Abstract for an Invited Paper
for the DPP08 Meeting of
The American Physical Society

Scaling of Asymmetric Magnetic Reconnection

PAUL CASSAK, West Virginia University

Theories of magnetic reconnection traditionally assume that the plasmas on either side of the dissipation region have identical densities and magnetic field strengths. While this canonical description is ostensibly appropriate for reconnection in the magnetotail, it is not appropriate in many settings, notably at the dayside magnetopause where the magnetosphere and magnetosheath plasmas have considerably different properties. There has been wide interest in the shock structure of fast asymmetric reconnection, but a general theory of the scaling of the rate of reconnection and the structure of the dissipation region during asymmetric reconnection has not been addressed until recently. In this talk, we will present a first principles analysis of the scaling of the reconnection rate and speed of the outflow jet in terms of upstream densities and magnetic field strengths for two-dimensional anti-parallel asymmetric magnetic reconnection. This analysis generalizes the classical Sweet-Parker scaling analysis to allow for asymmetric conditions. However, most of the scaling results are independent of the dissipation mechanism and, therefore, apply to asymmetric reconnection in general. In addition, we show that, unlike in symmetric reconnection, the X-line and stagnation point need not be located in the same place for asymmetric reconnection, and in fact usually are not. As such, there is a bulk flow across the X-line. Results from numerical simulations of asymmetric reconnection using resistive magnetohydrodynamics (MHD) and Hall-MHD will be presented, finding good agreement with the predicted scaling laws and properties of the dissipation region. Potential applications to reconnection at the dayside magnetopause and its impact on solar wind-magnetospheric coupling will be discussed. Collaborator: Michael A. Shay, University of Delaware