Optimization of Neutron Yield by Balancing the Reduction of CBET with Increased Nonuniformities: A series of experiments were conducted in July to determine the optimum laser-beam radius for an imploding target by balancing the reduction of cross-beam energy transfer (CBET) with increased nonuniformities. The experiments showed that the neutron yield increased by a factor of 2.6 when the laser spot size was reduced by 20% [Fig. 1(a)]. When reducing the spot size below 80% of the target radius $\left(R_{\text{beam}}/R_{\text{target}} = 0.8\right)$, the nonuniformities imposed by the smaller laser spots cause saturation of the neutron yield despite the increase in absorbed energy and decrease in bang time [Fig. 1(b)]. Figure 1(c) shows evidence of nonuniformities through the classic bubble/spike structures that form as the laser spot size is reduced below $R_{\text{beam}}/R_{\text{target}} = 0.8$ and the neutron yield saturates.

The increased implosion performance is a direct result of decreasing the laser energy passing through the edges of the corona leading to a reduction in CBET.[1] By varying the defocus of 60 beams outfitted with small phases plates ($R_{\text{beam}} = 860\ \mu$m to 430 μm), the absorption is measured to increase linearly from 70% to 95%. This increased absorption leads directly to an increase in the implosion velocity as measured by a linear reduction in bang time [Fig. 1(b)].

Figure 1(a) shows neutron yield results for implosions that were driven at an intensity of 4.5×10^{14} W/cm^2 using both 1-ns square (high-adiabat) as well as triple-picket (low-adiabat) pulse shapes. The low-adiabat experiments are expected to be more susceptible to nonuniformities imposed by the smaller laser spots, which is confirmed by the fact that saturation appears to occur at a larger beam radius $\left(R_{\text{beam}}/R_{\text{target}} = 0.8\right)$. These results show that an optimum laser spot size of $R_{\text{beam}}/R_{\text{target}} = 0.8$ to 0.9 will reduce CBET, increase the implosion velocity by 10%, and result in a substantial increase in the neutron yield.

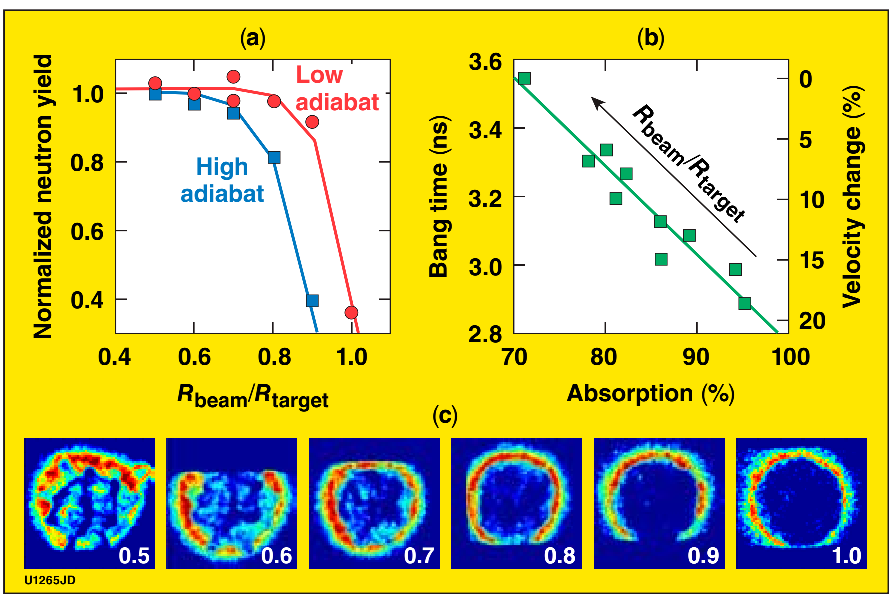

Figure 1. (a) The neutron yield is measured to increase significantly when the normalized laser beam radius is reduced: (blue squares) high-adiabat implosions, (red circles) low-adiabat implosions. (b) The absorption is measured to increase linearly as $R_{\text{beam}}/R_{\text{target}} = 1$ to 0.5. This increased absorption leads directly to an increased implosion velocity, which is evident in the measured reduction in bang time. (c) Images of the x-ray self-emission from the low-adiabat experiments show evidence of Rayleigh–Taylor growth when the laser spots are reduced below $R_{\text{beam}}/R_{\text{target}} = 0.8$, which correlates with the saturation in neutron yield observed in (a). These images were chosen to have the same diameter, which corresponds to the same time in the acceleration phase.

Omega Facility Operations Summary: The Omega Laser Facility conducted 179 target shots in July (152 target shots had been scheduled for the month). The OMEGA 60-beam Laser System accounted for 110 target shots with an experimental effectiveness of 98.2% while the OMEGA EP Laser System carried out 69 target shots with an average experimental effectiveness of 97.1%. The NIC program accounted for 65 target shots while the HED program accounted for 36 shots. Four NLUF experiments led by teams from the Princeton University, MIT, the University of Michigan, and the University of California at Berkeley conducted 52 target shots and two LBS experiments led by LLNL and LLE carried out 26 target shots.

1. I. V. Igumenshchev *et al*., Phys. Plasmas **17**, 122708 (2010).

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