

Comparison of the Size Distributions among Jupiter Trojan, Hilda, and Main-Belt Asteroids

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A number of studies suggest that our solar system has experienced a planetary migration inducing a massive scattering of small bodies at the final stage of the planet formation processes. Jupiter Trojans (JTs) and Hilda group asteroids (Hildas) are important small-body populations located between the inner and outer regions of the solar system for investigating this most tempestuous periods in the solar system history. Several models such as so-called "Nice model" and "Jumping Jupiter model" claim that JTs have been captured from the outer planetesimal disk, where trans-Neptunian objects (TNOs) originate, during the migration of the giant planets. Considering the similar taxonomic distributions between Hildas and JTs, Hildas may also have been implanted from the outer region in the same process as JTs. Such facts point out a hypothesis that the JT and Hilda populations share a common origin and have a different formation environment from main-belt asteroids (MBAs).

We focus on the size distributions of the small JTs and Hildas for understanding their origins and evolutions. The shape of size distribution of a small-body population in collisional equilibrium is useful as a diagnostic marker for this study because it basically depends on the impact strength properties which are characterized by the body composition and internal structure. Comparison of size distributions allows us to evaluate the similarity between different small-body populations from the point of view of the physical properties.

We performed a wide-field survey targeting the L4 JTs using the 8.2-m Subaru Telescope and Hyper Suprime-Cam, a gigantic mosaic CCD camera with a wide field-of-view of 1.5 deg in diameter. As the result of our data analysis, 631 JTs and 130 Hildas were detected in the survey area of 26 square degrees in *r*-band (0.55-0.7 μ m) images with the completeness limit of 24.4 mag corresponding to 1-2 km sized JT/Hilda asteroids. The size distributions derived from our unbiased samples including 481 JTs and 91 Hildas indicate that (i) JTs' size distribution can be represented by a single-slope power law between 2-10 km in diameter; (ii) Combining the size distribution of our JT sample with that of the known objects does not show a significant wavy pattern as seen in that of MBAs; (iii) The shape of Hildas' size distribution is indistinguishable from that of JTs in the kilometer size range. We also found that Hildas have a single-slope size distribution from 1 km to the largest bodies, implying that the Hilda population is in collisional equilibrium over the whole size range. The total number of Hildas larger than 2 km in diameter is estimated to be about 1×10^4 , which is less than that of JTs by a factor of five.

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