Joint SNL–LLE Magnetized Linear Inertial Fusion Project: Magnetized liner inertial fusion (MagLIF) relies on cylindrical compression of magnetized, preheated fuel to achieve fusion conditions at lower implosion velocities and lower areal densities than conventional inertial confinement fusion. The original MagLIF concept was developed by scientists at Sandia National Laboratories (SNL) and relies on pulsed power for compression and a laser for preheating.[1] A purely laser-driven, smaller-scale version of MagLIF on OMEGA was proposed by researchers at LLE at the end of 2013 as a means to test the scaling of MagLIF and to carry out experiments at higher repetition rate and with better diagnostic access than possible on the Z machine at SNL, facilitating the study of the basic physics of MagLIF.

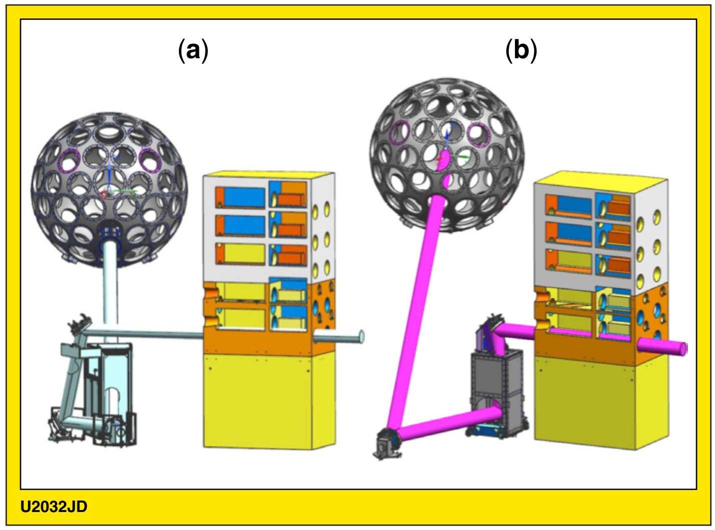

Figure 1. (a) Existing setup for bringing Beam 25 through port P9, with the beam detuned to 2ω. (b) Proposed setup for bringing Beam 35 through port P9. The beam remains at 3ω.

At the end of 2015, the Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) awarded a joint SNL–LLE proposal to study MagLIF—\$4M over ~2 years—part of its ALPHA (accelerating low-cost plasma heating and assembly) project exploring fusion at intermediate densities. OMEGA MagLIF experiments will require a laser beam aligned along the axis of the cylindrical target to preheat the fuel (D_2 gas in initial experiments). Port P9 is aligned along an axis of symmetry that provides reasonably good drive uniformity for a cylindrical implosion. This port is already used to bring Beam 25 either detuned from 3ω to 2ω or frequency converted to 4ω for optical Thomson-scattering measurements. The existing setup [shown in Fig. 1(a)] is not ideal for laser-driven MagLIF experiments because (a) the critical density at 2ω is too low to be used at the fuel densities of interest, (b) there are no phase plates or beam diagnostics for 4ω, and (c) Beam 25 is one of the beams that is required for compression. Conversely, 3ω has been demonstrated to provide adequate preheat in a series of experiments on OMEGA and OMEGA EP.[2] Time-resolved laser backscatter and transmission measurements on OMEGA were particularly useful in clarifying the preheating process. Therefore, as part of the ARPA-E project, it was decided to implement a 3ω beam from P9 (functionally equivalent to a standard OMEGA beam) using a beam not required for compression in laser-driven MagLIF. A new 3ω lens for P9 has been designed and ordered, and Beam 35 has been identified as the best alternative to Beam 25. The design for the 3ω mirror support structures is shown in Fig. 1(b). The second- and fourth-harmonic capabilities using Beam 25 will be retained. The target date for first operation is 19 July 2016.

Omega Facility Operations Summary: The Omega Laser Facility conducted 175 target shots in December with an average experimental effectiveness (EE) of 95.4% (88 shots with and an EE of 97.2% on the OMEGA laser and 87 shots with an EE of 93.7% on OMEGA EP). The ICF program accounted for 60 target shots for experiments for LLNL and LLE, while the HED program had 55 target shots for experiments conducted by LLNL, LANL, and LLE. The University of Michigan, Rice University, the University of California, Berkeley, and the University of California, San Diego carried out 39 target shots for five NLUF experiments while one LBS experiment led by LLNL had 7 target shots and the CEA program accounted for 14 target shots.

1. S. A. Slutz *et al.*, Phys. Plasmas **17**, 056303 (2010).
2. A. J. Harvey-Thompson *et al.*, Phys. Plasmas **22**, 122708 (2015).