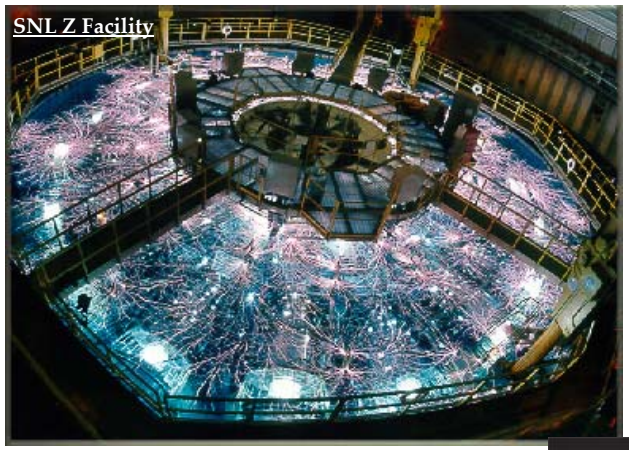
Inertial Confinement Fusion Ignition and High Yield Campaign



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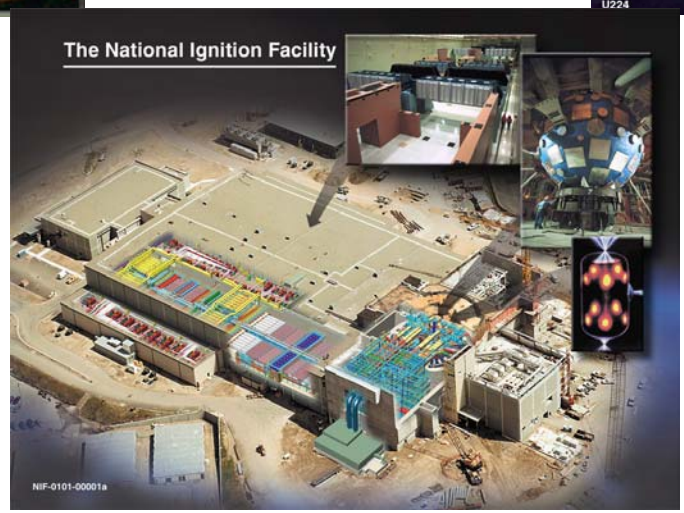

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Statements to FESAC IFE panel 10/28/03

- Ignition is a major goal for NNSA/Defense Programs and will be a major focus
- Defense Programs does not have an energy mission, but ignition supports OFES's mission and OFES use of NNSA's ICF facilities is accepted
- Defense Programs reserves right to redirect High Average Power Lasers to be synergistic with NIF ignition and other defense missions

Today's Message

- Inertial fusion will be achieved, probably in various forms, but inertial fusion energy remains elusive
- Precise nature of technology best suited to exploit ignition for energy will depend on what approach works best
- Application of fusion for Stewardship will continue to evolve well beyond achievement of ignition (20 year challenges)
- We need to develop a new generation of scientists for whom fusion isn't a goal, but a tool

High Energy Density Physics is an Essential Component of SSP

Directed Stockpile Work

"Non-Ignition"

Ignition

Production Readiness

ICF / High-Energy Density Physics

Hydrodynamics

Materials

Engineering Science

Simulation

ICF Campaign Strategic Goals

ICF Campaign strategic goals and key supporting strategies:

1. **Execute high energy density physics experiments necessary to provide advanced assessment capabilities for stockpile stewardship**
   - Support Science Campaigns milestones

2. **Achieve ignition in the laboratory and develop it as a scientific tool for stockpile stewardship**
   - Plan for indirect drive
   - Pursue direct drive for risk reduction and capability enhancement for defense issues
3. **Develop advanced technology capabilities that support the long-term needs of stockpile stewardship**
   - Pursue promising advanced concepts for better diagnostics (petawatts) or enhanced fusion burn capability (pulsed power, fast ignition)
4. **Maintain robust national program infrastructure and attract scientific talent to the Stockpile Stewardship Program**
   - Support university programs and use of NIF, Omega, Z (~15% level)

The ignition program has made major progress since 1999

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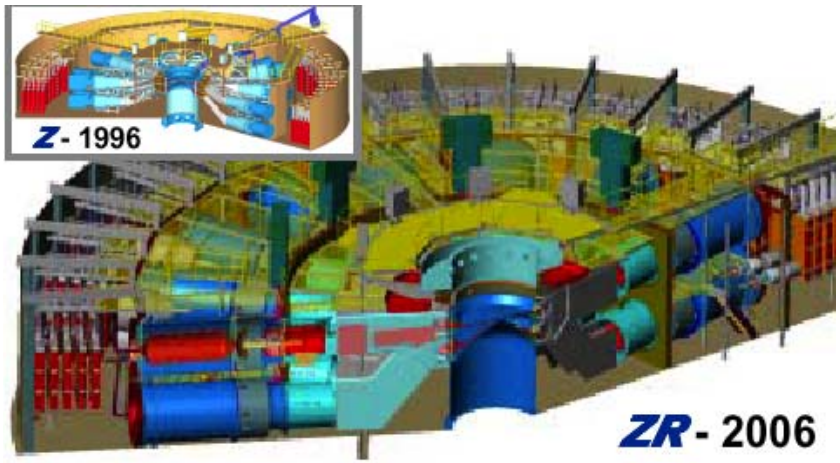
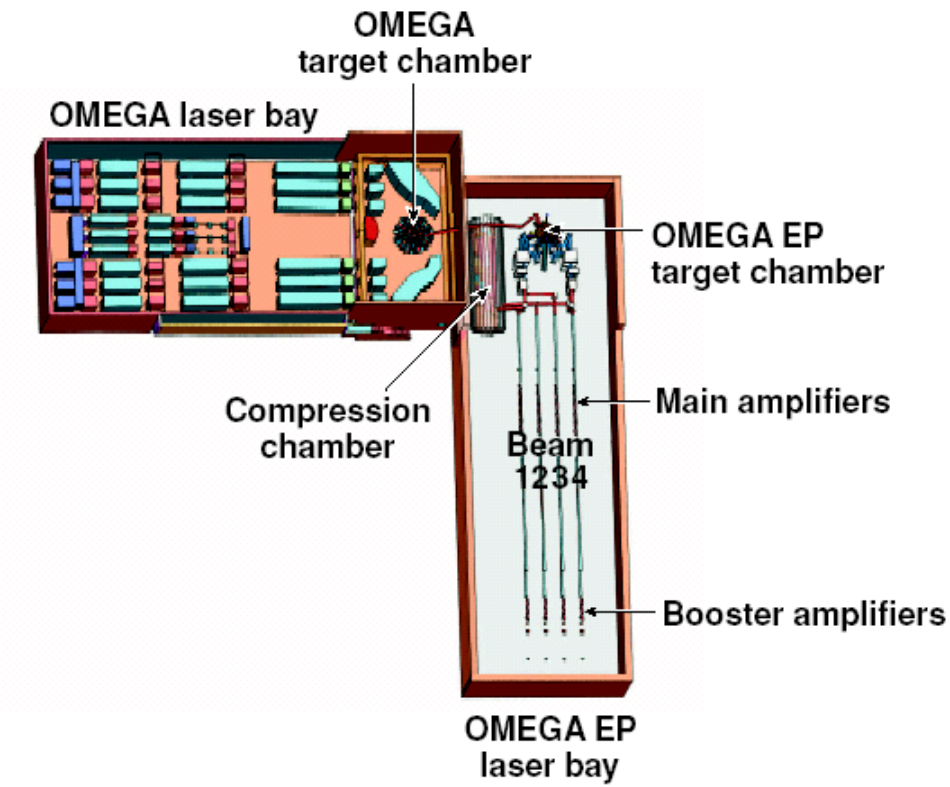
- Ignition appears feasible over a wider range of target and laser conditions and that range may widen further within a few years
- Predicted gains (fusion energy produced/laser energy input) have increased
- Direct drive ignition shows promise (~ 3 times higher gain than indirect drive)
- Recent experiments have shown improved target performance
  - High-quality direct-drive cryogenic target implosions (Omega)
  - Improved symmetry for indirect drive
  - Demonstration of neutron yield on Z-pinch driven implosions
- Significant progress has been made in producing cryogenic targets required for both x-ray and direct drive

A refurbishment of Z (ZR Project) is in progress



- Z machine originally constructed as R+D test stand
- Shot demand increasing, facility aging- refurbishment needed
- $57M total estimated cost, 4-5 year schedule

OMEGA Extended Performance (EP) Project has begun



- Will add two high-energy petawatt lasers for OMEGA for advanced backlighting and fast-ignition experiments
- $45-55M total estimated cost, 4-5 year schedule

The first four NIF beamlines have been commissioned to the center of the target chamber

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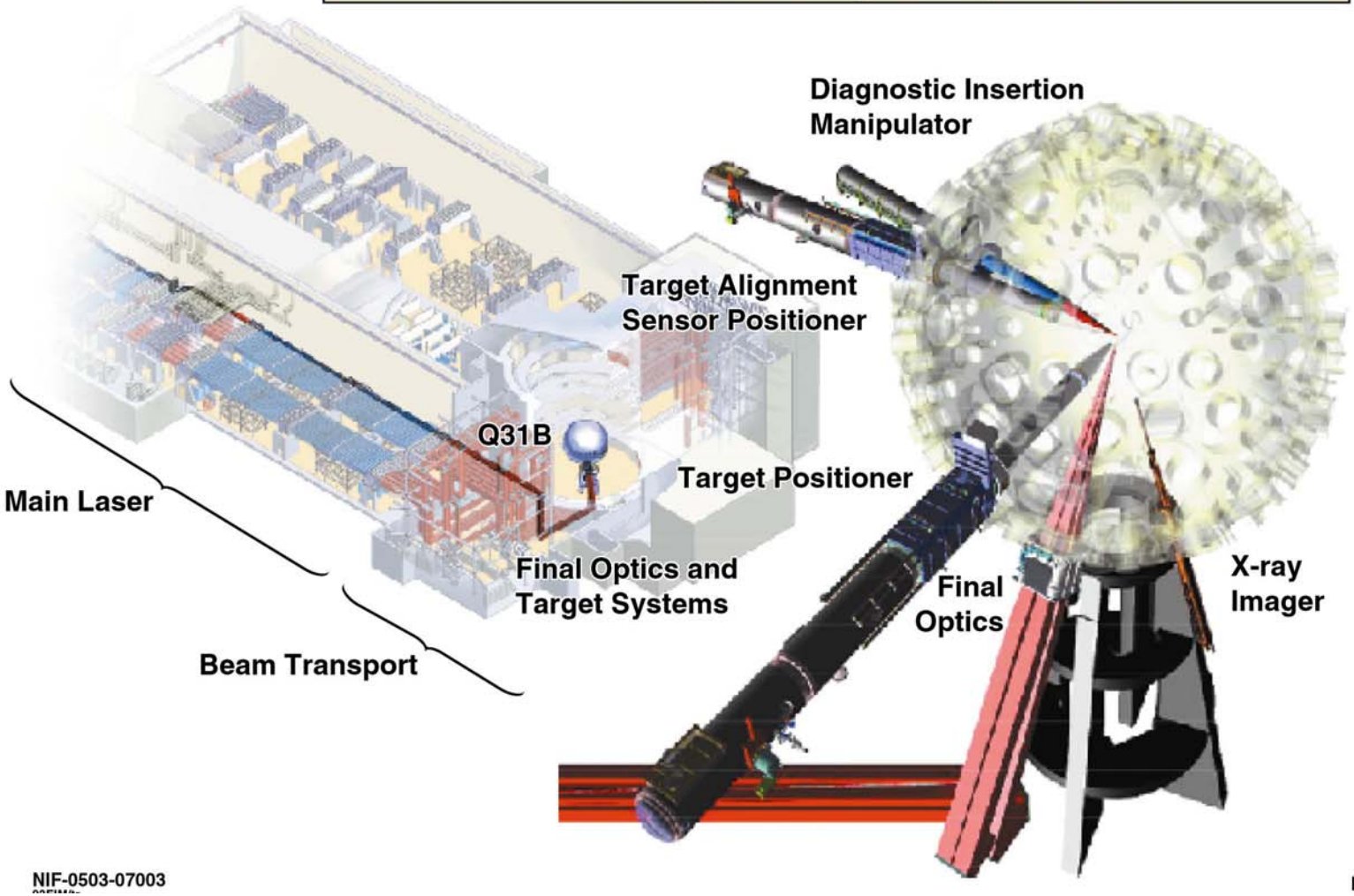
End-to-end functionality of all major subsystems demonstrated



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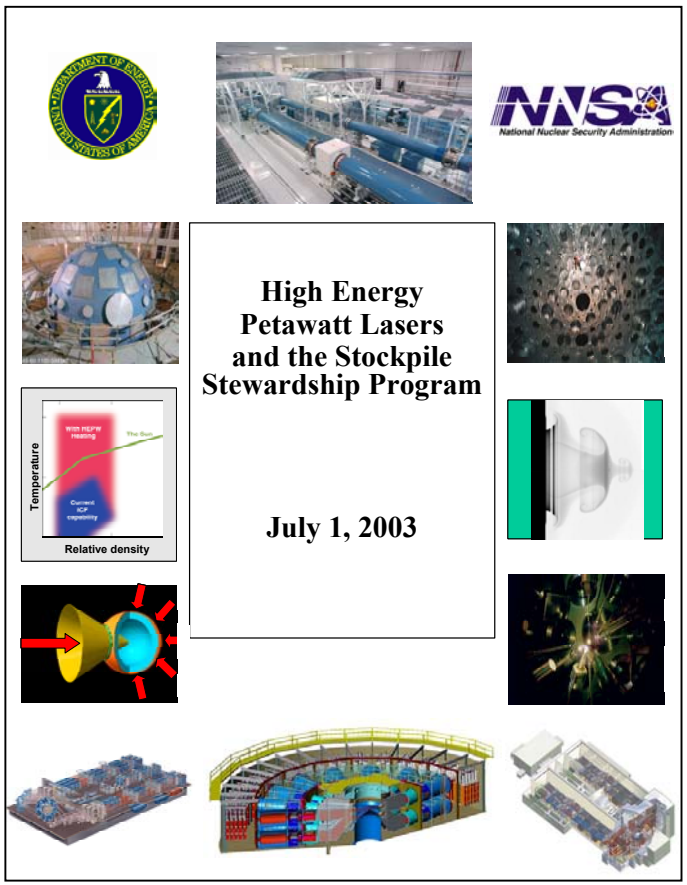
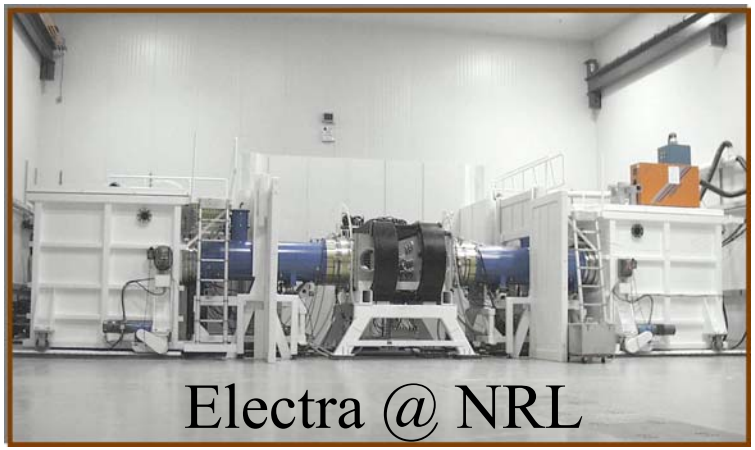
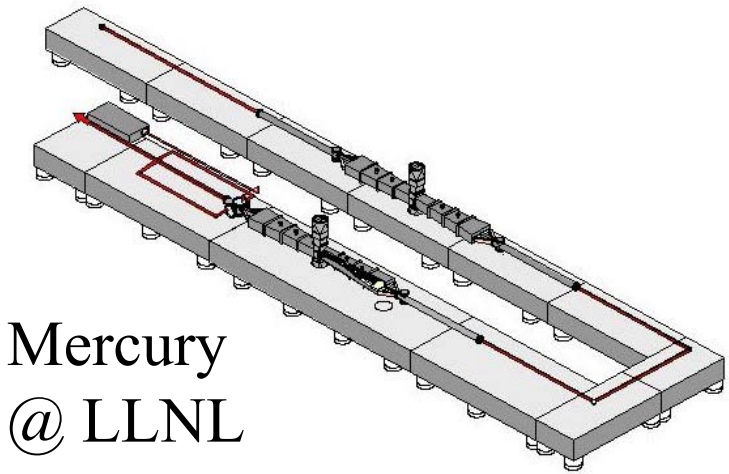
Petawatt Lasers are being studied as an essential SSP capability



- FY 2002 appropriation: Develop the National Petawatt Strategic Plan and determine the "programmatic need for a Petawatt Laser Facility."
- FY 2003 appropriation: Provide mission need report for the proposed OMEGA Extended Performance project.
- October 2002: NNSA conducts mission need review for OMEGA EP project
- February 2003: NNSA weapons labs and UR/LLE provide input to National Petawatt Strategic Plan
- March 2003: National Academy of Sciences reports on high energy density science support need for lasers
- April 2003: JASON panel recommends supporting HEPW lasers
- July 2003: NNSA submits Report and OMEGA EP mission need report to Congress

High Average Power Laser Program has been Congressionally Directed R&D in NNSA





- **Develop repetitively pulsed, efficient, and durable high energy lasers and associated technology**
  - **Mercury and Electra**
  - **Direct-drive target design, fabrication, characterization and injection**
  - **Chamber and optical materials**
- **Technology relevant to:**
  - **Inertial Fusion Energy**
  - **Inertial Confinement Fusion**
  - **Shot-on-demand for precise determination of material properties**

The future of ICF science is bright

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- 451 (27%) of papers presented at APS Division of Plasma Physics meeting were on ICF; over half the invited papers were OMEGA-related
- Recent NRC/NAS reports indicate the field is growing rapidly
- A worldwide “race” for high-energy petawatt lasers is in progress
- Strong Congressional support has helped maintain the vitality of U.S. ICF facilities

Summary

- Inertial fusion will be achieved, but inertial fusion energy is far in the future
- Precise nature of technology best suited to exploit ignition for energy will depend on what approach works best
- Fusion applications for Stewardship will continue to be developed well beyond achievement of ignition
- We need to develop a new generation of scientists for whom fusion isn't a goal, but a tool