Small Angle Neutron Scattering Instrument (SANS) at LENS

Low Energy Neutron Source

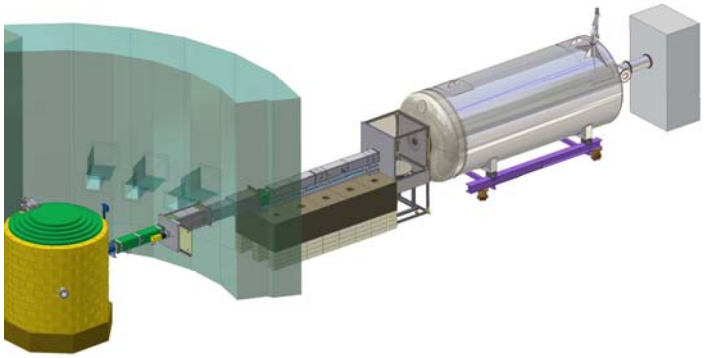
Helmut Kaiser[1,2], D.V. Baxter[1,2], D. Bossev[1,2], J. Fry[1,2], N. Remmes[1,2], P.E. Sokol[1,2], P. Zolnierczuk[1,2]

1 – Department of Physics and Indiana University Cyclotron Facility

2 – Low Energy Neutron Source

What is SANS?

Small Angle Scattering is a technique that measures the deviation to small angles (smaller than several degrees) of a neutron (or x-ray) due to structures of small size in the sample. Thus, it allows probing inhomogeneities (such as clusters in alloys, polymers, biological macromolecules, etc.) on a length scale between nanometers and fractions of micrometers.



Instrument Description and Layout

The LENS SANS utilizes a pin-hole collimation and covers a Q-range of 0.005 – 0.5 $Å^{-1}$ with an expected neutron flux of (2.5 – 5)*10^4 n/cm^2/sec at the final configuration of the proton accelerator. Such an instrument will allow probing inhomogeneities on a length scale of 10 – 1000 Å.

1. The Primary Flight Path (PFP) consists of a series of evacuated Al-housings and a tapered collimation system. The LN2 cooled Be-filter is located inside and the beam monitor outside of the vault wall.
2. The Sample Area (SA) consists of an interlocked enclosure and a sample rotation table inside.
3. The Secondary Flight Path (SFP) consists of the evacuated stainless steel tank, the 2D area detector and the beam stop assembly. The 2D-detector can be translated.
4. The Beam Dump (BD) functions as the beam stop for neutrons transmitted through the 2D detector.

Schematic of tapered Collimation System in PFP:

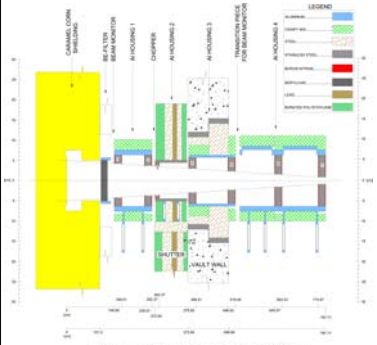
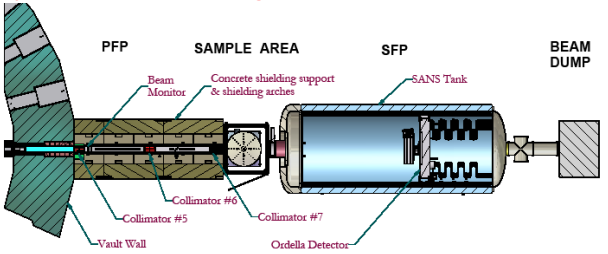


Fig. 2: Schematic of collimators and primary shielding for SANS PFP.



2D area Detector with Beamstop Assembly:

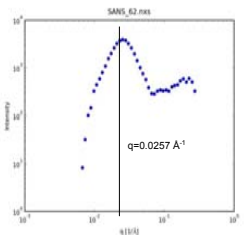
Instrument Characteristics

Source Frequency	10 – 30 Hz
Moderator	Coupled < 20 K solid methane
Wavelength Range	4 Å - 20 Å
Wavelength Resolution (Δλ/λ)	~ 11 % (FWHM)
Source-to-Sample Distance	8.55 m (fixed)
Sample-to-Detector Distance	1.1 m to 4.2 m (variable)
θ-Resolution (Δθ/θ)	3 - 48 % (FWHM)
Collimation	Circular pinhole collimation
Beam Diameter at Moderator	10 cm
Sample Aperture Diameter	1.5 cm, 2.0 cm, 2.5 cm (selectable)
Sample Size	0 to 25 mm diameter
Area Detector (^{3}He 2D ORDELA)	
Active Volume	64 x 64 cm^2, 4.4 cm thick
Pixel Size	1 x 1 cm^2
Detector Efficiency	71% for 5 Å neutrons, 52% for 3 Å neutrons
Count-Rate Capability	10^4 n/s for 10% coincidence losses (10^5 n/s max.)
Background	~ 0.5 Hz on whole 2D detector
Q-Range	0.005 $Å^{-1}$ to 0.5 $Å^{-1}$
Integrated Flux on Sample*	(2.7 - 5)*10^6 n/cm^2/s

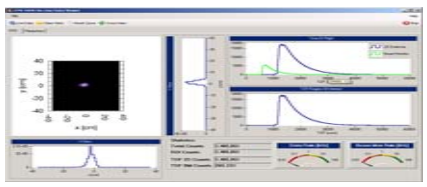
* This is the calculated flux at the sample position at the end of Phase II construction phase of the proton accelerator (13 MeV, 25 mA peak current, 2.7-4% duty factor (1.33 ms pulse length, 20-30 Hz pulse frequency)).

Preliminary Data

Vycor Scattering Data (no corrections)



Direct Neutron Beam on 2D area Detector



Scientific Program

Develop a Scientific Program on Study of Large Scale Structures:

- Polymer solutions, gels and blends
- Colloids and microemulsions
- Micelles
- Dendrimers
- Nanocomposites
- Biomembranes
- Hierarchical biological structures

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