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Development of a spectroscopic technique for simultaneous magnetic field, electron density, and temperature measurements in Z-pinch plasmas ERIC DUTRA, RADU PRESURA, Natl Security Technologies LLC, AARON COVINGTON, ROBERTO MANCINI, TIMOTHY DARLING, WILLIAM ANGERMEIER, University of Nevada, Reno — Visible spectroscopic techniques are often used in plasma experiments to measure B-field induced Zeeman splitting, electron densities via Stark broadening, and temperatures from Doppler broadening. However, when electron densities and temperatures are sufficiently high, the broadening of the Stark and Doppler components can dominate the emission spectra and obscure the Zeeman component. In this research, we are developing a time-resolved multi-axial technique for measuring the Zeeman, Stark, and Doppler broadened line emission of dense magnetized plasmas for Z-pinch. In parallel, we are developing a line-shape modeling code that incorporates the broadening effects due to Stark, Doppler, and Zeeman effects for dense magnetized plasma. Experiments were conducted at the University of Nevada (Reno) at the Nevada Terawatt Facility (NTF) using the 1 MA Z-pinch (Zebra). The research explored the optical emission of Al III doublet, 4P $^2P_{3/2}$ to 4S $^2S_{1/2}$ and 4P $^2P_{1/2}$ to 4s $^2S_{1/2}$ transitions and used it to measure Zeeman, Stark, and Doppler broadened emission. The initial parameters for the line shape code are varied to simulate emission spectra. The simulated spectra are compared to experimental results. These results are used to infer temperature, electron density, and B-fields in the magnetized plasma.

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