July 1999 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities

2-D* ORCHID *Simulation: A particularly sensitive parameter characterizing target performance is the density profile of the cold shell around peak compression. We measure this profile by doping part of the shell with titanium and imaging the Ti Kα fluorescence pumped by core radiation. Since the shell $\rho\Delta R$ is measured by the *K*-edge absorption and 1*s*–2*l* absorption lines, the density profile is thereby determined. Simulations were performed, using the 2-D hydrocode *ORCHID*, for a 25-μm-thick empty shell implosion. The effect of smoothing by spectral dispersion (SSD) on laser nonuniformity was modeled by random-phase reversal of the spatial modes every coherence time. Figure 1(a) shows calculated profiles, azimuthally averaged, at peak compression: a hot core is surrounded by a colder, Kα-emitting layer. To compare to the Kα-measured density profile, we consider only the cold material (defined by the Kα ionization state). In Fig. 1(b) we show examples of the calculated density of cold material only. Finally, we compare the time-averaged *ORCHID* profile with that measured from the time-integrated Kα profile. Good agreement is seen in both the shape and absolute magnitude of the density profile. On the other hand, the 1-D code *LILAC* (which does not include the effects of laser nonuniformity) shows a significant disagreement with the measurements.

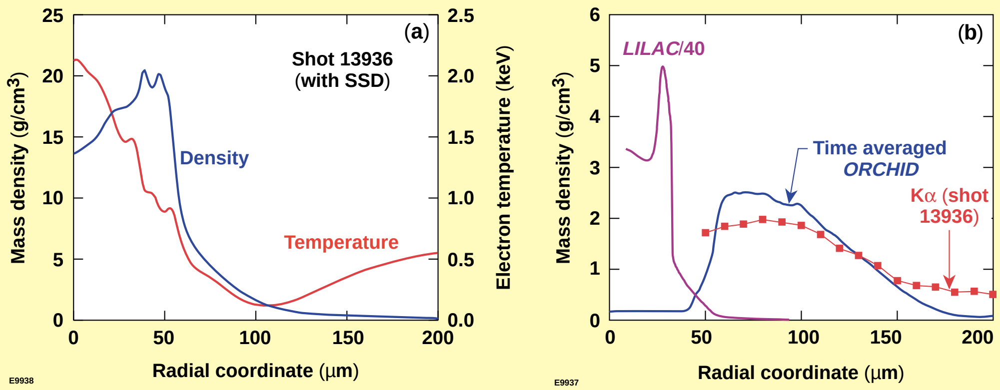

Fig. 1. (a) Density and electron temperature at peak compression calculated by *ORCHID* (azimuthally averaged); shot 13936, with SSD. (b) Cold density profile for shot 13936 (with SSD) deduced from Ti-Kα profile, replicated by 2-D *ORCHID* compared to 1-D *LILAC* prediction.

Secondary Neutron Spectrum Measurements: The secondary neutron yield (i.e., DT neutrons from DD-filled targets) is used to measure core ρR. By incorporating CD in the shell and measuring the energy spectrum of the secondary neutrons we gain information on the shell temperature and possibly the core–shell mixing because when tritons slow down, they generate a narrower secondary spectrum, and their total number is no longer simply related to the core ρR. Figure 2 shows the spectrum of secondary neutrons, normalized to the primary yield, for two identical targets, except that in one of them an inner CH layer was replaced by CD. The comparison shows that in the former case most of the secondary yield came from the shell. The narrowness of the spectrum in the former case is expected since the shell is colder than the core. In addition, we find that the spectrum gets narrower for thicker-shell targets, indicating, as predicted, colder compressed shells. In the future, we will use these techniques to study more unstable implosions with shaped pulses.

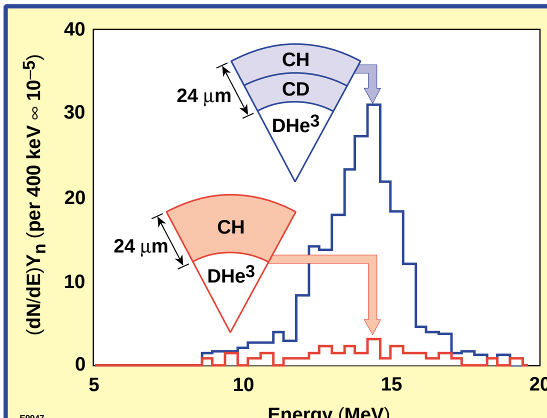

Fig. 2. Secondary neutron yield, normalized to the primary yield, Y_n, for two identical targets except that in one of them an inner CD layer replaced the CH. The targets were 24-μm shells filled with 3 atm of DHe^3, irradiated with a square pulse.

OMEGA Operations Summary: Over a period of three target-shot weeks during July, the OMEGA facility produced a total of 89 target shots in support of experiments run by scientists from LLNL, LANL, AWE, the University of Wisconsin (NLUF), and LLE. Experiments were conducted on spectroscopic measurements of radiation-driven ablators (NLUF), laser-driven ablators in planar foils (LLNL), jet formation using hohlraum drive (AWE/LLNL), simulation of drive symmetry in the foot of the pulse on NIF hohlraums (LLNL), radiation flow (LLNL), tetrahedral-hohlraum implosions (LANL), target diagnostics development (LANL), and Rayleigh–Taylor instability experiments (LLE). In addition to the target-shot weeks, one week of system time was dedicated to activating the improved, high-bandwidth SSD system.

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