Dust particle evolution of a near-Earth object 252P/LINEAR from near-infrared polarimetric observations in 2016

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Comets, one of the least-altered leftovers from the early solar system, have probably preserved the primitive structure inside, whereas their surfaces become differentiated from initial states after repetitive orbital revolutions around the sun. Resurfacing makes the surface drier and more consolidated than the bulk nuclei, creating inert refractory dust layer (so-called “dust mantle”). Near-Infrared (NIR) polarimetry is theoretically expected to maximize the contrast of the porosity between inner fresh and evolved dust particles, by harboring more dust constituents in the single wavelength than the optical, and thus intensifying electromagnetic interference in dust agglomerates. Despite the advantage, only few studies have been conducted in this approach at multiple observation epochs. Herein, we present our new multi-band NIR polarimetric (1.25—2.25 microns) study of near-Earth object 252P/LINEAR over 12 days near perihelion; alongside broadband optical photometric (0.48—0.80 microns) data over four months in 2016 and a subsidiary dynamical simulation over 1000 year backward in time. 252P/LINEAR drew attention due to (1) its close approach to the Earth (~0.036 au on 2016 March 16), (2) its possible pairing to a comet P/2016 BA14 (PanSTARRS), and (3) its very low activity level despite its relatively young dynamical age. In this study, we detected two discontinuous brightness enhancements of 252P/LINEAR, particularly, the former of which accompanied a significant increase of NIR polarization degree of the comet (by ~13 % at most) with unusual blue polarimetric color. We will discuss the most probable scenario of the observed results, together with the orbital evolution of the comet and a dynamical association with its pair.

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