Laboratory for Laser Energetics

Omega Laser Facility

The Laboratory for Laser Energetics (LLE) operates the Omega Laser Facility – two ultrahigh-power lasers providing high-energy density physics research opportunities to users from universities, national laboratories and industry.

Scientific Accomplishments

Inertial Confinement Fusion

The LLE Omega Facility has conducted tens of thousands of target shots over its thirty years of operations. The Laboratory is one of the principal participants in the national inertial confinement fusion program. One of LLE’s major achievements is the compression of heavy hydrogen to a pressure of 350 billion atmospheres at a temperature 25 million degrees – comparable to the conditions at the core of our sun. This research may one day lead to a safe, inexhaustible and economically competitive form of energy.

National Ignition Campaign

LLE is a partner in the NNSA National Ignition Campaign along with Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratory, and General Atomics. Experiments conducted on the Omega Facility are addressing some of the key physics issues of laser-initiated thermonuclear fusion including implosion of spherical capsules to ultra-high density conditions; hydrodynamic instabilities, laser-energy coupling to complex targets, x-ray opacity, and the development of diagnostic techniques for high density, high temperature plasmas.

Fundamental Knowledge

Some 30% of the Omega Facility time is dedicated to the advance of basic science including: laboratory astrophysics, high-energy density physics, nuclear physics, and high-intensity laser-matter interaction. As one example, OMEGA experiments were used to justify observational time on the Hubble Space Telescope. The Omega Laser Users Group (OLUG) was established by the user community in 2008 and has over 270 members from 32 universities, 28 research centers and 5 national laboratories.

Science Education

The Laboratory conducts a comprehensive science education program on several levels, LLE holds workshops and summer schools on high-energy-density science. Some 80 graduate and 30 undergraduate students are actively participating in laboratory research programs. A highly competitive high-school student program enables 16 high school juniors to conduct independent research programs. More than 280 high school students have participated in this annual LLE program and 10% of these attained finalist or semifinalist status at the INTEL Science Talent Search.

Societal Impact

The Laboratory for Laser Energetics (LLE) at the University of Rochester is a unique national resource for research and education in high-energy-density science and technology. The Laboratory was established in 1970 to a center for the investigation of the interaction of intense radiation with matter. LLE operates the National Laser Users Facility (NLUF) for high-energy-density-science users from universities, national laboratories and industry.

The Omega Laser Facility

The principal research tool at LLE is the Omega Laser Facility consisting of two lasers – OMEGA, a 60-beam, ultraviolet laser capable of producing 30 trillion Watt pulses, and OMEGA EP, a 4-beam laser system capable of producing pulses with peak power of over a thousand trillion Watts with two beams, or high-energy ultraviolet laser pulses with four beams. More than half of the Omega Facility shot time is dedicated to users from other universities, national laboratories and industry.