Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Generation and amplification of magnetic fields in laser-driven collisionless shocks FREDERICO FIUZA, DMITRI RYUTOV, Lawrence Livermore National Laboratory, ANATOLY SPTIKOVSKY, Princeton University, CHANNING HUNTINGTON, STEVEN ROSS, Lawrence Livermore National Laboratory, LUIS SILVA, GoLP-IPFN, Instituto Superior Tecnico, WARREN MORI, UCLA, BRUCE REMINGTON, HYE-SOOK PARK, Lawrence Livermore National Laboratory — Collisionless shocks are ubiquitous in astrophysical plasmas and are believed to play an important role in magnetic field amplification; however, the magnetic field dynamics in shocks is still poorly understood as in situ measurements are not available. Recent developments in high-power lasers are bringing the study of collisionless shocks into the realm of laboratory experiments. We have performed detailed 2D and 3D particle-in-cell simulations to explore the generation of collisionless shocks for laboratory conditions associated with counter-streaming high-velocity plasma flows. We capture all the relevant physics, which range from the generation of Biermann battery fields at the laser-foil region, to the micro-instabilities associated with the counter-streaming flows, and to the generation of turbulence at the shock. We show the generation of strong (>1% of equipartition) magnetic fields mediated by the Weibel instability and the conversion from well-defined filaments to magnetic turbulence as the shock is formed. We identify the conditions required to observe this magnetic field dynamics in shocks for the first time in the upcoming experiments at the National Ignition Facility.

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Date submitted: 11 Jul 2014 Electronic form version 1.4