Magnetic field and radiative cooling effects on accretion shock experiments using MAGPIE pulsed power generator

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Accretion shocks, common in many astrophysical systems, can be significantly influenced by radiative cooling effects [1-3], resulting in instabilities and turbulence. This study investigates accretion shock experiments at the MAGPIE pulsed power facility using X-ray radiation from a Z-pinch wire array to ablate solid targets.

In the first set of experiments, we investigate reverse shocks formed from the collision of counter-streaming supersonic plasma flows in an ambient magnetic field. The two plasma flows, radiatively ablated from small silicon targets, are spatially uniform, propagating along the magnetic field lines. The properties of the shocked layer were determined using various laser diagnostics and optical self-emission images, revealing overall consistency with a 1-D accretion shock model for a value of $\gamma \leq 1.2$. In the case of magnetic field perpendicular to the flow propagation direction, a shocked layer is not formed, instead, enhancement of density is observed at the edges of the two plasma plumes, resembling magnetohydrodynamic shocks.

Future work will include the use of high-Z metallic targets as plasma sources, exploring stronger radiative cooling regimes under various magnetic field configurations. Moreover, the collision of counter-streaming modulated flows will be also investigated as a new experimental platform to study turbulent plasmas using pulsed power facilities.

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