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Visualizing electromagnetic fields in laser-produced counterstreaming plasma experiments for collisionless shock laboratory astrophysics

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In astrophysical settings, large and stable structures often emerge from turbulent supersonic plasma flows. Examples include the cosmic magnetic field and the collisionless shocks [1] in supernova remnants. In a scaled environment created with the high power lasers at OMEGA EP, proton imaging shows that large, stable electromagnetic field structures arise within counterstreaming supersonic plasmas [2]. These field structures are large compared to the fundamental turbulence scale lengths of the plasma (e.g. the Debye length and the ion skin-depth), indicating a high degree of self-organization. These features remain in place from 4 to 7 ns, indicating a high degree of stability. At early times out to at least 8 ns, *intra*-jet ion collisions are strong (due to relatively low thermal velocities) but *inter*-jet ion collisions are rare (due to relatively high flow velocities), permitting the evolution of both hydrodynamic and collisionless plasma instabilities [3, 4]. This paper will present detailed results from our laboratory astrophysics experiments. Prepared by LLNL for US DOE under Contract DE-AC52-07NA27344.

[1] H. S. Park et al, HEDP, 8, 38 (2011).
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[3] J.S. Ross et al, Phys. Plas., 19, 056501 (2012).
[3] D.D. Ryutov et al, Phys. Plas., 19, 076532 (2012).