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Laser-Driven Magnetized Liner Inertial Fusion on OMEGA

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Magneto-inertial fusion (MIF) is an approach that combines the implosion and compression of fusion fuel (a hallmark of inertial fusion) with strongly magnetized plasmas that suppress electron heat losses (a hallmark of magnetic fusion). It is of interest because it could potentially reduce some of the traditional velocity, pressure, and convergence ratio requirements of inertial confinement fusion (ICF). The magnetized liner inertial fusion (MagLIF) concept being studied at the Z Pulsed-Power Facility is a key target concept in the U.S. ICF Program. Laser-driven MagLIF is being developed to enable a test of the scaling of MagLIF over a range of absorbed energy from of the order of 20 kJ (on OMEGA) to 500 kJ (on Z). It is also valuable as a platform for studying the key physics of MIF. An energy-scaled point design has been developed for the Omega Laser Facility that is roughly 10$\times$ smaller in linear dimensions than Z MagLIF targets. A 0.6-mm-outer-diam plastic cylinder filled with 2.4 mg/cm^3 of D_2 is placed in a 10-T axial magnetic field, generated by MIFEDS (magneto-inertial fusion electrical discharge system), the cylinder is compressed by 40 OMEGA beams, and the gas fill is preheated by a single OMEGA beam propagating along the axis. Preheating to $>$100 eV and axially uniform compression over a 0.7-mm height have been demonstrated, separately, in a series of preparatory experiments that meet our initial expectations. Preliminary results from the first integrated experiments combining magnetization, compression, and preheat will be reported for the first time. The scaling of laser-driven MagLIF from OMEGA up to the 1800 kJ available on the NIF (National Ignition Facility) will also be described briefly. This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0001944.