Radiatively cooled shocks in colliding supersonic plasma flows using inverse wire array z-pinches

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Abstract

Radiatively cooled shocks have applicability to a range of observations, from the interaction of young star jets with interstellar media, to solar winds and accretion phenomena. These systems combine the physics of radiation and hydrodynamics in a non-trivial manner, and are therefore of great interest to simulate.

Experiments published in [1] show that the ablation-phase of a wire array z-pinch can be used as a test-bed for radiative bow shocks. In this paper we will present experiments on the MAGPIE facility designed to use the diverging ablation plasma flow of an inverse (exploding) array set-up [2], which significantly increases diagnostic access to measure parameters of the shocks. This flow can interact with obstacles of different geometries to study features of the bow shocks and reverse shocks created. Interaction of the plasma streams from

individual wires allows formation of oblique shocks and their incidence angles can be controlled by positioning of the wires.

The rate of radiative cooling in shocks will be controlled by selection of the wire material. The set-up also allows study of differing regimes of flow collisionality and the possibility to vary magnetic fields in the interaction region to allow magnetically dominated interactions.

Spatially and temporally resolved plasma densities will be measured using laser interferometry. Measurements of flow velocities and temperatures across shock fronts will be obtained using optical Thomson-scattering. Results of the first experiments with this set-up will be presented.

[1] D. J. Ampleford et al., Phys. Plasmas 17, 056315 (2010)

[2] A. J. Harvey-Thompson et al., Phys. Plasmas 16, 0220701 (2009)