National Laser Users' Facility News

FY99 Experiments

During FY99 significant progress was made on several National Laser Users' Facility (NLUF) projects.

David Cohen and colleagues from the University of Wisconsin at Madison in collaboration with investigators from Prism Computational Sciences, the University of Rochester (UR/LLE), Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), and Sandia National Laboratory (SNL) carried out a series of x-ray spectroscopic measurements to explore the physics of radiation-driven, NIF-type ablators.

Hans Griem and colleagues from the University of Maryland conducted experiments using soft x-ray spectroscopy to investigate the plasma conditions at early times in ICF direct-drive capsules.

Bruce Remington, Harry Robey, and colleagues from LLNL in collaboration with investigators from the University of California (UC) at Davis, the University of Arizona, UR/LLE, the University of Chicago, Drexel University, CEA Saclay, Osaka University, State University of New York (SUNY) at Stony Brook, and LANL performed studies of supernova hydrodynamics on OMEGA. These experiments were a continuation of experiments initiated on the Nova laser at LLNL and now being performed on LLE's OMEGA under the NLUF program.

Dan Kalantar and colleagues from LLNL in collaboration with investigators from UC San Diego, the University of Oxford, California Institute of Technology, and LANL carried out studies of the dynamic properties of shock-compressed solids via *in-situ* transient x-ray diffraction.

Richard Petrasso and colleagues from the Massachusetts Institute of Technology (MIT) in collaboration with Stephen Padalino and colleagues from SUNY Geneseo as well as investigators from UR/LLE and LLNL conducted experiments to characterize high-density plasma conditions in imploded ICF capsules using charged-particle spectroscopy on OMEGA. These experiments explored several techniques for measuring fuel and ablator areal densities. The SUNY Geneseo group also carried out a collaborative series of tests to investigate the feasibility of carbon activation as a means of measuring tertiary neutron yield in high-performance OMEGA and NIF ICF capsules.

Charles Hooper and colleagues from the University of Florida along with investigators from the University of Nevada and UR/LLE performed a series of experiments to investigate via x-ray absorption spectroscopy the x-ray emission characteristics of ultrahigh-density plasma.

Bedros Afeyan from Polymath Research in collaboration with colleagues from LLNL, LANL, and UR/LLE carried out experiments to investigate optical-mixing-controlled stimulated scattering instabilities in NIF-like, long-scale-length plasmas.

Figure 80.26 shows an example of work carried out under the FY99 NLUF program; it illustrates the work of a team headed by H. Robey and B. Remington of LLNL 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 80.26 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 μm, 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. 80.26. The backlighter pulses were also 1 ns long but delayed by up to 78 ns relative to the drive pulses.

In FY99 a total of 144 OMEGA target shots were dedicated to the NLUF program. In addition to NLUF-supported programs, several direct- and indirect-drive experiments, also

coordinated through the NLUF Manager, were carried out on OMEGA by groups from LLNL and LANL. These experiments included campaigns on direct-drive cylinders, hohlraum symmetry, equation of state, RM and RT instabilities, tetrahedral-hohlraum implosions, double-shell targets, diagnostics development, radiation flow, opacity, and other topics. The variety of FY99 experiments is best illustrated by Fig. 80.27, which shows examples of targets shot on OMEGA during the fiscal year.

FY00 Proposals

Thirteen proposals were submitted to NLUF for FY2000. A DOE technical evaluation panel chaired by the NLUF Manager and including Dr. David Bradley (LLNL), Dr. David Montgomery (LANL), Dr. Ramon Leeper (SNL), and Dr. Ned Sautoff (PPPL) reviewed the proposals at a meeting held on 26 May 1999 and recommended approval of seven proposals for funding (see Table 80.VIII).

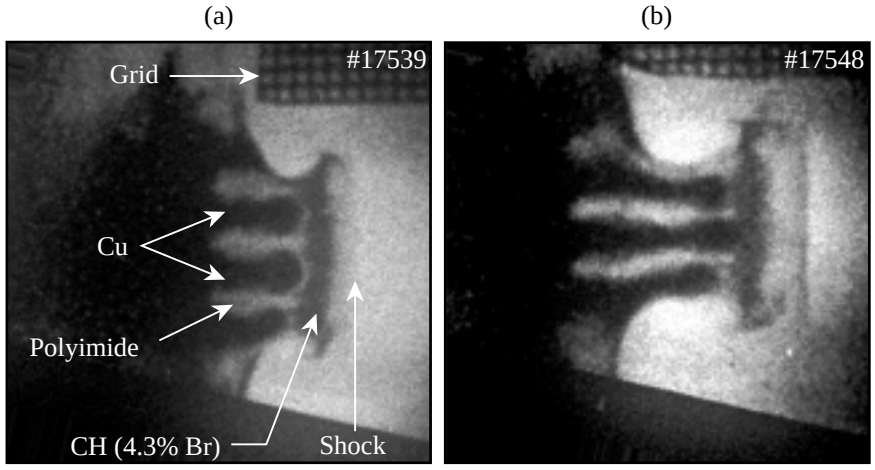

Figure 80.26
Two x-ray-backlighted images from two SNRT #1 experiments showing the time evolution of the shock and instability structure at late times.

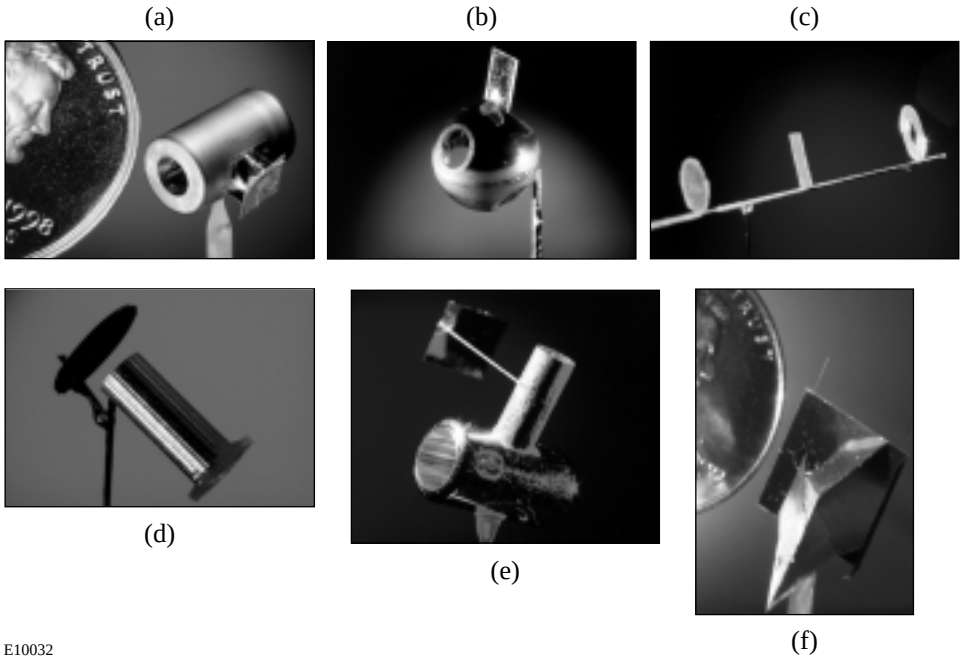

Figure 80.27
OMEGA routinely irradiates a variety of targets. (a) Cylindrical hohlraum target used for radiation ablation studies; (b) tetrahedral hohlraum target; (c) planar target; (d) direct-drive cylinder target; (e) radiation-driven shock target; and (f) x-ray diffraction target.

Table 80.VIII: Approved FY00 NLUF Proposals.

Principal Investigator	Affiliation	Proposal Title
R. Fisher	General Atomics	High-Spatial-Resolution Neutron Imaging of Inertial Fusion Target Plasmas Using Bubble Neutron Detectors
M. Myers	University of California at San Diego	Continuing Studies of Dynamic Properties of Shock-Compressed Solids by *In-Situ* Transient X-Ray Diffraction
R. P. Drake	University of Michigan	Supernova Hydrodynamics on the OMEGA Laser
R. Petrasso	Massachusetts Institute of Technology	Charged-Particle Spectroscopy on OMEGA: Recent Results, Next Steps
D. Cohen	Prism Computational Sciences	Development of X-Ray Tracer Diagnostics for Radiatively Driven NIF Ignition Capsule Ablators
K. Fletcher	SUNY Geneseo	Investigation of Solid-State Detection for Charged-Particle Spectroscopy
B. Afeyan	Polymath Research	Optical-Mixing-Controlled Stimulated Scattering Instability Experiments on OMEGA II: The Effects of Temporal Beam Smoothing and Crossing Angle Variation in CH and Al Plasmas.