EGU21-2332
https://doi.org/10.5194/egusphere-egu21-2332
EGU General Assembly 2021

The spacecraft wake as a tool to detect cold ions: Turning a problem into a feature

Mats André[1], Anders I. Eriksson[1], Yuri V. Khotyaintsev[1], and Sergio Toledo-Redondo[2]
[1]Swedish Institute of Space Physics, Uppsala, Sweden
[2]University of Murcia, Murcia, Spain

Wakes behind scientific spacecraft caused by supersonic drifting ions is common in collisionless plasmas. Such wakes change the local plasma conditions and disturb in situ observations of the geophysical plasma parameters. We concentrate on observations of the electric field with double-probe instruments. Sometimes the wake effects are caused by the spacecraft body, are minor and easy to detect, and can be compensated for in a reasonable way. We show an example from the Cluster spacecraft in the solar wind. Sometimes the effects are caused by an electrostatic structure around a positively charged spacecraft causing an enhanced wake and major effects on the local plasma. Here observations of the geophysical electric field with the double-probe technique becomes impossible. Rather, the wake can be used to detect the presence of cold positive ions. Together with other instruments, also the cold ion flux can be estimated. We discuss such examples from the Cluster spacecraft in the magnetospheric lobes. For an intermediate range of parameters, when the drift energy of the ions is comparable to the equivalent charge of the spacecraft, also the charged wire booms of a double-probe instrument must be taken into account to extract useful information from the observations. We show an example from the MMS spacecraft near the magnetopause. With understanding of the physics causing wakes behind spacecraft, the local effects can sometimes be compensated for. When this is not possible, sometimes entirely new geophysical parameters can be estimated. An example is the flux of cold positive ions, constituting a major part of the mass outflow from planet Earth, using electric and magnetic field instruments on a spacecraft charged due to photoionization