LASER-FUEL COUPLING STUDIES FOR MAGLIF WITH Z-BEAMLET

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The Magnetized Liner Inertial Fusion (MagLIF) concept is designed to achieve high yield nuclear fusion by compressing a pre-magnetized, pre-heated fuel with a slow (v ~ 100 km/s) pulsed-power driven implosion [1]. To achieve fusion conditions with a slow implosion and modest convergence (~20), the MagLIF concept requires substantial pre-heat of the fuel as part of the pre-conditioning process of the target. At Sandia National Laboratories, this stage of the concept is achieved by using the Z-Beamlet laser, which can deliver multiple kilojoules to the target within several nanoseconds. The optimization of the MagLIF campaign requires improving the understanding and performance of the energy deposition of the laser into the fuel, which involves propagation through the Laser-Entrance-Hole (LEH) and coupling to the fuel behind the LEH window without introducing substantial contamination from window expansion or from fuel container ablation.

We present the results of several experimental campaigns with Z-Beamlet that were dedicated to the pre-heat aspect of MagLIF at Sandia's "Z" pulsed power facility and at the Pecos target chamber within Sandia's Z-Backlighter facility. We will discuss the relevance of the laser pulse properties such as pre-pulse or varying sized phase plates, and target variations. A wide range of diagnostics were applied and developed to record laser penetration including blast wave propagation from the leaser-heated region, backscattered laser light, LEH window destruction, and X-ray response of the window. Between the various diagnostics a set of data with spectral, spatial, and temporal resolution could be assembled. First insights into contamination were gathered by using surface dopants on specific regions of the target.

We will discuss the progress of the investigations and suggest further steps to fully understand the details of pre-heat for the MagLIF program at Sandia.

[1] S.A. Slutz et al.: Phys. Plasmas **17**, 056303 (2010), and Phys. Rev. Lett. **108**, 025003 (2012)

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