National Ignition Facility & Photon Science

OTHER LINKS

Visit NIF Store

FAQs

What is NIF?

The National Ignition Facility (NIF), located at Lawrence Livermore National Laboratory, is the world's largest and highest-energy laser system. NIF's 192 intense laser beams are capable of delivering to their target more than 10 times the energy of any previous laser system. Ignition experiments began in 2010. During full-scale ignition experiments, NIF directs up to 1.8 million joules of ultraviolet laser energy in billionth-of-a-second pulses to the Target Chamber center, probing the conditions that would be needed to achieve the world's first self-sustaining fusion reaction with energy gain in a laboratory setting—in essence, creating a miniature star on Earth.

What is NIF used for?

NIF enables scientists to create extreme states of matter, including temperatures of 100 million degrees and pressures that exceed 100 billion times Earth's atmosphere. NIF supports national security, fundamental science, energy security, and national competitiveness missions.

How much did NIF cost?

The total cost for NIF including development, vendors, capital, installation, and commissioning was about $3.5 billion.

How does NIF advance national security?

As a cornerstone of the National Nuclear Security Administration (NNSA)'s stockpile stewardship program, NIF scientists conduct experiments necessary to ensure America's nuclear weapons stockpile remains safe, secure, and reliable without underground testing. NIF is the only NNSA facility with the potential to duplicate all the phenomena that occur in the heart of a modern nuclear device.

How does NIF advance basic science?

NIF provides unique experimental opportunities to enhance our understanding of the universe by creating the same states of high-energy-density matter that exist in the centers of planets, stars, and other celestial objects. For example, with NIF, we can "explore" planets by duplicating the extreme conditions found in their interiors.

How does NIF advance energy security?

Experiments at NIF are laying the groundwork to provide the nation with abundant clean energy by using lasers to ignite fusion fuel.

How much power and energy do NIF's 192 beams produce?

Lawrence Livermore National Laboratory's (LLNL) National Ignition Facility (NIF) laser system has set a new record, firing 2.15 megajoules (MJ) of energy to its Target Chamber—a 15 percent improvement over NIF's design specification of 1.8 MJ, and more than 10 percent higher than the previous 1.9 MJ energy record set in March 2012.

In 2017-18, several shots achieved a total fusion neutron yield of 1.7-1.9e16 (1.9x1016) and 50-54 KJ of fusion energy output, which doubled the previous record set in 2014.

Who uses NIF?

NIF users include researchers from Department of Energy national laboratories, universities, and other U.S. and foreign research centers.

What is ignition?

Ignition occurs when the energy liberated from the extreme heating and compression of the NIF fusion fuel equals or is greater than the amount of energy the 192 laser beams deliver to the target to start the fusion reactions. Achieving ignition and energy gain is one of NIF's chief missions.

What are ignition experiments?

NIF ignition experiments use a centimeter-sized holder called a hohlraum that contains a plastic capsule filled with deuterium and tritium (hydrogen isotopes) fuel. Laser beams converge at the top and bottom of the 10-meter-diameter target chamber and deposit their energy inside the hohlraum. The x-rays created when the laser beams strike the hohlraum walls compress the deuterium and tritium fuel, generating helium nuclei and neutrons (and extreme heat), creating conditions that exist only in the sun, stars, and a detonating nuclear weapon.

When will NIF achieve ignition?

Achieving ignition is a scientific grand challenge. The first experiments to investigate ignition began in 2010. Continuing experiments are underway to increase scientists' understanding of the conditions necessary to achieve ignition. Steady progress is being made, but we can't predict when ignition will be achieved.

Do NIF experiments present any danger to the public?

No. While the temperatures and pressures involved in creating a controlled fusion reaction are extreme, NIF is designed to make certain that the process is completely safe. The ignition "event" is very small—about the diameter of a human hair—and lasts for only a few trillionths of a second. The energy released is limited by the very small amount of fuel in the target capsule and is completely contained by the Target Chamber and the target bay and switchyard shielding.

How much tritium is used in NIF ignition experiments, and what are the hazards?

NIF is very environmentally friendly. A NIF target capsule is smaller than a peppercorn and contains less than 1 milligram of tritium, corresponding to about half the amount of radioactivity contained in a tritium-powered "Exit" sign. With our state-of-the-art Tritium Processing System, we collect more than 99.9% of the tritium that is used for experimental purposes in the Target Chamber.

In addition, because all NIF experiments use exceedingly small quantities of materials (including those that are radioactive or hazardous), even the hazard associated with the inner surfaces of the Target Chamber – our most impacted area – are easily managed by NIF's professional work force.

How long will NIF be used for experiments?

NIF is a national user facility that is expected to have a lifetime of at least 30 years.

Can I visit NIF?

Yes. Requests for public tours should be directed to the Lawrence Livermore National Laboratory Public Affairs Office at (925) 422-4599. Tours are limited to persons 18 years of age or older.

Can I get a job, summer internship, or postdoc position with NIF?

We are always interested in attracting great talent to join our team. You can find information about current job openings, internships, and postdoctoral opportunities on the LLNL Careers Site

Have a question?

Submit a question or comment

Lawrence Livermore National Laboratory
SCIENCE & TECHNOLOGY ON A MISSION

Lawrence Livermore National Laboratory • 7000 East Avenue • Livermore, CA 94550

Operated by Lawrence Livermore National Security, LLC, for the Department of Energy's National Nuclear Security Administration.

LLNL-WEB-771219 | Privacy & Legal Notice