Size Frequency Distributions of Jupiter Trojans, Hildas and Main Belt Asteroids

*吉田 二美[1]、寺居 剛[1]
*Fumi Yoshida[1], Tsuyoshi Terai[1]

1. 自然科学研究機構国立天文台
1. National Astronomical Observatory of Japan

Jupiter Trojans (JTs) share the orbit with Jupiter and make clusters around the L4 (leading) and L5 (trailing) Lagrangian points of Jupiter. They are an important population locating between the inner and outer regions of the Solar System. Two different models have been proposed on the origin of JTs: (1) Classical model; planetesimals were captured into the Trojan orbit during accumulation phase of Jupiter and (2) Capture model; during the migration phase of giant planets, outer small bodies were penetrated to the inner region and then captured into the Trojan orbit. The (2) model suggests that current JTs can share the origin with trans-neptunian objects (TNOs). Meanwhile, if the (1) is correct, the origin of the current JTs is independent, which is the planetesimal near Jupiter at early Solar System. Thus, determining the origin of JTs would be an important key for understanding dynamical/collisional evolutions at the early stage of the Solar System history.

We think that the size-frequency distribution (SFD) is a good probe to investigate such dynamical/collisional evolutions mentioned above. Many people have believed that the SFD of each of the small body groups contains signatures of the accretional and collisional evolutions depending on the origin, dynamical evolution, and body properties. Therefore the detailed study of the SFD (e.g. shape, knee, dip etc.) identifies the dynamical/collisional evolutions that each group has experienced in its proper history. It will enable us to identify the origin of each group, and specify a relation among the groups that have currently different characteristics at different locations in the solar system.

In this study, we examined the SFDs of the JTs and Hilda group by using the 8.2-m Subaru telescope equipped with the wide-field CCD camera: Hyper Suprime-Cam. We detected more than seven hundred of km-size JT/Hilda asteroids. Our survey is the deepest survey for JTs and Hildas so far. We noticed that the SFDs of JTs and Hildas in the size range obtained from our survey have almost the same shape (Figure 1). The best-fit power law slope of JT's SFD is b=1.84+/-0.05 in $N(>D) \propto D^{-b}$. Meanwhile that of Hilda's SFD is b=1.89+/-0.12. Since the size of our detected JTs and Hildas are small (D<10km), it is reasonable to regard as they are all collisional fragments. This fact that in the both of JT and Hilda groups the collisional fragments have similar collisional parameters may indicate that they have similar composition and internal structure. We compared the SFD of JTs (Figure 2) with that of the main belt asteroids (MBAs) and then confirmed that the SFD of inner MBAs and middle MBAs show the different SFD from JT's one. However, we notice that the SFD of outer MBAs show similar characteristic with JTs.

キーワード：木星トロヤ群、ヒルダ群、サーベイ観測、サイズ分布
Keywords: Jupiter Trojans, Hildas, survey observation, size distribution

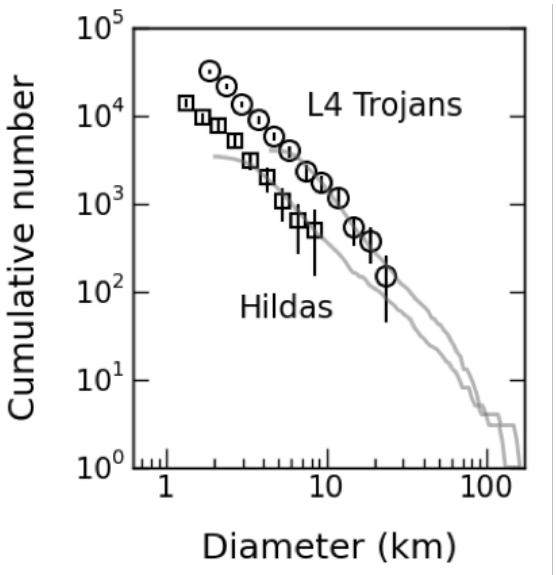

Figure 1. Cumulative size distributions of the L4 Jupiter Trojan (circles) and Hilda (squares) asteroids detected in our survey. Their cumulative numbers are scaled by those of the known objects shown as gray lines.

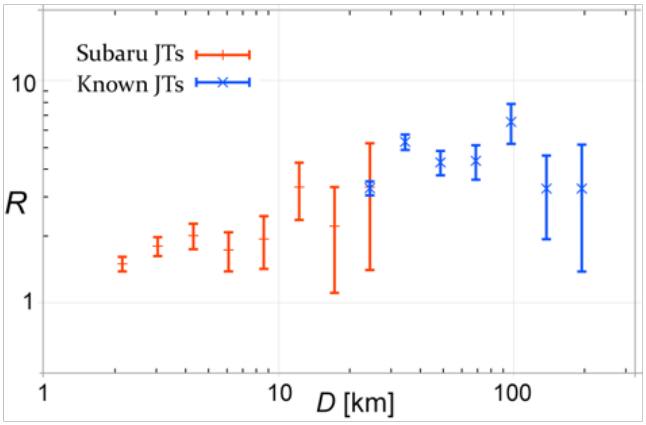

Figure 2. SFD of JTs on an R plot, this method can emphasize a shape of SFD. Blue: Known JTs with H < 12.3 mag (MPC). Red: JTs that we have detected through our own surveys. Note that the vertical axis is just relative to each other, and the unit is arbitrary.