DPP10-2010-000367

Abstract for an Invited Paper
for the DPP10 Meeting of
the American Physical Society

Measurements of magneto-Rayleigh-Taylor instability growth in solid liners on the 20 MA Z facility[1]

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The magneto-Rayleigh-Taylor (MRT) instability is the most important instability for determining whether a cylindrical liner can be compressed to its axis in a relatively intact form, a requirement for achieving the high pressures needed for inertial confinement fusion (ICF) and other high energy-density physics applications. While there are many published RT studies, there are a handful of well-characterized MRT experiments at time scales >1 μs and none for 100 ns z-pinch implosions. Experiments used solid Al liners with outer radii of 3.16 mm and thicknesses of 292 μm, dimensions similar to magnetically-driven ICF target designs [1]. In most tests the MRT instability was seeded with sinusoidal perturbations (λ=200, 400 μm, peak-to-valley amplitudes of 10, 20 μm, respectively), wavelengths similar to those predicted to dominate near stagnation. Radiographs show the evolution of the MRT instability and the effects of current-induced ablation of mass from the liner surface. Additional Al liner tests used 25-200 μm wavelengths and flat surfaces. Codes being used to design magnetized liner ICF loads [1] match the features seen except at the smallest scales (<50 μm). Recent experiments used Be liners to enable penetrating radiography using the same 6.151 keV diagnostics and provide an in-flight measurement of the liner density profile.

[1] S.A. Slutz et al., Phys. Plasmas 17, 056303 (2010).

[1]Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the U.S. DOE National Nuclear Security Administration under contract DE-AC04-94AL85000

[2]With S. Slutz, M. Herrmann, M. Cuneo, K. Peterson, R. McBride, R. Vesey, C. Nakhleh, B. Blue, K. Killebrew, D. Schroen, R. Stamm, K. Tomlinson, A. Edens, M. Lopez, I. Smith, G. Bennett, B. Atherton, M. Savage, B. Stygar, G. Leifeste, and J. Porter