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# LLE Review

## Quarterly Report

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## Contents

# In Brief

This volume of the LLE Review, covering the period January–March 1997, includes an article on the status of the optics on the OMEGA laser system after the first 18 months of operation. A vigorous program to monitor the performance of the optics has been followed since the inception of the OMEGA laser. The article presents results from these observations and defines the various types of possible damage. Many of the optics have not damaged, such as the frequency-conversion crystals, polarizers, calorimeters, and liquid crystal optics. The most significant damage has been sustained by the fused-silica spatial filter lenses. There has been no evidence of any propagation of damage downstream of damaged optics. In fact, after 1000 target shots the OMEGA laser has sustained remarkably little damage.

Other highlights of research presented in this issue are

- The development of a single-beam, ponderomotive optical trap for energetic free electrons. Numerical results show that a phase mask can form a central intensity minimum, producing a three-dimensional ponderomotive trap. A novel segmented wave plate has been manufactured and used on the $T^3$ laser to experimentally confirm the existence of this three-dimensional structure. Work continues to confirm the trapping properties of this unique optical device.

- A description of the new diode-pumped Nd:YLF master oscillator for the OMEGA laser. Special attention is paid to ensure long pulse operation and high stability. Experimental results are presented that confirm the excellent amplitude stability, low timing jitter, and long-term frequency stability of the new master oscillator.

- Simulations of heat transfer from localized absorbing defects to the host coating material in $HfO_2/SiO_2$ 351-nm high reflectors. Atomic-force microscopy has shown laser-induced submicron cratering of UV multilayers, which has been attributed to nanoscale, localized absorbers. A description of the model used to simulate these absorbers is presented. When thermal conduction is the only heat-transport mechanism, very high defect temperatures are required to explain the measured damage; consequently, other physical mechanisms must be considered.

- An experimental study of target performance and mixing in titanium-doped target implosions on OMEGA. Results from a recent experiment show the predicted absorption features from a thin Ti layer. These features were used to estimate the core temperature and $\rho R$ of the compressed target. In addition the EXAFS spectrum above the Ti *K* edge was observed for the first time in an implosion experiment that enabled the density of the Ti layer to be measured. These experimental techniques will be important in measuring improvements in target performance as OMEGA's uniformity improves.

- A theoretical calculation of the dephasing time of an electron accelerated by a laser pulse. The trajectory of a charged particle, determined analytically for various pulse shapes, is then used to determine the dephasing time of an accelerated particle.

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