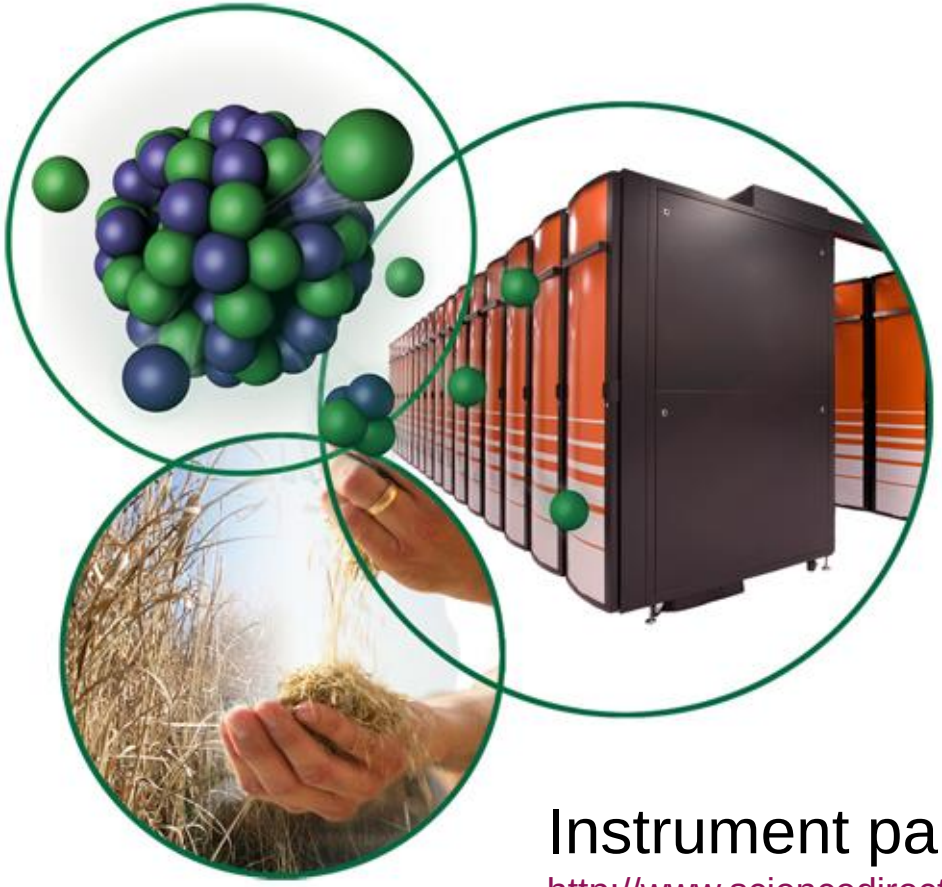
Overview of the Nanoscale Ordered Material Diffractometer (NOMAD)



INSTRUMENT TEAM

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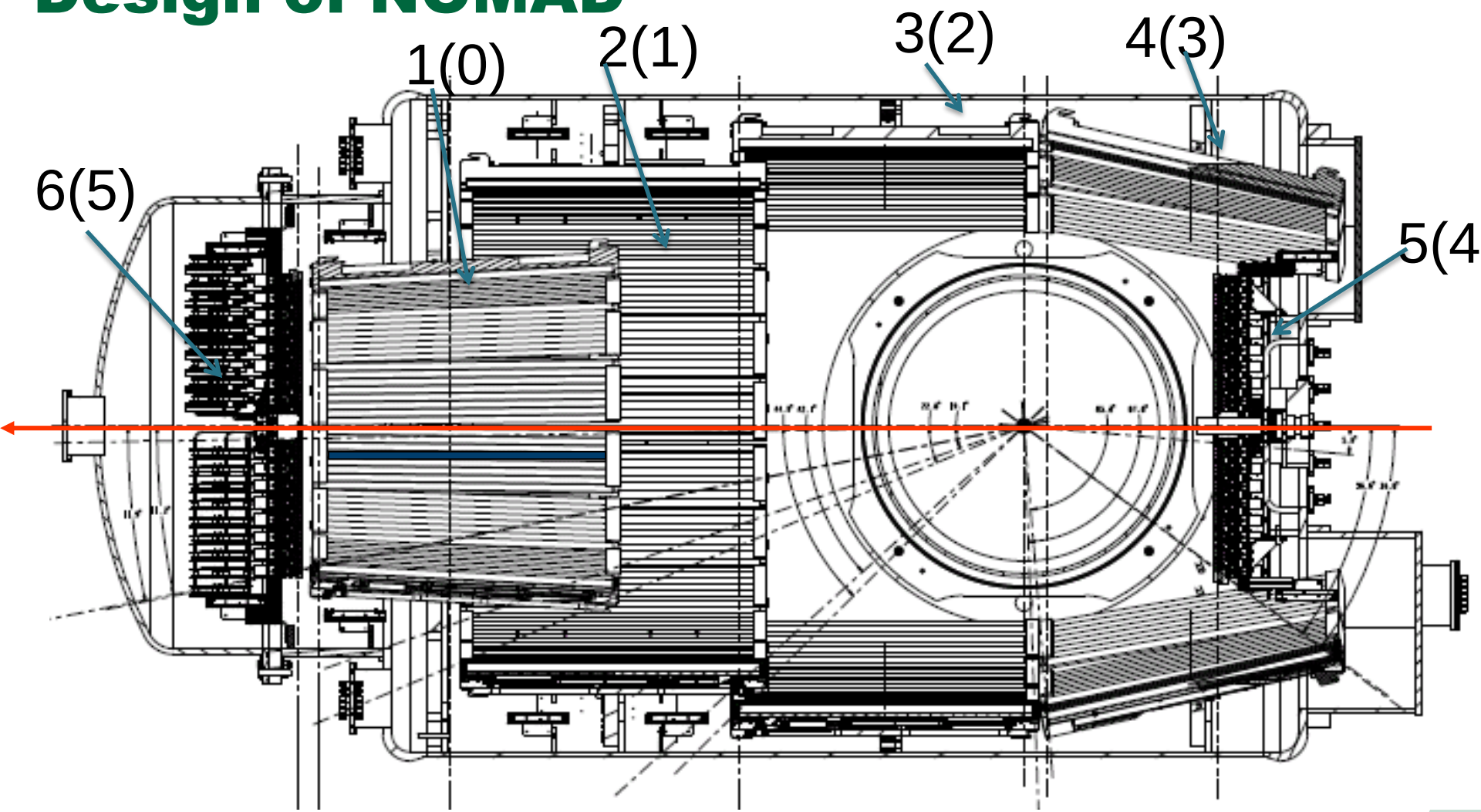
http://www.sciencedirect.com/science/article/pii/S0168583X12003291

What is NOMAD?

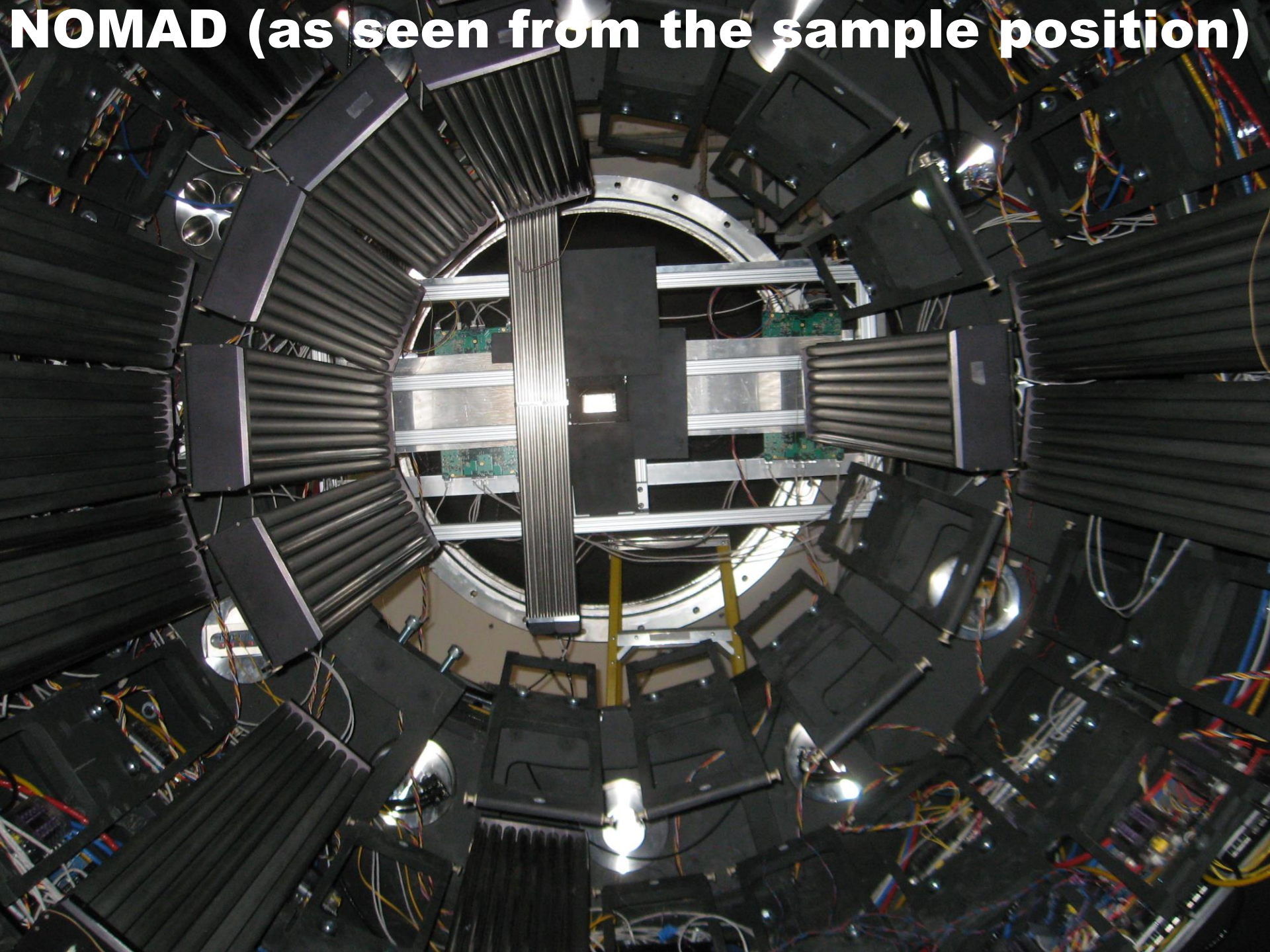
- **NOMAD is a diffractometer using a large bandwidth of neutron energies and extensive detector coverage to do structural determinations of local order in crystalline and amorphous materials.**
- **NOMAD was designed for studies of a large variety of samples ranging from liquids, solutions, glasses, polymers and nanostructured materials to long-range ordered crystals.**
- **NOMAD gives an access to high-resolution pair distribution functions (PDF), small-contrast isotope substitution experiments, small sample sizes, parametric studies and in-situ diffraction.**

Design of NOMAD



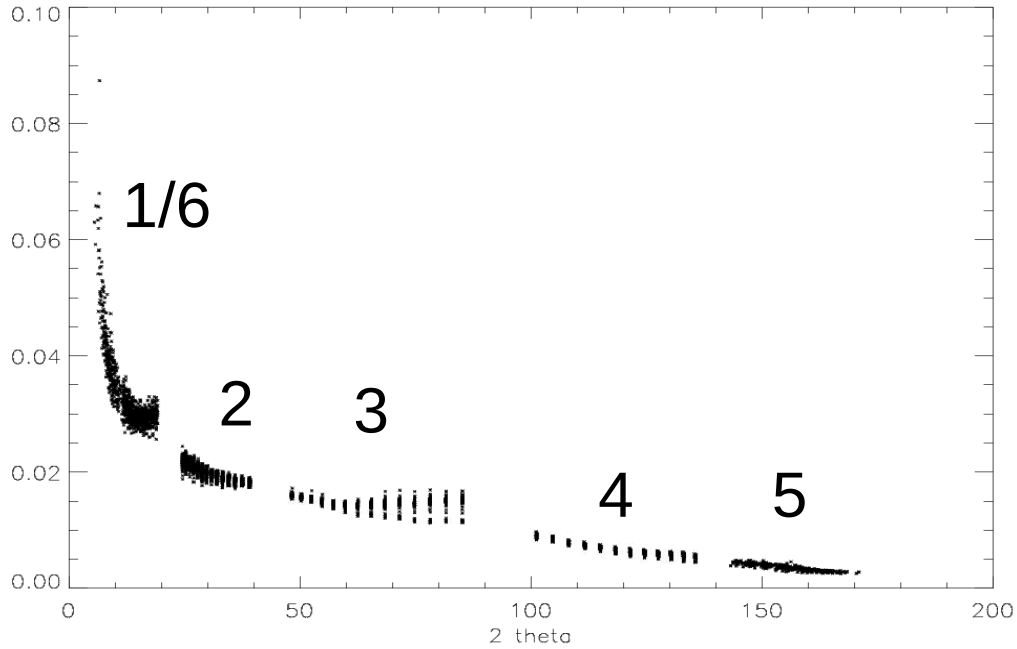
Currently, 50 out of 99 packs with eight ^{3}He linear position sensitive detectors are installed. 51200 pixels are grouped into six “banks”.

NOMAD (as seen from the sample position)



Resolution Δd/d

Bank	$\langle 2\theta \rangle$ /degree	$\Delta d/d$ FWHM	approx. d-range /Å (60Hz*)
1	15	0.029	0.5-13
2	31	0.019	0.3-6.5
3	67	0.0137	0.3-3
4	122	0.0069	0.2-1.9
5	154	0.0036	0.2-1.5
6	7	0.039	0.5-28



Measured pixel by pixel resolution (FWHM) vs. scattering angle 2θ

*30 Hz operation roughly doubles the d-range to longer d. Some sample environments (cryostat /furnace) restrict the accessible d range.

Sample environment

Standard

- **Sample translation stage combined with Cobra temperature controller.**

http://sns.gov/equipment/equip-detail.cfm?recordID=OSE-001&facility=All

- **Orange Cryostat (2- 300K)**

http://sns.gov/equipment/equip-detail.cfm?recordID=CRYO-004&facility=SNS

- **ILL furnace (300K- 1400K)**

http://sns.gov/equipment/equip-detail.cfm?recordID=HOT-001&facility=SNS

Special requirements

- **Aerodynamic levitator (800 -3500K + room temperature)**

http://sns.gov/equipment/equip-detail.cfm?recordID=HOT-018&facility=SNS

- **High voltage set-up (10kV)**

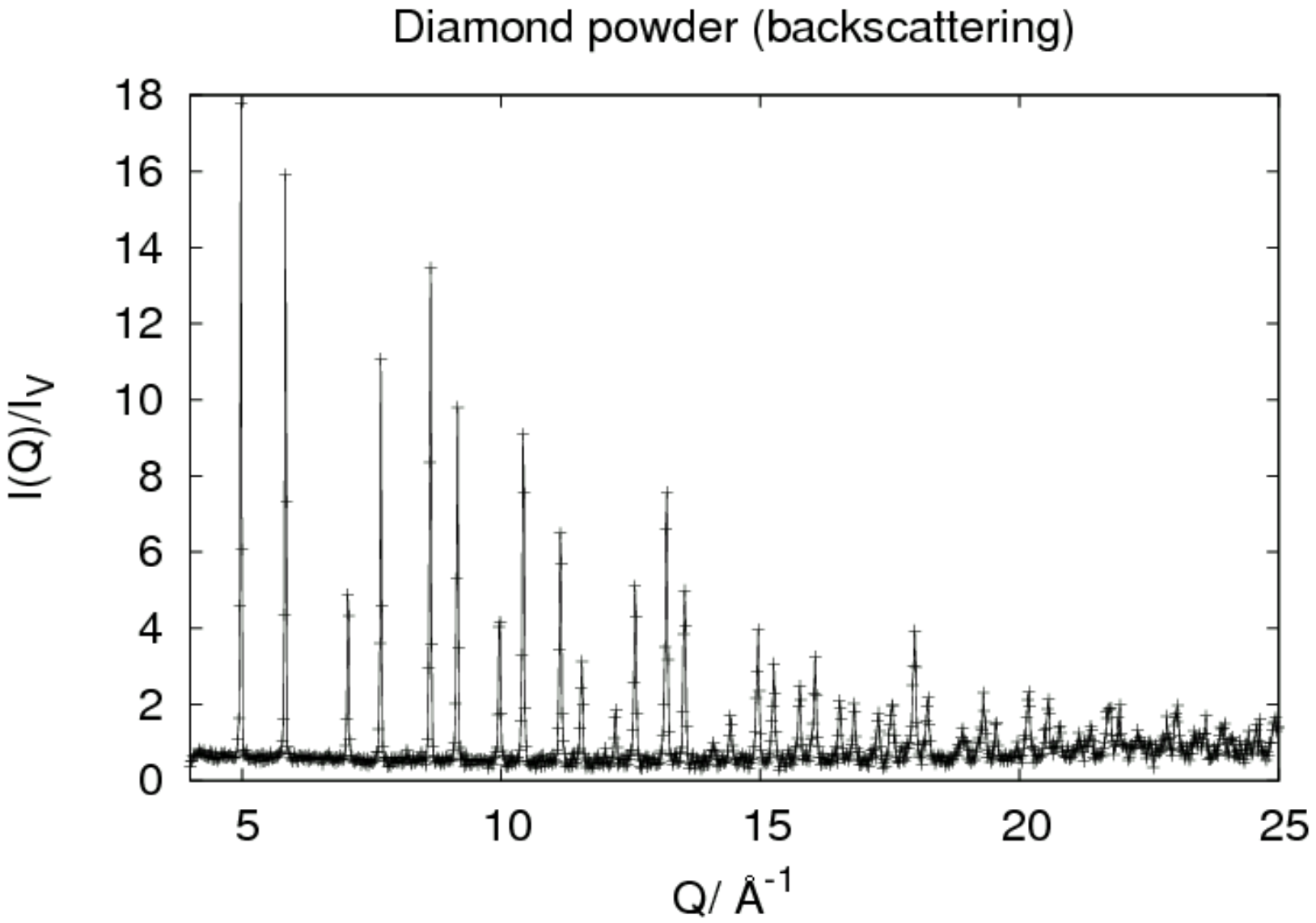
http://sns.gov/equipment/equip-detail.cfm?recordID=AE-013&facility=SNS

Sample size considerations

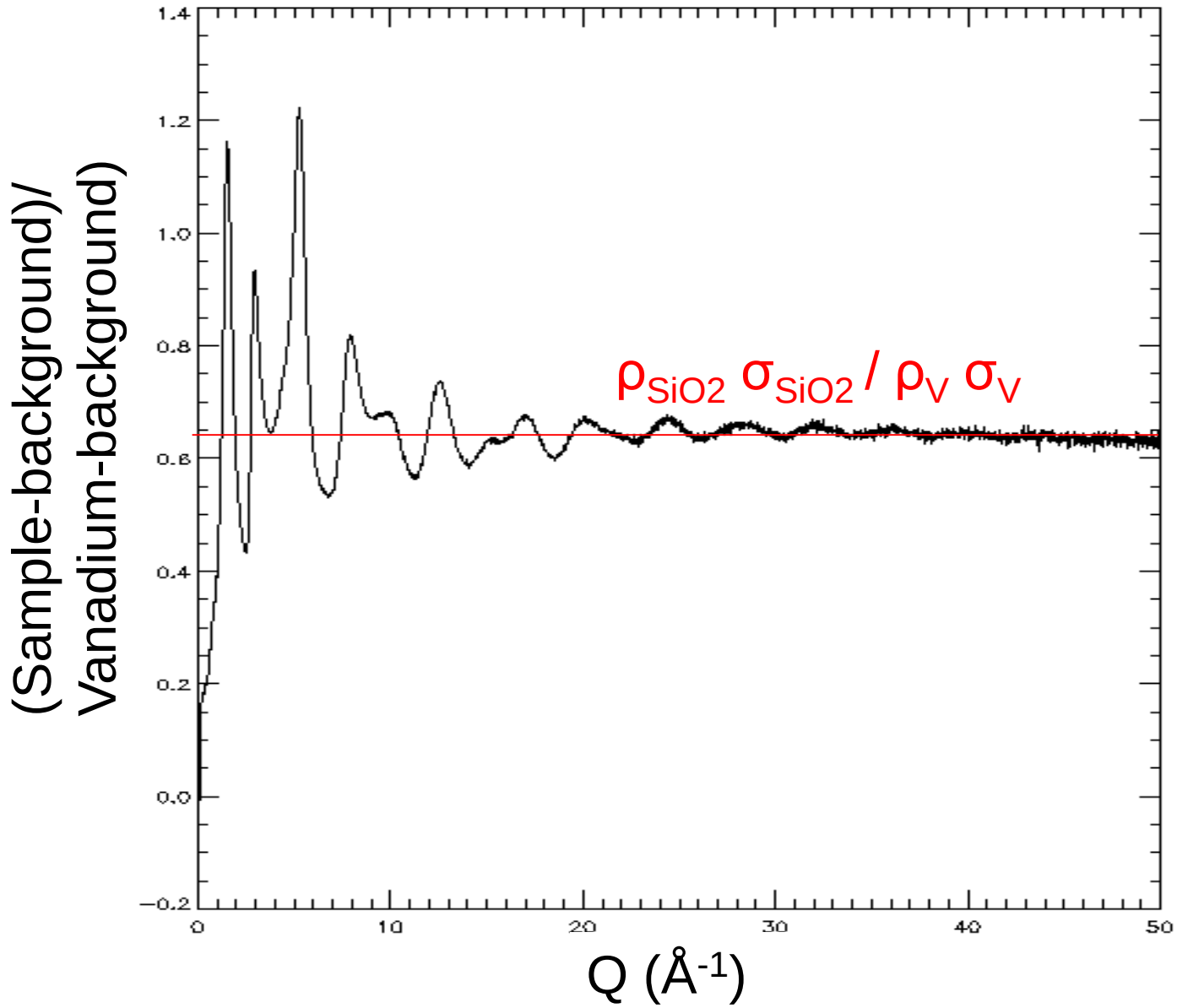
- **Neutron sized samples = synchrotron sized data acquisition times**
- **Synchrotron sized samples = neutron sized data acquisition times**

Rule of thumb: Fill a 2mm dia. capillary 2 cm high (~60mm^3),
if 100K< T <500K (cryostream/Cobra),
fill 6mm dia. vanadium can 2 cm high (0.5cm^3) for cryostat/furnace.
Count for 1h per sample and temperature.

Diffraction from a very strong scatterer (0.6 g diamond) obtained in 1 second.

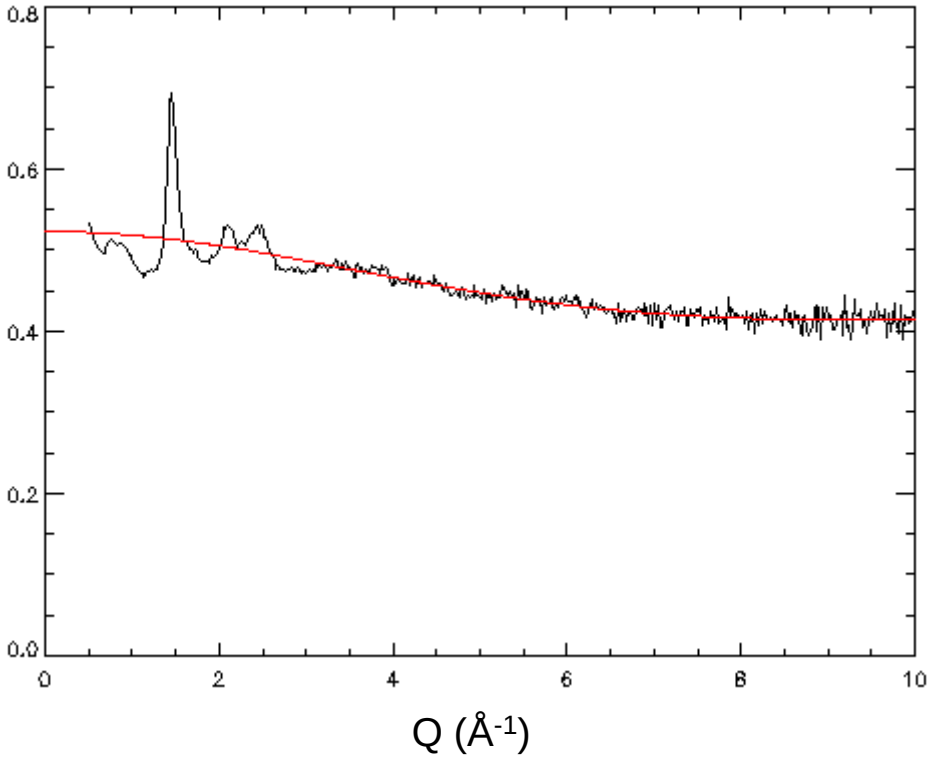


20 min data on glassy SiO_2

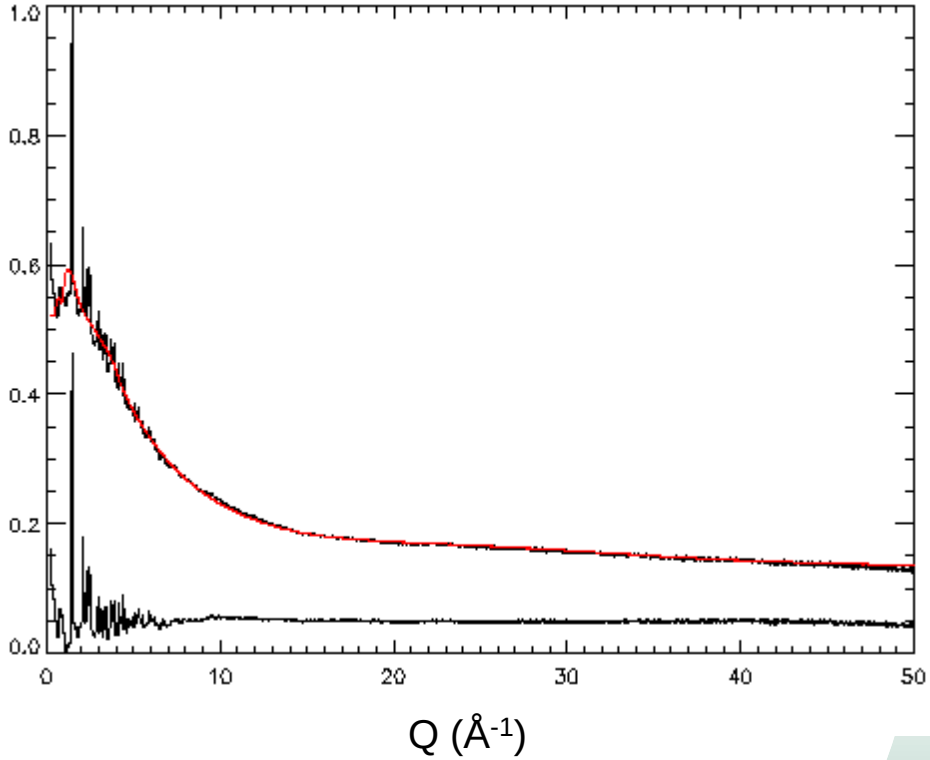


Sample with hydrogen

Forward detector bank



All detectors



⇒H is bad, but not completely excluded. If you can, substitute for D and the data quality will be better. It will save you a lot of time on data analysis.