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Interchange instability development in dipolarization front structure during reconnection in collisionless 3D PIC simulations

A. Vapirev, A. Divin, S. Markidis, and G. Lapenta
KUL, Heverlee, Belgium (alexander.vapirev@wis.kuleuven.be)

Massive parallel numerical simulations of magnetic reconnection are presented in this study. Electromagnetic full-particle implicit code iPIC3D is used to study the dynamics and 3D evolution of reconnection outflows. Such features as Hall magnetic field, inflow and outflow and diffusion region formation are very similar to 2D PIC simulations. In addition, it is well known that instabilities develop in the current flow direction or oblique directions. These modes could provide for anomalous resistivity and diffusive drag and can serve as additional proxies for magnetic reconnection. In our work the unstable evolution of reconnection jets are studied. Guide field and anti-parallel reconnection configurations are considered. Our study suggests that interchange instability leads to the development of finger-like density structures on ion-electron hybrid scales. These structures are characterized by a rapid increase of the magnetic field, normal to the current sheet (B_z). A small negative dip in B_z component is observed in the region ahead of the dipolarization front. Strong fluctuations in the B_x and B_y components are also observed shortly after the passing of the dipolarization front. The instability forms due to fact that the density gradient inside the dipolarization front region is opposite to the direction of the acceleration Lorentz force. Such density structures may possibly further develop into larger-scale Earthward flux transfer events during magnetotail reconnection.