9. Omega Laser Facility Users Group

9.1 BACKGROUND

The Omega Laser Facility is a user facility featuring both high-energy and high-intensity lasers and is capable of a wide variety of scientific experiments. At present ~30% of the facility use time is devoted to fundamental science experiments, with the remainder going to inertial confinement fusion and high-energy-density (HED) research. As a national users facility, LLE is a member of the National User Facility Organization, whose overall goal is to promote science education and outreach throughout the nation.

The facility users initiated a users group—the Omega Laser Facility Users Group (OLUG). Membership to OLUG is open to anyone who uses the Omega Facility, aspires to use it, or aspires to collaborate with a group or consortium that uses the facility. To join, either email R. D. Petrasso and request membership, or attend one of the annual OLUG User Workshops. There are no dues. Exclusions: employees of LLE significantly involved with the operation of the facility or the LLE scientific program at the facility are not eligible for membership.

The OMEGA Users comprise 304 academics and researchers from 32 Universities, and from 23 national laboratories and centers. Fifteen different countries are represented. The largest component of the membership derives from the universities.

The purpose of OLUG is to facilitate communication and exchanges among the users of the Omega Facility, from the users as a group to the facility, and from the users to the broader scientific community. OLUG organizes an annual 2.5 day workshop, which is held at the end of April. There are two major goals of the Users workshop: (1) To define improvements to the capabilities and operation of the facility that would advance research opportunities for a broad cross-section of the Users; this takes the form of Findings and Recommendations that the Users generate and then present to the facility management. This is an iterative process that transpires between the Users and the management, and it has proved to be very successful. (2) To provide an opportunity for young researchers—students, postdocs, recent Ph.D.'s—to present their research in a very interactive yet informal setting. In this regard, great effort is taken to obtain funding for student/postdoc travel to the workshop, something which has been generously funded by NNSA. In addition, the Users also meet annually at the Division of Plasma Physics meeting, typically Tuesday evening, to reassess the Findings and Recommendations, and to discuss with management progress toward their implementation.

9.2 CURRENT FINDINGS AND RECOMMENDATIONS (2013)

9.2.1 Wednesday Evening Session for Young Researchers

The young researchers would like to have a Wednesday evening session (on the first day of the workshop), where they could discuss topics and concerns that most directly impact their research, especially as it relates to the Omega Laser Facility. From their discussions, this would be used as important input to the Findings and Recommendations for the 2014 and subsequent workshops.

9.2.2 Tritium-Filling Capability

While notable and important capabilities have occurred in tritium filling of capsules with different gas mixtures (such as with ^{3}He for D^{3}He shots), and as well with reasonable high-T purity (for TT shots, where an ~1.5% D contamination level was achieved), we look forward, with implementation of the isotope separator, to even higher-purity-T experiments (0.2% D). This will lead to very important advances in plasma nuclear science.

9.2.3 OMEGA EP to Full Specifications

While very significant improvements in the last year (2013) have occurred in bringing OMEGA EP closer to full performance specifications, for which we applaud the Omega Laser Facility, we look forward to continued improvement in its capabilities.

9.2.4 OMEGA EP Long-UV-Pulse Operations

Long-pulse operation, in the 10- to 100-ns interval, would enable new and unique science to be performed. These include shock, photoionization-relaxation and nonequilibrium, late-time instabilities, and, in general, larger time-scale laboratory astrophysical experiments.

9.2.5 Opposing UV Beams on OMEGA EP

While OLUG recognizes this is a long-term, substantial project requiring considerable resources, it also felt that such a project would be an important new capability of the facility.

9.2.6 Independent, or Semi-Independent, Legs for OMEGA-60's Three Legs

While OLUG recognizes this as a major undertaking, this would bring with it significant new capabilities for exciting frontier science. Related to this is the possible decoupling of Beam 25 for Thomson scattering.

9.2.7 Foreground Target Illumination on OMEGA-60

Improvement in the foreground target illumination is recommended.

9.2.8 Updating the Omega Users' Guide

This document is extremely useful to all users and would benefit from being updated.

9.2.9 Low-Energy Neutron Spectroscopy

Extending spectroscopy in the ~1- to ~2-MeV regime, as well as from ~0.1 to ~1 MeV, would be an outstanding new diagnostic to add to the existing OMEGA 60-beam neutron diagnostics. In addition to giving a new window for basic capsule-implosion performance, it would almost certainly significantly advance the frontier field of plasma nuclear science, which has been pioneered at the Omega Laser Facility. It is important to note that very significant work has taken place in the past year in this regard.

9.2.10 High-Resolution X-Ray Imaging Spectrometer

This current project, initiated in 2013 by colleagues from Princeton and the University of Rochester, is an outstanding diagnostic that we applaud, bringing additional unique capabilities to the OMEGA 60-beam laser.

9.2.11 Super GCD-3 Gamma Spectrometer

Extending gamma spectroscopy to study low-probability reactions would be highly desirable from both the point of view of implosions physics and for enabling innovative plasma nuclear science/ nucleosynthesis such as the H–D fusion line at 5.5 MeV.

9.2.12 Differential Burn-Time Diagnostic of D–D and D^3He

There is a very strong likelihood that for capsules filled with D^3He, the bang times of D–D and D^3He may differ by an order of ~30 ps or more. Such a differential could be an indication of either two-ion-fluid effects or kinetic effects, neither of which has been deeply explored, although there is strong evidence that such effects should be present. This is a project that was initiated in 2013 and is well underway, with the first system tests and experiments conducted in 2013.

9.2.13 Implementing a Two-Ion-Fluid Capability in *LILAC*

LILAC and all other standard hydrocodes in existence—*LASNEX*, *HYDRA*, *DUED*, *HYADES*—are all single-ion-fluid codes. Having a capability to probe differences in bang time for the two-ion species would be a timely development, as noted above for the differential burn-time diagnostic.

9.2.14 Improvement in SOP/ASBO

Several recommendations were made in this regard. For the active shock breakout (ASBO): a faster comb (4 GHz) is needed along with the ability to image spatial-distortion data.

9.3 EXECUTIVE COMMITTEE

The Executive Committee, nominated and elected by the User Group, will define all aspects of the Users Group bylaws, policies, and procedures. The committee will elect a chair, who must be from the academic and/or small business community.

- Richard Petrasso, Committee Chair, Massachusetts Institute of Technology
- Hui Chen, Lawrence Livermore National Laboratory
- James Cobble, Los Alamos National Laboratory
- Paul Drake, University of Michigan
- James Knauer, LLE, University of Rochester (designated)
- Mark Koepke, West Virginia University
- Tammy Ma, Student-Postdoc Chair, Lawrence Livermore National Laboratory
- Roberto Mancini, University of Nevada, Reno
- Peter Norreys, Rutherford Appleton Laboratory

At the request of LLE, Dr. Richard Petrasso of MIT and Professor Paul Drake of the University of Michigan developed the initial plan. Subsequently it was amended and approved at the OMEGA EP User Workshop.