

# Full particle simulation of a magnetic reconnection using adaptive mesh refinement (AMR) technique

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It is widely believed that magnetic reconnection plays an important role in the magnetospheric substorm and the solar flare. However, physical processes around the diffusion region are not well understood. Recently, it has been suggested that multi-scale coupling process should be important in the reconnection triggering and the anomalous plasma heating and acceleration around the diffusion region. Now, it is necessary to conduct a self-consistent large-scale simulation including phenomena with various scales to describe multi-scale coupling. However, a realization of such a simulation with an ordinary PIC technique is still difficult because electron-scale phenomena are very localized in ion-scale or MHD-scale system.

To overcome this difficulty, we are developing a new electromagnetic particle code with adaptive mesh refinement (AMR) technique. The AMR technique dynamically subdivides the cells that satisfy a refinement criterion and effectively achieves high-resolution simulations. In fact, it is only in the vicinity of the central current sheet where high-resolution simulations are required and we can reduce the number of cells in the lobe region where plasma density is low so that both the electron Debye length and a characteristic scale length are large. With AMR technique, it is expected to realize self-consistent multi-scale simulations.

In this paper, we report our recent results of test simulations using newly developed 2-dimensional electromagnetic full-particle code with AMR technique. In this code, the system consists of the hierarchical cells and each super particle is pushed in time using electromagnetic field on the finest cells in which it is located. Calculations of electromagnetic field are performed first on the coarsest cells and the solutions are projected onto finer cells as their boundary conditions. Continuity of the physical quantities on the cells between hierarchies is realized by providing buffer region around each hierarchy. We show that a Langmuir wave and an ordinary-mode wave, as the representatives of the electrostatic and the electromagnetic waves, can properly propagate in the hierarchical cells. We will also show our preliminary result on the time developing Harris plasma sheet.