In-Situ Dust Analysis of Interplanetary and Interstellar Dust Particles on board the DESTINY+ mission to 3200 Phaethon

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About 40,000 metric tons per year of extraterrestrial materials enters the atmosphere and eventually reaches the ground. This extraterrestrial materials are derived either from cosmic dust background or from meteor showers. The former consists mostly of interplanetary dust and with minor interstellar dust. The latter are meteoroids generated from breakup of comets and asteroids. Parent bodies which are dynamically linked with major annual meteor showers have been identified. Meteoroid dusts are rare and important extraterrestrial matters of which origins are identified. Asteroid 3200 Phaethon is a parent body of the Geminids meteor shower, which is among the most active meteor showers. While most of the parent bodies of meteor showers are comets, cometary activity of Phaethon has only been reported near its perihelion at 0.14 AU. Phaethon is likely a comet to asteroid transitional body. Depletion of sodium, which is a moderately volatile element, and high dust density (about 2.9 g/cm3), relative to other meteor showers are reported from spectroscopic study of the Geminids meteoroid. Because of its small perihelion distance, dehydration of the surface material by solar heating is expected, but some primitive, hydrous material may still reside in its interior. Phaethon is an ideal body to understand the origin of meteoroid dusts and thermal evolution of primitive bodies in the near-Earth orbit. Also, Phaethon is the largest body among potentially hazardous asteroids (PHAs), of which cross the Earth`s orbit.

The Japanese Space Exploration Agency (JAXA) recently down-selected a small-scale deep space mission launched by Epsilon rocket, DESTINY+ (Demonstration and Experiment of Space Technology for INterplanetary voYage, Phaethon fLyby with reUSable probe). Its mission target is the active asteroid 3200 Phaethon, which a spectrally B-type, Apollo asteroid with an orbital period of 1.4 years. The launch is currently planned for 2022, and the DESTINY spacecraft with a daughter satellite, Procyon-mini will be orbiting the Sun between 0.8 and 1.2 AU, with a Phaethon flyby planned for 2025 (Sarli et al., 2016). Among the proposed payload is an in-situ dust analyzed, DESTINY+ Dust Analyzer (DDA), developed based on the Cosmic Dust Analyzer (CDA) onboard the Saturn orbiting Cassini spacecraft (Srama et al., 2004). The DDA is an impact ionization time-of-flight mass spectrometer, which is capable of analyzing sub-micron and micron sized dust grains with a mass resolution of $m/\Delta m=150$. In addition to surface imaging of Phaethon and its dust environment, its mission goals comprise the analysis of interplanetary and interstellar dust grains with DDA. Here, we present DESTINY+ mission objective, goals, and requirements with current design of DDA.