Prospects for Magnetic Indirect Drive Inertial Confinement Fusion

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Experimental, theoretical, simulation, and technological advances over the past 30 years are motivating a reassessment of the Magnetic Indirect Drive (MID) approach to Inertial Confinement Fusion (ICF). In this concept,¹ ² a radiation source drives a hohlraum to temperatures required to implode a capsule symmetrically and create a high (>200 MJ) neutron yield. The advances start with a new concept for a pulsed-power driver³ that creates high amounts of radiation that can be coupled into a hohlraum.¹ The capsule uses a liquid layer of deuterium-tritium fuel instead of the conventional cryogenic layer of DT used in current experiments.⁴ The liquid-layer approach is inherently low convergence (convergence ratio of 12–20) so that hydrodynamic instabilities and symmetry issues are greatly reduced. Experiments at the National Ignition Facility (NIF) demonstrated the basic robustness of this approach⁵–⁸. Advances in target fabrication⁹ ⁸ are creating higher quality capsules with the foam matrix needed to support the liquid DT. Using an indirect-drive hohlraum leverages ten years of experience at NIF using laser-driven hohlraums. This experience shows where capsule/hohlraum issues remain and where modeling gaps remain. We outline the main physics concerns of the MID approach. These include symmetry control, the very important issue of minimum case-to-capsule ratio (CCR),¹⁰ radiation coupling into the hohlraum, and pulse-shaping of the radiation drive.

References