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A novel experimental framework for investigating colliding plasma flows with radiative cooling

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We present first results from a novel platform which uses the radiation pulse from a wire array Z-pinch to drive plasma ablation from solid silicon targets. In this work, two radiatively driven plasma flows were made to collide, resulting in the formation of reverse shocks. The shocked plasma was observed to cool through the emission of radiation, and the structure of the shocks were influenced by the nature of the radiative cooling process. Recent work by Markwick et al [1] investigating colliding radiatively cooled plasma flows has shown that this experimental configuration may lead to the onset of radiative cooling instabilities in the shocked plasma.

The colliding plasma flows have a simple experimental morphology with well characterized boundary and initial conditions. The magnetic field produced by the Z-pinch is dynamically significant ($\sim 5\ T$) and parallel to the plasma flow, so that the shock normal is also parallel. We observe that the shocked flow escapes the downstream region in a narrow jet. The asymmetry of this outflow allows the influence or the parallel magnetic field to be investigated, since the magnetic field strength is different on each side of the shocked region.

The experiments were performed on the MAGPIE pulsed-power generator (1.4 MA peak-current, 240 ns rise-time) [2]. They were characterised with a diagnostic suite including optical fast-frame imaging; laser interferometry; optical Thomson scattering [3]; and Faraday rotation imaging [4].

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References

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