Measurement of Size Distribution of Cold Classical Trans-Neptunian Objects

*Tsuyoshi Terai[1], Fumi Yoshida[2], Keiji Ohtsuki[3]

1. Subaru Telescope, National Astronomical Observatory of Japan, National Institutes of Natural Sciences, 2. Planetary Exploration Research Center, Chiba Institute of Technology, 3. Graduate School of Science, Kobe University

Trans-Neptunian objects (TNOs), a small-body population beyond Neptune's orbit, are generally divided into several dynamical subpopulations. One of them, so-called "cold classical" (CC) population, consists of non-resonant objects with dynamically cold orbits, i.e., low inclinations and eccentricities. Since they have been free from significant gravitational perturbation from Neptune and thus are likely to maintain the primordial orbits since the formation, the CC population is a key for understanding the formation and evolution of the planetesimal disk in the outer solar system. In particular, the size distribution of CC population provides essential clues to unveil their nature and history of the primordial planetesimal disk. The shape of its size distribution reflects the results from the planetesimal accretion and mutual collision processes, which is useful information to explore the environment of planetesimal disk and the dynamical/collisional evolutions.

Our study is to measure the luminosity function (corresponding to the size distribution) of CCs down to a diameter of 100 km or less. Since TNOs are so far/faint, their sky number density with the same detection limit is very low compared with other small-body populations. Therefore, a combination of a large aperture telescope and a wide-field imaging instrument is required to obtain sufficient data for deriving the luminosity function with high accuracy. We performed an optical survey observation for TNOs 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, around the ecliptic sky area of 14 deg^2 with two (*g*- and *r*-band) filters on January 26, 2015 UT. Few have ever reported the absolute magnitude distribution of the CC population around 100 km in diameter from a single survey. Our homogeneous survey data acquired with the same instrument, at the same field, and by the same technique allows us to obtain a precise statistical sample.

We detected 173 TNOs from our survey data. The 50%-completeness detection limit is 25.0 mag in *r* band, corresponding to 80 km in diameter at heliocentric distance of 45 au assuming a geometric albedo of 0.1. We extracted a debiased sample containing 47 of the CC candidates based on their sky motion, brightness, and color. The absolute magnitude distribution derived from our CC sample are well fitted by a broken power law as pointed out by previous studies, but the bright-end slope looks shallower than those of the previous studies. We will discuss the similarity and difference between the obtained size distribution and that of other small-body populations such as Jupiter Trojans and Neptune Trojans.

Keywords: Trans-Neptunian objects, size distribution, Subaru Telescope

