Abstract Submitted
for the DPP09 Meeting of
The American Physical Society

Kinetic Theory and Petascale 3D Simulations of Magnetic Reconnection with a Guide Field W. DAUGHTON, V. ROYTERSHTEYN, L. YIN, B.J. ALBRIGHT, K.J. BOWERS, LANL, H. KARIMABADI, UCSD — In the presence of a finite guide field, current sheets are unstable to a spectrum of collisionless tearing modes at resonant surfaces across the layer. Fully kinetic treatments of this problem have typically focused on the fastest growing modes with resonant surface in the center of the layer. However in large-scale systems, tearing modes can grow at resonant surfaces on both sides of the layer, corresponding to oblique angles relative to the standard 2D reconnection geometry. In hydrogen plasmas, these modes couple to the electron drift wave while in electron-positron plasmas the oblique tearing modes are purely growing. In this work, we review the Vlasov theory for this problem using an exact integro-differential treatment. The theoretical results are used to guide and interpret 3D fully kinetic simulations performed on Roadrunner, the world's first petascale supercomputer. The evolution is highly dynamic and features the formation and interaction of flux ropes over a wide range of angles consistent with linear theory. Over long time scales, new current sheets form which are unstable to additional reconnection instabilities and island (flux rope) formation. The influence of this complex evolution on the dissipation of magnetic energy and particle acceleration is explored.

William Daughton
LANL

Date submitted: 15 Jul 2009 Electronic form version 1.4