Geophysical Research Abstracts
Vol. 12, EGU2010-5287, 2010
EGU General Assembly 2010

A.I.K.E.F. - An adaptive hybrid model for planetary plasma environment studies

Joachim Müller (1), Sven Simon (2), Uwe Motschmann (1), and Karl-Heinz Glassmeier (3)

(1) Institute for Theoretical Physics, University at Braunschweig, Braunschweig, Germany (joa.mueller@tu-bs.de), (2) Institute of Geophysics and Meteorology, University of Cologne, Cologne, Germany, (3) Institute for Geophysics, University at Braunschweig, Braunschweig, Germany

A wide range of methods is available to numerically model space plasma processes. Dealing with scales comparable to ion gyration radii (e.g. Mars, Titan or Mercury), a hybrid model is the most convenient choice. It treats the electrons as a fluid, whereas a completely kinetic approach is retained to cover ion dynamics. From the numerical point of view it can be categorized as a particle-mesh model. The ion representing particles interact with the electron fluid defined on the numerical mesh, where the spatial mesh resolution governs the scale of resolvable processes.

In order to highly resolve localized small scale plasma processes, block Adaptive Mesh Refinement (AMR) is implemented. I.e. the computational domain is initially composed out of blocks that can be further refined into 8 sub blocks (in three dimensions). However, we relax the common rule that a block must be either completely refined or not at all thereby achieving a higher flexibility and improved mesh adaptation to plasma features of interest. This modification is referred to as hybrid-block-AMR.

The adaptive hybrid simulation code is used to model Titan's and Mercury's plasma environment. In particular we are interested in resolving magnetic fine structures which are not accessible to standard hybrid simulation codes. For instance a double magnetopause signature has been observed during the first messenger flyby at Mercury, however a trusted explanation is still missing. During the T-32 flyby of Titan fossilized magnetic fields have been detected in the satellite's ram side ionosphere. Analysing these structures requires a local enhancement of mesh resolution which is why an adaptive hybrid model is the most convenient choice.