THE APPLICATION OF IMPOSED MAGNETIC FIELDS TO IGNITION AND THERMONUCLEAR BURN ON THE NATIONAL IGNITION FACILITY

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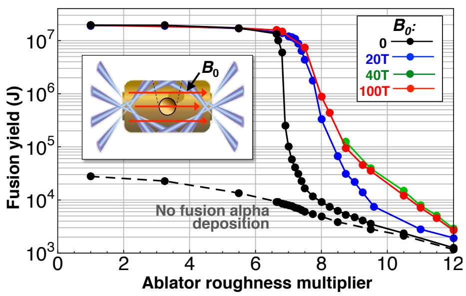
We are studying the impact of highly compressed magnetic fields on the ignition and burn of National Ignition Facility targets. Initial seed fields of 30-70T compressing to greater than 10^4T (100MG) under implosion can reduce hotspot conditions required for ignition and propagating burn through range reduction and magnetic mirror trapping of fusion alpha particles, suppression of electron heat conduction and potential stabilization of hydrodynamic instabilities. This may permit recovery of ignition, or at least significant alpha particle heating, in capsules that would otherwise fail because of adverse hydrodynamic conditions [1]. More generally, it may also permit attainment of ignition in targets redesigned to operate under reduced drive and/or lower convergence ratios.

Initial 2-D simulations for the NIF indirect-drive ignition platform (Fig.1) show that compressed magnetic fields shifts the ignition “cliff” to the right in that the capsule attains ignition and fusion yield at shell perturbations that would otherwise result in low yield, non-ignition. In particular, simulations indicate that B(0) ~50T could enhance alpha heating to close to MJ-yields in presently performing high-foot, three-shock capsules. We are also studying the utility of magnetic fields to give volumetric ignition in room temperature DT-gas capsules and to ameliorate hot electron preheat from hohlraum laser-plasma interactions.



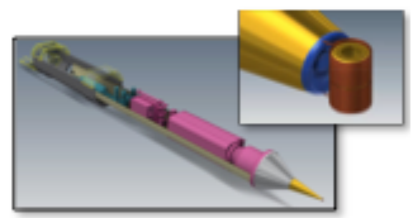


Fig. 1. Fusion yield of the NIF cryo ignition target versus multiplier on the amplitude of ablator roughness for seed magnetic fields from 0 to 100 T [1]. Fig 2. Initial design of hohlraum test coil and pulsed power supply for NIF

We are testing candidate hohlraum magnet coils (Fig.2) driven by a pulsed power supply that could be later integrated in a NIF Diagnostic Insertion Manipulator (DIM) and have achieved axial fields of ~30T on our way to a nominal design goal of 50T. Proof-of-principle experiments for magnetized ignition capsules and hohlraum physics on NIF are now being planned.

[1] L. J. Perkins, et al, “Two-Dimensional Simulations of Thermonuclear Burn in Ignition-Scale ICF Capsules Under Compressed Axial Magnetic Fields”, *Phys. Plasmas* **20**, 072707 (2013)

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