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Meteoroid ablation during entry into the solar corona

Hervé Lamy (1), Ingrid Mann (1,2), Joseph Lemaire (1,3)

(1) Belgian Institute for Space Aeronomy, Uccle, Belgium (herve.lamy@aeronomie.be), (2) School of Science and Engineering, Kinki University, Osaka, Japan, (3) Centre of Space Radiations, University of Louvain-La-Neuve, Belgium

The deposition of dust material in the close vicinity of the sun has been discussed before in the context of pick up ion production near the sun and in the context of the FIP (First Ionization Potential) effect. Pick-up ions are ions that are carried with the solar wind but have distinctly different charge states and velocities than the solar wind ions. The FIP effect describes an abundance anomaly observed in the slow speed wind, where elements with FIP below about 10 eV are enhanced in abundance.

In order to estimate the possible contribution of dust and meteoroids to these two phenomena, we study the mass deposition during entry of dust and meteoroids into the solar corona. The first-order model that we apply is similar to the one-dimensional ablation models previously developed by other groups for the Earth's atmosphere and for the atmosphere of Venus. We present the results of mass deposition profiles for a wide range of masses and velocities of objects falling into the Sun. Our main focus is in the bigger objects (masses greater than 1 Kg) for which most of the mass is deposited in the lower layers of the solar corona. As a first step, we consider only the ecliptic plane and extrapolate the mass flux from empirical models of the dust and meteoroid flux near Earth orbit. We calculate the mass deposition and estimate its effects on the coronal heavy ion composition. With a simple two-dimensional generalization of the model we can also include the interaction of sungrazing comets with the solar corona. We finally discuss the effect of different material compositions of these objects taking into account refractory and volatile materials.