Picket-Pulse Implosions: In previous monthly reports and publications,[1–3] the direct-drive picket-pulse implosion concept and initial experimental results were presented. This concept relies on the use of a prepulse (picket) with a narrow temporal width before the main laser drive pulse to control the growth of Rayleigh–Taylor instability (RTI) at the ablation surface of the target. The picket shapes the adiabat (ratio of pressure to Fermi-degenerate pressure) inside the shell so that at the ablation surface the adiabat is high and at the gas–shell interface it is low. The initial implosion experiments showed a significant increase in fusion yields relative to similar implosions with no picket pulse. To study the effect of the picket on target performance, a series of plastic-shell implosions (~900 mm diameter; ~33 mm thick; D_2 filled) were carried out varying the temporal spacing and intensity of the picket relative to the main drive pulse and varying the "foot" intensity of pulses without the picket (see Fig. 1). These pulse shapes create shock waves in the CH target shell that decay (in the case of a picket pulse) or are fully supported (in the case of a high-intensity foot).

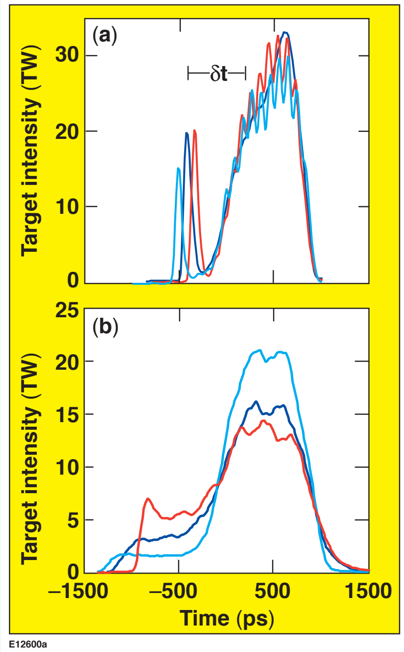

Fig 1. Pulse shapes used in the latest picket-pulse implosion experiments: (a) the timing (δt) between the picket pulse and drive pulse varied between 730 and 960 ps and (b) the leading edge of the drive pulse (commonly called the "foot") was varied between 2 and 6 TW.

The experiments demonstrate that picket-pulse shaping can be used to control the seed of fuel–pusher interface perturbations amplified during the deceleration phase. This seed or "feedthrough" is characterized by the deceleration interface amplitude a_d defined as $a_d = a_a e^{-kd}$, where a_a is the ablation-interface amplitude, k is the perturbation wave number, and d is the distance from the ablation interface to the fuel–pusher interface. The picket timing relative to the drive pulse (δt) controls the separation distance d. The ratio of the experimental neutron yield to the neutron yield calculated by the 1-D hydrodynamic simulation *LILAC* (YOC) is plotted in Fig. 2(a) as a function of d for cases with no picket pulse (solid points) and pickets (open points) with various δt. Two fill pressures were used for these experiments. The 3-atm-D_2-filled targets travel farther during the deceleration phase and thus show a more gradual improvement in performance relative to the 15-atm targets. Alternatively, the pulse shape can be used to control the ablation-interface amplitude a_a. Figure 2(b) shows how the YOC varies with the ratio of the bubble amplitude $A_{bubble} = \left[\Sigma_k a_a^2(k)\right]^{1/2}$ to the shell thickness in experiments where both picket (open circles) and non-picket pulses (solid points) were used. In these data [Fig. 2(b)], d is constant at ~18±2 μm. In summary picket-pulse shaping has been used to mitigate the effects of RTI growth during the deceleration phase of direct-drive implosions.

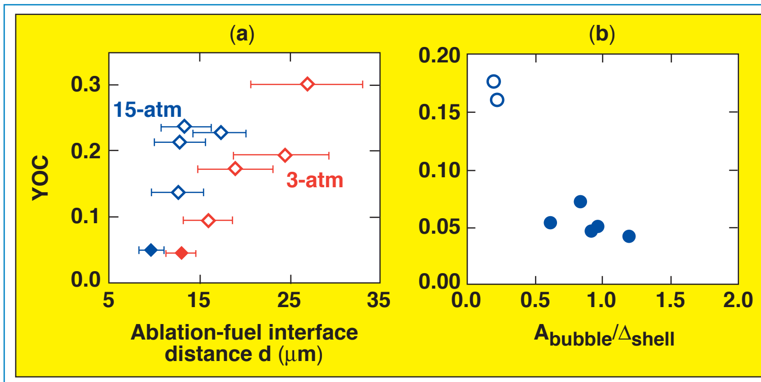

Fig 2. YOC plotted (a) as a function of d for 3-atm (red points) and 15-atm (blue points) D_2-filled targets and (b) as a function of the ablation-interface amplitude divided by the shell thickness. Picket pulses (open points) as well as non-picket pulses (solid points) were used to obtain these data.

OMEGA Operations Summary: A total of 110 target shots were taken on OMEGA during November: 35 shots for LLE programs including laboratory astrophysics, cryogenic implosions, diagnostic development, and integrated spherical implosions; 21 for LANL campaigns; 31 for LLNL experiments; 13 for SNL; and 10 for NLUF for two sets of laboratory astrophysics collaborations led by the University of Michigan and the University of California, Berkely, respectively.

1. March 2001 Progress Report on the Laboratory for Laser Energetics, Inertial Confinement Fusion Program Activities.
2. March 2002 Progress Report on the Laboratory for Laser Energetics, Inertial Confinement Fusion Program Activities.
3. V. N. Goncharov, J. P. Knauer, P. W. McKenty, P. B. Radha, T. C. Sangster, S. Skupsky, R. Betti, R. L. McCrory, and D. D. Meyerhofer, "Improved Performance of Direct-Drive Inertial Confinement Fusion Target Designs with Adiabat Shaping Using an Intensity Picket," Phys. Plasmas **10**, 1906 (2003).

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