Dust Measurements with the DESTINY$^+$ Spacecraft En Route to the Active Asteroid (3200) Phaethon and beyond

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The DESTINY$^+$ spacecraft will be launched by the Japanese Space Agency JAXA in 2028. The main mission target will be the active asteroid (3200) Phaethon, with a close flyby in 2030. Together with two cameras on board, the DESTINY$^+$ Dust Analyzer (DDA) will perform close observations of the active asteroid to solve essential questions related to the evolution of the inner Solar System, including heating processes and compositional evolution of small solar system objects. Phaethon is believed to be the parent body of the Geminids meteor shower and may be a comet-asteroid transition object. Such objects can likely provide information to better understand the nature and origin of mass accreted on to Earth. The DDA instrument is an upgrade of the Cassini Cosmic Dust Analyzer (CDA) which very successfully investigated the dust environment of the Saturnian system. DDA is an impact ionization time-of-flight mass spectrometer with integrated trajectory sensor, which will analyse sub-micrometer and micrometer sized dust particles. We give an overview of the DESTINY$^+$ mission, the Dust Analyzer DDA and the science goals for the analysis of Phaethon dust as well as interplanetary and interstellar dust to be measured en route to the active asteroid.

The instrument will measure the particle composition (mass resolution $m/\Delta m \approx 100 - 150$), mass, electrical charge, impact velocity (about 10% accuracy), and impact direction (about 10° accuracy). In addition to dust analysis in the vicinity of Phaethon during the close flyby at this small asteroid, DDA will continuously measure dust in interplanetary space in the spatial region between approximately 0.9 and 1.1 AU during the approximately two years spanning cruise phase from Earth to Phaethon.