SANS NUTS AND BOLTS

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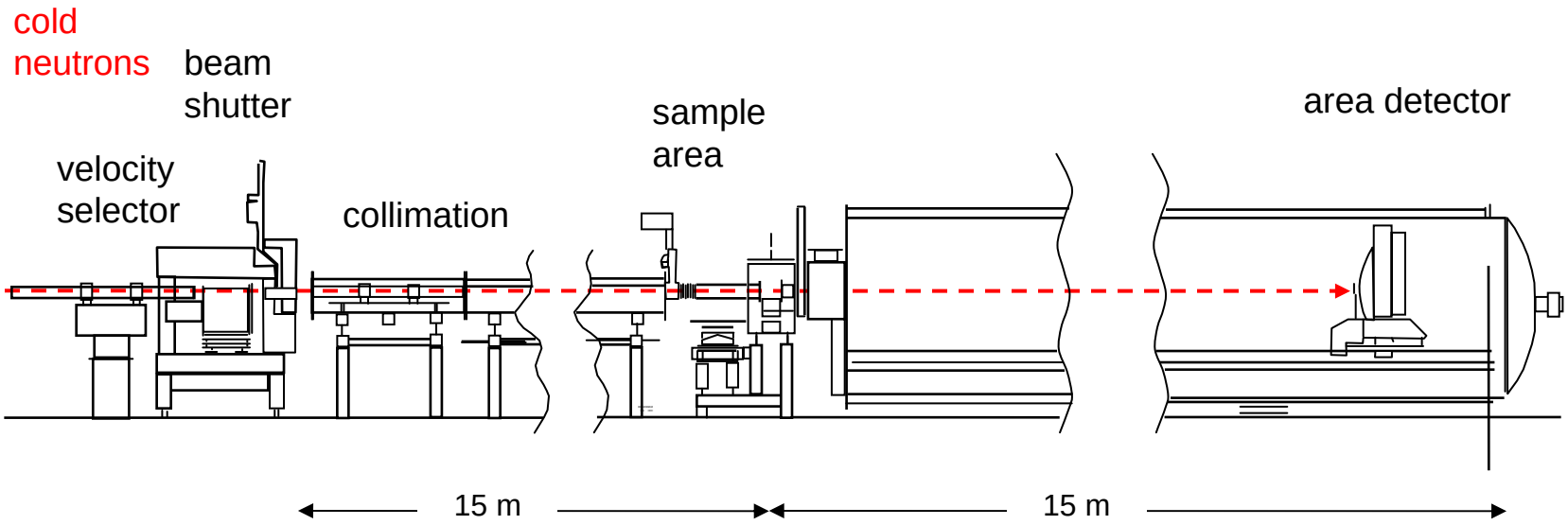
-- The 30 m SANS Instrument Description and Characteristics
-- SANS Components (Velocity Selector, Area Detector)
-- SANS Basics (Geometry, Typical Data, Cells)
-- SANS Data Acquisition, Reduction, and Analysis
-- Data Smearing and SANS Resolution
-- USANS Instrument and USANS Data Set

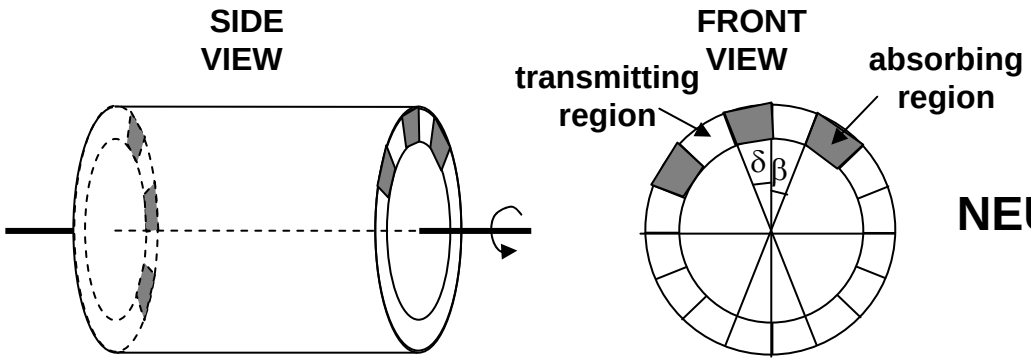
The NG3 30 m NIST-SANS Instrument



30 m NIST-SANS Instrument Characteristics

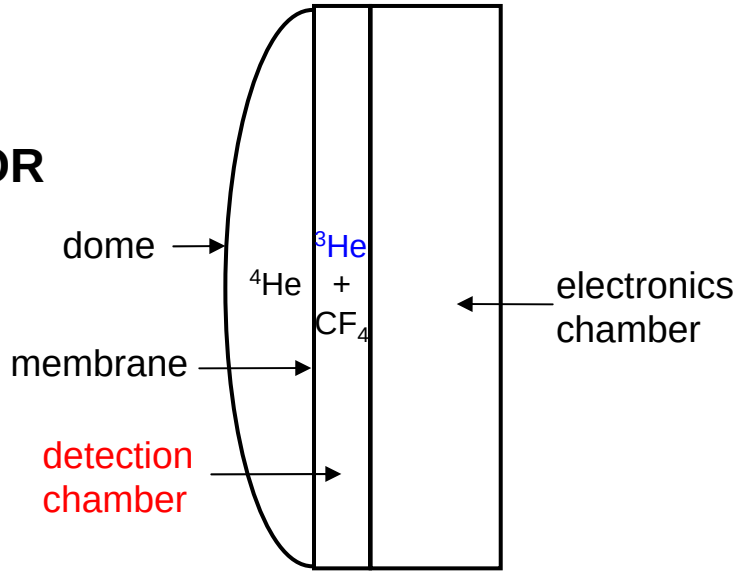
Source:	neutron guide (NG3), 6 x 6 cm^2
Monochromator:	mechanical velocity selector with variable speed and pitch
Wavelength Range:	variable from 5 Å to 20 Å
Wavelength Resol.:	10% to 30% for $\Delta\lambda/\lambda$ (FWHM)
Source-to-Sample Dist.:	3.5 to 15m in 1.5m steps via insertion of neutron guides
Sample-to-Detector Dist.:	1.3 to 13.2 m continuously variable for NG3
Collimation:	circular pinhole collimation
Sample Size:	0.5 to 2.5 cm diameter
Q-range:	0.001 to 0.6 $Å^{-1}$
Size Regime:	10 Å to 6000 Å
Detector:	64 x 64 cm^2 He-3 position-sensitive area detector proportional counter (0.5 cm^2 resolution).
Ancillary Equipment:	-automatic multi-specimen sample changer with temperature control from -10 to 200 ^oC -magnets (0 to 9 Tesla) -Couette flow shear cell -cryostats and vacuum furnace (10 to 1800 K) -pressure cell (0 to $1x10^8$ Pa, 25 ^oC to 160 ^oC

NEUTRON VELOCITY SELECTOR



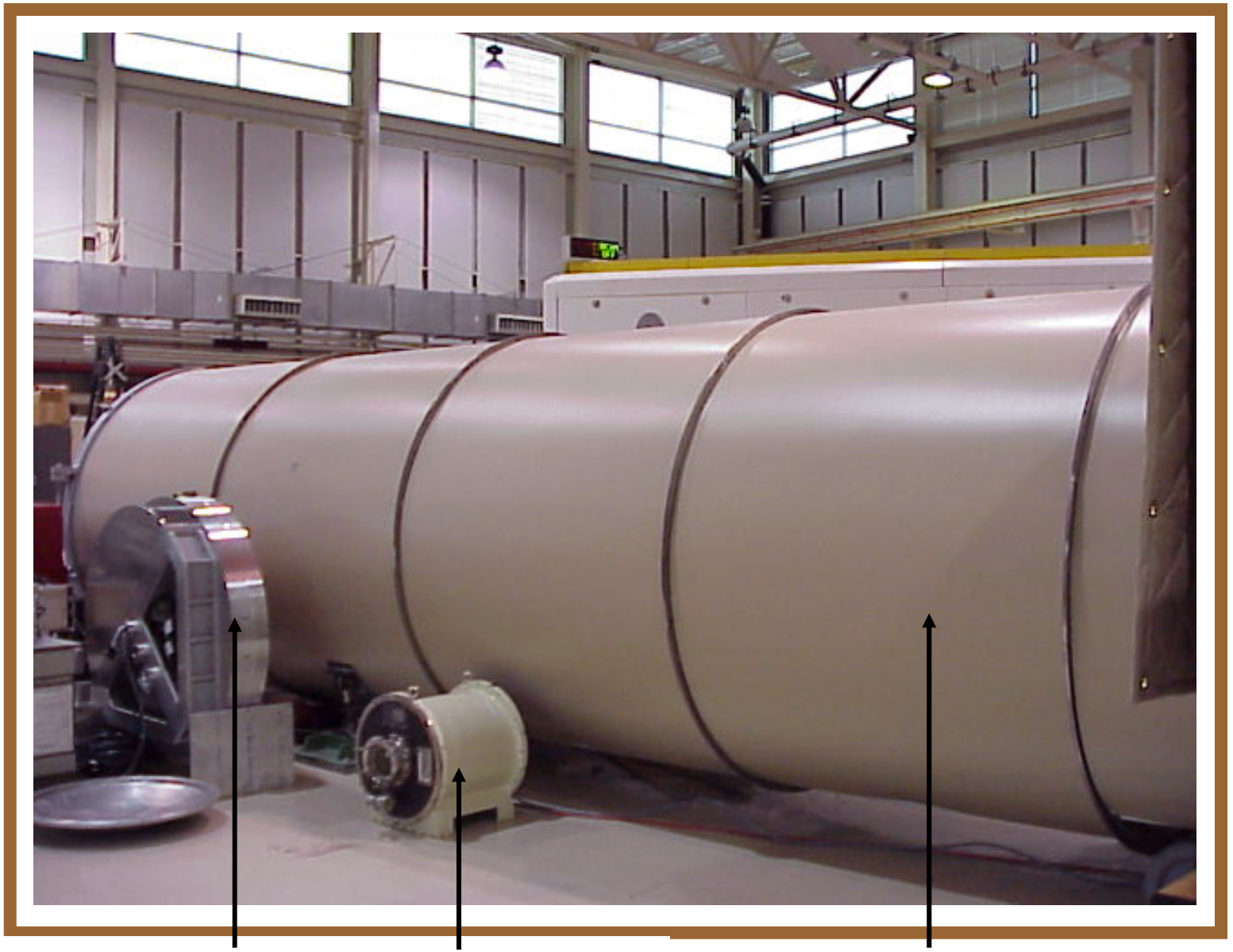
Neutron wavelength $\lambda \sim 1/\text{rpm}$
Wavelength range: 5-20 Å (mostly 6 Å)
Wavelength spread ~ tilt angle

NEUTRON AREA DETECTOR

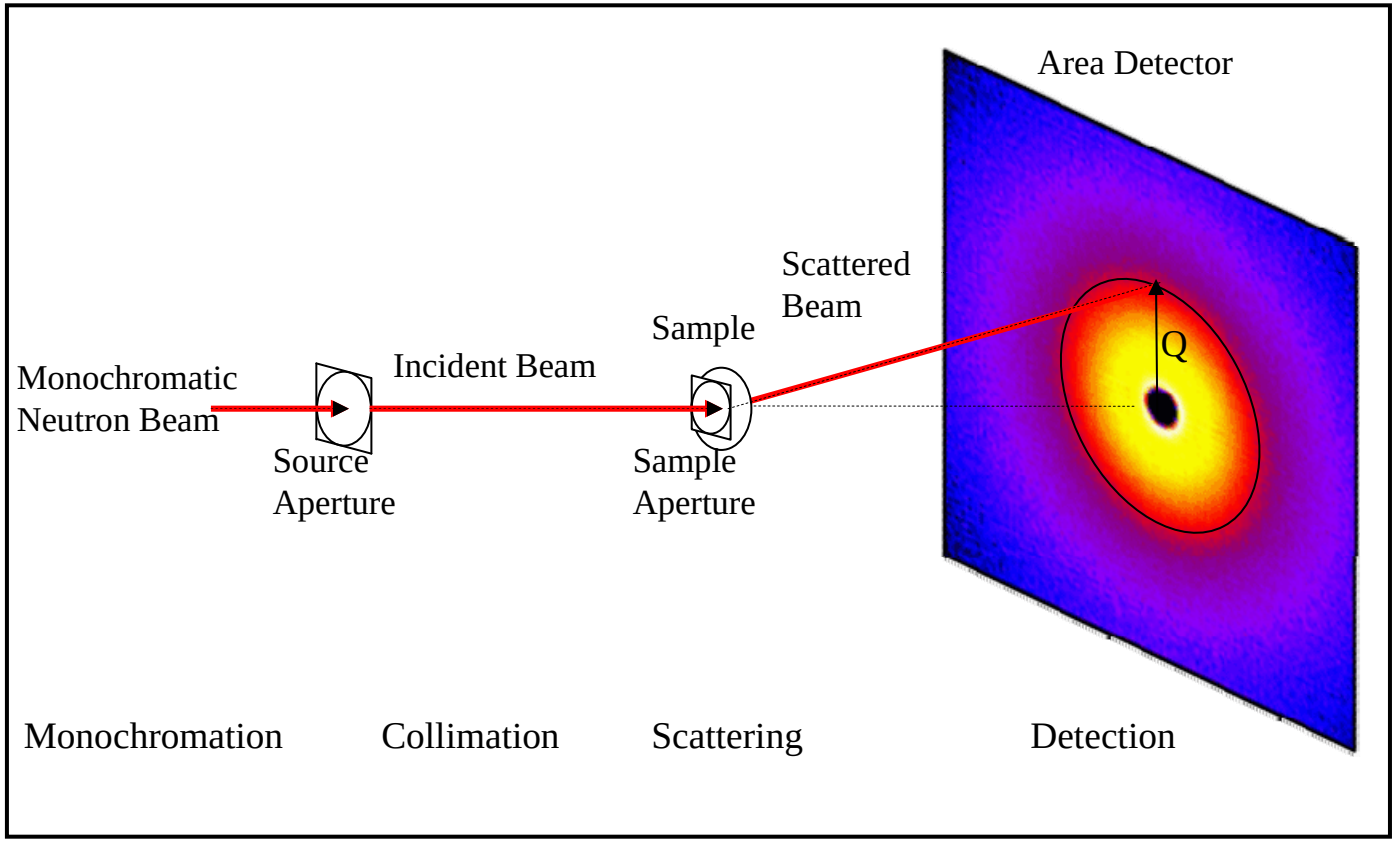


neutron + He-3 → proton + tritium
Detector resolution= 0.5*0.5 cm^2

30 m NIST-SANS Instrument Vessel

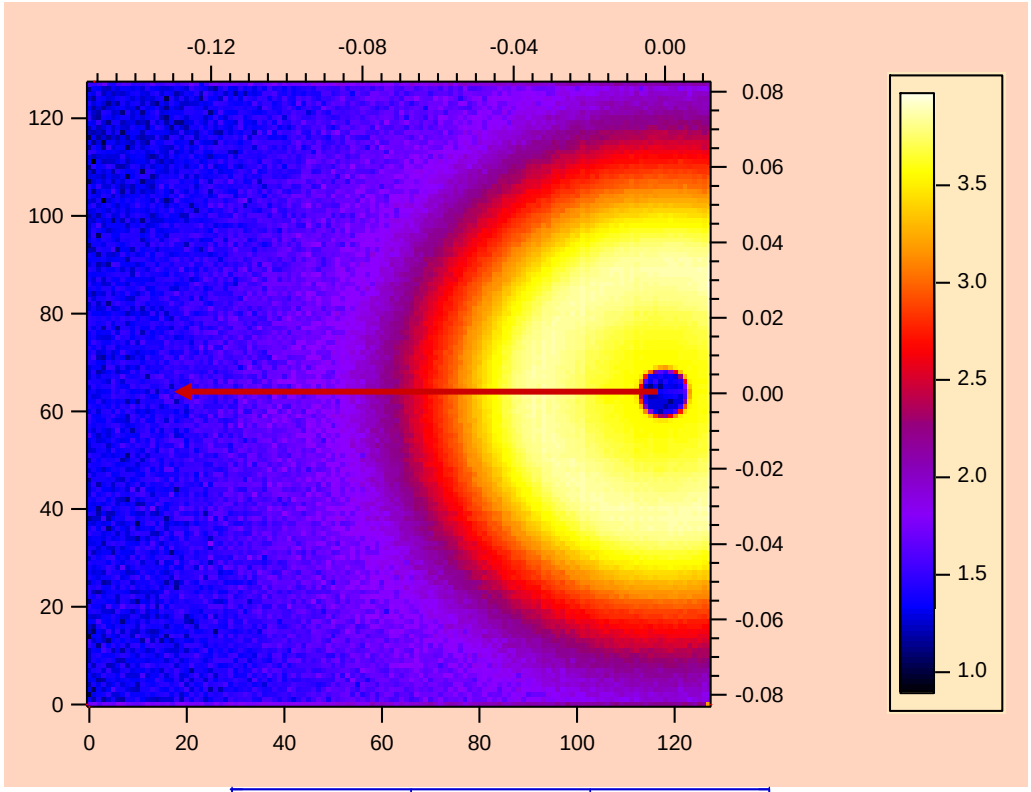


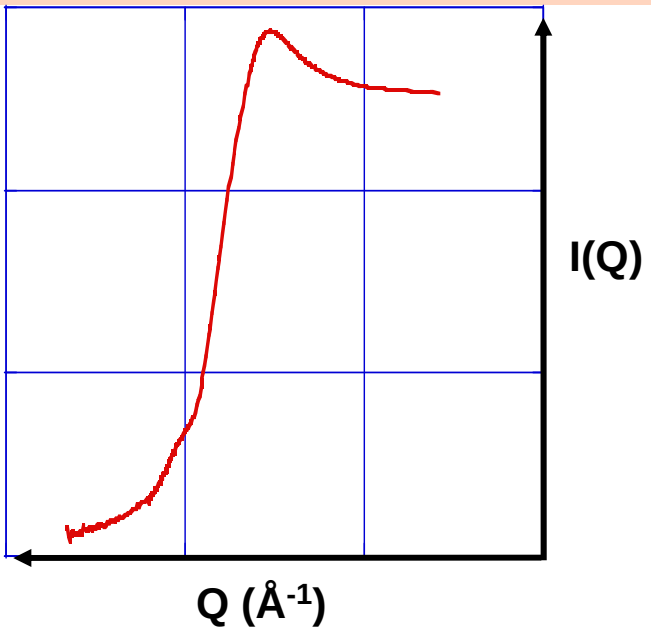
SANS GEOMETRY



10% P85 Pluronic

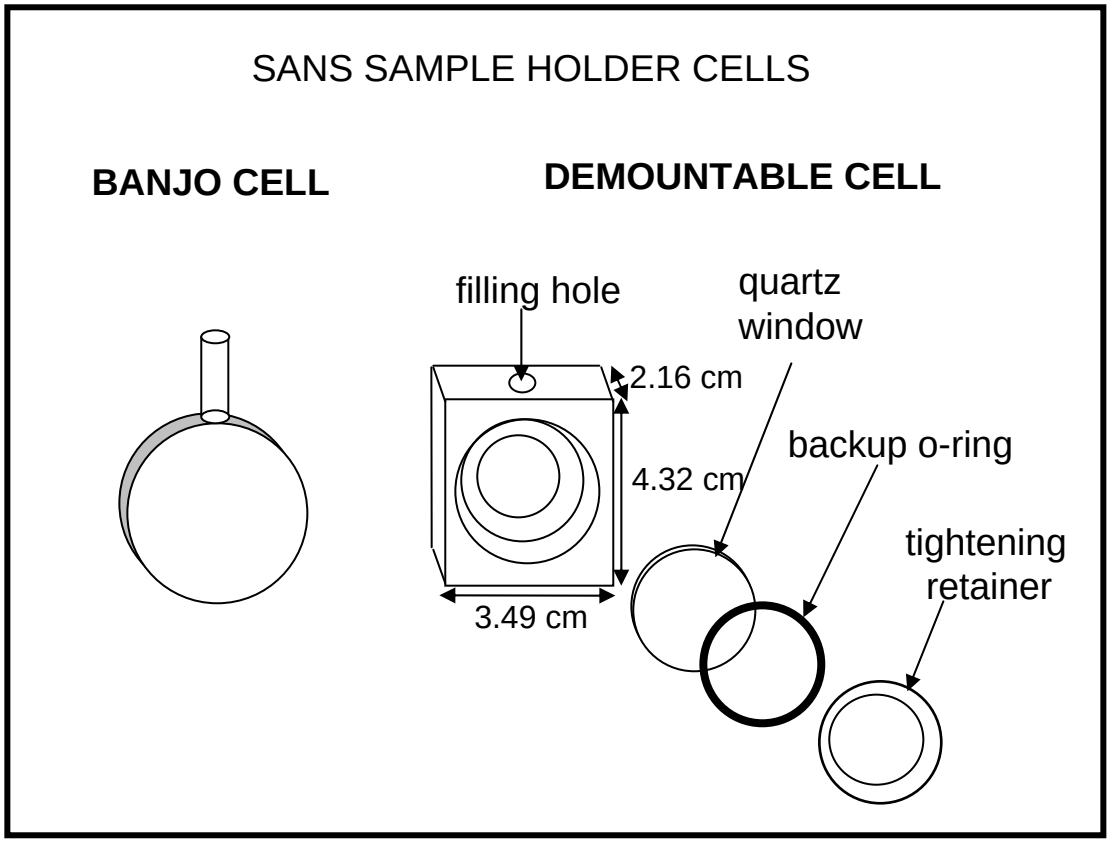
in d-water at 60°C





SANS SAMPLES AND CELL HOLDERS

SANS samples can be solid, gels, solutions or powders.
Sample thicknesses are 1 mm to 2 mm.
Sample diameter can vary between 0.5 cm and 2 cm.



SANS DATA ACQUISITION

-- Choose neutron wavelength (λ= 6 Å) and wavelength spread ($\Delta\lambda/\lambda$=15%).

-- Choose source-to-sample distance L_1 and sample-to-detector distance L_2.

-- Choose counting time.

-- Measure scattering:
- Empty cell scattering
- Sample scattering
- Blocked beam scattering

-- Measure transmission:
- Cell transmission
- Empty cell transmission

-- Neutron transmission is the ratio of the transmitted beam to the incident beam.

SANS DATA REDUCTION

Correct for empty cell and blocked beam scattering.

$$I(Q) = [I_{sample+cell} - I_{blocked\ beam}]/T_{sample+cell} - [I_{cell} - I_{blocked\ beam}]T_{cell}$$

Rescale the SANS intensity to an absolute scale (units of cm^{-1}).

Perform the radial averaging for isotropic scattering to obtain the Q-dependent macroscopic cross section $I(Q) = d\Sigma(Q)/d\Omega$.

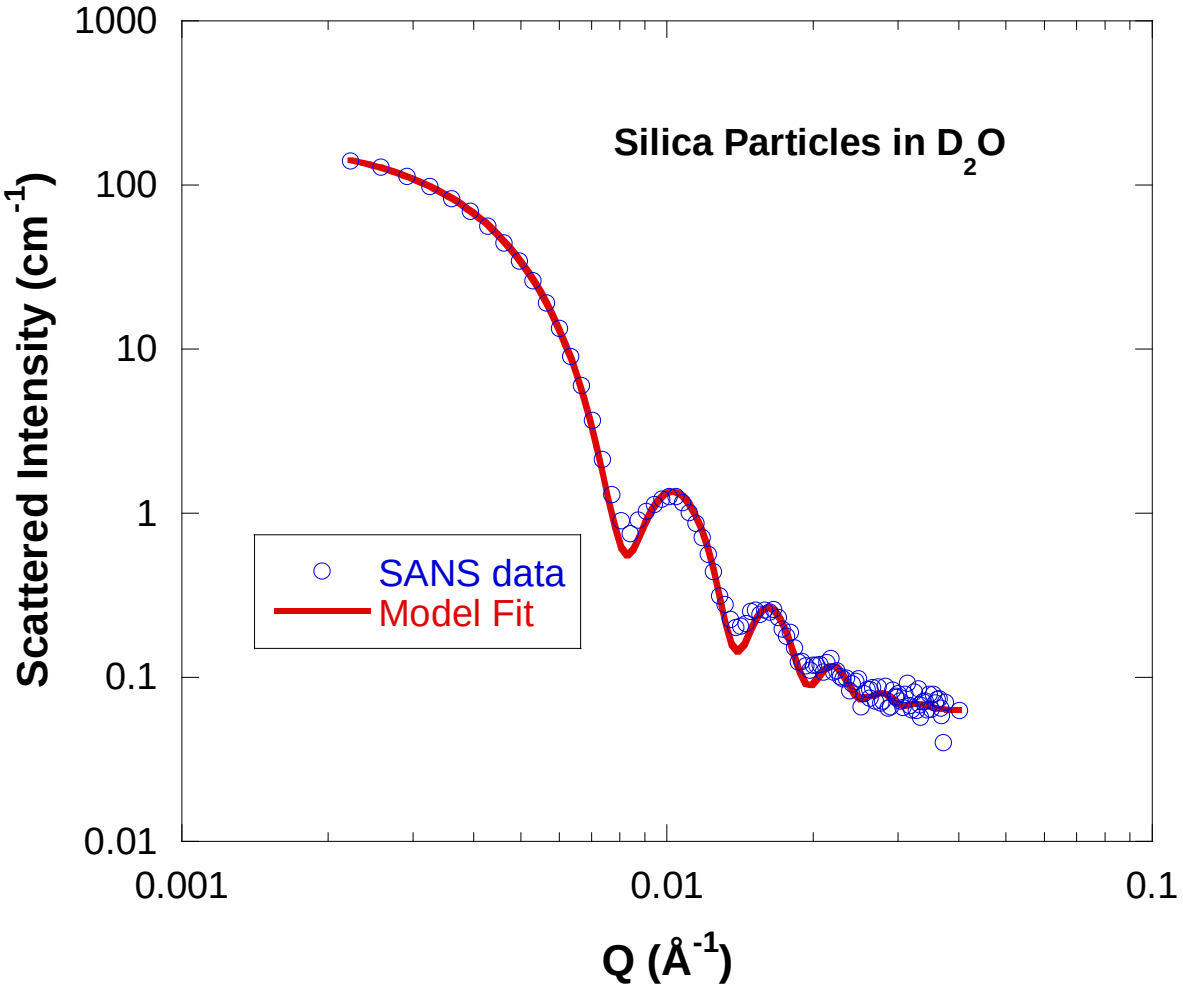
SANS DATA ANALYSIS

Standard Plots (Guinier, Porod, Zimm, etc).

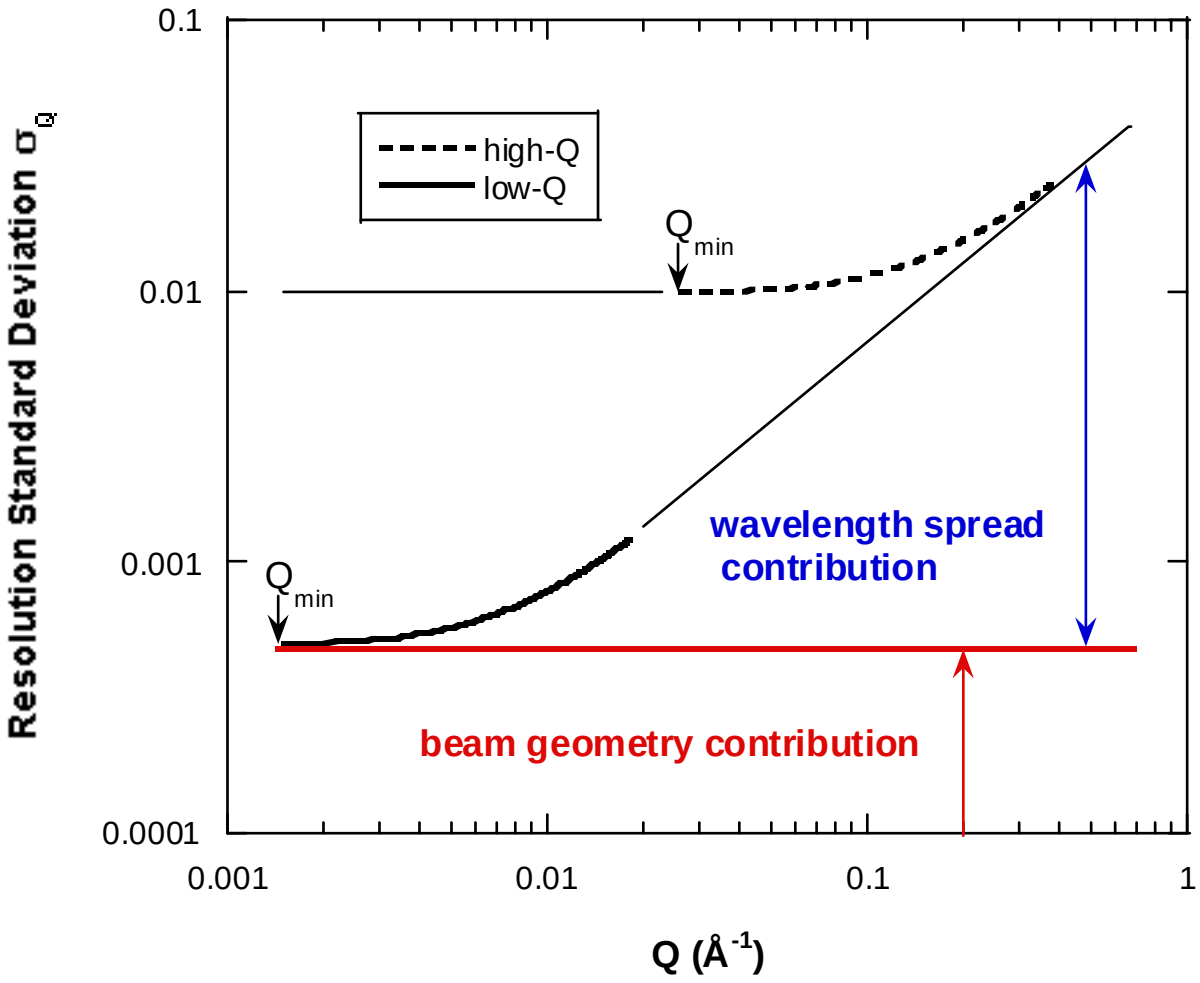
Data fitting to models.

Shape reconstruction and inversion methods.

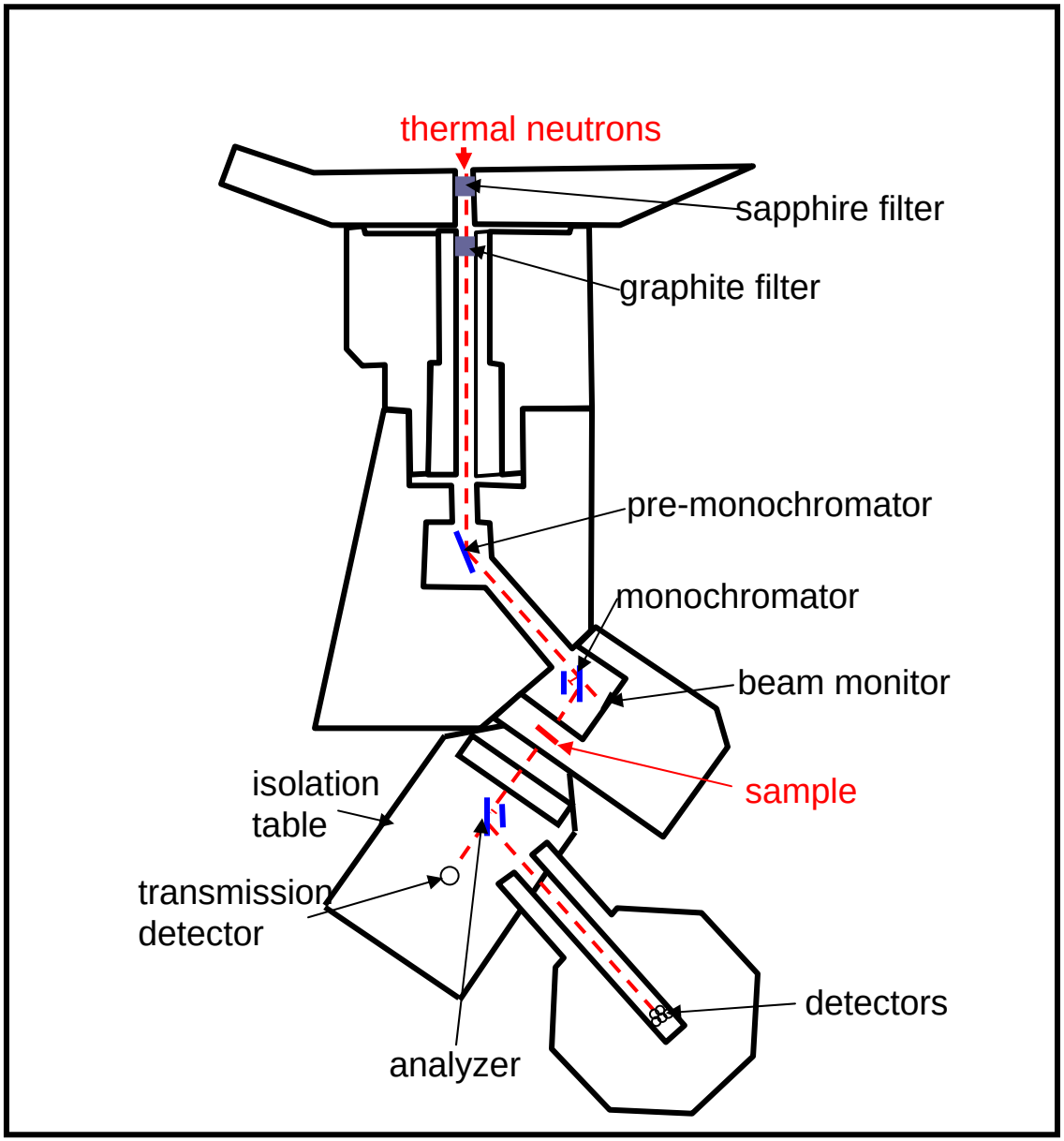
SMEARED SANS DATA



SANS INTRUMENTAL RESOLUTION



USANS INSTRUMENT SCHEMATICS



USANS DATA SET