

The Spallation Neutron Source

Overview

Thomas Mason
Associate Laboratory Director for the SNS
Oak Ridge National Laboratory

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College Park, MD

SNS - Guiding Principles

- **SNS will provide high availability, high reliability operation of the world's most powerful pulsed neutron source (cf white paper)**
- **It will operate as a User Facility to support peer reviewed research on a Best-in-Class suite of instruments**
 - Research conducted at SNS will be at the forefront of biology, chemistry, physics, materials science and engineering
- **SNS will have the capability to advance the state of the art in spallation neutron source technology. This includes:**
 - R&D in accelerators, target, and instruments to keep SNS at the forefront
 - Planned enhancement of SNS performance through upgrades of the complex and ongoing instrument development as part of the normal operating life of the facility

Spring 1999



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Spring 2000



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Spring 2002



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Spring 2003



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The Spallation Neutron Source

- The SNS will begin operation in 2006
- At 1.4 MW it will be ~8x ISIS, the world's leading pulsed spallation source
- The peak neutron flux will be ~20–100x ILL
- SNS will be the world's leading facility for neutron scattering
- It will be a short drive from HFIR, a reactor source with a flux comparable to the ILL

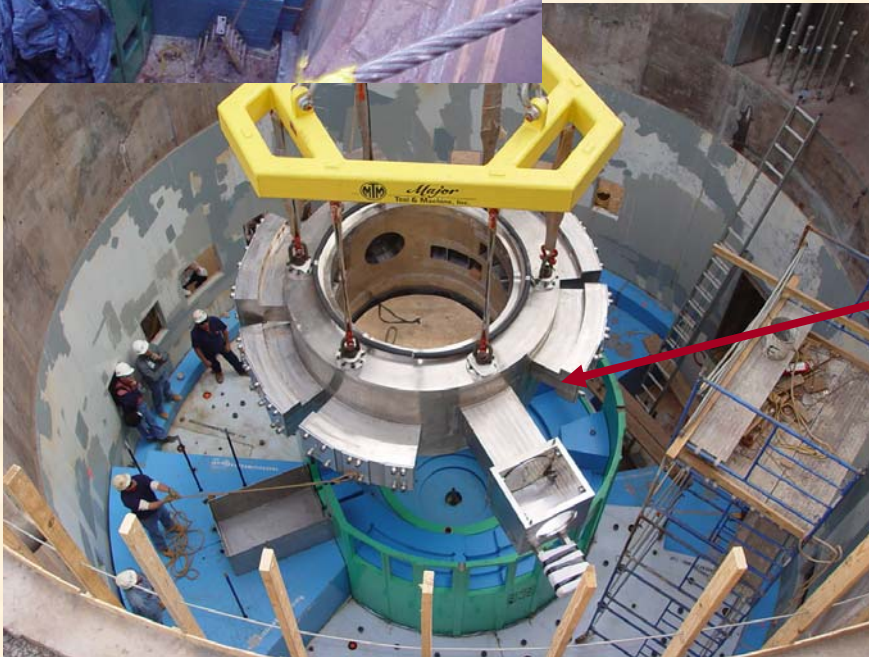


Conventional Facilities



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Target Monolith Installation

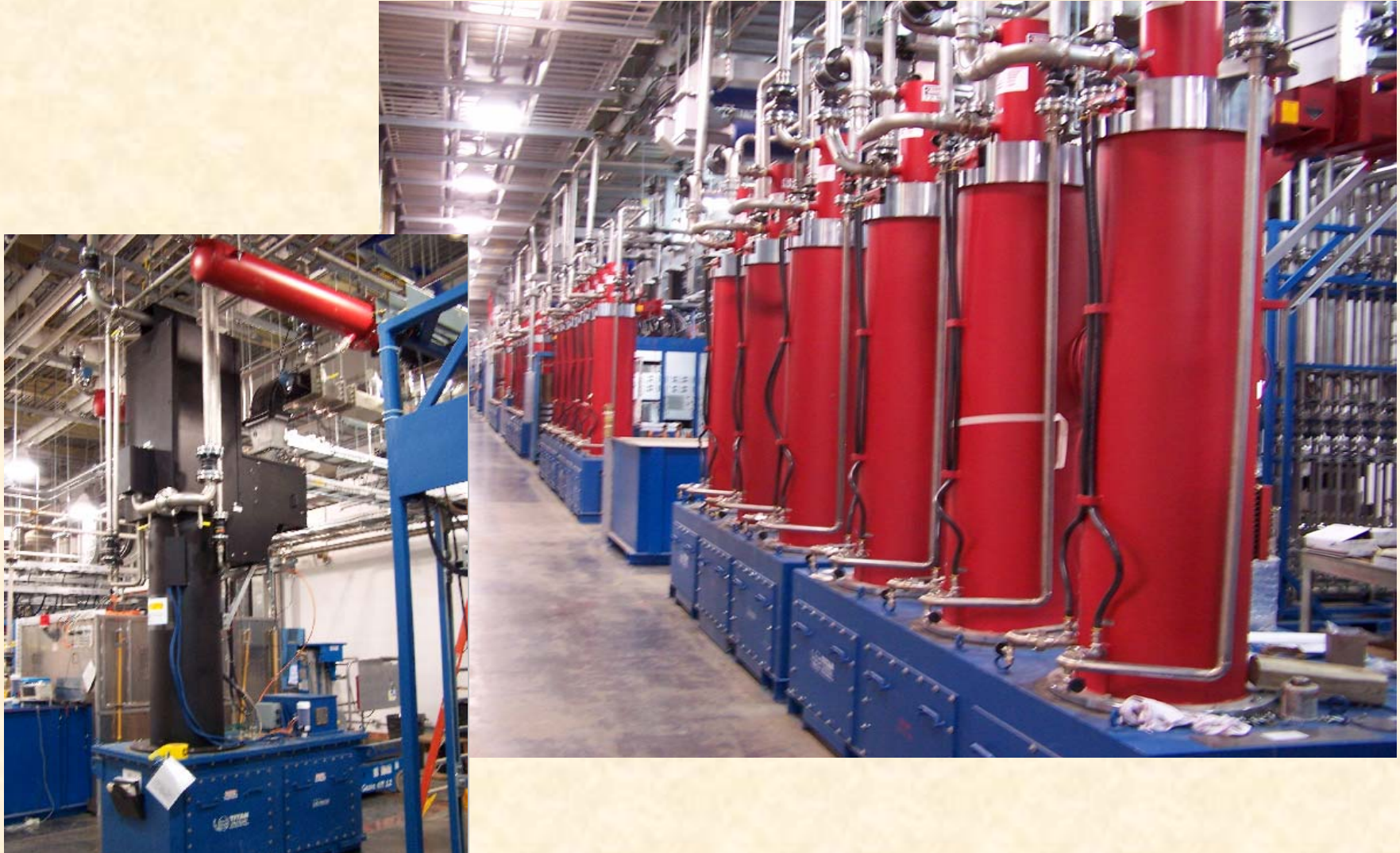


Core Vessel and
Shielding

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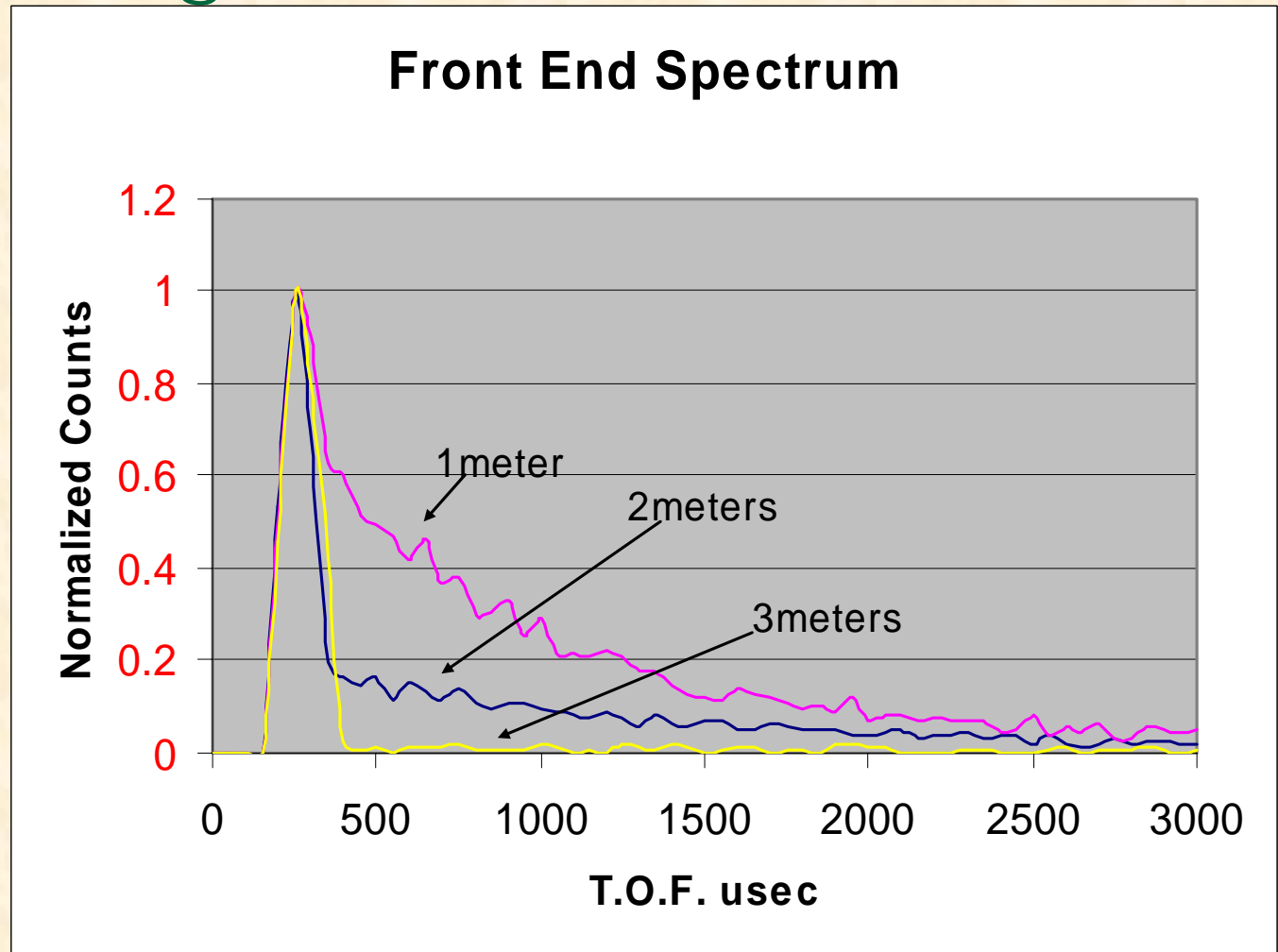
Installation Klystron Gallery



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Warm Linac Installation & Commissioning

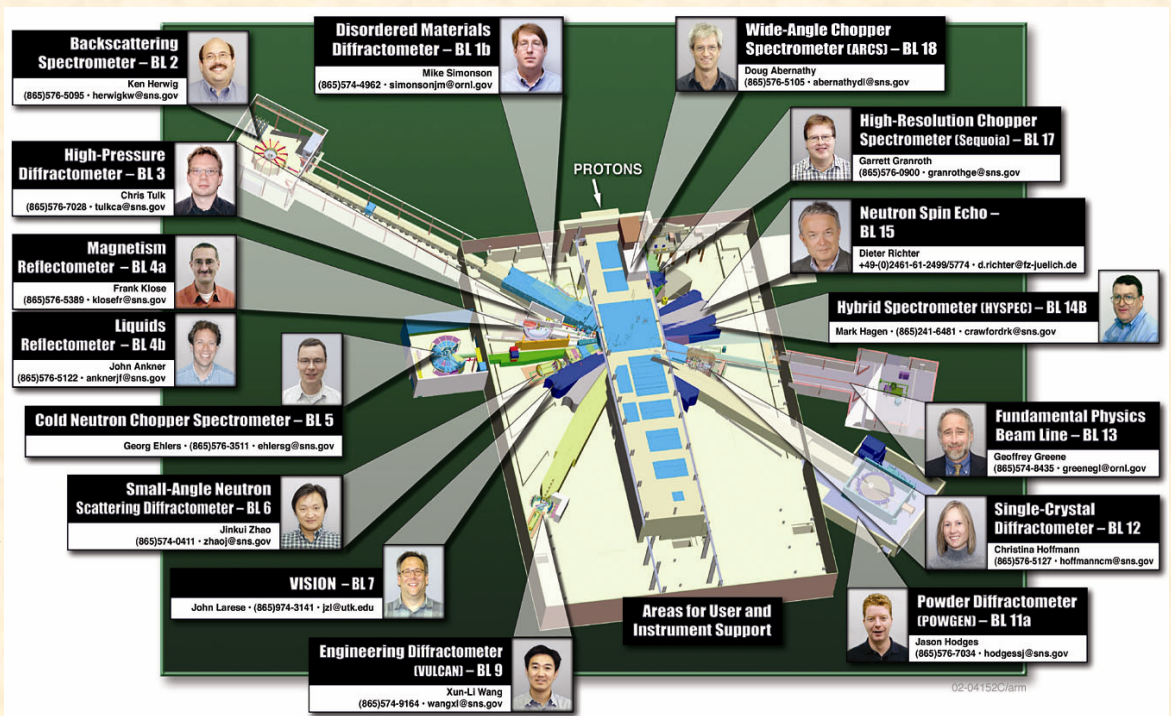
- DTL Tank 1 started operation on August 28.
- First beam 2 days later
- Ran up to 1mA average current
 - New record for H⁻
 - 7.5 kW
- Measured pulsed neutron spectra!
- DTL 1-3 April 04, 40 MeV



Instruments

- 16 instruments approved
 - Excellent progress with funding
 - DOE including \$75 M SING Project, foreign, NSF
- Working to enhance instrument technology

- International engagement and interest in the instrument suite
- Continuing engagement with scientific community



Status of SNS Instruments

Backscattering Spectrometer (BL-2)

Study of atomic scale dynamics at high resolution – diffusive and vibrational motions of adsorbed molecules or large molecules

Ken Herwig (SNS Instrument Scientist)

- Core-vessel insert to be delivered – April 2004
- Shutter insert to be delivered – June 2004
- Neutron guide system glass guide sections have been delivered
- 3 bandwidth choppers received
- Evacuated scattering chamber installation in progress
- Poured-in-place beamline shielding base part of target building general contract
- Satellite building ready for equipment
- 70% design review held April 6-7



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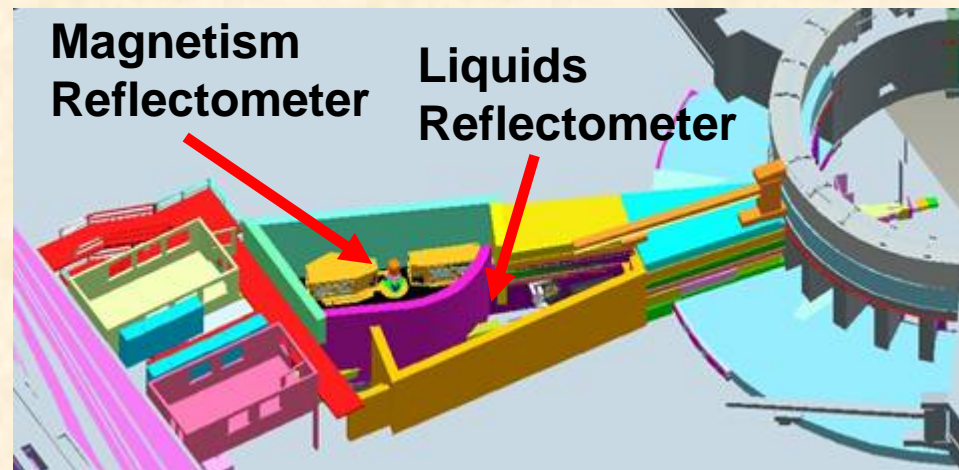
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Status of SNS Instruments – cont'd

Magnetism Reflectometer (BL-4A)

Magnetic and chemical density profiles in surfaces, thin films and multilayer systems

Frank Klose (SNS Instrument Scientist)



Liquids Reflectometer (BL-4B)

Density profiles normal to the surface at liquid surfaces and liquid interfaces

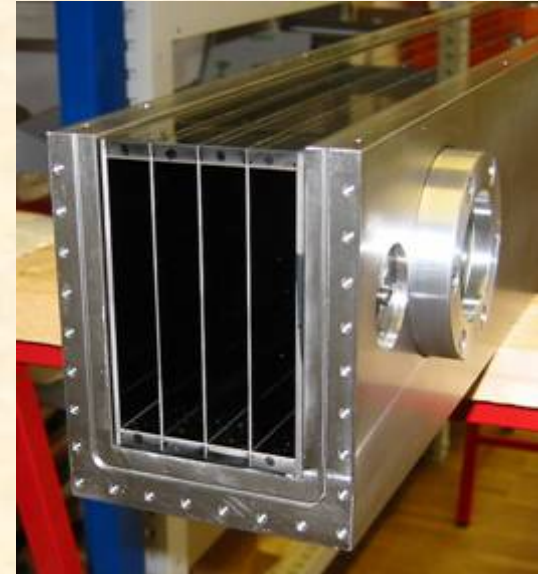
John Ankner (SNS Instrument Scientist)

Status of SNS Instruments – cont'd

Both Reflectometers

- Core-vessel insert to be delivered May 2004
- Shutter insert to be delivered June 2004
- Neutron guide system fabrication well along

Section of
supermirror
bender



Magnetism

- First 2 of 3 bandwidth choppers delivered March 2003
- Goniometer/optical bench procurement awarded – July 2003

Liquids

- Neutron guide system fabrication well along
- Sample mount/optical bench/detector mount procurement awarded February 2004

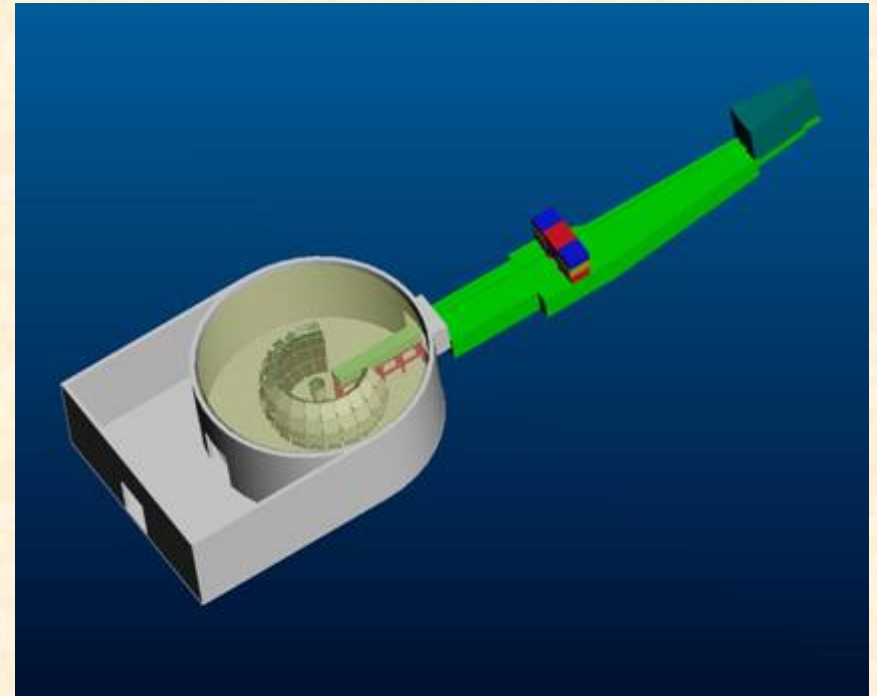
Status of Funded IDT Instruments

CNCS Cold Neutron Chopper Spectrometer (BL-5)

Atomic-scale dynamics in the 0-20 meV energy range

Paul Sokol (Penn State); Georg Ehlers (SNS Instrument Scientist)

- Draft MOA between Penn State and SNS prepared
- Design meeting held at Penn State September 2003
- Core-vessel insert to be delivered – April 2004
- Shutter insert to be delivered – June 2004
- Other procurements awarded or in progress at Penn State
- Mid-project review being planned for July-August



Status of Funded IDT Instruments – cont'd

ARCS Wide-Angle Chopper Spectrometer (BL-18)

Atomic-scale dynamics at thermal and epithermal energies -
optimized for angular coverage

Brent Fultz (Caltech); Doug Abernathy (SNS Instrument Scientist)

- Core-vessel insert to be delivered – April 2004
- Shutter insert to be delivered – June 2004
- Prototype detector module and electronics successfully tested
- Detector procurement in progress
- Engineering design well along
- Shielding analyses underway
- Mid-project review being planned for July-August



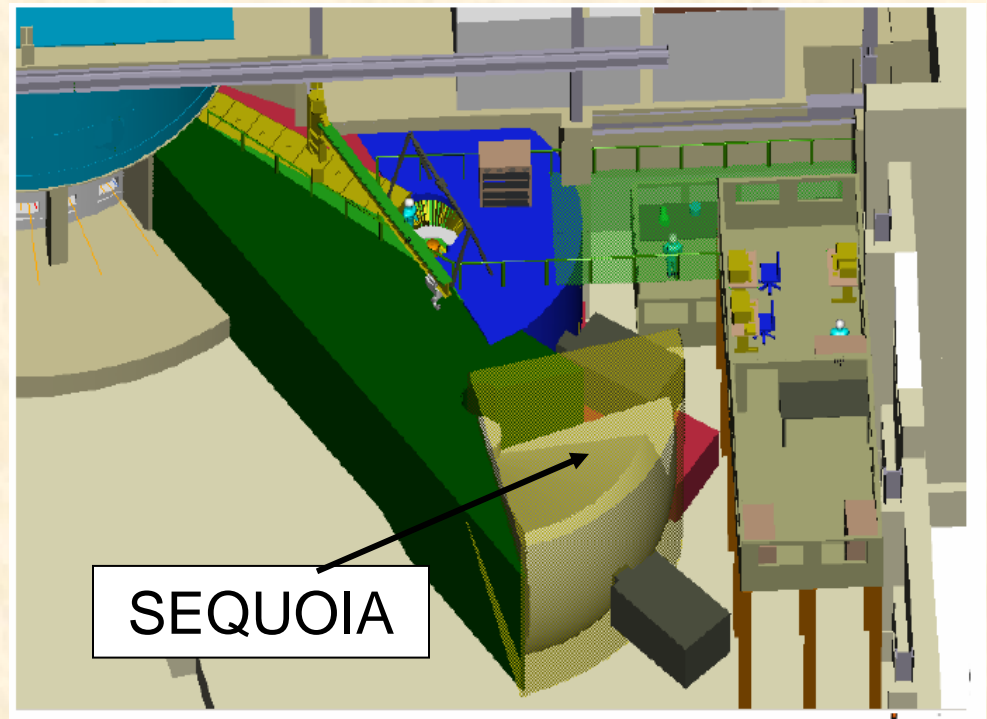
Status of SING Project IDT Instruments – cont'd

SEQUOIA High-Resolution Chopper Spectrometer (BL-17)

Atomic-scale dynamics at thermal and epithermal energies, with emphasis on magnetic scattering from single crystals

Steve Nagler (ORNL); Garrett Granroth (SNS Instrument Scientist)

- Lead engineer in place
- Draft design/cost/schedule baseline developed
- Core-vessel insert to be delivered – April 2004
- Shutter insert to be delivered – June 2004
- Preliminary design review scheduled May 5-6



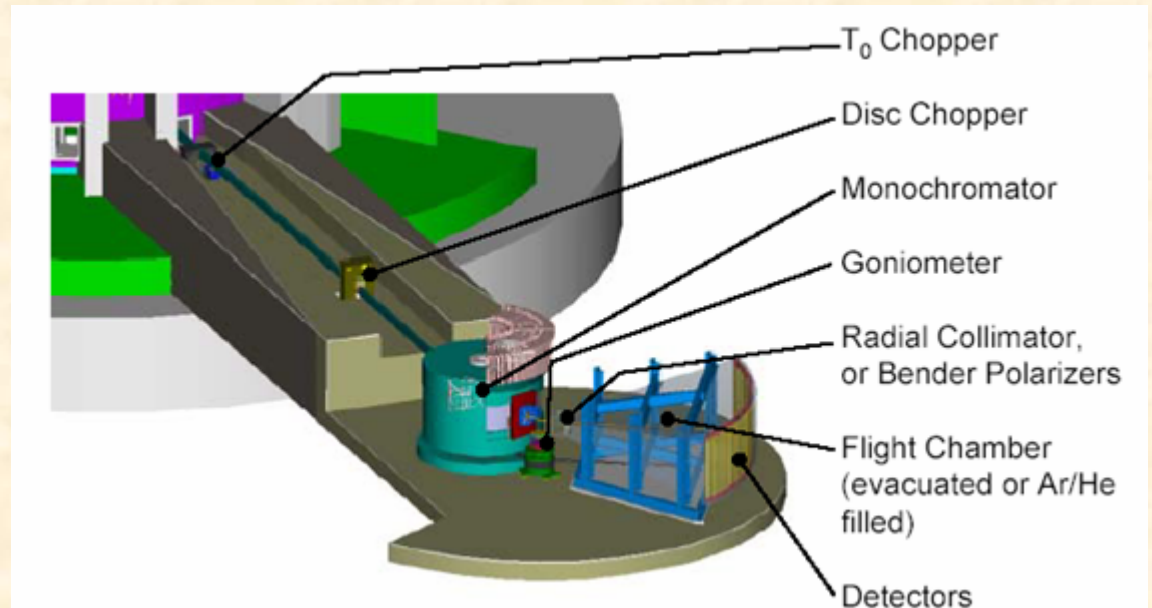
Status of SING Project IDT Instruments – cont'd

HYSPEC Hybrid Spectrometer (BL – 14B)

Spin dynamics and motions of atoms in single crystals, with emphasis on polarized neutron studies

Steve Shapiro (BNL); Mark Hagen (SNS Instrument Scientist)

- Conceptual design being refined
- Footprint issues being resolved
- Blank plug insert in core vessel initially
- Concrete in shutter position initially

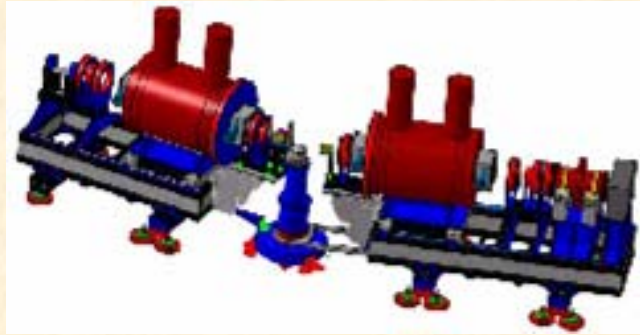


Status of Other Approved IDT Instruments

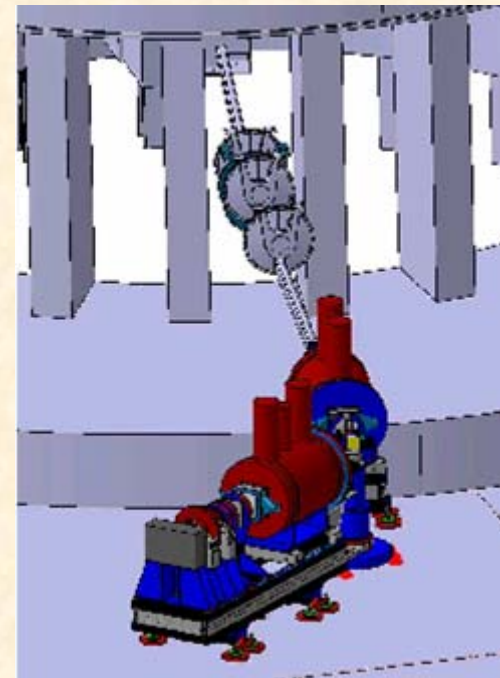
NSE Neutron Spin Echo Spectrometer (BL – 15)

Dynamics on mesoscopic scales, particularly for biomolecules, polymers,
and other soft matter systems

Michael Monkenbusch (Juelich); Michael Ohl (Juelich); Dieter Richter
(Juelich); Catja Pappas (HMI)



- Joint Juelich-HMI project – proposed to be funded by Germany
- Footprint issues being resolved
- Blank plug insert in core vessel initially
- Concrete in shutter position initially



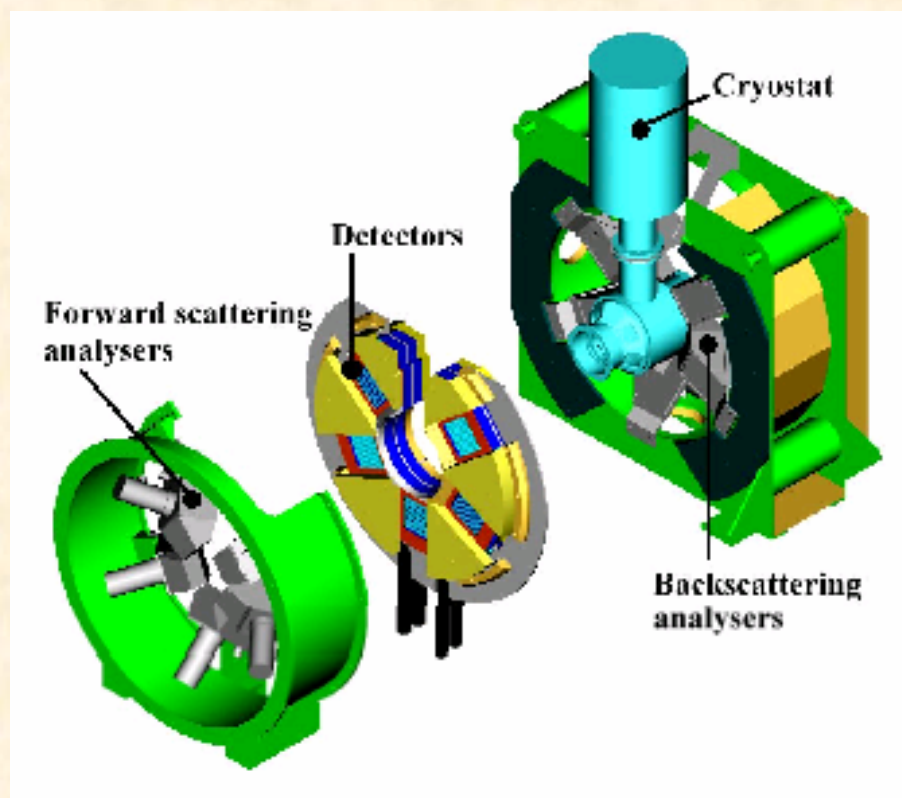
Status of Other Approved IDT Instruments – cont'd

VISION Chemical Spectrometer (BL – 7 ???)

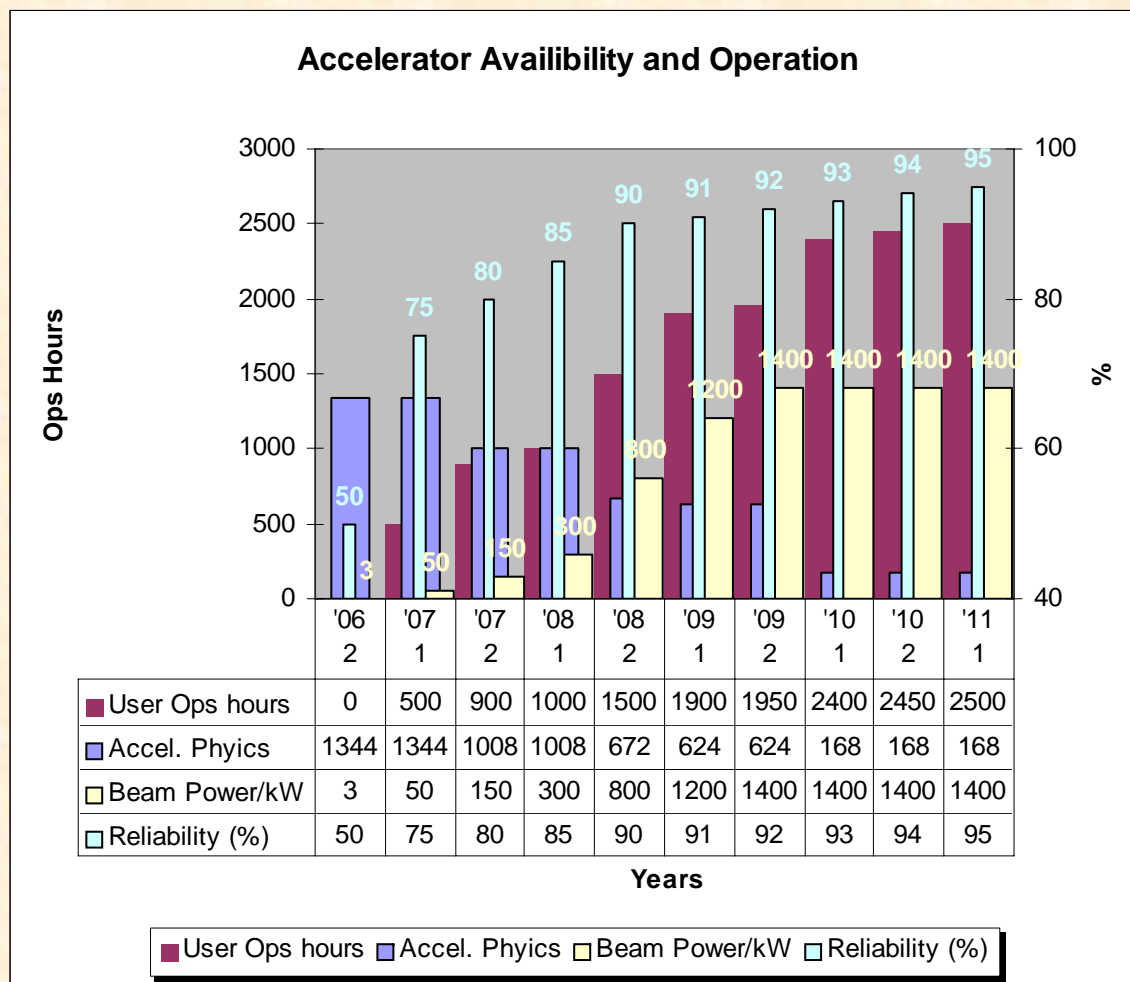
Vibrational spectroscopy in molecular systems

John Larese (Univ. of Tenn.); Bruce Hudson (Syracuse)

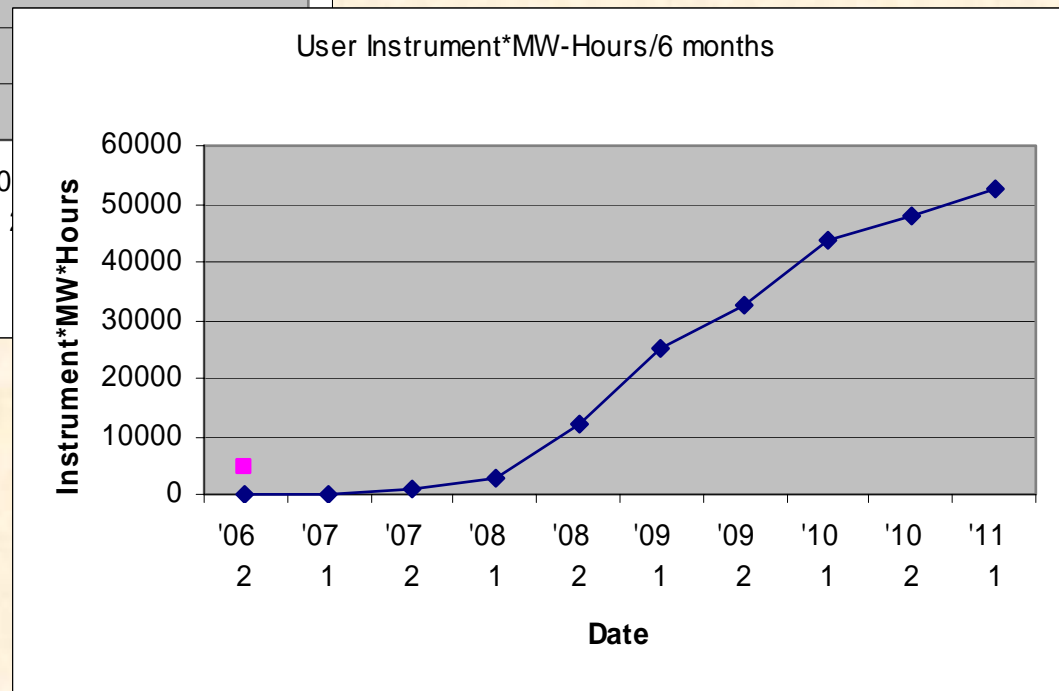
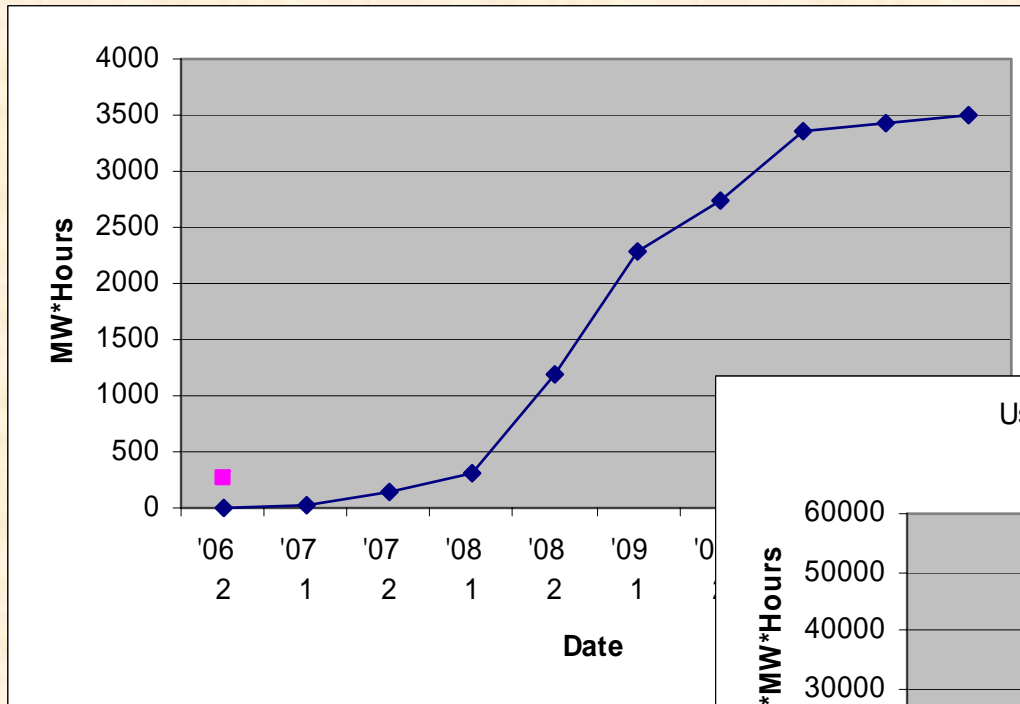
- Proposal for design submitted to NSF
- Beamline assignment tentative – water moderator desired



SNS Early Operations: Ramping up Scientific Productivity



Timeline for scientific productivity



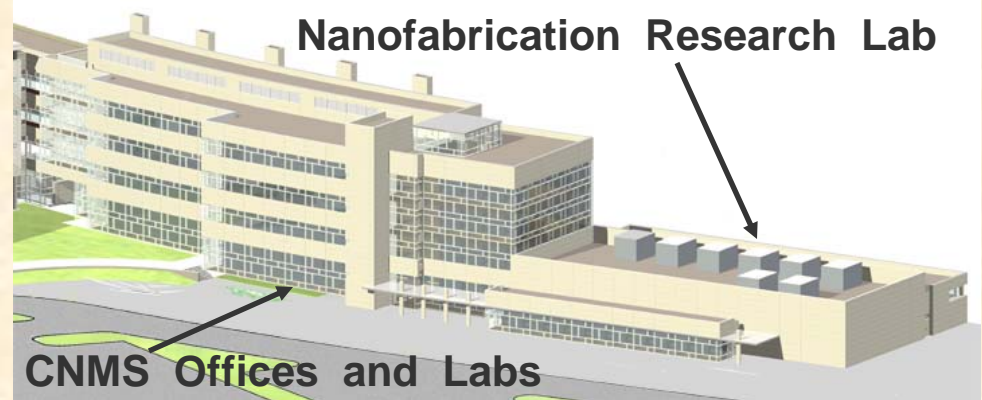
Scientific Scope and Vision for CNMS

Center for Nanophase Materials Sciences

- A **highly collaborative** and **multidisciplinary** research center
- **CNMS**: Provides urgently needed capabilities for materials synthesis, nanofabrication, and modeling

*The CNMS Concept:
Create **scientific synergies**
to **accelerate discovery**
in **nanoscale science***

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We intend to expand our use of third-party funding

Upgrade electrical distribution system

- 55 years old
- Reliability is declining and maintenance is expensive

Plan

Acquire agreement with third party (e.g., TVA) to design, construct, and operate new system



Provide on-site user housing

- No convenient housing available for expanding user community

Plan

Use third-party commercial developer to design, construct, and operate ... at full cost recovery



User Housing Facility

Condensed matter theory at SNS

- **The theory group in the Condensed Matter Sciences Division (CMSD) is in a rebuilding mode**
 - Recently recruited Elbio Dagotto and Adriana Moreo from Florida State/NHMFL to joint positions with UT Physics Department
 - Anticipate a group of 6 to 9, including students and postdocs
- **Computational materials science is an element of the Center for Nanophase Materials Sciences**

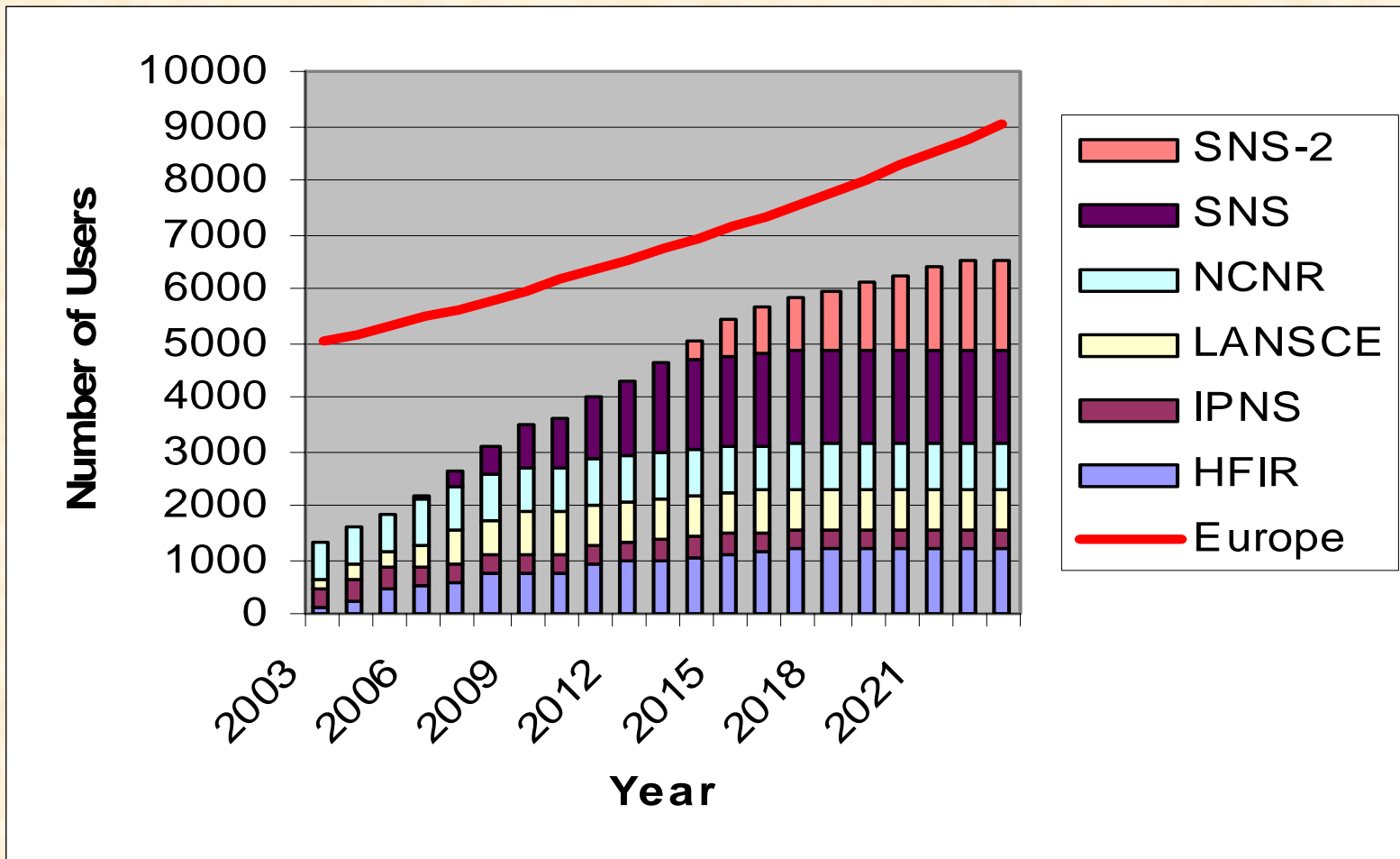


SNS 20-year plan

- **SNS will evolve along the path envisaged in the Russell Panel specifications**
- **In 20 years, it should be operating ~45 best-in-class instruments with two differently optimized target stations and a beam power of 3–4 MW**
 - **Ultimate target performance is probably the biggest unknown in projecting maximum power obtainable at SNS**
- **The Power Upgrade and Long Wavelength Target Station should follow a sequence that meshes with deployment of the initial capability and national needs**



Neutron Scattering 20 Year Outlook



Outlook Assumptions

- **Initiatives currently underway are sustained along the lines of the Office of Science and Technology Interagency Working Group report**
 - **Buildout of SNS instrument suite on HPTS**
 - **HFIR upgrades and user program**
 - **Enhancement of capabilities and user operations at IPNS and NIST**
 - **Instrument development and user program growth at LANSCE**
- **Added to that baseline are the impacts of the SNS upgrade path and a second guide hall at HFIR as described later today**
- **For comparison user growth in Europe based on current ENSA estimate of user community and 3% growth rate**
 - **Less than historical value over the past 20 years**
 - **Can be sustained in the near term by FRM II, ISIS-2, and Millenium Program at the ILL**
- **This trajectory for neutron capability is realistic and desireable in order to support needs of the materials community in coming years, not to mention eventual need to replace ageing facilities**

Overall Prospects

- **Funding and technical performance are relatively secure for SNS and CNMS completion as well as buildout of the SNS instrument suite**
- **Existing neutron sources have ~stable overall funding however science budgets are a concern**
- **There are good prospects for seeing the operating funds (\$160 M/year) that we need to bring SNS online quickly and insure robust, reliable operations**
- **State funding for Joint Institutes is arriving as expected**
- **SNS Upgrades have passed initial scientific review hurdles**