

Impact ionization experiments with porous cosmic dust particle analogs

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Abstract

Impact ionization dust instruments in the solar system have provided mass, velocity and directional information from impacting interplanetary and interstellar dust particles. Calibration of these instruments is usually performed with a van de Graaff dust accelerator. Most of these calibrations use relatively compact dust analogues like iron, carbon or coated minerals. In this work, we report on the preparation of low-density dust analogs, the experiments to fly these in the accelerator, and on preliminary calibration results.

Low-density dust analog preparation and experiments

Impact ionization experiments have been performed since more than 40 years for calibration of cosmic dust instruments using a linear Van de Graaff dust accelerator. Such an accelerator can accelerate conductive dust particles of sizes between about a few tens of microns, and a micron to speeds up to 80 km s^{-1} depending on particle size. Many different materials have been used for instrument calibration, from iron in the earlier days to carbon, metal-coated minerals and most recently, minerals coated with conductive polymers [1]. While different materials with different densities have been used for instrument calibration, this study focuses on a comparative analysis of compact particles versus porous or fluffy particles of the same material in specific. Porous or fluffy particles are increasingly found to be present in the solar system, e.g. dust from comet 67P Churyumov-Gerasimenko or aggregate grains from the plumes of Enceladus. Recently also indications were found for low-density interstellar dust from Stardust sample return [2], and from Ulysses interstellar dust data and trajectory simulations [3]. These recalibrations are important

for determining the size distributions of interplanetary and interstellar dust.

We report on the calibrations that were performed at the Heidelberg dust accelerator facility for investigating the influence of particle density on the impact ionization charge after impact. We used the Cassini Cosmic Dust Analyser as an impact target. We explain the experiment set-up, the preparation of the materials, and the materials used: polypyrrole (PPY) coated compact, hollow silica dust particles, and carbon aerogel. Also an attempt was made to fly PPY-coated silica aerogel particles. We elaborate on the technical challenges and on the preliminary results of this work.

References

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