Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Pulsed power produced counter-propagating plasma flows and the study of shock wave formation for laboratory astrophysical phenomena[1]

JULIO VALENZUELA, GILBERT COLLINS, TOM ZICK, JEFF NARKIS, IGOR KRASHENINNIKOV, FARHAT BEG, University of California, San Diego — We report on counter-propagating plasma flows produced by two vertically opposing conical wire arrays using a compact current driver capable of producing 250 kA in about 150 ns. Laser interferometry and extreme ultraviolet imaging were performed to study the collision of the jets. A shock formed by jets interaction was clearly observed and remained stationary for at least 50 ns, after this period a bow shock developed propagating downwards at $\sim$ 20km/s. Interferometry data showed that the ion density of the jets prior to collision was of the order of $2 \times 10^{17}\text{cm}^{-3}$ and a jump in density of ~ 4 was observed at the shock region. A lower limit of $\sim$ 100 km/s has been measured for the jets velocity. The inter ions mean free path has been estimated to be $\sim$ 12 mm, which is larger than the shock wave scale ~ 5 mm, and hence the shock is not mediated by collisions. Magnetic field advection, which can drastically modify the conditions for shock formation, will be discussed. Kinetic particle-in-cell modeling using LSP code has also been implemented and benchmarked against the experimental results.

[1]The work was partially funded by the Department of Energy Grant No. DE-SC0001063.

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Date submitted: 13 Jul 2014 Electronic form version 1.4