Inside California's star power fusion facility

- By Sebastian Anthony on October 24, 2011 at 11:08 am
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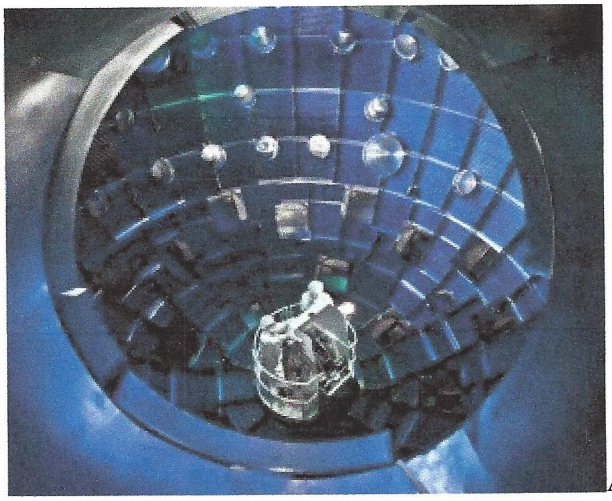

At the National Ignition Facility at the Lawrence Livermore National Laboratory, in California, scientists are using 192 lasers and 500 trillion watts of power in an attempt to fuse hydrogen, to create miniature stars. These lasers are all focused on a tiny cylinder of beryllium, called a *hohlraum*, that contains a mixture of deuterium and tritium — hydrogen isotopes — and when the switch is thrown, the isotopes are heated to 100 million degrees centigrade for 20 nanoseconds… and they fuse.

For now, the process requires more energy than is produced, but by the end of 2012 the scientists hope to live up to the name of the facility and create *ignition*, where the amount of energy produced is greater than the initial laser pulse. At this point, the tiny star will be hot enough to continue the fusion process on its own, as long as there's enough hydrogen fuel to burn. You don't need to worry (too much) about the tiny star gobbling up the western seaboard and eventually the entire planet, either: the walls of the fusion chamber are 10cm-thick aluminium encased by a 20cm-thick layer of boron-imbued concrete to prevent any neutrons from escaping.

As you probably know, fusion is one of the many energy sources that could eventually replace our dependence on fossil fuels. Fusion power is clean and produces a truly vast amount of energy from just a few grams of hydrogen. The only real difficulty is starting the chain reaction: so far, the only foolproof ways of producing fusion are in the heart of a massive star or a thermonuclear bomb, and neither method seems likely to get planning permission here on Earth.

You've probably guessed by now, but the National Ignition Facility is an engineering marvel — it's hard work to focus 192 of the world's most powerful lasers on a target the size of a BB pellet, after all. Read on for some of the most beautiful photos of California's star factory.

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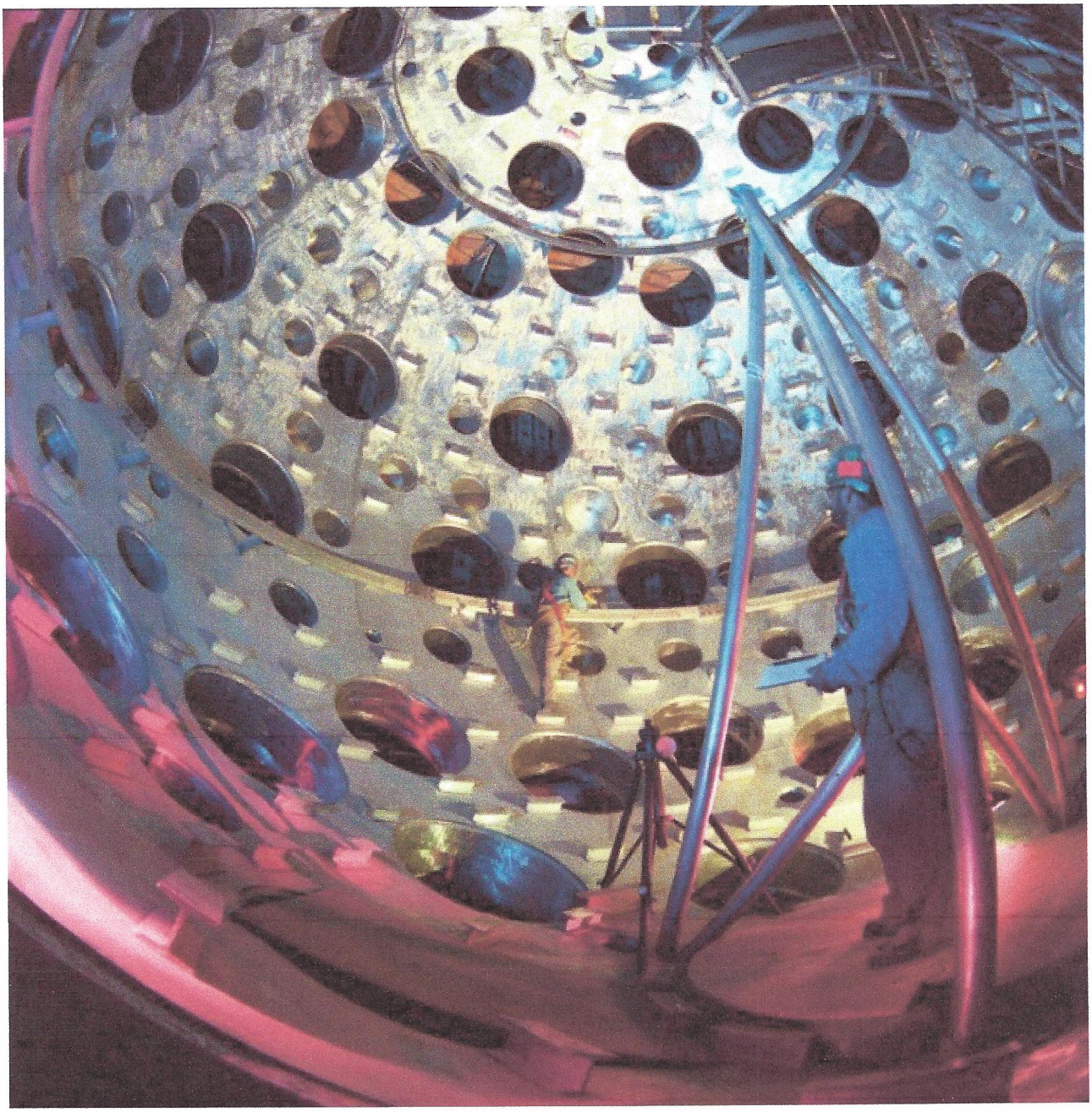

NIF target chamber

Here you can see the spherical target chamber where hydrogen atoms are fused together. The holes in the wall are where the 192 lasers shoot from, and they also act as viewports for NIF's diagnostic equipment.

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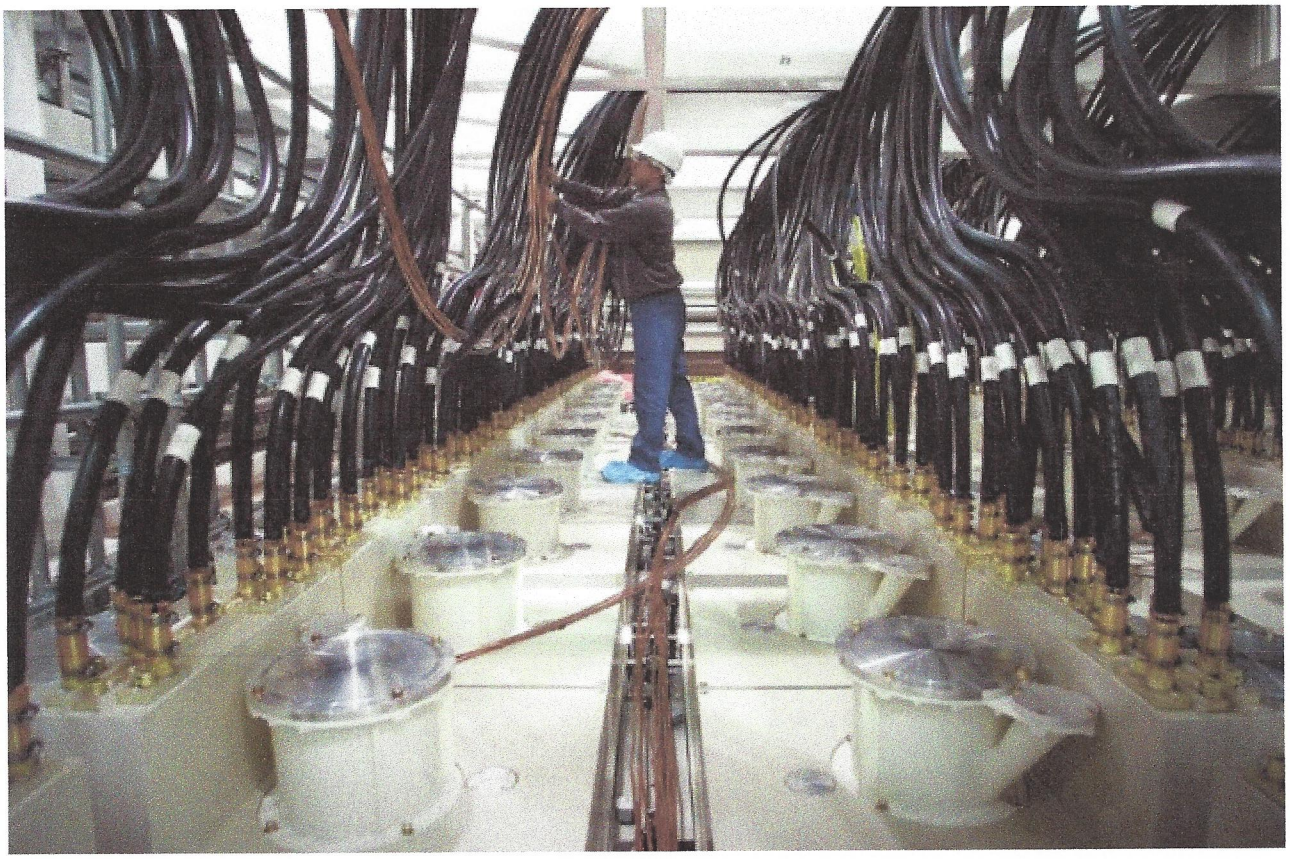

Power conditioning system

To produce its 500-trillion-watt laser burst, NIF basically uses a bank of capacitors: it charges them for 60 seconds, and then unleashes all of the power in a few microseconds.

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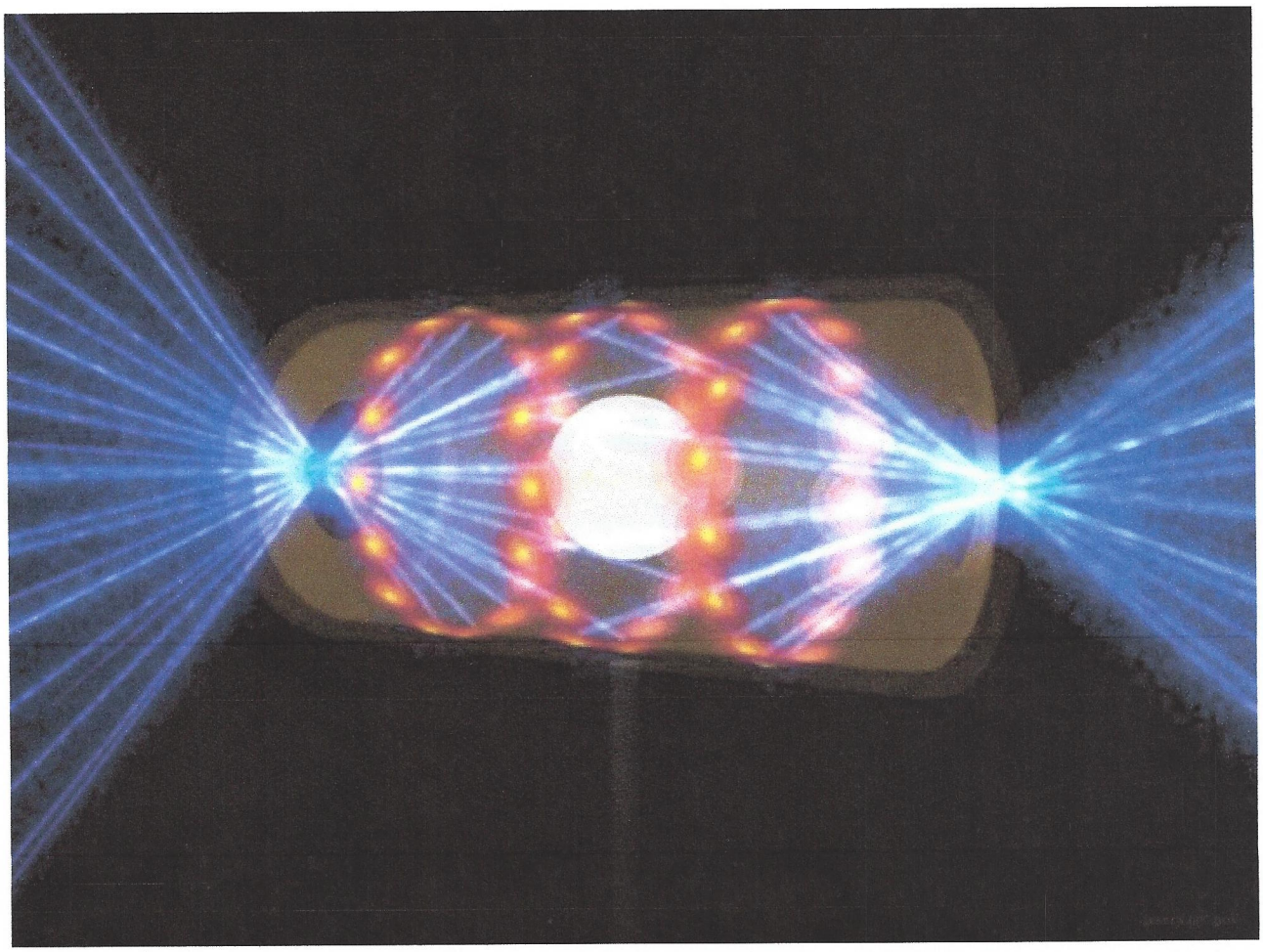

The hohlraum

This is an artist's rendering of what the hydrogen-carrying beryllium cylinder, or hohlraum, will look like when 192 lasers hit it at once. The idea is that the beryllium collapses under immense heat and pressure, which then triggers a fusion reaction.

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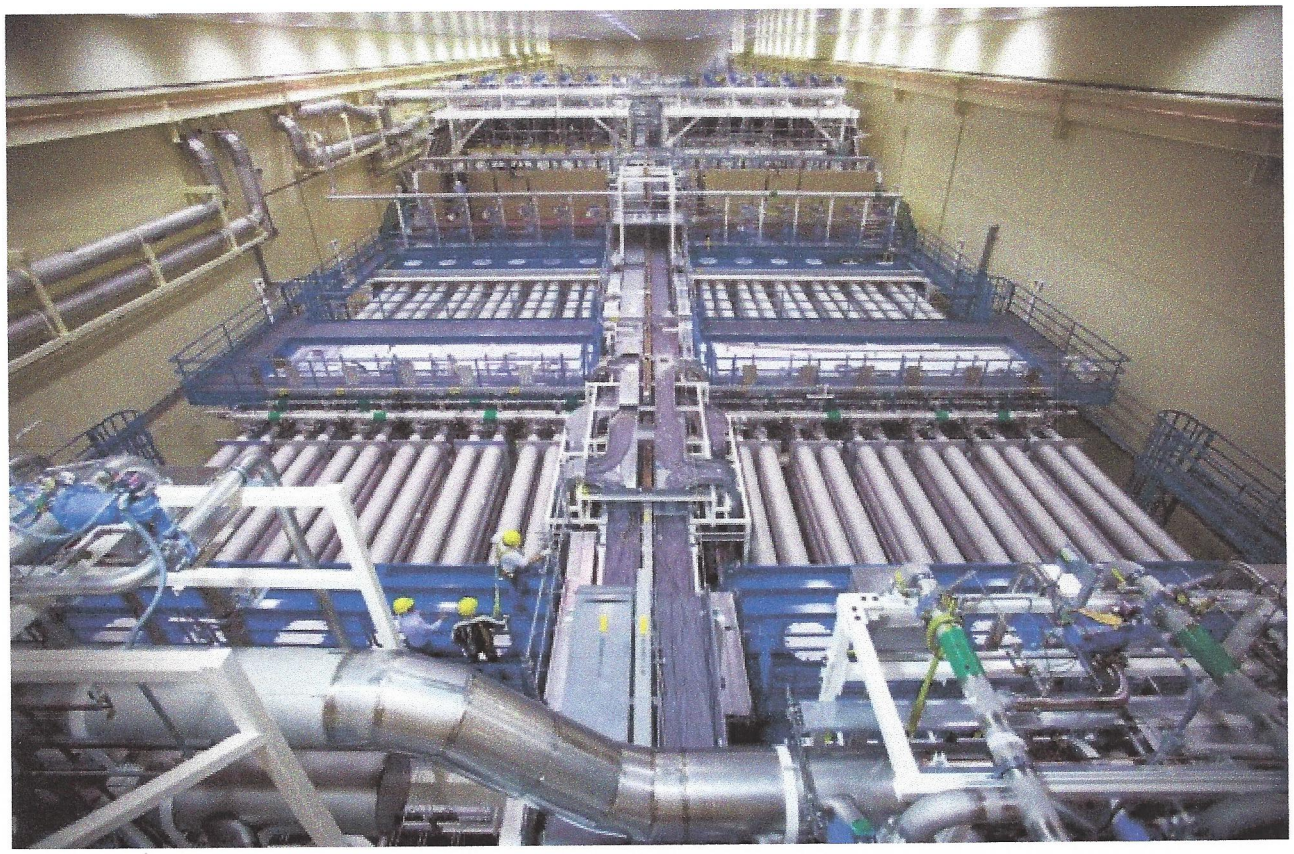

Laser bay

Here you can see two clusters of 48 laser tubes, making up 96 lasers — or half the total.

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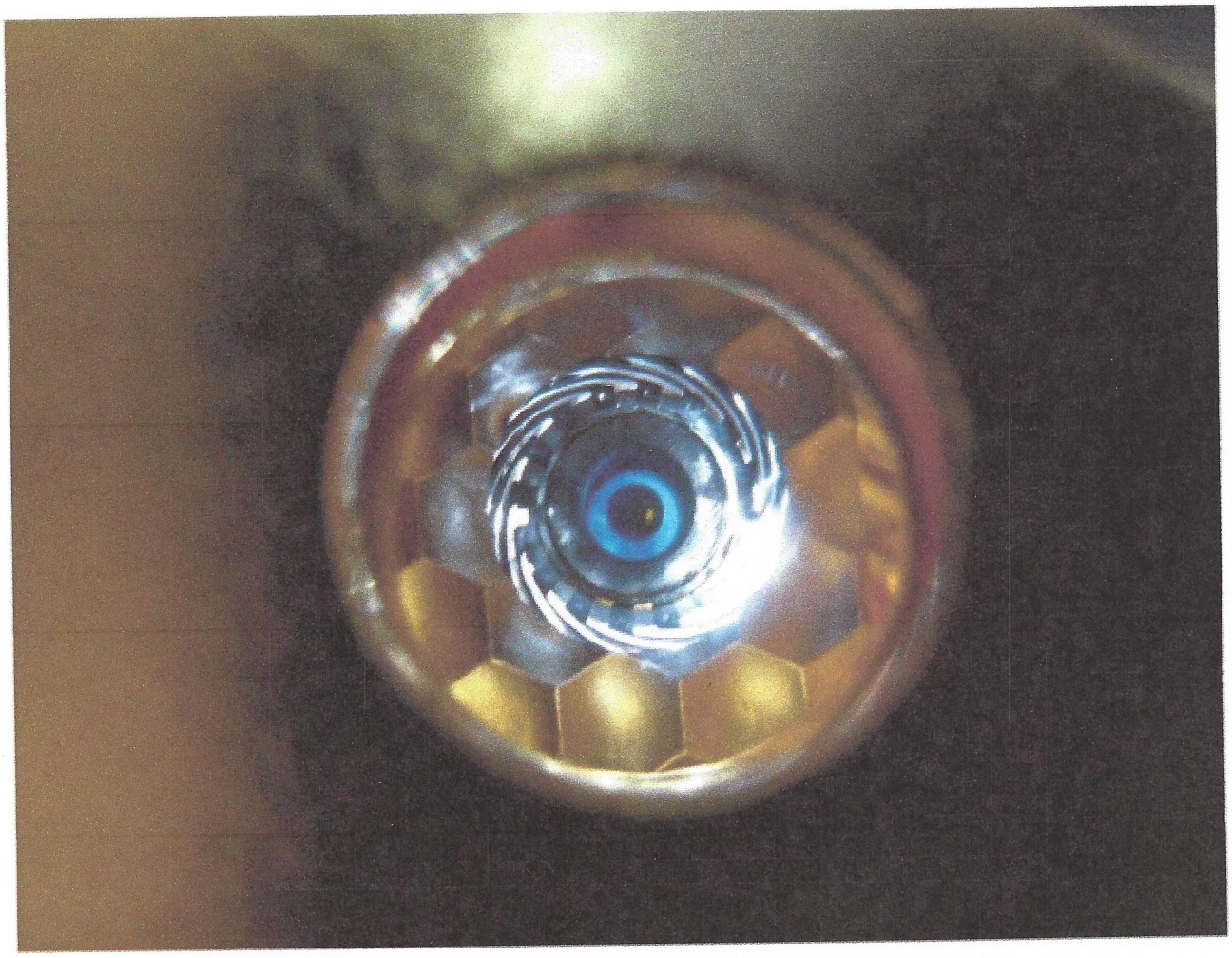

Laser-eye-view of the hydrogen fuel

We're looking down through the top of the hohlraum cylinder at the capsule of hydrogen fuel. The hohlraum and its fuel are cryogenically cooled so that the hydrogen solidifies, increasing its density by 30 to 50 times. To create fusion, it must be compressed even further — and that's the job of the lasers.

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Tritium processing system

Despite using minute amounts of tritium, NIF has a tritium processing system that both contains the material both before and after it is used.

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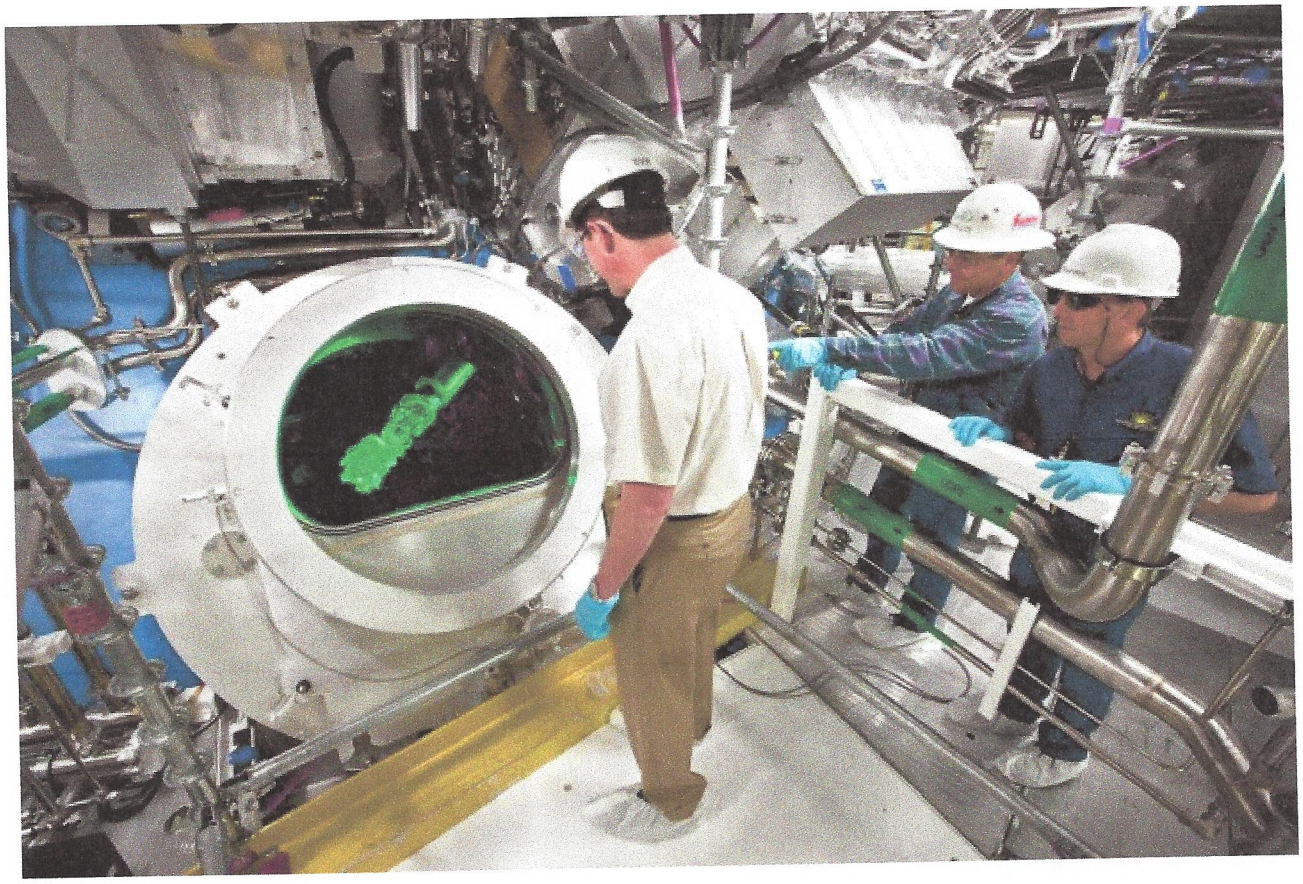

Looking into the target chamber

The NIF's experiments occur way too fast for a human scientist to take notes — but still, it must be nice to look through a window and observe fusion…

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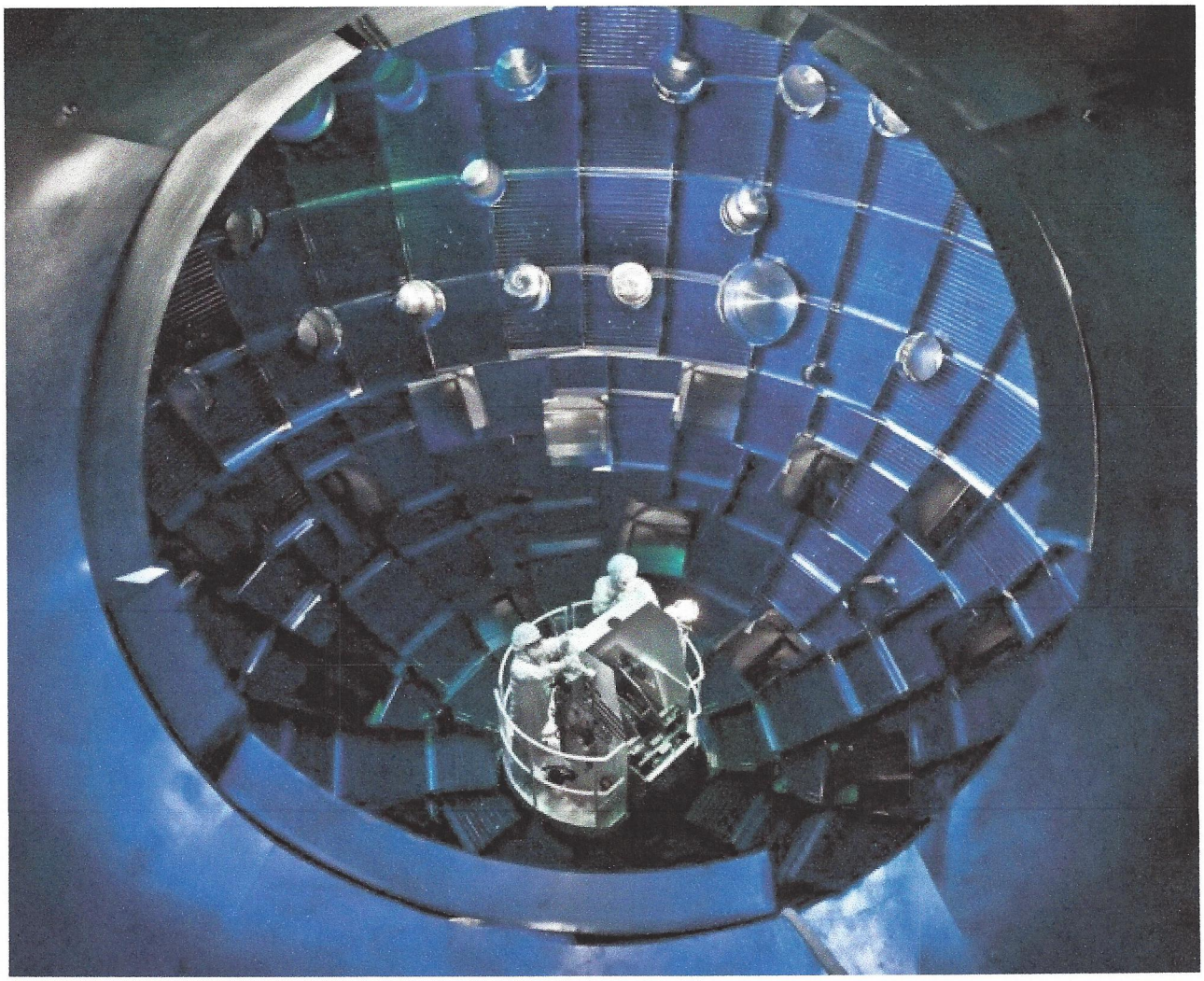

Target chamber

Finally, one more photo of the target chamber. It almost looks like the world's coolest (or hottest) discotheque.

Read more about the National Ignition Facility on Wikipedia, or check out lots more photos at the NIF website

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