EGU22-7233
https://doi.org/10.5194/egusphere-egu22-7233
EGU General Assembly 2022

Three-dimensional particle-in-cell simulation of high-speed plasma jets interacting with Mercury's magnetosphere

Gabriel Voitcu[1], Marius Echim[1,2], Eliza Teodorescu[1], and Costel Munteanu[1]
[1]Institute of Space Science, Space Plasma and Magnetometry Laboratory, Magurele, Romania (gabi@spacescience.ro)
[2]Royal Belgian Institute for Space Aeronomy, Brussels, Belgium (marius.echim@aeronomie.be)

The transport of high-speed plasma jets (or clouds, streams, blobs, plasmoids) across magnetic discontinuities/shocks is a key process for planetary magnetic environments. Recently, a large number of localized magnetic structures detected in-situ by MESSENGER in the Hermean magnetosheath has been reported in the literature. These structures are similar to the high-speed plasma jets identified in the Earth's magnetosheath. Due to some limitations in the plasma measurements on-board MESSENGER, only the magnetic signature has been studied. The BepiColombo mission provides a great opportunity to further advance this type of investigation. In this paper we use 3d3v electromagnetic particle-in-cell simulations to study the transport and entry of high-speed plasma jets into Mercury's magnetosphere. The physical setup is adapted to simulate the kinetic effects and their role on the dynamics of localized plasma structures propagating from the magnetosheath toward the Hermean magnetopause. The magnetospheric field of planet Mercury is provided by the KT17 model, while the high-speed plasma jets are defined as 3D finite-size elements with their bulk velocity pointing towards the dayside magnetopause. We investigate the space and time evolution of the plasma jets prior, during and after their impact on the Hermean magnetopause. We analyse the parallel and perpendicular dynamics with respect to the background magnetic field and emphasize key physical processes for the propagation of high-speed plasma jets across transverse magnetic fields. Our simulations shall support the future exploitation of in-situ data from BepiColombo.