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**Observations of altered instability structure for imploding z-pinch liners that are premagnetized with a uniform axial field**[1]

THOMAS AWE, Sandia National Laboratories

Magnetically driven implosions provide an energy-rich platform for inertial confinement fusion. The magnetized liner inertial fusion concept (MagLIF, Slutz *et al.* Phys. Plasmas, 17, 056303 (2010)) uses a pulsed-power-driven metallic liner to compress and inertially confine preheated and premagnetized fusion fuel. The fuel is premagnetized with a uniform axial seed field $B_{z,0}$ of 10 to 30 T, which is then compressed by the liner to nearly 1000 T. In the fuel, the ultra-high field reduces thermal conduction and enhances alpha-particle heating. Preheating the fuel to 100-300 eV eases requirements on liner-convergence; nonetheless, convergence ratios at stagnation of 20 or more may be necessary. The ability to maintain liner stability and uniformity through stagnation may ultimately determine the success of the MagLIF concept. The integrity of magnetically imploded liners is compromised both by electrode instabilities and by the magneto-Rayleigh Taylor (MRT) instability. Electrode instabilities form local perturbations that can mix liner material into the fuel prior to bulk compression. Recent experiments on the Z facility have shown that this instability is mitigated when the liner's ends implode onto a nylon "cushion," which impedes local perturbation growth. Other recent experiments have, for the first time, studied the implosion dynamics of *premagnetized* ($B_{z,0} > 0$) MagLIF-type liners. When seeded with a 7 or 10 T axial field, these liners developed 3D-helix-like surface instabilities; such instabilities starkly contrast with the azimuthally-correlated MRT instabilities that have been consistently observed in many earlier *unmagnetized* ($B_{z,0} = 0$ T) experiments. Quite unexpectedly, the helical structure persisted throughout the implosion, even though the azimuthal drive field greatly exceeded the expected axial field at the liner surface for all but the earliest stages of the experiment. Thus far, no self-consistent model has reproduced this fundamentally 3D experimental result.

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