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Beryllium liner implosion experiments on the Z accelerator in preparation for Magnetized Liner Inertial Fusion (MagLIF)*

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Magnetized Liner Inertial Fusion (MagLIF) [1] is a concept that involves using a pulsed electrical current to implode an initially-solid, cylindrical metal tube (liner) filled with preheated and magnetized fusion fuel. One- and two-dimensional simulations predict that if sufficient liner integrity can be maintained throughout the implosion, then significant fusion yield (>100 kJ) is possible on the 25-MA, 100-ns Z accelerator. The greatest threat to the liner integrity is the Magneto-Rayleigh-Taylor (MRT) instability, which first develops on the outer liner surface, and then works its way inward toward the inner surface throughout the implosion. Two-dimensional simulations predict that a thick liner, with $R_{outer}/\Delta R=6$, should be robust enough to keep the MRT instability from overly disrupting the fusion burn at stagnation. This talk will present the first experiments designed to study a thick, MagLIF-relevant liner implosion through to stagnation on Z [2]. The use of beryllium for the liner material enabled us to obtain penetrating monochromatic (6151 ± 0.5 eV) radiographs that reveal information about the entire volume of the imploding liner. This talk will also discuss experiments that investigated Z's pulse-shaping capabilities to either shock- or shocklessly-compress the imploding liners [3], as well as our most recent experiments that used 2-micron-thick aluminum sleeves to provide high-contrast tracers for the positions and states of the inner surfaces of the imploding beryllium liners. The radiography data to be presented provide stringent constraints on the simulation tools used by the broader high energy density physics and inertial confinement fusion communities, where quantitative areal density measurements, particularly of convergent fusion targets, are relatively scarce. We will also present power-flow tests of the MagLIF load hardware as well as new micro-B-dot measurements of the azimuthal drive magnetic field that penetrates the initially vacuum filled interior of the liner during the implosion.

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[1] S.A. Slutz, et al., Phys. Plasmas **17**, 056303 (2010).
[2] R.D. McBride et al., "Penetrating radiography of imploding and stagnating beryllium liners on the Z accelerator," submitted to Phys. Rev. Lett. (May 2012).
[3] M. R. Martin, R. W. Lemke, R. D. McBride, et al., Phys. Plasmas **19**, 056310 (2012).