Development of Laser-Driven MagLIF on OMEGA: Magnetized liner inertial fusion (MagLIF) is an inertial confinement fusion (ICF) scheme proposed by researchers at Sandia National Laboratories (SNL) that uses cylindrical compression of magnetized, preheated DT fuel.[1] The axial magnetic field reduces electron thermal conductivity, allowing for near-adiabatic compression at lower implosion velocities (~100 km/s) than conventional ICF. Preheating to 200 eV or higher is required to reach the ignition temperature of 7 keV with a compression ratio of no more than 30. The compressed magnetic field (B) then confines alpha particles, replacing the areal-density (ρR) requirement for ignition with a BR > 0.6 T m requirement. The confinement time is provided by cold dense material surrounding the hot fuel, as in conventional ICF. MagLIF experiments have been carried out on the Z pulsed-power machine at SNL,[2] using the Z-Beamlet laser to preheat the fuel, achieving peak temperatures of ~3 keV and BR ~ 0.4 T m. Magnetized cylindrical compressions were carried out on OMEGA, using MIFEDS (magneto-inertial fusion electrical discharge system) to provide the magnetic field, before MagLIF was proposed.[3] The only element of MagLIF missing from these experiments was the preheating, which could easily be provided by an OMEGA beam. MagLIF experiments on OMEGA would provide the first experimental data on scaling and provide a higher shot rate with better diagnostic access than on Z. A point design for laser-driven MagLIF on OMEGA has been developed [Fig. 1(a)]. The energy available on OMEGA is 1000× lower than on Z, so linear dimensions are reduced by a factor of 10, leading to the choice of a 600-μm-outer-diam target. MIFEDS can provide a 10-T axial magnetic field, the same as that used in Z experiments. Two-dimensional hydrodynamics calculations with *DRACO* indicate that a 200-eV preheat temperature could readily be achieved. The shell thickness, fill density, and laser pulse duration have been chosen, based on 1-D *LILAC* calculations, to optimize neutron yield at a convergence ratio <30 and an implosion velocity <150 km/s, leading to the choice of a 30-μm-thick shell, a fill density of 2.4 mg/cm^3 D_2, and a 2-ns pulse duration. Preliminary experiments have been carried out with the support of the Laboratory Basic Science (LBS) Program and SNL, which confirm the accuracy of the preheat calculations and show that it is possible to uniformly compress a 700-μm-long cylinder at 140 km/s. Sample axial and radial views from a compression experiment are shown in Fig. 1(b). The collaboration established with SNL led to the submission of a joint proposal to ARPA-E (Advanced Research Projects Agency-Energy) to study MagLIF, which has been awarded $4M over the next two years. The first integrated MagLIF experiment on OMEGA is scheduled for 1 June 2016.

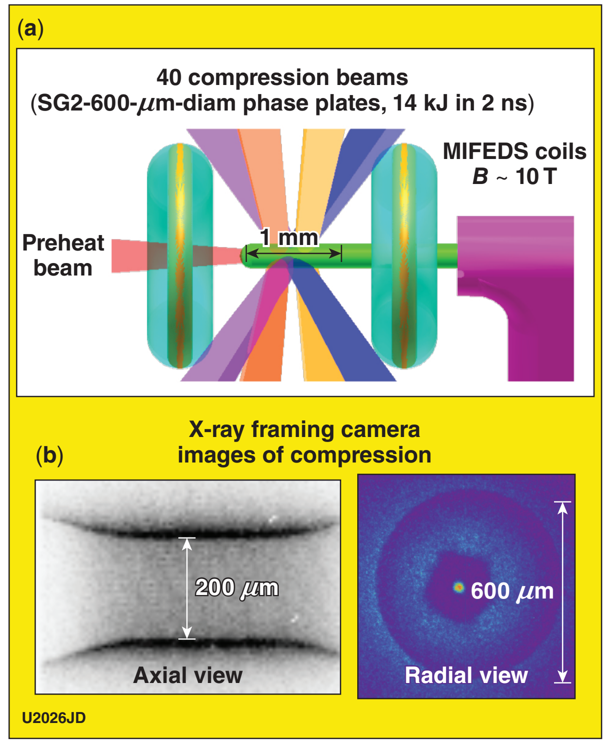

Figure 1. (a) A schematic of the point design for laser-driven MagLIF on OMEGA. (b) Axial and radial x-ray framing-camera images of self-emission at the end of the laser pulse from a cylindrical compression experiment without magnetic field or preheat, showing compression and shock convergence at the center. MIFEDS: magneto-inertial fusion electrical discharge system

Omega Facility Operations Summary: The Omega Laser Facility conducted 147 target shots in November with an average experimental effectiveness (EE) of 99.0% (OMEGA conducted 99 target shots with an EE of 98.5% and OMEGA EP had 48 and 100%, respectively). The ICF program accounted for 84 target shots for experiments led by LLNL, LLE, and SNL; while the HED program had 27 target shots for experiments led by LLNL. Two NLUF experiments led by MIT and the University of California, Berkeley, took 19 target shots and two LBS experiments led by LLNL and LLE had 17 target shots.

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3. O. V. Gotchev *et al.*, Phys. Rev. Lett. **103**, 215004 (2009).