Spectroscopic characterization of core conditions in magnetized cylindrical implosion experiments

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We discuss the application of Ar K-shell spectroscopy to characterize the core conditions in highly magnetized cylindrical implosion experiments performed at the OMEGA laser facility. Targets filled with Ar-doped deuterium were symmetrically imploded using 40-beam, 14.5 kJ, 1.5 ns laser drive. The implosions were magnetized using the MIFEDS pulsed-power capability, delivering a seed B-field of 24 T. According to 2D numerical simulations using the extended-MHD code Gorgon, this seed B-field is compressed with the target up to $\sim$10 kT [1]. Such a compressed magnetic field would be strong enough to alter the characteristic conditions of the compressed core. Recorded Ar K-shell spectra show highly reproducible differences in the line ratios, indicative of a higher temperature in the magnetized implosions compared to the non-magnetized case, as predicted by the numerical simulations. Post-processing the MHD output by means of detailed Non-LTE atomic kinetics and Stark broadened line profiles permits to obtain synthetic spectra, which qualitatively explain the observations. Methods to extract representative values of core conditions in spite of large spatial gradients arising in the magnetized scenario are presented. Additionally, we assess the use of Kr K-shell spectroscopy for a more robust characterization of the magnetized hot spot.

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References

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