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[구 SS-12] Near-Infrared Photopolarimetry of Large Main Belt Asteroid - (4) Vesta

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The polarization degree as a function of phase angle (the Sun-target-observer's angle), so-called the polarimetric phase curves (PPC), have provided priceless information on asteroids' albedos since B. Lyot (1929). Succeeding experimental works in 1970s have confirmed the Umow law: There is a universal and strong correlation between the albedo and the PPC slope (slope of the tangential line at the zero of the PPC at phase angle ~ 20 degrees). Experiments in 1990s (ref [1]), on the other hand, have demonstrated that the negative branch of PPC is dependent on the size parameter (X ~ π * particle-size / wavelength), especially when X <~ 5. The change in particle size changed the minimum polarization degree, location of the minimum, and the width of the negative branch (called the inversion angle).

From polarimetry[2] and spectroscopy[3], large asteroids are expected to be covered with fine (<~ 10 μm size) particles due to the gravity. The size parameters are X ~ 30 at the optical wavelength (λ ~ 0.5 μm) and X ~ 10 in near-infrared (J, H, Ks bands; λ ~ 1.2-2.2 μm), if the representative particle size of 5 μm is considered. Accordingly, the near-infrared polarimetry has a great potential to validate the idea in ref[1].

We conducted near-infrared photopolarimetry of the large asteroid (4) Vesta using the Nishiharima Infrared Camera (NIC) at Nishi-Harima Astronomical Observatory (NHAO). NIC allows simultaneous polarimetric measurements in J, H, and Ks bands, and thus the change of PPC is obtained for three different size parameters. As a result, we found a signature of the change in the negative branch in the PPC of asteroid (4) Vesta. We will introduce our observation and the results and give an interpretation of the regolith on Vesta.

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[구 SS-13] Polarimetry of (162173) Ryugu at the Bohyunsan Optical Astronomy Observatory using the 1.8-m Telescope with TRIPOL

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The Hayabusa 2 mission target asteroid (162173) Ryugu is a near-Earth, carbonaceous (C-type) asteroid. Before the arrival, this asteroid is expected to be covered with mm- to cm- sized grains through the thermal infrared observations [1]. These grains are widely understood to be formed by past impacts with other celestial bodies and fractures induced by thermal fatigue [2]. However, the close-up images by the MASCOT lander showed lumpy boulders but no abundant fine grains [3]. Morota et al. suggested that there would be submillimeter particles on the top of these boulders but not resolved by Hayabusa 2's onboard instruments [4].

Hence, we conducted polarimetry of Ryugu to investigate microscopic grain sizes on its surface. Polarimetry is a powerful tool to estimate physical properties such as albedo and grain size. Especially, it is known that the maximum polarization degree (Pmax) and the geometric albedo (pV) show an empirical relationship depending on surface grain sizes [5]. We observed Ryugu from UT 2020 November 30 to December 10 at large phase angles (ranging from 78.5 to 89.7 degrees) to derive Pmax. We modified TRIPOL (Triple Range Imager and POLarimeter, [6]) to attach to the 1.8-m telescope at the Bohyunsan Optical Astronomy Observatory (BOAO). With this instrument, we observed the asteroid and determined linear polarization degrees at the Rc-band filter. We obtained sufficient data sets from 7 nights at this observatory to determine the Pmax value, and collaborated with other observatories in Japan (i.e., Hokkaido University, Higashi-Hiroshima, and Nishi-Harima) to acquire linear polarization degrees of the asteroid from