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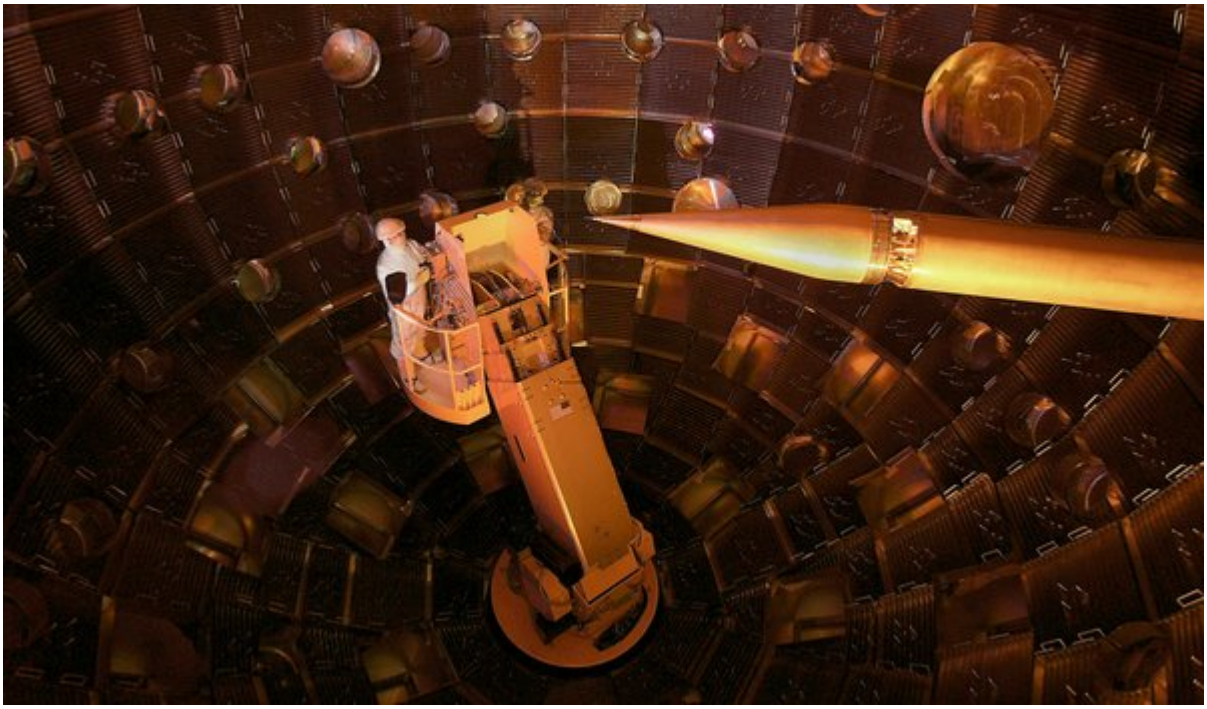
So Far Unfruitful, Fusion Project Faces a Frugal Congress



National Ignition Facility
The giant laser at the Lawrence Livermore National Laboratory in California.

By WILLIAM J. BROAD

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For more than 50 years, physicists have been eager to achieve controlled fusion, an elusive goal that could potentially offer a boundless and inexpensive source of energy.

To do so, American scientists have built a giant laser, now the size of a football stadium, that takes target practice on specks of fuel smaller than peppercorns. The device, operating since 1993, has so far cost taxpayers more than $5 billion, making it one of the most expensive federally financed science projects ever. But so far, it has not worked.

Unfortunately, the due date is Sunday, the last day of the fiscal year. And Congress, which would need to allocate more money to keep the project alive, is going to want some explanations.

“We didn’t achieve the goal,” said Donald L. Cook, an official at the National Nuclear Security Administration who oversees the laser project. Rather than predicting when it might succeed, he added in an interview, “we’re going to settle into a serious investigation” of what caused the unforeseen snags.

The failure could have broad repercussions not only for the big laser, which is based at the Lawrence Livermore National Laboratory in California, but also for federally financed science projects in general.

On one hand, the laser's defenders point out, hard science is by definition risky, and no serious progress is possible without occasional failures. On the other, federal science initiatives seldom disappoint on such a gargantuan scale, and the setback comes in an era of tough fiscal choices and skepticism about science among some lawmakers. The laser team will have to produce a report for Congress about what might have gone wrong and how to fix it if given more time.

"The question is whether you continue to pour money into it or start over," said Stephen Bodner, a former director of a rival laser effort at the Naval Research Laboratory in Washington. "I think they're in real trouble and that continuing the funding at the current level makes no sense."

China is studying the program's mistakes, Dr. Bodner added, perhaps with a goal of building an improved machine.

"It's kind of an amazing device," said William Happer, a physicist at Princeton University who directed federal energy research for the first President George Bush. "Still, it's not science if you don't fail now and then. But you do have to have some wins."

Many science analysts predict that the big laser will survive, because its powerful beams can still squeeze materials to extraordinarily high pressures, temperatures and densities that are useful in safeguarding the nation's nuclear arms — a goal that attracts bipartisan support. For instance, the laser might help engineers see if a particular metal part that had to be substituted in a class of aging nuclear arms would still work as needed.

Even so, skeptics outside the government have long assailed the laser project, known as the National Ignition Facility, or NIF, as a colossal waste of money. Just operating it, officials concede, costs roughly $290 million a year. Some doubters have ridiculed it as the National Almost Ignition Facility, or NAIF.

Big science projects more costly than the laser include NASA's newest space telescope, whose price tag now runs to more than $8 billion, and the 17-mile circular accelerator in Europe that recently helped pin down the elusive subatomic particle known as the Higgs boson. It cost about $10 billion.

In interviews, the laser's architects and supporters at the Livermore lab defended the device as working beautifully and pointed to the challenge of planned breakthroughs as the fundamental problem.

"It's like having a cure for cancer by a certain date," said Penrose C. Albright, the laboratory's director. "I understand why people want to have milestones. But when you're dealing with science and Mother Nature, all you really can do is agree on whether you're on the right path."

The sprawling laser complex, the officials insisted, would one day achieve its advertised goal: fusing the hydrogen atoms in a speck of fuel into helium, and thus creating what physicists liken to a tiny star.

“Contrary to what some people say, this has been a spectacular success,” said Edward Moses, the laser’s director. Even so, he added, “science on schedule is a hard thing to do.”

What has eluded Dr. Moses and thousands of other scientists over the decades is a controlled version of nuclear fusion — the process of atomic merger that powers the sun, the stars and hydrogen bombs. The laser uses blasts of concentrated light to compress, heat and ignite tiny capsules of hydrogen fuel smaller than match heads — hopefully, one day, setting them ablaze in thermonuclear fire.

The result, scientists hope, would include not just new science but radically new kinds of reactors to generate electric power at low cost. Hydrogen, they note, is the most abundant element in the universe.

“Bringing Star Power to Earth,” read a giant banner that workers in 2009 unfurled on the newly inaugurated National Ignition Facility. Over budget and behind schedule, the construction had taken a decade.

Today, the complex has millions of parts and 192 lasers made up of 15 miles of mirrors and lenses, crystals and light amplifiers. Its innards look something like a spaceship engine room from a science fiction movie.

From the start, critics saw NIF’s delays and spiraling price tag as symptoms of overreaching. In 2000, soon after the start of construction, what was then the General Accounting Office questioned the “independence” of ad hoc assessment panels and detailed a number of management and oversight failures.

By 2005, a panel of scientific experts judged the goal of ignition in 2010 during the initial laser firings as unlikely and faulted the project for what it called a lack of “standing external oversight.”

In July, a report to Dr. Cook, the official in charge, called ignition by the end of this year “highly unlikely” and recommended that the project be “redirected towards a broader and more balanced research program.”

Dr. Moses, the laser’s director at Livermore, called many of the critics misinformed and defended the project as fundamentally sound. He said that China, France and Russia all have similar laser projects under way that use NIF as a model.

“They’re betting with their pocketbooks to recreate what we’re doing,” he said.

Dr. Albright, the laboratory’s director, insisted that the big laser would still end up being the first on the planet to make a tiny star. The question is when.

“Everybody believes we can get there,” he said. “But we’re exploring parts of physical space that no one has ever done before, and that’s a hard problem.”