Experiments and Modeling of Coronal Plasma Formed by Exploding Wires in Z-Pinch Experiments

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Abstract:

A review of experiments and magnetohydrodynamics (MHD) simulations of single-wire and multi-wire loads for Z-pinch generators aimed to develop MHD simulation for single-wire and multi-wire loads for the Zebra machine at the Nevada Terawatt Facility (NTF). The experiments conducted at the NTF on Zebra and (MHD) simulation using MACH2 of nanosecond scale exploding wire are presented. MACH2 was adapted for Zebra configuration and utilized to developed 1D MHD simulation of a single wire, 99 um Aluminum wire (Alloy 5056). The radial electron density distribution is simulated and then compared with experimental results. Single wavelength laser interferometry shows an expanding electron density with the decreasing electron density as it moves radial away from the wire core. The interferograms presented represent the radial electron density distribution at 50 ns before peak current. Optical streak cameras provided radial streak of the exploding wires which is used for velocimetry and to bound ion temperature. The simulation shows similar trends to the experimental data. However, further development of MACH2 code will be required to simulate Zebra wire pinches and fit experimental data points within error bars.