



Discharging processes of positively charged dust grains

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Dust grains in planetary magnetospheres can be charged to high positive potentials by energetic ions. The energy of the ions is of the order of the keV, therefore the electric field at the surface of micron sized grains is high enough to induce field ionization and other self-discharging processes. The discharging current depends on the surface electric field, surrounding pressure and composition, amount of atoms leaving the grain due to diffusion processes and other effects.

We have used the quadrupole electrodynamic trap to simulate these charging and discharging processes in the laboratory under the controlled conditions. In this experimental set-up, charged dust grain is situated in the trap in UHV chamber. We optically measure a frequency of the grain oscillation and we compute the charge-to-mass ratio according to the equations of the trap. Differentiating this value with respect to the time, we obtain the discharging and charging currents. This method is able to record the currents of units of elementary charges per minute.

We charge the grain to a high positive potential using either the ion gun (He and Ar ions) or the high-energy electron beam. During the discharging, the pressure in the chamber can be altered. The intensity of laser light illuminating the grain can be slightly altered and it leads to the change of the grain temperature and diffusion and to desorption fluxes leaving the grain. The choice of particles charging the grain (electrons or ions) change the amount of gas dissolved inside the grain at the beginning of the discharging.