The effect of advected magnetic fields in jet propagation experiments

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Astrophysical jets are a common feature during star formation. It is believed that magnetic fields play a key role in the formation of these jets, however the interaction of the jet with the ambient medium far from the source is dominated by purely hydrodynamical processes [1]. Appropriately scaled laboratory experiments, in which the amount of advected magnetic field can be controlled, can aid our understanding of the observed complex structure of these jets. The use of pulsed power-driven ablation of conical wire arrays [2] has allowed the production of supersonic, radiatively cooled jets scalable to astrophysical systems. In some of these experiments, the advected magnetic field was dynamically significant, which was most evident in the interaction of the jet with an ambient medium [3]. To enable the full range of jet dynamics to be studied, it is desirable to be able to modify the jet magnetisation within the same experimental setup.

Here we present experimental results from a new conical wire array jet-launching platform, in which the magnetic field advected by the jet is expected to be significantly reduced in comparison with previous experiments. This is achieved by preconditioning the wires with a pre-pulse current [4], allowing the formation of a supersonic jet driven by a fast plasma implosion. These experiments are carried out on the Magpie (~1 MA, 250ns) pulsed power generator, using a suite of high temporal and spatial resolution diagnostics. Faraday rotation polarimetry, Thomson scattering and laser interferometry, allow direct measurement of the magnetic field, electron and ion temperatures, flow velocities and electron density distributions.

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