Smoothing Performance of Ultrafast Picket Fence Pulses on the NIF: The current base-line pulse shape for the NIF direct-drive ignition capsule can be divided into two regions; a low-intensity "foot" (of ~4.2-ns duration) followed by a high-intensity "drive" (of ~5-ns duration). The low-intensity part of the pulse (foot pulse) is used to shock preheat the target and control the isentrope of the ablation surface and the fuel. The energy in the low-intensity foot pulse is converted to the third harmonic (UV) inefficiently. Beam-to-beam power imbalance is also exacerbated for the low-intensity foot because of the low conversion efficiency at those intensities.

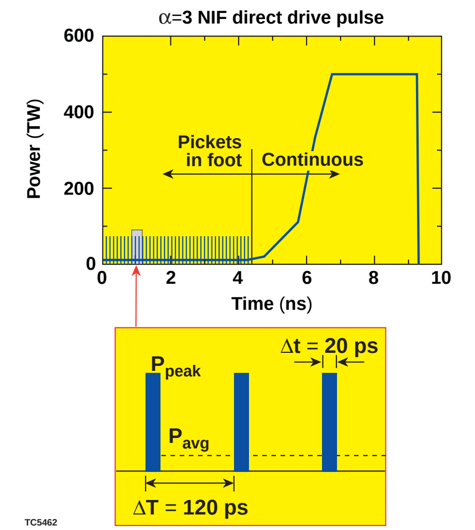

Figure 1. Schematic showing the required power history of the NIF base-line direct-drive ignition pulse (dark solid line) and the proposed ultrafast pickets for the "foot" portion of the pulse shape. The figure on the bottom is an enlarged view of the "picket fence". For the case illustrated here ($P_{peak} \sim 6\ P_{avg}$), the overall UV energy conversion efficiency is 73% compared to 68% for the continuous pulse shape.

Ultrafast picket-fence pulses were proposed by J. Rothenberg at Lawrence Livermore National Laboratory (LLNL) to maximize the conversion efficiency to the UV and to minimize the beam-to-beam power imbalance. Ultrafast pickets consist of a train of laser pulses with a duty cycle that leads to near-constant-intensity target illumination when time skewing due to the SSD dispersion gratings is included (see Fig. 1). The beam-smoothing performance of the proposed NIF ultrafast picket pulses is currently under investigation at LLE (see Fig. 2). Initial results using LLE's diffraction beam propagation code *Waasikwa'* show that picket-fence pulses can achieve the beam-uniformity levels required for direct drive on the NIF using the base-line1-THz, two-color -cycles, 2-D SSD NIF design.

Multibeam Streak Cameras: Six UV streak cameras—one on each cluster of ten beams—have now been installed on OMEGA to measure power balance. These cameras have a bandwidth of 11 GHz and a signal-to-noise ratio at the peak of 1000:1. The pulse shape, beam timing, and power balance can now be measured for all beams on every shot. Figure 3 shows an overlay of the individual streaks for each of the 60 beams.

OMEGA Operations Summary: During April, a total of 116 target shots were produced by OMEGA for 11 different campaigns directed by scientists from LLE (54 shots), LLNL (19 shots), LANL (33 shots), and programs under the NLUF (10 shots).

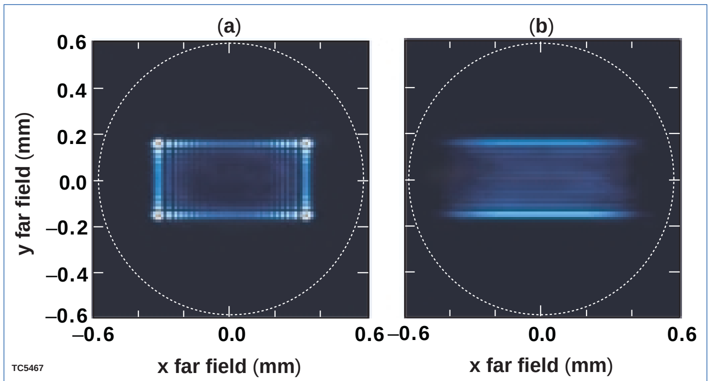

Figure 2. Calculated, time-integrated, diffraction-limited far-field patterns for the NIF with 2-D SSD: (a) base line (without picket fence) and (b) with ultrafast pickets. The images are plotted using the same color scale to indicate relative fluence levels. The baseline design shows high fluence levels near the four outer corners of the pattern. In contrast, the pattern from the ultrafast-picket design shows a much lower fluence level more uniformly distributed about the center. Both images show the distinct "Bessel" pattern in the direction corresponding to the second SSD dimension. The dashed circles represent simulated spatial-filter pinholes.

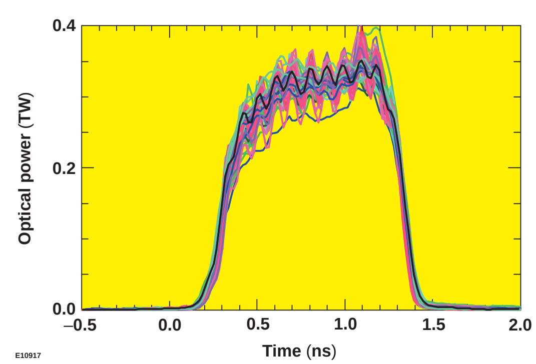

Figure 3. The streak camera recordings of all 60 beams of OMEGA overlayed for shot 23141. This was the first OMEGA 60-beam shot with all UV streak cameras active and calibrated. The 10-GHz modulation from the SSD system can be easily resolved.

Contact: Wolf Seka (716) 275-3815; fax: (716) 275-5960; e-mail: seka@lle.rochester.edu
John M. Soures (716) 275-3866; fax: (716) 256-2586; e-mail: jsou@lle.rochester.edu