High reconnection rate and associated strong electron acceleration with the super Alfvenic shear flow: Particle simulations

Takuma Nakamura[1]; Iku Shinohara[2]; Masaki Fujimoto[3]
[1] ISAS,JAXA; [2] ISAS/JAXA; [3] ISAS, JAXA

We have performed two-dimensional full particle (EM-PIC) simulations to investigate the magnetic reconnection process with the super Alfvenic velocity shear flow. Generally, the velocity shear flow across the current sheet tends to reduce the reconnection rate, but only when the magnitude of the shear flow becomes larger than the ion Alfven speed, the reconnection rate increases since the Kelvin-Helmholtz (KH) instability can grow overcoming the magnetic field tension and kinks the current sheet. These results, however, have been shown only by the fluid approximation simulations. Thus, in this study, to quantitatively estimate the reconnection rate considering kinetic effects, we use full particle simulations of reconnection at thick (D$<$ion inertial length) and thin (D$>$ion inertial length) current sheets. As a result, we found that the reconnection rate with the super Alfvenic shear flow is always higher than that with the sub-Alfvenic shear flow and increases in proportion to the magnitude of the shear flow. This is because the reconnection inflow (corresponding to the reconnection rate) at the kinked current sheet by the KH vortex is controlled by the strong vortex flow. Furthermore, we also found that the maximum kinetic energy of the accelerated electron by the reconnection electric field in super Alfvenic shear flow cases is always more than twice that in sub-Alfvenic shear flow cases. In addition, the acceleration efficiency increases as the vortex size decreases or the shear flow magnitude increases. These results imply that the vortex-induced reconnection process may play a crucial role in heating plasmas on the MHD turbulence in space, in which various scale vortices exist.