Magnetized collisionless shock experiments, using a pulsed power driven magnetic piston from an exploding wire array

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Collisionless shocks are frequently inferred in astrophysical systems where abrupt structural transitions occur over scales much shorter than mean Coulomb collisions. These transitions are instead mediated by a variety of wave-particle interactions with fields, leading to plasma instabilities across the shock transition.

We present the development and first data from a platform to study collisionless shocks using a pulsed power driver. The setup fielded on the MAGPIE generator (1.4 MA, 500 ns current drive) at Imperial College utilizes two side-by-side inverse wire arrays to produce counter-streaming, supersonic flows of plasma ablated from metal wires. One ("over-massed") wire array produces a steady flow of ablated background plasma. The second exploding wire array launches a piston-like current loop into this plasma with significant velocity and self-generated magnetic field, to allow the reflection of oncoming particles.

The dynamics of the interaction are captured using multi-frame, self-emission imaging (optical & XUV) and a suite of laser based diagnostics (interferometry, Thomson scattering, Faraday rotation imaging) allows the parameters and structure of the interactions to be measured.

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