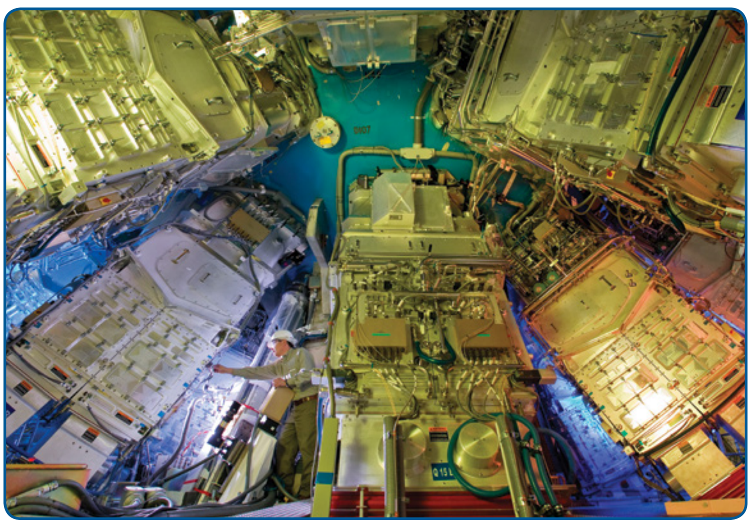
National Ignition Facility & Photon Science

Frequently Asked Questions

Q. What is NIF?

A. The National Ignition Facility (NIF) is the world's largest and highest-energy laser. NIF's 192 intense laser beams are capable of delivering to their target more than 100 times the energy of any previous laser system. Experiments on the path to ignition began in 2010. During full-scale ignition experiments, NIF will direct up to 1.8 million joules of ultraviolet laser energy in billionth-of-a-second pulses to the target chamber center, creating the conditions 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.



Final Optics

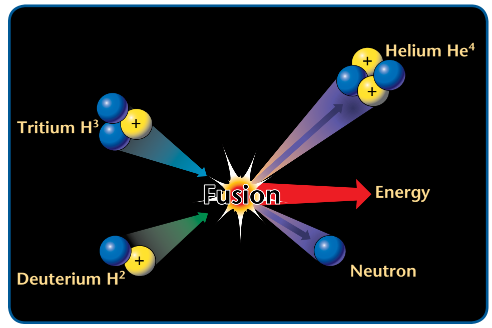
A technician inspects a final optics assembly on the NIF target chamber.

Q. Why was NIF built?

A. The goals of NIF are to provide a better understanding of the complex physics of nuclear weapons; provide scientists with the physics understanding necessary to create fusion ignition and energy gain for future energy production; and explore basic science, such as astrophysical phenomena, materials science, and nuclear science, under conditions that can't be duplicated in any other facility.

Q. When was the NIF project completed?

A. NIF became fully operational in March 2009 and was dedicated May 29, 2009. Please see the Project Status page at **lasers.llnl.gov/newsroom/project_status/index.php** for the most recent National Ignition Campaign updates.



Q. What is ignition?

A. The scientific definition of ignition is that ignition occurs when the fusion target produces more energy than the laser energy required to initiate the fusion reaction—in other words, more energy out than laser energy in. Inertial confinement fusion works by heating and compressing deuterium–tritium fuel (deuterium and tritium are two isotopes of hydrogen). Energy production occurs when the compressed fuel fuses, creating a helium atom and a free neutron, and releasing energy.

Q. When will the facility achieve ignition?

A. Achieving ignition will be a major scientific breakthrough. The first experiments to investigate ignition began in 2010. Continuing experiments are increasing scientists' understanding of the conditions necessary to achieve ignition, and the scientists are optimistic that the goal will be achieved in the near future.

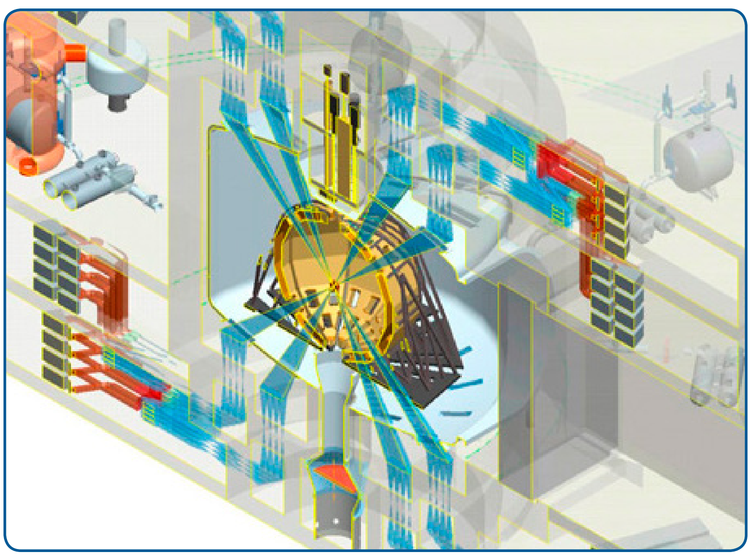
FAQ

Q. What is stockpile stewardship?

A. The National Nuclear Security Administration's Stockpile Stewardship Program is an initiative to maintain the safety and reliability of the U.S. nuclear deterrent in the post-Cold-War era. It is based on the maintenance of the weapons stockpile through an ongoing process of surveillance, assessment, refurbishment, and recertification, without nuclear testing. NIF is a unique facility for the experimental study of thermonuclear burn and high-energy-density phenomena that occur in modern nuclear weapons. Thermonuclear burn is at the very heart of how the stockpile works, and the inability to experimentally study physical phenomena in this physical regime would lead to reduced confidence in the U.S. nuclear weapons stockpile. By fine-tuning and verifying computer simulations of the physics that occur in nuclear weapons explosions, NIF will make major contributions toward ensuring the continued safety and reliability of the nation's nuclear deterrent.

A LIFE Power Plant

This conceptual design shows a LIFE engine and power plant with a two-megajoule laser system. At the facility's center is the fusion chamber.



Q. How soon will we have fusion power plants?

A. Transforming fusion energy into a source of electricity can be thought of as a five-step process: (1) demonstrate that the underlying principle of achieving fusion is sound; (2) achieve net energy gain from a fusion system; (3) resolve technical challenges in a directed research, development, and engineering effort; (4) build and demonstrate a prototype power plant; and (5) build commercial power plants. The principles of how to produce fusion energy in a controlled and repeatable manner are understood (Step 1), and obtaining ignition on NIF would mark off Step 2 on the path toward inertial fusion power. Building from ignition on NIF, the Laser Inertial Fusion Energy, or LIFE, approach offers a practical, near-term roadmap for achieving subsequent steps. LIFE is designed to use materials and technologies that enable an immediate project start and plant construction within a decade. For more information on LIFE, visit the LIFE website at **life.llnl.gov**.

Q. What would an inertial fusion energy (IFE) commercial power plant be like?

A. In an IFE power plant, many (typically 10–20) pulses of fusion energy per second would heat a low-activation coolant surrounding the fusion targets. The coolant in turn would transfer the fusion heat to a turbine and generator to produce electricity. See ***How IFE Works*** **(lasers.llnl.gov/programs/ife/how_ife_works.php)** for a more detailed discussion.

llnl-br-611652_14_nif-0210-18390r5_faq

Q. What is LIFE?

A. LIFE, an acronym for Laser Inertial Fusion Energy, is an advanced energy concept under development at Lawrence Livermore National Laboratory. Based on physics and technology developed for NIF, LIFE has the potential to meet future worldwide energy needs in a safe, sustainable manner without carbon dioxide emissions. Visit **life.llnl.gov** for more information.

Q. Will fusion energy be safe?

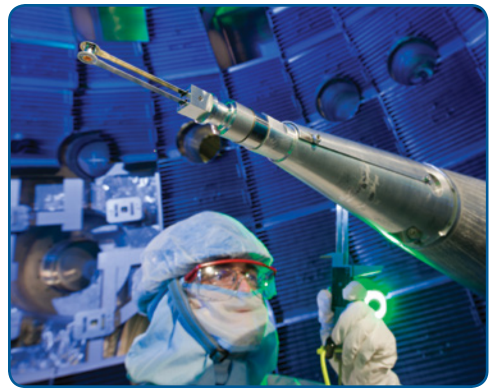
A. Yes. The small size of the fusion target and the nature of a fusion reaction make a runaway chain reaction or "meltdown" impossible. As soon as the target's fuel is expended, in just a few billionths of a second, the reaction stops. Although fusion is a nuclear process, it also differs from the fission process in that there are no long-lasting radioactive by-products from the fusion reaction.

NIF Laser Bay

Seen from above, each of NIF's two identical laser bays has two clusters of 48 beamlines, one on either side of the utility spine running down the middle of the bay.

Q. Is the NIF fusion process better than using a magnetically controlled plasma fusion reactor?

A. Magnetic fusion is fundamentally different from, but complementary to, inertial fusion research. Magnetic fusion uses magnetic fields to confine and heat the deuterium–tritium (DT) plasma, while inertial fusion uses large lasers or other pulsed-power sources to compress and heat capsules filled with DT fuel. Both approaches show promise as potential sources of fusion energy, but both require significant development to realize their potential. The next major step for both is the demonstration of burning DT plasmas in the laboratory. NIF is the inertial fusion facility built in Livermore, CA, for this purpose. For magnetic fusion, the International Tokamak Experimental Reactor (ITER) will be built in France, with the first experiments beginning in 2019.



Q. What possible effects would successful demonstration of ignition on NIF have on the environment and the global economy?

A. Fusion energy is a promising future energy source, as the fuels required to generate it are relatively abundant on Earth and the creation of energy is safe and friendly to the environment. Deuterium is extracted from seawater, and tritium is derived from the metal lithium, a common element in soil. One gallon of seawater would provide the equivalent energy of 300 gallons of gasoline, and fuel from 50 cups of water contains the energy equivalent of two tons of coal. A fusion power plant would be carbon-free and would produce none of the difficult-to-store radioactive by-products that fission power plants produce. There would be no danger of a runaway reaction or core "meltdown" in a fusion power plant. Consequently, fusion energy would be beneficial to both the environment and the economy. Ignition on NIF will help prove the feasibility of fusion power as a near-term energy option.

FAQ CONTINUED

National Ignition Facility & Photon Science

Q. How long will NIF be used for experiments?

A. NIF is intended to be a national user facility on which experiments will be conducted to ensure the safety of our nuclear weapons stockpile, to expand our knowledge of the universe, and to explore possible future energy sources. As such, it is expected to have a useful lifetime of at least 30 years.

Q. Is it possible to buy stock in the NIF project?

A. No. The National Ignition Facility is a project funded by the National Nuclear Security Administration, part of the U.S. Department of Energy. It is located at Lawrence Livermore National Laboratory, which is operated for the government for a fee by a non-publicly held consortium of university and private-sector companies. There are no investment opportunities associated with this facility.

Q. How much did the NIF project cost?

A. Construction of NIF cost $3.5 billion.

Q. Can I visit NIF?

A. 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. The Public Affairs information line, (925) 422-4599, is also a good resource for questions about the Laboratory's mission, programs, and activities.

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

A. We are always interested in attracting great talent to our team. You can find information about current job openings, internships, and postdoctoral opportunities on the LLNL Careers Site (**careers.llnl.gov**).

llnl-br-611652_14_nif-0210-18390r5_faq