Magnetic Field Measurements of Magnetized Plasmas Using Zeeman Broadening Diagnostics

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Abstract:

Magnetic fields and current distributions within plasmas are crucial parameters in the study of laboratory plasmas. However, they are very difficult to measure because often, the magnetic fields undergo significant spatial and temporal fluctuations. Based on an idea proposed by Tessarin et al. (2011), we have measured the field in current-driven exploding wire plasmas and the magnetized precursor of wire array z-pinches. This spectroscopic technique is applicable even in cases when the line broadening due to the high plasma density and temperature surpasses the Zeeman splitting. Time-gated spectra with one-dimensional space-resolution were obtained at the Nevada Terawatt Facility for wire array plasmas driven by the 1 MA configuration of the Zebra generator. The components of the Al III 4s $^2S_{1/2} - 4p ^2P_{1/2,3/2}$ doublet were observed. In these measurements the Zeeman splitting was not resolved, but the magnetic field strength was measured from the difference between the widths of the line profiles.

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