Laser Facility Report

This report summarizes activities on the OMEGA laser system for FY96—the first full year of operations. The format for operations has been to allocate laser time to experimental programs in single-week units of nominally 20 target shots. Many experimental programs were supported on the facility, as well as several laser enhancement projects. FY96 laser improvements included 2-D SSD, backlighter, pulse shaping, and an integrated hardware timing system.

The first quarter of FY96 was devoted to activating SSD beam smoothing on OMEGA. The initial plan of implementation of 1-D SSD (LLE U2 Program) was expanded to encompass the full capability of 2-D SSD (LLE U3 Program). This effort required the full resources of the laser drivers and precluded the use of OMEGA for target shots. The objectives of installation, integration, and activation were met, bringing the 2-D smoothing effect to target, combined with DPP[1] beam uniformity enhancements.

Second-quarter accomplishments included the activation of a third laser source capable of feeding the OMEGA beamlines as a backlighter. This wholly separate laser system—the backlighter driver—can feed 20 beams of OMEGA with one pulse shape, while the other 40 beams are fed by either the SSD or main driver. A large proportion of the planar-foil backlit beam imprinting and acceleration target shots used this flexible feature of OMEGA.

Pulse shaping was added to the OMEGA laser system during the third quarter FY96. This system allows the generation of selected temporal pulse shapes from 180-ps to 3-ns duration. Each input pulse shape design compensates for frequency conversion and gain saturation effects in the OMEGA system. The leading edge of the laser pulse experiences the largest gain and the rest of the pulse has a gain related to the cumulative amount of energy preceding it. Precompensation is accomplished by applying a specific voltage to an integrated optical waveguide modulator that shapes an optical pulse in such a way that when injected into the system produces the desired pulse shape on target.

Target interaction experiments were divided among a number of internal LLE campaigns and external NLUF and National Laboratory users. Internal campaigns followed the LLE Program Plan, which is summarized in Table 68.VII (see. p. 226).

In summary, 30 weeks of FY96 were used for target shots and 22 weeks were dedicated to modifying the laser for increased uniformity and functionality. During the 30 weeks of target shooting, 588 individual target shots were taken (average of 20/week). Of the 22 weeks when targets were not shot, 14 were used for the U2/U3 Program, 4 for activation of pulse shaping, and 4 for maintenance and laser calibration shots.

The shot summary for OMEGA for FY96 is as follows:

Driver	900
Beamline	221
Target	588
Total	1709

REFERENCES

1. Laboratory for Laser Energetics LLE Review **65**, NTIS document No. DOE/SF/19460-117, 1996 (unpublished), p. 1.

Table 68.VII: LLE Program Plan

Laser Physics Programs		Progress summary
PB1	Demonstration of 3%–4% rms beam-to-beam energy balance	Complete
U1	Implementation of optimized distributed phase plates (DPP)	Initial 60-beam experiments completed; manufacturing problems caused premature damage of epoxy DPP's. Replacement with ion-etched DPP's is planned for FY97.
U2	Implementation of 1-D SSD	Complete
U3	Implementation of 2-D SSD	Interim bandwidth of 0.6×1.5 Å complete
U4	Implementation of polarization rotators	Prototype complete and tested
PS1	Temporal pulse shapes on target with contrast ratios of 20:1	Complete
Target Physics Programs		
PP2	Implosion experiments with varying convergence ratio	Supported with 60-beam shots
S1	Planar-foil Rayleigh-Taylor growth-rate experiments	Supported with backlighter, pulse shaping, and SSD
S2	Planar-foil imprinting experiments	Supported with backlighter, pulse shaping, and SSD
S3	Spherical hydrodynamic stability experiments	Supported with pulse shaping and SSD, 60-beams shots
HE1	Surrogate (noncryogenic) hydrodynamic-equivalent experiments	Supported with 60-beam shots
NLUF	Proposals as reported in LLE Review	Supported several users with target shots
ID	Indirect drive on OMEGA	Proof-of-principle experiment completed