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3D Stagnation instabilities in MagLIF loads on the Z Generator.[1]

CHRISTOPHER JENNINGS, Sandia National Laboratories

Experiments with Magnetized Liner Inertial Fusion (MagLIF) [S.A. Slutz et al. Phys. Plasmas 17, 056303 (2010)] loads have successfully demonstrated the premise of magnetized fusion [M.R. Gomez et al Phys. Rev. Lett. 113, 155003(2014)]. While these experiments are increasingly well diagnosed, many of the measurements (particularly during stagnation) are time integrated, limited in spatial resolution or require additional assumptions to interpret in the context of a structured, rapidly evolving system. As such, there is some ambiguity over what may be limiting performance. Poor laser coupling in preheating the fuel prior to implosion has been suggested as a mechanism [A.B. Sefkow et al. Phys. Plasmas 21, 072711(2014)]. Mix of high Z contaminants that cool the fuel is also a significant concern [S.B. Hansen et al. Phys. Plasmas 22,056313(2015)] In addition, time integrated crystal imaging has shown significant structure in the final fuel assembly indicating potential disruption from instabilities. Understanding the balance between these degradation mechanisms is vital to progress with MagLif. We compare several sets of experimental data with synthetically generated data from systematically varied 3D resistive-MHD simulations to gain insight into the relative contributions of different degradation mechanisms. We demonstrate how some measurements strongly indicate disruption from liner material penetrating into the fuel at stagnation, and discuss the implications this has for how MagLif targets work and scale to larger drive currents. We then explore the extent to which different combinations of instability development, current delivery, high-Z mix into the fuel and initial laser deposition can be differentiated in our existing measurements. Better determining the dominant degradation mechanisms can directly influence the direction we take to improve performance, or our confidence in scaling these targets to higher currents.

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