**On the rocket interaction with ionospheric plasma; study by numerical simulations**

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Interaction of plasma with finite-sized objects is one of the central problems in the physics of plasmas. An example is a sounding rocket in the Earth's ionosphere. A rocket, like any other spacecraft, will be electrically charged by the plasma, photoemission, and other currents. With respect to the surrounding plasma, the rocket will be at floating potential, at which net current to its surface vanishes (E.C. Whipple, *Rep. Prog. Phys*, **44**, 1981, p.1197). The plasma flow will break the symmetry of charging, and the resulting wake can influence the performance of the payload instruments, such as Langmuir probes. The spin of the rocket will further complicate the problem.

The rocket charging is often a nontrivial and nonlinear process, and it is advisable to address this issue with numerical simulations. First-principle simulations are the most promising approach because they allow for studying trajectories of electrons and ions in self-consistent force fields. One of such approaches is the particle-in-cell method, in which complex shapes of objects can be introduced and studied for various surface conditions and charging effects.

In this work we employ the DiP3D numerical particle-in-cell code to address the rocket-plasma interactions in the ionospheric plasma (W.J. Miloch and D. Block, *Phys. Plasmas*, **19**, 2012, 123703). The payload potential will in general depend on the plasma composition and the relative speed between the rocket and plasma. Under usual conditions the flow will be supersonic, and the Mach-like cone will be formed behind the rocket. As a particular example we consider the launch conditions for ICI-2 and ICI-3 sounding rockets, which is the rocket series at the University of Oslo for investigation of cusp irregularities and related effects (A. Spicher, W.J. Miloch, and J.I. Moen, *Geophys. Res. Lett.*, **41**, 2014, p.1406). It is demonstrated that under certain conditions, the wake effects and the rocket potential can have implications on the probe performance and in-situ measurements, which thus need to be accounted for in data analysis. The simulation results are compared to the rocket data, and the analysis of wake effects on the rocket performance is carried out.