

# Fundamental High Energy Density Science on the National Ignition Facility



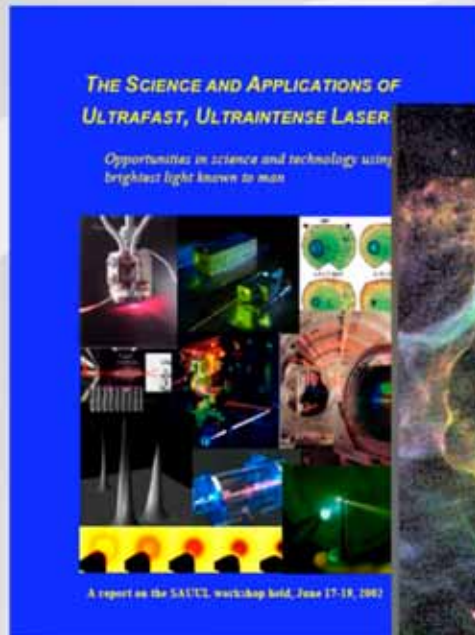
PRES-LLNL-416642

**Edward I. Moses, Principal Associate Director, National Ignition Facility & Photon Science**  
**Christopher J. Keane, Director of the NIF User Office**  
**Presented to: NIF - Jupiter users Group Meeting**  
**September 6, 2009**

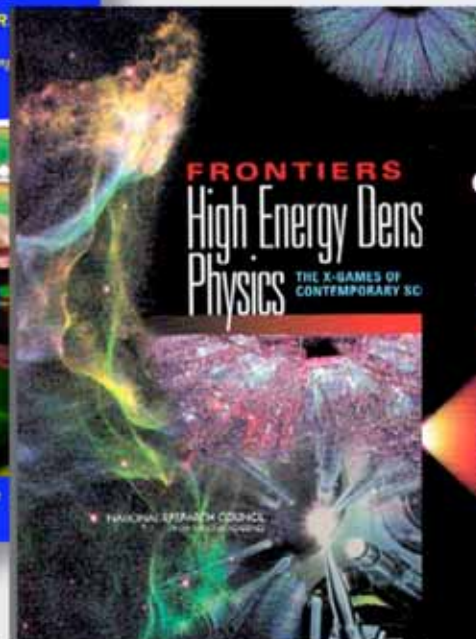
This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

# HEDS – An important emerging discipline

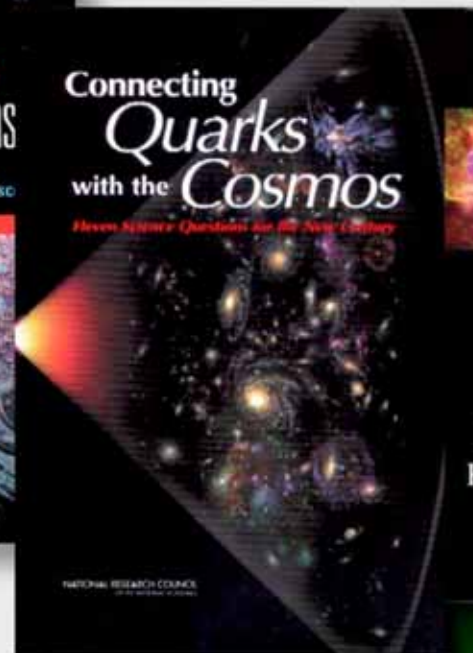
2002



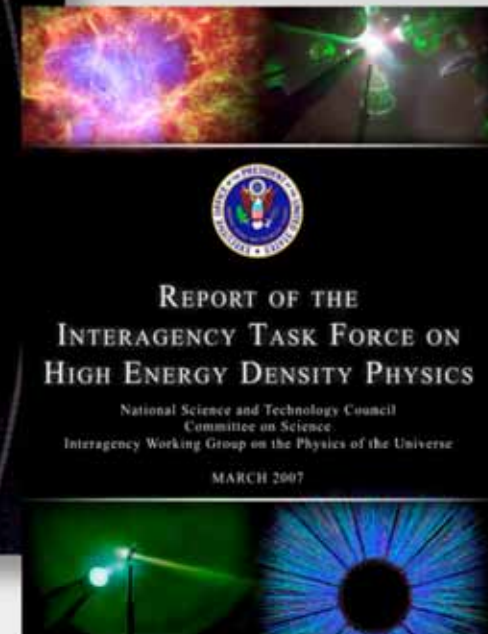
2003



2003



2007





# US HED facilities

## Omega, OMEGA EP Lasers



## Trident Laser



## National Ignition Facility Laser



## Jupiter Laser Facility

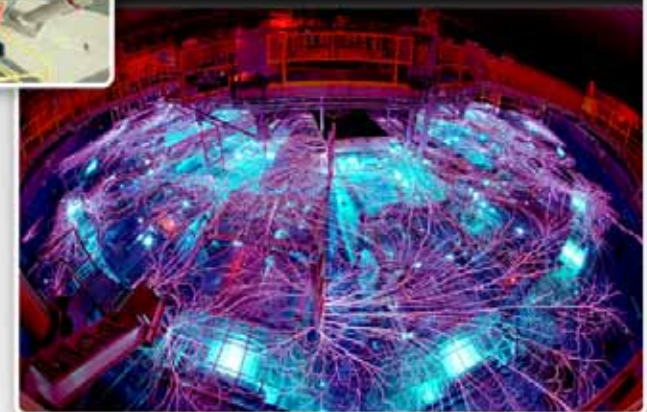
**10 TW Europa**

Crack Camera Test  
Atomic Physics  
100 fs Oscillator  
Harmonics and Calibrations  
Absorption

Capabilities	
Wavelength	800 nm, 400 nm
Contrast	$>10^9$
Energy	1 J, 1 m; 250 mJ, 20
Pulsewidth	<150 fs
Spot size	<3 $\times$ diffraction limited
Rep Rate	1 J @ 20/hour; 100 mJ @ 10 Hz

Fourier Domain Interferometry  
High Intensity X-ray generation  
High Intensity  $\beta$ -beam interactions  
X-ray lasers

## Z, ZR Z-Pinch Facility



# NNSA leadership spurring international effort

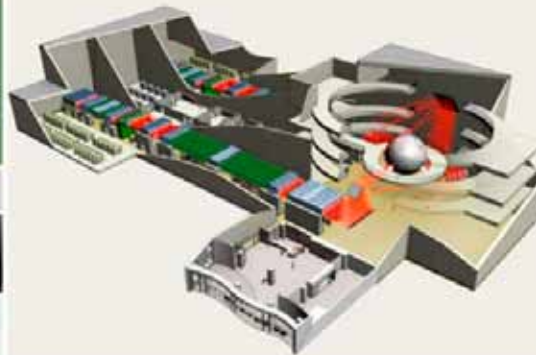
**LMJ (France)**



**ORION (UK)**



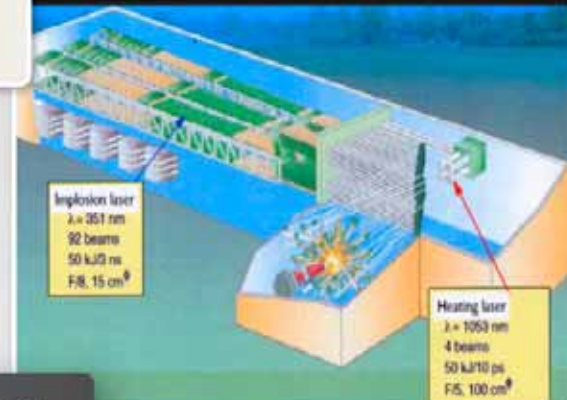
**HiPER (EU)**



**SGIII (China)**



**FIREX II (Japan)**



Activities are also being pursued in other countries



CERN



Chandra x-ray observatory



**NIF will be a premier international  
center for experimental science**



APS



SLAC



**We are developing academic users and need to continue growing this community**

**Astro/Nuclear Physics**



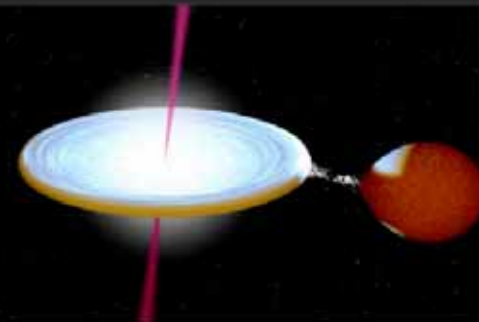
George Fuller, UC San Diego  
Carl Brune, Ohio State

**Ultra-Dense Matter**



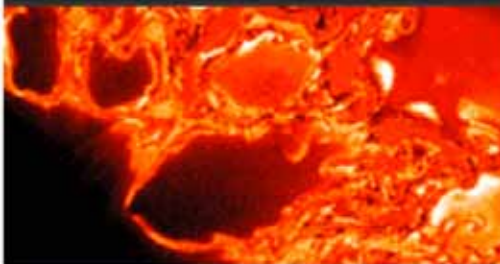
Tom Duffy, Princeton

**Burning Plasmas**



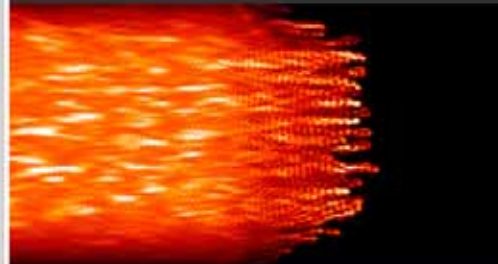
Steve Rose, Imperial College

**Supernova  
Hydrodynamics**



Paul Drake, Univ. of Michigan

**LPI and Ultra-Intense  
Light Sources**



Nat Fisch, Princeton

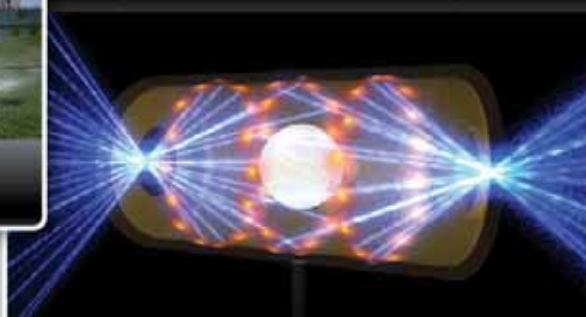
# NIF Master Strategy

## NIF Project



**Operational**

## National Ignition Campaign



**2006–2012**

## National User Facility

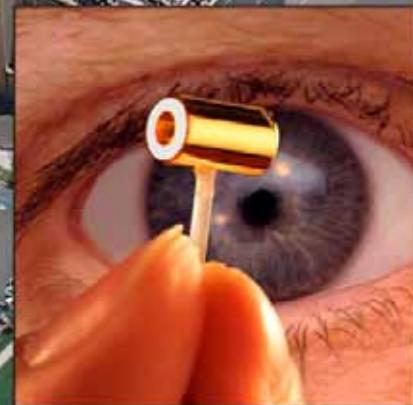


**2009–2030**



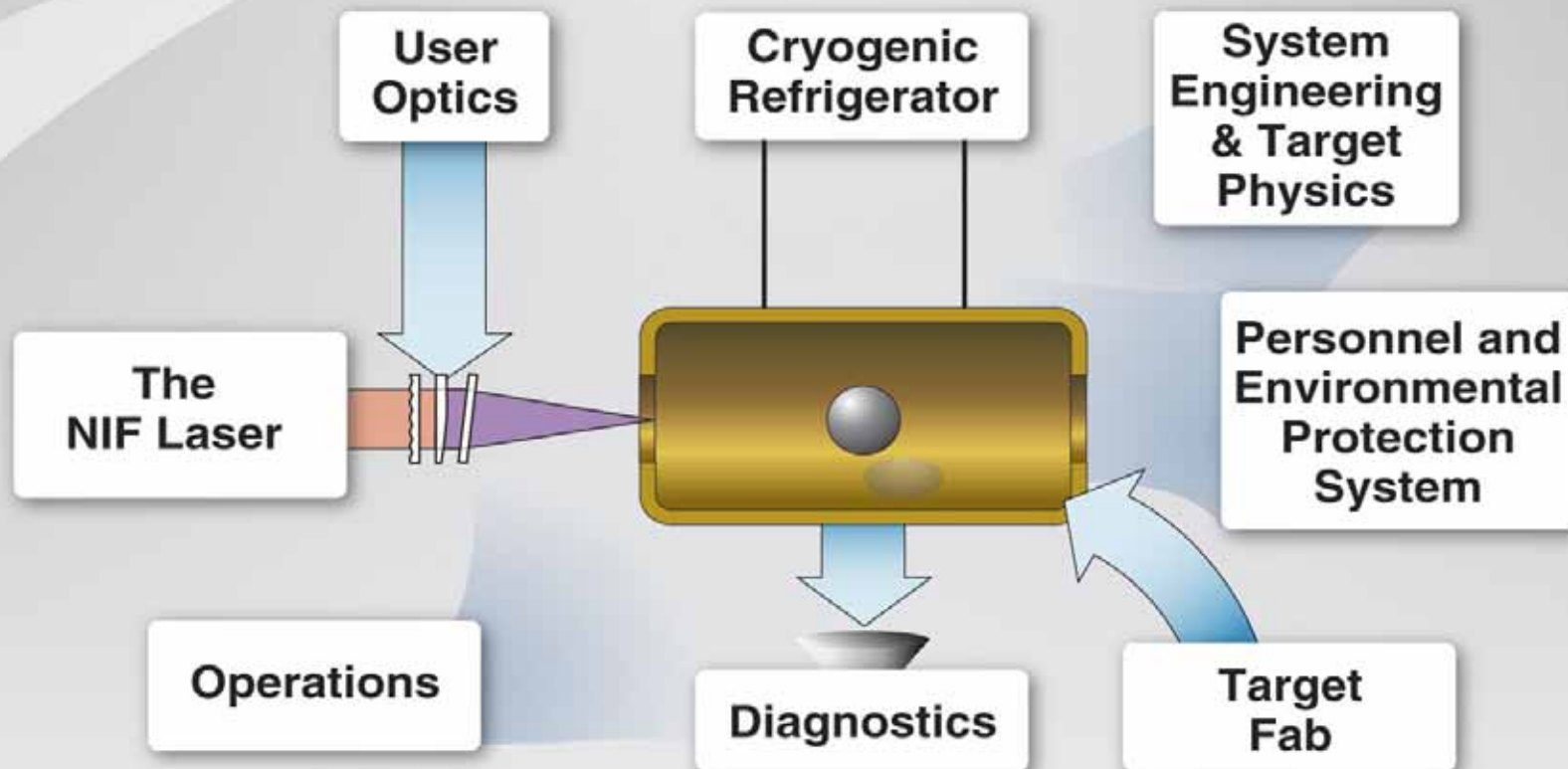
NIF concentrates all 192 laser beam energy  
in a football stadium-sized facility into a  $\text{mm}^3$

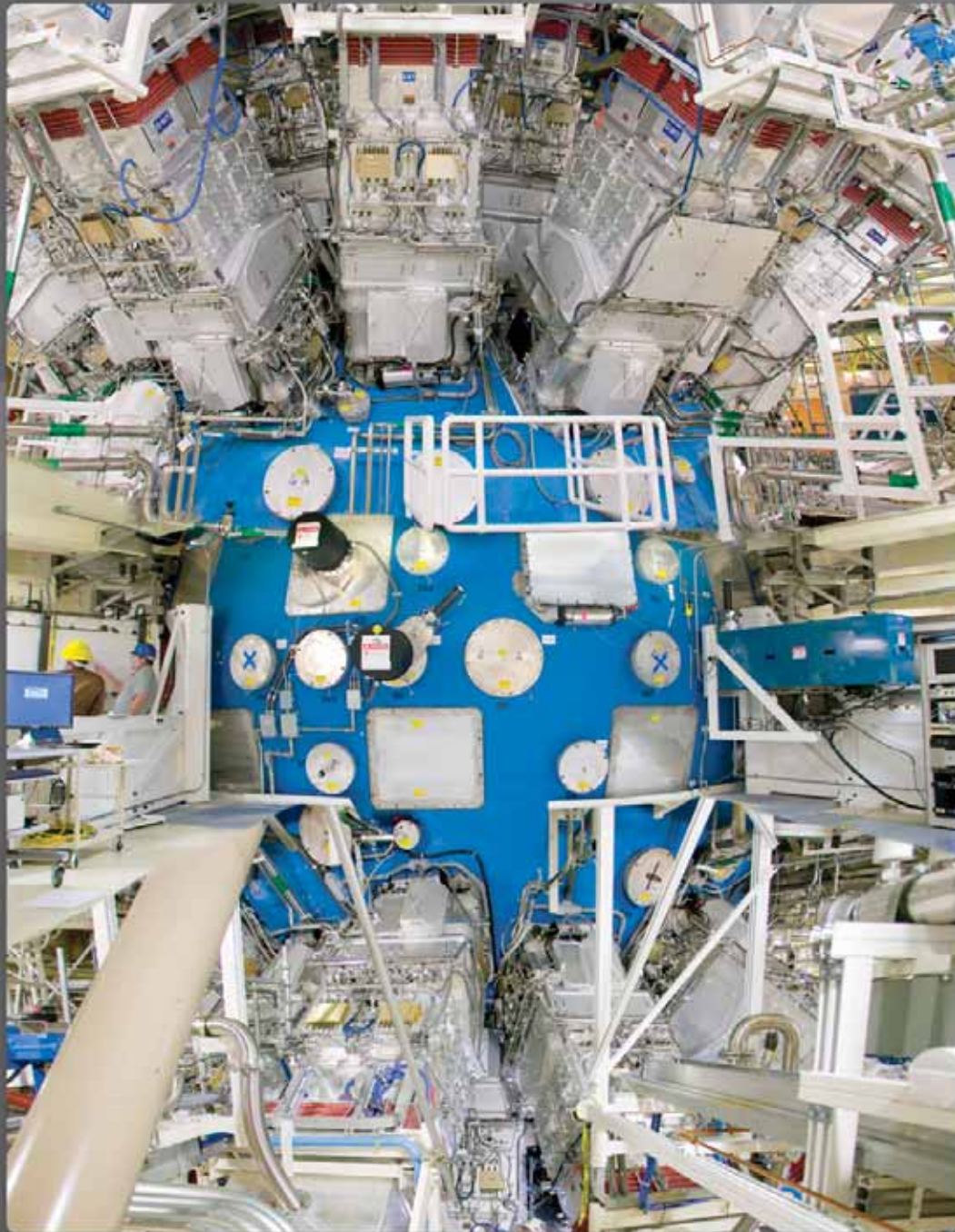
Matter  
Temperature  $>10^8 \text{ K}$   
Radiation  
Temperature  $>3.5 \times 10^6 \text{ K}$   
Densities  $>10^3 \text{ g/cm}^3$   
Pressures  $>10^{11} \text{ atm}$





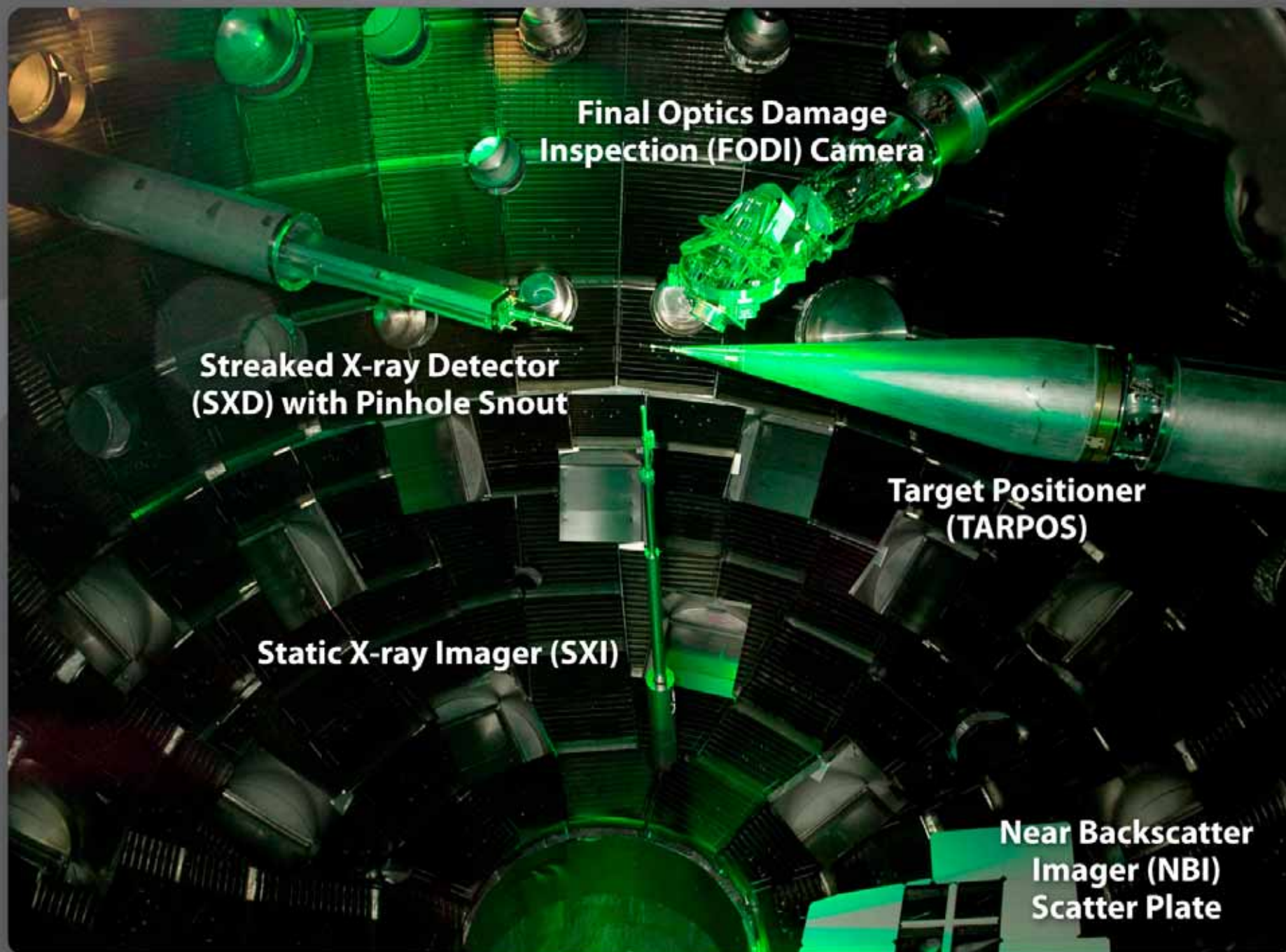
# Elements of NIC



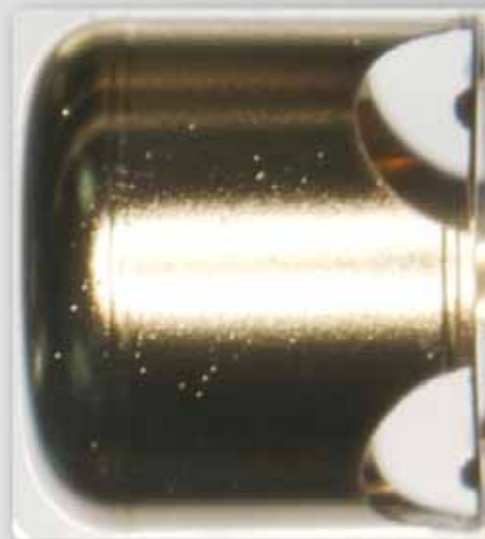


NIF laser operational  
192 beam shot at  
1.1 MJ  $3\omega$  on  
March 10, 2009





# Target Fabrication Capabilities





# First gas filled capsule in a warm gas filled Hohlraum August 28, 2009



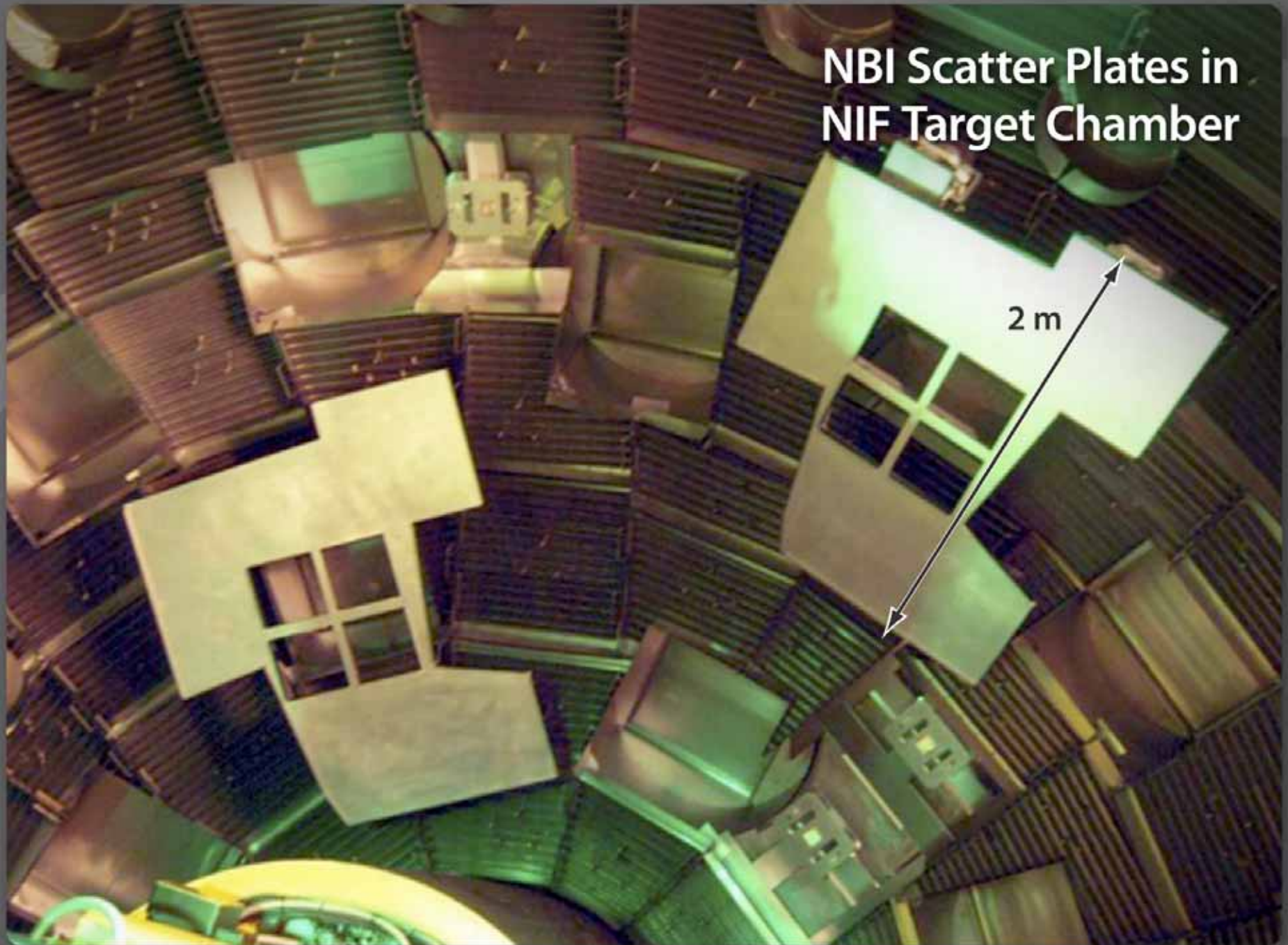


# Target Diagnostics





## NBI Scatter Plates in NIF Target Chamber





# Two LANL built Gated X-ray Detectors (GXD) undergoing acceptance test for the first energetics campaign in August



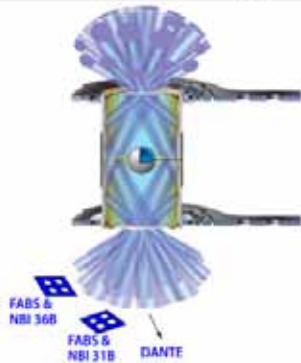


## LLE nTOF 4.5 installed 6/09

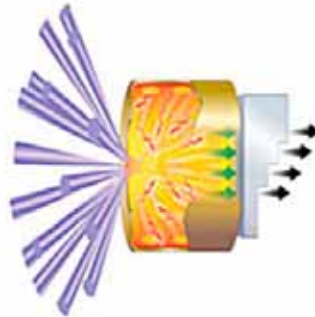
- Yield
- Bang-time
- Core Temp
- Downscattered neutrons

# NIF platforms available to users

## Hohlraum energetics



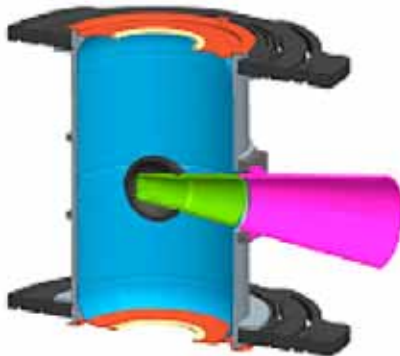
## Radiation transport



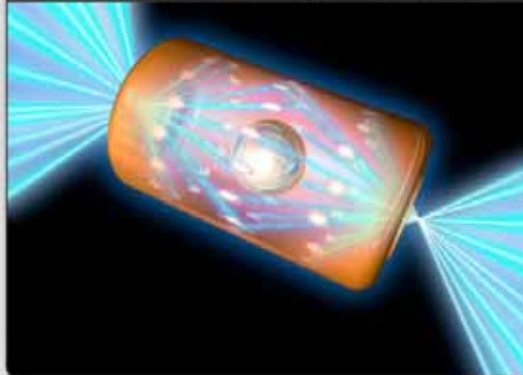
## X-ray opacity



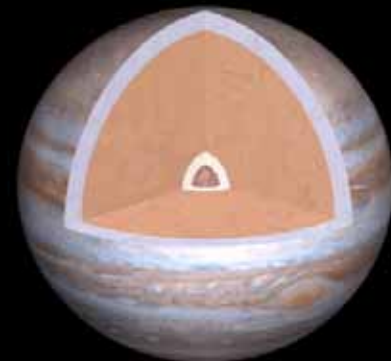
## Shock timing



## Capsule implosions



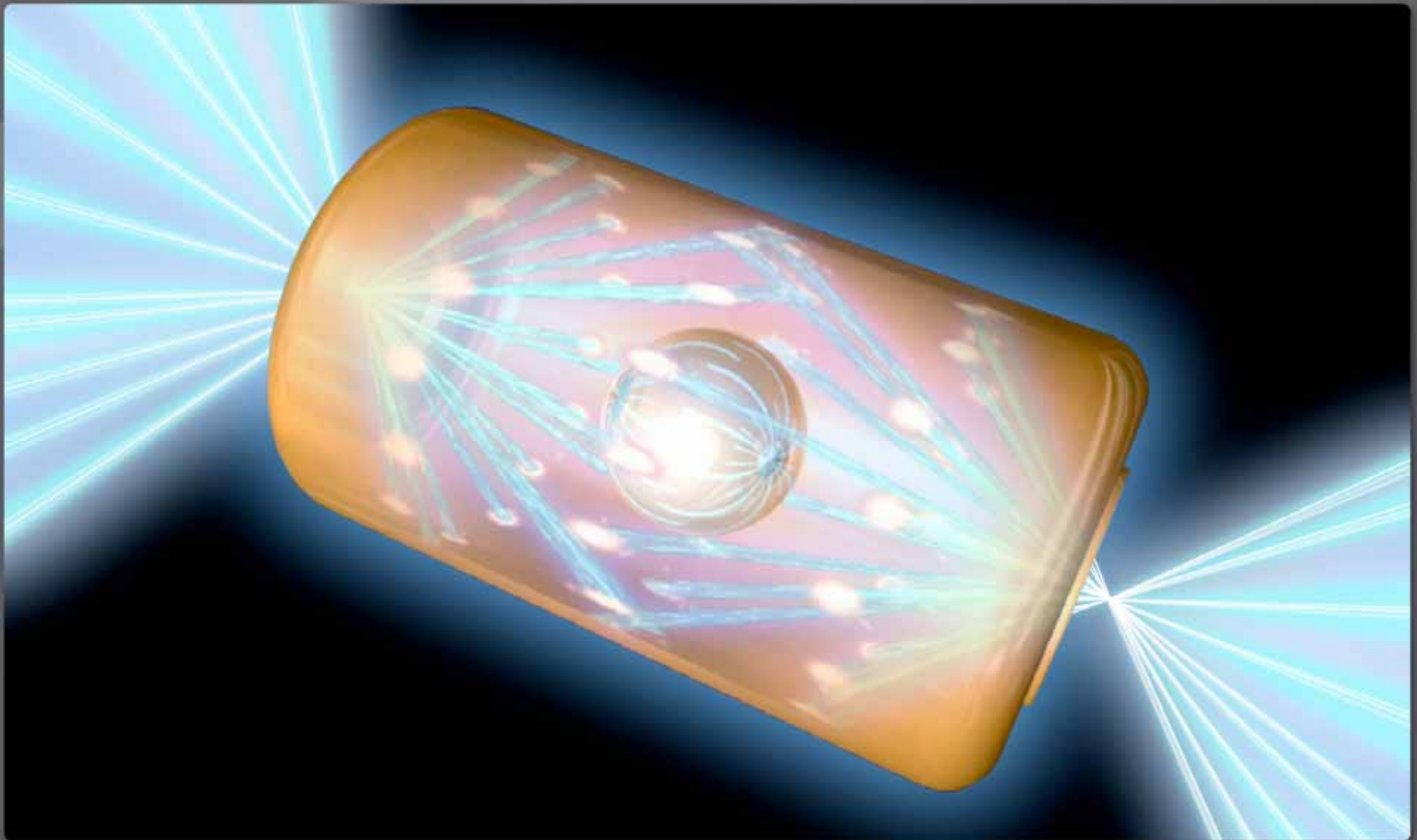
## Materials



More information at: [https://lasers.llnl.gov/for\\_users](https://lasers.llnl.gov/for_users)



The long-sought goal of achieving self-sustained nuclear fusion and energy is close to realization



DRAFT- PREDECISIONAL

## National Ignition Facility Governance Plan



August 31, 2009

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**Proposed NIF experiments will be reviewed by an advisory committee chaired by Dr. Robert Rosner**



# Call for proposals: Fundamental High Energy Density Science Experiments at the NIF



Visit us on the web at:  
<https://lasers.llnl.gov/>

## NIF Call for Proposals Facility time

- Letter of Intent due 12/01/09
- Open to academic/private sector/national lab scientists

CERN



Chandra x-ray observatory



**NIF will be a premier international center for experimental science**



APS



SLAC



**“ I am personally committed as NIF Director to developing external access and fundamental science at NIF”**



