Modeling of an Ejecta Cloud in the Vicinity of Asteroid (3200) Phaethon: A Predicton for the Detection of Ejecta Dust by the DESTINY+ Dust Analyzer (DDA)

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1. PERC/Chitec

We report on the detectability of an ejecta cloud around Asteroid (3200) Phaethon by the DESTINY+ Dust Analyzer (DDA), based on a model of dust dynamics in the cloud for a collection of spherical dust particles of blackbody with a power-law mass distribution. We demonstrate that solar radiation pressure plays a vital role in shaping the spatial distribution of dust particles in the ejecta cloud of Phaethon by expelling small particles from the sunward direction. We find that the DDA onboard the DESTINY+ spacecraft will have an opportunity of detecting dust particles in the ejecta cloud of Phaethon if the closest approach to the asteroid is confined within 500 km at 1 au from the Sun. Increased opportunities are seen if the Phaethon flyby takes place at a closer distance of 250 km and a smaller heliocentric distance of 0.8 au, and if the surface of Phaethon is porous and the initial velocity of ejecta exceeds 20 m/s. It turns out that impacts of 100 μm-sized ejecta particles scarcely happen to make tiny holes on the surface of the spacecraft during a flyby and that the spacecraft does not seem to suffer a serious damage nor encounter a centimeter-sized particle that causes catastrophic destruction of the spacecraft.

Keywords: Phaethon, dust, ejecta cloud, DESTINY+, in situ measurements, regolith

