A more stable, more uniform MagLIF liner configuration*

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Magnetized Liner Inertial Fusion (MagLIF [1]) utilizes a pulsed-power driven low-Z metallic liner to compress a preheated, pre-magnetized fusion fuel. Initial experiments provided many useful results, including a helical structure of the x-ray emitting stagnated fuel and variations in x-ray brightness along the length of the stagnation column [2].

Recent experiments have used an insulating coating on the outside of a high aspect ratio liner. Theoretical calculations [3] have shown that this coating can reduce the early time electro-thermal instabilities which seed the dominant magneto-Rayleigh Taylor (MRT) implosion instability and previous radiographs of imploding liners [4] have both indicated that this coating is effective at reducing late time MRT. Here we use Be liners with an aspect ratio (AR, ratio of liner outer radius to thickness) of 10.6, with a 75μm Epon coating providing a mass equal to an AR 9 Be liner. We explore these coated liners in radiography experiments and full MagLIF stagnation experiments.

Radiography experiments with coated high AR magnetized liners show that, in addition to improving implosion stability this coating affects the liner mass distribution during the implosion – specifically the coating increases the radial extent of the liner material in-flight, reducing the liner density. The reduction in the ρR would be detrimental to fuel confinement, however this reduction in liner ρR could also potentially reduce the growth of late-time instabilities (e.g. deceleration-RT).

Full MagLIF experiments (i.e. using a preheated, magnetized fuel) show that these coated high AR liners can provide DD yields which are comparable to uncoated AR 6 liners. Self-emission imaging shows these coated liners, with a more uniform in-flight inner surface and lower liner ρR, provide improved uniformity in the stagnated column with more continuous emission and less helical structure compared to regular AR 6 liners (and significantly less than uncoated AR 9 liners). On two separate Z experiments these liners produced $>2.10^{12}$ DD neutrons, secondary DT neutron yields $\sim 4.10^{11}$, burn weighted ion temperatures > 2 keV and x-ray weighted electron temperatures ~3 keV; reproducibility studies are ongoing. We will also compare data to experiments where we decreased the liner aspect ratio to improve implosion stability.

References

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