Inertial Fusion Energy and the National Ignition Facility

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SMUD Panel Discussion with Board of Directors

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NIF is the world’s largest and most energetic laser enabling the study of extreme conditions for fusion & high energy density science

- 192 laser beams
- Energy and Power: 1.9 MJ, 500 TW
- Beams are focused on a mm³ target containing deuterium-tritium fuel
- Creates matter temperature 100 million degrees, density 100g/cm³
- Can recreate astrophysical phenomena
The NIF uses a laser driven x-ray oven (hohlraum) to compress a fuel capsule to achieve the conditions for ignition

- Each of the 192 laser beams are focused onto the inner wall of the hohlraum
- Laser beams rapidly heat the inside surface of the hohlraum creating x-rays
- The x-rays blow off the fuel capsule wall, accelerating the fuel inward to 1 million MPH
- The fuel core reaches 100 times the density of lead and ignites at 100,000,000°C
- Fusion burn spreads rapidly through the compressed fuel, yielding many times the input energy

Achieving ignition in the laboratory is a scientific grand challenge 60 years in the making
Last August, a shot on the NIF achieved 1.35 MJ of fusion energy; 70% of laser input

- Progress was slow but steady for a decade
- Then in August of 2021, there was a 25x improvement from 2020
- Attempts to repeat have shown that target quality is the limiting factor
- Better targets are expected in December that could push beyond gain = 1; a small increase in laser energy on 9/19 resulted in an experiment with 1.15 MJ of fusion
- Gain of 10 to 100 is needed for energy production
The concept for an inertial fusion power plant includes a driver, target chamber, target factory, and a steam turbine to generate electricity.

900 cycles / minute provides ~ 1 GWe output

The challenges are many:
- Ignition and fusion energy gain
- Fuel system delivery and cost
- Lifetime of the fusion chamber and optics
- Safety and licensing — Tritium and any activated materials
- High availability plant operations

But the benefits are great:
- Carbon-free
- Ability to meet baseload
- Can be generated near population centers
- Attractive development path (many potential spin-out technologies)
We are holding a virtual Industry Day Oct. 27 to facilitate Public-Private Partnerships in inertial fusion energy R&D

The national labs will provide details about their capabilities, and discussions will be held on potential areas of collaboration / tech-transfer

https://events.bizzabo.com/RFI-IFE