New SANS Instruments at HFIR

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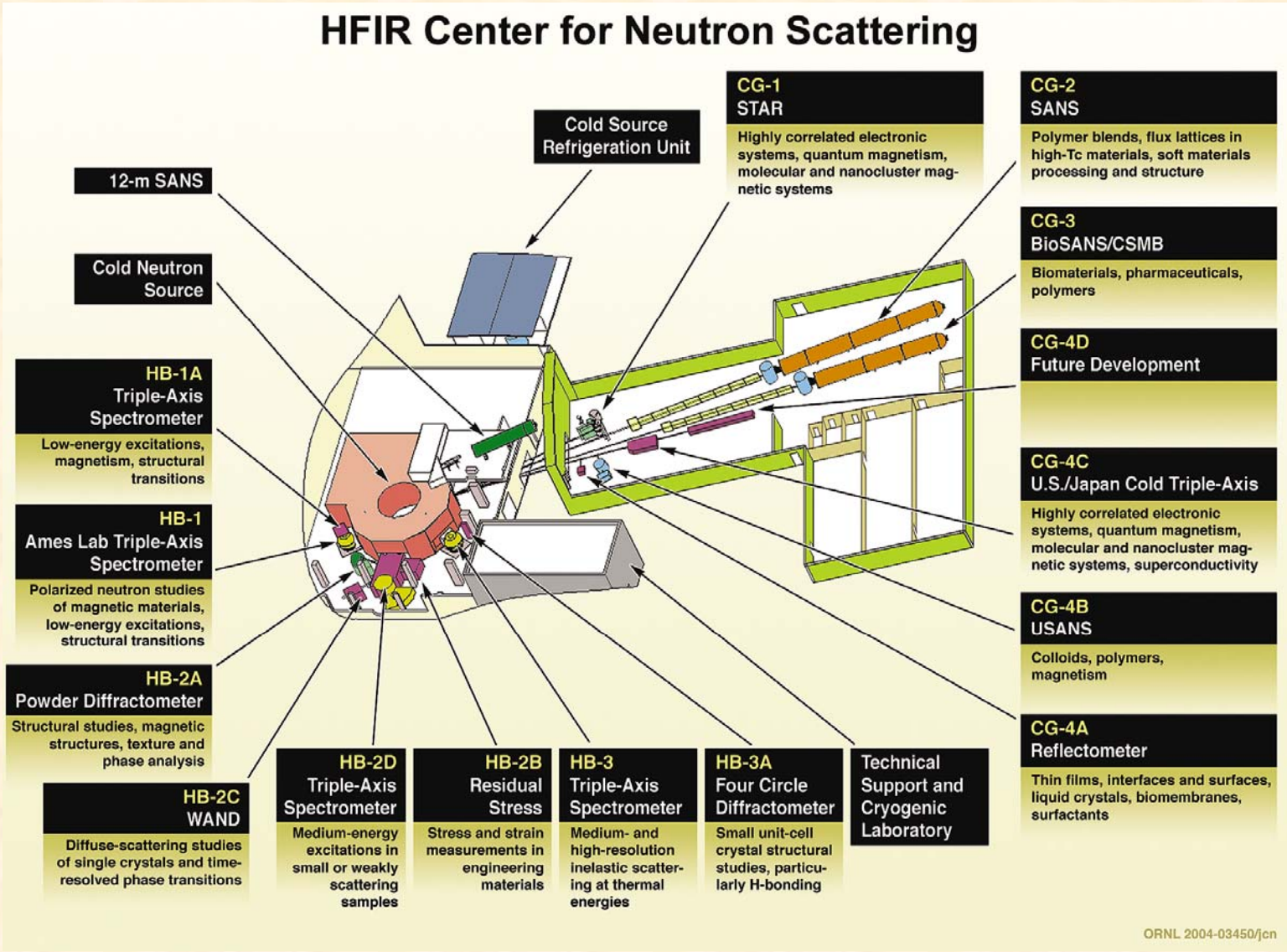

HFIR Center for Neutron Scattering
12-m SANS
Cold Neutron Source
Cold Source Refrigeration Unit
CG-1
STAR
Highly correlated electronic systems, quantum magnetism, molecular and nanocluster magnetic systems
CG-2
SANS
Polymer blends, flux lattices in high-Tc materials, soft materials processing and structure
CG-3
BioSANS/CSMB
Biomaterials, pharmaceuticals, polymers
CG-4D
Future Development
HB-1A
Triple-Axis Spectrometer
Low-energy excitations, magnetism, structural transitions
HB-1
Ames Lab Triple-Axis Spectrometer
Polarized neutron studies of magnetic materials, low-energy excitations, structural transitions
CG-4C
U.S./Japan Cold Triple-Axis
Highly correlated electronic systems, quantum magnetism, molecular and nanocluster magnetic systems, superconductivity
CG-4B
USANS
Colloids, polymers, magnetism
HB-2A
Powder Diffractometer
Structural studies, magnetic structures, texture and phase analysis
CG-4A
Reflectometer
Thin films, interfaces and surfaces, liquid crystals, biomembranes, surfactants
HB-2C
WAND
Diffuse-scattering studies of single crystals and time-resolved phase transitions
HB-2D
Triple-Axis Spectrometer
Medium-energy excitations in small or weakly scattering samples
HB-2B
Residual Stress
Stress and strain measurements in engineering materials
HB-3
Triple-Axis Spectrometer
Medium- and high-resolution inelastic scattering at thermal energies
HB-3A
Four Circle Diffractometer
Small unit-cell crystal structural studies, particularly H-bonding
Technical Support and Cryogenic Laboratory
ORNL 2004-03450/jcn

Project Background

- **SANS1 project initiated in 1996 with a proposal to the DOE Office of Basic Energy Sciences (G.D. Wignall)**
- **SANS2 proposal to the DOE Office of Biological and Environmental Research 1999 (M.V. Buchanan)**
- **DOE Milestone for SANS1 completed Sept. 30, 2005**

Velocity Selectors

- **Cold guide 2 ($5 < \lambda < 30$ Å)**
  Cold guide 3 ($6 < \lambda < 30$ Å)

- **SANS1 variable resolution ($\Delta\lambda/\lambda$) range of 5-12 %**
- **SANS2 $\Delta\lambda/\lambda$ = 8-45 %**

- **HFIR tours Wednesday afternoon (October 12)**

Pre-sample Collimation

- **16 m of collimation from 8 removable guide sections (1.9 m in length, 4 x 4 cm^2 cross section**

- **Three positions on table that can translate in and out of the main beam**

Sample Area

- **15-position sample changer for liquid samples (5-120 °C)**
- **1000 lb capacity multi-axis stage (cryo-magnets, etc.)**
- **Dog-leg monochromator ($\Delta\lambda/\lambda < 1$ %)**
- **Lenses (Q_{min}< 0.0005)**

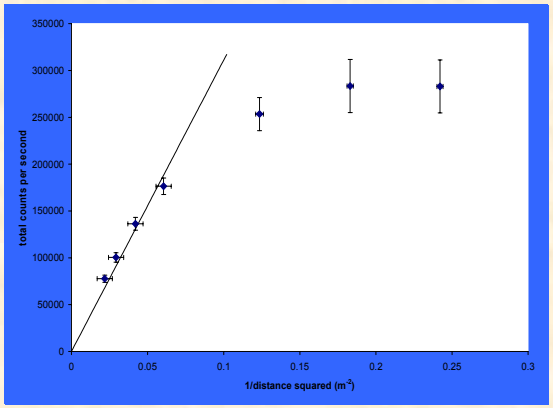
http://neutrons.ornl.gov/hfir_cns/sample%20environment.pdf

Post-sample Flight-tube

- **SANS1 sample-to-detector distance 1<D<18 m**
- **SANS2 sample-to-detector distance 1<D<15 m**
- **Detector can translate 45 cm off axis**
- **Q-range (<0.001-1.0 $Å^{-1}$ overall) length scales 5-2000 Å**

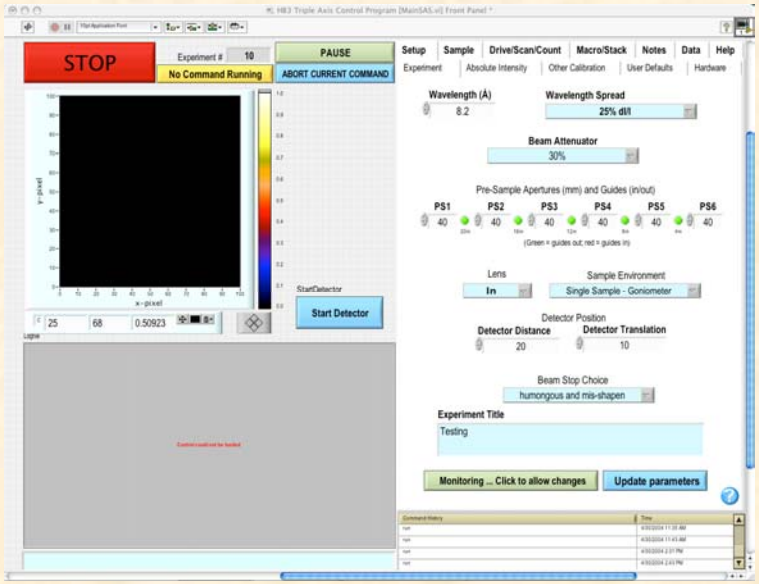
Detector

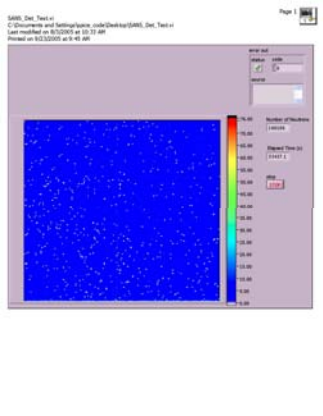
- **ORDELA 21000N 2D position-sensitive detector**
- **1 x 1 m^2 active area**
- **5 x 5 mm^2 pixel area (192 x 192 wires)**
- **Counting rate > 10^6 Hz Background < 3 Hz**



Data Acquisition

- **Adapting SPICE (Spectrometer Instrument Control Environment)**
- **LabVIEW-based data acquisition system**
- **NeXus data format**





Instrument Performance

λ = 10Å	Pre-sample Collimation, L (m)	Wavelength Range, $\Delta\lambda/\lambda$ (%)	Collimator Area, A (cm^2)	Flux at Sample $10^5 sec^{-1}\text{-}cm^{-2}$
ILL-D22	18.0	10	22	7.5
ORNL SANS1/2	18.0	10	16	4.1-4.6
ILL-D11	18.0	10	15	2.7

Experiment Support

- **Wet-lab space at HFIR**
- **Center for Structural and Molecular Biology (CSMB):**

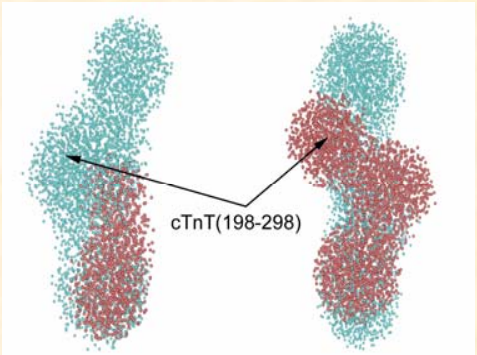
Bio-sample prep lab

Deuteration lab

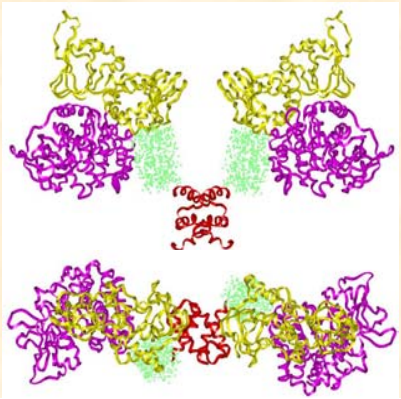
SAXS and light scattering

Computational tools

- **SANS workshop Thursday morning (October 13)**



W.T. Heller et al., *Biochem* 2003



W.T. Heller et al., *J. Biol. Chem.* 2004

DOE Milestone SANS1 complete
Both SANS Instruments ready for operation (June 2006)
Cold H_2 neutrons (Oct. 2006)

SANS Design Team

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