Mass-Ablation-Rate Measurements in Polar-Direct-Drive Implosions on OMEGA: A new diagnostic technique has been developed on OMEGA to measure the mass ablation rate in direct-drive implosions.[1] It is being applied to polar-direct-drive (PDD) experiments to validate the 2-D cross-beam energy transfer (CBET) and nonlocal thermal-conduction modeling. Adding a thin layer of Si over a CH shell generates two peaks in x-ray self-emission images that are measured with a gated pinhole imager [Fig. 1(a)]. The location of the inner peak is related to the position of the ablation front and the outer peak corresponds to the position of the interface of the two layers in the plasma [Fig. 1(c)]. The emergence of the second peak is used to measure the burnthrough time of the outer layer, giving the average mass ablation rate (73±15 μg/ns for this case) of the Si layer and instantaneous mass remaining [Fig. 1(d)].

This technique has been adapted to measure the angular mass ablation rate in PDD experiments. Figure 1(b) shows a self-emission image obtained from a PDD experiment on OMEGA. From this image, it is evident that the mass ablation rate was larger on the pole than on the equator. The larger mass ablation rate results in the larger expansion of the Si/CH interface (solid curve) and a faster implosion on the pole (dashed curve). For each experiment, 16 images spread over 1 ns were used to determine the angular dependence of the laser burnthrough time, which relates directly to the angularly resolved mass ablation rate. This technique will be the focus of a PDD experiment on the National Ignition Facility, where two Si thicknesses will be used in successive shots to quantify the angular mass ablation rate. These results will be used to validate the 2-D CBET and nonlocal thermal-transport models at direct-drive–ignition plasma conditions.

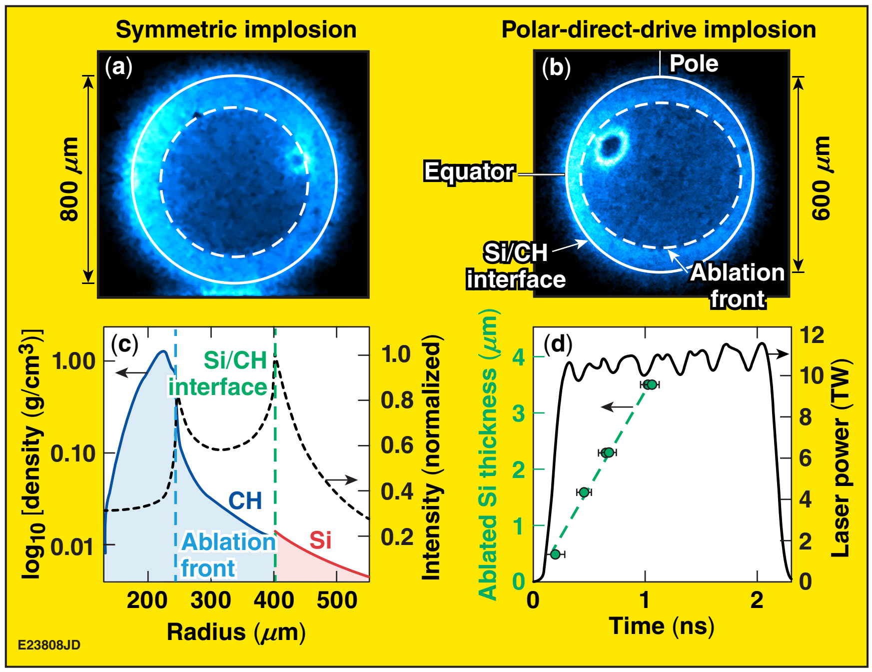

Figure 1. X-ray self-emission images measured on a (a) symmetric and (b) polar-direct-drive implosion on OMEGA where the targets were constructed with 3 μm of Si on top of a 20-μm-thick CH shell. (c) The simulated density (solid curve) and temperature were used to calculate the x-ray emission profile (dotted black curve). (d) An average mass ablation rate of 73±15 μg/ns was calculated from the measurement of the time to ablate four different thicknesses of Si.

Omega Facility Operations Summary: During January 2015, the multi-pulse driver line (MPD) was activated on the OMEGA 60-beam UV laser. MPD provides the capability to perform dynamic bandwidth reduction on OMEGA target shots. The system provides on-shot co-propagation of two separate pulse shapes in all 60 OMEGA beams. Dynamic bandwidth reduction (bandwidth only on pickets) provides increased energy in the drive pulse. In addition to the MPD activation, several other projects were implemented during this period, including: a new neutron temporal diagnostic designed for the high neutron yields of cryogenic targets (CryoNTD); a 16-channel Kirkpatrick–Baez x-ray imager with 5- to 7-μm spatial resolution and 30-ps temporal resolution; improvements to the velocity interferometer system for any reflector; replacement of the OMEGA off-axis parabola; use of a new UV beam-timing system; and the activation of a new controller on the linear induction motor used on cryogenic target shots. OMEGA EP carried out a limited number of target shots during January (41 total with an experimental effectiveness of 98.8%). These shots included 10 for the ICF campaign and 18 for the HED program. The remainder of the shots and facility time were used for various maintenance activities including: a UV focus scan; testing of the multi-FM SSD system to be used eventually on the NIF; and grating compressor chamber maintenance.

1. A. K. Davis *et al*., Rev. Sci. Instrum. **85**, 11D616 (2014).