Doped-Ablator Implosions: Experiments on OMEGA are measuring the effect of Si-doped CH ablators on direct-drive implosions of gas-filled shells. Two specific effects of the dopant are being investigated: (a) how the increased coronal x-ray radiation changes the shell convergence and resulting neutron yield and (b) how the intensity of x rays with energies >50 keV depends on the presence of Si at the quarter-critical surface. The 860-μm-diam target shells are composed of varying thicknesses of a Si-doped (5.9±0.3% atomic concentration) CH layer (CHSi) over an undoped CH layer. The shell mass is kept constant and is equivalent to a 27-μm-thick CH shell. Doped layer thicknesses of 0, 3, 5, and 10 μm were used as the ablation surface and the targets were filled with 15 atm of D_2. The pulse shapes were designed to implode an undoped 27-μm CH shell target with $\alpha = 2$ (LA2201) and $\alpha = 3$ (LA1501), where α is defined as the pressure/Fermi pressure. The total laser energy on target was 18 kJ, resulting in a drive intensity of 8×10^{14} W/cm^2.

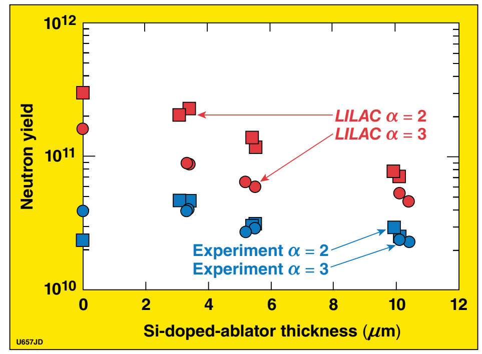

Figure 1. Calculated and measured neutron yields for the Si-doped-ablator implosions plotted as a function of the thickness of the Si-doped ablator. Red points are predictions from the 1-D hydrodynamics code *LILAC*. Blue points are the experimental measurements. The squares are for the $\alpha = 2$ pulse shape and the circles are for the $\alpha = 3$ pulse shape.

The results of neutron-yield measurements and comparisons to calculations carried out with the 1-D hydrodynamic code *LILAC* are shown in Fig. 1. Compared to the calculations, the experimental data show less of a decrease in yield as the doped-ablation layer thickness is increased. The $\alpha = 2$ experimental yield increases, going from 0-μm to 3-μm CHSi layer thickness and then decreases with layer thicknesses of 5 and 10 μm. This may indicate that initially, as the doped-layer thickness is increased, there is a lower growth rate for the ablation-interface Rayleigh–Taylor (RT) instability as Si is added to the ablator, but then coronal radiation increases the shell adiabat, making it more difficult to compress the target. This conjecture is supported by the neutron yield from the $\alpha = 3$ implosions. The undoped higher-adiabat capsules have a lower RT growth rate at the ablation interface and the addition of Si in the ablator for all thicknesses raises the shell adiabat; the principal effect of the dopant in this case is to make the capsules more difficult to compress.

The intensity of x rays with energies >50 keV is used to infer the effect of "preheat" from high-energy electrons created at the 1/4 critical-density surface. The data from both pulse shapes (see Fig. 2) show a significant reduction in high-energy x-ray intensity when the CHSi layer thickness is increased to 5 or 10 μm. The $\alpha = 2$ data show the high-energy x-ray intensity decreases only slightly when a 3-μm CHSi layer is used in the ablator, and then drops rapidly when the layer is increased to 5 μm. High-energy x-ray-intensity data from $\alpha = 3$ implosions show a steady de-cline in high-energy x-ray intensity as the CHSi layer thickness is increased. The lowest level of high-energy x-ray intensity is the same for both pulse shapes and is obtained with a CHSi layer thickness ≥5 μm. These data imply that "preheat" from high-energy electrons should be reduced when a CHSi layer thickness ≥5 μm is used in the ablator.

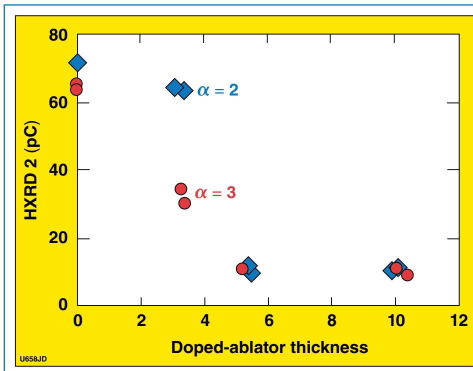

Figure 2. The intensity of x rays with an energy >50 keV is plotted as a function of the thickness of the Si-doped ablator. The diamond points are for the $\alpha = 2$ pulse shape and the circles are for the $\alpha = 3$ pulse shape.

OMEGA Operations Summary: A total of 85 target shots were taken on OMEGA during September with an overall experimental effectiveness of 94.7%. Forty-four of these shots were for NIC and 41 shots were for non-NIC programs. The lead laboratories for these shots included LLNL (47), LANL (12), CEA (9), and LLE (17). The month's operations efforts included scheduled maintenance work, optics replacements and integration activities including short-pulse beam tube (SPBT), parabola alignment diagnostic (PAD), and the magnetic recoil spectrometer (MRS). OMEGA produced a total of 1514 target shots during FY07 with an overall experimental effectiveness of 95.9%. The NIC accounted for 66% of the shots. Nearly 55% of all the shots taken in FY07 were for external user programs.