Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

Progress toward astrophysically relevant collisionless shock experiments in the laboratory A.L. MOSER, S.C. HSU, LANL, C.S. ADAMS, M.A. GILMORE, UNM, C. THOMA, Voss Scientific — Astrophysical shock waves are often collisionless, and are believed to amplify magnetic field strengths and accelerate particles to relativistic energies. In these shocks, mean-free-paths are longer than system scale lengths, and the role in shock formation usually played by collisions is instead played by collective effects and wave–particle interactions. Laboratory experiments to produce astrophysically relevant collisionless shocks could provide much-needed information about details of shock formation and evolution, including the effects of changes in plasma parameters. One such experiment at LANL has begun unmagnetized experiments using counter-streaming plasma jets to produce a collisionless interaction, with the ultimate goal of producing magnetized, collisionless shocks. Jets are produced by plasma railguns and can be made with argon, helium or hydrogen. Each jet reaches a length of $\approx$50 cm and a radius of $\approx$25 cm as it propagates 1.1 m to chamber center; jet densities are $\approx 10^{13}$–10^{16} cm^{-3}, temperatures a few eV, and velocities $\approx$30–60 km/s. Numerical simulations using experiment-relevant parameters aid in interpreting experimental results and guiding future experiments. Recent unmagnetized experiments have generated structure with a length scale smaller than calculated Coulomb collision lengths; a Helmholtz coil, currently under construction, will allow the addition of a magnetic field at the jet interaction region in the direction either parallel or perpendicular to shock propagation. Future magnetized experiments will satisfy criteria for astrophysical relevance.

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Date submitted: 12 Jul 2013 Electronic form version 1.4