FUSION NEUTRON MEASUREMENTS FOR MAGNETIZED INERTIAL FUSION EXPERIMENTS ON THE Z ACCELERATOR

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Measurements of the neutrons produced during magnetized liner inertial fusion (MagLIF) experiments conducted at the Z accelerator at Sandia National Laboratories show strong evidence that the neutron production mechanism is of thermonuclear origin. The MagLIF concept[1] utilizes the implosion of a laser-preheated, magnetized fuel by a solid cylindrical metal (i.e., beryllium) liner that is magnetically compressed by the 18 MA delivered by the Z pulsed-power accelerator. To date, these experiments have utilized deuterium fuel and produced primary DD fusion neutron yields up to 2e12 with electron and ion stagnation temperatures in the 2-3 keV range[2]. Nuclear measurements have revealed several other important features. As one of the most essential metrics to support the notion of thermonuclear neutron production, the DD neutron yields appeared to be isotropic and the radially and axially measured DD neutron spectral shapes appear to be very similar and Gaussian shaped. Significant production of secondary DT neutrons produced from the interaction of deuterons and secondary tritons from the aneutronic branch of the primary deuteron reaction indicates that the fuel is strongly magnetized given the rather low fuel areal density in the radial direction (~2 mg/cm^2)[3]. Asymmetry in the DT spectral shapes measured radially and axially are yet another indicator of strong magnetization. Based on x-ray measurements, the neutron burn duration appears to be ≤ 2 ns FWHM, and estimates of the neutron bang time from neutron time-of-flight methods indicate that the peak neutron production occurs near the time of peak x-ray emission. There is evidence of down-scattered primary neutrons from the highly compressed beryllium liner that suggest *liner* areal densities of O(1) g/cm^2. Implications of the neutron measurements and comparisons with photon-based measurements and neutron and plasma simulations[4] are presented. Plans for improvements to the neutron diagnostic suite are briefly discussed.

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