# *September 1999 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities*

UR LLE

***Laser Prepulse Contrast:*** Prepulse noise prior to the arrival of the main laser pulse is of great importance to laser fusion as it may be detrimental to the target performance. To minimize such prepulse noise it is important to control and maximize the signal-to-noise ratio (SNR) at every step of the entire amplification process. The amplifier with the greatest gain per stage is the regenerative amplifier (regen, $G > 10^6$) at the beginning the OMEGA laser. The SNR at the output of the regen (i.e., peak power over average interpulse noise power) depends on both the SNR and the injected energy of the input pulse to the regen. For high injected pulse energies the output SNR equals the input SNR, i.e., the contribution to the output SNR of the regen from amplified spontaneous emission (ASE) is negligible. In contrast, for low injected energies the output SNR is dominated by the regen ASE. We have developed a theoretical model for the regen output SNR as a function of injected pulse energy and input SNR. As shown in Fig. 1, the model predictions fit the experimental points very well. The maximum measured output SNR of $\leq 2.7 \times 10^4$ is limited by the available injected pulse energy (power). Higher values can be obtained for higher injected pulse energies (power), but beyond a certain input power the injected SNR must be further increased.

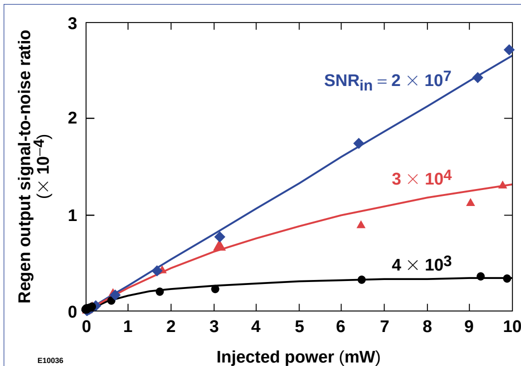


Fig. 1 Measurements and predictions (lines) of the signal-to-noise ratio at the regen output as a function of the injected power and input SNR.

***NLUF Experiments:*** During the reporting period, 30 NLUF target experiments were performed on OMEGA. In one of the campaigns (12 shots), a team of investigators headed by D. Kalantar of LLNL studied the shock compression of Cu by diffracting x rays from a laser-shocked Cu lattice. In a second campaign (18 OMEGA shots), a team headed by H. Robey and B. Remington of LLNL carried out a series of experiments to study two aspects of the physics of supernovae. These experiments studied the growth rate of the Richtmyer–Meshkov (RM) and Rayleigh–Taylor (RT) instabilities of a perturbation seeded by the arrival of a rippled shock wave on an initially unperturbed interface. Figure 2 shows images demonstrating the time evolution of the shock structure of a laser-driven, planar, copper ablator and a CH payload. In these experiments, the Cu/CH interface had an imposed perturbation wavelength of 200 $\mu$m, and the Cu ablator was driven with ~3 kJ in a square-top 1-ns pulse. A separate x-ray backlighter and an x-ray framing camera were used to obtain the x-ray radiographs of Fig. 2. The backlighter pulses were also 1-ns long but delayed by up to 78 ns relative to the drive pulses.

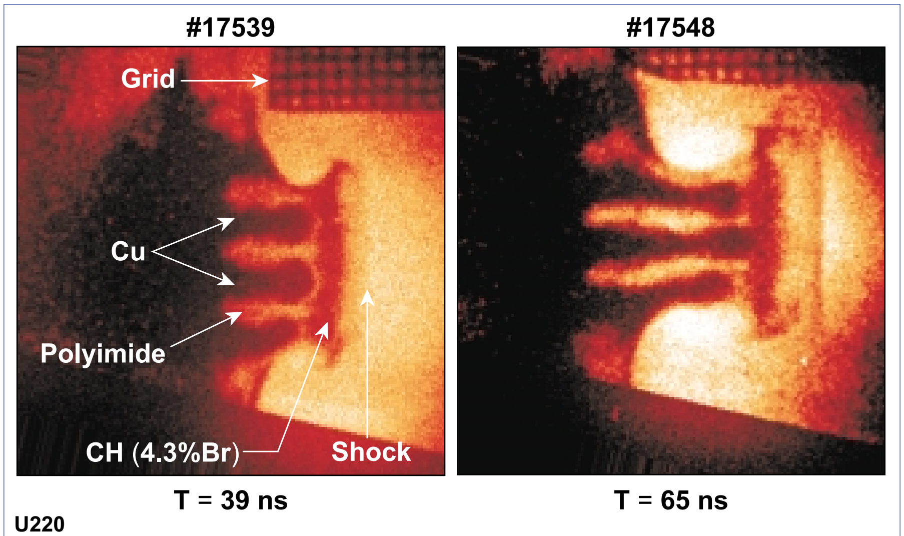


Fig. 2 Two x-ray backlit images from experiments showing the time evolution of the shock and instability structure at late times.

***OMEGA Operations Summary:*** During September, 101 target shots were taken for eight experimental campaigns. National laboratory and NLUF users included a team headed by D. Kalantar, who conducted dynamic diffraction tests (12 NLUF shots); G. Glendinning, who investigated hydrodynamic instabilities (12 LLNL shots); and H. Robey and B. Remington, whose team continued supernova Rayleigh–Taylor physics experiments (18 NLUF shots). Internal LLE campaigns for Rayleigh–Taylor instability (RTI) experiments and integrated spherical experiments (ISE) completed the remainder of the month with 17 and 42 target shots, respectively. The 12-month total for FY99 was 1207 on-target shots.

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