Three-dimensional MHD simulations of a current sheet with initial finite perturbations on the resistivity

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The magnetic reconnection is considered to be the main engine of the energy release in solar flares. The structure of the diffusion region is, however, not still understood under the circumstances with enormously large magnetic Reynolds number as the solar corona. In particular, the relationship between the flare's macroscopic physics and the microscopic ones are unclear. It is generally believed that the MHD turbulence should play a role in the intermediate scale. In the previous two-dimensional MHD simulations, a dynamic behavior appears in a current sheet with intermittent generations and ejections of magnetic islands with enhanced reconnection rate.

In this study, we extend them into the three-dimensional regime. The initial current sheet is in an approximately hydromagnetic equilibrium with anti-parallel magnetic field in the y-direction. We imposed a finite-amplitude perturbations (=50%) on the resistivity with a random spatial distribution and see what happens. Special attention is paid upon the evolution of a three-dimensional structure in the direction along the initial electric current (z-direction). Our preliminary results are as follows: (1) In the early phase of the evolution, high wavenumber modes in the z-direction are excited and grow. (2) Many X-type neutral points (lines) are generated along the magnetic neutral line (plane) in the current sheet. When they evolve into the non-linear phase, three-dimensional structures in the z-direction also evolve. The spatial scale in the z-direction seems to be almost comparable with that in the xy-plane.