Abstract Submitted
for the DPP09 Meeting of
The American Physical Society

A Next-Generation Experiment To Study Magnetic Reconnection and Related Explosive Phenomena in Large and Collisionless Plasmas H. JI, M. YAMADA, S. PRAGER, PPPL, W. DAUGHTON, V. ROYTERSHTEYN, LANL — Magnetic reconnection, a topological change in magnetic field in plasmas, often occurs explosively leading to rapid conversion of magnetic energy to plasma particle energy in space, astrophysical and laboratory fusion plasmas. The Magnetic Reconnection Experiment (MRX, http://mrx.pppl.gov) is a primary dedicated experiment to study reconnection in a controlled environment. However, further critical understanding and contributions to space and astrophysical plasmas are limited by the parameters achievable in MRX and other dedicated experiments. The MRX plasmas are relatively collisional (Lundquist numbers $S \sim 10^3$) and effectively small (plasma size normalized by ion skin depth or ion sound radius ~ 10). In this paper, we discuss plans for a next-generation reconnection experiment based on MRX. By a combination of larger physical size, stronger magnetic field, and higher heating power, we aim to increase S by a factor of 100 and effective size by a factor of 10, representing a very large jump in the laboratory capabilities. Kinetic simulations in realistic boundaries will be used to guide the experimental design. Research topics include: (1) transition of collisional to collisionless reconnection and its scaling with collisionality and size, (2) interacting multiple reconnections as a possible cause of explosive phenomena, (3) particle energization by reconnection, (4) relation between local reconnection and global magnetic self-organization in 3D realistic geometry and boundary.

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Date submitted: 17 Jul 2009 Electronic form version 1.4