Investigation of Magnetic Fields in Wire Array Z-Pinches by Proton Deflectometry
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It is often difficult to determine the true structure of B-fields within z-pinch plasma systems. Typical laser diagnostics are limited in the densities of hot plasmas that they are able to probe, and electrical diagnostics are prone to failure as well as perturbation of the system. A demonstration of a new method for determining the magnitude and orientation of the magnetic fields in these systems is being developed. The use of proton beams launched by high intensity lasers, and the subsequent tracking of their deflected trajectories, will enable access to field measurements in previously inaccessible plasma densities.

The experimental testing of this method is performed at the Nevada Test Facility (NTF) using the 10J 0.3ps Leopard laser coupled to the 1.6MA ZEBRA pulsed power generator. Leopard provided focused intensities of ~5x10^{19} W cm^{-2}, and generated up to 10 MeV protons from thin metallic targets with good reproducibility and low divergence, even when placed within the ZEBRA chamber.

Quantitative data from wire array experiments detailing the conditions of the plasma, such as density and temperature, unique to each experimental setup, is used to constrain the simulation of exploding wire and x-pinch plasmas performed using the 3D resistive MHD code, GORGON. Protons are then injected and tracked through the plasma using the 3D PIC Large Scale Plasma code in order to produce possible proton image plane data. Interpretation of experimental results can only be achieved by performing many iterations of simulation, with varying conditions, in order to definitively determine the field maps.

The first computational demonstration of protons propagating through single wire and x-pinch plasmas, along with comparison to recent experimental data will be presented.

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