

## Development of cross-reference framework for macro- and micro-scale simulations of the magnetosphere

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For some years we have studied the magnetospheres of Jupiter, Saturn and Earth by using 3-dimensional magnetohydrodynamic (MHD), electro-hybrid, and Particle-In-Cell (PIC) simulations. These simulations have not been able to connect each other due to substantial differences of the spatial and temporal scales which their simulations should treat. However, thanks to the recent development of supercomputer, the coupling simulations come close to be achieved in a few years.

On the other hand, these simulation codes are developed independently so that the implementation and construction of code are quite unlike and hard to understand for each simulation code developer. As a result, it is difficult to connect these simulation codes.

To overcome this difficulty, recently the cross-reference framework for macro- and micro-scale has been developed using RMA (remote memory access), which name is CoToCoA (Code to Code Adapter). CoToCoA framework can make the data generated by the different simulation codes transferred between those simulation codes easily. The main concepts of CoToCoA are that we do not add modifications to the simulation codes as possible without data transfer and we do not need to know the referred simulation code without data format. These concepts allow for many simulation codes to participate in this framework.

In this study, we will show the design of CoToCoA framework in detail and status of development. In particular, we focus on coupling MHD and electro-hybrid simulations. The magnetic field data of MHD simulation is transferred to the cross-reference framework and the magnetic field lines are calculated then these lines are transferred to the electro-hybrid simulation. Some implementations and performance evaluation of this simulation using CoToCoA will be shown.