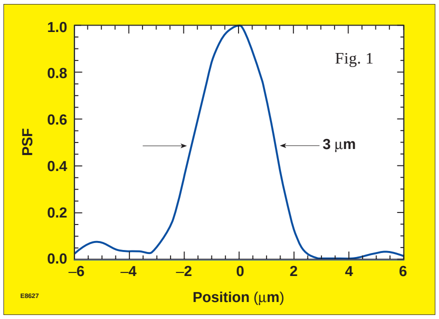
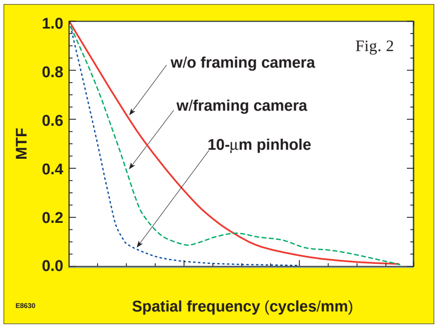
October 1997 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities

***Summary*:** During October, OMEGA supported the (S3) spherical-target Rayleigh–Taylor and PP2 spherical implosion experiments. Indirect-drive experiments were also conducted for LLNL and LANL. In this report we also highlight the development of a high-resolution x-ray microscope, new pulse-shaping concepts, and the status of computing systems at LLE.

***High-Resolution X-Ray Microscope*:** A soft x-ray microscope (~1 to 3 keV) operating at a magnification of ~14 with 3-μm spatial resolution [FWHM of the point spread function (PSF) is ~3 μm (Fig.1)] was characterized and used for initial experiments on OMEGA to study the hydrodynamic stability of directly driven planar foils. An optimized Kirkpatrick-Baez (KB) microscope is used to obtain up to four simultaneous x-ray radiographs of laser-driven planar foils. Time-resolved radiographs can be obtained by using either a short-pulse backlighter (~100 ps) or framing cameras (frame time ~80 ps). Figure 2 shows the measured modulation transfer function (MTF) of the microscope at best focus, when recorded directly on film (solid line), as would be the case when using short-pulse backlighting, and when recorded by a framing camera (dashed line). The MTF of a 10-μm pinhole camera at comparable magnification is shown for comparison (dotted line).



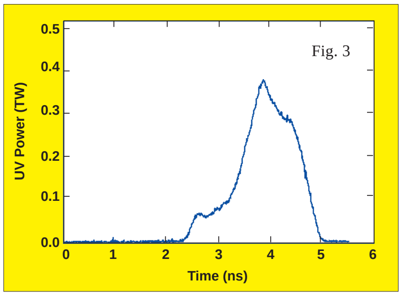


***S3 Experiments*:** During the past month, shots were taken on OMEGA for the spherical hydrodynamic stability (S3) campaign designed to measure conditions in both the fuel and pusher layers in imploding capsules. The implosion is affected by mix resulting from unstable RT growth at the ablation surface during the acceleration phase and at the pusher–fuel interface during the deceleration phase. The linear growth in the ablation surface was previously studied using the "burnthrough" technique. Recently the RT growth during deceleration was studied using buried signature layers on the inside of the shell and Ar-doping in the fuel. The signature layers were either CD or Ti-doped polymer layers buried 0 to 5 μm from the fuel–pusher interface. Neutron diagnostics, x-ray spectroscopy, and monochromatic x-ray imaging were used to interrogate the signature layer. The results from these experiments are being analyzed.

***Pulse Shaping*:** A new way was proposed to provide a pulse-shaping capability for individual beams on OMEGA. Normally each beam has the same pulse shape, determined by the parameters of the driver line being used. However, by putting a small frequency chirp on the oscillator pulse and individually tuning the frequency-conversion crystals, it is possible to generate significantly different pulse shapes in different beams. The increased flexibility offered by this proposed technique could enable a wider range of beam-phasing experiments to be carried out on the OMEGA laser. The practicality of this concept is being evaluated.

***Computing at LLE*:** LLE uses 400 computers ranging from personal to multi-CPU mid-range and mainframe servers. To optimize performance, a two-tier protocol was introduced. At the first tier, practically all LLE employees and students have access to either a personal workstation or a pool of shared Unix workstations. Personal workstations provide sufficient power for most staff requirements and can even support relatively complex scientific applications. For more demanding tasks, much more powerful time-shared computing servers are used, including a Cray YMP, a 24-CPU SGI Origin 2000 NUMA system, a 4-CPU DEC Alpha 8200 SMP system, and two 2-CPU Sun Ultra servers. In addition, a separate isolated network of Sun servers and workstations is used to control and maintain the OMEGA laser system. Both networks exchange data via the LLE intranet servers that provide access to the whole LLE information system.

***OMEGA Operations Summary*:** OMEGA's October operations included shots for Rayleigh–Taylor stability (S3) and spherical implosion (PP2) experiments as well as a week of indirect-drive experiments for LLNL and LANL users. Optimizing the pulse-shaping system to simulate the PS26 intensity profile of the Nova laser resulted in the shape shown in Fig. 3. The curve represents an average of nine UV beams delivered to target on shot 10919. A total of 53 spherical and 22 indirect-drive target shots were executed this month.



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