2006

National Ignition Campaign (NIC) Milestone Achieved

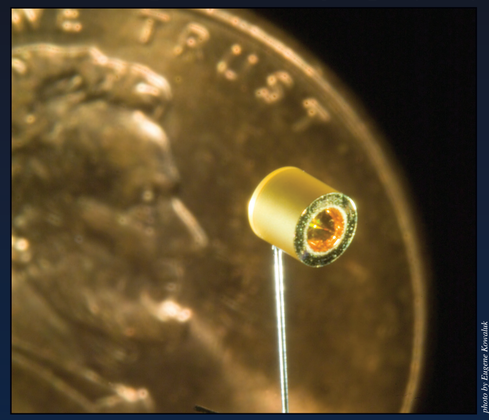
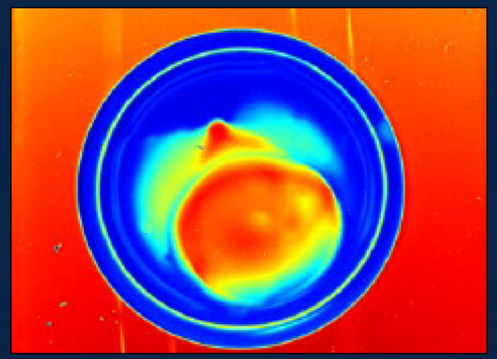


Photo by Eugene Kowaluk

A half-hohlraum target used on an LLE-directed indirect-drive experiment in support of the NIC

Scientists at LLE and Lawrence Livermore National Laboratory completed a NIC milestone on 17 August 2006 dealing with hohlraum energetics experiments with elliptical phase plates. A set of 43 elliptical phase plates (E-IDI300) were designed and manufactured for these OMEGA experiments. Seven scale-1, thin-walled, gold hohlraums were irradiated with 40 beams smoothed with E-IDI-300 phase plates. Several gas fills were investigated. High-Z dopants were introduced into the gas fills to reduce hard x-ray production and laser scattering levels. The hohlraum energetics were measured for a 13.5-kJ shaped laser pulse (PS26) with the following diagnostics: Dante, full-aperture backscatter, near-backscatter imaging, gated hard x-ray imaging, gated soft x-ray imaging, and the hard x-ray detector. The peak radiation temperature T_r inferred from the measured levels of the x-ray flux increased by 17 eV when the laser beams were smoothed with phase plates. The improved coupling was a consequence of reduced laser-scattering losses.

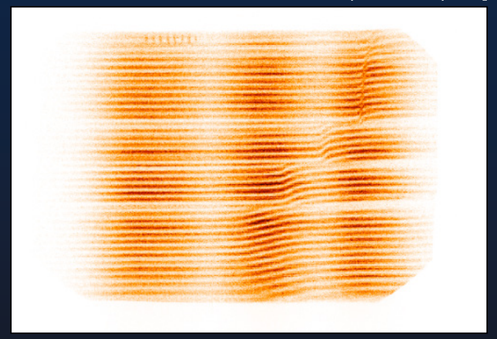
Cryogenic DT Target Experiments



◀ *Shadowgraph of a β-layered DT target containing ~35% tritium*

The first direct-drive, ignition-scaled, cryogenic target containing tritium was imploded on the OMEGA laser in February 2006. The target contained 0.06% tritium by atom fraction. This implosion was the first in a series of planned experiments that led to LLE scientists imploding two fully β-layered DT capsules during the week of 27 March 2006. The tritium fraction in each capsule was 13.5%. Both capsules were layered without external IR radiation, confirming earlier estimates that a tritium fraction of ~10% would be sufficient for β-layering to occur. This is the first time that a β-layered DT target was used in a laser-driven implosion.

Active Shock Breakout (ASBO) Upgrade

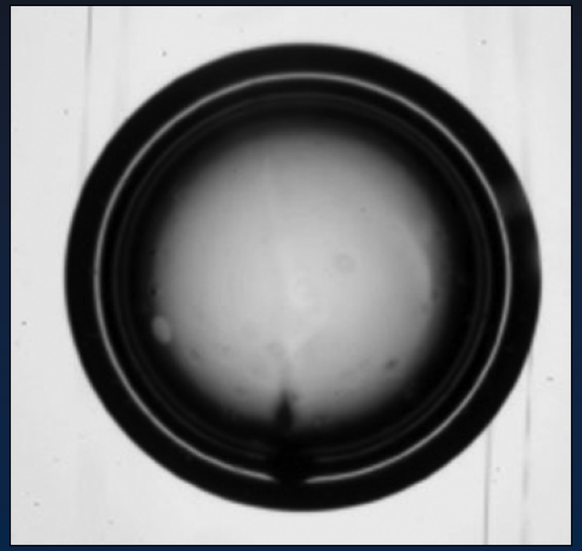


◀ *VISAR data from the upgraded ASBO system*

A year-long project to upgrade the ASBO diagnostic was completed in April 2006. The ASBO diagnostic measures the timing of shock waves inside an imploding cryogenic D_2 sphere. Using the existing system as a baseline, a new optical layout was conceived that uses two Rochester Optical Streak System (ROSS) streak cameras as detectors for the two VISAR (velocity interferometer system for any reflector) channels. The result was an outstanding optical device that provides excellent optical performance and smooth operation using the accurately calibrated ROSS cameras.

2007

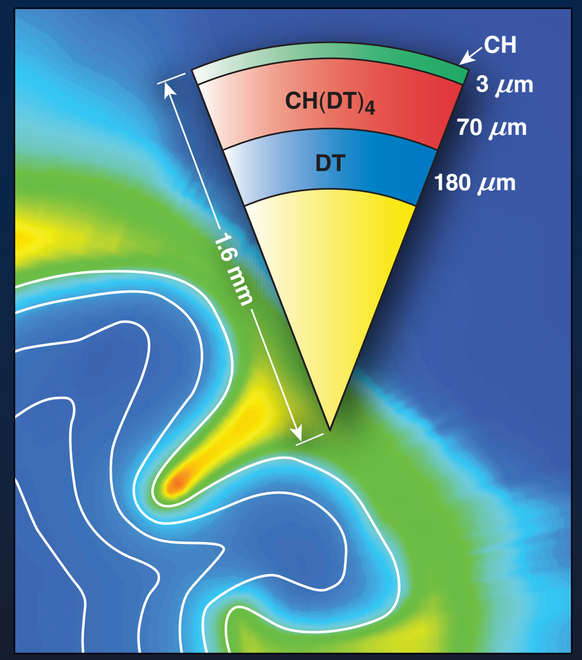
LLE Infers 200 mg/cm^2 Fuel Areal Density



◀ *Optical shadowgraph showing a 2.4-μm rms inner-ice-surface roughness of a cryogenic D_2 capsule*

On 17 April 2007, LLE scientists completed a National Ignition Campaign (NIC) Level-2 milestone when a neutron-burn-averaged areal density of 202±7 mg/cm^2 was measured for the first time from a direct-drive cryogenic D_2 implosion on OMEGA. This demonstrated that hydrogen could be compressed to ignition-relevant densities using laser-driven capsules.

LLE Validates Polar-Direct-Drive for Ignition on the NIF



◀ *Isodensity contours (color) and ion-temperature contours (white lines) of the implosion of a NIF wetted-foam, polar-drive–ignition target*

LLE completed a study using the National Ignition Facility (NIF) in the x-ray-drive configuration for direct-drive–ignition experiments. The study focused on implementing the standard polar-direct-drive (PDD) illumination scheme, which uses judicious repointing of the NIF beams to minimize illumination perturbations that arise from the absence of equatorial beams in the x-ray-drive laser configuration. The conclusion of the study validated the polar-direct-drive concept using numerical simulations and experiments on OMEGA for ignition on the NIF.