Areal-Density Analysis of OMEGA Implosions: A systematic study of the evolution of the areal density (ρR) of OMEGA plastic-shell implosions is underway. The study uses target thicknesses and laser pulse shapes resulting in implosions with a range of values of the shell adiabat. Due to truncation of the experimental neutron rate, the inferred neutron-averaged areal density $\langle \rho R \rangle$ was measured to be lower than the 1-D predicted value. Two examples of this analysis are shown in Figs. 1 and 2. The target in Fig. 1 is a 27-μm-thick CH shell filled with 3 atm of D_2 gas and irradiated with a 1-ns-square pulse that sets the target on an adiabat $\alpha \sim 5$. Two-dimensional simulations[1] indicate that the shell is integral in this implosion during the acceleration phase. Figure 2 shows the results from an implosion of a 27-μm-thick CH shell filled with 15 atm of D_2 gas and irradiated with a shaped pulse that sets the target at $\alpha \sim 2$. Simulations indicate that the shell integrity is severely compromised during acceleration for this implosion. Secondary proton spectra were used to measure the areal density and are shown in red [Fig. 1(b) and Fig. 2(b)]. Time evolution of areal densities results in an increasingly broadened secondary proton spectrum as indicated by the low- and high-energy tails of the spectrum. Since the measured spectra are averaged over several views, it is likely that the low-energy end-point of the spectrum is a measure of the peak areal density in the implosion. The measured fusion neutron-production rates are overlaid on the 1-D simulated neutron-production histories and ρR evolution for the two implosions in Fig. 1(a) and Fig. 2(a). The measured neutron rate is shifted in time to match the onset of the compression yield in the 1-D simulation and is used to postprocess the 1-D simulated temperature and density profiles to calculate the secondary proton spectrum. This calculation is overlaid on the experimentally measured spectra and is shown as a shaded region in Fig. 1(b) and Fig. 2(b). This region spans the possible spectra by making different assumptions about the source size in the 1-D profiles: a central source that is less downshifted and an extended source as calculated by the profiles. Excellent agreement is obtained for the high-adiabat implosion indicating 1-D evolution of areal density during neutron production. In particular, simulated and experimentally inferred $\langle \rho R \rangle$ (inset) are in excellent agreement once neutron-rate truncation is taken into account. Good agreement is obtained at the high-energy end of the spectrum for the low-adiabat implosion, indicating 1-D evolution of the ρR earlier in the implosion. The low-energy tail of the measured spectrum is less downshifted than the calculated spectrum for this implosion. This, likely, indicates that the implosion did not reach the peak value of areal density as calculated by the 1-D code. The complete study for many different targets and pulse shapes indicated that any reduction in the values of peak areal density is correlated with poor shell stability during acceleration.

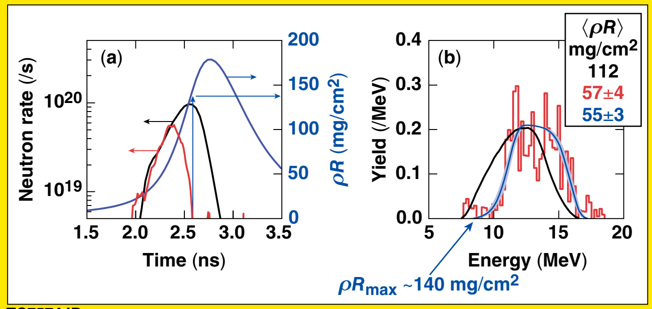

Figure 1. Results from a high-adiabat implosion ($\alpha \sim 5$) of a 27-μm-thick CH shell with 3 atm D_2. (a) Left axis: Measured neutron rate (red) overlaid on the simulated neutron-production history (black). Right axis: The 1-D simulated values of areal density. (b) The measured secondary proton spectrum (red), the simulated secondary proton spectrum (black), and the calculated secondary proton spectrum using the 1-D profiles and the measured neutron rate (blue). Good agreement between the measured and calculated secondary proton spectra indicates 1-D evolution of areal densities during neutron production.

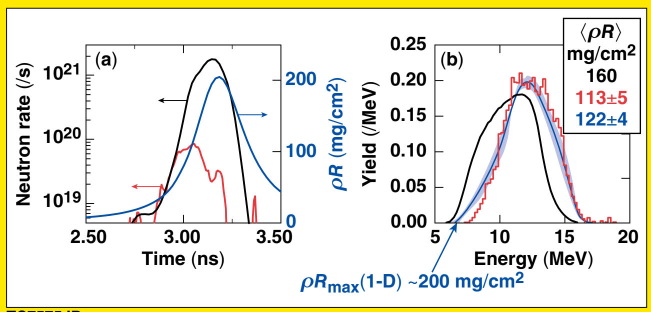

Figure 2. The same plots as Fig. 1 for a low-adiabat implosion ($\alpha \sim 2$) of a 27-μm-thick CH shell with 15 atm D_2. The difference in the spectra at the low-energy tail corresponds to ~15% reduction in the peak value of the measured areal density compared to the simulated value.

OMEGA Operations Summary: During October 2006, OMEGA conducted 135 target shots for LLE (53), LLNL (46), LANL (24), and NLUF (12) campaigns. Of these shots, 46 were for the IDI NIC and 45 for the DDI NIC programs, respectively. The overall shot effectiveness during October was 94.8%.

1. P. B. Radha *et al.*, Phys. Plasmas **12**, 032702 (2005).

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