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STAGNATION PERFORMANCE SCALING OF MAGNETIZED LINER INERTIAL FUSION

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Magnetized Liner Inertial Fusion (MagLIF) is a magneto-inertial fusion concept that is presently being studied on Sandia's Z machine. The concept utilizes an axial magnetic field of order 10 T to reduce thermal conduction losses as a cm-scale beryllium can implodes and compresses fusion fuel, which was preheated to of order 100 eV with a few kJ from a TW-class laser. During the implosion, the magnetic field is amplified through magnetic flux compression to several thousand Tesla, and the fuel temperature increases to several keV.

Scaling studies indicate that >100 kJ deuterium-tritium fusion yields are possible on the Z machine; however, this level of performance can only be reached by simultaneously scaling up the initial applied B-field, the energy coupled to the fuel by the laser, and the current driving the system. Using the original MagLIF platform, the input parameters were limited to 10 T, approximately 1 kJ of laser energy coupled, and 16 MA. Experiments conducted with these parameters resulted in a primary deuterium-deuterium neutron yield around 3x10¹² and a burn-averaged ion temperature of 2.5 keV. Recent efforts focused on developing enhanced capabilities for the MagLIF platform have demonstrated peak load currents approaching 20 MA and initial applied B-fields exceeding 15 T. Combining these improvements with a change in laser preheat protocol led to a primary neutron yield exceeding 10¹³ and an ion temperature over 3 keV. Additional efforts to further increase the B-field to >20 T, the laser preheat to >2 kJ, and the current to >20 MA are underway.

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