Light and Charge Measurements of Simulated Aluminum Micrometeoroids

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Simulated micrometeoroid ablation experiments have been conducted with aluminum dust utilizing the 3 MV dust accelerator at the Institute for Modeling Plasma, Atmospheres, and Cosmic Dust (IMPACT) at the University of Colorado Boulder. Aluminum dust particles less than a micron in diameter were shot at speeds between 10 and 70 km/s into a gas chamber containing air held at various pressures less than a torr. When dust particles are shot into the gas chamber, they heat up and ablate, producing charges and light which are measured by instruments inside and outside the chamber. The chamber contains a serious of 16 charge detectors arrayed along the inside of the chamber which collect the charges that each particle produces. An impact detector at the end of the chamber determines whether or not each particle fully ablated. For particles that entered the chamber at a given velocity and fully ablated, the ionization coefficient β can be measured at that velocity by dividing the total number of collected charges by the number of atoms in the original particle. In this experiment, β measurements were made for aluminum dust particles at a variety of velocities. In addition, multi-channel photomultiplier tubes placed in windows outside the chamber measured the light produced by the particles as they traveled through the chamber. These light measurements allowed each particle's motion to be tracked as they traveled through the chamber. The combined light and charge profiles of the particles will be applicable to the modeling of meteors entering planetary atmospheres, and the β measurements of aluminum will be useful for radar studies of the meteoric mass entering Earth's upper atmosphere.