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Modeling the structure of Enceladus' dust charge plume

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Enceladus' plume is a remarkable place to explore plasma-dust interaction. In this work, we present a consistent model for the Enceladus dust plume and its interaction with the plasma. We perform Monte-Carlo simulations with a Particle-In-Cell method for the dust resulting in 3D density and velocity profiles of the dust plume. The motion of the dust is determined by gravitation and the Lorentz force. For that, dynamic charging of the dust grains is included stochastically. The dust is initially uncharged and its size distribution is described by a broken power law ranging from nanometer to micrometer size. The dust sources are the four "tiger stripe" fissures and the eight jets on Enceladus south pole with size depending start velocity. Since the Lorentz force acting on the charged dust as well as the charging itself strongly depend on the local plasma environment of a dust particle, we use output from plasma simulations performed with the hybrid code A.I.K.E.F. (Adaptive Ion Kinetic Electron Fluid) as background. However, the high densities of charged dust in the plume act back on the plasma environment. Therefore, the dust simulation results are used as input for the plasma simulations and both simulations are run iteratively. In contrast to previous plume models, our model focuses on the dust sizes with highest charge density (between $1\,\mathrm{nm}$ and $10\,\mathrm{nm}$). The plume is adjusted to measurements of the Cassini spacecraft, especially the charged nanograins smaller $2\,\mathrm{nm}$ detected by the plasma spectrometer (CAPS). Moreover, the model is matched to dust detector (CDA) data to reproduce the micrometer dust models, too. Furthermore, the plasma simulation results are compared to magnetometer (MAG) data. In particular, we will discuss the dust charging time, the fraction of charged dust and the spatial distribution of the charged dust.