Geophysical Research Abstracts
Vol. 16, EGU2014-4366-1, 2014
EGU General Assembly 2014

Study of Electron Acceleration and Multiple Dipolarization Fronts in 3D kinetic models

Giovanni Lapenta (1), Maha Ashour-Abdalla (2), Raymond Walker (2), and Mostafa El-Alaoui (2)

(1) Katholieke Universiteit Leuven, Afdeling Plasma-astrofysica, Departement Wiskunde, Heverlee, Belgium (giovanni.lapenta@wis.kuleuven.be, +32-(0)16-327998), (2) Institute of Geophysics and Planetary Physics, UCLA

The THEMIS mission encountered a depolarization front (DF) during a magnetotail crossing in the interval 035600 – 035900 UT on February 15, 2008 [1].
We present the results of an innovative investigative approach: we combine a global MHD model of the full Earth environment with a local PIC simulation. The global MHD view is provided on the UCLA model applied to the conditions for the interval of interest on Feb 15, 2008. At the specific time of 034800UT, a reconnection site first appear at about x=-15RE, y=4RE.
We then use this specific MHD state as the initial setup for a fully kinetic PIC simulation, performed with the iPic3D code [2]. We consider a one way coupling where the MHD state is used as initial state and boundary conditions for the kinetic study [3]. In the present case, the time span of the kinetic simulation is short form the perspective of the global MHD simulation and does not require a full coupling where the MHD then process the information received back from the kinetic run [4].
The fields and particles are advanced self-consistently from the MHD state using a completely kinetic treatment. Many features missed by the MHD model emerge. Most notably a fast reconnection pattern develops and an unsteady reconnection process develops. The typical signatures of fast kinetic reconnection (Hall field) are observed and particle acceleration is obtained self consistently in the fields generated by the PIC simulation.
The focus of the presentation will be the mechanisms of unsteady reconnection leading to multiple DFs. We observe intense wave activity propagating off the separatrices. We conduct a spectral analysis to isolate the different wave components in the lower hybrid and whistler regime. The unsteady reconnection and multiple DFs are also analysed in their impact on the energy transfer. We track the conversion of magnetic energy to particle energy and Poynting flux. The processes observed in the simulation are then compared with in situ THEMIS data.

[1] Ashour-Abdalla, Maha, et al. "Observations and simulations of non-local acceleration of electrons in magnetotail magnetic reconnection events." Nature Physics 7.4 (2011): 360-365.

[2] Markidis, Stefano, and Giovanni Lapenta. "Multi-scale simulations of plasma with iPIC3D." Mathematics and Computers in Simulation 80.7 (2010): 1509-1519.

[3] Baumann, G., Troels Haugbølle, and Å. Nordlund. "Kinetic Modeling of Particle Acceleration in a Solar Null-point Reconnection Region." The Astrophysical Journal 771.2 (2013): 93.

[4] Daldorff, L. K. S., et al. "Coupling the BATS-R-US global MHD code with the implicit particle-in-cell code iPIC3D." Bulletin of the American Physical Society 58 (2013).