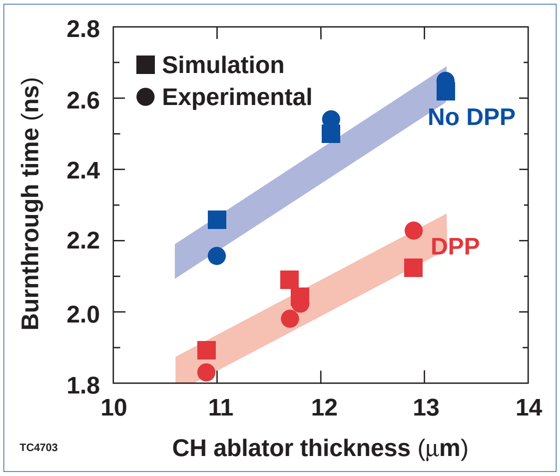
May 1998 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities

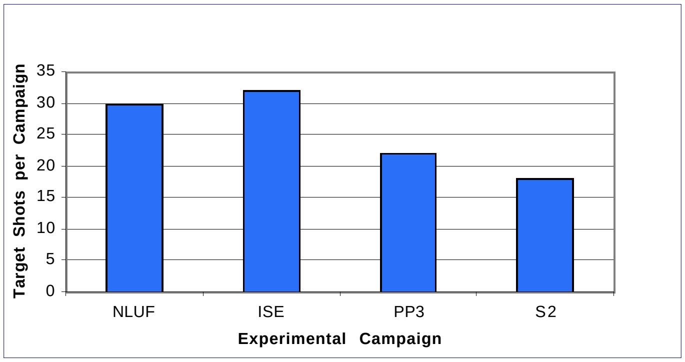
Charged-Particle Spectrometer: During the reporting period, spectroscopic measurements of energetic charged particles were carried out on OMEGA. Individual line profiles of charged fusion products were obtained, including D-^{3}He protons (14.7 MeV) and alphas (3.6 MeV), DT alphas (3.5 MeV), and DD protons (3.0 MeV) and tritons (1.0 MeV). The measurements provided fusion yields, ion temperatures, fuel and ablator areal densities, and identification and quantification of anomalous charged-particle acceleration effects. In addition, energetic ablator ions with energy up to 1.2 MeV were observed. In particular, under certain conditions, sharply defined "lines" of energetic ablator protons were detected. When they occur, they have strong intensities at energies of 400 keV, with separations between adjacent "lines" of the order of 20 keV. These data were obtained with CPS-1—a large spectrometer with a 7.6-kG magnet and CR-39 track detectors. CPS-1 resolves energetic particles from 50 keV to 40 MeV (proton-equivalent energy, or energy of a particle with the same gyroradius as a proton of this energy). In the next two months a second spectrometer (CPS-2) will be installed on OMEGA with a significantly improved capability for shielding against neutron-induced background, higher collection efficiency, and electronic detection capability.

New Diode-Pumped Monomode Laser: A new diode-pumped monomode laser has been developed and tested for OMEGA. The laser is capable of long-term, reliable, single-mode operation with an output wavelength stable to ±0.005 nm. The wavelength can be temperature tuned over several angstroms for proper matching to our regenerative amplifiers and our SSD and frequency-tripling system. Implementation of this oscillator into the OMEGA oscillator room is in progress.

Spherical Burnthrough Experiments: A series of spherical burnthrough experiments were conducted to investigate the effects of laser uniformity changes on RT growth in imploding capsules. These experiments use time-resolved x-ray spectroscopy to measure x-ray emission from a signature layer buried under a CH ablator. The onset time of x-ray line emission from this layer has been shown to be a sensitive indicator of both irradiation nonuniformities and Rayleigh–Taylor growth. Spectra were recorded from targets imploded using both unsmoothed beams and DPP-smoothed beams. Analysis of the data was carried out using a multimode RT postprocessor to the 1-D hydrocode *LILAC* that uses an initial perturbation spectrum derived from actual single-beam uniformity data. The conversion between laser uniformity and initial mass perturbation (the "imprint parameter") in the model is calculated by normalizing against one experimental point and is then left unchanged for all subsequent calculations. The figure shows the measured and calculated signature-layer emission times (burnthrough times) as a function of CH ablator thickness. The model clearly reproduces well the effects of adding phase plates to the laser beams, and this agreement increases our confidence in our ability to predict the effects of future uniformity changes on target performance.



OMEGA Operations Summary: May '98 operations included a transition from four shot days to three extended shot days. Setup time has been streamlined, and target shots begin after an 0800 preshot briefing. Continuous staffing allows target shots on a 1-h shot rate through 2000. We expect this operations strategy to achieve an average of 30 target physics shots per week. Early experience indicates that this goal is achievable: Results for May include 102 target shots spread over four campaigns in addition to two dedicated days of laser experiments on the beam-uniformity campaign.



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