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

***Ion Temperature Measurements:*** A new neutron time-of-flight (NTOF) scintillator counter based on a fast-quenched scintillator and microchannel-plate photomultiplier tube was recently installed on OMEGA at 3 m from the target chamber's center. This 3-m NTOF counter can measure simultaneously the ion temperature and neutron yield from $10^8$ to $10^{10}$. An example of recent ion temperature measurements is shown in Figs. 1 and 2. In these experiments we investigate direct-drive implosions of $D^3He$-filled spherical plastic shells of 20-$\mu$m total thickness and varying thickness of inner CD layer. Figure 1 shows a fit of the 3-m NTOF signal from DD-fusion neutrons. Only the rising edge of the signal is fitted to exclude the contribution of $\gamma$ rays from $n$-$\gamma$ reactions. Figure 2 shows the obtained ion temperature as a function of inner-CD-layer thickness. The decrease of the ion temperature is consistent with the assumption that in addition to neutrons coming from the "hot" compressed fuel, there are also neutrons born in a "cold" CD shell. The portion of neutrons generated in the CD increases with the thickness of the CD layer and consequently decreases the effective ion temperature.

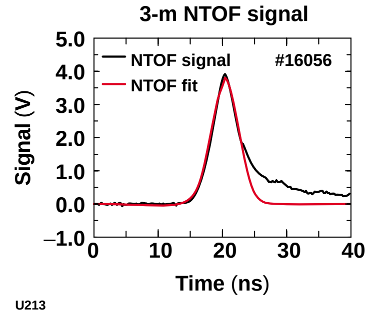



Fig. 1

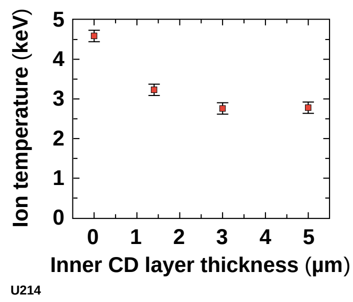
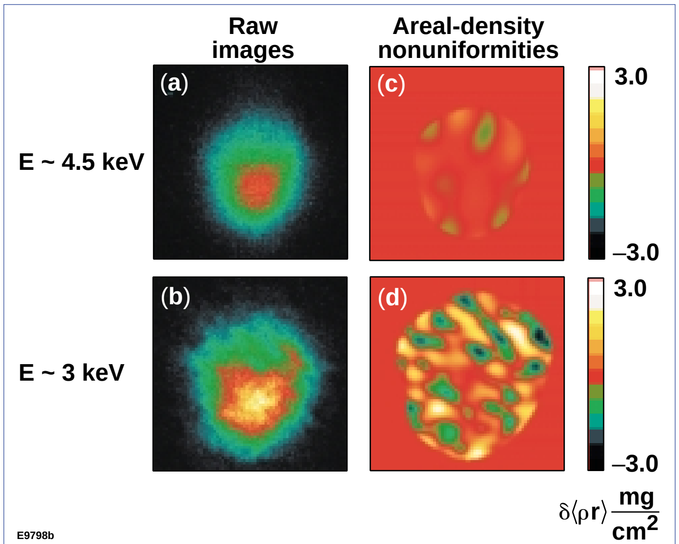



Fig. 2

***Shell Integrity Imaging:*** We are conducting studies of the compressed shell integrity of imploded spherical capsules using x-ray imaging of the core. The emission from the hot core is imaged through the cold shell at two x-ray energy bands, absorbing and nonabsorbing by the shell. This allows nonuniformities in the core emission and the cold shell areal density to be measured. Images of the target were obtained using a pinhole array with K-edge filters. The peak x-ray energies used are around 3 and 4.5 keV for pure CH shells. The image taken at x-ray energies around 4.5 keV represents emission from the core; it is uniform for a typical implosion. The core emission at lower x-ray energies is attenuated by the shell and contains information regarding the shell nonuniformities. The images were filtered, and resulting nonuniformities in the intensity were converted to nonuniformities in optical depth that are proportional to the shell-areal-density nonuniformities. Initial results show that the shells have time-integrated nonuniformity levels of the order of 10% of their areal density at peak compression.




Images of the core taken at x-ray energies around (a) 4.5 keV and (b) 3 keV. Nonuniformities in core radiation and nonuniformities in the shell (c,d) converted into areal-density modulations of the cold CH.

Fig. 3

***OMEGA Operations Summary:*** During June OMEGA was wholly allocated to external users. NLUF users' experiments included x-ray spectroscopy on ultrahigh-density implosions led by a team from the University of Florida, x-ray diffraction experiments carried out by a team involving several research groups, and astrophysical simulation experiments carried out by a multigroup effort. Experiments to test the symmetry of cylindrical hohlraum-driven capsule implosions were carried out by LLNL and CEA. These were followed by a shot day dedicated to the development of a new EOS diagnostic fielded by a team from LANL. The third week of June was also dedicated to a LANL-led series of shots to study shock propagation and Rayleigh–Taylor instability in tetrahedral-hohlraum x-ray-driven targets. The final week of June was a non-target-shot week used to install the next generation of SSD beam-smoothing systems. A total of 94 shots to target were delivered in 10 shot days for experiments by six external research teams.

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