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P1.4014 Magnetosonic shocks in laboratory astrophysics experiments at the Prague Asterix Laser System

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Shock formation through the interaction of supersonic plasma jets with ambient plasma is ubiquitous in astrophysics. Since magnetic fields often play a role in these systems, it is of particular interest to understand how they affect the formation and evolution of shocks. An investigation of magnetized shocks has been carried out using the iodine laser at the Prague Asterix Laser System (PALS) facility. Collimated supersonic plasma jets have previously been observed at PALS, and it has been shown that when such jets interact with a gas target, supersonic shocks can be generated [1]. The present work builds on these experiments by including a perpendicular ambient magnetic field of B 10 T, with particular focus on the effect on the shock compression ratio, and magnetic field enhancement in the interaction region. The third harmonic (lambda = 0.438 μm) of the laser was used for the main beam, with pulse duration tao = 250 ps, energy on target E_L= 15-100 J, intensity I_L ~ 10^14 Wcm^-2, and a focal spot radius of rL= 300 μm. Solid copper targets were used for the plasma jet formation, and argon/helium with pressure of P= 1040 bar for the gas target. The temporal evolution of the shock was observed using three frame shadowgraphy/interferometry, an X-ray streak camera, and a four frame XUV pinhole camera. The optical diagnostics could alternatively be set up for single-frame interferometry and polarimetry, thereby providing simultaneous measurements of density and magnetic field. The experiment has been simulated with a radiation magnetohydrodynamic code including laser energy deposition. The data concerning compression of the plasma and magnetic field in the bow shock are compared with the experiment, thus providing scaling to astrophysical conditions.

References
[1] Ph. Nicolaï, C. Stenz, A. Kasperczuk et al, Physics of Plasmas 15, 082701 (2008)

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