Performance Evaluation of TRIPOL on the 61-cm Telescope at Seoul National University for Polarimetric Observations of Solar System Small Bodies

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Polarimetry of solar system small bodies is a powerful technique for investigating their physical properties, such as albedos, particle sizes, and porosities of these bodies. Observational opportunities arise sometimes suddenly, that is, just after unforeseeable activations of comets and discoveries of near-miss asteroids. Here, we introduce our activity to install the polarimetric instrument, TRIPOL (Triple-Range Imager and POLarimeter) on the 61-cm telescope (a Ritchey-Chretien reflector with f/7.0) at the Center for Astronomy and Space Science, Seoul National University, and report an observational result of three comets. This combination provides an 8.0’´8.0’ field of view and pixel resolution of 0.94” pixel^{-1}. Throughout photometric observations, we determined the limiting magnitudes (defined as magnitudes for S/N=5) of 15.17±0.06 (g’-band), 15.68±0.01 (r’-band), 16.24±0.03 (I’-band), respectively, with total 240-seconds exposure (four 60-seconds exposure images, each was taken at different rotation angle for the half-wave plate). We also found that the instrumental polarizations are negligibly small, that is, -0.32±0.04% (g’-band), -0.36±0.05% (r’-band) and -0.21±0.04% (I’-band), while the polarization efficiencies are large enough to maximize the performance, that is, 97.52±0.03% (g’-band), 98.83±0.02% (r’-band) and 99.15±0.02% (I’-band).

With this instrument, we conducted polarimetric observations of three Jupiter-family comets, 21P/Giacobini-Zinner, 38P/Stephan-Oterma, and 46P/Wirtanen on a trial basis. It is known from a recent study that the polarization degrees of cometary dust particles are significantly influenced by gas emissions [1] With multiband data taken with TRIPOL, we eliminated an influence of gas contaminations and found that the dust polarization degrees of these three comets coincide with those of so-called ‘dust-rich comets’. From this result, we conjecture that the polarimetric property of Jupiter-family comets is broadly homogeneous, unlike asteroids. We plan to describe our future plan using the polarimetric system.

[1] Kwon, Y. G. et al. Astronomical Journal, 154, 4, 173, 2017

Keywords: Comet, Instrument, Polarimetry

