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Simulation of Flares in Magnetic Reconnection

Thiem Hoang
(hoang@astro.wisc.edu)

Flares of magnetic reconnection, e.g. Solar flares, require two stage
process, which include the stage of flux accumulation, when the reconnection is slow and the stage of flux annihilation, when the reconnection is fast. While this process is attempted to be described in the framework of collisionless plasma reconnection, a model of the reconnection of weakly magnetic field proposed in Lazarian \& Vishniac (1999) provides a more natural explanation. Within this model the reconnection is initially slow as the magnetic field is nearly laminar and the field line stochasticity increases as the reconnection proceeds, which, in turn, through positive feedback increase the reconnection rate inducing a flare.

In our 3D MHD simulations we do not simulate the entire flare, but start with the stage when the flux is already accumulated. To initiate stochastic, as opposed to the Sweet-Parker, reconnection we gently perturb the magnetic field at the initial moment and allow the system to evolve without further external driving. We find that the reconnection occurs with slow rate and is relatively stable during a first few Alfven crossing times. During this time we found a strong dependence of reconnection rate on the amplitude of initial perturbation. After a few Alfven times, the magnetic reconnection occurs much faster, and exhibits more fluctuations. For this phase, the reconnection rate does not depend on the amplitude of initial perturbation. The magnetic flux in the box is being reconnected in about 10 Alfven times.