Sample Environment Plans and Progress

October 2005

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SNS Sample Environment Team Leader

Talk Outline

- Sample environment support staff
- Standards & infrastructure
- Equipment inventory

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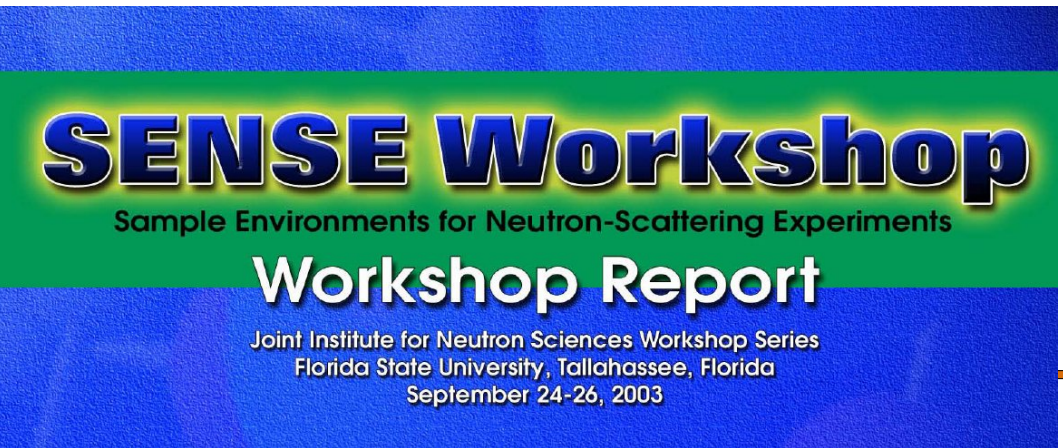
- Equipment inventory

discussed in light of user needs



User-Driven Priorities

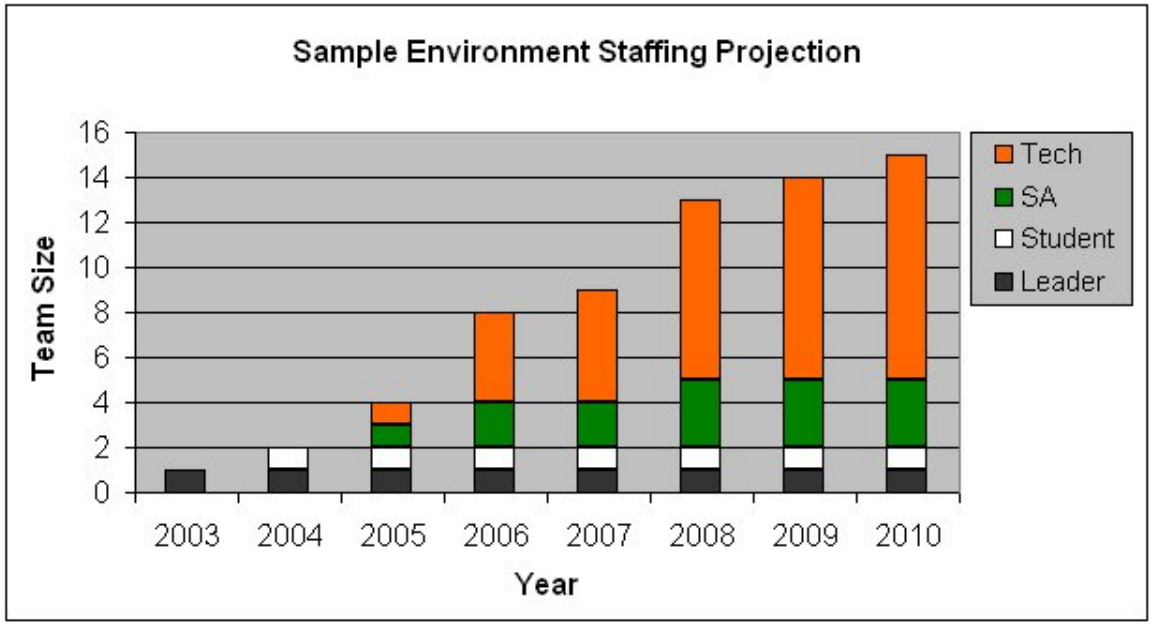
- Ample support staff
- Laboratory infrastructure
- Versatile standard equipment inventory
- Special environments developed with user community input

SENSE Workshop Participants Sep 2003

Workshop on Sample Environments at Neutron Scattering Facilities, 2004

SNS Sample Environment Team

- Forming large dedicated team →
- Gearing up for full user program in 2008
- Working closely with Instrument teams
- Foundational work has been underway for years



Increasing Support at the HFIR

- Existing technician pool includes six with sample environment expertise
  - Chris Redmon, Brent Taylor, Scott Moore, Brian Larkins, Daryl Valentine, Doug Jones
- New scientific associates (SA) and technicians are coming on board
- Lee Robertson new technical group leader
- Instrument scientists play active role in user support

Standards & Infrastructure

Support Laboratories

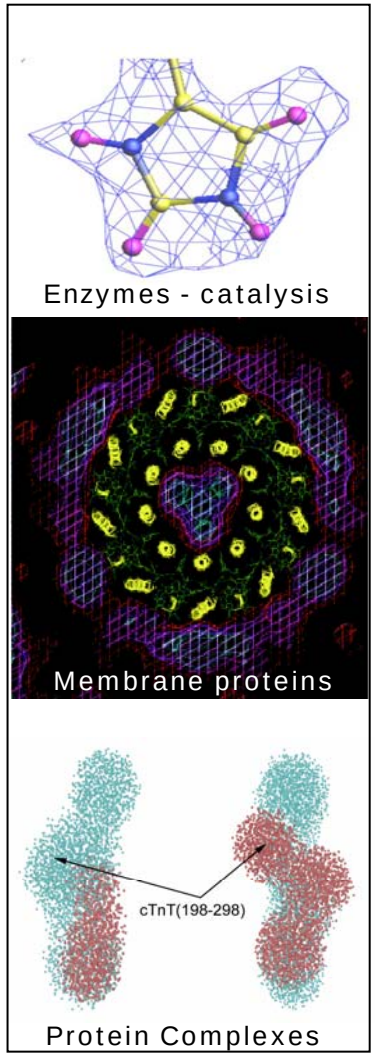
- One of the major concerns raised at 

- ORNL plan
  - Sample environment team maintains basic support areas
    - Equipment setup
    - Sample loading
    - Common tools and supplies
  - Beamline-adjacent sample prep areas (space permitting)
  - ORNL centers such as …

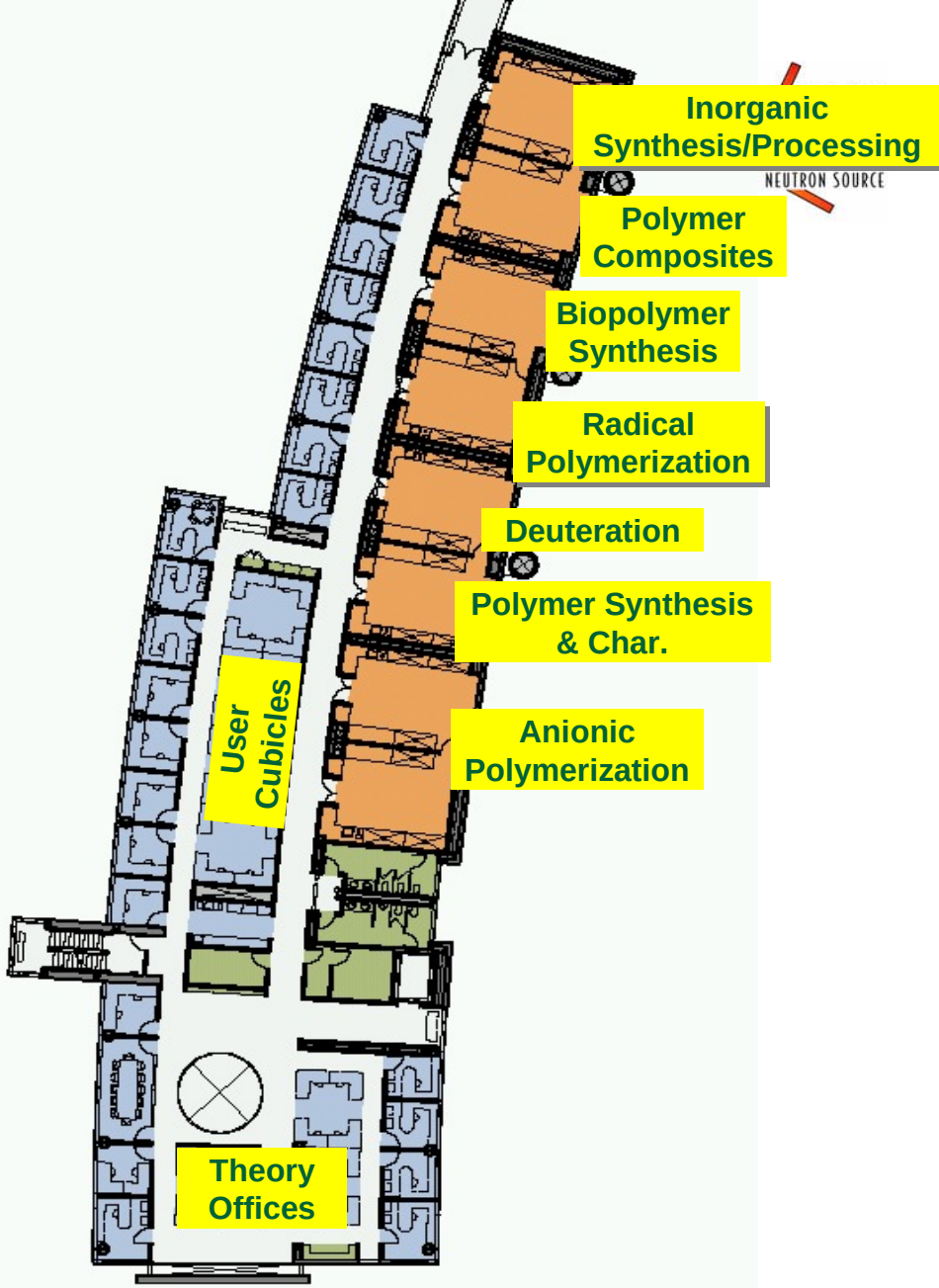
ORNL Center for Structural and Molecular Biology

A Central facility and user program for *in vivo* H-D labeling of macromolecules

- **Develop a Central Deuteration Laboratory** dedicated to specific H/D labeling of cells, proteins, nucleic acids and other bio-molecules.
- **Develop better and faster systems and methods** to produce deuterium labeled biological macromolecules for the biology community
- **Improving downstream technologies** to exploit these reagents (including data collection and interpretation for neutron scattering)
- **Train research students and staff** in application of these techniques



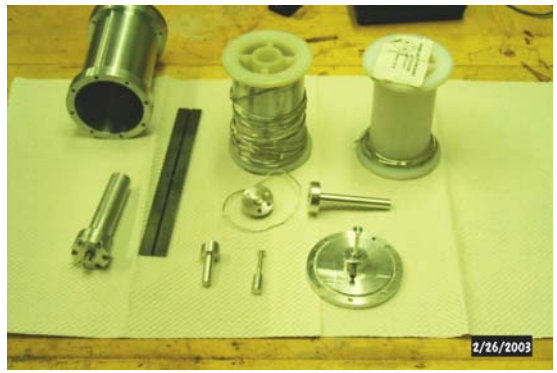
- Seven synthetic labs
- Most labs have three hoods:
  - 8’ benchtop
  - 8’ walk-in
  - 10’ walk-in
- GPC characterization
- Glass annealing oven
- Refrigerators/freezers
- Glove box
- Three characterization labs
- Instrumentation used in many research themes



Jimmy W. Mays and Phillip F. Britt, CNMS
Scientific and Operational Leaders

Standards for Samples and Sample Holders

- Ken Herwig will outline sample policy in later talk
- SE team will stock standard aluminum and vanadium cans



- Special cells will be developed through collaborative work among beamline teams and users
  - Transfer relevant knowledge & technology to SE team

Beamline Utilities and Setup Space

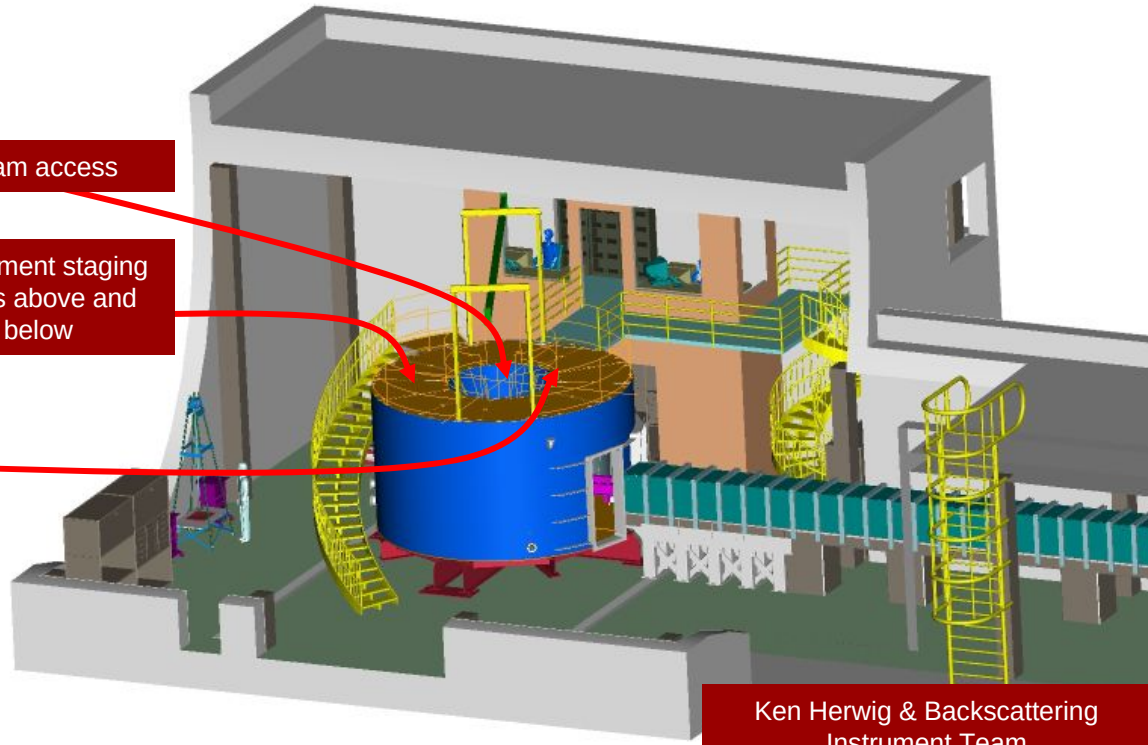
- Numerous electrical outlets
- Cooling water, compressed gases
- Equipment staging areas
  - Shared space planned on instrument floor
  - Instrument specific areas

Utility service panels (electrical, water, compressed gas) mounted around inner and outer perimeter railings

Double-sided electrical service panel shown below

Beam access

Equipment staging areas above and below



Ken Herwig & Backscattering Instrument Team

Standard Equipment Mounting Scheme

- Off-the-shelf systems are easily equipped with ORNL standard flanges
  - Body flange
    - Tank interface
  - Tail flange
    - Goniometer interface

- SNS and HFIR compatible cryofurnace already commissioned for user experiments

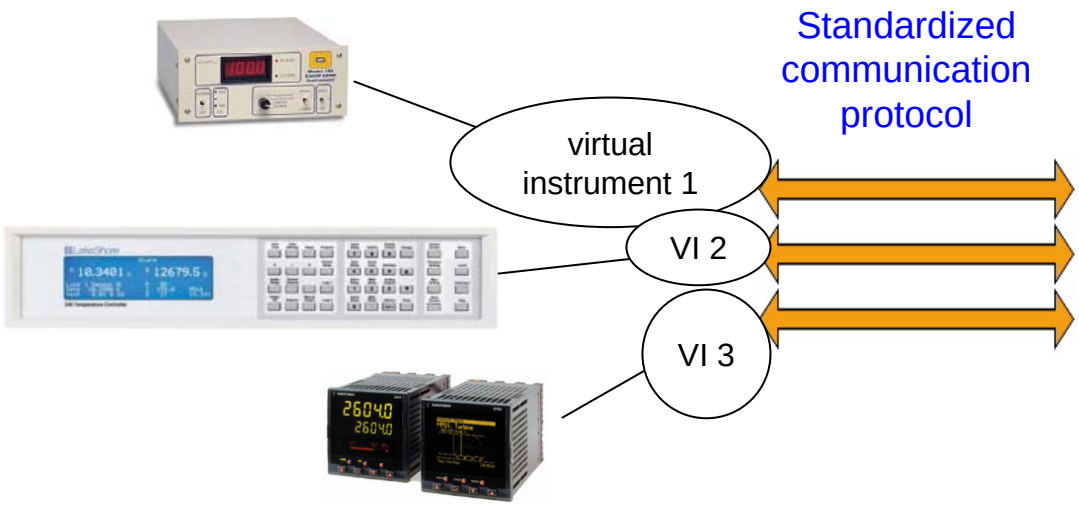
Cryofurnace (2 to 600 K) purchased in 2003

Commissioned for user experiments at the HFIR

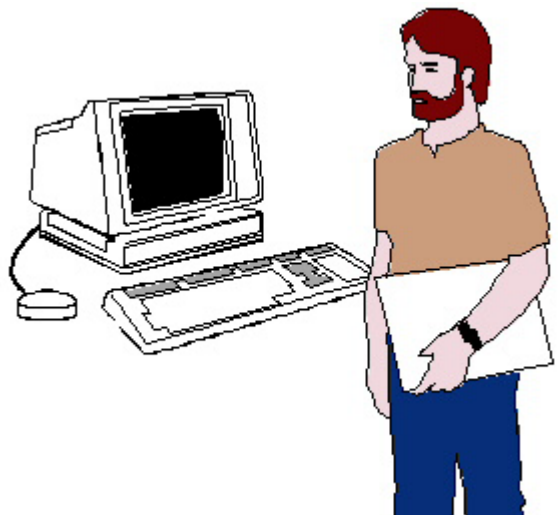
Data Acquisition System

Designed with sample environment issues in mind

- Multiple devices & software modules
- Routinely changed
- Accommodate user-supplied hardware & software



- Integrated control package
- Consistent look-and-feel
- User-friendly



Equipment Inventory

Standard Cryogenics

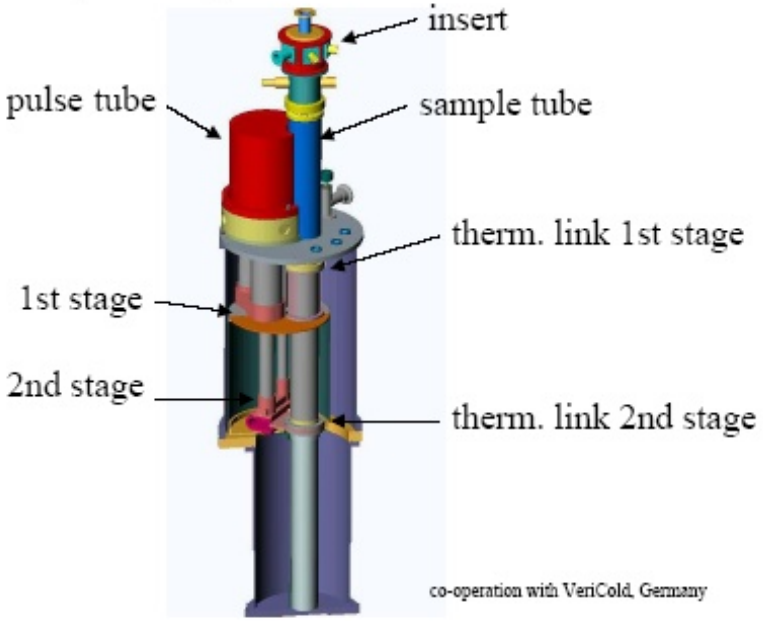
- 2 K to 600 K range readily available
  - Maximum versatility, reliability, and ease-of-use sought
- Must combine with pressure, gas environment, etc.
  - Suite of specialty probes and sample cells needed
  - Standard and special equipment are interrelated
- Add beamline-specific options such as remote sample manipulation, automatic sample changing, etc.

Worldwide Trend in Standard Cryogenics …

increasingly involves top-loading closed cycle refrigerators

The new neutron source FRM-II

Closed cycle refrigerator CCR2



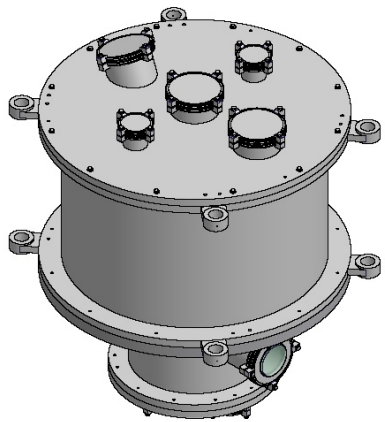
Workshop on Sample Environment at Neutron Scattering Facilities, June 23-25 2004, Cosener's House, Abingdon, UK

New Cryogenic Environments at ORNL

- HFIR now commissioning “Omniplex” system & high-temperature “Displex”

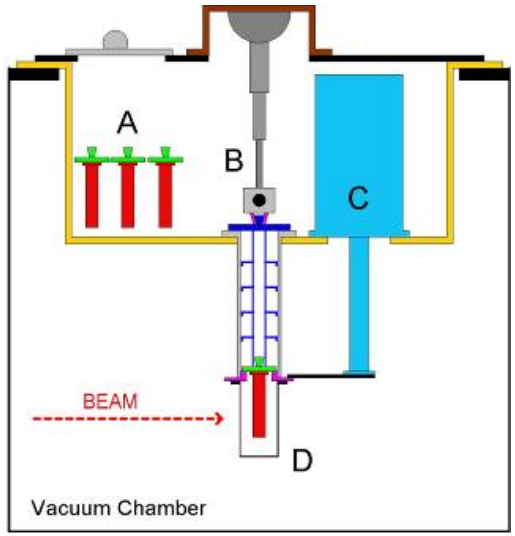
- Custom R&D platform in use at SNS
  - Developed in collaboration with Omniplex vendor
  - Completely re-configurable
  - Serving as test platform for special components

SMASH Rig



SE Team Collaborating with Several Groups to Develop Special Components for CCR Rigs

- Rapid cooling, control and sample changing modules
  - POWGEN3 diffractometer team, ANL/IPNS & small business
- Sample manipulation
  - TOPAZ single crystal team & small business
  - ARCS spectrometer team, LANL/LANSCE & consultant



Sample Changer Schematic

A: sample storage carousel

B: pick and place device

C: CCR cold head

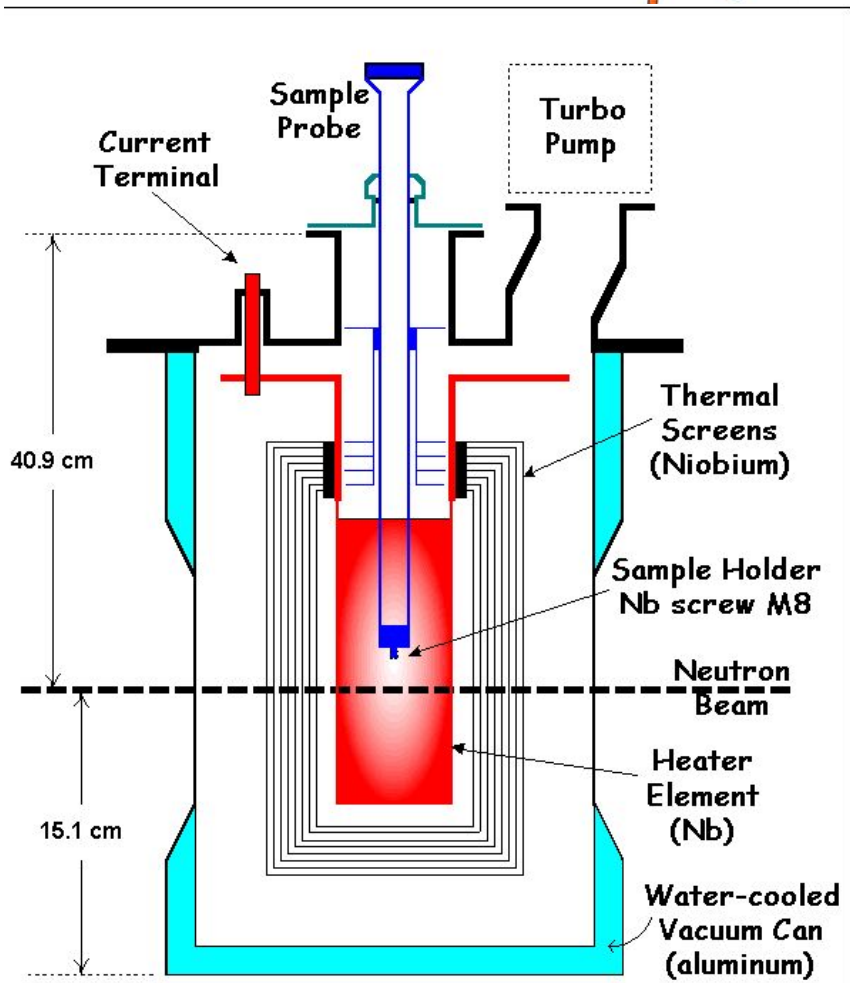
D: sample tube

Standard Cryo-Inventory Plan

- Implement a system of rigorous testing, preventative maintenance, and continuous upgrades
- At least one CCR rig per instrument
  - Beamline-specific options such as sample changer
- Additional liquid helium systems (high cooling capacity)
- Extensive suite of specialty probes and cells

High Temperature Environments

- Maximum versatility and modularity sought
- SNS preparing first furnace purchase
  - Top-loading 1800 C system
  - Delivered as vacuum furnace
  - Add controlled atmosphere capability (special probe)
  - Collaboration with POWGEN3 team



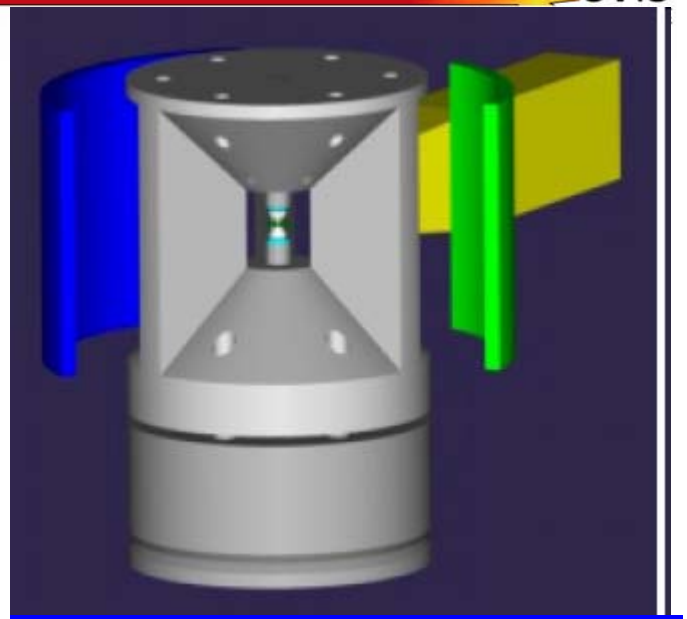
Furnace sketch (courtesy of NIST)

High Temperature Environments

- HFIR has 3 furnaces in service
- New controlled atmosphere system under development
  - Collaboration with ORNL High Temperature Materials Laboratory
- Alternate technologies under evaluation
  - Image furnaces
  - Custom systems developed at other neutron facilities

SNS High Pressure Plan

- The *SNAP* team will play a leading role in developing and identifying world-class technology for SNS
  - Instrument-dedicated large anvil
  - Portable clamp and gas pressure cells
  - Training



Early conceptual drawing of SNAP

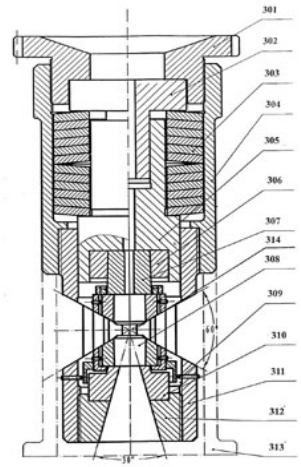


Fig. 3

Suite of small, portable cells under development by SNAP team

Panoramic anvil cells

Magnet Systems

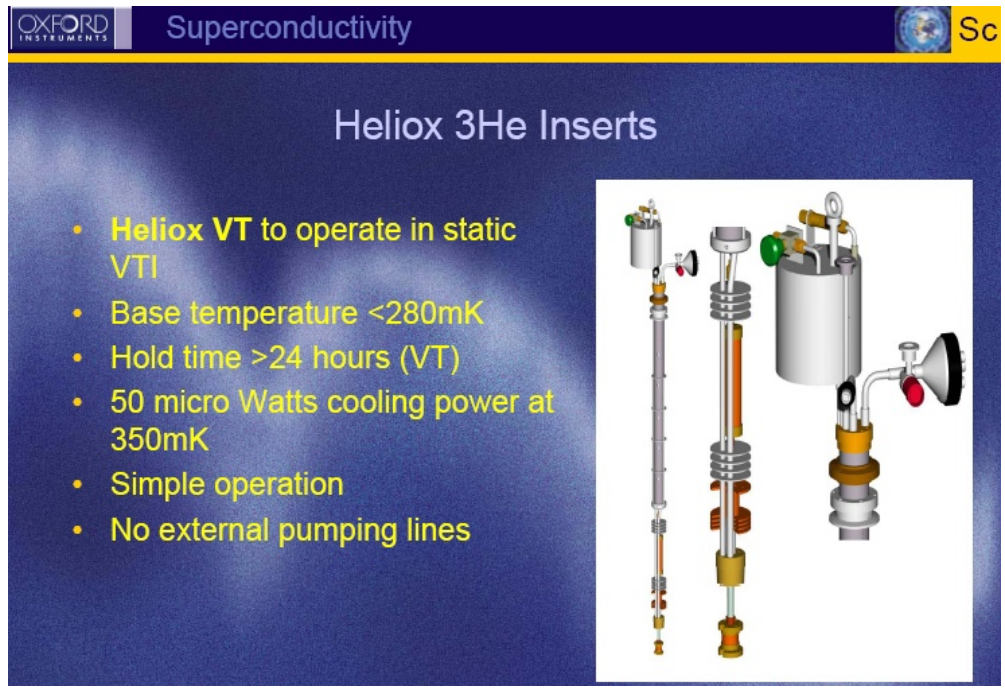
- High fields are on the way to Oak Ridge
  - 15 Tesla is present world standard for neutrons
  - 16 Tesla system now under development for SNS
    - PSI/SNS collaboration (deliver system in 2007)
  - Dedicated 40T instrument in planning

- Addressing stray field and spin transport challenges
  - SNS first facility in the world to implement policy and technology for stray field compensation and spin-transport optimization

- Medium field (7 – 10 T) also needed
  - Larger bores, combination environments, easier operation
  - SNS-vendor collaboration underway

Intensive Cryogenics (below 1.4 K)

- Traditionally involves liquid helium cryostat plus a special insert and gas handling system
  - Hence “intensive”
  - Off-the-shelf equipment
    - *e.g.* →
- New trend
  - CCR compatible inserts



SNS Intensive Cryogenics Plan

- Purchase the best off-the-shelf technology

- Helium-3 inserts (0.3 K)
  - Compatible with standard CCR-rigs and cryostats
  - One on day-one of SNS operations
  - Three by 2008

- Dilution inserts (0.03 K)
  - One for each magnet system
    - Interchangeable if possible
  - One shared insert for standard cryo-system by 2008

Mechanical Behavior Studies

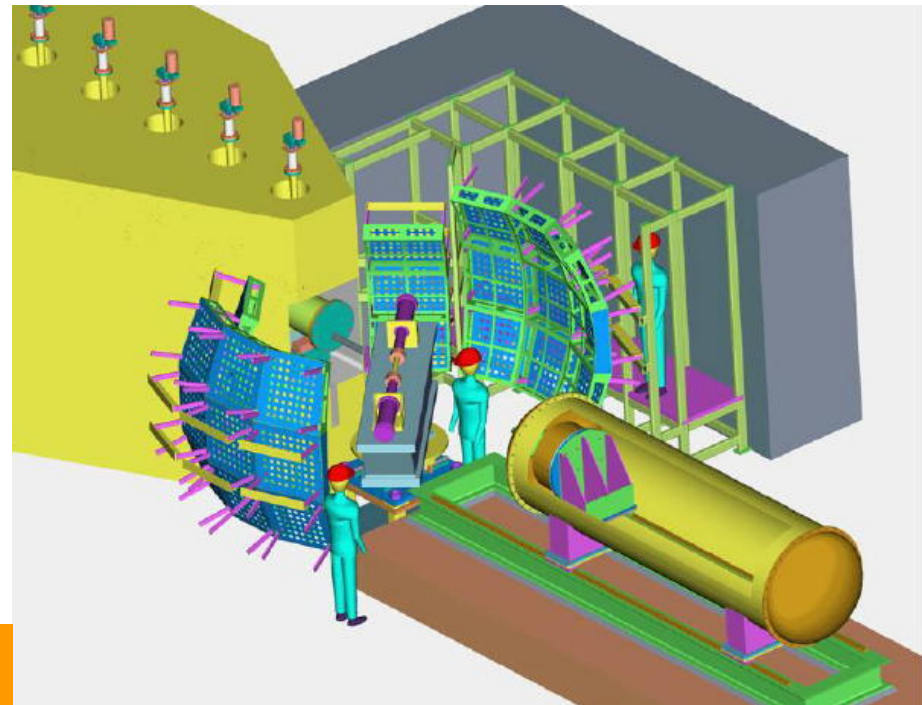
- Vulcan team awarded NSF Major Research Instrumentation (MRI) Proposal

  "Development of an In-Situ Neutron-Scattering Facility for Research and Education in the Mechanical Behavior of Materials"

P. K. Liaw, H. Choo, R. A. Buchanan (U. Tennessee)

C. R. Hubbard and Xun-Li Wang (ORNL)

$2M USD



Environments for Liquids

- Liquids Reflectometer and SANS teams will play leading role in identifying and acquiring dedicated equipment

- Will work with SE team to identify general-use items and provide training
  - Cells and ancillary equipment for liquids
  - Humidity control

- SE team will provide …
  - Maintenance and custom fabrication support
  - Budget for general-use cells and instrumentation

SNS Inventory Projection

Shared Inventory

year-by-year >>	2005	2006	2007	2008
Beamline instruments	*0*	*3*	*7*	*10*
Closed Cycle Refrigerator Rig	*1*	*4*	*8*	*11*
Liquid Helium Cryostat	*2*	*2*	*3*	*4*
Furnace	*0*	*1*	*3*	*4*
Mid Range Magnet (5 to 10 T)	*0*	*1*	*2*	*3*
Gas Atmosphere Control System	*0*	*2*	*5*	*10*
Gas Pressure Rig, Probe & Cell	*0*	*1*	*3*	*6*
Chem/Bio Compatible Probes	*0*	*1*	*3*	*5*
Intensive Cryogenics (3He & 3/4He)	*1*	*2*	*4*	*6*
High-Field Magnet (> 10T)	*0*	*0*	*1*	*2*
Standard sample cans	*4*	*500*	*1500*	*2500*
Vacuum system	*1*	*4*	*6*	*8*
Leak detector	*2*	*3*	*4*	*5*

Summary

- Staffing projection
  - Users have been heard
  - Large dedicated sample environment team forming

- Comprehensive equipment suite by 2008
  - You will be the judge

- Sample environment team does not work in isolation
  - Close interaction with Instrument Scientists and SA's
  - Working with vendors
  - Input and collaboration with the user community