Abstract Submitted
for the DPP09 Meeting of
The American Physical Society

Reconnection Line Breaking Interpreted in Terms of Electron Trajectories DANIEL LECOANET, UW - Madison, Madison, WI 53706, PPPL, Princeton, NJ 08540, RUSSELL KULSRUD, MASAAKI YAMADA, PPPL, Princeton, NJ 08540 — In many physical situations, the width of the reconnection layer as predicted by the classical Sweet-Parker theory is smaller than the ion skin depth. In this case, the electrons and ions decouple, and the plasma must be treated as two fluids resulting in a fast reconnection rate with the layer width set by the ion skin depth. The line breaking mechanism in the two-fluid regime is no longer resistive but is driven by the anisotropic electron pressure tensor. By calculating electron trajectories near the origin, we show numerically that this can be interpreted in terms of an unmagnetized region [1]. We find the electrons in the unmagnetized region are freely accelerated by the induced electric field, producing the reconnection current. We measure the average time electrons are accelerated in the unmagnetized region. For plasma parameters similar to those in the Magnetic Reconnection Experiment [2], we find this acceleration time is shorter than the collision time, implying an effective resistivity larger than the classical Spitzer resistivity. Understanding electron trajectories elucidates the reconnection mechanism and places additional constraints on analytic theories of two-fluid reconnection.

[1] R. Kulsrud et al, Phys. Plasmas 12, 082301 (2005).
[2] M. Yamada et al, Phys. Plasmas 4, 1936 (1997).

Daniel Lecoanet
University of Wisconsin - Madison

Date submitted: 17 Jul 2009 Electronic form version 1.4