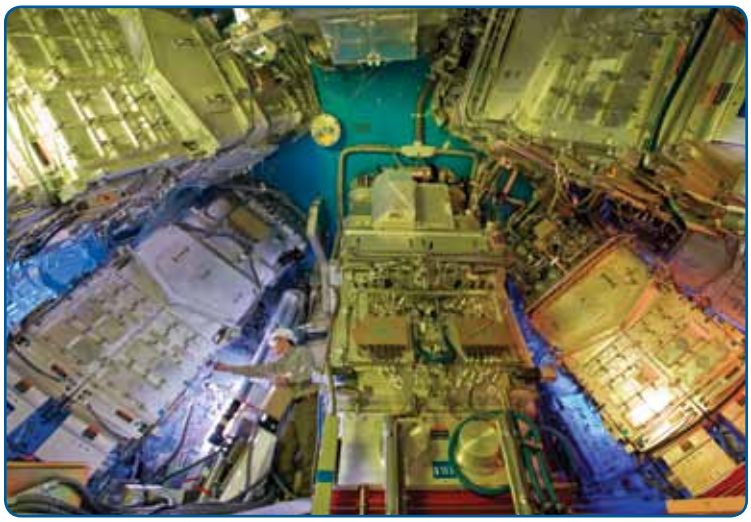
National Ignition Facility & Photon Science

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 will deliver to its target more than 60 times the energy of any previous laser system. Ignition experiments will begin in 2010. At that time NIF will direct up to 1.8 million joules of ultraviolet laser energy in tens of billionth-of-a-second pulses to the target chamber center, creating the conditions necessary to achieve the world's first self-sustaining fusion reaction in a laboratory setting – in essence, creating a miniature star on Earth.



Final Optics

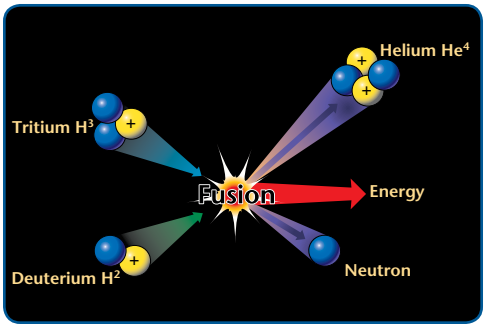
A technician inspects a final optics assembly on the NIF target chamber.

Q. Why is NIF being 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.

Q. When was the NIF project completed?

A. NIF became operational in March 2009. Please see the NIF Status page at **https://lasers-dev.llnl.gov/newsroom/project_status/index.php** for the most recent updates.



Q. What is ignition?

A. The scientific definition is that ignition is obtained when the fusion target produces more energy than the laser energy required to initiate the fusion reaction. 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 burns and releases a helium atom and a neutron, creating energy.

Q. When will the facility achieve ignition?

A. Achieving ignition will be a major scientific breakthrough. The first experiments to investigate ignition are scheduled to begin in summer 2010.

FAQ

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Q. What is stockpile stewardship?

A. The National Nuclear Security Administration's Stockpile Stewardship Program (SSP) 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 assuring 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 1.4 megajoule laser system. At the facility's center is a fusion or fusion-fission target chamber.

Q. How soon will we have inertial fusion power plants?

A. Obtaining ignition on NIF is only the first step toward inertial fusion power. Further research is needed to optimize energy gain and make the fusion process more efficient. Significant technology development is also required. Lasers need to be developed that can be fired about ten times a second (NIF can be fired once every few hours). Reactors need to be designed that can manage and contain the yields and convert the fusion energy released into electricity. Estimates of the time required for these developments vary from 10 to 20 years.

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

A. In an IFE power plant, a few pulses of fusion energy per second would heat low-activation coolants, such as lithium-bearing liquid metals or molten salts, surrounding the fusion targets. These in turn would transfer the fusion heat to steam-turbine generators to produce electricity. See our Web page, "How IFE Works" **(https://lasers.llnl.gov/programs/ife/how_ife_works.php)**, for a more detailed discussion.

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Q. What is LIFE?

A. LIFE, an acronym for Laser Inertial Fusion Engine, 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. See the LIFE Website at **https://lasers-dev.llnl.gov/missions/energy_for_the_future/life/** 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 insure against a runaway chain reaction or "meltdown." 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 is no radioactive by-product from the fusion reaction – only helium gas and a neutron.

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) is being planned to be built at Cadarache, France, with the first experiments beginning in 2018.

Q. What are the possible effects that the success of the NIF Project will have on the environment and the global economy?

A. Fusion energy is very promising as a long-term 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, as well as produce considerably lower amounts and less difficult-to-store radioactive by-products than current nuclear power plants. Also, 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. NIF is just the first step, and further research and technology development are needed to reach this goal.

FAQ CONTINUED

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Q. How long will NIF be used for experiments?

A. NIF is being built as 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 being built 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. The NIF construction project 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 available to answer 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 join our team. You can find information about current job openings, internships and postdoctoral opportunities on the LLNL Jobs Site (**https://jobs.llnl.gov/prod_index.html**).

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