***OMEGA 2ω Probe Activation:*** A new 2*ω* probe laser has been activated on the OMEGA laser facility to characterize under-dense plasmas and to investigate 2*ω* laser–plasma interactions. This project is a collaboration between LLNL's target physicists and engineers and LLE's target and laser scientists and engineers. The project redirects the 2*ω* laser light of an existing beam (beam 25) to port P9 using a kinematic mirror. Beam pointing, focusing, energy diagnostics, and a dedicated 2*ω* distributed phase plate (DPP) (200-*μ*m spot diameter) have been successfully activated. Figure 1 shows an example of a pointing shot close to best focus of the 2*ω* beam on a gold-coated target sphere. The first target physics experiments using the new probe have provided high-quality data for backscattering in large-scale-length plasmas. These experiments used the new 2*ω* full-aperture backscatter station (FABS) and Thomson-scattering diagnostics that measure the absolute, spectrally resolved scattering from the target, resulting in measurements of the density and electron temperature of the plasma. This 2*ω* probe beam is scheduled to be upgraded to a 4*ω* Thomson-scattering probe by inserting a KDP quadrupler (plus rotator) into the present 2*ω* beamline. The present 2*ω* beam performance is 380 J in 1 ns in an ~100-*μ*m focal spot. With the specialized 2*ω* phase plate, a 200-*μ*m spot is obtained.

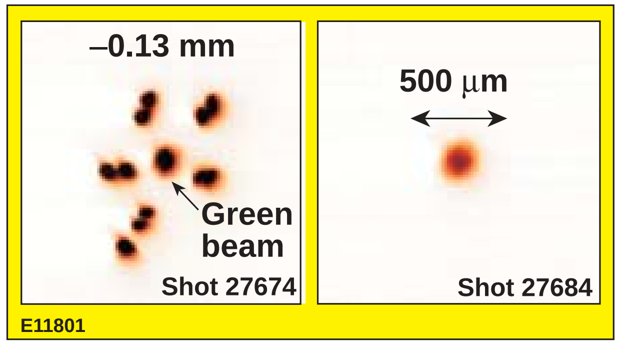


Figure 1. Pointing shot (27674) on a gold sphere. The double spots arise from the distributed polarization rotators (DPR's) on 3*ω* beams. There are no phase plates on any of the beams and no DPR in the green probe beam. Shot 27684 shows the green beam only, focused on a pointing target with a DPP producing a 200-*μ*m spot.

***Measurement of Capsule-Areal-Density Evolution:*** The temporal evolution of an imploding capsule's areal density is important in understanding core assembly and hot-spot formation. In recent OMEGA implosion experiments, a collaborative effort between the MIT Plasma Science and Fusion Center and the Laboratory for Laser Energetics (LLE) led to two distinct measurements of the capsule areal density: first at shock coalescence, and then approximately 400 ps later during compression burn. These measurements were carried out through the spectral analysis of 14.7-MeV protons generated in the implosion of $D^3He$-filled, 24-*μ*m-thick CH shells. The proton spectra were measured using high-resolution charged-particle spectrometers simultaneously viewing each implosion from different directions.[1] Figure 2 shows a typical two-peak spectrum obtained on these experiments. The narrow, higher-energy peak is associated with the ~40-ps burn at shock coalescence, while the broader, lower-energy peak is associated with the ~150-ps burn near peak compression. Through the use of plasma-stopping power calculations, the observed energy downshifts are related to capsule $\rho R$: 13±2.5 mg/cm$^2$ at shock coalescence and 70±8 mg/cm$^2$ at compression burn. The basic structure of the data is reproduced reasonably well by hydrodynamic simulations.

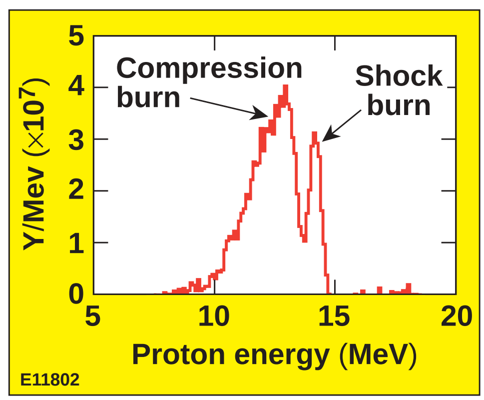


Figure 2. Measured spectrum of 14.7-MeV proton from shot 24811: a 940-*μ*m-diam, 24-*μ*m-thick CH shell filled with 6 atm of $D_2$ and 12 atm of $^3He$. The high-energy peak corresponds to the protons produced during the burn generated by the shock coalescence and shows a downshift corresponding to $\rho R$ ~ 13 mg/cm$^2$, whereas the broader, lower-energy peak corresponds to the protons generated during the compression burn at a higher capsule $\rho R$ of ~70 mg/cm$^2$.

***OMEGA Operations Summary:*** During July 2002, a total of 118 target shots were taken on OMEGA for campaigns carried out by LLE, Lawrence Livermore National Laboratory (LLNL), and Los Alamos National Laboratory (LANL). The 51 LLE shots were for the Stockpile Stewardship Program (SSP), integrated spherical experiments (ISE), and cryogenic target campaigns. The LLNL campaigns included 34 shots for equation of state (EOS), IDrive, and NIF symmetry experiments. The 33 LANL experiments included direct-drive spherical implosions and direct-drive, double-shell cylindrical implosions.

1. F. H. Séguin *et al.*, "Spectrometry of Charged Particles from Inertial Confinement Fusion Plasmas," to be published in the Review of Scientific Instruments (2002).

Contact: Wolf Seka (585) 275-3815; fax: (585) 275-5960; e-mail: seka@lle.rochester.edu
John M. Soures (585) 275-3866; fax: (585) 256-2586; e-mail: jsou@lle.rochester.edu