

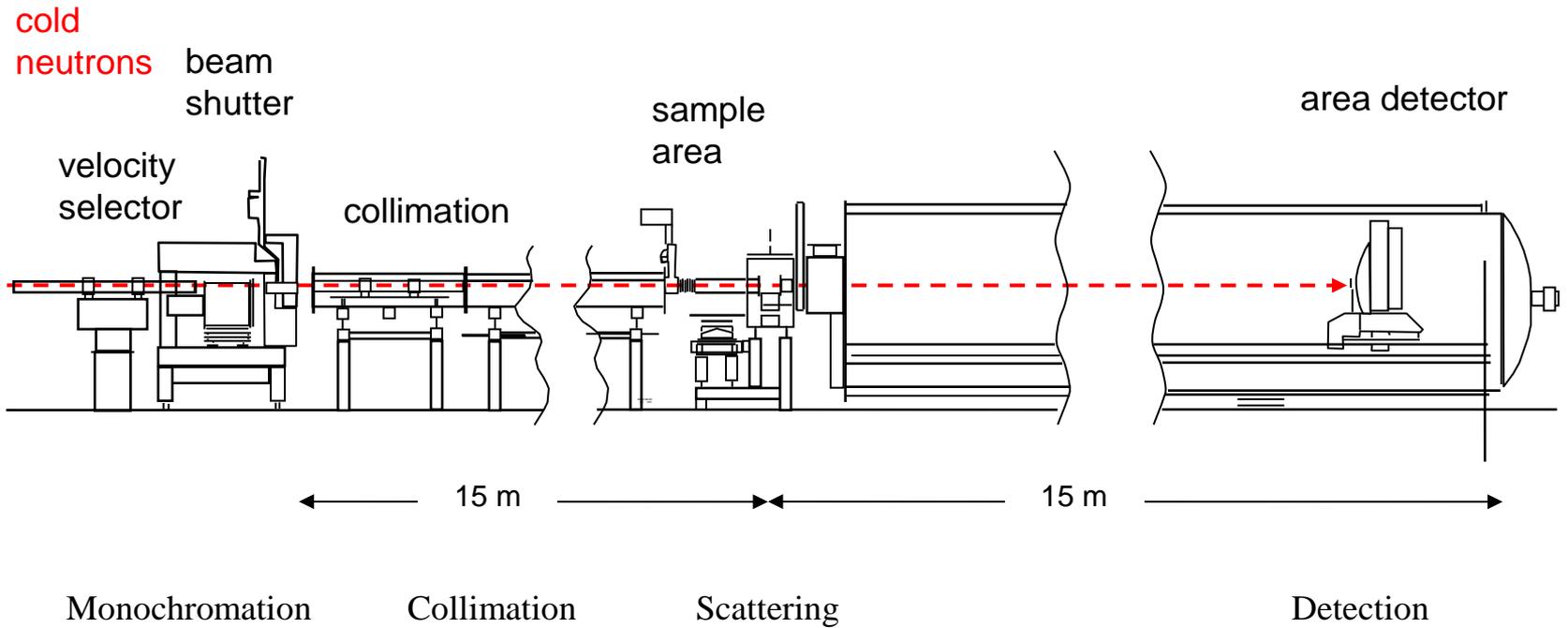
SANS NUTS AND BOLTS

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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

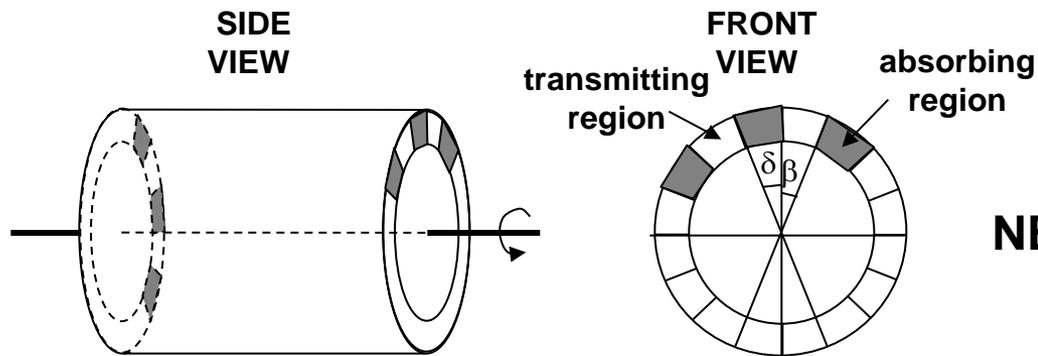


30 m NIST-SANS Instrument Characteristics

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:**

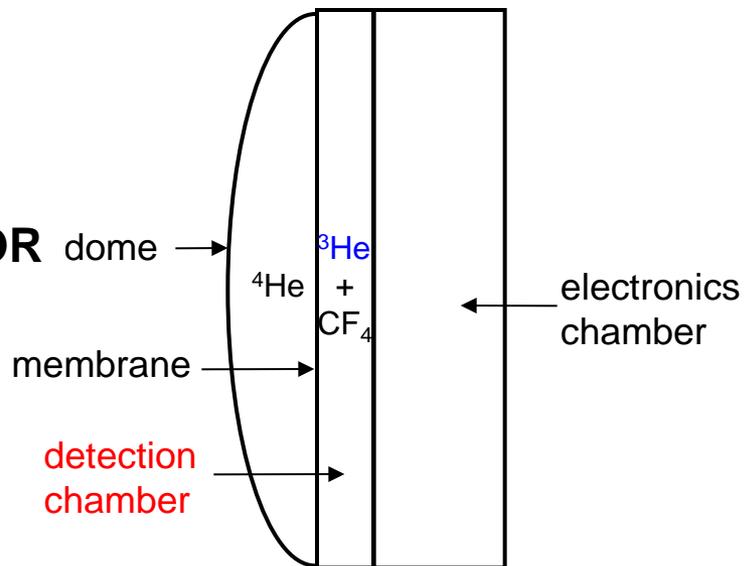
- automatic multi-specimen sample changer with **temperature control** from -10 to 200 °C
- magnets (0 to 9 Tesla)
- Couette flow **shear cell** and **rheometers**
- cryostats and vacuum furnace (10 to 1800 K)
- pressure cell** (0 to 1x10⁸ Pa, 25 °C to 160 °C)



NEUTRON VELOCITY SELECTOR

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

NEUTRON AREA DETECTOR

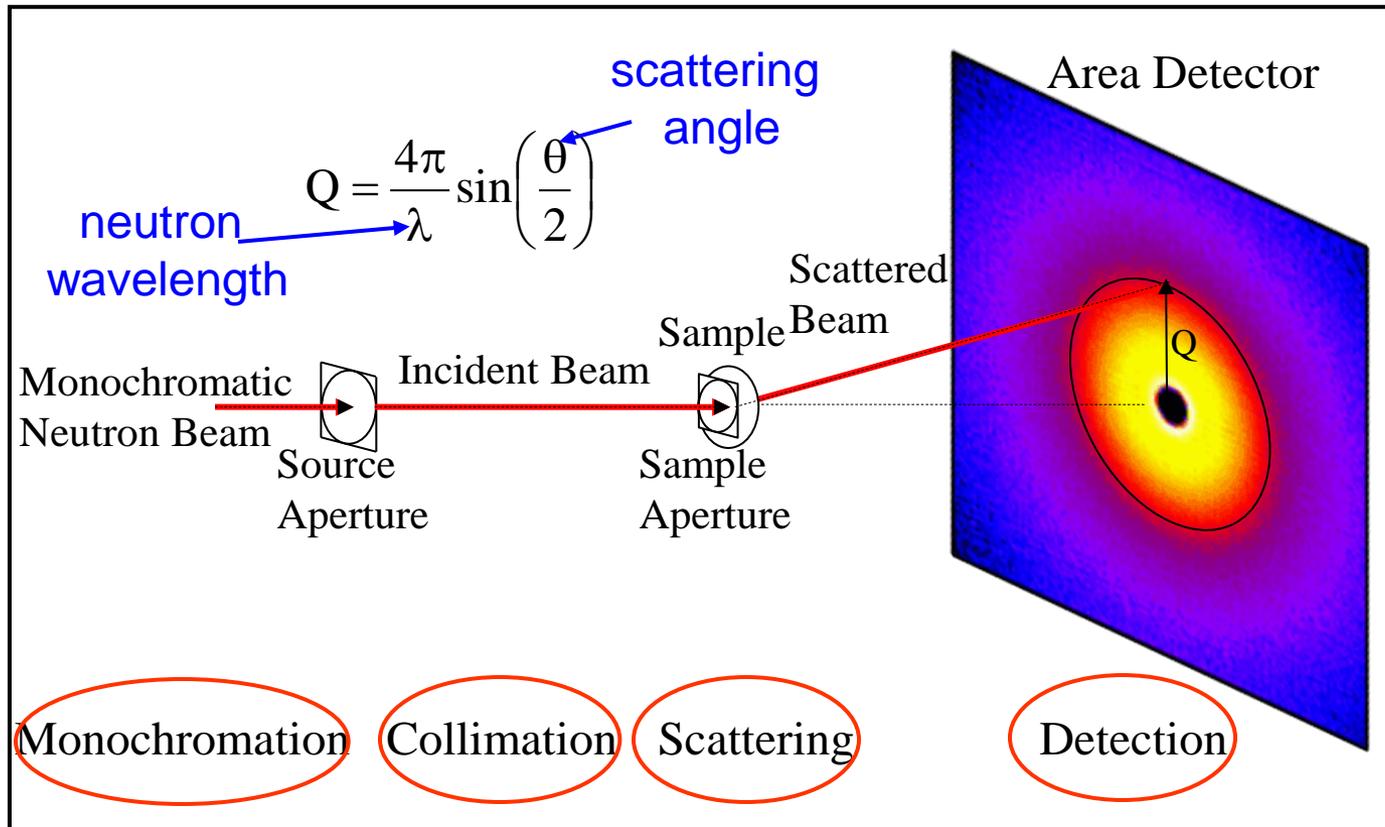


neutron + ^3He \rightarrow proton + tritium
 Detector resolution = $0.5 \times 0.5 \text{ cm}^2$

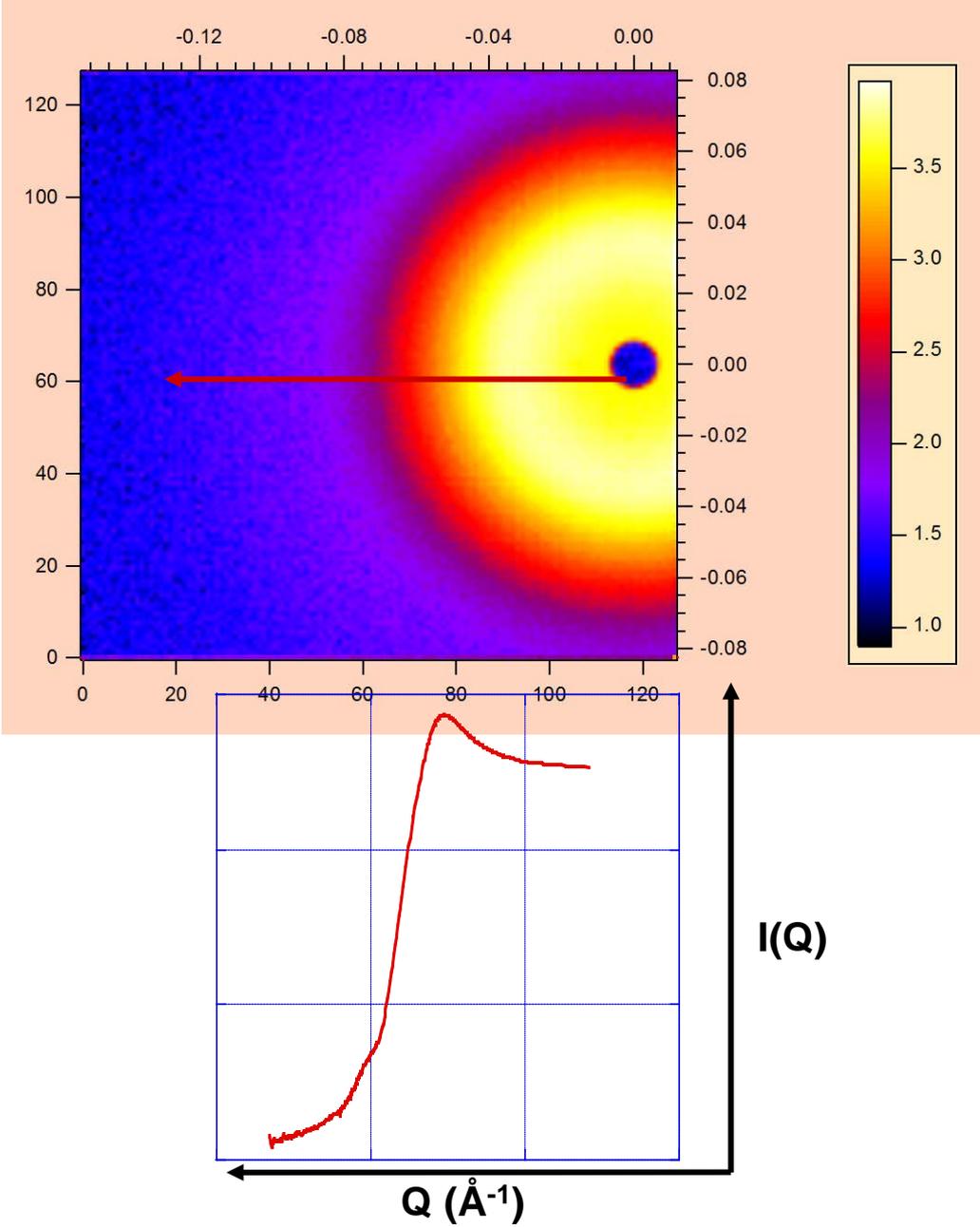
30 m NIST-SANS Instrument Vessel



Small-Angle Neutron Scattering



**10% P85 Pluronic
in d-water at 60°C**

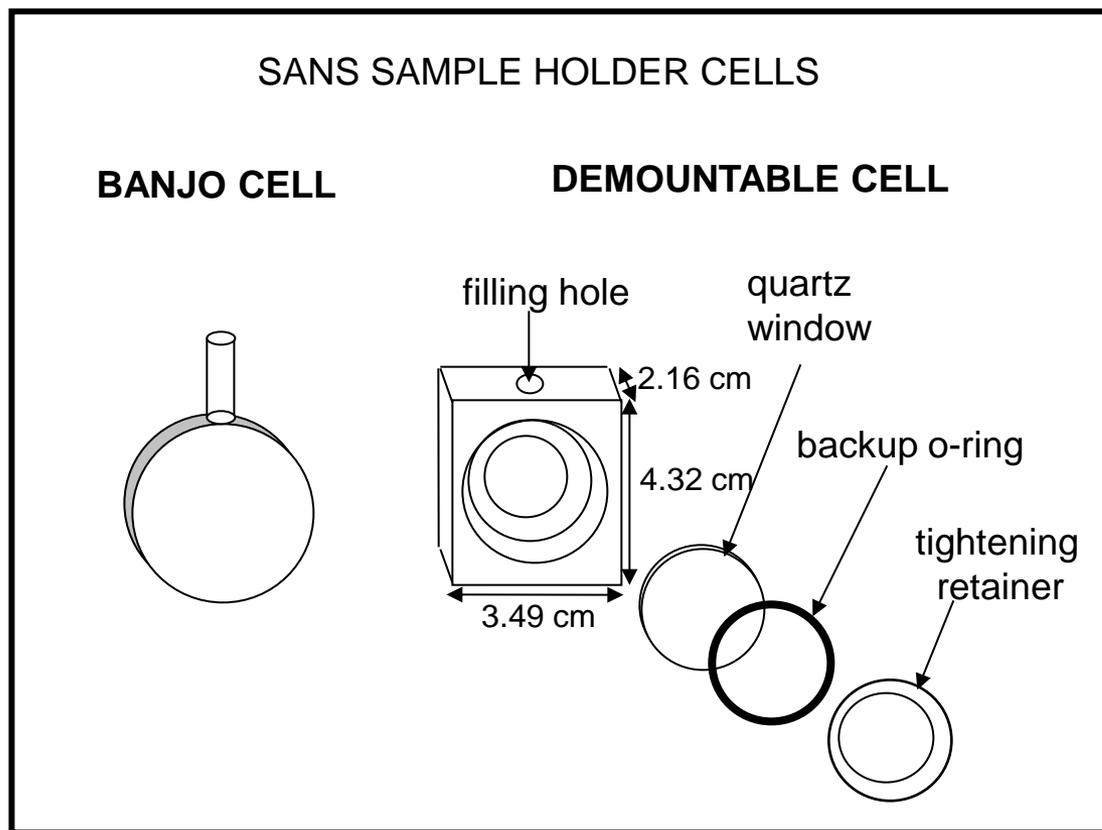


SANS SAMPLES AND CELL HOLDERS

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** ($\lambda = 6 \text{ \AA}$) 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**:
 - Empty cell transmission
 - Sample transmission
 - Empty beam 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.

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

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** $I(Q) = d\Sigma(Q)/d\Omega$.

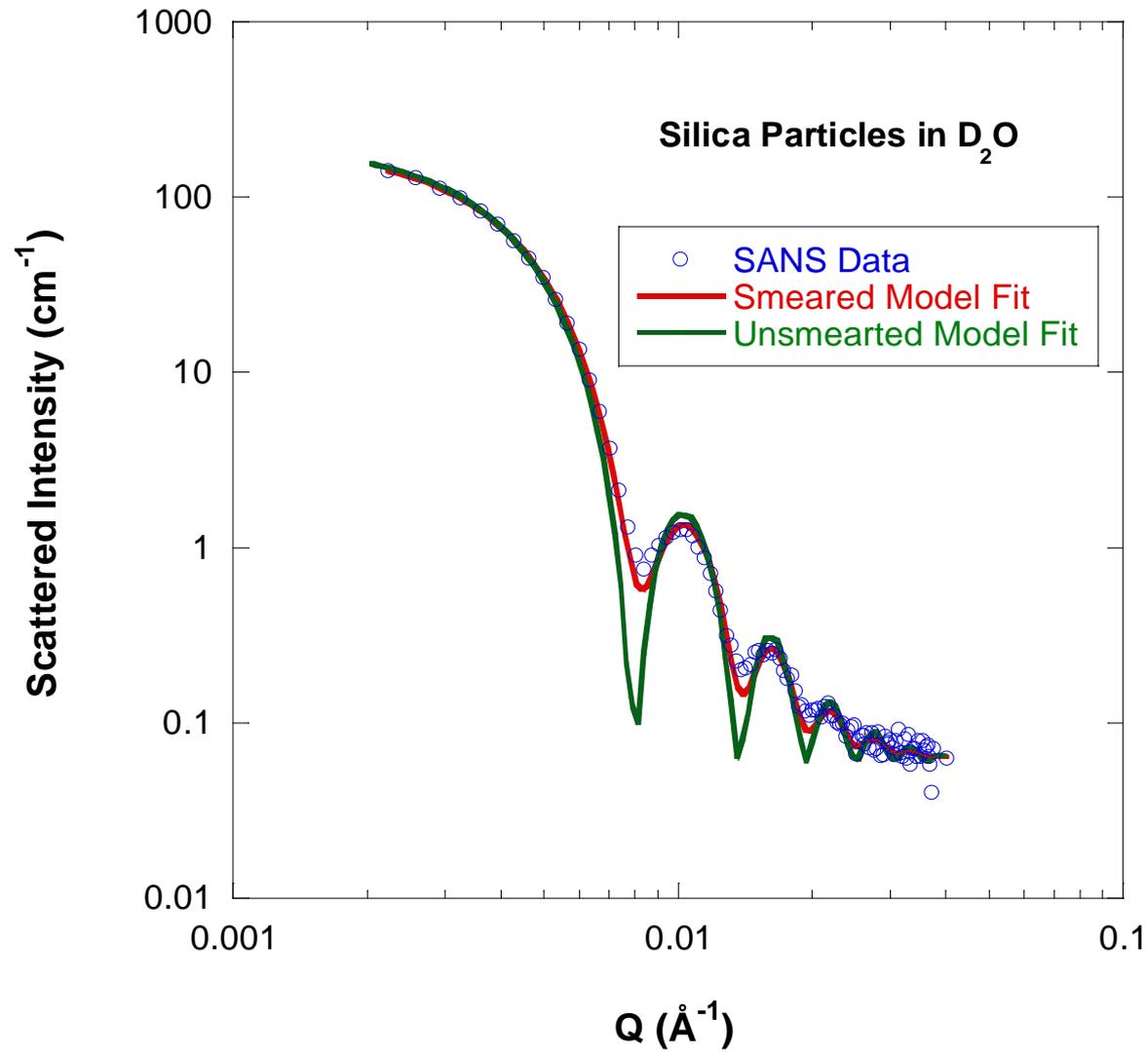
SANS DATA ANALYSIS

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

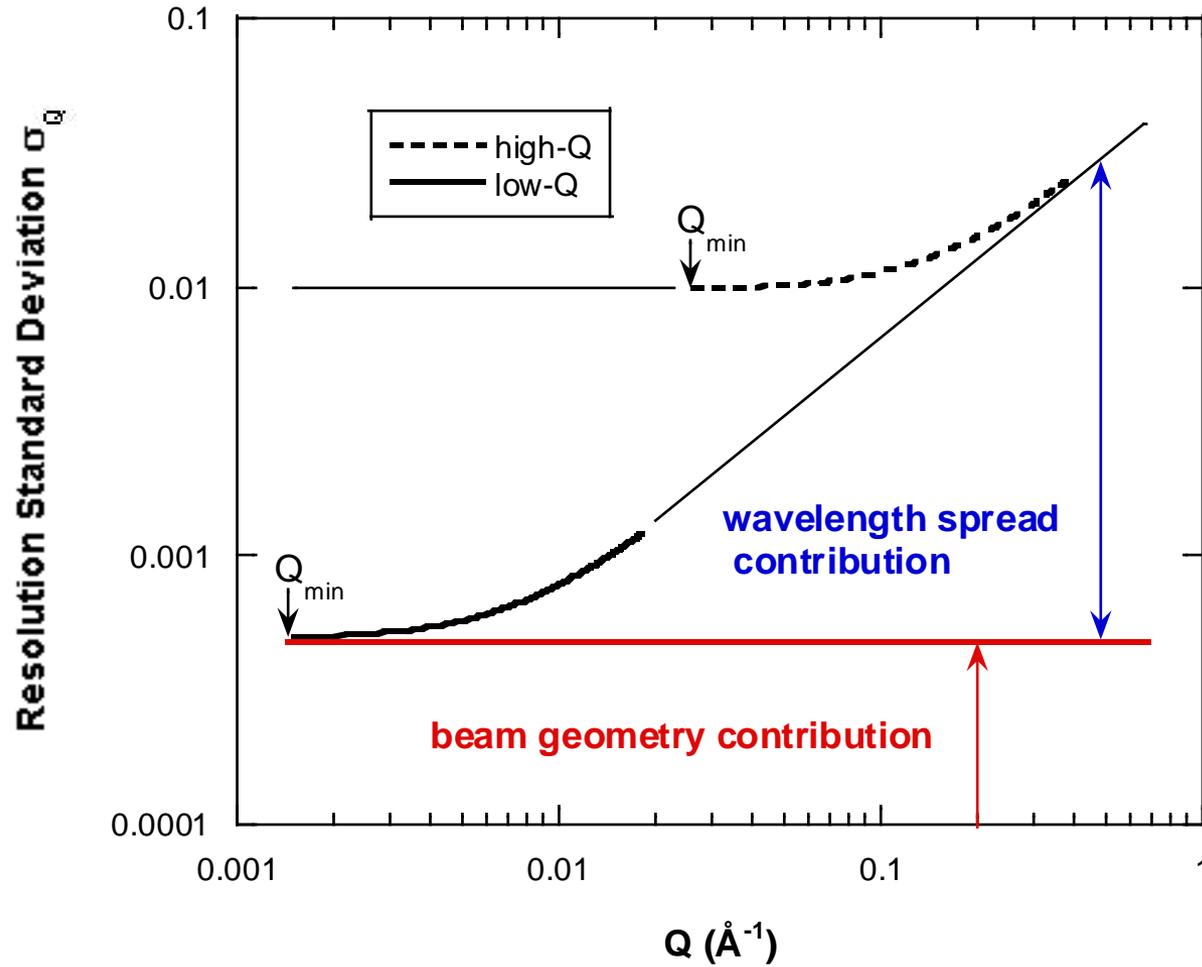
Data fitting to models.

Shape reconstruction and inversion methods.

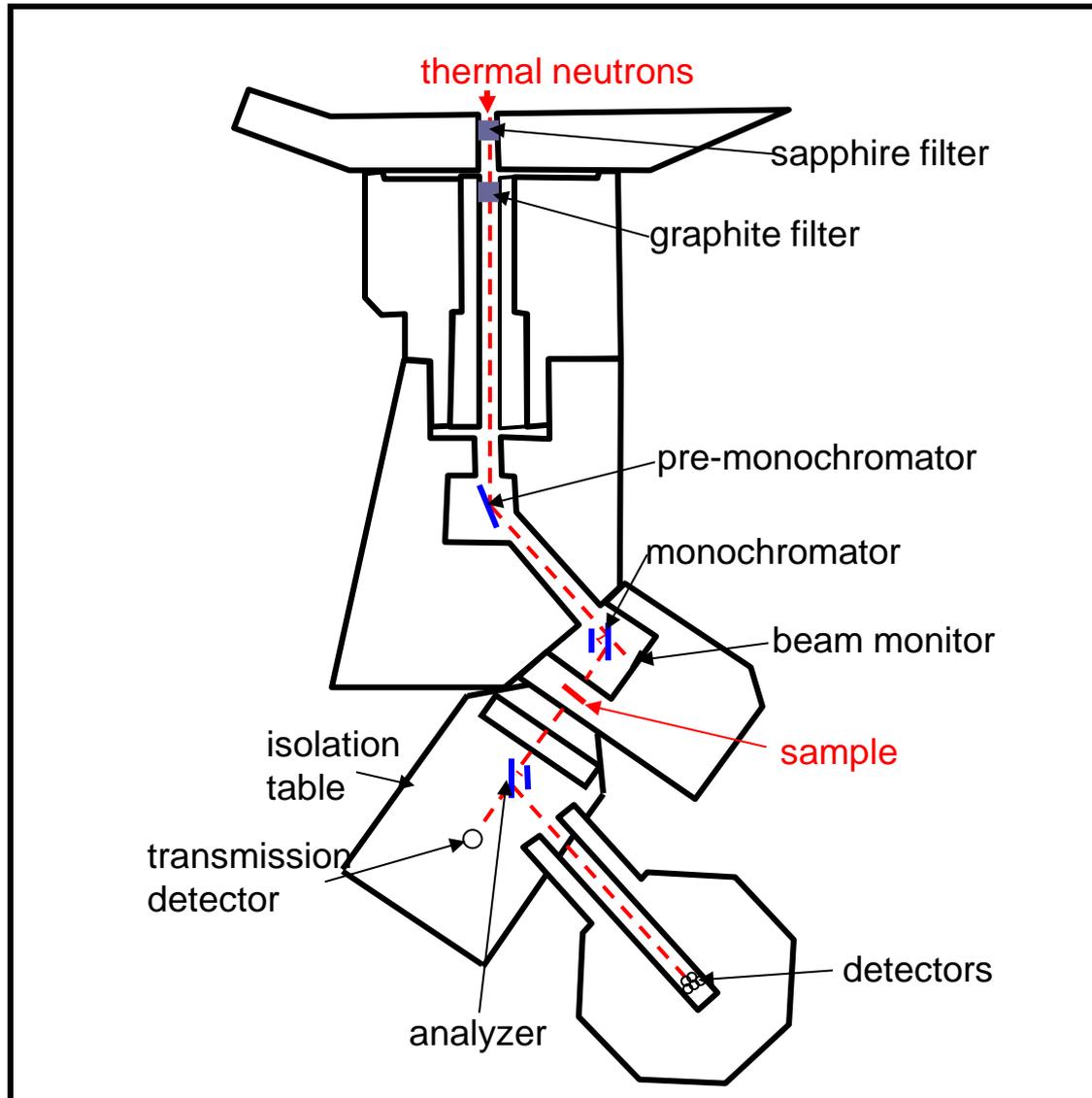
SMEARED SANS DATA



SANS INSTRUMENTAL RESOLUTION



USANS INSTRUMENT SCHEMATICS



USANS DATA SET

4% PEO/d-Ethanol, $M_w = 42,900$ g/mole, $T = 25$ °C

