
FY04 Laser Facility Report

The OMEGA Facility conducted a record number 1558 target shots in FY04—a 13% increase over FY03—by operating extended shifts during select weeks to accommodate user demand (see Table 100.IV). Improvements to the Spherical Cryogenic Target Handling System increased system reliability and target positioning stability. More-complex planar cryogenic target assemblies were fielded including planar cryogenic D₂ cells for radiographic measurements of shock timing and cryogenic hohlraums for energy coupling and symmetry studies. Highlights of these changes and other FY04 achievements include the following:

- A total of 35 spherical and 35 planar cryogenic shots were performed. Eight spherical cryogenic target shots were conducted within one week in FY04, demonstrating increased system reliability. The rigidity of the lower pylon structure was improved, and electrically energized docking clamps were installed to increase the stability of cryogenic target alignment. This resulted in an approximately 2× improvement in the target offset at shot time for a series of 20 spherical cryogenic target implosions during Q2 and Q3.
- An improved multichannel IR streak camera (IR3) was installed and integrated into the OMEGA front end, enhancing pulse-shape measurement and prediction capability. This camera measures the temporal input to each of the three OMEGA driver lines, and its data are used in a system performance model that predicts the OMEGA output temporal pulse shape. The combination of the new streak camera’s improved CCD camera, much shorter fiber signal delivery system, and the improved channel distribution on its photocathode resulted in a lower noise floor, higher bandwidth, and reduced channel crosstalk. An entirely recoded software user interface made it easy for the operators to use the streak camera. This new camera’s enhanced performance was in large measure responsible for successfully fielding 80-ps, picket, low-adiabat pulse shapes used for both the imprint growth measurements on foam targets¹ and the cryogenic target implosion campaigns.
- Improved amplifier-gain-measurement hardware and gain-equalization procedures were implemented on OMEGA. Precision gain matching of all the amplifiers within a stage is crucial to obtaining on-target power balance objectives. OMEGA’s harmonic energy diagnostic (HED) system was extended to measure the output of the driver lines, enabling simultaneous on-shot measurement of an amplifier stage’s input and output energies. This provided absolute stage-gain-measurement capability and allowed the stage gains to be set to a predetermined value rather than just minimizing gain variance. This improved long-term stage-gain stability (see Fig. 100.58) and dramatically reduced the number of amplifiers that were being flagged for unnecessary maintenance. The more-efficient use of maintenance resources has resulted in their concentration on the worst-performing amplifiers.
- New target designs were also fielded to begin validation of the polar-direct-drive ignition concept proposed for the NIF. These included 40-beam, directly driven “Saturn” ring targets and 40-beam, directly driven CH cells. These were the first LLE experiments to combine symmetric illumination with radiographic diagnostics (backlighting).
- A new UV spectrometer was installed to measure the spectrum of all 60 beams with 0.02 to 0.07 Å of spectral resolution. The spectral data obtained from this instrument provided insight into *B*-integral effects on OMEGA’s beamlines. Online spectral-based FCC tuning capability is planned for FY05.
- OMEGA conducted the first cryogenic gas hohlraum experiments for LLNL.

REFERENCES

1. “August 2004 Progress Report on the Laboratory for Laser Energetics, Inertial Confinement Fusion Program Activities,” University of Rochester, Rochester, NY (2004).

Table 100.IV: The OMEGA target shot summary for FY04.

Laboratory	Planned Number of Target Shots	Actual Number of Target Shots
LLE	741	756
LLNL	405*	431
LANL	150*	168
SNL	20	31
NLUF	135	127
CEA	25	32
NRL	10	13
Total	1486	1558
LLE ISE		304
LLE SSP		127
LLE RTI		86
LLE DD		69
LLE LPI		60
LLE CRYO		35
LLE ASTRO		30
LLE DDI		24
LLE PB		21
LLE Total		756

* 20 shots in collaboration.

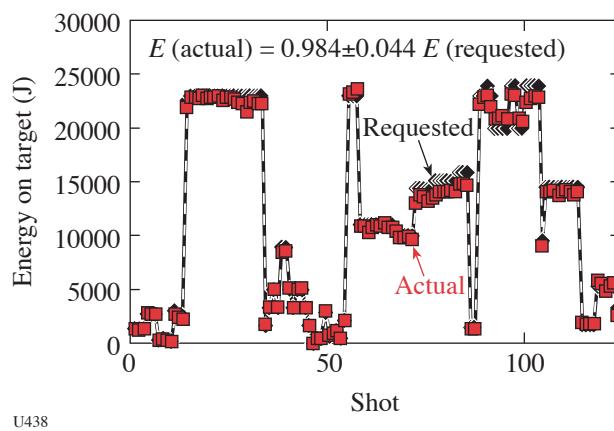


Figure 100.58
Record of requested and actual on-target energy for OMEGA shots in October 2004.

