Experimental studies of extended-MHD effects and confinement properties of magnetized cylindrical implosions

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Abstract

The demonstration of nuclear fusion gain at the National Ignition Facility (NIF) is a major milestone towards fusion energy. The addition of a background magnetic field (B-field) could further increase fusion yields. Indeed, the B-field compressed with the target acts in addition to inertia to confine the hot spot, resulting in a hotter fuel. This would allow to ignite at lower areal densities than otherwise possible and with slower implosions less susceptible to hydrodynamic instabilities. Compared to spherical-, cylindrical-implosions facilitate the study of the magnetized transport of heat and magnetic flux [1]. Ar-doped D2-filled cylindrical implosion experiments were realized at OMEGA with 15 kJ laser drive, with and without an imposed B-field. The observed systematic changes in Ar K-shell spectra reveal a 50% core temperature increase at peak compression when a 30 T seed B-field is applied. The experimental data is in line with extended-MHD simulations, evidencing the impact of a 10 kTesla compressed B-field [2].

The platform was scaled to 20 times higher laser drive energy – with shots scheduled at NIF and at Laser Mega Joule (LMJ) – foreseeing a spatial resolution of the core temperature [3] and B-field compressibility measurements.

References

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[3] G. Pérez-Callejo *et al.*, Physical Review E **106**, 035206 (2022).