OVERVIEW OF THE MAGNETIZED LINER INERTIAL FUSION RESEARCH PROGRAM IN THE UNITED STATES

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Most fusion research has focused on magnetic confinement fusion with densities of ~10^{14} ions/cm^3 and confinement times of ~10 s, or pulsed inertial confinement fusion (ICF) with densities >10^{25} ion/cm^3 with confinement times <1 ns. Some concepts have been proposed to achieve thermonuclear fusion in between these two extremes, typically through the addition of strong magnetic fields in a pulsed confinement system. One such approach being studied in the United States is Magnetized Liner Inertial Fusion (MagLIF) [1]. MagLIF targets may be capable of large, pulsed fusion yields at densities roughly two orders of magnitude lower than traditional ICF, which could be easier to achieve than the typical radial fuel convergence required of ICF implosions.

The Z Facility at Sandia National Laboratories consists of the Z Machine, a pulsed power driver capable of delivering 26 MA with a 110 ns risetime to a magnetically-driven target, and the Z-Beamlet Laser (ZBL), which can deliver a 2 TW, 2-4 ns laser pulse at 527 nm to the center of Z. Magnetically-driven targets coupled to pulsed power drivers may be a promising path for efficient, high-yield inertial confinement fusion (ICF) as previously outlined [2]. MagLIF uses cylindrical Be or Al liners to compress magnetized, laser- heated fusion fuel. The axial magnetic field inhibits radial thermal conduction losses from the heated fuel to the colder liner plasma, reducing typical ICF velocity, convergence, and stagnation pressure requirements substantially.

This talk will summarize the research program on MagLIF, including results obtained on Z [3,4] and additional science- focused experiments on the Z-Beamlet, OMEGA, and OMEGA-EP laser facilities. The plans for the next several years will also be described, which includes upgrades that to increase the drive current, axial magnetic field strength, and laser energy. If the research program on Z is successful in demonstrating the credibility of this approach, it may be possible to achieve >100 MJ fusion yields per pulse on higher-current, next-generation pulsed power facilities [5].

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