



How Zygo supports the Lawrence Livermore National Laboratory's National Ignition Facility's quest for sustainable clean energy_

Situation

The Lawrence Livermore National Laboratory's (LLNL's) National Ignition Facility (NIF) precisely guides, amplifies, reflects, and focuses 192 powerful laser beams into a target about the size of a pencil eraser in a few billionths of a second, delivering more than 2 million joules of ultraviolet energy and 500 trillion watts of peak power.

The NIF's laser system generates temperatures in the target of more than 180 million degrees Fahrenheit and pressures of more than 100 billion Earth atmospheres. Those extreme conditions cause hydrogen atoms in the target to fuse and release energy in a controlled thermonuclear reaction.

NIF's experiments such as this provide the scientific basis for a revolution in energy production. Inertial fusion energy offers the potential for virtually unlimited safe and sustainable clean energy by harnessing the power of the sun and stars.

Achieving these heights of energy production requires using highly precise optics—the kind of optics produced by Zygo.

// Zygo is the world's top expert in high-precision, high-energy flat optics. I recommend Zygo to other organizations with similar needs because of the company's proven reliability and professionalism."

Christopher Stolz_

Associate Program Manager for the Optics Production Group in the National Ignition Facility_

Solution

Zygo has been making optics for the NIF's laser program since the early 1970s. According to Christopher Stolz, Associate Program Manager for the Optics Production Group of the NIF, "The company is well known for making optics of very high-precision flatness. One of the reasons why we've been doing business with Zygo for so long is because of that expertise."

Zygo worked closely with LLNL to develop optical manufacturing processes that support high-volume production of meter-class, laser-grade optics for the NIF laser. Such optics include amplifier slabs, turning mirrors, vacuum windows, continuous phase plates, gratings, and main debris shields.

Zygo's role is critical because the NIF's laser system is the only facility in the world that operates above the laser damage threshold requirements for optics. This means that the laser damages the optics every time it's used. Consequently, those optics need to be replaced periodically.

"We are happy with our relationship with Zygo because it is one of the very few suppliers capable of continually providing optics with very long lifespans that meet our high energy requirements," said Christopher. "We send the Zygo team raw materials, and they either finish or refinish the optics for us. Once we receive the optics, we do some processing on them and assemble them into a frame before placing them into the laser system."

NIF's partnership with Zygo has been mutually beneficial. NIF helps push Zygo's state-of-the-art processes, making its instrument quality better, and Zygo continues to advance its optical performance, which improves the performance of NIF's laser systems.

Results



Ongoing Partnership

"Zygo routinely meets our quality requirements," said Christopher. "When we need new optics, the Zygo team is one of the companies that we talk to and see if they're interested in whatever that new challenge is. They regularly say yes."



Strong Future

"When we succeed and start building commercial power plants based on this technology, it will revolutionize the laser optics industry," said Christopher. "Zygo will have played a huge role in that."