UNIVERSITY OF ROCHESTER
LABORATORY FOR LASER ENERGETICS

LLE IN FOCUS

FALL 2024 | VOLUME 1, ISSUE 4

FOCUS ON EDUCATION AND OUTREACH

CULTIVATING CURIOSITY AND COMMUNITY

UNIVERSITY of ROCHESTER

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Innovating Through Education

Undergraduate students Ruth Reynolds and Daniel Menis collaborate through hands-on learning in LLE's cutting-edge microfabrication laboratory.

LLE IN FOCUS

Focus on: Education and Outreach

FALL 2024
Volume 1, Issue 4

Advancing Laser Technologies, Fusion, and High-Energy-Density Physics at Scale

The Laboratory for Laser Energetics at the University of Rochester is the only university-based laboratory dedicated to advancing the field of inertial confinement fusion. LLE operates at a scale comparable in capability to the US Department of Energy's 17 national laboratories, enabling research education, and training. Housing the largest lasers in any academic setting, LLE is is the preeminent user facility in the world for high-energy-density physics.

What We Do:

- **Innovate:** Pioneer advancements in laser technology, inertial confinement fusion and high-energy-density physics, target fabrication, diagnostics, operations, and engineering
- **Collaborate:** Enable scientific breakthroughs that could lead to the development of clean energy sources, together with national laboratories, academic partners, and industry
- **Educate:** Prepare the next-generation workforce in electro-optics, high-power lasers, high-energy-density physics, plasma physics, and nuclear fusion technology

The Impact:

- A clean and potentially limitless source of energy
- Strengthened national security
- Scientific and technical excellence in the workforce

COLUMNS

FEATURED ARTICLES

About the cover

Graduate student Manfred Virgil Ambat and undergraduate student Isabelle Settle (front) and graduate student Isabelle LaBelle (back) are shown working inside of the Underdense Plasma Chamber in LLE's Laser Development Laboratory.

LLE IN FOCUS

From the Director

DR. CHRISTOPHER DEENEY | DIRECTOR, LABORATORY FOR LASER ENERGETICS

This year has flown by—I cannot believe this is already the fourth quarter. First, congratulations to our Publications and Design Department and content providers for publishing our fourth, newly formatted issue of our quarterly magazine, *LLE In Focus*. Second, LLE has not only accomplished several major research and development advances, but also launched into sustaining the laboratory's facilities into the 2030s—all of which are discussed in this report. Many of our technical successes are driven by our students, who continue to be motivated by LLE mentors to engage in science and technology. Whether it be through our high school programs, our newly architected and expanded undergraduate program, or our PhD research activities, LLE's outstanding mentors convey their passion for science and technology, inspiring future generations of scientists while solving today's problems.

We live in an amazing ecosystem of industry and other academic institutions here in the Finger Lakes region of New York. In this issue, we could not highlight scientific mentorship and inspiration without shining the spotlight on Professor Stephen Padalino at SUNY Geneseo and his numerous contributions to LLE and to the broader scientific community during his 40-year career. All I can add is: "Thank you, Steve!" Steve has said that "LLE is the best kept secret in Rochester"—a statement we actually hear frequently. What is amazing, however, is just how many other major academic facilities not only know of us, but also rely on our facilities and capabilities to conduct their research and train their students. The National Laser Users' Facility program is the avenue that has continued to make this happen for the past 45 years.

Steve Jobs once said, "Innovation distinguishes between a leader and a follower"—a statement we take to heart in our everyday efforts at the Laboratory. We have highlighted some of the innovations LLE has made in laser technology over the last decades. Hopefully, there are many more to come, and as I watch the new students joining our programs, I am confident that they will drive innovation wherever they are working—whether it be at LLE, national laboratories, in industry, or elsewhere. The US must remain innovative in this competitive world, and we are committed to helping pave the way for innovation to flourish.

Christopher Deeney
Director, Laboratory for Laser Energetics

First Focus

In LLE History

35 YEARS

This year marks the 35th anniversary of the Summer High School Research Program. A total of 448 students have participated in the program since its inception in 1989. This year, 17 students from 15 different area high schools participated in the program. They conducted hands-on research on the Omega Laser Facility, the world's largest laser in an academic institution, gaining valuable experience in experimental physics and laser science. The program continues to be a stepping stone for students pursuing careers in STEM fields.

Fast Facts

75

undergraduate students engaged in the LLE Undergraduate Program for the summer of 2024.

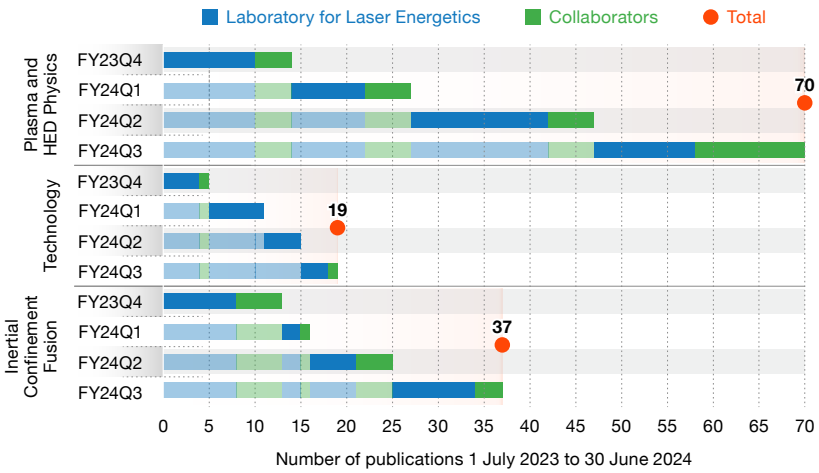
448

students have taken part in the Summer High School Research Program since 1989.

160+

graduate students performed research at LLE in 2024.

Publications



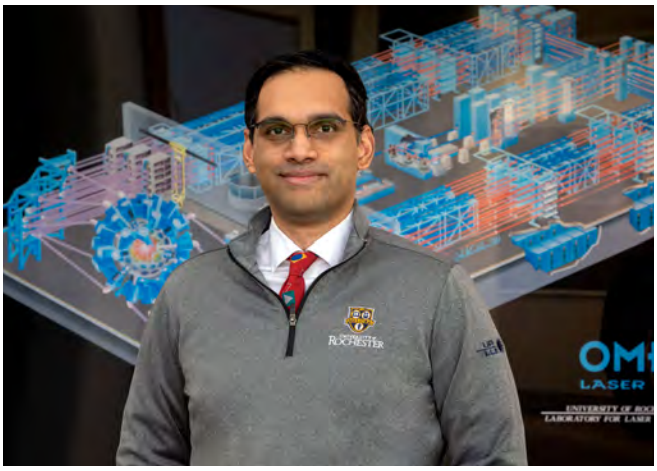
Research Highlights

The science and engineering research at the Laboratory for Laser Energetics is captured through peer-reviewed publications, which include LLE lead-authored (blue bars) and LLE co-authored papers (green bars). LLE averages more than 100 published articles annually across three broad areas: Technology, Plasma and High-Energy-Density (HED) Physics, and Inertial Confinement Fusion.

Awards and Honors

2024 Mentor Award Presented to R. Stephen Craxton

R. Stephen Craxton, Distinguished Scientist in the Theory Division, was awarded the LLE Education Program's inaugural 2024 Mentor Award for outstanding contributions to the community by a mentor. Steve has made significant contributions to LLE's Summer High School Research Program, expertly running it for 25 years. He has mentored over 50 students and regards the opportunity to introduce them to the excitement of scientific research as one of the highlights of his career.



Varchas Gopalaswamy Appointed Assistant Professor

Varchas Gopalaswamy, LLE Scientist in the Integrated Modeling Group, has been appointed to the position of Assistant Professor (Research) in the University of Rochester's Department of Mechanical Engineering. Gopalaswamy, who has worked at LLE since 2016 during graduate school, was awarded the 2024 European Physical Society–Plasma Physics and Controlled Fusion Sylvie Jacquemot Early Career Prize earlier this year for his impressive contributions to the development of statistical modeling used in inertial confinement fusion experiments.

2024 Student Award Presented to Joanna Rosenbluth

Joanna Rosenbluth, senior optics major at the University of Rochester, was awarded the LLE Education Program's inaugural 2024 Student Award for outstanding contributions to the community by a student. Joanna has been recognized for her exceptional ability to apply classroom knowledge to real-world problems and her remarkable technical competency as an undergraduate student in optical engineering.

2024 High School Teacher Award

Michael Madden, a physics teacher at Pittsford Mendon High School, received the 25th annual William D. Ryan Inspirational Teacher Award for motivating participants of LLE's Summer High School Research Program to study science, mathematics, or technology. He was nominated by students from the 2023 program who praised his interest and passion for physics, his infectious energy and enthusiasm, and his emphasis on the real-world applications of everything his students learn.

Awards Received by Omega Users


2024 Stewardship Science Academic Programs Best Poster Award

Based on Omega experiments

Afreen Syeda (Graduate student, University of Rochester)—"Viscosity Measurements of Shock-Compressed Epoxy"

Michael Pokornik (Graduate student, UC San Diego)—"Using Deep Learning to Analyze Thomson-Scattering Diagnostic Data in Laboratory Astrophysics Experiments"


2024–2025 DOE NNSA Stewardship Science Graduate Fellowship

Matthew Cufari (MIT, Plasma Physics; advised by Johan Frenje)—Matthew is an LLE Summer High School Research Program alumnus studying an advanced inertial confinement fusion concept that uses external magnetic fields applied to an implosion performed on the 60-beam OMEGA laser.

Julian Kinney (University of Michigan, Plasma Physics; advised by Scott Baalrud and Carolyn Kuranz)—Julian's research focuses on radiation transport in high-energy-density plasmas. Julian uses first-principles molecular dynamics simulations as a benchmark and is aiming to compare his theoretical models against real-world data including Omega experiments.

Fusion Power Associates 2023 Leadership Award

Johan Frenje (MIT)—Johan was recognized for his key role in support of the recent historic National Ignition Facility (NIF) inertial confinement fusion (ICF) experiments, and two decades' worth of contributions to the development of diagnostics and methodologies used to push the boundaries of ICF and high-energy-density physics. Johan also mentors younger colleagues and PhD students, many of whom have gone on to become leaders in the field.

2024 DOE NNSA Laboratory Residency Graduate Fellowship

Skylar Dannhoff (MIT, Plasma Physics; advised by Chikang Li and Johan Frenje; residency location: LLNL)—Skylar studies electric and magnetic fields generated in a hohlraum plasma in indirect-drive inertial confinement fusion (ICF) experiments, in addition to building nuclear diagnostics for studies of ICF and high-energy-density plasmas.

2024 NIF–JLF User Group Meeting Best Poster

Based on Omega experiments

Skylar Dannhoff (Graduate student, MIT)—"Investigations of Plasma Flow, Interface Dynamics, and Self-Generated Fields in Ta_2O_5- and SiO_2-Lined Hohlraums at OMEGA"


Prestigious Postdoctoral Fellowship Awarded to recent NLUF PhD graduates

Patrick Adrian (MIT, PhD 2023)—LANL Director's Postdoctoral Fellowship in High-Energy-Density Sciences

Graeme Sutcliffe (MIT, PhD 2023)—LLNL High-Energy-Density Science Center Postdoctoral Fellowship

National Academy of Sciences 2024 Kavli Fellow

Raspberry Simpson (LLNL)—Raspberry was selected by a committee of National Academy of Science members as a 2024 Kavli Fellow for recognized scientific contributions made by an outstanding young scientist. Raspberry's work is aimed at addressing the need for next-generation diagnostics and developing new experimental and machine-learning tools to optimize laser-driven secondary particle sources.

Diversity, Equity, and Inclusion Council

To better support the LLE community, the Diversity, Equity, and Inclusion Council (DEIC) aims to represent the experiences of the LLE workforce. Its members represent a wide array of experiences crucial to cultivating and nurturing a strong sense of belonging. In collaboration with senior leadership across the laboratory and with other institutions, the DEIC promotes conversations, offers resources, and creates opportunities directly related to building a workplace that is committed to enacting a cultural shift where we prioritize acceptance and inclusion through workshops, trainings, learning opportunities, and community building. LLE's LGBTQ+ group, LLE Pride, and Women in Science and Engineering at LLE, WiSE-LLE, further support these efforts in collaboration with the DEIC.

Allyship Workshop

"Ally as a Verb," hosted by Dr. S. Simmons, offered an interactive workshop where attendees had an opportunity to explore what allyship looks like and more-holistically understand the responsibility of advocating for those who hold marginalized identities and experiences. Attendees learned how to disrupt microaggressions and were invited to see the importance of allyship in day-to-day interactions to further promote a sense of belonging.

Day of Caring

DEIC hosted a successful second annual day of giving back to the community through United Way's Day of Caring. Sixty employee and student volunteers had the opportunity to contribute at two local community organizations, YMCA Camp Northpoint and El Camino Trail at Conkey Corner Park, where they assisted with the tasks of weeding, painting, gardening, mulching, and trail cleanup and revitalization.

Meet and Greet

In an effort to promote a welcoming work environment, DEIC facilitates Meet and Greet (Meet your CoLLEagues) events where newly hired employees and students are especially encouraged to attend to meet and connect with the LLE community. This opportunity facilitates the transition into a new job for new employees by providing a space to meet colleagues, ask questions, and engage in critical conversations. These events also create an opportunity to check in with colleagues to garner a sense of community and belonging.

Outreach

Outreach opportunities like WiSE-LLE's participation at Rochester Museum and Science Center's eclipse event (shown above) enables alignment with the mission of education by sharing with the community what makes LLE special. By actively engaging with communities through workshops and demonstrations, LLE reaches a broader audience, thus creating a more-diverse pool of talent for staff, faculty, and students at LLE. A commitment to outreach fosters a more-equitable environment while driving scientific advancement.

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Forging Futures in Physics

How SUNY Geneseo and LLE Create a STEM Success Pipeline

Stephen Padalino, Distinguished Professor at the State University of New York (SUNY) College at Geneseo and Visiting Senior Scientist at LLE, has played a key role in mentoring students and shaping their careers in physics during his 40-year career. The decades-long partnership between LLE and Geneseo, which was started by Padalino and scientist Bob Kremens in the mid-1990s, has been instrumental in providing hands-on research opportunities to students, who work alongside world-class scientists and engineers and gain invaluable experience that prepares them for advanced studies and careers in physics and engineering. "The undergraduate-to-graduate-to-professional pipeline is the real story here," Padalino explains, highlighting how these experiences enable students to see how their STEM educations translate into in-demand careers.

At Geneseo, Padalino's undergraduate students gain practical experience working in the university's two accelerator labs. They also have opportunities to work at LLE, performing shots on the Multi-Terawatt laser and experiments on OMEGA. Early in the partnership between Geneseo and LLE, Padalino's students contributed to the MEDUSA project on OMEGA, which involved developing a 1000-neutron detector array for measuring implosion performance using deuterium–tritium fuel, in addition to calibration measurements at the Geneseo accelerator lab. Padalino and his students have been conducting nuclear physics and diagnostic research in collaboration with LLE for well over three decades, during which time hundreds of his students have presented this research at American Physical Society (APS) national meetings. In 2019, Katelyn Cook—a student working for Mark Yuly, a faculty member in Padalino's group—won the APS LeRoy Apker Award for outstanding undergraduate research—the most-prestigious award in the US recognizing undergraduate research.

Reflecting on his extensive teaching career, Padalino takes pride in having mentored over 200 students—at least 75 of whom have gone on to pursue doctoral degrees in a variety of science and engineering fields. In addition, many of Padalino's students have found work at national labs, in industry, academia, and here at LLE. One full-circle moment in Padalino's career was when Geneseo alumna Danae Polsin, who had worked in his lab for three summers, joined LLE as a scientist and University of Rochester faculty member and became a mentor to several of Padalino's students.

In 2016, LLE Scientists Craig Sangster and Sean Regan co-nominated Padalino for the APS Fellowship in honor of his tremendous commitment to students and to science. Many of Padalino's achievements were detailed in his nomination letter, including "obtaining over $7 million in funding from a variety of agencies for the sole purpose of undergraduate research opportunities in the fields of accelerator physics, inertial confinement fusion, and high-energy-density physics."

> ***"I am incredibly grateful for Dr. Padalino's mentorship over the years. His infectious enthusiasm and positive energy make the lab an inviting place to learn, grow, and innovate."***
>
> *LLE Scientist Danae Polsin*

"I couldn't ask for a better partner than LLE in this work," Padalino states, noting that approximately 10% of the LLE workforce are Geneseo graduates. He is a vocal advocate for LLE, often promoting the institution during his talks at other universities and encouraging similar partnerships. He considers it a privilege to teach at Geneseo and work so closely with LLE, describing LLE as "the best-kept secret in all of Rochester."

Above all, Padalino enjoys being part of the scientific community and spending time with students who have a passion for discovery. "I think people think of a scientist as some guy sitting in a lab alone," he says. "I enjoy science because it is a social event. It's a society of people discovering fantastic stuff about the universe, sharing that information, and constantly learning. That's what excites me most."

LLE is grateful for Stephen Padalino's unwavering dedication to his students and his ongoing partnership with the laboratory.

Steve Padalino (in front) with researchers from SUNY Geneseo and LLE Geneseo alumni at LLE in 2019.

Laser Facility Report

The Omega Laser Facility conducts experiments for research and development in support of the NNSA High-Energy-Density Program, National Laser Users' Facility, and Laboratory Basic Science Program, in addition to other research and educational efforts. During Quarter 3 of FY24, the Omega Laser Facility conducted 286 target shots on OMEGA and 152 on OMEGA EP for 438 total target shots for 53 unique campaigns. In Q3, OMEGA averaged 93% availability and 93% experimental effectiveness while OMEGA EP averaged 93% availability and 91% experimental effectiveness.

A distinct feature of the Omega Laser Facility is the availability of precision diagnostics to measure experiments. Not only are the facilities equipped with an extensive suite of diagnostics, but scientists and engineers are constantly working to field new diagnostic capabilities or upgrade/sustain the useful diagnostics in the inventory.

In the past year, LLE completed 16 projects to augment diagnostic capabilities (see a list of the upgrades below). Highlights include the replacement of the OMEGA high-resolution velicometer (OHRV) laser. This project included a significant rework of the laser location and functionality to improve reliability and decrease the effort required to deploy the laser.

On OMEGA EP, the spectrally resolved streaked optical pyrometer (SOP) has enabled a new regime of measurements. This diagnostic uses a pickoff from the SOP diagnostic beam and includes a spectrometer to resolve the wavelength of light to >4 nm per pixel accuracy. Combined with the streak-camera detector, the SOP spectrometer provides a spatially integrated, time-resolved measurement of the emission spectrum of a target sample during the experiment. The design captures light in the 450- to 750-nm-wavelength range and includes a location for notch filters to tune spectral sensitivity. See Fig. 1 for a top view of the diagnostic design.

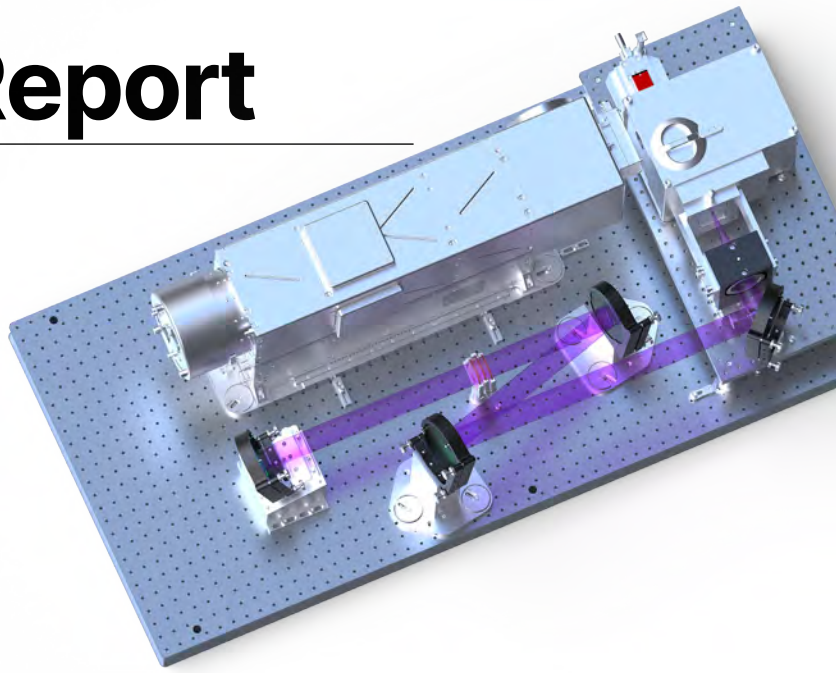

Figure 1. The SOP spectrometer is located directly under the SOP diagnostic in the OMEGA EP Bay. Light enters the diagnostic table from the left as shown and is directed onto the spectrometer in the top right. The output from the spectrometer is incident upon the Rochester Optical Streak System to make temporal measurements.

OMEGA Diagnostic Upgrades

- OHRV replacement laser
- Multiframe Fresnel zone-plate imager
- Port P9 full-aperture backscatter station
- Knock-on-deuteron imager (KoDI) film pack
- Expanded streaked x-ray spectrometer (SXS) qualification on x-ray framing camera (XRFC) to all ten-inch manipulator (TIM) locations on OMEGA
- Electromagnetic pulse measurements
- KoDI configured with a charge-injection device to function as an x-ray pinhole camera
- Gated optical imager for analyzing refracted light from laser plasmas
- H17E/H4D neutron time-of-flight relocation

OMEGA EP Diagnostic Upgrades

- THz radiation background measurement
- Magnetic-field measurement capability from a fixed location
- Broadband reflectivity for SOP
- Wide-angle x-ray and electron spectrometer
- Expanded SXS qualification on XRFC to all to all TIM locations in OMEGA EP
- Addition of spectral resolution to SOP
- Velocity interferometer system for any reflector (VISAR) was augmented to capture images from a different port of the chamber (TIM-14)

Omega Sustainment in Action

Focus on Power Conditioning: High-Voltage Capacitor Sustainment

As the OMEGA and/or OMEGA EP lasers begin their shot sequence, electrical energy from the grid is used to charge high-voltage capacitors, which store the electrical energy until it is released at the end of the shot sequence. A typical shot will include 2 to 3 minutes of "charge time" while the capacitors reach voltages up to 14,000 volts. While the shot takes place, the stored energy in the capacitors is transferred to the amplifier flashlamps, converting the electrical energy to light. There are 3770 high-voltage capacitors in use across the OMEGA and OMEGA EP Laser Systems.

In June 2023, several OMEGA capacitors were found to be leaking oil from the black colored bushings at the terminals (see Fig. 2, top of blue capacitor on the right). These leaky capacitors were manufactured in the 1990s, at the time of the 60-beam OMEGA Upgrade. Some caps on the system date to pre-1980. When enough oil leaks out, it can lead to catastrophic failure. As part of the Omega Sustainment Plan, many of these failing capacitors are being refurbished to extend their lifespan. Additionally, a new vendor has been qualified, and new capacitors are being tested on the system. These continuing efforts will help ensure Omega Laser Facility readiness and availability into the future.

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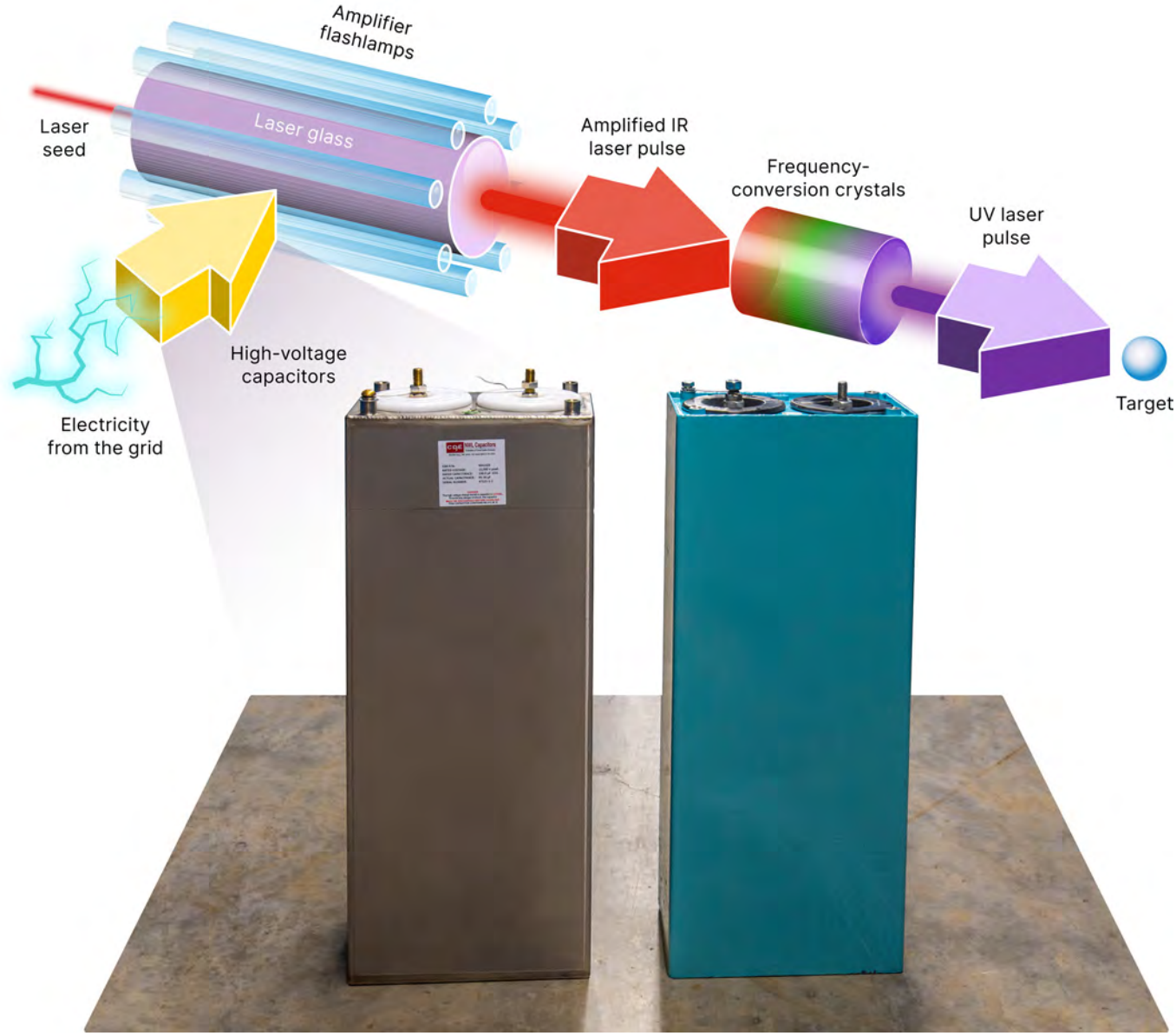


Figure 2: A new model capacitor (left) shown beside an original blue capacitor (right). The black bushings on top of the original have begun to form cracks, releasing oil. Energy transfer on OMEGA begins with electricity from the grid flowing into thousands of these high-voltage capacitors. The capacitors release their energy into the amplifier flashlamps at the time of the shot.

National Laser Users' Facility students and postdocs at the annual Omega Laser Facility Users Group Workshop.

NLUF GRADUATE STUDENTS

The Future of Science

LLE is a world-leading, university-based laboratory that enables research, education, and training relevant to national laboratories. The OMEGA and OMEGA EP lasers are the largest in any academic setting and are the major user facility in the world for high-energy-density (HED) physics and inertial confinement fusion (ICF) science. LLE has operated the National Laser Users' Facility (NLUF) since 1979, providing scientists and students broad access to unique experimental capabilities for conducting cutting-edge basic science research. The high shot rate, extensive diagnostics, and flexibility of the Omega Laser Facility currently supports the education and training of over 80 graduate students from the Omega user community, primarily through the NLUF Program. The Omega Laser Facility Users Group (OLUG) further facilitates the integration of students and young researchers into the Omega user community, providing networking and career-building opportunities.

LLE congratulates and celebrates the achievements of seven students from our user community who earned their PhD degrees in the last 12 months: Patrick Adrian, Cameron Allen, Krish Bhutwala, Enac Gallardo-Diaz, Tyler Perez, Camille Samulski, and Hongmei Tang—six of whom have since joined or will join Department of Energy national laboratories. These NLUF students conducted a majority of their thesis research utilizing experiments conducted at the Omega Laser Facility, and five are highlighted here. Their contributions to HED science include applying advanced radiography measurements for thermal conductivity in warm dense matter, developing novel techniques to measure transport properties of planetary building materials, studying ICF implosions via nuclear and x-ray diagnostics, optimizing direct laser acceleration of relativistic electrons, and investigating intense proton-beam heating and transport in high-intensity, short-pulse experiments. LLE extends its best wishes to these students as they begin the next phase of their careers.

Dr. Patrick Adrian

Department of Nuclear Science & Engineering, Massachusetts Institute of Technology
Advisor: **J. A. Frenje**

Patrick joined the Omega Laser Facility user community in 2017 when he began his graduate work at the MIT Plasma Science and Fusion Center. Since then, Patrick has been an avid user of the facility, leading four NLUF shot days and supporting over 40 other shot days. His work on OMEGA was integral to his PhD thesis, "Studying Particle and Energy Transport Using Nuclear and X-Ray Diagnostics for Discovery Science and Inertial Confinement Fusion."

One of the primary questions addressed in Patrick's thesis was how charged particles deposit their energy in a plasma. In the experiments he conducted on OMEGA, which involved implosions of gas-filled capsules to pressures exceeding one billion atmospheres, Patrick measured how charged particles lose energy as they scatter off other particles in the extreme conditions created by the laser. This work validated the particle and energy transport models relevant to alpha-particle deposition in ignition experiments and provided invaluable experimental benchmarks for charged-particle transport modeling used in simulation codes throughout the community. Patrick presented this work as an invited speaker at the American Physical Society Division of Plasma Physics Meeting in 2020.

Central to Patrick's thesis work was the development of diagnostics that enabled these unique measurements, including an x-ray imaging spectrometer used to measure the temperature and density profiles generated in his experiments. This effort enabled several collaborations with scientists both at LLE and at others institutions across the country. For this work, Patrick also gave an invited talk at the High-Temperature Plasma Diagnostics Conference in 2022.

After graduating in October 2023, Patrick joined Los Alamos National Laboratory as a Director's Postdoctoral Fellow in the P-4 Thermonuclear Burn Group, where he will continue to utilize OMEGA for studies on charged-particle transport in a plasma.

"LLE is a fantastic place to work because of the world-class Omega Laser Facility and the community that uses it. **The collaborations that I formed at LLE were instrumental in my development as a scientist.**"

> “My time as an Omega user has fundamentally shaped my career and given me a great appreciation for collaborative science. **The staff and scientists at LLE make each trip a great experience, and I look forward to working with them for years to come.**”

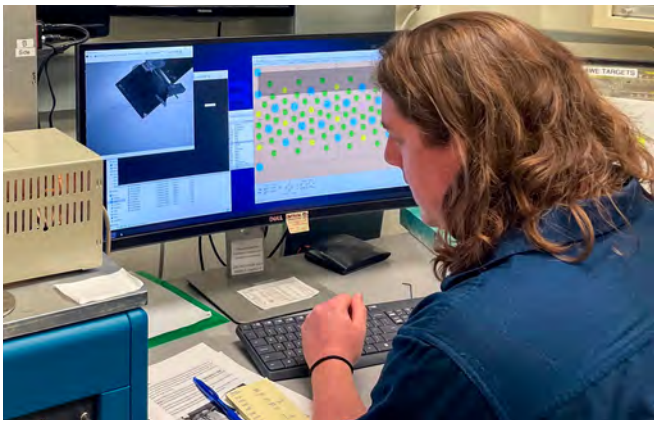
Dr. Cameron Allen

Department of Physics, University of Nevada, Reno
Advisor: **T. G. White**

Thermal conductivity is a fundamental quantity that measures how efficiently heat moves through a material. It is crucial for accurately modeling the formation and evolution of planets and stars, and plays a pivotal role in inertial confinement fusion and materials processing. The extreme conditions in these environments, however, make theoretical and computational predictions challenging, which necessitates robust experimental benchmarking. Cameron’s PhD work has focused on how interfaces can impede heat transport, particularly in scenarios where neighboring materials exhibit significant differences in electronic properties. While the concept of interfacial thermal resistance (ITR) is well established in solids, Cameron's research delves into whether this resistance can persist in high-energy-density (HED) matter despite the abundance of conducting electrons.

In a groundbreaking study conducted at the Omega Laser Facility, Cameron confirmed the presence of ITR under extreme conditions by observing a heated tungsten wire encased in a plastic layer. He employed diffraction-enhanced imaging to track density discontinuities at the interface between the two materials and reconstruct the temperature profiles. To achieve these results, Cameron developed a new x-ray radiography platform on OMEGA capable of micron-scale resolution—a fivefold improvement over previous work. This breakthrough was made possible by using a focused ion beam at the University of Nevada, Reno to fabricate micron-wide slits, which were combined with precise target-alignment techniques. The findings revealed compelling evidence of a significant heat barrier, illuminating the crucial role of ITR for interpreting HED experiments and driving applications such as inertial confinement fusion.

After graduating, Cameron joined the P-2 Applied and Fundamental Physics Group at Los Alamos National Laboratory and continues to perform HED experiments on OMEGA.



Dr. Krish Bhutwala

Department of Mechanical & Aerospace Engineering, University of California, San Diego
Advisor: **F. N. Beg**

The discovery of laser-driven proton beams in the early 2000s has resulted in novel and remarkable applications over the last two decades. These beams, which boast ultrashort bunch durations of ~100 ps with incredibly high intensities exceeding 100 A/cm^2, are uniquely effective tools in high-energy-density physics. Positioned at the intersection of basic sciences and thermonuclear fusion, Krish Bhutwala's PhD research comprehensively explored the heating and transport properties of these novel particle sources within both warm and hot dense plasmas.

Krish's research utilized the OMEGA EP Laser System to investigate whether these proton beams can maintain their directionality through low-density foam media, corroborating a potential fusion scheme called proton fast ignition. With OMEGA EP's proton-focusing platform, the short-pulse lasers not only generated but also focused proton beams through cone-structured targetry. After focusing, the protons entered a foam sample where spherical crystal imaging diagnostics were used to detect cross sections of the beam at various foam depths. The resulting images, with accompanying transport simulations, qualitatively showed that the protons not only retain their beam-like qualities, but also heat the foam to warm and hot-dense matter commonly found in extreme astrophysical environments. This delves into fundamental science research, a field where the modeling of warm dense matter is particularly challenging and demands advanced first-principles techniques. In addition, Krish has made significant contributions to the warm-dense-matter studies led by his team at UC San Diego, which leverage OMEGA EP's proton-heating platform to advance their research efforts.

Krish, currently a postdoctoral researcher at the DOE's Princeton Plasma Physics Laboratory, is excited to continue his work at LLE utilizing OMEGA EP's proton-focusing and proton-heating platforms. His future research aims include optimizing proton-focusing structures, which will in turn advance basic sciences with more-efficient proton heating of warm dense matter. Integrated shots planned for 2024, in which the 60-beam OMEGA Laser System drives capsule compression while OMEGA EP generates and focuses protons onto the compressed capsule, will also motivate further efforts on proton transport and heating.

> "In a single day, scientists from around the world come together to peek at nature's inner clockwork for a few select moments—an experience like no other. **I am grateful for the opportunity to conduct research at a world-class institution like LLE.**"

> “Designing and working with a new diagnostic for **one of the top-tier laser facilities has been an enriching experience for me.** Seeing how the unique data opens a window to study HED physics is a great motivation to push the boundaries of science.”

Dr. Enac Gallardo-Diaz

Department of Physics, University of Nevada, Reno
Advisor: **R. C. Mancini**

How do you interrogate matter at extreme temperatures and densities? How do you measure its properties without perturbing them? How do you learn about energy balance and transport? At the stagnation of an implosion experiment driven by the 60-beam OMEGA Laser System, a dense plasma is produced where compression exceeds solid density, its temperature reaches tens of millions of degrees, and its atoms are highly ionized. These HED plasmas are relevant to both inertial fusion energy and astrophysical systems. The challenge to understanding them, however, is in being able to develop nonintrusive diagnostics that can characterize them in both time and space. For example, it turns out that the light emitted by suitable tracer elements carries information about plasma temperature, density, and ionization, but one needs to develop the means to record and interpret this information. The latter, ionization, relies on physics models that cut across atomic physics processes, statistical mechanics, and radiation transport.

Enac’s work has focused on establishing novel x-ray spectroscopy methods to record and interpret plasma self-emission to determine temperature and density spatial distributions in the hot dense plasmas created in implosion-core experiments. Specifically, he employed krypton as a spectroscopic tracer element to obtain plasma conditions at electron temperatures exceeding 20 million degrees—a range that had been beyond the reach of previous tracer elements such as argon. To this end, he designed a new instrument, the krypton multimonochromatic x-ray imager (Kr MMI), to test the full potential of the spectroscopy diagnostic technique. The new Kr MMI enabled the observation of Kr K-shell line-emission x-ray spectra with both time and spatial resolution. This was accomplished by recording gated arrays of a large number of plasma images, each one characteristic of a slightly different photon-energy range.

The unique data collected with the Kr MMI instrument and the advanced physics models needed to interpret the data have allowed Enac to extract electron temperature and density spatial distributions and observe their evolution in time and under a temperature regime previously inaccessible. These measurements, which have been used to extract information about implosion asymmetries, core sizes, energy losses, and heat transport, have helped push the frontier of our understanding of implosion-core physics. In addition, Enac’s work has produced a new instrument for the Omega Laser Facility that will benefit and advance the research of other users.

Enac will join the P-4 Group at Los Alamos National Laboratory, where he will continue to utilize OMEGA to study the impact of different tracer elements in implosion core hydrodynamics to improve computational models.

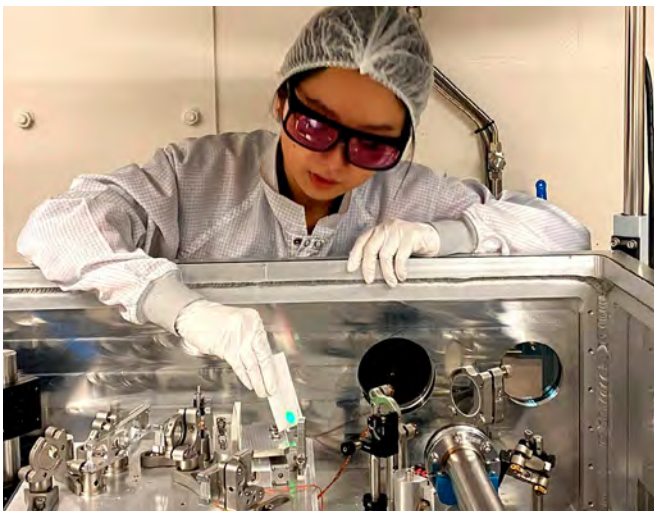
Dr. Hongmei Tang

Department of Electrical & Computer Engineering, Univesity of Michigan
Advisor: **L. Willingale**

An important electron-acceleration mechanism, particularly as laser pulses reach ever higher powers, is direct laser acceleration (DLA). Electrons are able to efficiently and rapidly gain energy directly from transverse laser fields when aided by external channels and plasma fields that work to keep the electrons in phase with the laser. DLA is a complex and highly dynamic process and a rich topic to explore. High-charge, high-energy electron beams are a route to secondary radiation, such as bright and directional x-ray beams, high-energy bremsstrahlung, or positron-generation sources.

Hongmei's PhD dissertation investigated the DLA of electrons in experiments using the OMEGA EP laser through the NLUF Program. Hongmei worked to explore how the various laser and plasma parameters influence DLA. New facility capabilities—namely, the gas-jet target and apodization of the beams to change the diameter of the laser beams—enabled her to make significant new discoveries. She found that the focusing geometry of the laser beam is important to match with laser power and plasma density to optimize DLA. This work was recently accepted for publication in the *New Journal of Physics*. A second key result was the influence of the plasma density on the observed electron beam. An extended rear-density gradient created conditions that both improved the channeling of the laser over longer distances to enhance DLA and inhibited the formation of a sheath field to allow more electrons to escape into the vacuum.

Throughout this project, Hongmei collaborated with researchers from the University of California, San Diego, LLE, Lawrence Livermore National Laboratory, and Instituto Superior Técnico in Portugal. Hongmei is currently a postdoctoral researcher at Lawrence Berkeley National Laboratory, where she is applying her knowledge of electron acceleration to laser wakefield acceleration.



> "I am so grateful to have the opportunity to work with this world-class laser and laser team. Collaborating with the brilliant minds at LLE has been an absolute delight! **Their intelligence and expertise have consistently inspired my passion for this research field.**"

LLE as an Innovator

"What makes LLE innovative?"

One thing that is clear to all who visit LLE is the laboratory's rich history of scientific risk taking, which is founded in the collective drive to tackle challenges and face the unknown with confidence—ultimately, innovation is about people overcoming uncertainty to go where no one has gone before.

Those who tour LLE experience a vibrant, multidisciplinary institution brimming with unique opportunities to approach grand challenge applications. Visitors witness a research institution at its finest—and one that combines the key stages of the scientific supply chain. They encounter a facility that performs fusion and high-energy-density science at the highest level and achieves this by operating the world's largest lasers in an academic institution. These lasers, which exist as a result of over 50 years of LLE excellence in laser science, are driven by a team of engineers who work with researchers to meet the most-demanding requirements in their field. Ultimately, it is this vertical integration that allows LLE to push the boundaries of science each and every day, while looking ahead to the future and providing a foundation for training the next generation.

> *"I have suggested that scientific progress requires a favorable environment."* —E. O. Lawrence, nuclear physicist and winner of the 1939 Nobel Prize in Physics

Innovation starts with the cultivation of an atmosphere in which individuals are encouraged to follow their passions, and key to this process is an institution that adapts to the needs and aspirations of its people. The halls of LLE are filled with individuals who are driven to dig deeper, who ensure that their projects are as successful as they can be, and who guarantee that any setbacks they encounter are the result of a concept flaw, rather than a failure of their attention to detail. It is this approach, bolstered by the freedom to explore and learn, that encourages scientists and engineers to embrace LLE's extraordinary resources to follow their passions. The common tools available to all at LLE—a high-power laser systems, advanced diagnostics, state-of-the-art computational capabilities, optical fabrication technologies, and beyond—help guide the researcher's passions and align their endeavors with the institution's goals. When their endeavors stray from these goals, it is likely time to reevaluate and evolve by recognizing the innovations at hand and adapting accordingly.

By empowering its people, LLE creates the fertile environment needed for innovation, where they can feel encouraged and comfortable to push the envelope and be free to learn from the challenges they encounter. Generations of funding LLE research at the highest level has produced an educational environment where ambitious projects can be properly planned, providing valuable lessons upon failure and rapid advancement when successful. It is this empowerment that maximizes the potential of the people at LLE, fostering their passions and promoting ownership, while encouraging collaboration and providing energy to an engaged workforce excited to innovate at every stage.

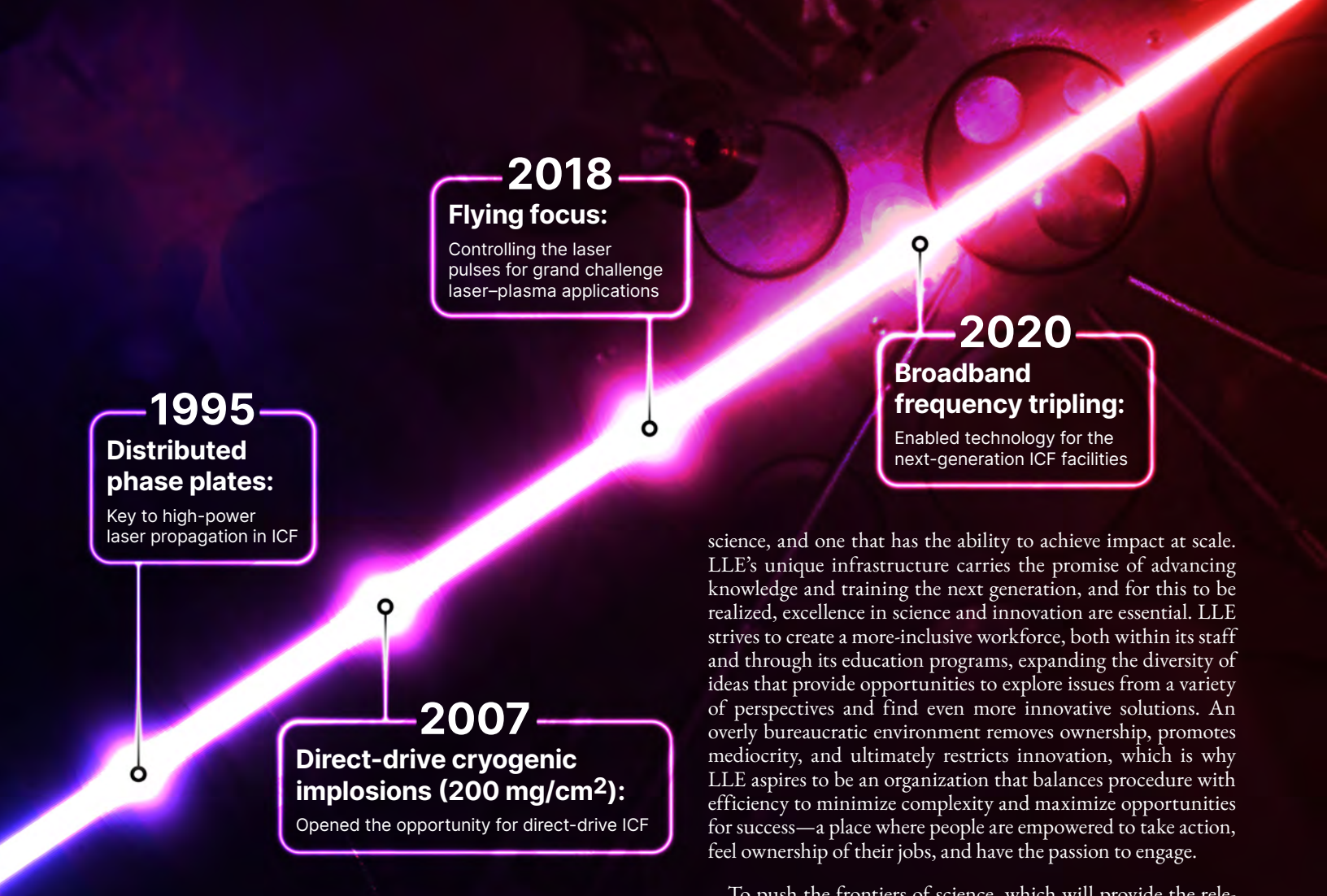
> *"LLE innovations have occurred because creative and clever individuals have been able to work across divisions and groups to understand our scientific challenges, to invent novel solutions, and to persevere in making them real."* —Terrance Kessler, Senior Research Engineer, LLE

At the heart of LLE is a team of experts who by nature collaborate across disciplines, fostering opportunities to make connections that create impactful change. LLE is at its best when its advanced science and engineering teams tackle challenges

1980
High-efficiency frequency tripling:
Enabled inertial confinement fusion (ICF) to overcome early laser–plasma instabilities

1985
Chirped-pulse amplification:
Laid the path to high-power, short-pulse lasers (2018 Nobel Prize in Physics)

1989
Smoothing by spectral dispersion:
Temporal smoothing to limit hydrodynamic instabilities in direct-drive ICF



holistically to find novel solutions—solutions that are not necessarily the first that come to mind, but elegant solutions that arise from considering a problem from each and every angle. LLE's vertically integrated structure enables its teams to maintain ownership and understand problems from all directions and at every stage of the supply chain: from the initial science, to engineering, fabrication, and metrology, to the final application. The solutions that result are often unconventional and pioneering, leading to final applications that meet the grand challenges of the task.

> *"LLE has the right ratio of dreamers to thinkers to builders."* —Robert Boni, Senior Research Engineer, LLE

The Dreamer—*"Some people see things as they are and ask, 'Why?'" Dreamers imagine things "...that never were and ask, 'Why not?'"* —George Bernard Shaw, playwright

The Thinker—*The grander the challenge, the greater the satisfaction in meeting it.*

The Builder—*"The will to do it."* —Marshall Space Flight Center Director Wernher Von Braun, in answer to President Lyndon B. Johnson's question of what it would take to build a rocket to reach the moon.

It is the combination of all aspects of LLE's vertically integrated structure that has created an educational research institution situated at the intersection between technology and science, and one that has the ability to achieve impact at scale. LLE's unique infrastructure carries the promise of advancing knowledge and training the next generation, and for this to be realized, excellence in science and innovation are essential. LLE strives to create a more-inclusive workforce, both within its staff and through its education programs, expanding the diversity of ideas that provide opportunities to explore issues from a variety of perspectives and find even more innovative solutions. An overly bureaucratic environment removes ownership, promotes mediocrity, and ultimately restricts innovation, which is why LLE aspires to be an organization that balances procedure with efficiency to minimize complexity and maximize opportunities for success—a place where people are empowered to take action, feel ownership of their jobs, and have the passion to engage.

To push the frontiers of science, which will provide the relevant problems for future generations to solve, we must first determine where these frontiers are. How? Here at LLE, the answer to this question lies in cultivating a fertile environment for innovation to happen and empowering passionate people who will undoubtedly produce powerful and transformative results.

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Focus Points

- Key to fostering innovation is the cultivation of a favorable environment.
- By empowering LLE employees, we create an engaged workforce of individuals excited to innovate.
- Close collaboration across LLE's disciplines leads to elegant and novel solutions that push the boundaries of science.
- LLE's infrastructure provides a solid foundation for training the next generation.

Celebrating the Mentors

Inspiring the Next Generation of Researchers

Some of LLE's many mentors are pictured here alongside the students they guide and inspire.

Celebrating the Mentors

LLE's rich history of education is supported in large part by the mentoring efforts of our dedicated staff. Through our Summer High School Research Programs, Undergraduate Education Program, and Graduate Research Program, students have amazing opportunities to engage in the field with devoted hands-on mentors who dedicate their time to teaching the next generation of scientists and researchers. Our programs are designed to offer students practical experience and a chance to work on cutting-edge research projects, allowing them to gain valuable insights into the scientific process and discover their own passions within the field. Featured here are just a small sampling of the many amazing mentors at LLE. We have had over 100 mentors in the past year—a number that continues to grow each year. These mentors play a crucial role in fostering an environment of learning and innovation, ensuring that students receive personalized guidance and support, which helps them develop the skills needed to excel in their scientific pursuits. By working closely with these experienced professionals, students are encouraged to ask questions, explore new ideas, and contribute to ongoing research efforts, setting them on a path to becoming the future leaders of science and technology. Our mentors are not only educators but also role models who inspire and motivate students to reach their full potential.

Seung-Whan Bahk

Seung-Whan, who has been at LLE since 2005, has been passionate about science since elementary school. As a student, he tried to build a ruby laser with his mother's jewelry, which ignited his passion for optics. As someone who has always figured things out on his own, Seung-Whan never had the experience of being mentored as an undergraduate, and this has driven him to become a mentor to others. One of his greatest challenges as a mentor has been explaining complex concepts in a way that makes sense, but the process of simplifying a complex idea has helped him better understand his own research. Seung-Whan's high school students share that "working with Dr. Bahk has been both immensely enjoyable and informative, as he always goes above and beyond to help guide us through our projects and answer our questions." Seung-Whan's advice to young scientists is: "Take advantage of the opportunities in front of you. Be diligent and proactive in finding a mentor who helps you grow."

Bob Boni

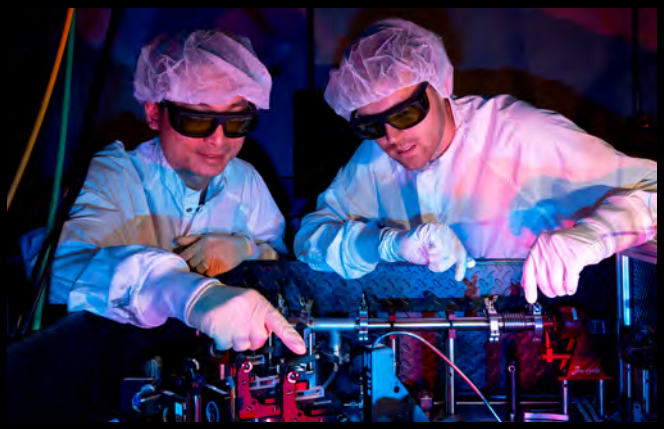
Bob is a mentor to many of us—scientists, engineers, operators, and of course, students. As one of LLE's original employees from when the laboratory first opened in 1973, Bob has dedicated his career to the University of Rochester and the last decade to ensuring that LLE continues to excel well past his retirement. One way that he ensures LLE's continued excellence in innovation is through mentoring students at all levels—high school, undergraduate, and graduate. Lillian Zullow (left) and Heidi Donovan, both undergraduates at the University of Rochester, describe Bob as "an incredibly caring and encouraging mentor whose dedication to intellectual growth inspires his students to strive for excellence." This year, Bob is mentoring students on projects including an optical technique that allows a mirror's focal point to move along the optical axis at nearly the speed of light and creating a MATLAB User GUI for a spatially resolved reflectometer used in shock physics experiments.

Mark Bonino

Mark was a high school mentor in 2004 but stepped away from this role for a period of time to develop his own skills in order to better teach others. Mark excels at asking the right questions and identifying key details in target fabrication and was excited to take on two undergraduate students, Ruth Reynolds and Daniel Menis, this year. Mark considers his work important to applications broader than these four walls—he teaches laboratory techniques that students can use wherever their future takes them. Mark encourages questions and loves seeing his mentees think about the big picture. He enjoys being a mentor because it energizes him to see students' fresh enthusiasm and hope for the future. "Mark has been incredibly supportive in our microfluidics research, creating an open environment for us to ask about any issues we come across or to pick his brain on target fabrication and working at LLE as a whole," says Daniel.

Tim Collins

Tim is an accomplished scientist and a committed mentor who sees potential in every student who enters the lab. He views his role as a steadying force for uncertain and apprehensive mentees, helping them feel welcome and part of the family of scientists at LLE. His message to students is simple: "There is a place for you here." Over the years, he has witnessed students making significant contributions to the lab, and he is filled with pride when their work broadly contributes to difficult projects. Undergraduate student Lillian Smith worked with Tim on a novel scientific visualization project that made research accessible in a new way. "Working on the scientific visualization project was a blast—I was able to combine science with my passion for art. Dr. Collins was a great mentor, providing encouragement, and showing excitement for my work, and always sharing opportunities, readings, and interesting finds to further my education," says Lillian.

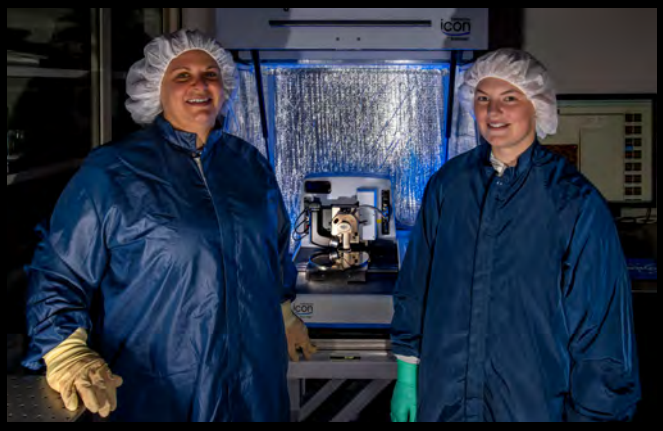


Chengyong Feng

Chengyong joined LLE as a Research Engineer eight years ago, bringing his technical expertise to the team, and transitioned to the role of scientist in 2022. He believes that research is not an independent endeavor, and that teamwork is needed to be successful. It is this philosophy that drives him to be a mentor and take on graduate students over the years. He helps students gain confidence and hands-on experience with high-power lasers while encouraging them to explore their own research ideas. Chengyong finds it rewarding when students have breakthrough ideas and shares that there are many inspiring moments like this as a mentor. Chengyong routinely seeks input on his own research from more-senior scientists in the lab, and their feedback helps him become a better mentor to others. "Chengyong's expertise in ultrafast-laser development has been a crucial resource for my academic growth," says graduate student Rob Holcomb.

Brittany Hoffman

Brittany has always embraced mentorship as part of her role, and she loves that the culture at LLE lends itself to teaching and guiding others. She enjoys being a mentor because students bring fresh ideas to research and an energy that makes the lab a better place. Brittany has always been an inquisitive person, and she tries to foster a sense of curiosity in her students. She takes a personalized approach to mentoring, evaluating what each student needs to be successful. When they encounter challenges, she encourages them to keep going. Getting students excited about science is an integral part of her mentoring, and Brittany has been impressed by their ability to stay on track and their analytical skills with data. Her high school mentee expressed gratitude for her experience at LLE, sharing, "Working with Brittany has been a very unique and amazing experience and I have learned so much from her, especially how to troubleshoot and compare data."



Suxing Hu

Suxing encourages his mentees to do two things: "Enjoy what you do, and give every project your best effort—not just at the lab but in life." Having had research experiences in different countries, Suxing has a broad perspective on being a mentee and a mentor. This has helped him appreciate and respect that each person chooses their own path to success and happiness. When one of his graduate students chose to go into the private sector, he struggled with that choice, feeling it underutilized their skills. In retrospect, Suxing has learned that the expertise students develop in the lab setting can be used in many ways, including important industrial applications, to make the world a better place. Undergraduate student Annie Maloney praises Suxing's mentorship and describes Suxing as "a very supportive and insightful mentor" who emphasizes the importance of pursuing work that one genuinely enjoys, fostering both personal and academic growth in his students.

Focus on Education and Outreach: Celebrating the Mentors

Ken Marshall

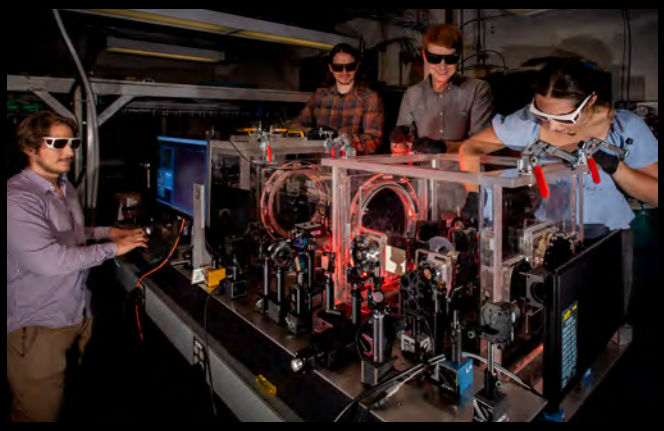
Ken's mentorship at LLE began 40 years ago, before a high school or undergraduate program existed. Since then, he has mentored many students from high school through graduate levels, and was one of the first mentors for the BEST Program. He teaches his students to communicate across disciplines, give impactful presentations, develop leadership skills, and recover from setbacks. Ken emphasizes self-belief and loves his students' enthusiasm for research, especially when experiments succeed or lead to unexpected discoveries. His students often bring fresh perspectives to problems that experienced individuals may overlook. "I have learned so much working with Ken Marshall this summer—not just new technical or chemistry-related things, but also what it's truly like to be a scientist and tackle big, unanswered questions with dedication and hard work," says student Lillian Smith. Ken's advice to students is: "Learn as much as you can and don't restrict your horizons."

Marcela Mireles

Marcela draws her strength from being with and helping others. She has mentored at every level, investing in high school, undergraduate, and graduate students while also participating in the BEST program. Most recently, Marcela and undergraduate Angel Aquino worked on a complex project for broadband laser systems. "Working with Marcela has been an invaluable experience, as her guidance and expertise have deepened my research skills, particularly through the advanced techniques and problem-solving strategies I've learned," says Angel. Marcela knows the value of sharing her knowledge, and when a student finds a mistake in her work or is able to teach her something new, she knows she has succeeded as a mentor. Marcela is grateful for the undergraduate program at LLE. At other institutions, paperwork and bureaucracy can be barriers to mentorship, but "here, if you are committed to being a mentor, all you have to do is raise your hand!" says Marcela.

John Palastro

John has been mentoring since graduate school. Currently, he mentors graduate students Amanda Elliott and Lavonne Mack in the PULSE division. He understands that physics can seem intimidating and views his mentoring role as helping students build confidence, showing them they have both the creativity and intelligence to succeed. John encourages students to generate lots of ideas, reminding them that the best ideas surface when there are many to choose from. As students refine their ideas and begin mentoring others, John knows he has succeeded. He reminds students that it is better to thoughtfully complete projects and take pride in their work than rush things out the door. Lavonne shares that "John has been instrumental in deepening my understanding of the laser–plasma physics we work on, offering guidance and support, and being deeply committed to my success in the lab and throughout my graduate journey."

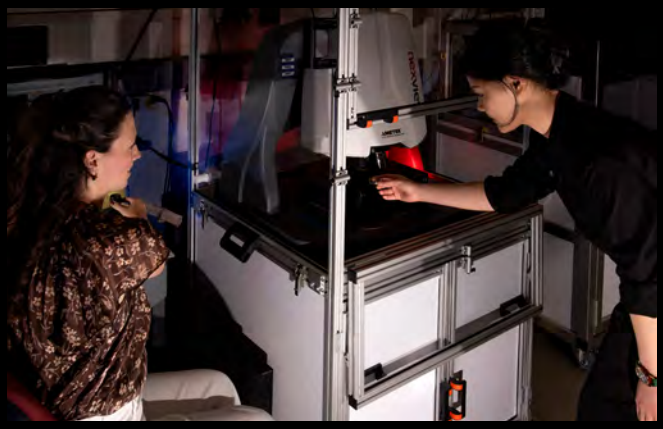


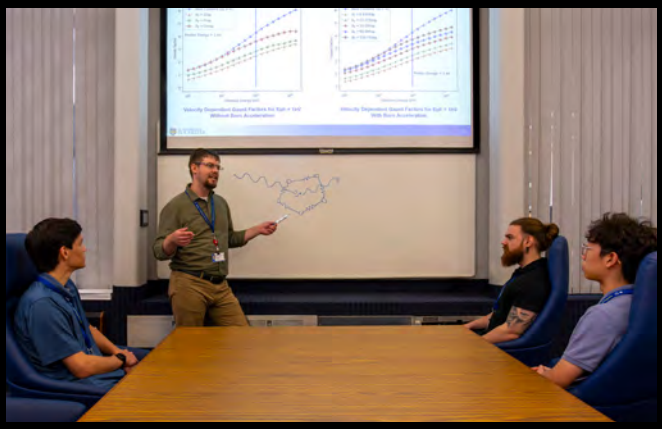
Jeremy Pigeon

When asked the question, "Why are you a mentor?" Jeremy replies, "Why does a fish swim?" For him, mentoring is just a part of what you do as a scientist and he wouldn't know any other way to exist in the world if not teaching and collaborating with others. Jeremy credits his mentors and his training as a PhD student with shaping his collaborative approach to science. Jeremy loves the improvisational nature of lab instruction and relishes being asked difficult questions on the fly and developing new ways to explain concepts. He finds it particularly rewarding when a student suddenly grasps a new concept or idea for the first time. Jeremy sees his students as peers who may have less experience but make equally critical contributions to research. Jeremy's undergraduate student Joanna Rosenbluth appreciates how "Jeremy gives me the freedom to be curious and make mistakes while being there for me whenever I need guidance or support."

Danae Polsin

Danae has spent over a decade at LLE, starting as a graduate student in 2013 and later as a scientist in 2018. Mentorship has been integral to Danae's scientific journey, tracing back to her undergraduate days at SUNY Geneseo and the impact of her mentor, Stephen Padalino, whose enthusiasm and engaging nature inspired her to pursue her PhD in physics at LLE. As a grad student, her advisors Tom Boehly and Rip Collins inspired her to mentor others. Danae has enjoyed working with high school, undergraduate, and graduate students, finding energy in solving problems together and witnessing their successes. Her most recent mentee, Zechen (Cheryl) Liu, praises Danae's patience and guidance, saying, "Dr. Polsin is patient and meticulous, guiding me effectively in understanding and completing the project. My experience with Dr. Polsin has been excellent." Danae values the lab's focus on educating future scientists and the sense of community in LLE's education programs.



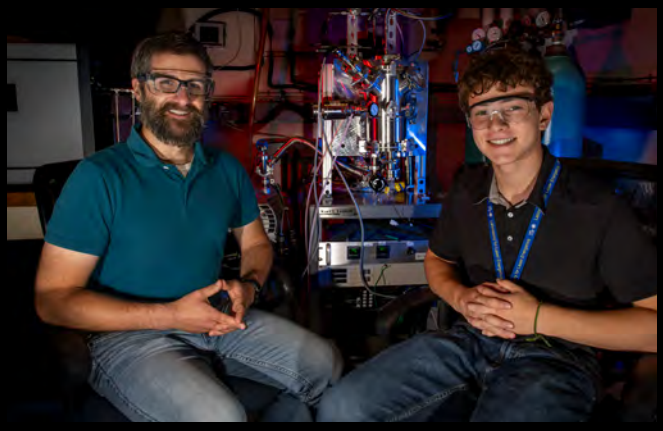


Nathaniel Shaffer

Nathaniel has been at LLE for three and a half years and a mentor during much of that time. He challenges students with tasks that may seem daunting and finds joy in their surprising achievements. This approach makes the mentor–mentee relationship mutually beneficial, allowing them to tackle bigger, more-complex problems than any individual could alone. One of Nathaniel's mentees, Ioannis Pagiazitis, reiterates the value of the mentor–mentee relationship: "Dr. Shaffer has provided me with exceptional support and wisdom, helping me navigate challenges and develop skills that will be invaluable in my future work." Nathaniel routinely communicates with people outside of his research group to solve problems and work together. "At some institutions, you do your work, and you hope someone cares. Here, your work is valued, and you know it will be used," says Nathaniel.

Matt Sharpe

Matt wears many hats at LLE. He is a scientist, radiation safety officer, and a dedicated mentor. In each of these roles, Matt has a passion for collaboration and bridging gaps that are barriers to progress. Whether it is sharing information among educational institutions, national labs, and industry, or welcoming new mentees to the lab to work with seasoned scientists, Matt is a conduit who brings people together. Matt was inspired to pursue fusion energy in high school and never looked back. Mentoring high school, undergraduate, and graduate students, he brings this passion full circle. Being a mentor is rewarding for Matt, and he recognizes the need to foster the next generation of scientists and encourage workforce development for the future. Matt's hope is that his students develop a love of learning and approach complex problems with humility and collaboration.



Jessica Shaw

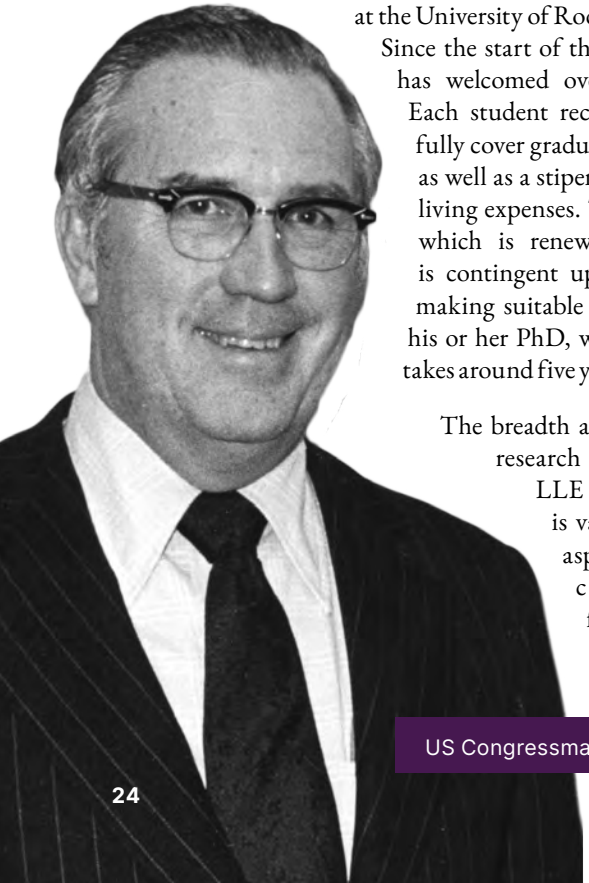
Jessica has been at LLE for eight years, and her background prepared her to step into a mentorship role from the start. Her research has always emphasized collaboration, and she naturally excels as a leader. Jess's mentees quickly grasp that science is as much about teamwork as it is about data collection. Jess knows that experiments can be challenging, but the shared experience of working through difficulties creates a unique bond, making the successes all the more rewarding. Over the years, Jess has mentored numerous undergraduate and graduate students, who, in turn, continue to inspire her. Graduate student Manfred Virgil Ambat credits Jess with nurturing his lab skills, scientific communication, and confidence as a researcher. Kyle McMillen remarks, "Working with Jess has been great; she taught me so much about the research process, from experimental design to communicating results," and Isabelle LaBelle praises Jess for her "essential guidance and support in developing hands-on lab skills."

The Horton Fellowship Program

One of the many important scholarship opportunities available each year to LLE graduate students is the Horton Fellowship Program, which was established in 1993 to honor the legacy and contributions of retired Congressman Frank J. Horton. Horton served in the House of Representatives for 30 years, representing parts of Monroe and surrounding counties during his long tenure. He was a member of the Joint Committee on Atomic Energy, vice chairman of the Committee on Government Operations, a member of the Post Office and Civil Service Committee, and chairman of the Commission on Federal Paperwork. As an environmentalist, he was deeply invested in conserving the country's natural resources and improving the quality of life for the communities he served.

Congressman Horton was also a longtime supporter of LLE's mission, proclaiming the Laboratory as "one of the most-exciting and significant energy research centers in the nation" in his weekly column dated March 25, 1975. Horton played a crucial role in mobilizing federal support to upgrade LLE's laser system and expand the facility in 1976 to support its expanding laser-fusion research program. He also supported an Energy Research and Development Administration special report on laser fusion, which accelerated national investments.

A central tenet of LLE's mission is education, and the Horton Fellowship Program has had a profound and enduring impact on the lives and careers of hundreds of students—many of whom have come from all across the United States and countries around the world to take advantage of the world-class facilities and wealth of resources available to them at the University of Rochester and LLE. Since the start of the program, LLE has welcomed over 260 Fellows. Each student receives a grant to fully cover graduate tuition costs, as well as a stipend to use toward living expenses. The scholarship, which is renewable each year, is contingent upon the student making suitable progress toward his or her PhD, which on average takes around five years to complete.



US Congressman Frank Horton

The breadth and depth of the research endeavors of LLE Horton Fellows is vast, spanning all aspects of inertial confinement fusion, hydrodynamic stability, laser–plasma interaction, thermal transport in high-temperature plasmas, nonlinear optical phenomena, and picosecond phenomena in solids. These young scholars, who are helping to shape the trajectory of our global future, are making tremendous contributions to science. Many graduates of the program have gone on to lead long and successful careers at prestigious research institutions, including national laboratories, universities, and at industrial research facilities. Some have even continued on at LLE to inspire and empower a new generation of scholars.

From the archives: US Congressman Frank Horton fired the first shot on ZETA, a laser comprising the first six beams of OMEGA, on October 17, 1978. The shot generated more than 300 million neutrons and climaxed the morning of what University President Robert L. Sproull called "a great day in the life of this University." It was witnessed by approximately 200 guests from government, industry, and academia.

–Courtesy of Rare Books & Special Collections, University of Rochester Libraries

"My Horton Fellowship and PhD research at LLE helped me realize my career goal to advance laser science and technology for important applications in science and elsewhere. I worked closely with scientists, engineers, technicians and other LLE staff, learning what was important and how to get things done. I also brought my own experiences [...] and started contributing to the LLE mission as a student," reflects Distinguished Scientist and Laser and Materials Technology Division Director Jon Zuegel, who was a Fellow in the first year of the program's history.

What do students today say about their experiences at LLE? We invited current Horton Fellows to share a few words, and one common theme stood out above all else: the recognition that they are part of an incredibly unique institution, whose nurturing and collaborative atmosphere fostered amongst fellow students, scientists, and staff is indeed a testament to the legacy of Congressman Horton and other early visionaries of the Laboratory.

Contributing author: R. Shojaie (rosh@lle.rochester.edu)

What is the most-surprising, unique, or rewarding thing you have learned, experienced, or accomplished as a graduate student at LLE?

"The most-beneficial aspect about being a student at LLE is the immediate access you have to experts across many fields—plasma physics, high-energy-density physics, diagnostics and detectors, laser systems, and many others. As a personal example, I recently asked a senior scientist about a problem that I was working on. He invited me over to his office and promptly handed me an original print of an article that he had published on the exact subject over 30 years ago. This is one of countless examples of the ongoing legacy of expertise cultivated at LLE."

—David Bishel, Physics & Astronomy

has been the opportunity to work with phenomenal technicians and scientists to bring our ideas to life, as well as the chance to present my research at conferences in Honolulu and Las Vegas. During my graduate studies, my research has introduced base-initiated chemistry to the two-photon polymerization process, through which we demonstrated our resin's strength and resolution by printing one of the smallest-ever replicas of the Eiffel Tower."

—Madelyn Jeske, Chemistry

"One of the most-rewarding experiences as a graduate student at LLE has been my ability to serve on different DEI committees at UR, LLE, and APS-DPP, and have my work valued by my advisor and by upper management."

—Abigail Armstrong, Physics & Astronomy

"The best way to summarize my exciting time at LLE is that my supervisor and the scientists with whom I work treat me, a student, as their equal, and take the learning process incredibly seriously. They not only encourage students to take up real responsibilities as Theory or Experimental Principal Investigators on projects worth hundreds of thousands of dollars, but also offer classes no other university offers and leave their doors open for you, should you need anything. What students are encouraged to do at LLE is a unique endeavor in the US and the world. You come to realize the importance of collaboration, perseverance, and resolve to extend human knowledge to new heights with your personal input."

—Pericles Farmakis, Mechanical Engineering

"The people at LLE are very cooperative and understanding. They are also very willing to share their knowledge and guide me through the complicated processes of using LLE facilities. Performing experiments on the big laser systems is also very rewarding since they are not at all common in typical university labs. I'm amazed by the intricacy of those lasers."

—Jiacheng Zhao, Optics

"For me, the most-rewarding experience as a graduate student at LLE was sharing my passion for science with high school students at the BEST Program last year. Seeing the students' eyes light up when I showed them the first plasma globe they had ever seen and seeing how deeply focused they were as they solved hands-on laser maze puzzles brought back memories of when I was in their shoes and I first became interested in science. The Horton Fellowship has helped bring full circle my dreams of becoming a scientist, and sharing that passion with these students has been immensely rewarding."

—Manfred Virgil Ambat, Mechanical Engineering

"I've learned a lot by leaning on my peers. My research has been extremely complicated at times, and I have found that it is a fool's errand to try to solve every problem I encounter on my own. I think collaboration is necessary to succeed in an academic environment."

—Zachariah Barfield, Physics & Astronomy

"LLE is one of the most-important hubs in plasma physics studies and maybe the best platform for graduate students pursuing a degree. In the area of plasma physics, LLE has almost every resource available, especially renowned scientists and experts in this field."

—Zhang Yu (Victor), Mechanical Engineering

Undergraduate Education Program

Workforce development is an important part of the LLE strategy and is highlighted every year as a critical need of the National Nuclear Security Administration (NNSA) and many other government agencies. In January 2023, the Laboratory for Laser Energetics launched an Undergraduate Education Program in order to provide a more-robust pipeline of students from the University of Rochester, Rochester Institute of Technology, and other institutions and external programs across the country. With internship sessions offered during the fall, spring, and summer semesters, the program engages undergraduate students in mission-critical science and engineering and provides unique training and career-building opportunities.

LLE has seen many successful undergraduate students come through our facility over the years—most recently, over 50 undergraduates who participated in the summer 2023 session and over 75 during the summer 2024 session. Our LLE undergraduate students major in a wide range of fields, including applied math, applied physics, astronomy, chemical engineering, chemistry, computer science, data science, electrical and computer engineering, engineering sciences, math, mechanical engineering, physics, software engineering, and more. In addition, many of the students in our summer program are invited to continue on during the academic year.

Over 40 mentors have now engaged with our undergraduate program, facilitated by LLE's undergraduate office, which pulls together applicants for potential mentors, who are then able to select and match with the right candidate. The program, which has grown quickly, has received a wealth of positive feedback from both students and LLE staff alike.

Our new Undergraduate Education Program is a great reflection of the existing outstanding scientific community at LLE,

Students participating in an undergraduate poster session.

striving to provide everyone with an optimal experience and ever ready to grow and evolve.

Above all, LLE's educational mission strives to build a workforce for the future. Many of our students stay in touch as they head into the next stages of their careers, including graduate school, future internships at national labs, permanent positions at LLE, or in industry. At the root of each of their collective journeys, however, is the LLE undergraduate program—a unique and incredible experience on the path to a successful future.

National Laboratory Trip

Earlier this spring, the LLE Undergraduate Education Program took 15 students on a trip to visit three national laboratories as part of ongoing NNSA workforce development efforts at LLE.

The trip began at Lawrence Livermore National Laboratory (LLNL) in Livermore, CA with tours of LLNL's bioengineering and advanced manufacturing labs. The day finished with a mesmerizing tour of the National Ignition Facility (NIF) given by David Mathisen, LLNL Computer Scientist and Systems Engineer, who has over 15 years of experience sharing his passion for the NIF and its missions.

Lunchtime at LLNL included an engaging career panel with NIF Workforce Manager Zhi Liao; Staff Scientist and Director of NIF & Photon Science Summer Student Program Patrick Poole; LLNL Experimental Physicist Alison Saunders; and LLNL Theoretical Physicist Ryan Nora and LLNL Plasma Physicist Alison Christopherson (both University of Rochester alumni), which was made possible thanks to Joanna Albala, Manager of the Science Education Program at LLNL.

The students then headed to Los Alamos National Laboratory (LANL) in Los Alamos, NM. Dmitry Yarotski, Group Leader of the P-4 Thermonuclear Plasma Physics Division, provided students with an introduction to LANL's education programs, followed by tours of the target fabrication facility and both the plasma liner and magnetic shock experiments. The students were joined by Matthew Murray of the proton radiography team for an incredible tour of the Los Alamos Neutron Science Center (LANSCE) facility. They were joined on their LANSCE tour by Levi Neukirch, Proton Radiography Experimental Scientist and University of Rochester alumnus. The day concluded at LANL's official public museum, the Bradbury Science Museum.

The third and final stop was to visit Sandia National Laboratories (SNL) in Albuquerque, NM, with tours hosted by Gregory Rochau, SNL Senior Manager of Radiation and Fusion Physics. Students learned about pulsed power and the magnetized liner inertial fusion science happening at SNL and had the opportunity to tour the Z-facility, Microsystems Engineering, and Science and Applications (MESA) Complex. In addition, the students had the chance to meet with several University of Rochester alumni currently working at SNL and finished another great day with a career panel discussion.

The 2024 National Laboratory Trip for our LLE Undergraduate Education Program was a resounding success and an inspiring experience for our students, who continue to build careers in science and technology, encouraging many to apply for future internships and jobs within the NNSA complex.

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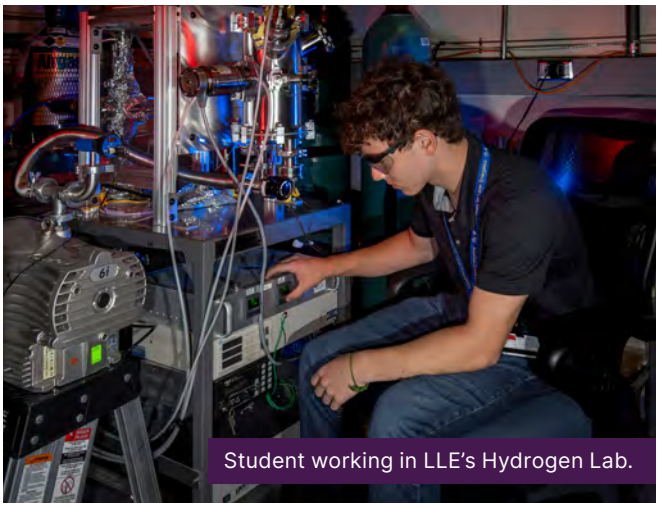
Undergraduate students during the national laboratory trip.

Summer High School Research Program

Each summer, LLE runs a high school research program for highly motivated students from Rochester-area high schools. Up to 17 students work full time for two months between their junior and senior years on individual research projects that are supervised by senior members of the Laboratory. By engaging the students in their advisors' current research activities, the program provides the students with a unique educational experience in a state-of-the-art environment that gives them insight into how research is done.

The students experience many of the trials, tribulations, and rewards of scientific research. Many students have been inspired to progress from their first research experience at LLE to pursue research in a broad range of scientific areas. From the inception of the program in 1989, a total of 448 students have participated in the program of whom over 100 have received doctorates. In addition, LLE gains from the contributions of the many highly talented students who are attracted to the program. Students from the program frequently appear as coauthors, or sometimes first authors, on scientific publications and conference presentations. Some of the students have entered their project reports into the highly competitive Science Talent Search, currently sponsored by the biotechnology company Regeneron. Since the inception of LLE's program, a total of 39 students have been designated as "Scholars," including four finalists.

During the summer of 2024, 17 students representing 15 Rochester-area high schools participated in the program. The students spent most of their time working on their individual



Student working in LLE's Hydrogen Lab.

research projects, which covered a broad range of areas of interest including experimental diagnostic development, hydrodynamic computer modeling, statistical implosion modeling, physical and computational chemistry, laser physics, materials science, and plasma physics.

The students attended weekly seminars on technical topics associated with LLE's research and topics of general scientific interest. Topics in 2024 included laser physics, fusion, spectroscopy, LLE's cryogenic target program, and uncertainty in science. The students also received safety training, learned how to give scientific presentations, were given guidance on writing project reports and scientific papers, and were introduced to LLE's computational resources.

The program culminated on August 28 with a symposium at which the students presented the results of their research to an audience including parents, teachers, and LLE staff. The students' written reports are and bound into a permanent record of their work that can be cited in scientific publications.

The 2024 students were selected from just under 70 applicants. Each applicant submitted an essay describing his or her interests in science and technology, a copy of his or her transcript, and a letter of recommendation from a science or math teacher. Many applicants were chosen for individual interviews. Over 50 local schools have had students in the program, with 22 schools represented in the last four program years.

Student presenting research at the symposium.

> ***"I was looking at summer research opportunities and this one checked all the boxes. It was a paid internship with a chance to do research with distinguished scientists. It was perfect. And the building is massive and super cool."***
>
> *2024 Summer High School Research Program alumna*

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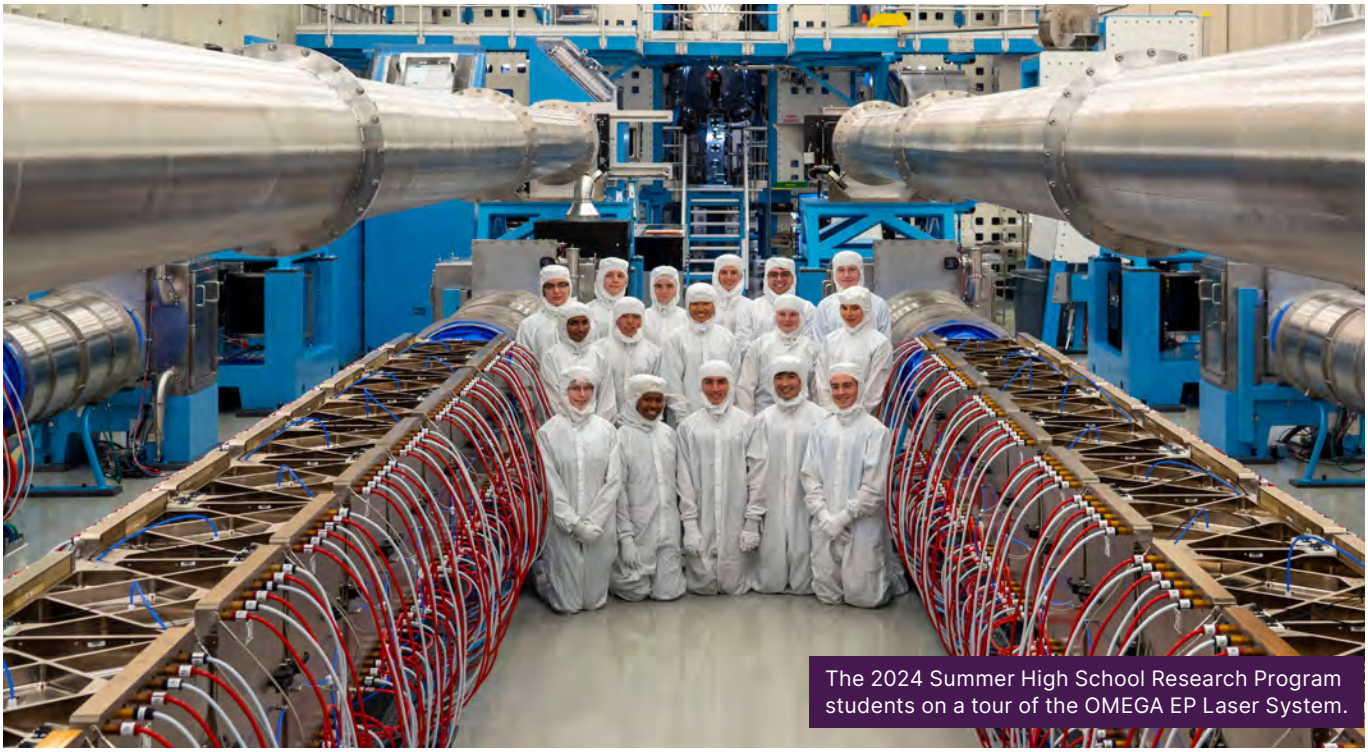


The 2024 Summer High School Research Program students on a tour of the OMEGA EP Laser System.

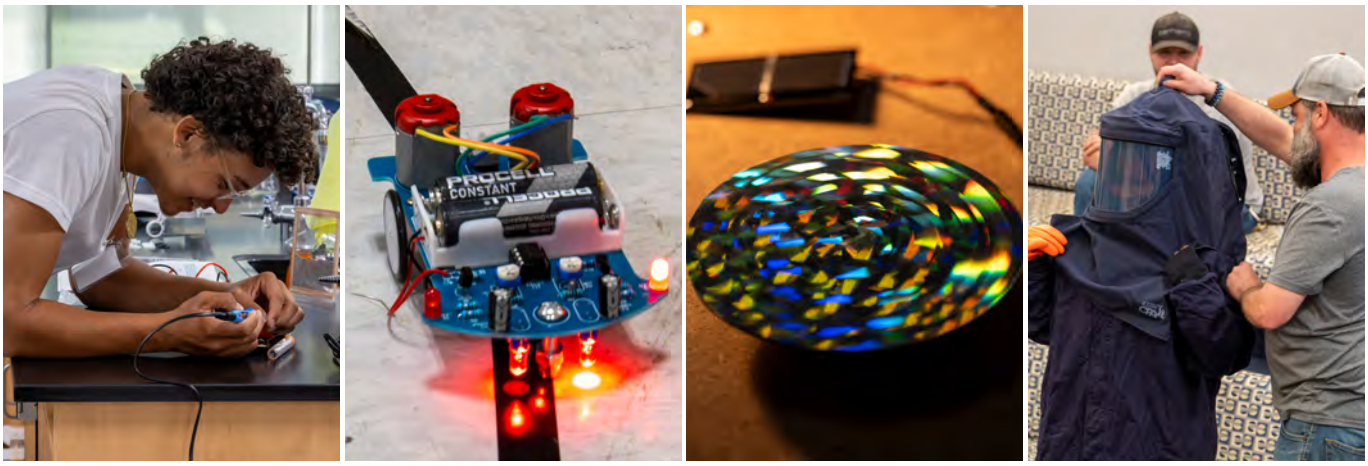
BEST High School Student and Teacher Research Program

The Broad Exposure to Science and Technology (BEST) Research Program at LLE strives to engage underrepresented high school students and their teachers in the many areas of science and technology that support LLE's laser science and applications research. This broad exposure helps guide students in their pursuit of STEM fields and encourages them to explore the next generation of related jobs and careers. Teachers gain knowledge and experience in science and technology that can be brought back to their schools to enhance the curricula presented to their students. The BEST Program is carried out at East High School within the Rochester City School District (RCSD). This fourth year of the program ran over a six-week period during the months of July and August 2024. To assist the participants in their education and career planning, the BEST Program provides a paid learning opportunity.

Research Engineer Marcela Mireles teaching a BEST Program student about material science.

Large scientific institutions, such as the University of Rochester and LLE, employ a wide variety of professionals to carry out a diverse set of research and development activities. Each of these research activities requires support teams consisting of professionals who contribute their expertise cooperatively. Broad exposure to all the members of the LLE community provides the students and teachers with an understanding of the extensive range of research activities that take place as well as the rich diversity of individual professionals that enable and support this research.

A team of LLE volunteers works with the BEST students and teachers in a variety of science, technology, skilled trade, and technical communication fields. Over 30 volunteers spend between one and two days at East High school over a six-week period. Each volunteer, being an expert in their field, is able to bring detailed information, coupled with hands-on opportunities, into the high school laboratory environment. Emphasis is placed on demonstrations and lab work with a limited amount of classroom lectures.



BEST Program students get hands-on learning experiences about electronics technology, material sciences, laboratory saftey, and many more career-related opportunities in the STEM fields.

The teachers and students are exposed to many different areas of science and technology research including laboratory safety, optical microscopy, spectroscopy, magnetic technologies, illustrations and graphic design, technical communications, light polarization and liquid crystal applications, high-energy-density physics, diffraction grating applications, electrical technologies, building operations and maintenance, database applications, code development, theoretical physics, laser holography, Omega facility operations, light–matter interaction, and the technology trades that support all research activities at LLE. The importance of engineering support for research—including chemical, electrical, mechanical, optical, and computer engineering, together with support from facilities groups and graphics experts—are emphasized to highlight the extensive teamwork required to make scientific advancements and to be able to communicate the results to both colleagues and the general public.

One of the core areas of research covered in the BEST Program involves optics and lasers. Various laser interferometers are constructed in the East High classroom to study the properties of light, record holographic images, and fabricate array-generating diffraction gratings. Students observe the multicolor diffracted orders by looking through the diffraction grating at a white-light source. The arrays of multicolor spots can be photographed, showing the characteristic blue-to-red angular shift for each order. This activity provides students with hands-on experience to understand how gratings and grating spectrometers work. LLE mentors then build on this experience to instruct the students and teachers on the basic concepts of chirped-pulse amplification and smoothing by spectral dispersion—two important laser schemes to produce high-intensity short pulses and uniform focal spots on the OMEGA EP and OMEGA lasers, respectively.

Students and teachers work together in assembling several mounted mirrors, lenses, and beam splitters on a floating optical table to construct an interferometer that is capable of recording and reconstructing holographic images. Together, they learn how to probe holograms using laser beams with different states of vergence in order to visually display both real and virtual images.

Several of the LLE mentors expose the students and teachers to various technologies that are critical to the design and operation of the OMEGA and OMEGA EP Laser Systems, including exploring circuit board technologies by taking apart computer systems, practicing microsoldering techniques used to assemble electronic components, and building electric vehicles equipped with optical sensors for reading the track on which they travel.

One of the areas of science that is central to fusion science is electricity and magnetism, especially electromagnetic waves, or light. Both laser fusion and magnetic fusion are studied around the world to eventually harness the vast resource of nuclear energy. LLE mentors share real-world aspects of magnetism including strong magnetic materials, examples of the Hall effect, and the fundamentals of electromagnetic motors.

BEST Program student learning about LLE laser amplifiers.

Focus on Education and Outreach: **BEST Program**

Senior Research Engineer Bob Boni teaching BEST Program students about magnets and motors.

BEST participants visit LLE three to four times during the summer program to tour the Omega Laser Facility, optical manufacturing facilities, and other support laboratories. During one of the visits to LLE, aspects of theoretical physics and computation are introduced in ways that engage both the students and teachers alike. Theoretical physicists provide instructive examples of computer code development and discuss interesting aspects of high-energy-density physics, while sharing their personal career paths from grade school to graduate school to their current professional careers. In addition, the BEST group participates in tours of optics and imaging-related departments at Monroe Community College, Rochester Institute of Technology, and the University of Rochester.

Throughout the school year, the students and teachers in the BEST Program serve as ambassadors for outreach to other students enrolled at RCSD high schools. On the last day of the six-week schedule, LLE mentors join the students and teachers to celebrate the successful completion of the program and to share their broad exposure to science and technology with friends and family members. The students work together to present a series of slides that describe their progress in the program and to highlight their areas of interest. This presentation also serves to increase awareness of LLE and its novel student program. In planning for the 2025 BEST Program, as well as programs in the future, students and teachers from additional RCSD high schools are being invited to participate in this unique learning experience.

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LLE Director Chris Deeney and BEST students on their visit to the Laboratory.

Optical Manufacturing Group Leader Amy Rigatti (left) with a BEST Program student on a tour of the Optical Manufacturing Facility at LLE.

Explore • Discover • Imagine • Create

At LLE, educational opportunities abound for high school, undergraduate, and graduate students across a wide variety of disciplines including laser technology, high-energy-density physics, plasma physics, optics, engineering, and more.

We look forward to having you joining us!

High School Students

Calling all Rochester-area high school students! Are you interested in doing physics research next summer or learning more about the many science, technology, engineering, and math careers that support the work done at LLE? Get a head start by learning more about our two programs—the Summer High School Research Program and BEST High School and Teacher Research Program—and we'll see you next summer!

Undergraduate Students

Are you a math, physics, chemistry, or engineering major? Check out LLE's Undergraduate Education Program, which offers internships during the fall, spring, and summer semesters. Students will be matched with a dedicated mentor and have the opportunity to engage in mission-critical science and engineering projects while receiving unique, hands-on training and valuable career-building opportunities.

Graduate Students

The University of Rochester provides a wide range of doctoral programs with an emphasis on high-energy-density physics, inertial confinement fusion, and laser science and technologies. These programs provide students with research opportunities in collaboration with our cutting-edge facilities. If you are a prospective graduate student interested in pursuing research at LLE, we highly encourage you to reach out to us.

Visit our website to learn more and apply today!
www.lle.rochester.edu/education

National Laser Users' Facility and Laboratory Basic Science User Programs

The National Nuclear Security Administration (NNSA) supports two basic science user programs at LLE's Omega Laser Facility: the National Laser Users' Facility (NLUF) for US academic and industry scientists and students, and the Laboratory Basic Science (LBS) for researchers from the Department of Energy (DOE) national laboratories and LLE, including the University of Rochester. International institutions can collaborate in these programs.

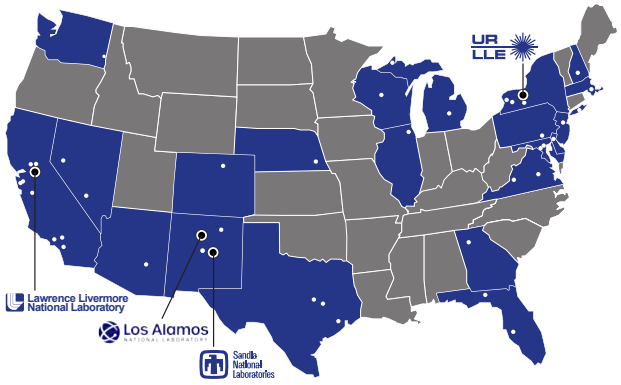
The NNSA's Office of Experimental Sciences funds LLE operations, specifically NLUF and LBS, enabling users to conduct experiments without direct facility charges. Approximately 18% of experimental time at Omega is allocated to NLUF and 10% to LBS. Projects are selected through an open-solicitation, peer-reviewed process, with NLUF on a biennial cycle and LBS annually. Research supported by NLUF and LBS spans fundamental high-energy-density (HED) plasma physics, including laboratory astrophysics, materials under extreme conditions, magnetized plasmas, nonlinear optics, laser–plasma interaction, high-field science, warm dense matter, atomic physics, nuclear physics, fusion science, and instrumentation development.

National Laser Users' Facility

The NLUF Program, established in 1979, is the world's longest-running high-power laser user program. Its primary goal is to provide access to the Omega Laser Facility for a wide range of academic and industrial researchers. The program supports basic research in laser–matter interactions, inertial confinement fusion (ICF), and HED science. Additionally, it aims to train scientists to meet future national needs in these fields. The NLUF Program welcomes participation from US universities, higher-education institutions, and private sector organizations.

Over its 45-year history, NLUF has been instrumental in advancing HED science and fostering a strong research community. The program has made 273 unique awards involving 90 institutions and over 300 graduate students and postdoctoral researchers. Since 1995, NLUF users have conducted 6000 target experiments. Research conducted under NLUF has led to thousands of peer-reviewed journal articles and numerous prestigious awards, including three APS John Dawson Awards for Excellence in Plasma Physics Research. The program has been a crucial pipeline for developing experienced scientists, with 60 PhDs produced in the last decade—many of whom have joined DOE national laboratories and become leaders in the field.

Locations of NLUF Participating Institutions in the US



Until FY21, NLUF was a DOE/NNSA grant program managed by NNSA with support from LLE. NNSA funded the research and provided the necessary resources for experiments at the Omega Laser Facility. Typically, NNSA awarded 10 to 13 NLUF grants during each two-year cycle, with associated Omega beam time and target support provided by General Atomics.

In FY22, the NLUF Program evolved into the Omega Facility Access Program, maintaining target support from General Atomics and NNSA funding. This transition streamlined the process and expanded user participation. LLE now oversees the biennial NLUF solicitation and review process. An independent proposal review panel evaluates proposals based on scientific merit and impact, while LLE assesses feasibility and executability. In the current FY24–25 cycle, the program awarded beam time to 23 projects, with more than half led by early-career scientists and graduate students, involving over 80 students from 20 universities. LLE plans to call for proposals later this year for experiments to be scheduled for FY26 and FY27.

Laboratory Basic Science

The LBS Program, established in FY08, provides dedicated access to the Omega Laser Facility for HED science research. It is led by researchers from NNSA's ICF Program laboratories (Lawrence Livermore, Los Alamos, Sandia, and LLE), and DOE Office of Science laboratories, including Lawrence Berkeley, Princeton Plasma Physics Lab (PPPL), SLAC, and others since FY18.

LBS projects are selected through an annual proposal and review process. Proposals undergo rigorous merit and impact review by an independent panel, with feasibility evaluated by LLE's support team. In FY24, 15 scientific teams from LLNL, LLE, SLAC, and PPPL are conducting LBS experiments, and 18 projects have been selected for FY25. A call for FY26 proposals will be issued later this year.

Since its inception, the LBS Program has made 286 awards. Over 50% of the projects are led by postdoctoral researchers and early-career scientists, many of whom collaborate with the academic community, including graduate students and postdocs. The program continues to foster cutting-edge research and collaboration in the HED science field.

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Omega Laser Facility Users Group and the 15th OLUG Workshop

Poster session at the 15th OLUG Workshop at LLE.

The Omega Laser Facility Users Group (OLUG) was established in 2008 to promote the interests of the scientific users of the Omega Laser Facility and to facilitate the integration of young researchers and new users into the OLUG community. It is a self-governed user group led by its Executive Committee, which currently consists of 11 elected members including the Chair and Vice Chair, both from US universities, and an ex officio LLE representative (non-voting member). OLUG represents over 800 Omega users from more than 70 institutions around the world, and its largest component comes from the academic community. OLUG advocates for improvements to

- the capabilities and operation of the facility to advance research opportunities for a broad cross section of users,
- the operation of the facility to serve the needs of its users,
- the use of the facility in training students, and
- the administrative and regulatory context within which the facility is used.

To fulfill its goals, OLUG conducts an annual workshop held at LLE at the end of April to (1) facilitate communication and exchange among users and the Laboratory through the Findings and Recommendations (F&Rs) form that users generate and present to the facility management; (2) to present ongoing and proposed research; and (3) to provide an opportunity for students, postdoctoral researchers, and early-career scientists to present their work in an interactive yet informal setting to foster collaboration and networking. OLUG also meets annually at the American Physical Society Division of Plasma Physics Meeting to reassess F&Rs and to discuss the progress toward their implementation with LLE facility and management. This iterative process between Omega users and the LLE facility and management has proven to be very successful.

The 15th OLUG Workshop was held on April 16–18, 2024 at the Bloch Alumni Advancement Center and LLE. The workshop attracted over 170 participants, including 64 students and 44 postdoc and early-career researchers, from 39 institutions. A broad range of user-focused topics was covered over the course of three days: high-energy-density (HED) science talks by Omega users, including four by PhD students; a joint poster session; three F&Rs; target discussions; an evening tutorial on facility requirements and best practices for users when designing and preparing their experiments; a young researchers forum; workforce developments; a community diversity, equity, inclusion, and accessibility discussion; career and training opportunities in HED science; LLE Director's remarks; perspectives from federal funding agencies and programs; Omega facility and user program updates; a talk on the NSF OPAL design project; and a tour of the facility.

The OLUG community submitted 28 F&Rs to facility management and of the 67 total poster presentations during this workshop, 56 were given by students and postdocs. Ten Best Posters were awarded to undergraduate students Noah Harley and Chunsun Lei (Houghton University); Kevin Cerda, Dylan Christopherson, and Shoshanna Hertz (SUNY Geneseo); and Ann Truong (UCSD); graduate students Justin Kunimune (MIT), Kassie Moczulski and Tristan Bachmann (University of Rochester), and Matthew Cufari (MIT); and postdoctoral researchers Heath LeFevre (University of Michigan), Michael Wadas (University of Michigan, now at CalTech), and Victor Tranchant (University of Rochester).

The OLUG Workshop is made possible in part by the generous support from the National Nuclear Security Administration for travel expenses of students and postdocs, and by sponsorship from Luxel Corporation, Prism Computational Sciences, Inc., and Sydor Technologies.

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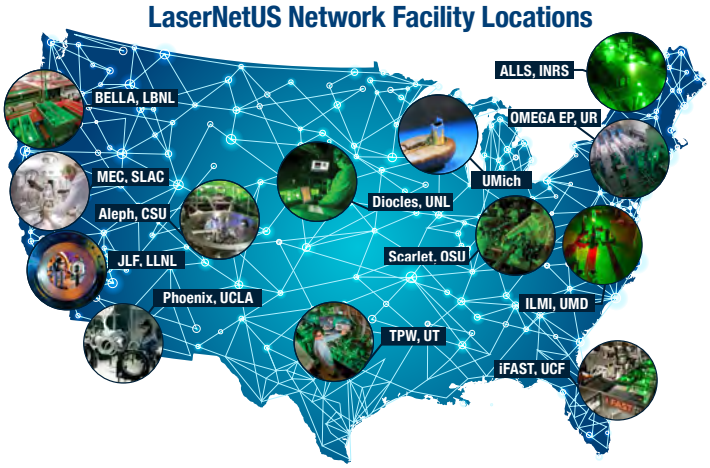
To learn more about OLUG, check out the website: www.lle.rochester.edu/about-the-laboratory-for-laser-energetics/omega-laser-facility-user-group/

In-person attendees at the 15th OLUG Workshop.

LaserNetUS

In 2018, the Department of Energy Office of Fusion Energy Sciences established LaserNetUS, a collaborative network of high-power laser facilities in North America that operates effectively as a single user facility. The mission of LaserNetUS is to reestablish US scientific competitiveness in high-energy-density physics (HEDP) and high-field optical science by advancing the frontiers of laser-science research, providing students and scientists with broad access to unique facilities and enabling technologies, and fostering collaboration among researchers and networks from around the world.

LaserNetUS started with seven high-power, short-pulse laser facilities and has now grown to 13 facility institutions geographically distributed throughout the US and Canada, as shown below.



- Advanced Beam Laboratory at Colorado State University
- Advanced Laser Light Source (ALLS) at l'Institut national de la recherche scientifique (INRS), Canada
- Berkeley Lab Laser Accelerator (BELLA) Center at Lawrence Berkeley National Laboratory
- Extreme Light Laboratory at the University of Nebraska, Lincoln
- Institute for the Frontier of Attosecond Science and Technology (iFAST) at University of Central Florida
- Jupiter Laser Facility at Lawrence Livermore National Laboratory
- Laboratory for Intense Laser–Matter Interaction (ILMI) Physics at the University of Maryland
- Matter in Extreme Conditions (MEC) at SLAC National Accelerator Laboratory
- Michigan Target Research and Fabrication (MiTRF) at the University of Michigan
- OMEGA EP Laser System at the University of Rochester's Laboratory for Laser Energetics
- Phoenix Laser Laboratory at the University of California, Los Angeles
- Scarlet Laser Facility at the Ohio State University
- Center for High Energy Density Science at the University of Texas, Austin

To learn more about the LaserNetUS including details of its network facilities and user experiments, check out their website: https://lasernetus.org/.

The network facilities offer a wide range in laser pulse energy and pulse duration, repetition rates, experimental diagnostic equipment, and target technologies. The network's open mission and broad range of capabilities and expertise put LaserNetUS in an excellent position to advance science, technology, and the workforce for HEDP and inertial fusion energy (IFE) research.

User Access to the Network Facilities

Users obtain LaserNetUS laser facility time for experiments via a competitive proposal process. The network solicits proposals for experimental time on the network facilities on an annual basis, after which proposals are reviewed, ranked, and allocated to facilities by an independent proposal review panel (PRP) of national and international subject-matter experts. Users who request a run at a fully booked facility are referred to a different network facility when possible. Additional user support, including travel, targets, and equipment, is also provided to US users for conducting their experiments.

LaserNetUS is a relatively new entity that has already had a large impact on the HEDP and IFE communities. The network has completed six annual solicitations, and facility time has been awarded for 180 experiments (including 22 on OMEGA EP) from Cycle 1 to Cycle 6, including the new Joint Research Initiative (Cycle 6b). More than 140 user experiments (Cycles 1–5) have been conducted, involving over 400 unique users with almost half being students and postdoctoral researchers.

LaserNetUS Ecosystem

The network is led by the LaserNetUS Chair and Vice Chair, both members of the Network Facilities Committee, along with a dedicated coordinator overseeing operations and management. The Network Facilities Committee, which includes all facility points of contact and other facility personnel, and the Coordinator meet regularly to develop long-term strategic plans, execute network activities including annual solicitation and annual user meetings, and implement recommendations by its scientific advisory board. The PRP conducts independent reviews of proposals based on scientific and technical merit and broad impact. The network has also formed several other committees including the Intense-Light Users Engagement Committee, which represents users' interest within the network; the Diagnostics Committee, which prioritizes the development of common diagnostics by engaging both users and facilities; and the Simulations Committee, which facilitates connections between users and the teams that build simulation codes and capabilities. LaserNetUS has more than 1300 registered members who receive regular updates and information from the network.

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This material is based upon work supported by award numbers Department of Energy (DOE) National Nuclear Security Administration DE-NA0004144; DOE ARPA-E DE-AR0001272-062197-002 and DE-AR0001269-062274-002; DOE DE-SC0024415, DE-SC0021032-062471-002, DE-SC0021057-062426-002, DE-SC0020431-061817-002, DE-SC0022979, DE-SC0023331, DE-SC0021057, DE-SC0023246, and DE-SC0023239; New York State Energy Research and Development Authority 568-FFES-FUC-83; Department of Defense; Commissariat à l'énergie atomique 3957; U. S. National Science Foundation 2329970, 2205521; Lawrence Livermore National Laboratory B647588, Subcontracts B637954 and B647770; Air Force Office of Scientific Research FA9550-23-1-0475; Stanford University Subcontract 217663; Sandia National Laboratories PO 2300100, PO 2378255, and PO 2332811; SLAC 228271; Johns Hopkins University Subawards 2004758202 and 181839; Seurat Technologies; United Kingdom Atomic Energy Authority COL054-2022 and COL055-2022; Duke University 323-000028; Verus Research Subcontract No. 1175-00083; Sydor Technologies; Mission Support and Test Services LLC 286264; Los Alamos National Laboratory Subcontract 20345; and University of California at San Diego Subaward 705841.