Two-scale structure of the electron dissipation region during collisionless magnetic reconnection: PIC simulations and Cluster satellite observations

MICHAEL SHAY, JAMES DRAKE, MARC SWISDAK, TAI PHAN, JONATHAN EASTWOOD, University of Delaware — Particle in cell (PIC) simulations[1] and Cluster satellite observations of collisionless magnetic reconnection are presented that demonstrate that the electron dissipation region develops a distinct two-scale structure along the outflow direction. Consistent with past hybrid and two-fluid simulations, the rate of reconnection remains fast in very large systems, independent of the mass of the electrons. A surprise is the existence of an outer electron dissipation region downstream of the inner one, which extends up to 40 ion inertial lengths downstream of the X-line in the largest simulations. This outer region consists of a super-Alfvenic jet of electrons which are decoupled from the magnetic field. The existence of this outer dissipation region is confirmed by Cluster satellite observations during a current sheet crossing in the flanks of the dayside magnetopause about 30 ion inertial lengths downstream of an x-line.