In-Tank Focal-Spot Diagnostic: High-convergence, laser-driven DT cryogenic implosions for the 100-Gbar Campaign require uniform laser illumination of the target.[1] Through a balancing of gains, losses, and frequency conversion, the OMEGA laser now consistently delivers an rms power (energy/unit time) balance among all 60 beams of 2% to 3% (Ref. 2). While balancing the power in each of the 60 beams is an important first step, the relevant quantity for these experiments is not the power, but the intensity (power/unit area) balance on target. A quantification of intensity balance requires not only measurements of energy and pulse shape, but also a characterization of the on-target focal spot.

LLE has developed an in-tank diagnostic to measure both the on-shot focal-spot spatial profile and the energy of each laser beam at the target. This system, the full-beam, in-tank (FBIT) diagnostic, was recently commissioned on OMEGA.[3] The FBIT diagnostic uses a wedged pair of final optics to pick off a full-aperture, low-energy sample of the beam [see Fig. 1(a)]. The uncoated, wedged vacuum window creates a sequence of low-energy, forward-going replica beams while the wedged debris shield compensates the aberrations introduced by the vacuum window. The FBIT diagnostic is inserted into the target chamber via a ten-inch manipulator and captures one of the replicas, imaging it to a charge-coupled–device (CCD) camera [see Fig. 1(b)].

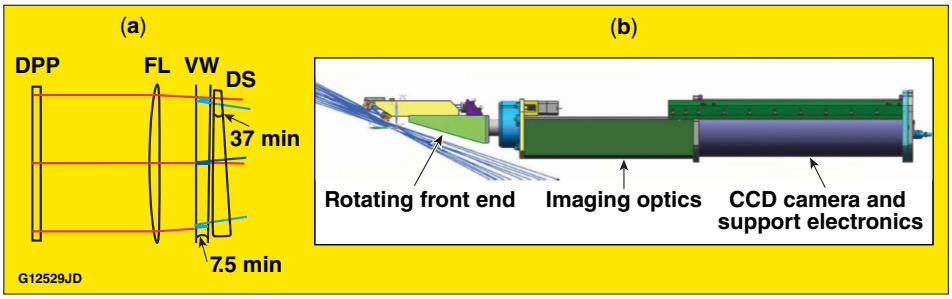

Figure 1. (a) Diagram of the modified final optics assembly (FOA) used for the FBIT diagnostic. For clarity, wedges are exaggerated and some of the reflections have been omitted. (b) CAD drawing of the ten-inch–manipulator (TIM)-based FBIT diagnostic. DPP: distributed phase plate; FL: focus lens; VW: vacuum window; DS: debris shield.

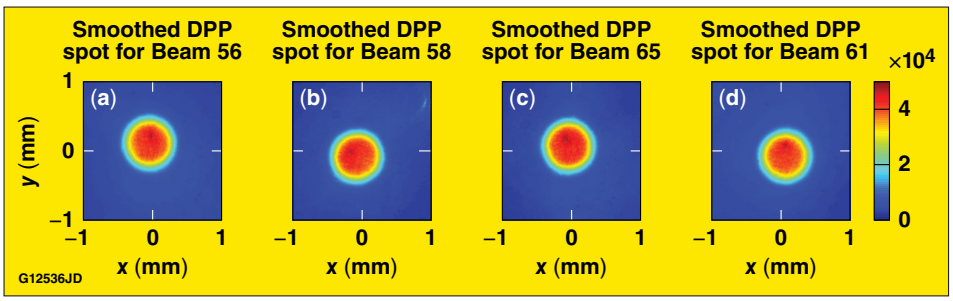

Figure 2. FBIT measured and smoothed DPP far-field profiles for (a) Beamlines 56, (b) 58, (c) 65, and (d) 61. All shots used ~350-J, 1-ns square pulses.

Figure 2 shows data from the FBIT commissioning experiments. The on-shot (350-J, 1-ns square pulse), distributed phase plate (DPP) smoothed focal spot in Beamlines (a) 56, (b) 58, (c) 65, and (d) 61 is measured and can be analyzed to determine illumination uniformity on target. By the end of FY19, the FBIT diagnostic will characterize the focal spot of 31 of OMEGA's 60 beams, providing an excellent estimate of overall intensity balance on target.

Omega Facility Operations Summary: During November 2018, the Omega Laser Facility conducted 184 shots with an average experimental effectiveness (EE) of 96.8%. The OMEGA laser had 118 shots with an EE of 94.9% and the OMEGA EP laser had 66 shots with an EE of 100%. The ICF Program was responsible for 96 shots led by LLE, LLNL, and NRL and the HED Program had 53 target shots for experiments led by LLNL, LANL, SNL, and LLE. Twenty-eight target shots were taken for NLUF experiments led by the University of Michigan, Princeton University, and MIT. One LBS experiment led by LLNL had 7 target shots.

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2. S. Sampat *et al.*, Appl. Opt. **57**, 9571 (2018).
3. L. J. Waxer *et al.*, Proc. SPIE **10898**, 108980F (2019).

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