

Development of magnetic reconnection interlocked simulation model based on domain division method

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Various physically interesting multi-hierarchy phenomena are observed in plasmas, and have stimulated many scientist to evolve theoretical and numerical studies in the wide academic fields. As well known, magnetic reconnection, which is a fundamental process to lead to the fast energy release from magnetic field to plasmas, is one of the typical multi-hierarchy events. Namely, magnetic reconnection shows global changes in magnetic field topology and global plasma transport, however as the trigger, microscopic kinetic processes which violate the frozen-in condition are necessary. Therefore, for the full understanding of magnetic reconnection, we have developed a multi-hierarchy simulation model which treats both microscopic and macroscopic physics consistently and simultaneously.

Our multi-hierarchy model is based on the domain division method, and thus is composed of three domains: PIC, MHD, and Interface domains. Figure 1 displays the schematic diagram of our multi-hierarchy simulation model. The neighborhood of reconnection points is PIC domain, where microscopic kinetic process play important roles[1]. Dynamics in this system are solved by particle (PIC) simulation with PASMO[2]. On the other hand, the domain which is far away from reconnection points is MHD domain, whose physics is described by MHD simulation. Between MHD and PIC domains, an Interface domain with a finite width is inserted. MHD and PIC domains can be smoothly interlocked via the Interface domain.

The applicability of our model has been examined with simulations of linear waves[3]. Furthermore, as a first step of magnetic reconnection studies, propagation of plasma flow from MHD to PIC domains is simulated in the configuration shown in Fig.2. In our presentation, these simulation results will be demonstrated.

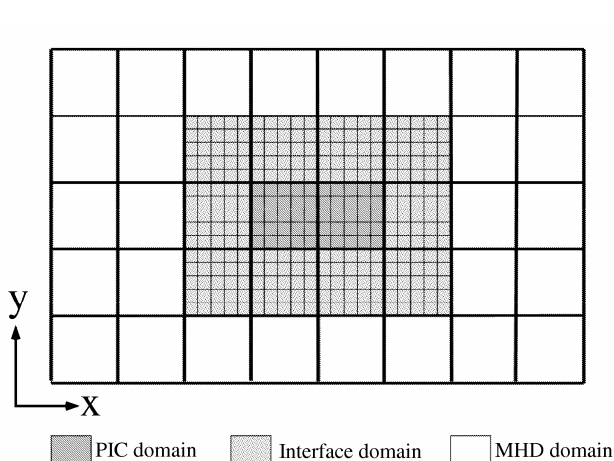


Fig.1: Schematic diagram of multi-hierarchy model

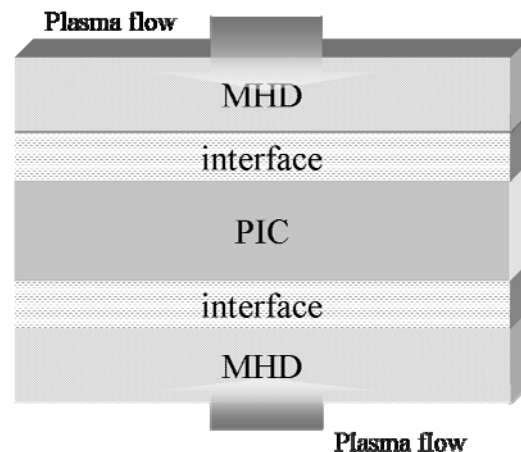


Fig.2: Simulation box for plasma flow injection

[1] T. Moritaka, R. Horiuchi, and H. Ohtani, *Phys. Plasmas* 14, (2007) 102109.

[2] H. Ohtani and R. Horiuchi, submitted to *J. Comput. Phys.*

[3] S. Usami, H. Ohtani, R. Horiuchi, and M. Den, *Comm. Comput. Phys.* 4, (2008) 537.