

Small Angle Neutron Scattering Instrument (SANS) at LENS

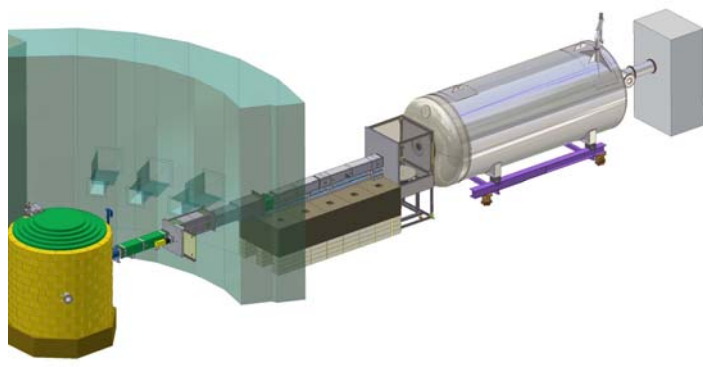


Low Energy Neutron Source

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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

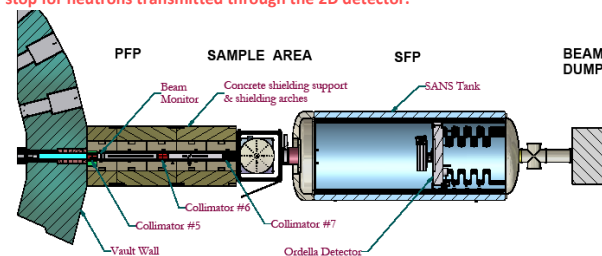
The LENS SANS utilizes a pin-hole collimation and covers a Q-range of $0.005 - 0.5 \text{ \AA}^{-1}$ with an expected neutron flux of $(2.5 - 5) \times 10^4 \text{ n/cm}^2/\text{sec}$ at the final configuration of the proton accelerator. Such an instrument will allow probing inhomogeneities on a length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

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:

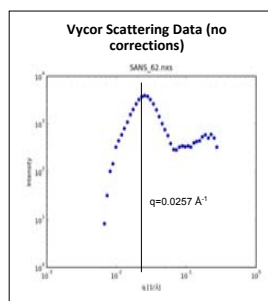


Instrument Characteristics

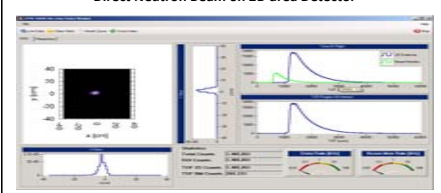
Source Frequency	10 - 30 Hz
Moderator	Coupled < 20 K solid methane
Wavelength Range	4 Å - 20 Å
Wavelength Resolution ($\Delta\lambda/\lambda$)	~ 11 % (FWHM)
Source-to-Sample Distance	8.55 m (fixed)
Sample-to-Detector Distance	1.1 m to 4.2 m (variable)
$\Delta\theta$ -Resolution ($\Delta\theta/\theta$)	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	84 x 64 cm ² , 4.4 cm thick
Pixel Size	1.1 x 1 cm ²
Detector Efficiency	71% for 5 Å neutrons, 52% for 3 Å neutrons
Count-Rate Capability	10 ⁷ n/s for 10% coincidence losses (10 ⁶ 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) x 10 ⁴ 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 ns pulse length, 20-30 Hz pulse frequency)).

Preliminary Data



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

The Low Energy Neutron Source at the Indiana University Cyclotron Facility is funded by:

