APR06-2006-000528

Abstract for an Invited Paper
for the APR06 Meeting of
the American Physical Society

Magnetic Reconnection in a Laboratory Plasma[1]

HANTAO JI, Princeton University

Magnetic reconnection plays an important role in determining the evolution of magnetic topology in relaxation processes in laboratory plasmas, magnetospheric substorms, solar flares, and more distant astrophysical plasmas. Often, magnetic reconnection is invoked to explain the observed rapid release of magnetic energy. A central question concerns why the observed reconnection rates are much faster than predictions made by classical theories, such as the Sweet-Parker model based on MHD with classical Spitzer resistivity. In general, the reconnection process is determined by both local plasma dynamics in the diffusion region as well as by global boundary conditions. Presently, there are two prevailing theories to explain the mechanism of local dissipation enhancement and fast reconnection, based on the generalized Ohm's law. One is anomalous resistivity due to wave particle interactions and the other is the Hall effect originated from separation of electron motion from ions. In this talk, I would like to present recent results on these fundamental issues of reconnection from a well-controlled laboratory experiment, Magnetic Reconnection Experiment (MRX). Both electromagnetic turbulence and out-of-plane quadrupole magnetic field (a hallmark of the Hall effect) have been observed during fast reconnection process, which is also strongly affected by boundary conditions. Physics insights based on these observations as well as their comparisons and implications to space, solar and astrophysical plasmas will be discussed.

[1]This work is supported jointly by US DOE, NASA and NSF.