Geophysical Research Abstracts,
Vol. 11, EGU2009-6534, 2009
EGU General Assembly 2009

Distinct electron regions around flow and magnetic field reversals in the magnetotail current sheet

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Correlated reversals of ion flows and magnetic fields are often observed during the energy release phase of the magnetotail, and have traditionally been taken as signatures of magnetic reconnection. We map out distinct electron regions around such reversals in a dozen of published reconnection events to understand energy conversion processes associated with generations of fast plasma flows and suprathermal particles. Our approach employed time series of electron distribution functions from the four Cluster spacecraft to form electron maps. The electron maps combined with field measurements reveal that there are three main classes of distinct electron regions. The passage of reconnection electron current layers near the maximum reconnection rate, and the passage of magnetic islands during active reconnection can account for the first two classes, with the former being responsible for the fast flow generation, and the latter the production of suprathermal particles. Evolution of distinct electron regions within the reconnection ion diffusion region based on 2D PIC simulations is examined to understand whether the third class could be due to the passage of electron current layers at different phases of magnetic reconnection.