Online Card

Small Angle Neutron Scattering Instrument

CHRNS NSF NIST

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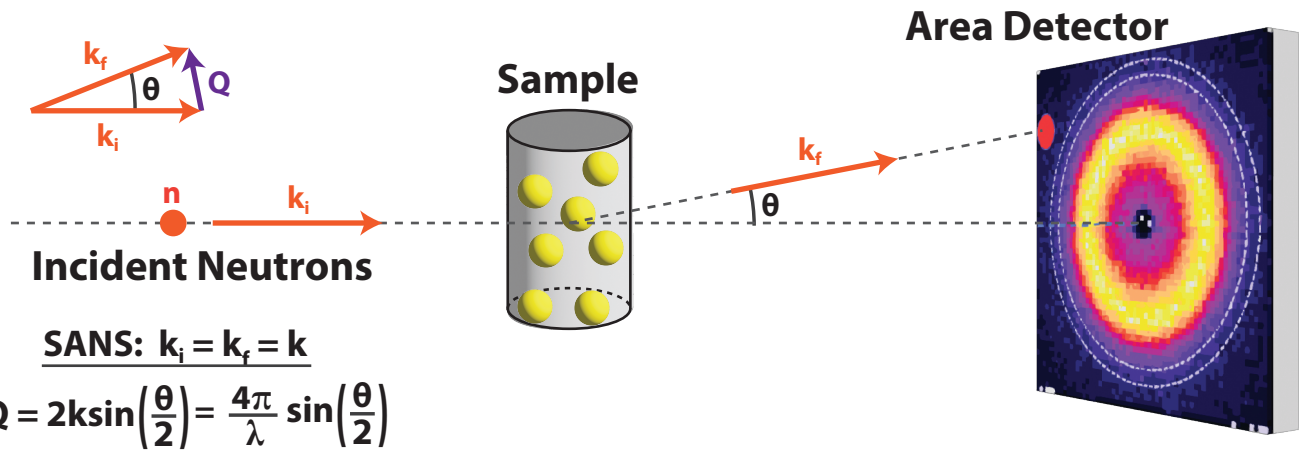
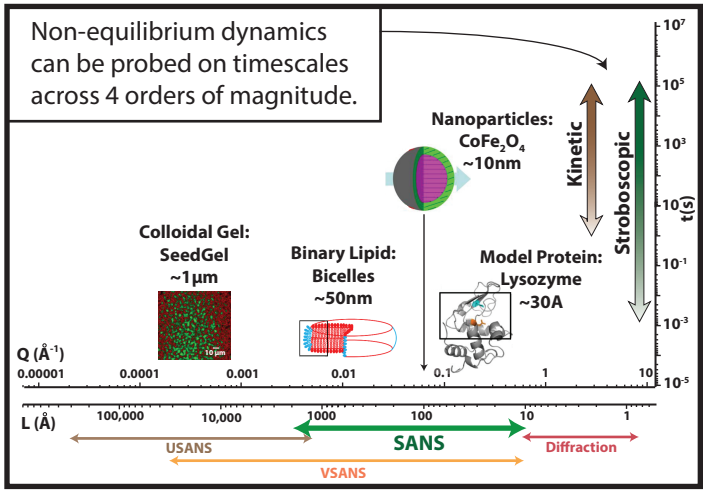


SANS: $k_i = k_f = k$

$$Q = 2k\sin\left(\frac{\theta}{2}\right) = \frac{4\pi}{\lambda}\sin\left(\frac{\theta}{2}\right)$$

Non-equilibrium dynamics can be probed on timescales across 4 orders of magnitude.



Operating Principles

1) For most reactor based SANS instruments, a monochromator (velocity selector or crystal) is employed to select k_i.

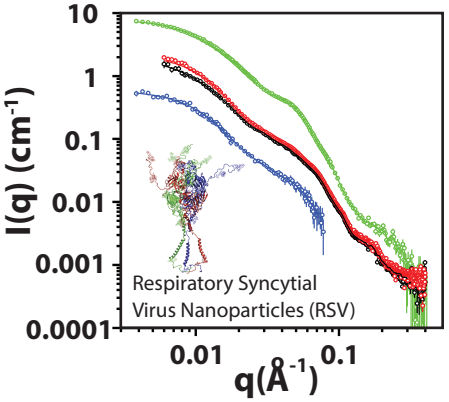
2) Scattered neutrons are typically dominated by elastic scattering. Thus, $k_i = k_f$ and no energy analyzer is required.

3) SANS measures long length scales d (~1 nm to ~1 μm). Since Q is inversely related to d ($Q = 2\pi/d$), this corresponds to small Q measurements.

4) Long distances from sample to detector are employed in order to resolve the small θ angles associated with small Q.

Example:
Structure of macromolecules in solutions

https://pubs.acs.org/doi/10.1021/acs.molpharmaceut.0c00986



vSANS reveals the arrangement of RSV F trimers around a micellar core and how it contributes to the vaccine's broad clinical efficacy.

S. Krueger et al., Mol. Pharmaceutics **18**, 359(2021)

Example:
Origin of color in a bottlebrush material

https://doi.org/10.1039/d0sm00397b

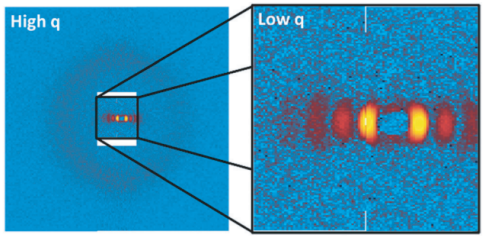


Diagram demonstrating how vSANS simultaneously collected high and low Q data. The high Q detectors were positioned such that a portion of the central beam could pass through to the low Q detectors.

A diblock bottlebrush material shows a color change as a function of shear rate. An in-situ Rheo-vSANS experiment provided insight into the shear force induced structural change of the lamellae phase in the sample.

M. Wade et al., Soft Matter **16**, 4919 (2020)

Instrument Webpage

Very Small Angle Neutron Scattering (vSANS)

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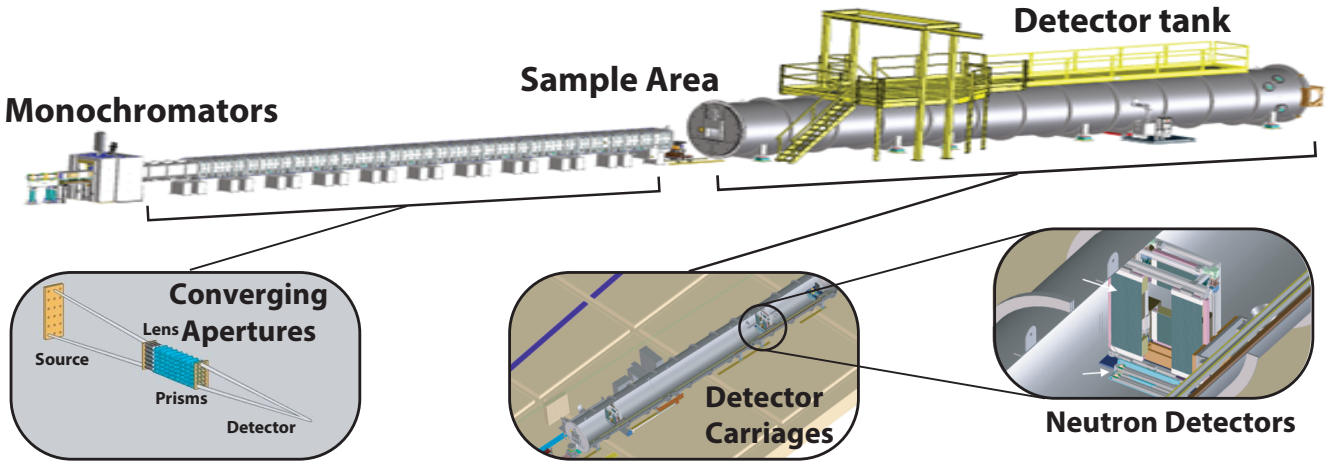
Instrument Paper: https://journals.iucr.org/j/issues/2022/02/00/ge5109/ge5109.pdf
Instrument Webpage: https://www.nist.gov/ncnr/chrns-vsans-very-small-angle-neutron-scattering

vSANS provides unprecedented opportunities for structural studies of complex systems with hierarchical structures from the nano to mesoscale, with newly added time-dependent capabilities. In addition, the large, flexible sample area opens a host of possibilities for complex sample environments, and full beam polarization is available to study magnetic structures. Since its launch in 2018, vSANS has quickly earned its place among the premier instruments in the world for investigations of soft matter structure.



Sample Changers

System	Positions	Temp. Control
9CB	9	3 indep. zones
7HB	7	RT - 250 C
9p	9	—

Pressure

- **Gas cells:** <69 MPa
- **Liquid pressure cells:** <350 MPa
- Syringe pump systems for gases (including flammable gases)

Shear

- Anton Parr Rheometers: MCR 501, MCR 301
- ARES G2
- 1,2-plane shear cell
- Capillary flow setup

Magnets

System	Max Field (T)
9 T Horiz. Magnet	9
Titan Magnet	1.6
Walker Magnets	1.8 (L), 0.5 (R)
Little Red Magnet	0.4

https://www.nist.gov/ncnr/sample-environment/sans-equipment

Operational Range

Wavelength range: 4.5 Å to 12 Å
Q range: 0.0002 $Å^{-1}$ to 1 $Å^{-1}$

Monochromator Options

- **Velocity selector:** wavelength from 4.5 Å to 12 Å; typical resolution 12%.
- **White beam:** 5.3 Å; resolution 40%
- **HOPG:** wavelength 4.75 to 5.5 Å; resolution 1%

Multiple Detectors

Three detector carriages:
- **Front:** 4 detectors
- **Middle:** 4 detectors
- **Rear:** 1 high resolution detector

Polarization

- **Before sample:** Polarizing Guide
- **After sample:** ^{3}He polarizaiton analysis
- RF flippers & guide fields

Collimation

- Circular pinhole
- Multiple converging apertures and slits
- Variable source/sample/detector distances