Polarimetric Study of Asteroids in Comet-Like Orbits (ACOs)

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It is important to determine the taxonomic types of small bodies in the solar system and further to study the spatial distribution of the planetary system. Among the small bodies, it is considered that there should be dormant comets that have lost a significant fraction of volatile materials in their subsurface layers. As a result, they are unable to produce any detectable coma and recognized as asteroids. It has been challenging to find out such dormant comet population from a list of known asteroids because of the asteroidal appearances. There are several attempts to find the dormant comet nuclei from asteroidal catalogs, for example, by using their reflectance spectra or orbital elements. However, little has been studied via polarimetry.

We conduct a polarimetric study of three candidates of dormant comet nuclei, (331471) 1984 QY1, (3552) Don Quixote and (944) Hidalgo, by using the 1.6-m Pirka Telescope at the Nayoro observatory (operated by Hokkaido University, Japan). We chose these asteroids in comet-like orbits (ACOs) based on the orbital elements (i.e., the Tisserand parameter with respect to Jupiter $T_J < 3$). We found that 1984 QY1 has a polarimetric albedo (geometric albedo determined via polarimetry) $p_V = 0.16 \pm 0.06$ while both Don Quixote and Hidalgo have Rc-band polarimetric albedo $p_R < 0.05$. Based on the polarimetric result together with a dynamical analysis, we conjectured that 1984 QY1 could be an S-type asteroid transported into the current orbit via 3:1 mean motion resonance with Jupiter. From the previous spectroscopic study, Don Quixote and Hidalgo are classified into D-type taxonomic group, which are typical of comet nuclei. In this presentation, we will introduce our polarimetric observations of ACOs and emphasize that polarimetry is a powerful tool for discriminating the asteroidal and cometary origins.

Keywords: Polarimetry, Asteroid