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Laboratory astrophysical collisionless shock experiments with interpenetrating plasma flows on Omega and NIF[1] JAMES ROSS, H.-S. PARK, C. HUNTINGTON, D. RYUTOV, LLNL, R.P. DRAKE, U. Michigan, D. FROULA, LLE, G. GREGORI, M. LEVY, Oxford, D. LAMB, U. of Chicago, F. FIUZA, SLAC, R. PETRASSO, C. LI, A. ZYLASTRA, H. RINDERKNECHT, MIT, Y. SAKAWA, Osaka, A. SPITKOVSKY, Princeton — Shock formation from high-Mach number plasma flows is observed in many astrophysical objects such as supernova remnants and gamma ray bursts. These are collisionless shocks as the ion-ion collision mean free path is much larger than the system size. It is believed that seed magnetic fields can be generated on a cosmologically fast timescale via the Weibel instability when such environments are initially unmagnetized. Here we present laboratory experiments using high-power lasers whose ultimate goal is to investigate the dynamics of collisionless shock formation in two interpenetrating plasma streams. Particle-in-cell numerical simulations have confirmed that the strength and structure of the generated magnetic field are consistent with the Weibel mediated electromagnetic nature and that the inferred magnetization level could be as high as $\sim 1\%$. This paper will review recent experimental results from various laser facilities as well as the simulation results and the theoretical understanding of these observations. Taken together, these results imply that electromagnetic instabilities can be significant in both inertial fusion and astrophysical conditions. We will present results from initial NIF experiments, where we observe the neutrons and x-rays generated from the hot plasmas at the center of weakly collisional, counterstreaming flows.

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