Three-Dimensional Hydrodynamic Simulations of OMEGA Implosions: The effect of large-scale (with Legendre modes less than about 10) asymmetries in cryogenic and room-temperature OMEGA implosions were investigated using the 3-D Eulerian hydrodynamic code *ASTER*.[1] Sources of these asymmetries include laser illumination nonuniformities (because of overlapping the 60 OMEGA beams and power imbalance, mispointing, and mistiming of these beams), target offset, and variation in target-layer thickness. Simulations assuming the measured sources of asymmetries indicate that the performance of cryogenic implosions is mainly affected by target offsets (~10 to 20 μm), beam-power imbalance (σ_{rms} ~ 10%), and variations (~5%) in deuterium–tritium (DT) ice-layer thickness. These sources result in significantly distorted implosion cores, reduced hot-spot confinement, and increased residual kinetic energy that is not converted to the hot-spot internal energy. Simulations indicate that mode 1 is typically the most destructive one. The predicted reduction of the neutron yield in asymmetric implosions (down to 50% to 10% of the yield in symmetric implosions) shows good agreement with measurements. The ion temperature inferred from the width of simulated neutron spectra is influenced by bulk fuel motion in distorted hot spots and can result in up to an ~1-keV increase in the apparent temperature. Similar temperature variations along different lines of sight are observed.

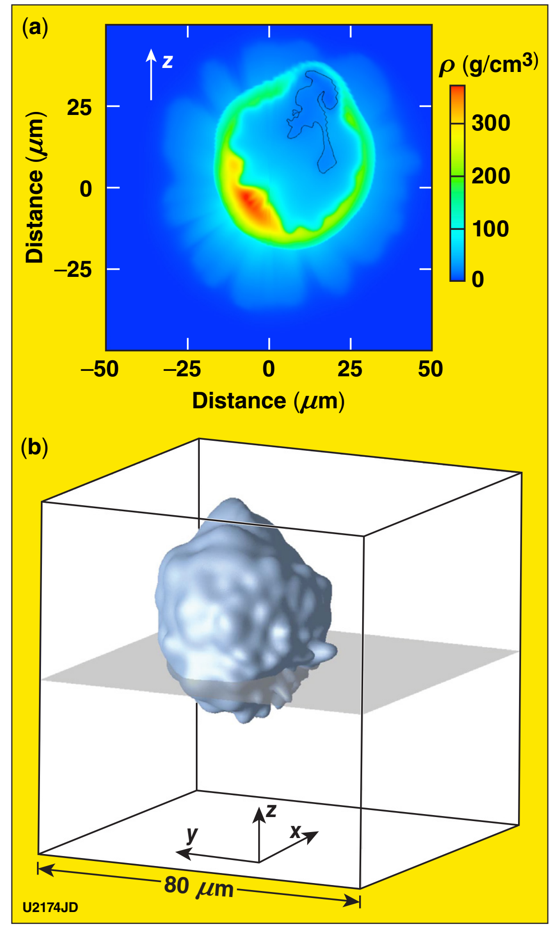

Figure 1. *ASTER* simulation of cryogenic shot 77066 showing (a) the density distribution and (b) a 3-D view of the hot spot (isosurface T_i = 900 eV).

Figure 1 shows results of *ASTER* simulations of cryogenic shot 77066. These simulations assume all best-known (measured) sources of low-mode asymmetries in this particular implosion including individual beam power history, beam mispointing (σ_{rms} ≈ 10 μm), target offset (4 μm), and DT ice layer thickness variation (±2 μm in mode 1; the bottom is thinner). Figures 1(a) and 1(b) show the distribution of density in the meridional plane (at φ = 83°) and 3-D view of the hot spot (represented by the isosurface T_i = 900 eV), respectively, at peak neutron production (t = 3.57 ns). The implosion demonstrates the apparent mode-1 asymmetry of the dense shell and corresponding displacement of the hot spot toward the "north" pole and in the azimuthal direction φ ≈ 83°. The ion temperature of the hot spot was inferred from simulated neutron spectra in three different directions and shows a directional variation of ~0.9 keV. This value is in good agreement with the variation of ~0.6 keV in experiment. Simulations do not exactly reproduce the directions of observed maximum and minimum ion temperatures. This discrepancy can partially be attributed to measurement inaccuracy of the sources of low-mode asymmetries assumed in the simulations. The neutron yield and hot-spot pressure predicted by *ASTER* for shot 77066 are 39% and 64% of the values obtained by a uniform (1-D) simulation, respectively. The observed yield and pressure are consistent with the *ASTER* predictions (~30% and ~60% of 1-D predictions, respectively).

Omega Facility Operations Summary: The Omega Laser Facility conducted 198 target shots in February 2017 with an average experimental effectiveness (EE) of 95.0% (124 shots were conducted on OMEGA and 74 on OMEGA EP with EE of 95.2% and 94.6%, respectively). The ICF program accounted for 101 of the shots for experiments led by LLNL and LLE, while the HED program had 52 target shots for experiments led by LANL and LLNL. Three NLUF experiments led by the University of California, Berkeley, University of Michigan, and Princeton University carried out 22 target shots. Twenty-three target shots were provided to LBS program experiments led by LLNL.

1. I. V. Igumenshchev *et al*., Phys. Plasmas **23**, 052702 (2016).