The Fifth Omega Laser Facility Users Group Workshop

Introduction

A capacity gathering of over 100 researchers from 25 universities and laboratories met at the Laboratory for Laser Energetics (LLE) for the Fifth Omega Laser Facility Users Group (OLUG) workshop. The purpose of the 2.5-day workshop was to facilitate communications and exchanges among individual Omega users and between users and the LLE management; to present ongoing and proposed research; to encourage research opportunities and collaborations that could be undertaken at the Omega Laser Facility and in a complementary fashion at other facilities [such as the National Ignition Facility (NIF) or the Laboratoire pour l'Utilisation des Lasers Intenses (LULI)]; to provide an opportunity for students, postdoctoral fellows, and young researchers to present their research in an informal setting; and to provide feedback to LLE management from the users about ways to improve the facility and future experimental campaigns. The interactions were wide-ranging and lively, as illustrated in the accompanying photographs.

OLUG consists of over 300 members from 35 universities and many centers and national laboratories. Names and affiliations can be found at **http://www.lle.rochester.edu/media/about/documents/OLUGMEMBERS.pdf**. OLUG is by far the largest users group in the world in the field of high-energy-density physics and is also one of the most active.

The first two mornings of the workshop were comprised of seven science and facility presentations. The facility talks proved especially useful for those unfamiliar with the art and complexities of performing experiments at the Omega Laser Facility. But since the facility is constantly evolving and improving, even experienced users benefited significantly from these updates. The overview science talks, given by leading world authorities, described the breadth and excitement of high-energy-density (HED) science either being undertaken at the Omega Laser Facility or well within the reach of the facility with improvements or upgrades.

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Figure 136.31

A capacity gathering of 100 researchers from 25 universities and laboratories around the world participated in this year's workshop. The users group itself has well over 300 members from 35 universities and 25 laboratories, making it by far the largest users group in the world in high-energy-density physics. The next annual OLUG Workshop will occur 23–25 April 2014.

Forty students and postdoctoral fellows participated in the workshop, and 36 were supported by travel grants from the National Nuclear Security Administration (NNSA). The content of their presentations encompassed the spectrum from target fabrication to simulating aspects of supernovae; the presentations generated spirited discussions, probing questions, and friendly suggestions. In total, there were 68 contributed posters, including eight that focused on the Omega Laser Facility.

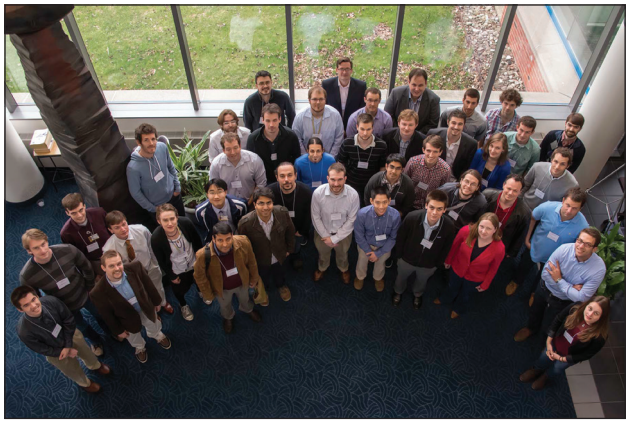

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Figure 136.32
Nearly all the 40 students and postdoctoral fellows who attended made poster presentations; 36 received travel assistance from an NNSA grant. The workshop emphasized the participation and involvement of young researchers.

An important function of the workshop was to develop a set of **Findings and Recommendations** to help set and define future priorities for the Omega Laser Facility. These were grouped into three areas: 60-beam OMEGA, OMEGA EP, and general facility improvements and accessibility of OMEGA operational information. LLE management uses these recommendations as a guide for making decisions about Omega Laser Facility operations, priorities, and future changes. In addition, the status of these OLUG **Findings and Recommendations** will be updated and reviewed at a satellite evening meeting during the 2013 APS-DPP Conference. They will also form the grist for the forthcoming workshop. The widely discussed **Findings and Recommendations** are listed below.

One highlight of the workshop, as in past workshops, was a panel of students and postdoctoral fellows who discussed their experiences at the Omega Laser Facility and their thoughts and recommendations on facility improvements. Engaging discussions were sparked by this forum, which resulted in the student/postdoctoral recommendations for the facility.

For the first time, three posters were presented by students in LLE's Summer High School Research Program. We plan to expand the number of these excellent presentations in the 2014 April Workshop.

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Figure 136.33
A total of 68 posters, the majority by young researchers, were presented during three poster sessions.

Another important event at the end of the workshop was a panel of experts who gave an overview of the HED opportunities at national laboratories. These discussions are very useful for young researchers who may not know all the capabilities and HED research occurring at these various institutions.

Finally, it was decided to hold the next workshop on 23–25 April 2014. Plans are already well underway for this event.

Principal Findings and Recommendations of the 2013 Workshop

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 workshop.

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 (D. McNabb, M. Gatu Johnson, D. Casey, J. Caggiano, H. Herrmann, L. Bernstein, and J. Frenje).

3. OMEGA EP to Full Specifications

While very significant improvements in the last year 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 (L. Willingale, M.-S. Wei, R. Mancini, P. Norreys, and P. Drake).

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 (R. Mancini, C. Kuranz, R. Heeter, D. Martinez, J. Kave, P. Drake, P. Keiter, M.-S. Wei, and H.-S. Park).

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 (M.-S. Wei, L. Willingale, C. Kuranz, H. Chen, P. Drake, C. Huntington, and H.-S. Park).

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 (C. Kuranz, R. Mancini, L. Willingale, R. Rygg, and P. Norreys). Related to this is the possible decoupling of Beam 25 for Thomson scattering (C. Huntington).

7. Foreground Target Illumination on OMEGA-60

Improvement in the foreground target illumination is recommended (J. Cobble and C. Kuranz).

8. Updating the Omega Users' Guide

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

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 (C. Forrest, M. Gatu Johnson, D. McNabb, C. Sangster, J. Frenje, L. Bernstein, J. Caggiano, H. Herrmann, and Y. Kim).

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 (K. Hill, P. Nilson, H.-S. Park, N. Landen, and J. Frenje).

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 (Y. Kim, H. Herrmann, D. McNabb, A. Zylstra, J. Frenje, and L. Bernstein).

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 have 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 to be conducted on 20 November 2013 (H. Sio, C. Bellei, R. Mancini, P. Amendt, P. Norreys, N. Hoffmann, S. Wilks, S. Atzeni, J. Frenje, C. Stoeckl, V. Glebov, R. Betti, and D. Shvarts).

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 (H. Sio, C. Bellei, J. Frenje, S. Wilks, P. Amendt, N. Hoffmann, G. Kagan, R. Betti, S. Atzeni, K. Molvig, and D. Shvarts).

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

at full sweep speed; alignment and Q-switching procedures should be updated; new etalons should be acquired. For the streaked optical pyrometer (SOP): improvements are needed in background and noise mitigation along with absolute calibration and imaging spatial-distortion data at full sweep speed (M. Millot, P. Celliers, and T. Boehley).

15. Compact High-Resolution, 14.1-MeV Neutron Spectrometers

Since kinetic-flow effects are very likely to have a significant impact on furthering our fundamental understanding of cryo and non-cryo capsule implosions, this new diagnostic would extend and nicely complement OMEGA-60's present capabilities. The compactness of the design would allow, for the first time, comprehensive views of the implosions, therefore enabling blue and red shifts to be simultaneously observed. This project is well underway, with some excellent preliminary data already obtained (A. Zylstra, J. Frenje, V. Glebov, V. Goncharov, J. Caggiano, and J. Kilkenny).

16. 4ω Thomson Scattering on OMEGA EP

This would be an extremely valuable capability and may not be too resource intensive (W. Fox, C. Kuranz, L. Willingale, H.-S. Park, and C. Hungtington).

The photographs on the following pages provide a representative sampling of the workshop's talks, interactions, and ambience.

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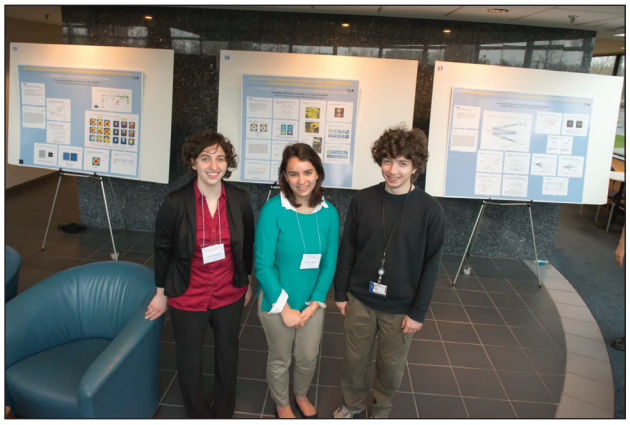
Figure 136.34
The posters ran the gamut from (a) laboratory astrophysics (Christine Krauland from the University of Michigan), to (b) reconnection in high-β plasmas (Will Fox, from the University of New Hampshire), to (c) high-end simulations utilizing FLASH (Chris Orban from Ohio State University).

U1609JR

Figure 13.35
NASA's Einstien postdoctoral fellow Mario Manuel presented his continuing OMEGA research plans. Mario, now at the University of Michigan, is the first NLUF/NNSA-sponsored Ph.D. to receive this prestigious Einstein Fellowship. Congratulations to Mario and the Omega Laser Facility, where Mario's Ph.D. research was conducted.



U1610JR

Figure 136.36
Presentations included superb posters given by three researchers in LLE's 2012 Summer High School Research Program. Shown from left are Emily Armstrong, Christa Caggiano, and Raz Rivlis. We plan to expand the number of these high school LLE summer participants in the 2014 workshop.

(a) (b)

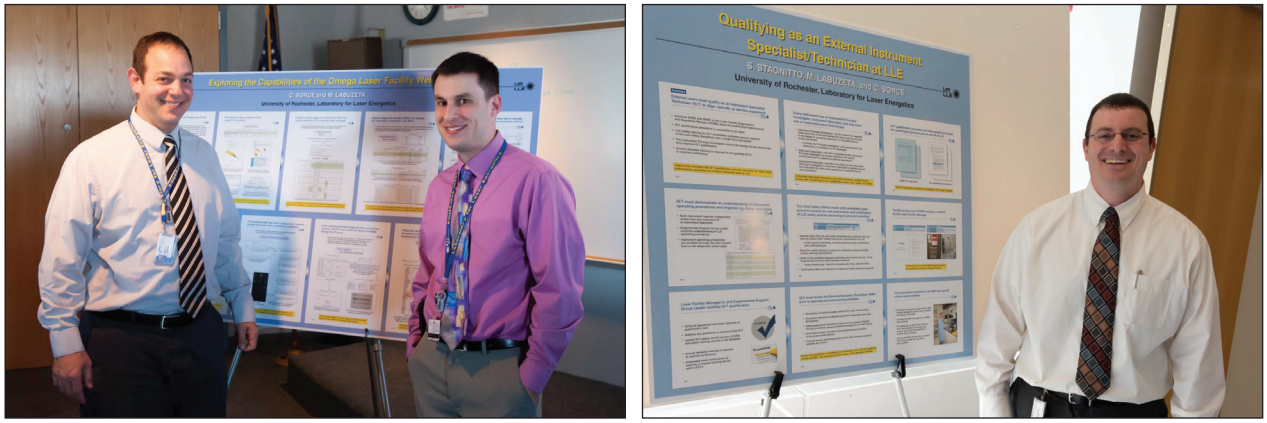


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Figure 136.37
(a) Engineers Mark Labuzeta and Chuck Sorce and (b) engineer Steve Stagnitto. The eight "Facility" posters, many addressing Findings and Recommendations of OLUG, were widely lauded by the users; "tremendously useful and informative" was the universal sentiment for this session. The 2014 workshop will continue this tradition since it has proved so valuable to the workshop attendees.

U1614JR

Figure 136.38
The young researcher's panel and town meeting is one of OLUG's most important sessions, highlighting many of the challenges faced by young researchers at the Omega Laser Facility and elsewhere. Next year's chair of the young researcher's panel is MIT's Alex Zylstra (far left).

U1613JR

Figure 136.39
Tours of the facility are a critical part of the workshop and bring home the complexity, coordination, and long-range planning needed for implementing a successful campaign. Here OMEGA EP Senior Engineer and Laser Facility Manager Dave Canning describes OMEGA EP's hardware, layout of the principal components in the Laser Bay, and the planning needed for a successful OMEGA EP campaign.

U1617JR

Figure 136.40
One of the Finding and Recommendations, discussed here by MIT Ph.D. student Hong Sio, was to use a novel diagnostic to measure, with high accuracy, the differential nuclear bang time of D–D and D^3He in D^3He–filled implosions. Such work should illuminate two-fluid-ion effects and/or kinetic plasma effects. The first full-on test of this diagnostic will take place 20 November 2013.

(a)

(b)

(c)

U1612JR

Figure 136.41
World-class physicists described cutting-edge research either ongoing at the Omega Laser Facility, or those tantilizing possibilities "just around the corner:" (a) Don Lamb from the University of Chicago, (b) Mark Koepke from West Virginia University, and (c) Valeri Goncharov from LLE.

U1620JR

Figure 136.42
The workshop banquet at the Meliora, on the University of Rochester's campus, offered a wonderful time for old and new friends to mingle in a congenial ambiance.