

NIF: Transition to a Target Shooter

**Presentation to
Fusion Power Associates
Annual Meeting and Symposium**



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NIF-0703-07093_72
08EIM/tr

P6030

Agenda



The National Ignition Facility

Introduction

Architecture

Beam Path Status

Nearing Completion

Technology Status

LRUs and Optics

NIF Early Light

Meeting Full Specifications

Experimental Capability

Diagnostics, Cryo, Optics

Enhanced Capability

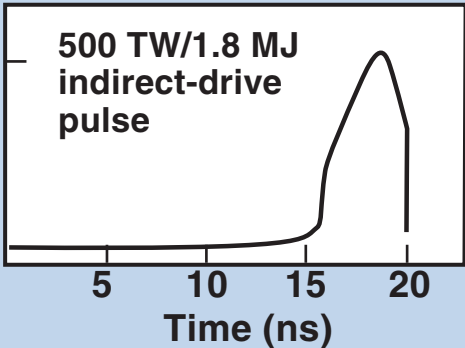
Fiscal Year	Beams Available	Key Milestones
FY03	0	Early quad
FY04	~12	Full bundle
FY05	~24	6-quad DD planar
FY06	~48	1st cluster, 10-quad halfraums
FY07	~96	12-quad halfraums, 4-fold, 2-cone symmetry
FY08	~144	8-fold 2-cone symmetry, 4-quad vert. DD planar, 4-fold symmetry
FY09	192	Full NIF, more inner beams better symmetry

HEPW, 2 ω

Performance of the National Ignition Facility



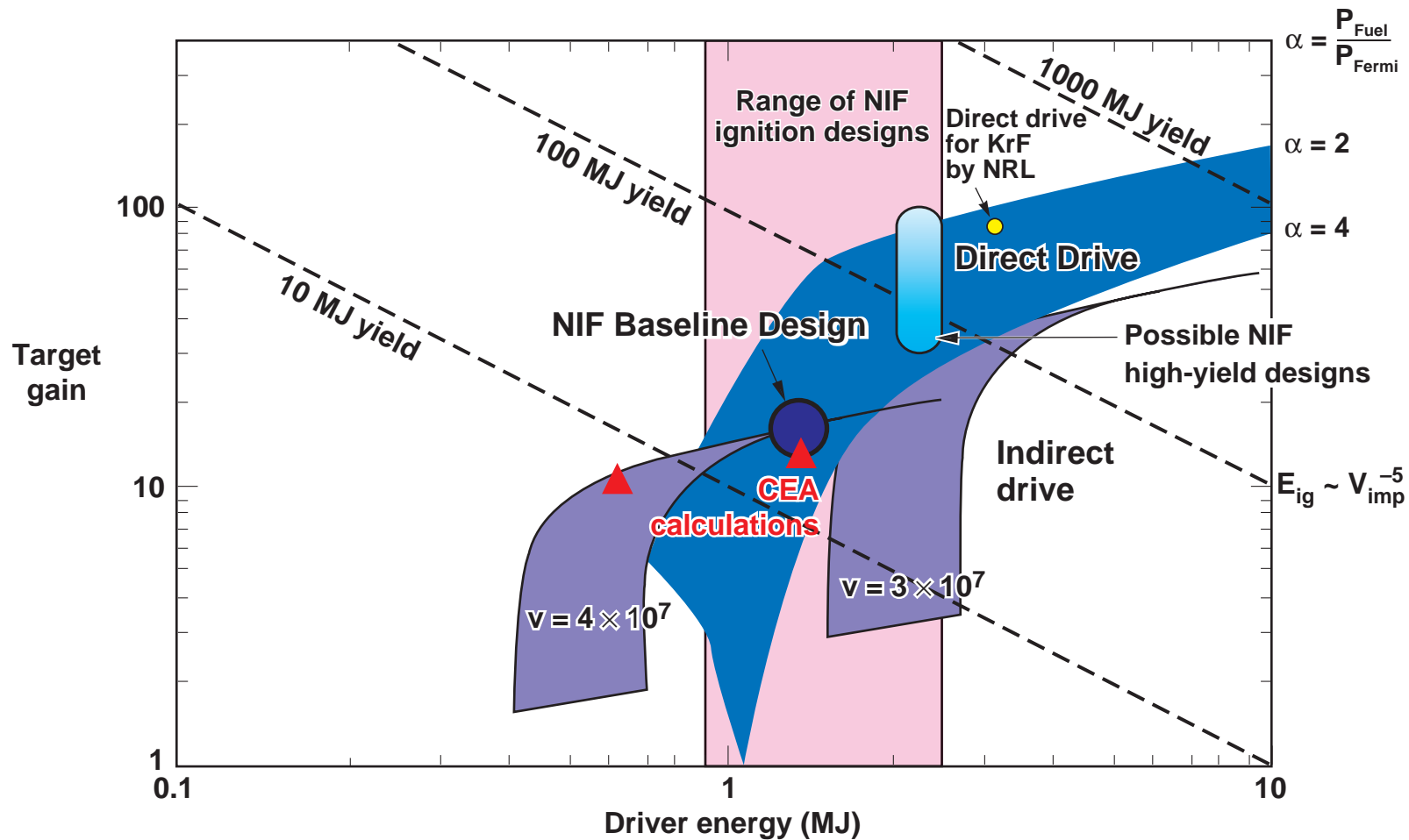
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Performance parameter	Value
Energy	1.8 Megajoules
Power	500 Terawatts
Wavelength	351 nm
Pulse length	1 to 21 nsec
Pulse shape	Flexible,
	
Power balance	8% over any 2-nsec interval in 48 beams spots
80% focal spot diameter	250 to 350 microns

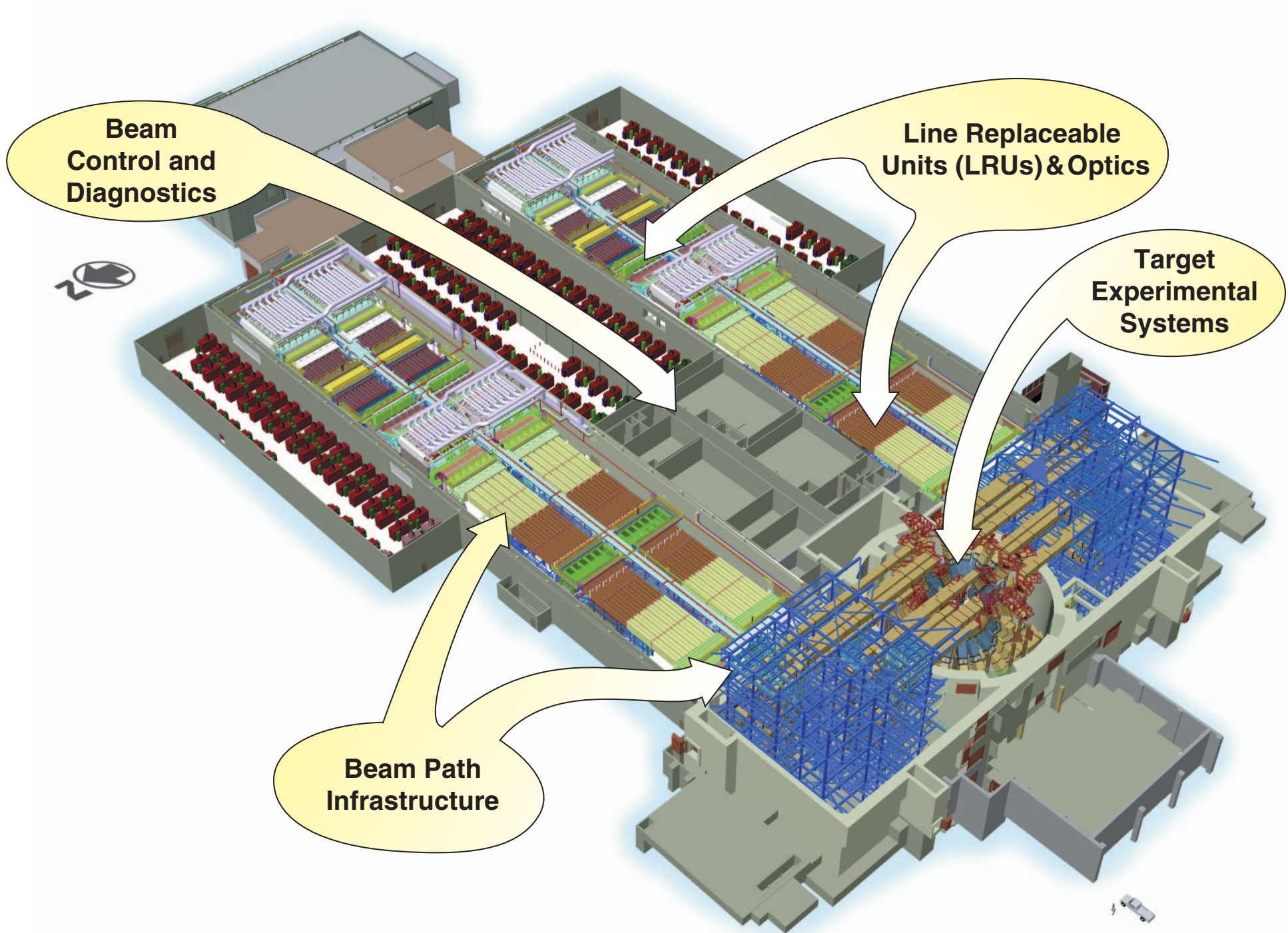
NIF will map out ignition and gain curves for multiple target concepts

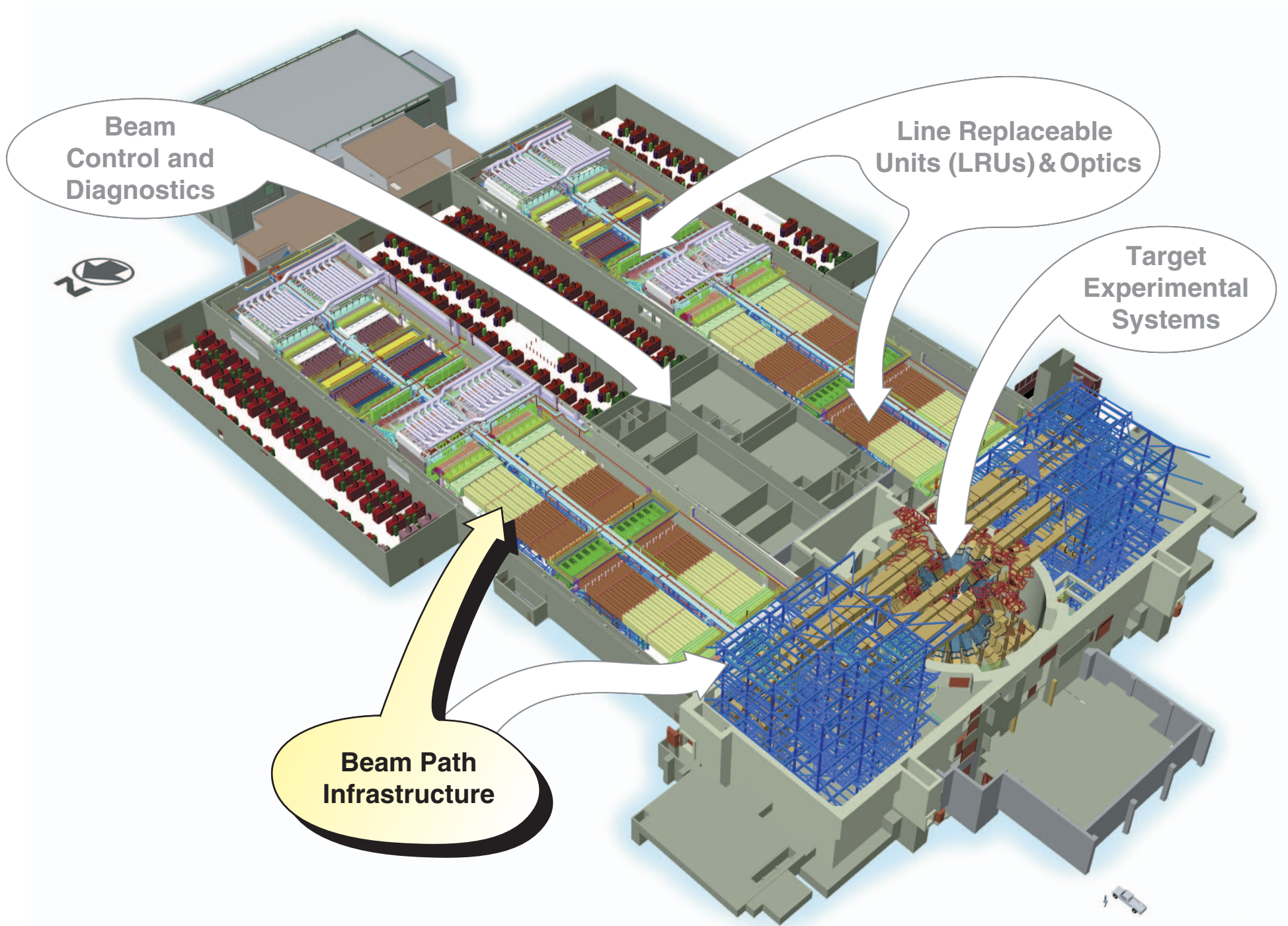


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**Beam
Control and
Diagnostics**

**Line Replaceable
Units (LRUs) & Optics**

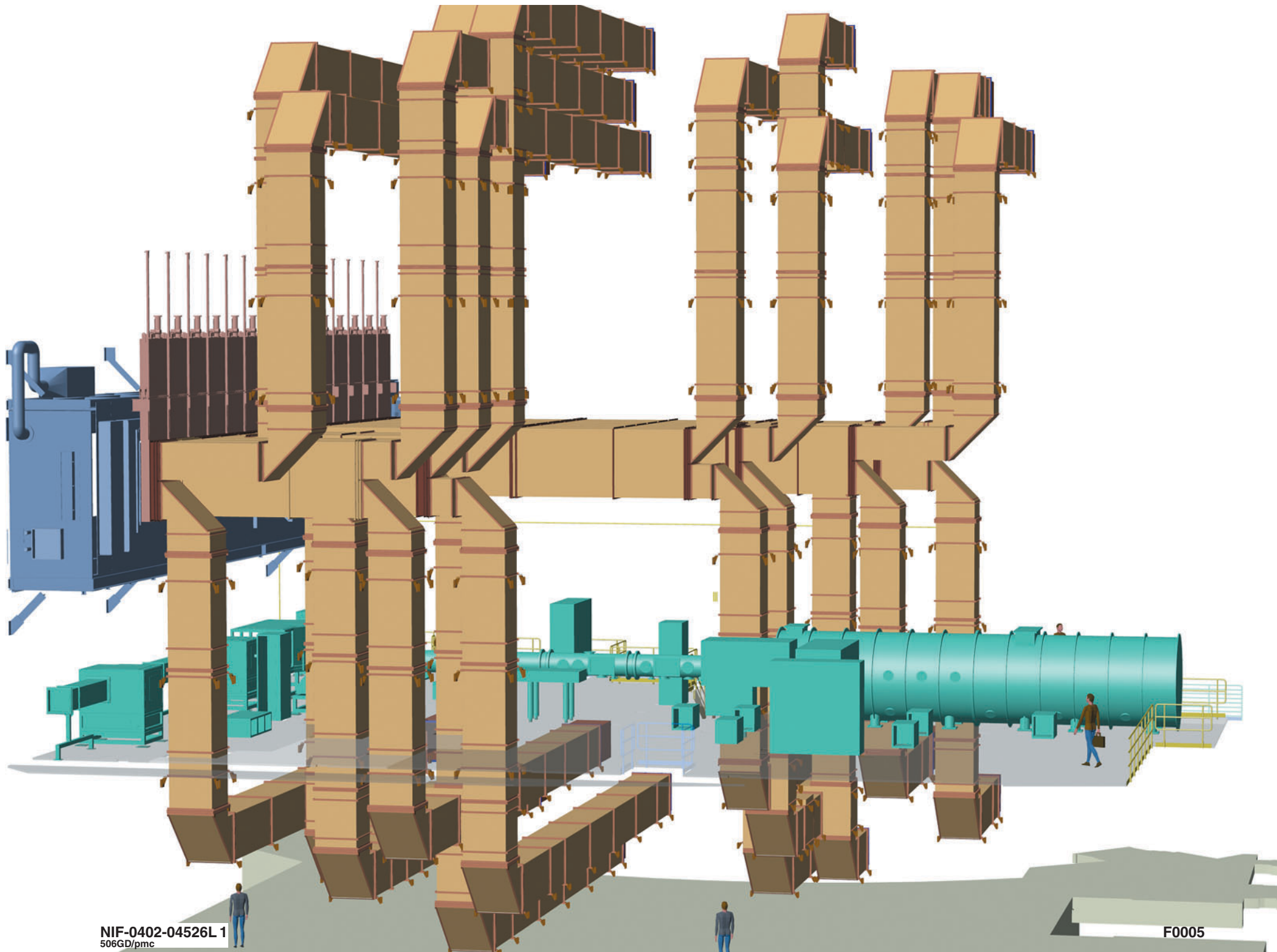
**Target
Experimental
Systems**

**Beam Path
Infrastructure**







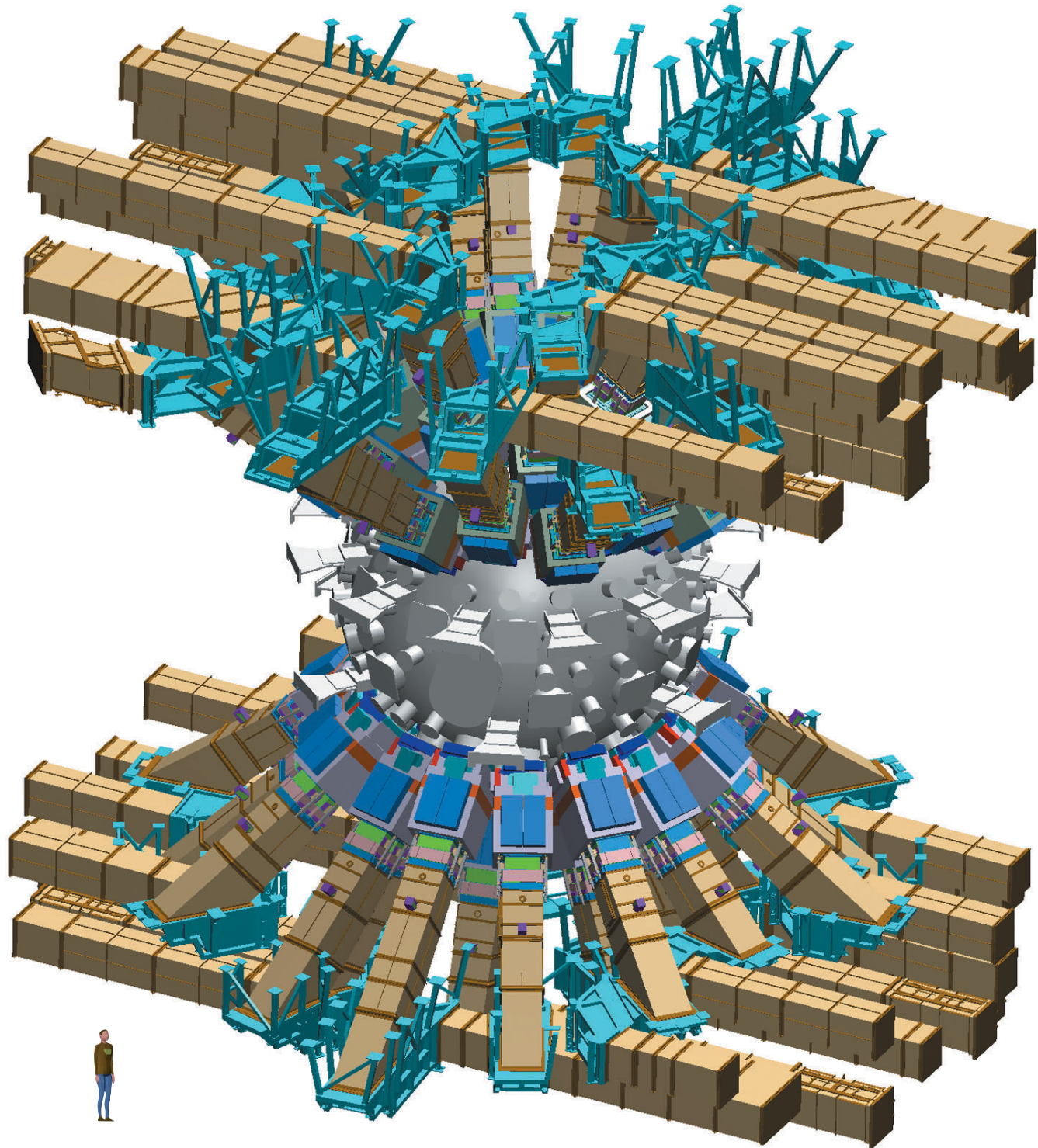


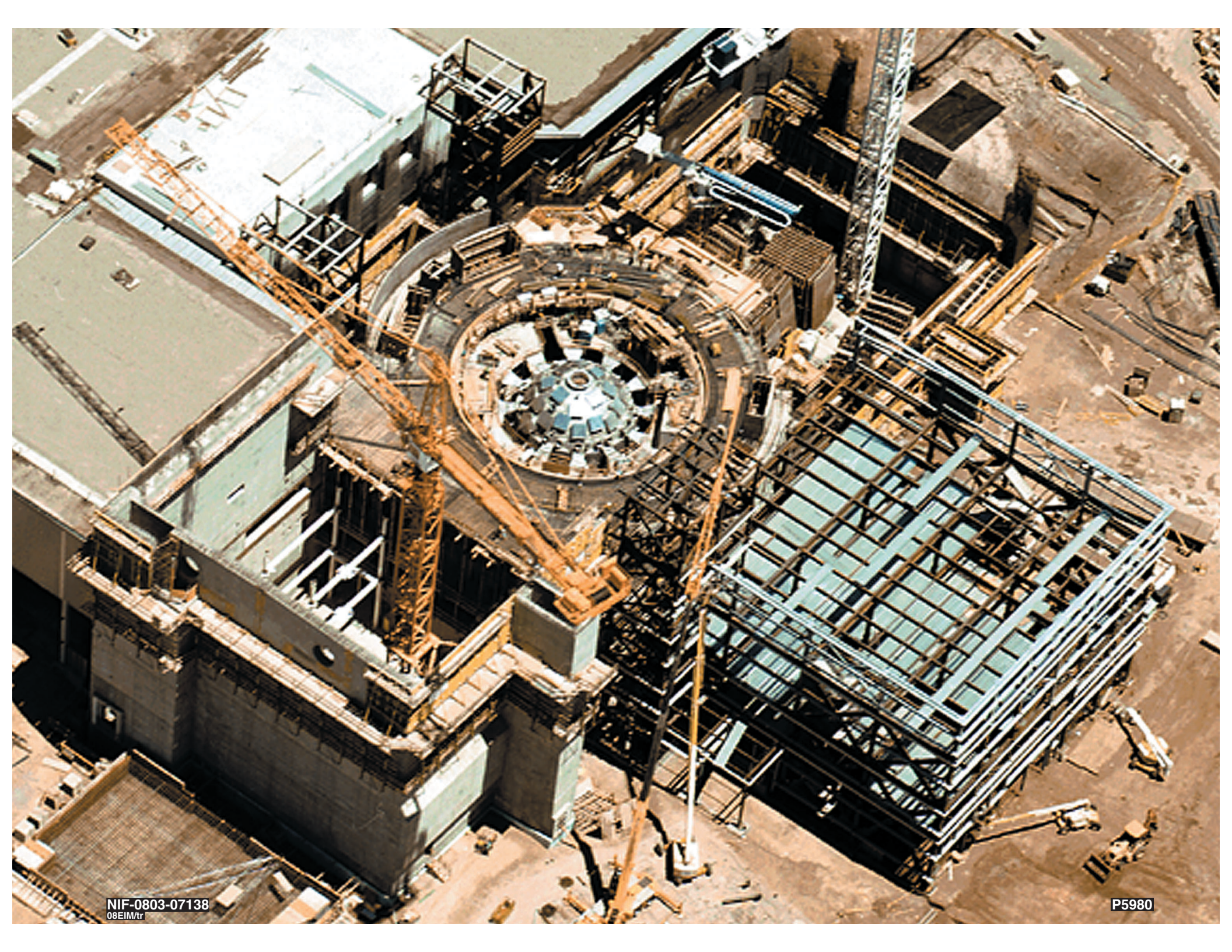
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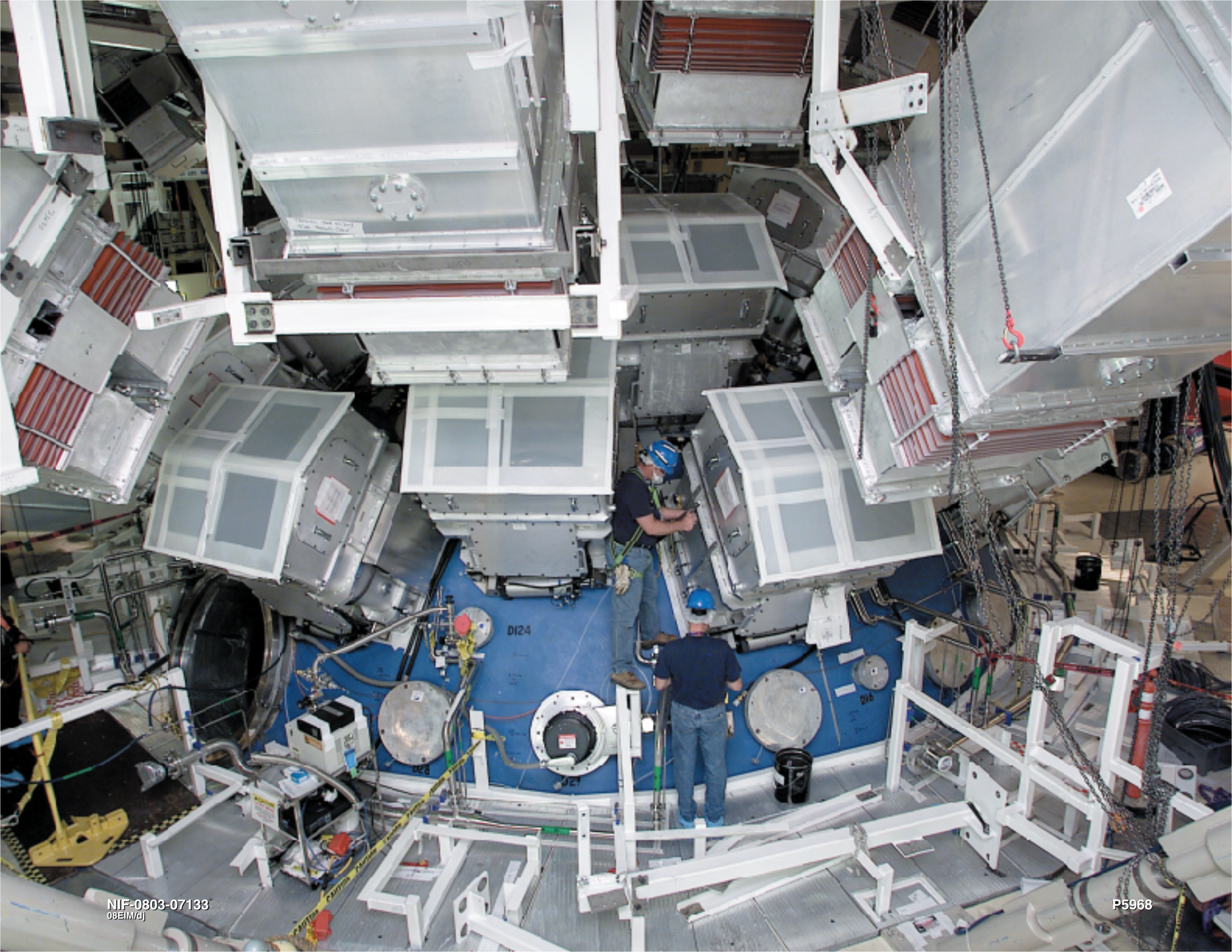






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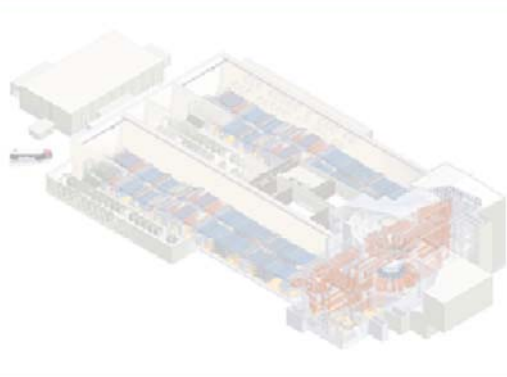


NIF-0501-02172

X2235


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Introduction



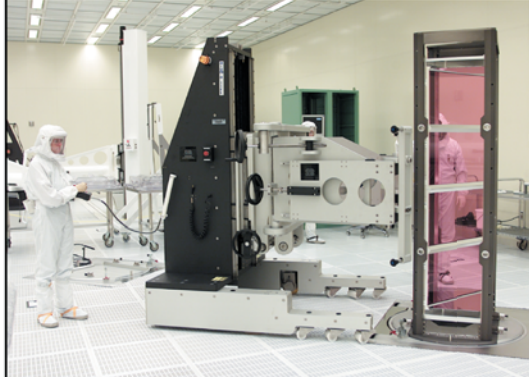
Architecture

Beam Path Status



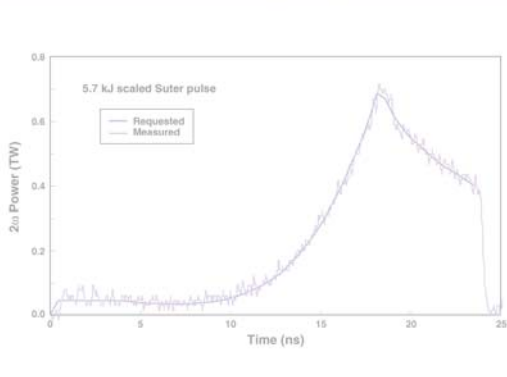
Nearing Completion

Technology Status



LRUs and Optics

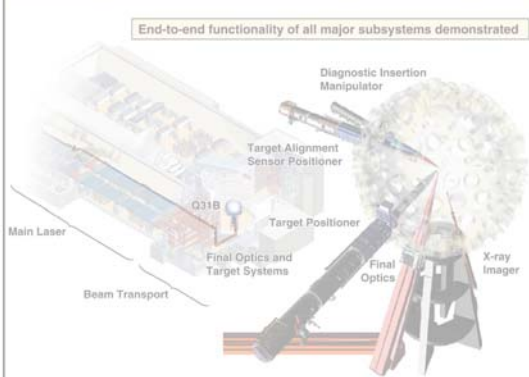
NIF Early Light



Meeting Full Specifications

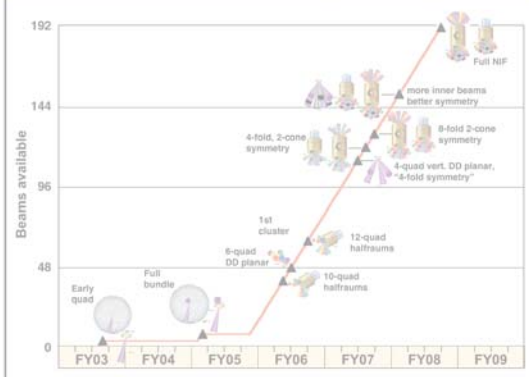
Experimental Capability

End-to-end functionality of all major subsystems demonstrated



Diagnostics, Cryo, Optics

Enhanced Capability

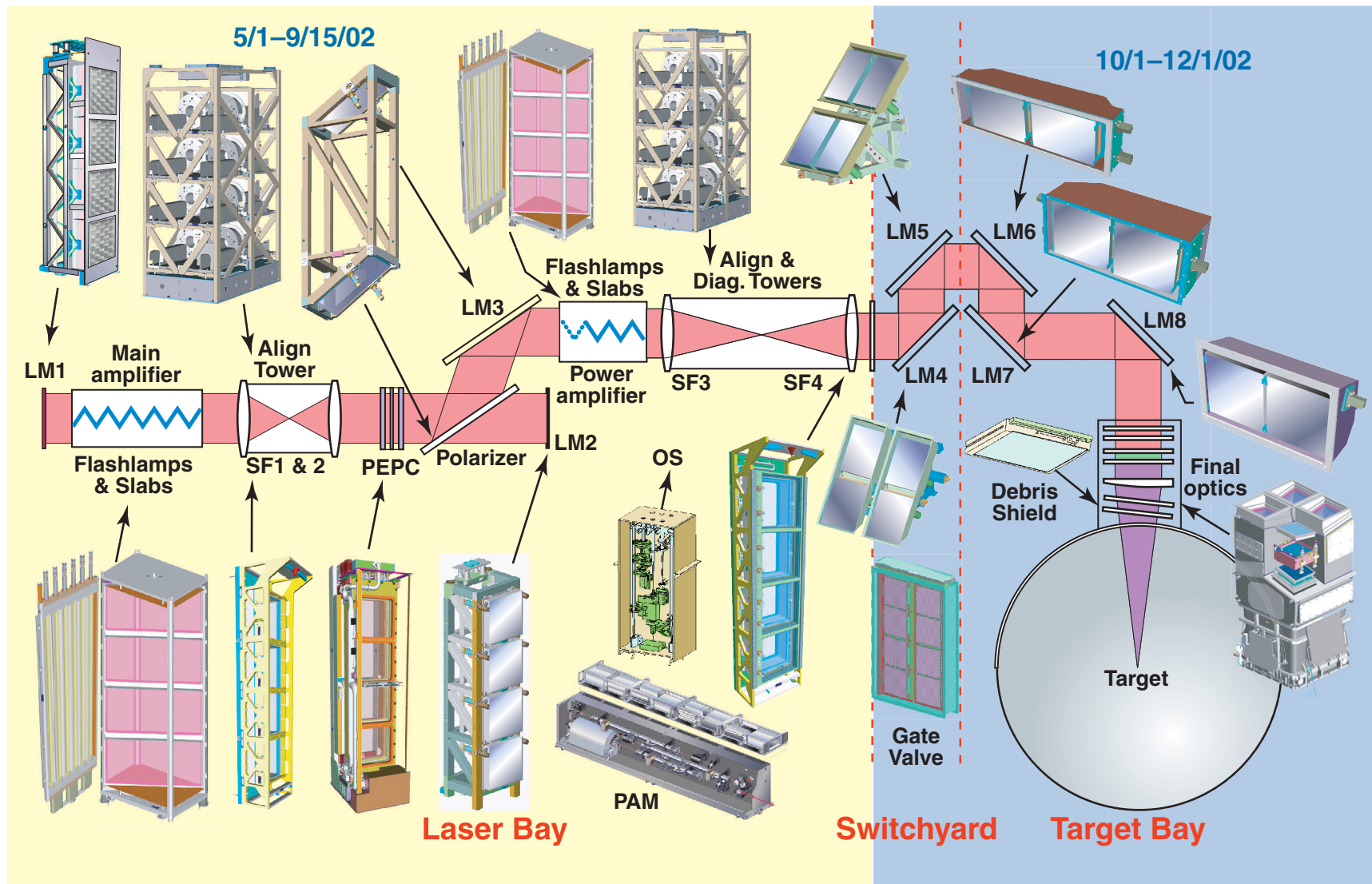


HEPW, 2 ω

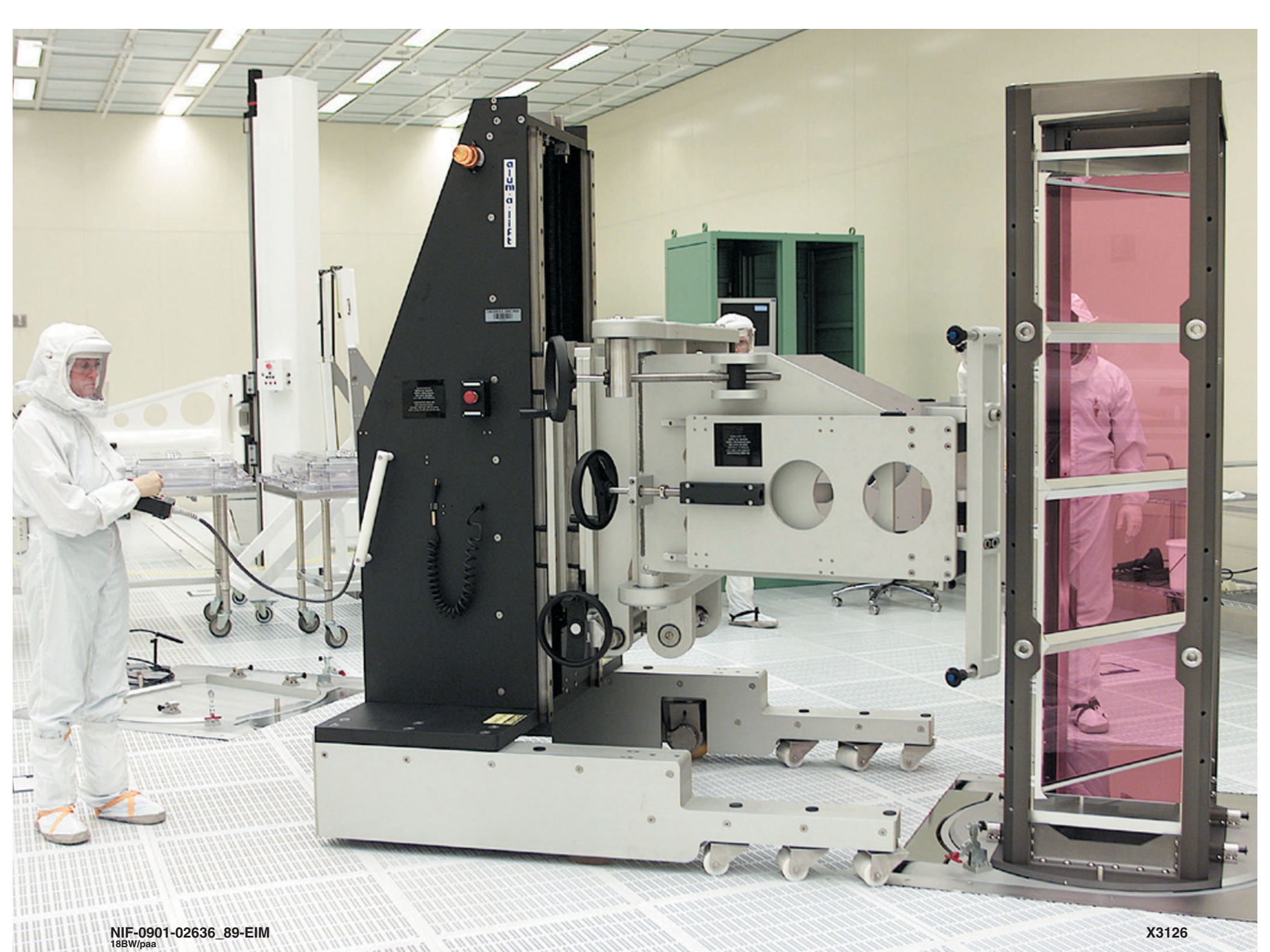
Beamline and Line Replaceable Units



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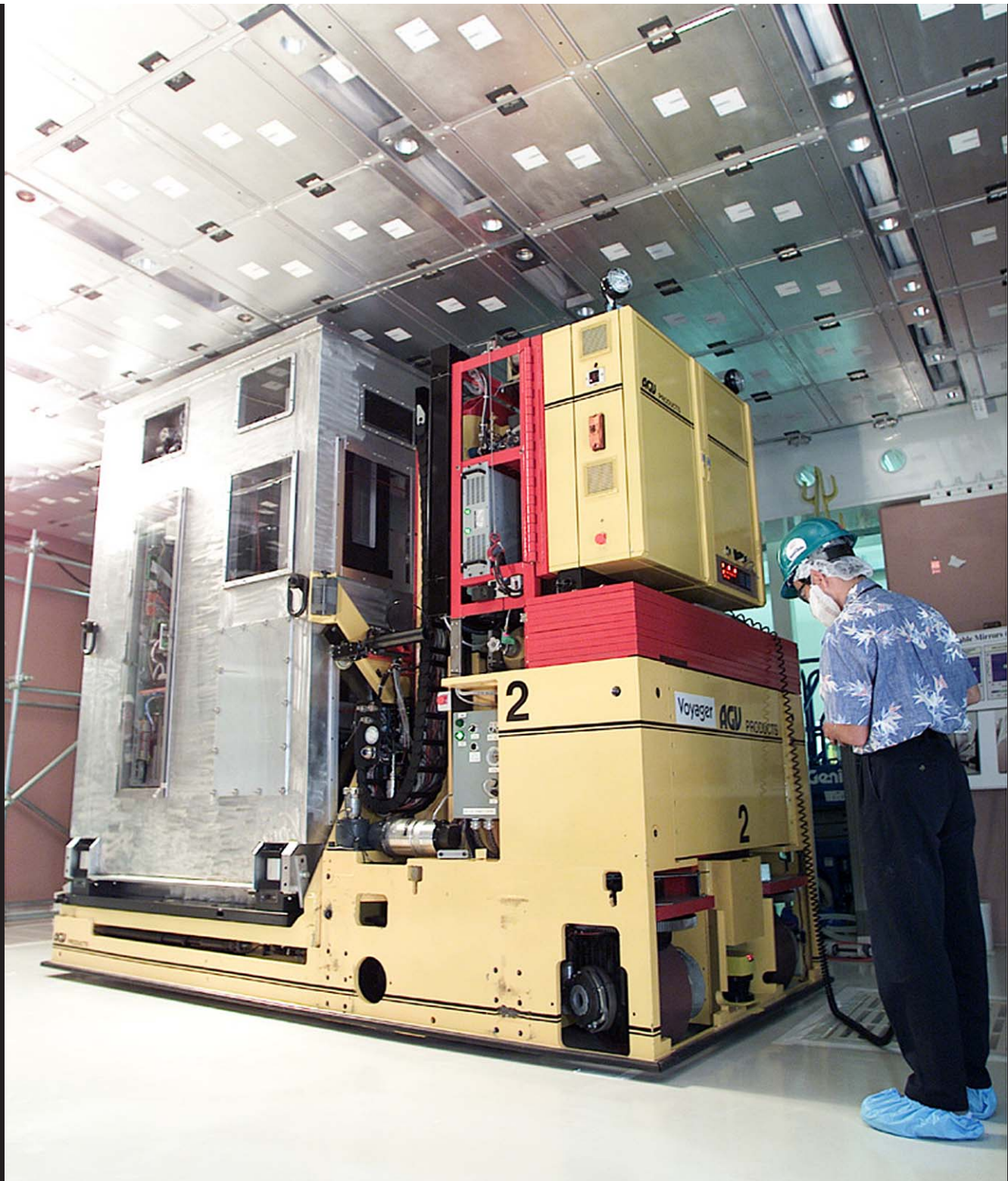




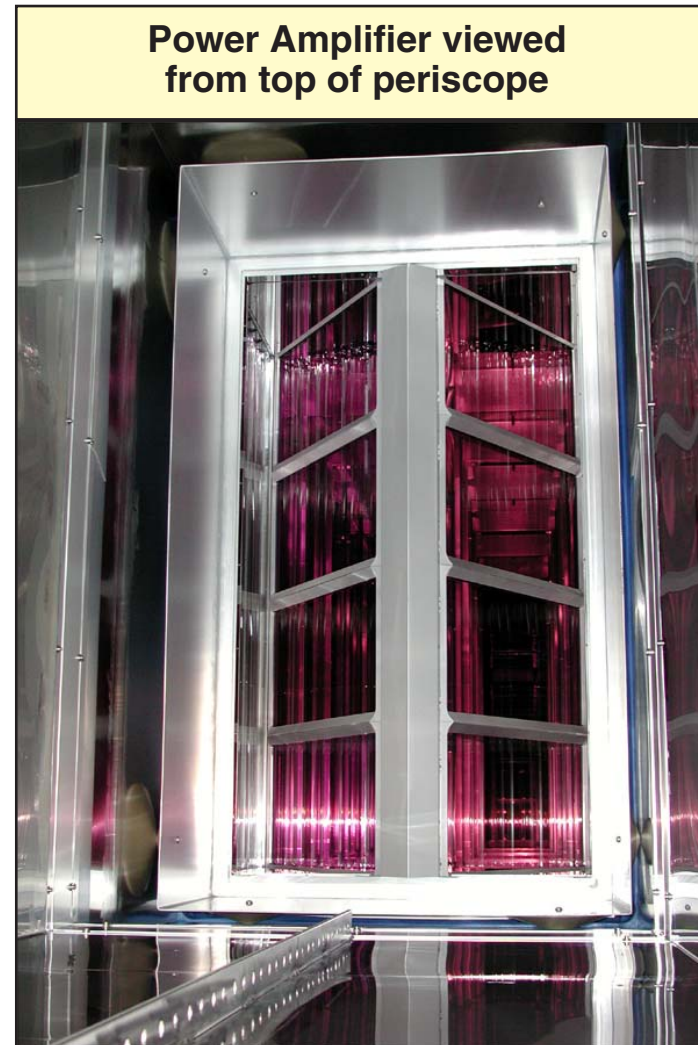








Interior of the amplifier



Major amplifier components are glass slabs and flashlamps



40-00-0100-0215#581
23GM/mcm

P5486



Forward
Technology

70-00-1199-2650A
23LH/skl

X4125



LRUs

Commissioning Operations Control Room



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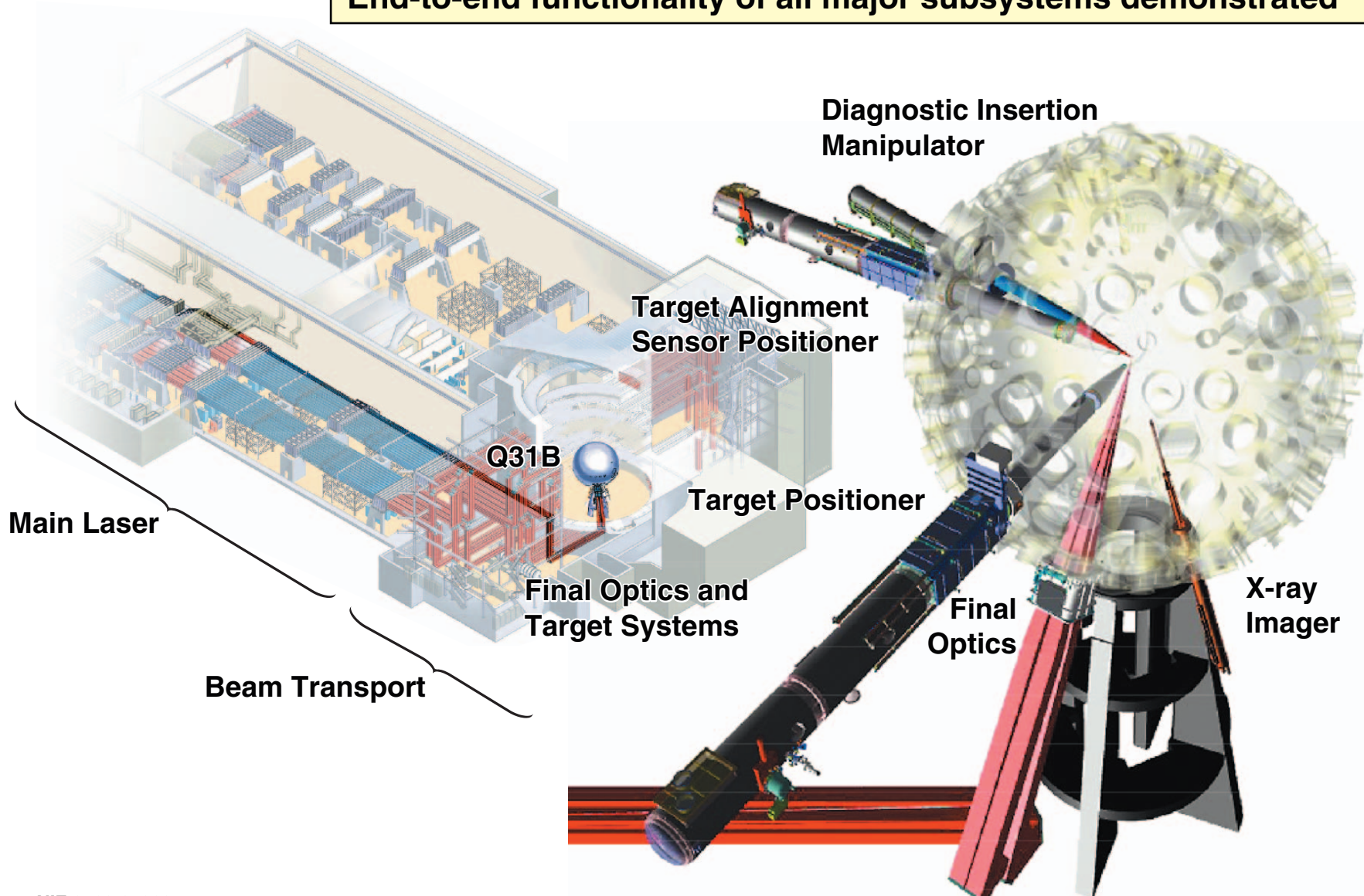
Diagnostics, Cryo, Optics

Enhanced Capability

HEPW, 2 ω

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

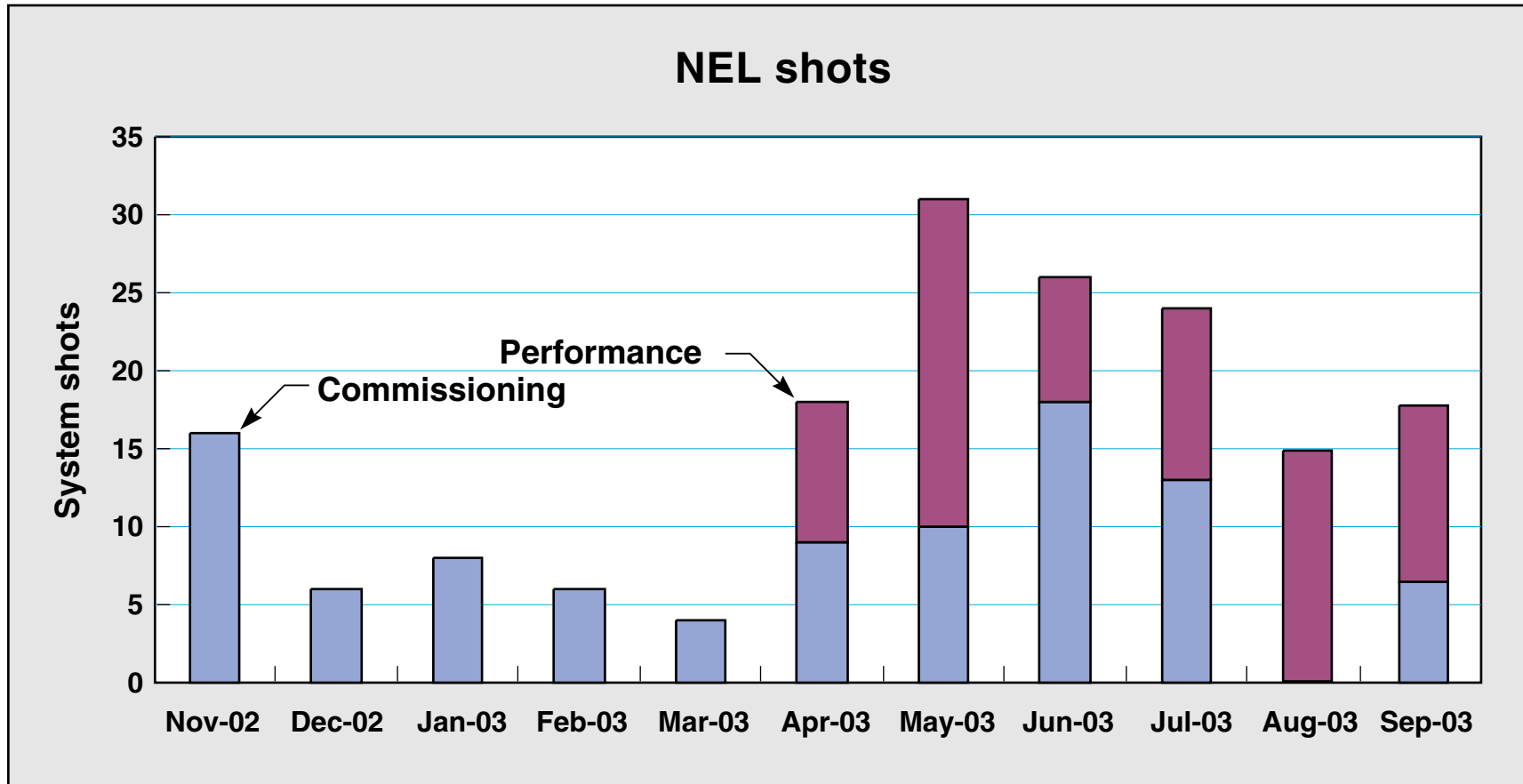
End-to-end functionality of all major subsystems demonstrated



NEL has fired over 173 system shots so far



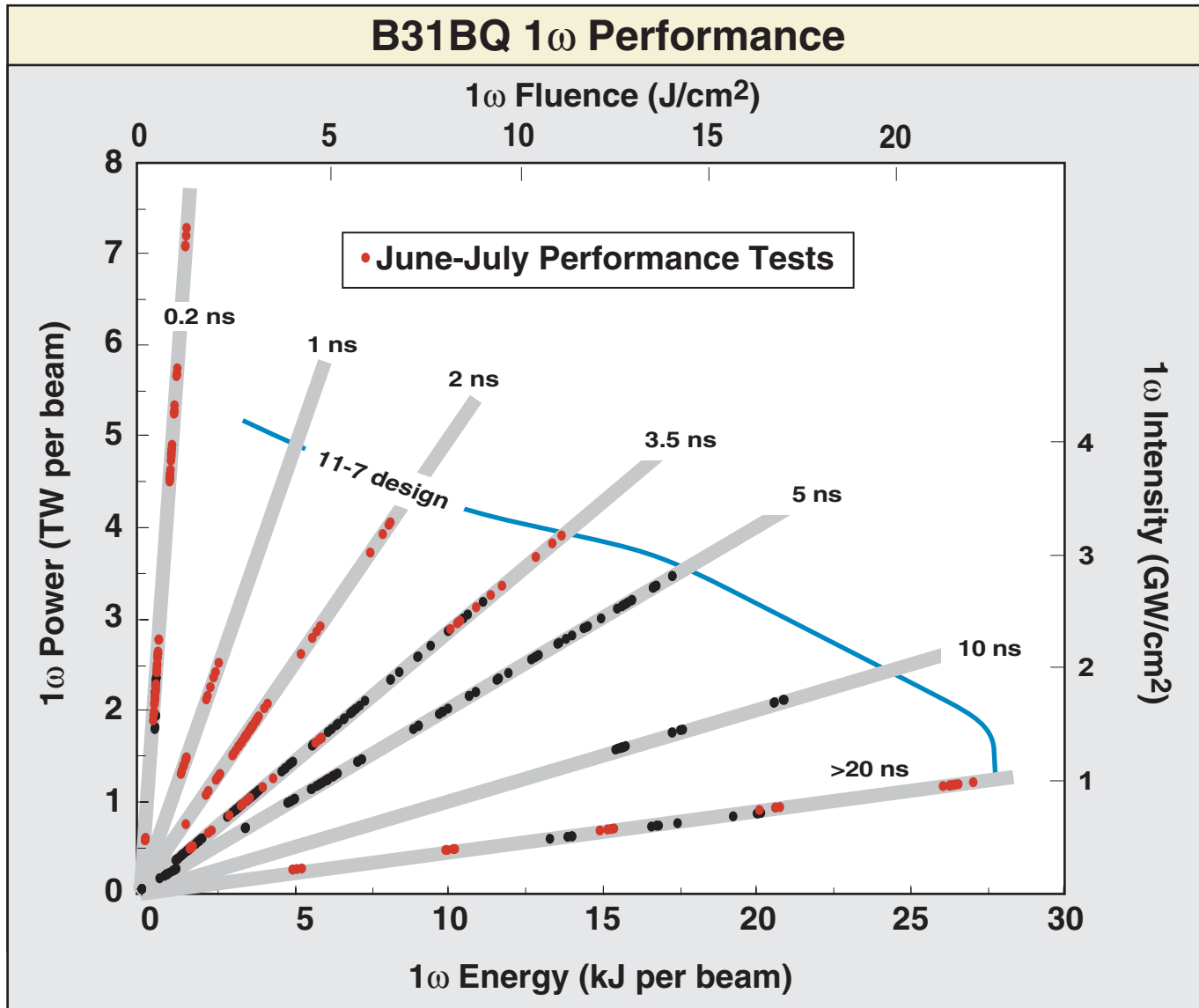
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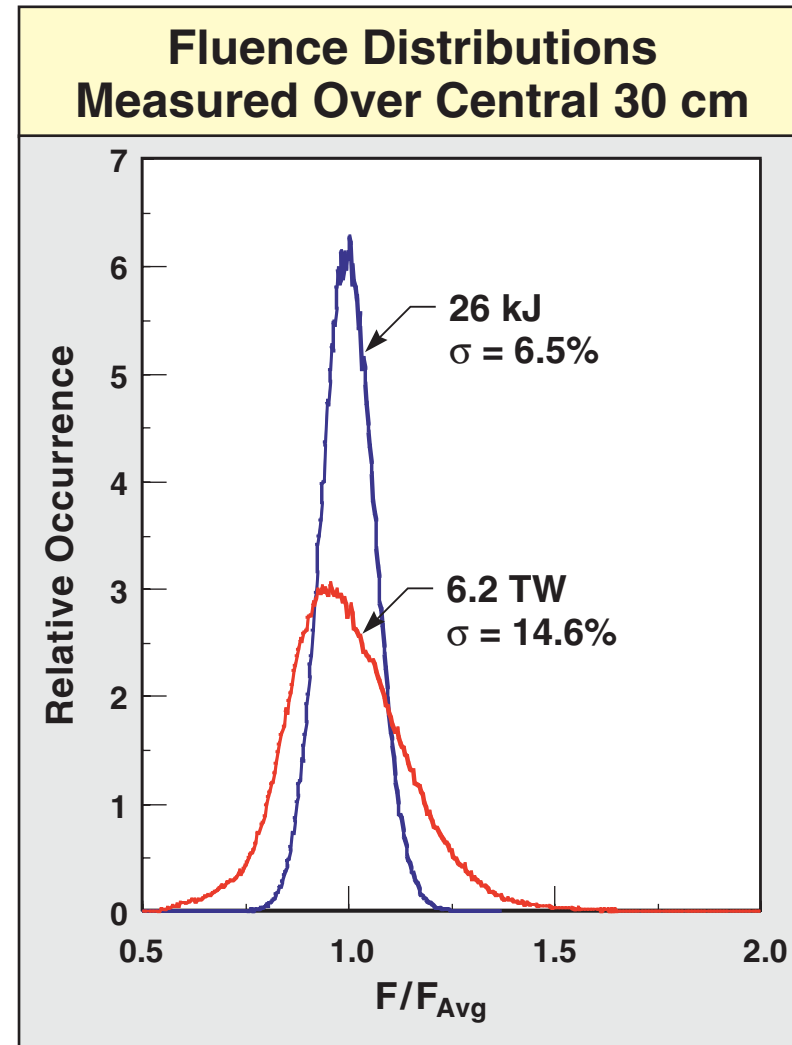
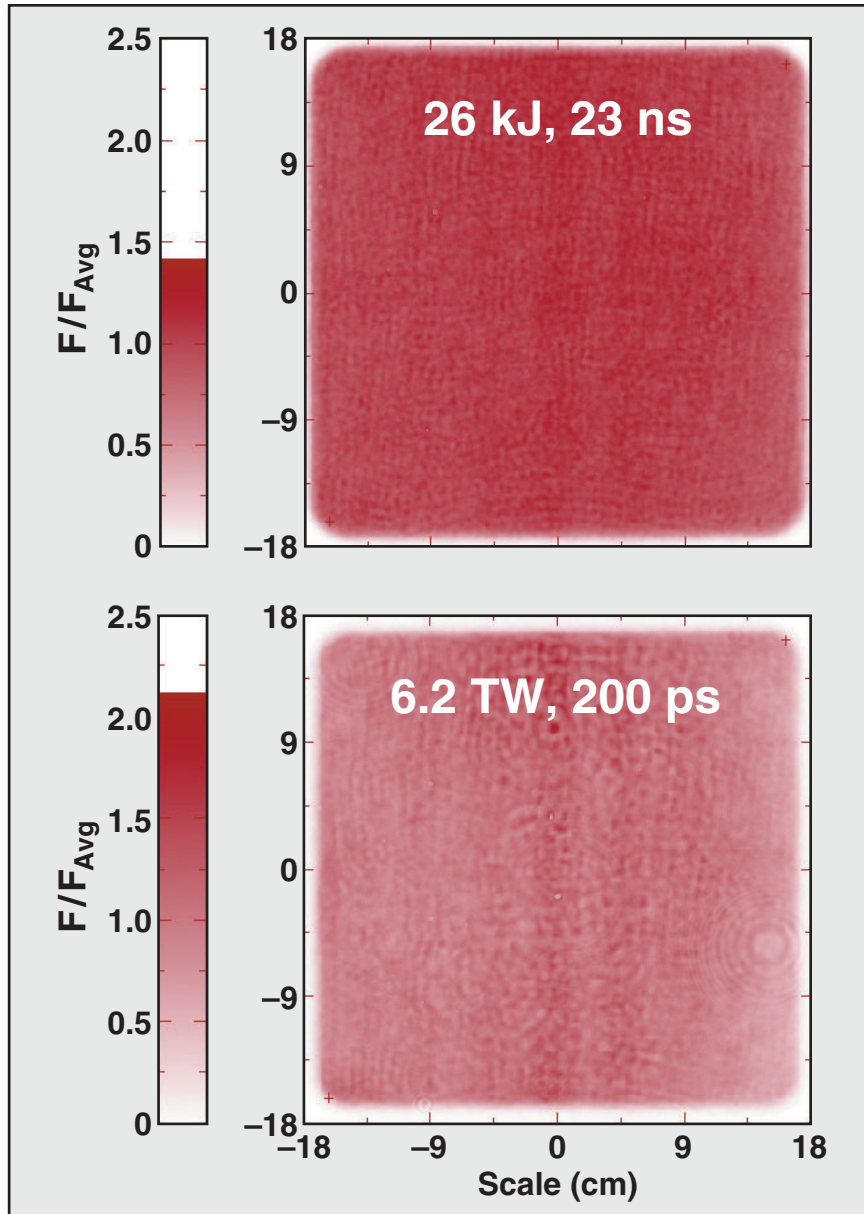
NIF 1 ω laser exceeds power and energy requirements for entire operational parameter space



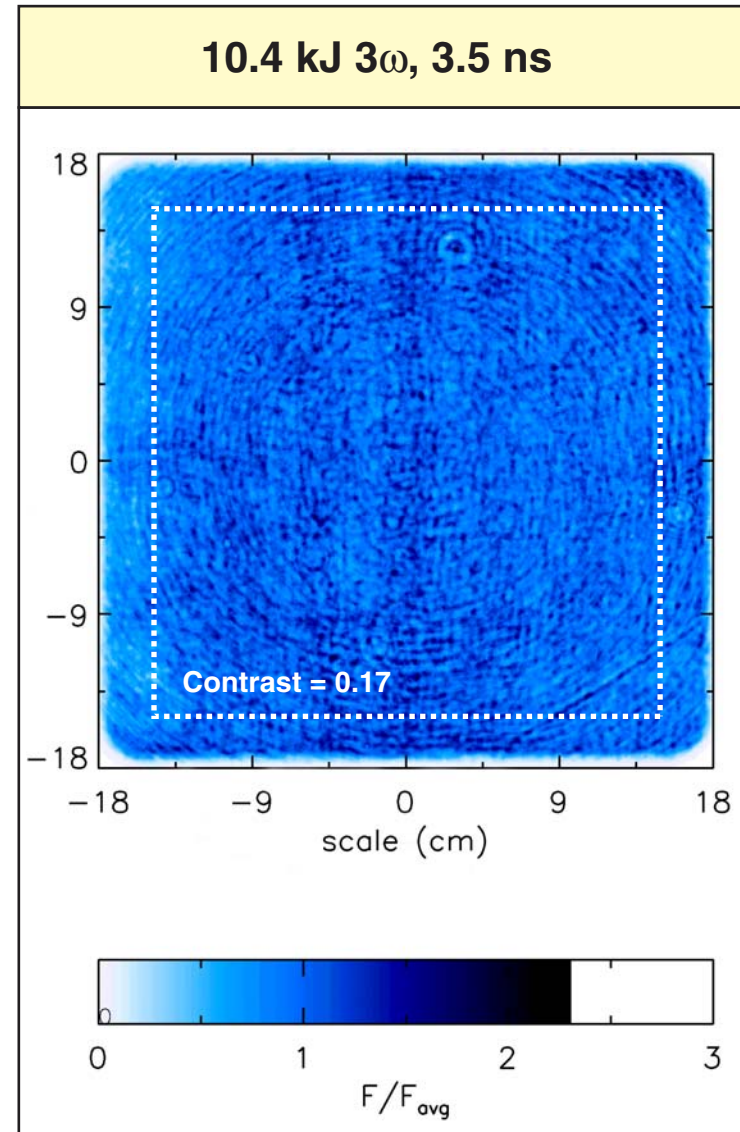
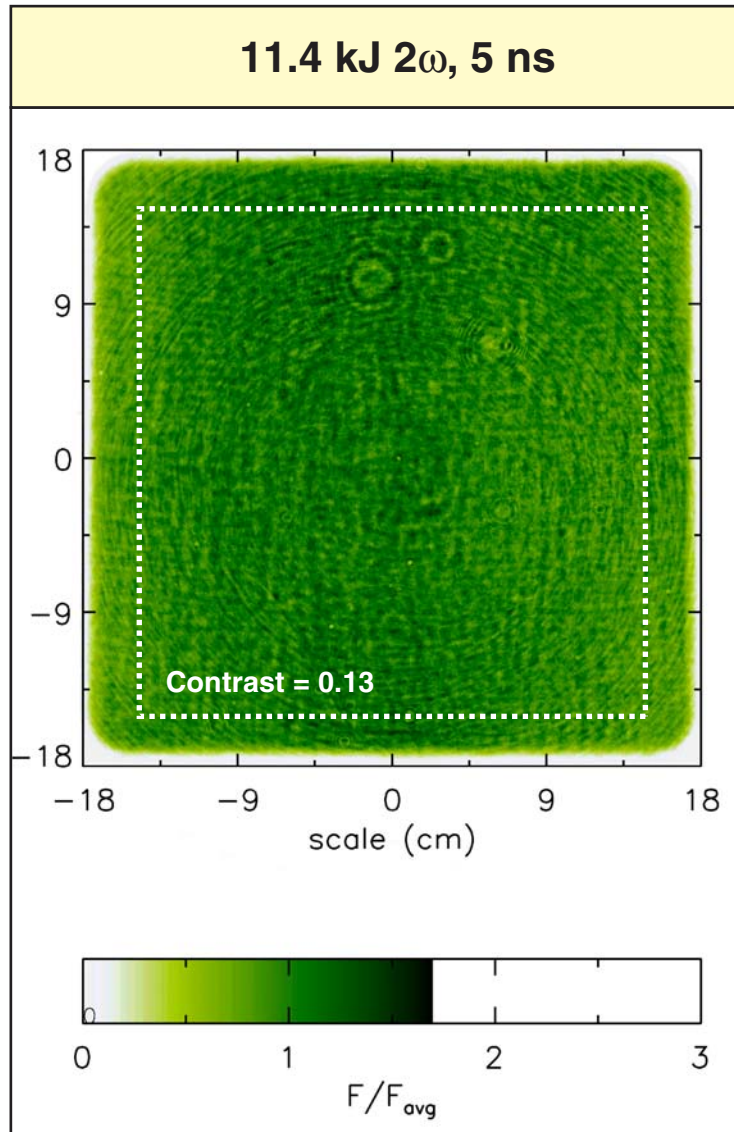
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Design goals for 1ω energy and power exceeded with high overall beam quality



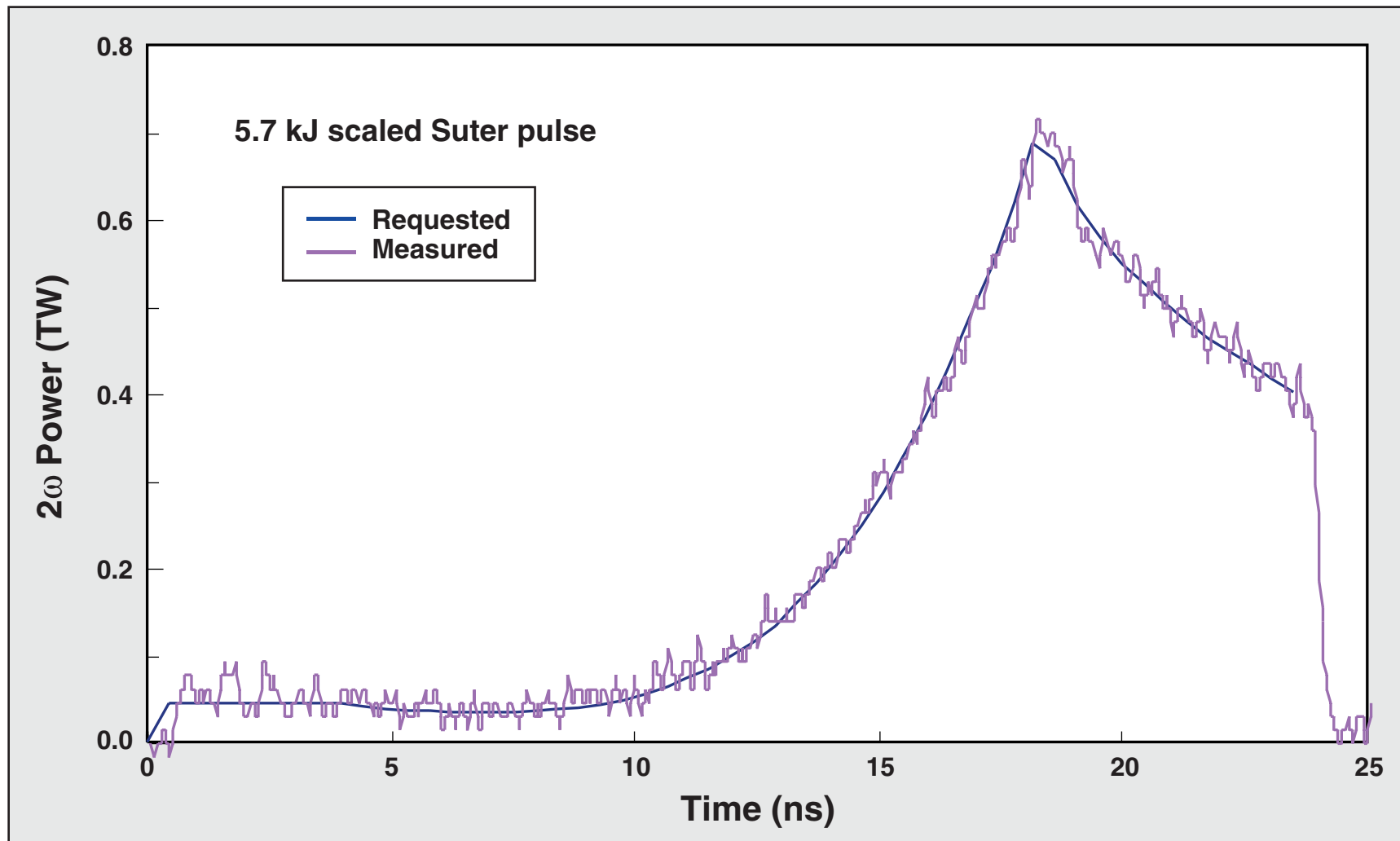
2 ω and 3 ω beamline energies are highest ever achieved: Near-field 2 ω and 3 ω intensity profiles are excellent



Measured temporal profile of scaled Suter pulse closely replicates the requested pulse shape



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No pinhole closure for 23 ns beam

Summary



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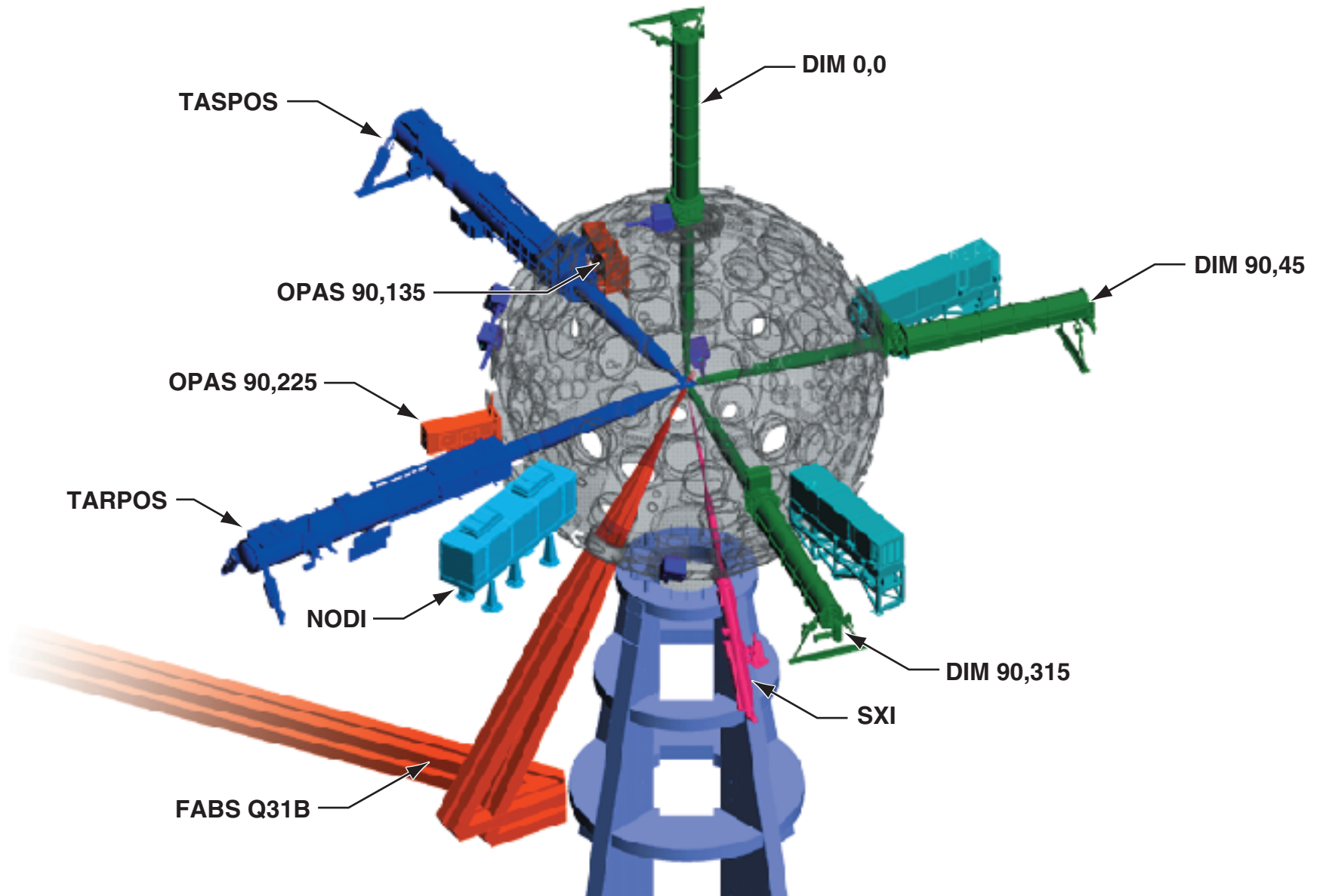
- **Quad 31B beam path fully commissioned**
- **500 kJ 3ω Full NIF Equivalent demonstrated on target**
- **2.0 MJ 3ω Full NIF Equivalent demonstrated on PDS**
- **2.2 MJ 2ω Full NIF Equivalent demonstrated on PDS**
- **5 MJ 1ω Full NIF Equivalent demonstrated on Quad 31B latest-class final optics**

NIF has demonstrated all aspects of quad performance

September 2003 – state of the chamber



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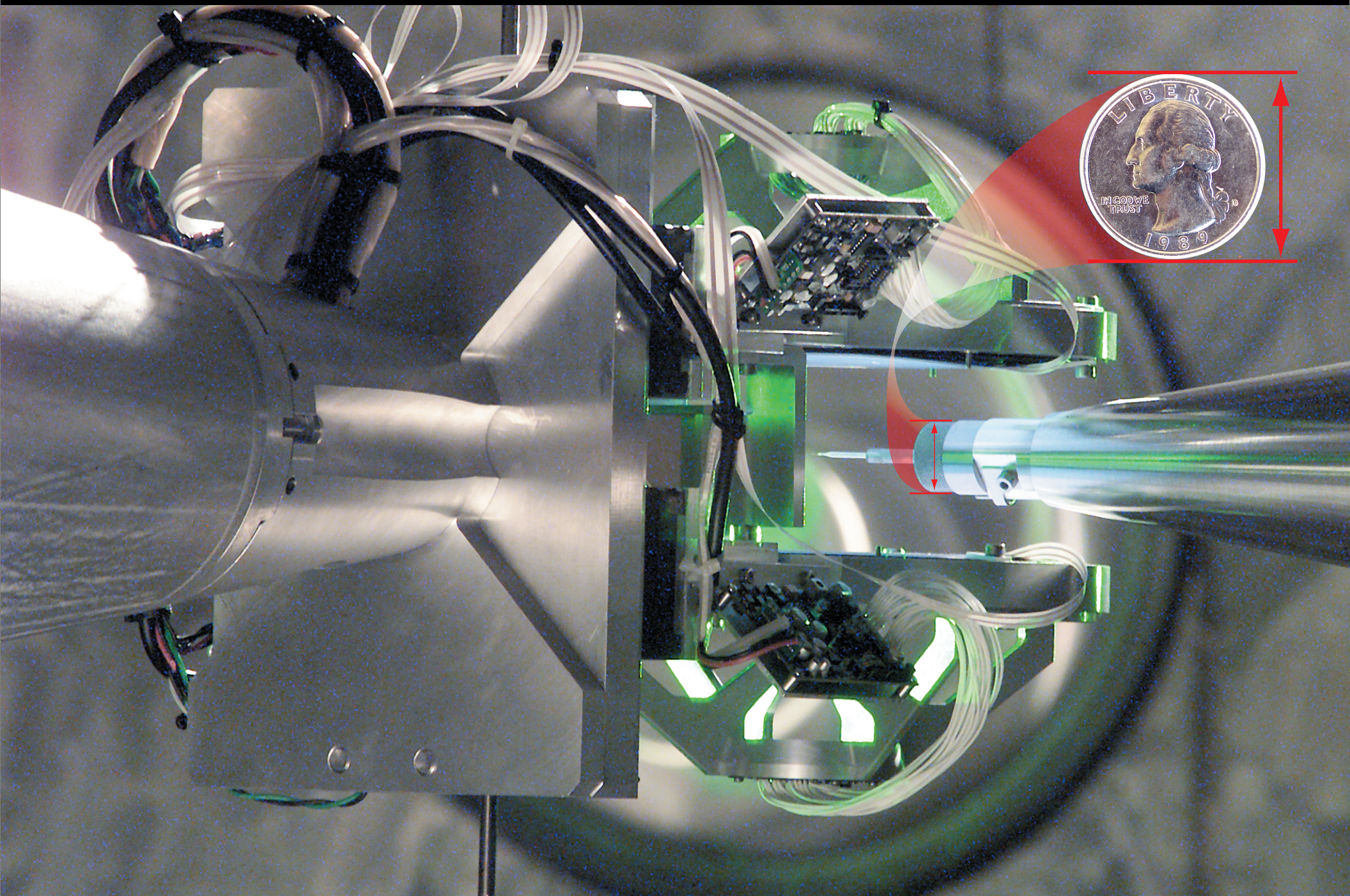




Positioner

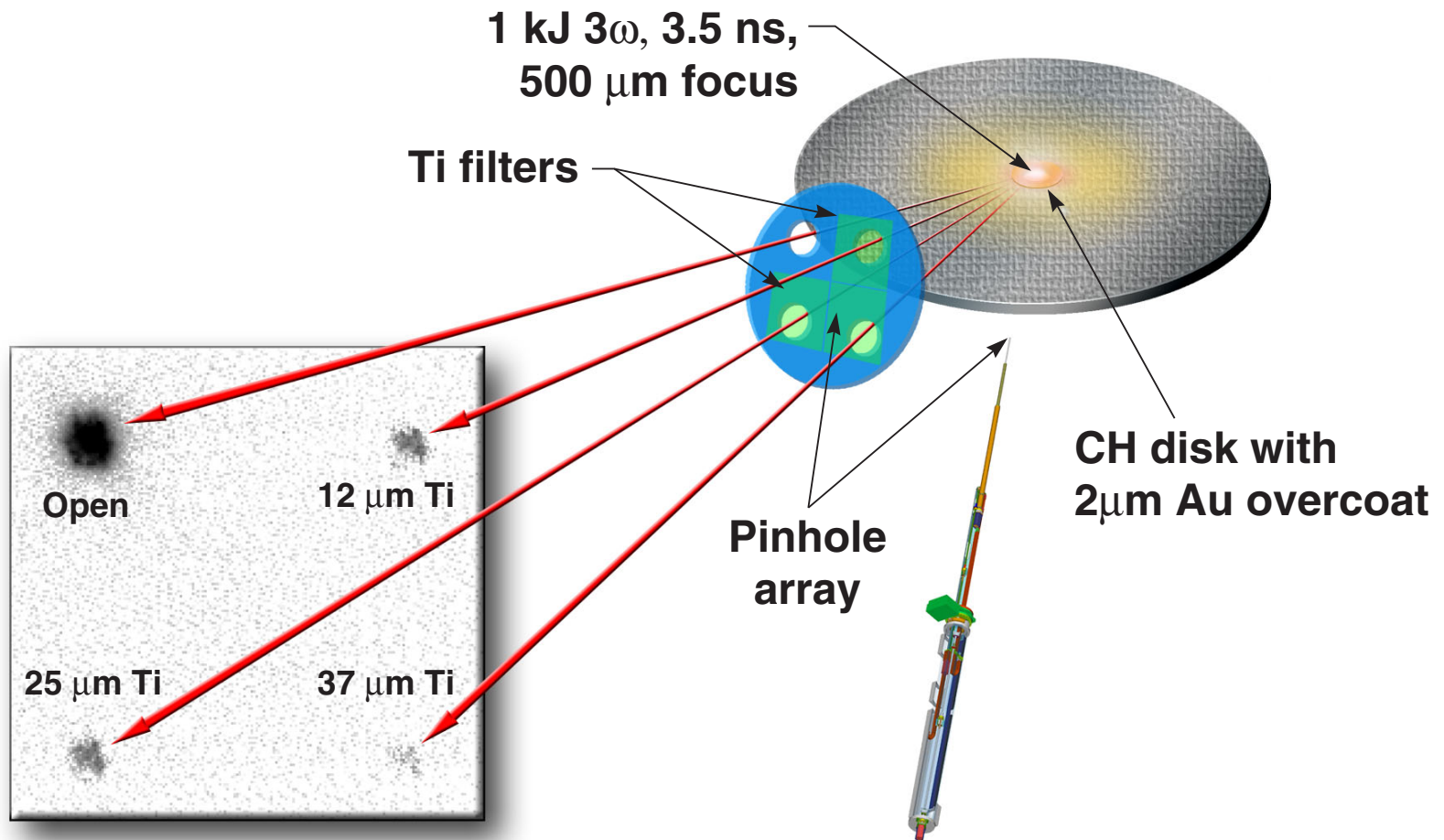
Target Alignment Sensor

System Engineer

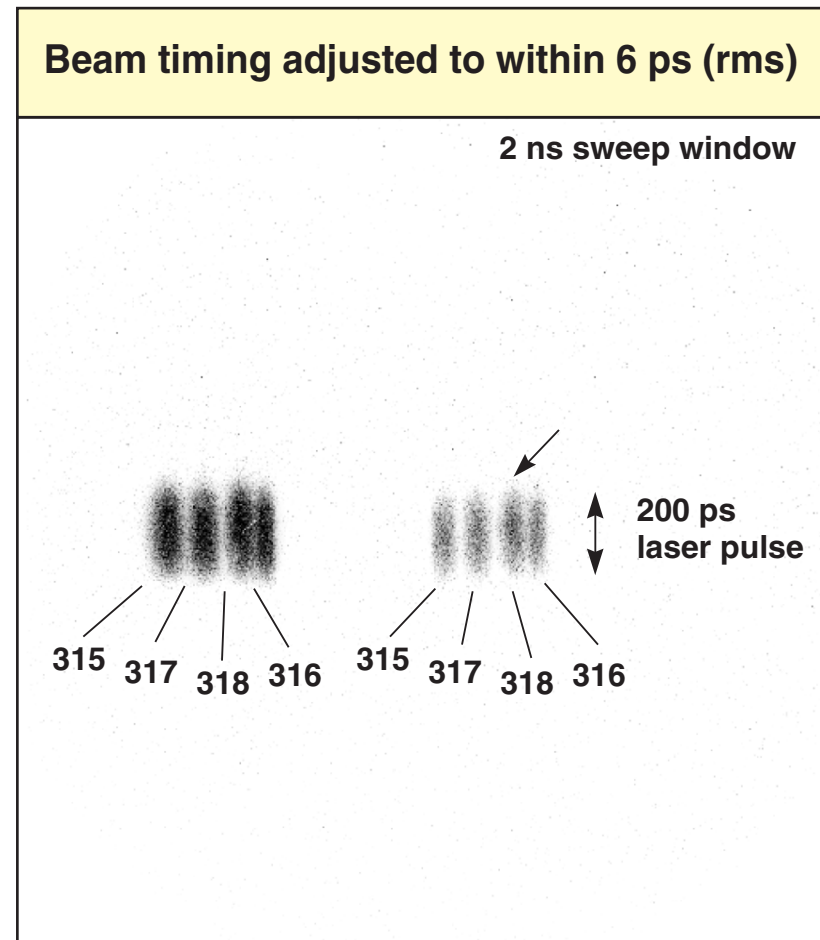
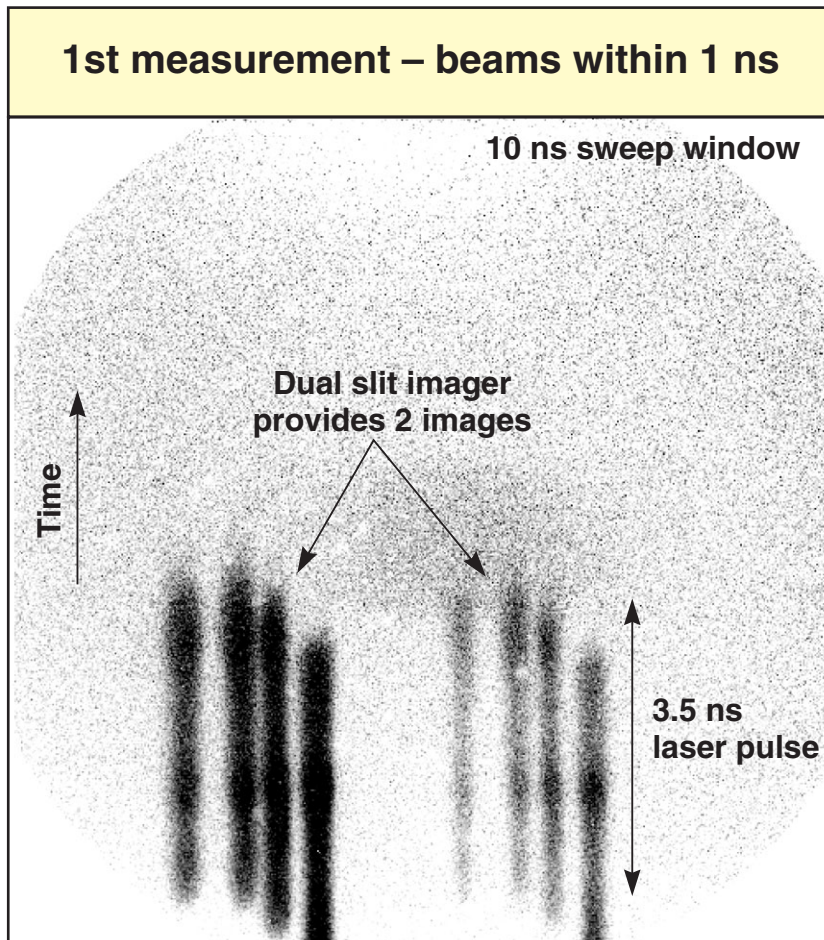


The SXI was fielded on the laser commissioning shots to target chamber center

- 1 kJ 3ω incident onto a disk target at TCC

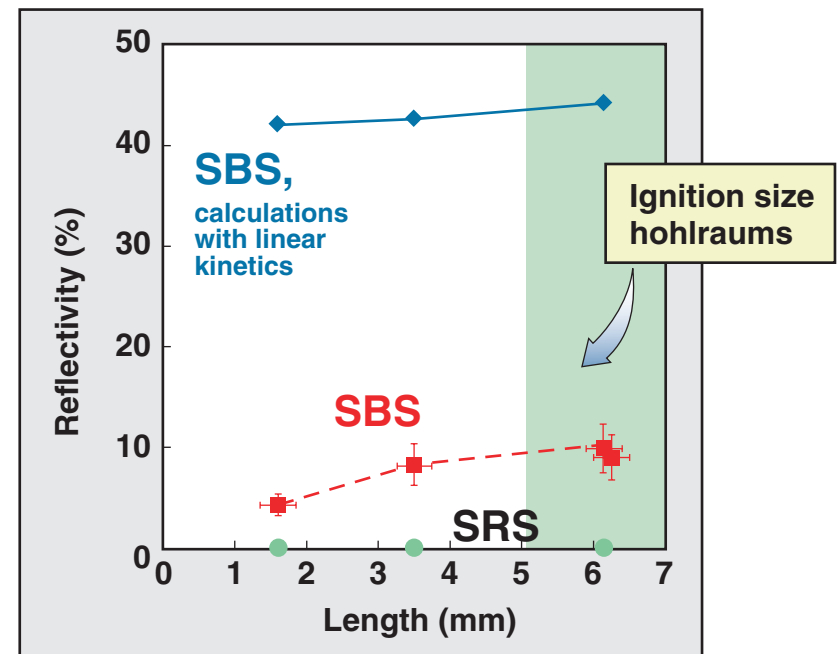
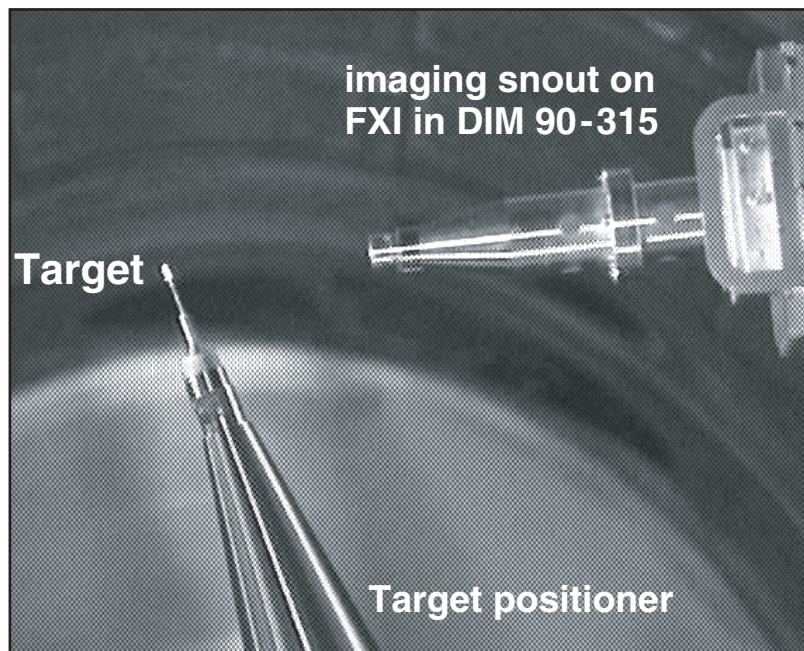
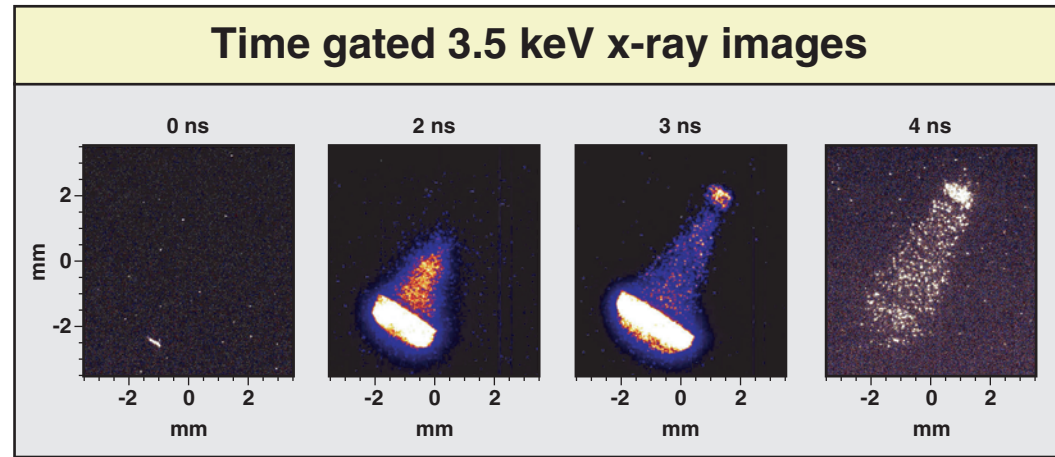
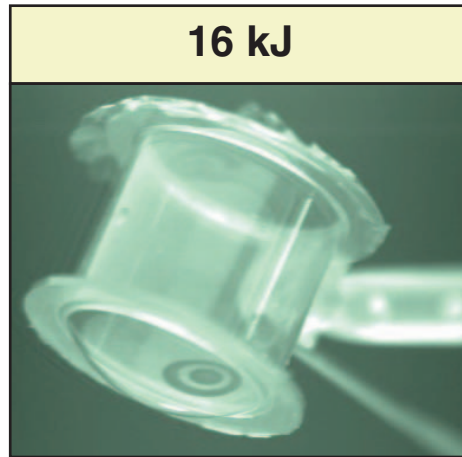


The SXD was used to validate beam synchronization



Beam timing is better than NIF requirements

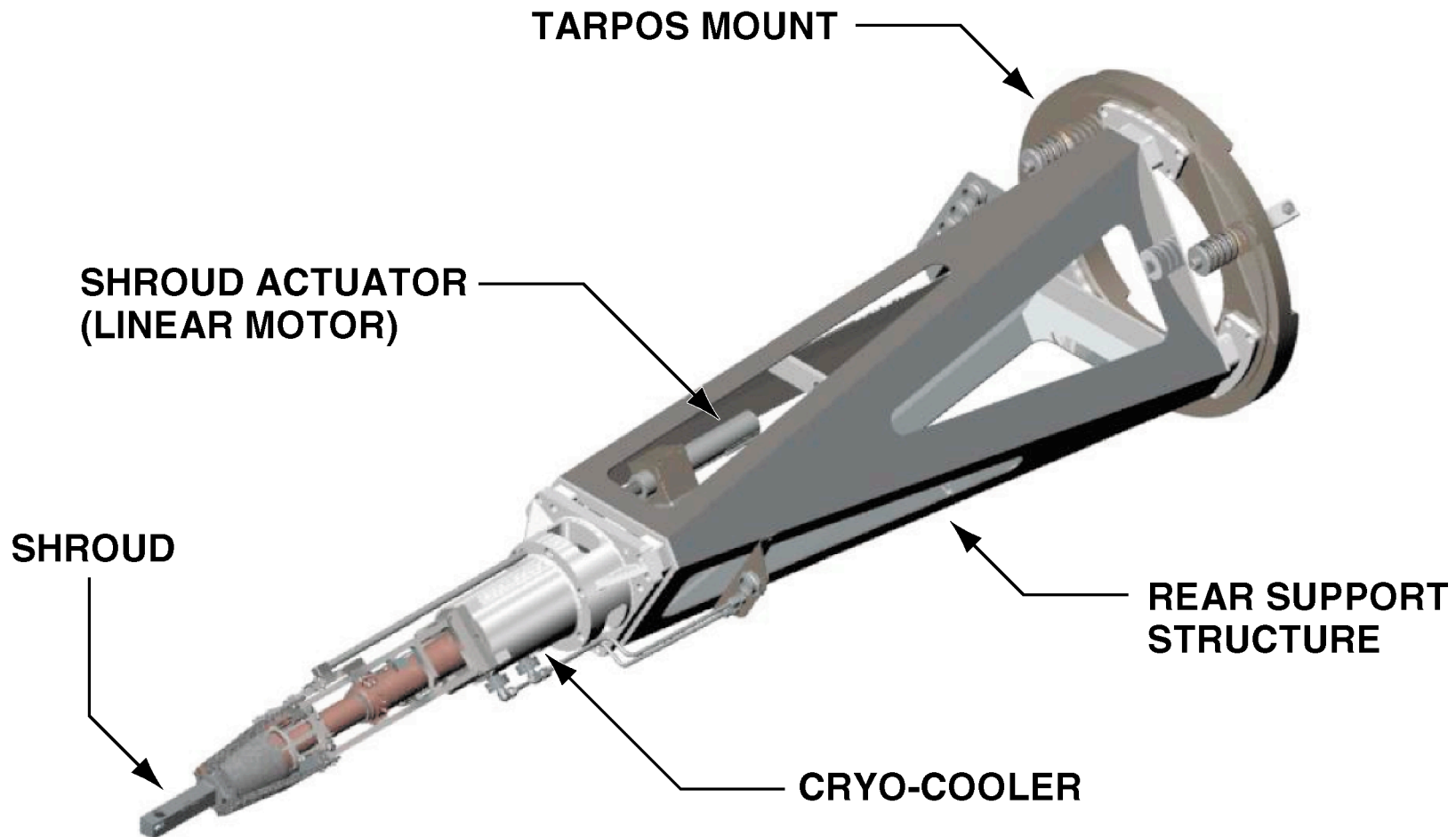
The initial hohlraum characterization experiment heated large scale plasmas and observed backscatter saturation



First cryogenic capability is planned for FY05



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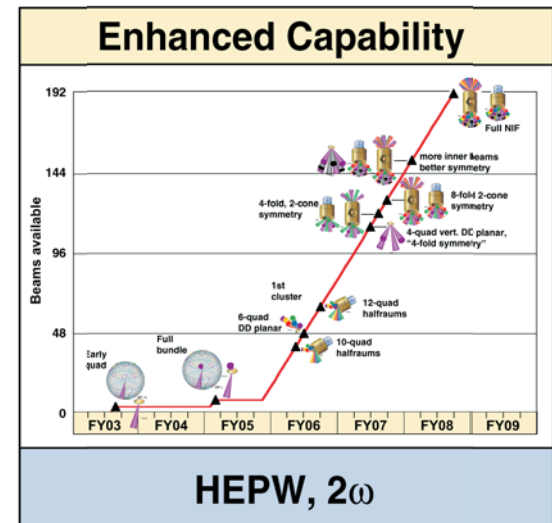
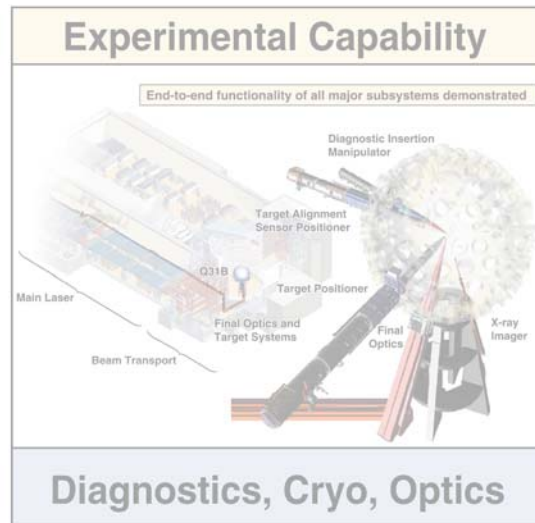
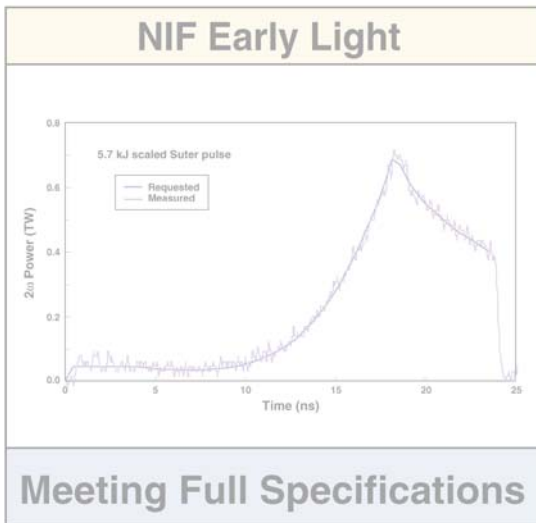
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LLNL is developing a high-energy Petawatt (HEPW) for NIF



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Enhance Stockpile Program Mission

Image without Petawatt

Image with Petawatt

- Substantial improvements to planned experiments
- Explore relevant conditions inaccessible on long pulse lasers

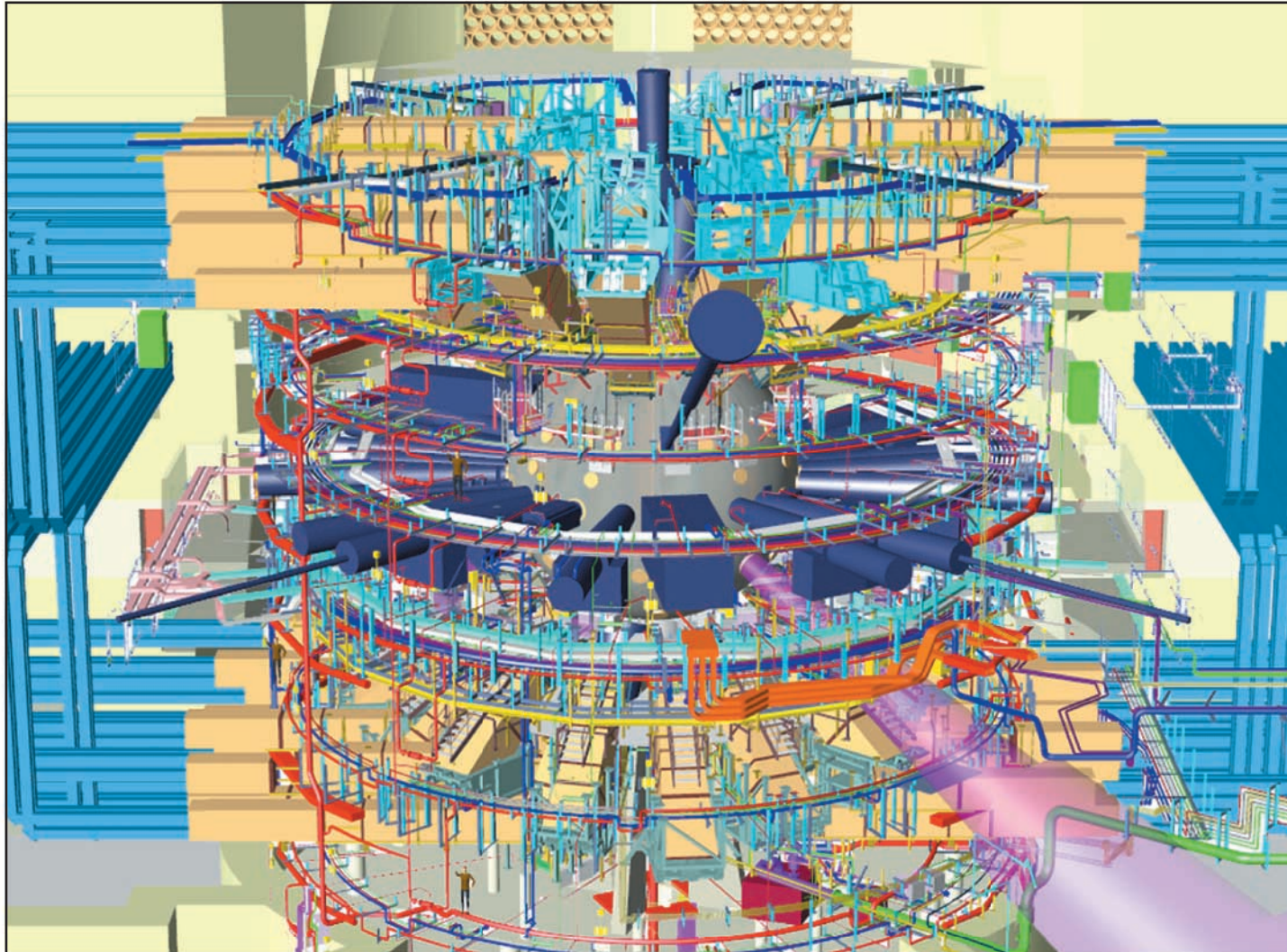
Establish High Visibility HED Science

- 1 The powerful gravity of a tiny, dense neutron star pulls gas from a nearby star to its poles. The gas strikes with the power of a billion hydrogen bombs every second in every square yard.
- 2 Intense X-rays push back against the falling gas, creating mile-high towers of X-ray "bubbles" that bob up and down thousands of times a second.
- 3 The violent oscillation of the bubble towers generates a rhythmic hum—in E and G flat. Pulsars also blink, because the neutron star rotates, turning its poles to and from the Earth.

Leads to Potential Post-Ignition Programs

- Robust, high gain with fast ignition provides opportunities for new national security programs and enhanced support of existing programs
 - Energy independence (IFE)
 - Weapons Program

Transforming NIF into an experimental facility is a complex task requiring a high level of discipline



The Experimental Facility Commissioning Steering committee (EFC) has responsibility for guiding integration and demonstration of the NIF experimental capabilities



