R008-05
Zoom meeting D ：11/3 AM2 （10:45-12:30）
10:45-11:00

弱磁化宇宙プラズマ中の固体物体周辺の静電構造に関する粒子シミュレーション

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Simulations of Electrostatic Structure near Solid Bodies in a Weakly-Magnetized Space Plasma

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Interactions between space plasma and solar system solid bodies (airless bodies with no global magnetosphere) have been one of outstanding problems in the space science community, in the context of its application for understanding the plasma environment near the terrestrial moon, asteroids, spacecraft, and small dust grains. A solid object immersed in space plasma absorbs most of impacting plasma electrons and ions, and in some occasions it also releases charged particles such as photoelectrons, secondary electrons, and some other minor charged particles. As a result, the object in space will be electrically charged. The solid surfaces and electric potential of the object also alter the dynamics of charged particles in its vicinity, giving rise to a sheath or wake around it, where the plasma quasi-neutrality is locally violated. It is generally believed that the spatial extent of such non-neutral regions is characterized by the Debye length, the shortest characteristic length in the plasma.
Our particular interest is on a magnetized plasma contacting with solid bodies, the dimensions (D) of which are greater than the average electron gyroradius (R_{eg}) of the environment. Attributed to the strong magnetization of electrons, electric disturbances generated at the solid surface will survive in a long distance along magnetic field lines and extend much farther than the local Debye length of the plasma. Such sufficient spatial extent of the disturbance will support wave-associated phenomena generated away from the bodies. The condition ($D>R_{eg}$) in consideration will be satisfied for some sort of solar-system bodies such as the terrestrial moon in the solar wind, as well as manmade spacecraft in the ionospheric plasmas.
In the present study, spacecraft-plasma interaction in a weakly magnetized plasma is studied with numerical plasma particle simulations. The simulations confirm that a negatively charged satellite will repulse incoming electrons, pushing them off to its sides if the spacecraft is traveling fast enough through plasma. The electrons will be directed along magnetic field lines in jet-like flows that resemble wings in our models. This particular feature is confirmed to extend tens or even hundreds of meters to the sides of the spacecraft, which are much longer than local Debye lengths of the ionospheric plasma. We have dubbed this signature as an electron wings, and reported it as another form of spacecraft interference with in-situ measurements.