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Experimental Characterization of the Stagnation Layer between Two Obliquely Merging Supersonic Plasma Jets[1]

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Experiments on the oblique merging of two supersonic argon plasma jets have been conducted at LANL in order to assess the use of such jets to form imploding spherical plasma liners for high energy density physics applications [1]. The plasma jets are formed and launched by pulsed-power-driven railguns and have initial jet parameters of $n \approx 2 \times 10^{16}$ cm^{-3}, $T_e \approx 1.4$ eV, ionization fraction ≈ 0.96, velocity ≈ 30 km/s, diameter $= 5$ cm, and length ≈ 20 cm [2]. We have experimentally identified density increases that are consistent with shock formation, and a few-cm thick stagnation layer structure observed both in CCD camera images and interferometer density profiles. Although the jets are each individually collisional, the mean free path between counter-streaming ions is on the same order as the stagnation layer thickness, placing the jet merging in a semi-collisional regime. It was not known *a priori* whether the observations corresponded to hydrodynamic oblique shocks and whether two-fluid or kinetic effects played a role. Through careful analysis [3] of the stagnation layer density and emission profiles, and comparisons between the data and both analytic hydrodynamic shock theory and multi-fluid plasma simulations, we demonstrate that our observations are consistent with collisional shocks.

[1] S. C. Hsu et al., IEEE Trans. Plasma Sci. **40**, 1287 (2012).
[2] S. C. Hsu et al., Phys. Plasmas **19**, 123514 (2012).
[3] E. C. Merritt et al., “Experimental characterization of the stagnation layer between two obliquely merging supersonic plasma jets,” submitted for publication (2013).

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