# May 2000 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities

***Power-Balance Diagnostics:*** P510 streak cameras are very important diagnostics for the OMEGA power balance and UV optical pulse shape. A fiber delivery system consisting of seven-fiber bundles was developed to bring light to a streak camera located behind the shield wall to minimize neutron-induced noise. The overall bandwidth of a streak camera is limited by the transmission bandwidth of a single optical fiber that we measured to be >30 GHz. Another bandwidth-limiting factor is unequal fiber length in a fiber bundle. Using the SBS–SRS pulse-compression laser system described in the November 1999 LLE Progress Report we demonstrated that the seven-fiber-bundle bandwidth is nearly equal to that of a single fiber. Figure 1 compares a laser pulse propagated through a single fiber with a pulse propagated through a seven-fiber bundle. This measurement demonstrates that our fiber bundle assembling technique does not limit the overall bandwidth of the OMEGA streak camera diagnostics.

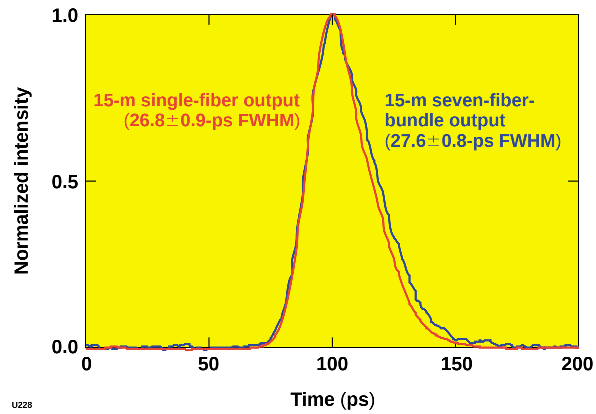

Figure 1. Comparison of short-pulse propagation through single- and seven-fiber bundle.

***Shock-Heating Measurements:*** Absorption spectroscopy experiments were performed on OMEGA to measure shock heating in directly driven planar targets. X rays (1.5 keV) from a Sm backlighter target were used to probe 1*s*–2*p* absorption lines in an Al layer embedded in the target. Figures 2(a) and (b) show streaked x-ray spectra for CH planar targets driven on OMEGA by a 1-ns square pulse (at $4 \times 10^{14}$ W/cm$^2$). For the streak data shown in Fig. 2(a), a 0.5-$\mu$m-thick Al layer was placed 10 $\mu$m from the irradiated surface; in Fig. 2(b) the Al layer was 5 $\mu$m from the surface. The absorption spectra show that F- and O-like Al lines appear at times consistent with the primary shock's arrival at the Al layer (i.e., 300 ps for the 10-$\mu$m depth and ~150 ps for 5 $\mu$m). Later, higher ionization states (N-like through Be-like) are seen in progression as the leading edge of the laser-driven heat front reaches the Al layer. In the 5-$\mu$m case, the heat front fully reaches the Al, producing He-like emission. Note in both figures that the Al *K*-shell absorption edge moves to higher energy as higher ionization states are produced. Furthermore, shock heating creates an abrupt change whereas the heat front produces a slower change. Similar experiments with ramp pulses (with rise time >1 ns) do not produce observable shock heating. These experiments will be analyzed and refined to obtain results that can be used to validate our hydrocodes' ability to predict the isentrope of direct drive-implosions.

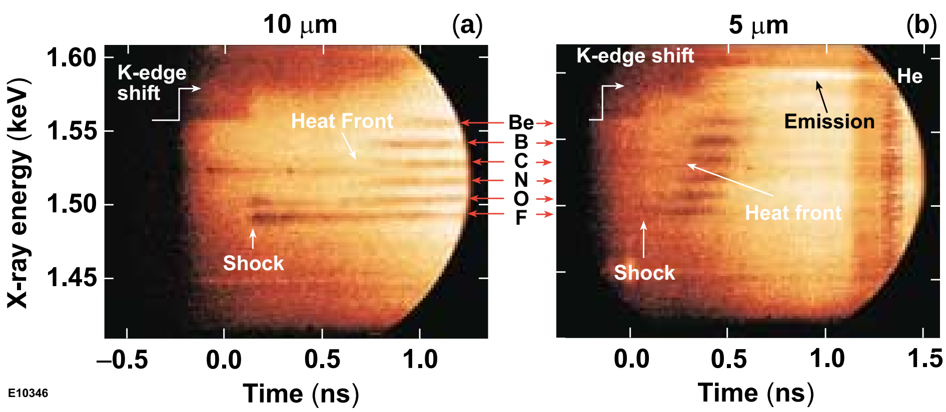

Figure 2. X-ray streak camera recordings of absorption spectra from directly driven CH planar targets. (a) the streaked spectrum of a CH target where the Al absorbing layer was buried 10 $\mu$m inside the target; (b) the Al layer was placed 5 $\mu$m inside the CH target.

***OMEGA Operations Summary:*** In May, ten days were dedicated to target shots; one week was a maintenance week. The 92 total target shots were distributed as follows: LLE-led campaigns included 57 shots for the Rayleigh–Taylor instability campaign and 16 for laser–plasma interaction (LPI) experiments. Nine shots were taken for an NLUF LPI experiment and 10 shots were taken for a collaborative LLNL/AWE experiment on colliding jets. Highlights from the maintenance period included installation of a new TIM 1 assembly, a new IR alignment laser, 60 blast window assemblies, and an additional 30 other optical component replacements. By the end of May, 50 of the 60 FCC assemblies were refurbished and upgraded to THz-bandwidth-capable frequency-conversion systems.

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