National Ignition Facility & Photon Science

NIF *Fun Facts*

The National Ignition Facility (NIF), became operational in March 2009. Planning began in the early 1990s, and ground was broken for the facility on May 29, 1997—12 years to the day before NIF's dedication.

Construction

Construction of the main NIF building, known as the "conventional facility," was completed in 2001.

- Building height: 10 stories
- Building width: 3 football fields
- Cubic meters of soil excavated: more than 160,000
- Cubic meters of concrete poured: more than 55,000
- Tons of reinforcing steel rebar installed: 7,600
- Tons of structural steel erected: about 5,000
- Hours of craft labor worked: more than 1.7 million

NIF Optics

NIF is not only the world's highest-energy laser, it's also the largest optical instrument ever built. NIF scientists worked closely with optics vendors to develop the technologies required for NIF's construction. The partnership made dramatic improvements in manufacturing precision large optics, including continuous-pour glass, rapid-growth crystals, optical coatings, and new finishing techniques that can withstand the ultra-high energy of the NIF lasers.

NIF's major optics vendors include

- Cleveland Crystals
- Hoya Corp. USA
- ITT
- Kodak
- SCHOTT North America, Inc.
- Spectra-Physics
- Tinsley Laboratories
- Zygo Corp.

Total optical surface

NIF's total optical surface area is three-quarters of an acre—40 times the surface area of the giant Keck telescope in Hawaii.

Some other "Fun Facts" about NIF optics

- Number of large (meter-sized) optics: 7,500
- Number of small optics: more than 26,000
- Length of NIF laser glass if stacked end-to-end: 1.5 miles
- Time to grow NIF crystals using traditional techniques: up to 2 years
- Time to grow crystals using LLNL-developed rapid-growth process: 2 months

Target chamber

The NIF target chamber was installed in June 1999.

- Weight: 130 metric tons (287,000 pounds)
- Diameter: 10 meters (33 feet)
- Exterior material: Welded aluminum covered by 1 foot of neutron-absorbing concrete
- Interior wall: Stainless-steel louvers
- Capacity of installation crane: 900 tons
- Trucks required to transport crane from Nevada Test Site: 66

Target bay

The target bay houses the final optics assemblies, diagnostics, and the target chamber.

- Height: 30 meters (98 feet)
- Diameter: 30 meters
- Material: Reinforced concrete
- Wall thickness: 2 meters (6.5 feet)

Laser bay

Laser Bay 2 was commissioned in August 2007; Laser Bay 1 was commissioned in September 2008.

- Number of laser beams: 192
- Length of laser bay: 122 meters (400 feet)
- Number of amplifier glass slabs: more than 3,100
- Number of large (meter-sized) optics in beamlines: 7,500
- Number of small optics in beamlines: more than 26,000
- Number of flashlamps: 7,680
- Number of line replaceable units (mechanical housings that hold the lenses, mirrors, and utilities): 6,206

NIF *FUN FACTS*

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Lasers

NIF's laser pulses are generated by an optical fiber laser called the master oscillator.

- Duration of laser pulse: 20 billionths of a second
- Length of laser pulse: 6.1 meters (20 feet)
- Total distance of pulse travel from master oscillator to target chamber: 1,500 meters (4,900 feet)
- Duration of pulse travel: about 5 millionths of a second
- Initial laser energy: 1 billionth of a joule
- Laser amplification: 4 million billion times
- Infrared laser energy at full power: 4.2 megajoules (million joules)
- Equivalent peak power: 500 trillion watts
- Ultraviolet laser energy at full power: 1.8 megajoules

Control system

The NIF Control Room, housing the Integrated Computer Control System, is modeled on NASA's Mission Control in Houston, Texas, and is one of the most complex automated control systems ever designed for a scientific machine.

- Control points (for motorized mirrors and lenses, energy and power sensors, video cameras, laser amplifiers, and pulse power and diagnostic instruments): more than 60,000
- Number of computers: 850
- Lines of computer code: more than 2 million
- Beam alignment tolerance on target: 50 micrometers (millionths of a meter)
- Beam timing tolerance on target: 30 trillionths of a second

Targets

A variety of NIF targets are designed and machined to meet the needs of different experiments.

- Hohlraum material: gold
- Target capsule material: beryllium or plastic
- Hohlraum length: 9 millimeters (thousandths of a meter)
- Hohlraum diameter: 5 millimeters
- Target capsule diameter: 2 millimeters
- Target fill tube diameter: 10 micrometers (millionths of a meter)
- Construction tolerance (density, concentricity, and surface smoothness): 1 micrometer

Fusion fuel

NIF's fuel consists of deuterium and tritium, two forms of hydrogen with one or two extra neutrons.

- Temperature prior to compression: 18 kelvins (-427 degrees Fahrenheit)
- Temperature at ignition: 100 million kelvins (180 million degrees Fahrenheit), more than six times hotter than the core of the sun
- Pressure at ignition: More than 100 billion atmospheres
- Density at ignition: Up to 100 times the density of lead

Power Conditioning System

NIF's high-voltage capacitors are charged for about 60 seconds before releasing their energy.

- Length of energy burst: 400 microseconds (millionths of a second)
- Electrical system peak power: More than 1 trillion watts
- Total length of high-voltage cable: More than 305 kilometers (about 190 miles)

Switchyards

After amplification in the laser bays, the NIF beams enter the switchyards, where they are redirected by turning mirrors to the target chamber.

- Height of switchyards: 30 meters (98 feet)
- Tons of steel in switchyard space frame structures: 1,000
- Thickness of reinforced concrete walls: 0.6 meters (2 feet)

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