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Hybrid Simulations of Energetic Ions in Magnetic Reconnection

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In space plasma physics, production of high energy particles is one of the most important topics.

Magnetic reconnection has been thought to happen everywhere in space with magnetic field, and thought to be a strong driver to accelerate particles by releasing energy of magnetic field in a short period of time, and many computer simulation and observational studies have revealed the acceleration mechanism of electrons. On the other hand the dynamics of ions in magnetic reconnection still remains an open question. This is because commonly used full-particle simulations are based on electron scale, and they are not good at treating ion scale phenomena. We investigated ion dynamics in magnetic reconnection by using two dimensional hybrid code. Hybrid codes treat ions as particles, like full-particle simulations, but treat electrons as a massless fluid. In other words, because of neglecting electrons' feature as particles, hybrid codes have the advantage to describe ion spatial and temporal scale behavior in terms of computational resources and computing time.

In this study, we used predictor-corrector scheme [Winske and Quest, 1986] and Harris current sheet as the initial condition. As the results of the simulations, we have observed the non-thermal energetic ions in the system at the end of the time evolution of the simulations. Non-thermal electrons are observed by using full-particle simulations, but non-thermal ions were not. In this study, non-thermal ions are mainly observed after magnetic coalescence, and energy conversion from the field to the particles occurs effectively in the magnetic pile-up region.