lightcurve. When we assume TC4 is an ellipsoidal body, the normalized axis lengths L1, L2, and L3 are around 2.4, 1.6, and 1.0. Moreover, the visible and near-infrared photometry shows that the taxonomy class of TC4 is X-type. In this presentation, we present the observation results of TC4 and discuss the structural strength and/or the constituting substance of TC4.

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