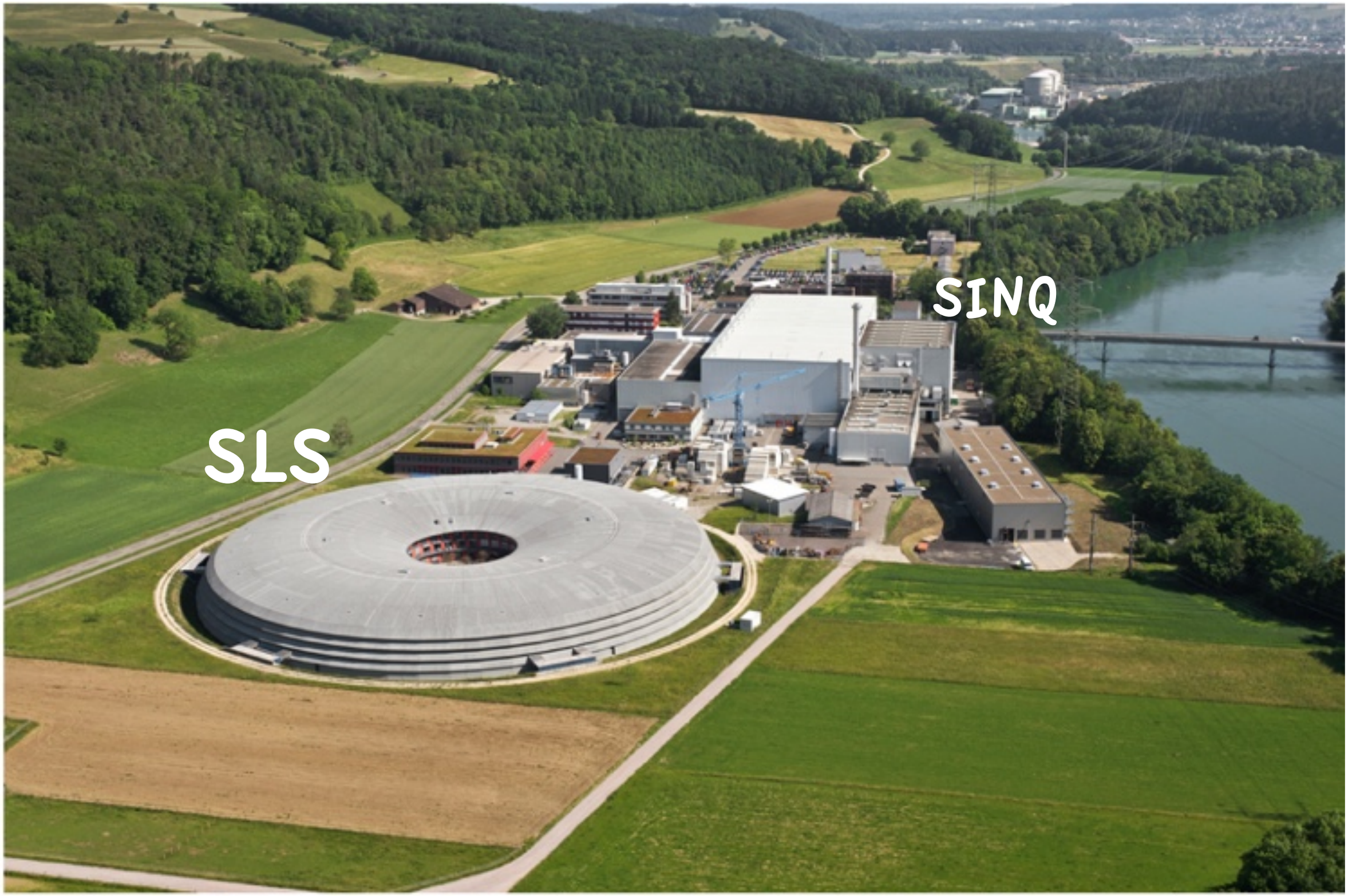
Diffraction at swiss spallation source SINQ

Vladimir Pomjakushin
Laboratory for Neutron Scattering, Paul Scherrer Institute

Paul Scherrer Institute (West)



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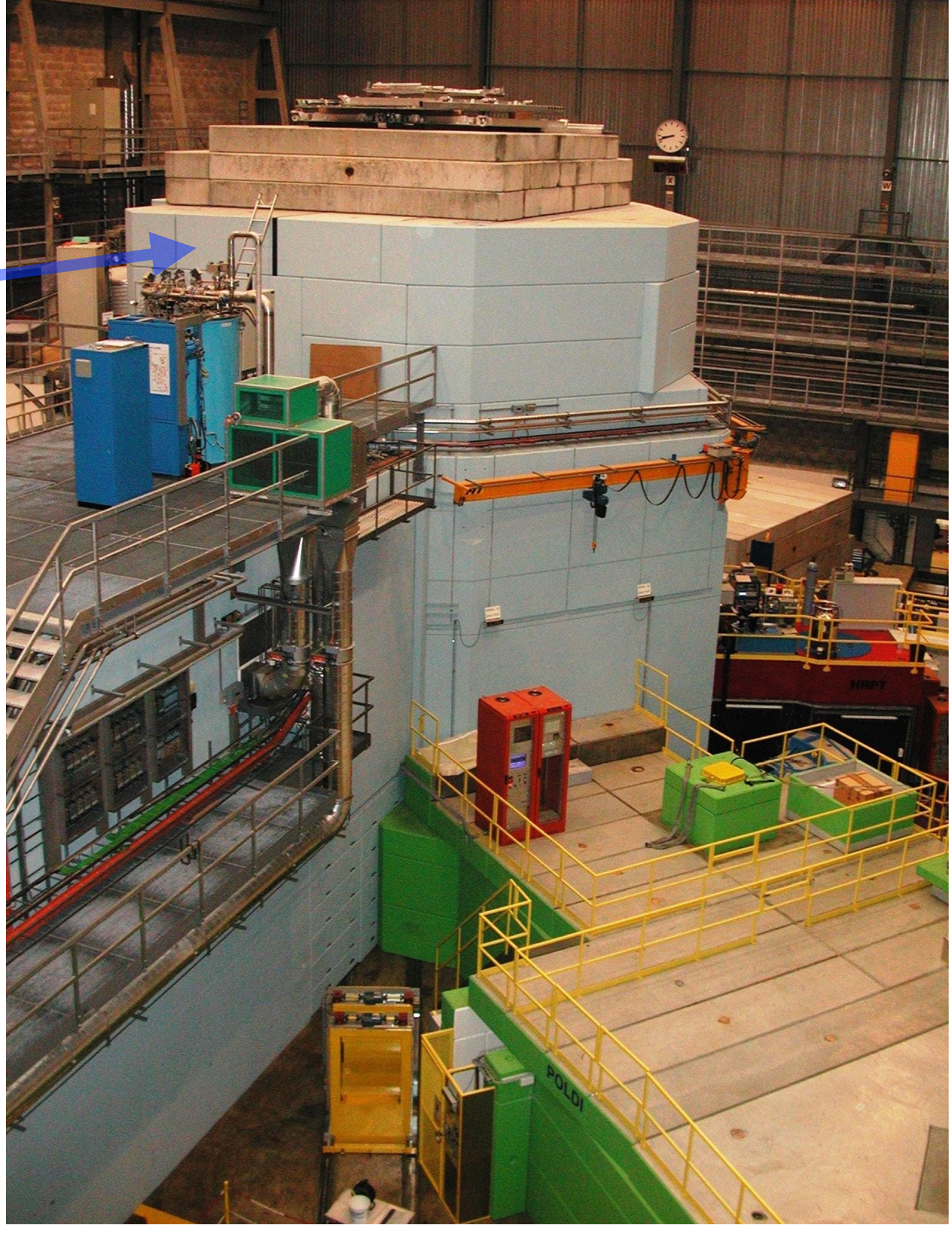
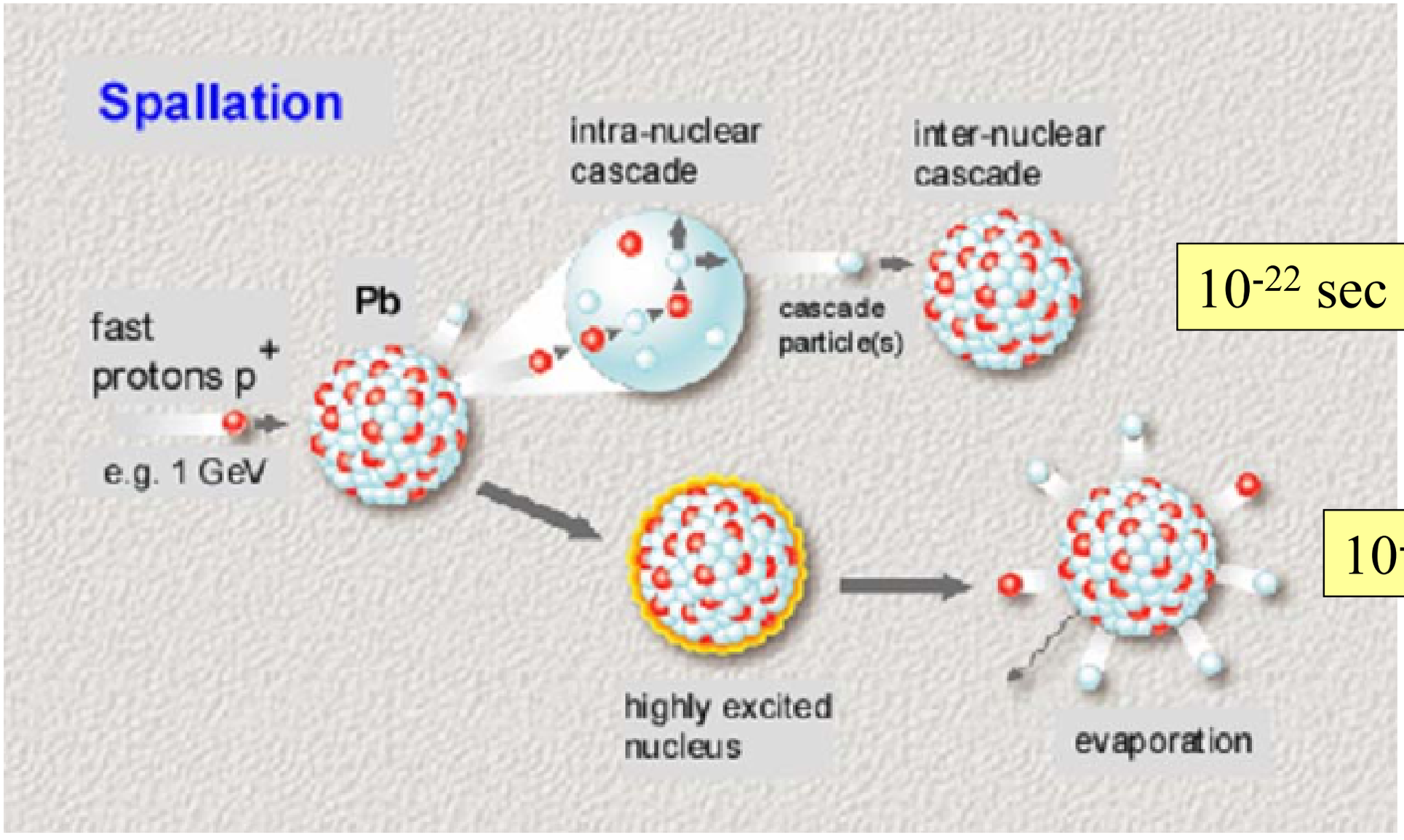
SINQ hall

The spallation neutron source SINQ is a continuous source - the first of its kind in the world - with a **flux of about 10^{14} n/cm^2/s**. Beside thermal neutrons, a cold moderator of liquid deuterium (cold source) slows neutrons down and shifts their spectrum to lower energies.

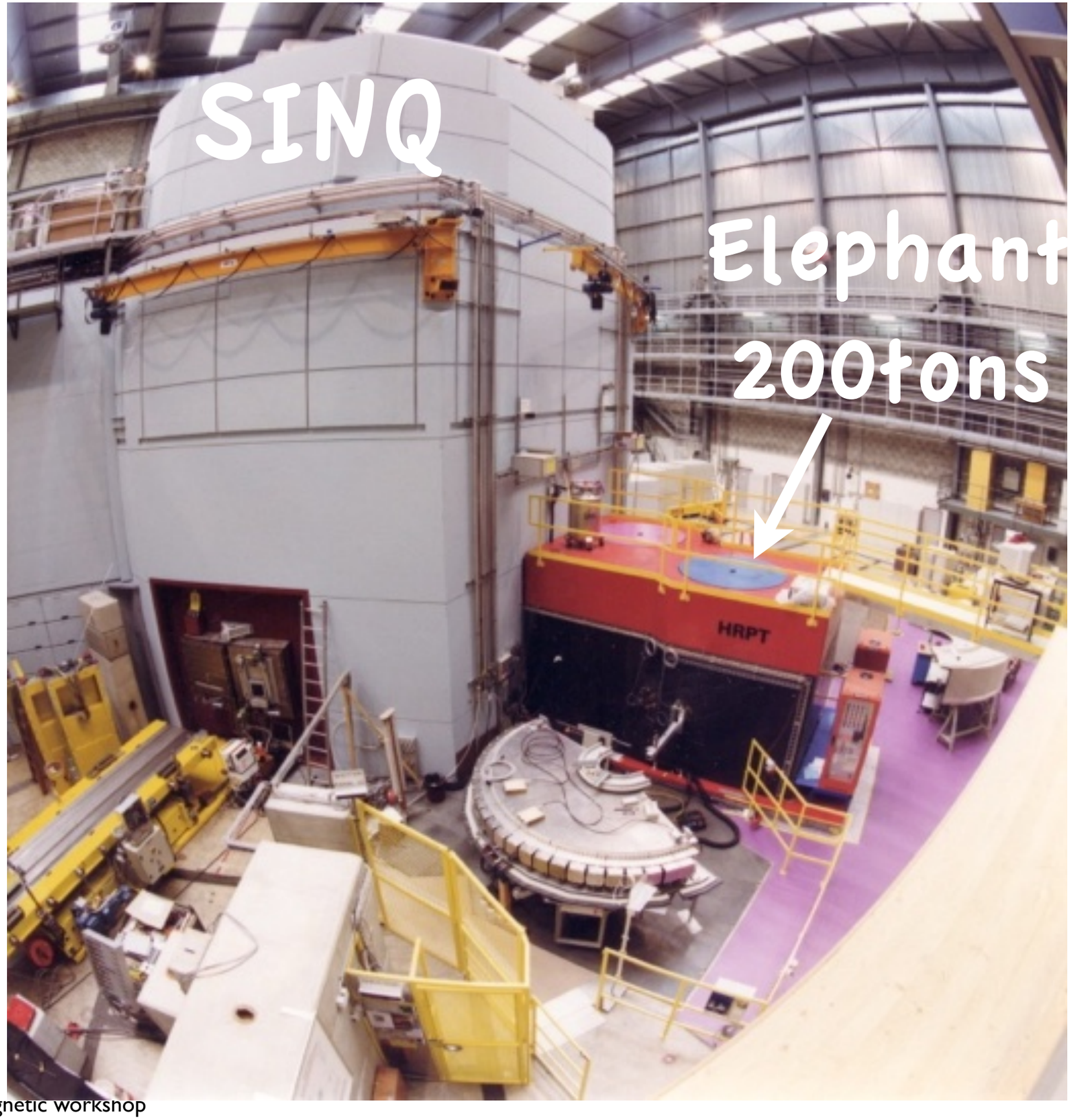


Spallation

30 - 35 MeV/useful neutron (Hg 1.3 GeV protons)



SINQ hall

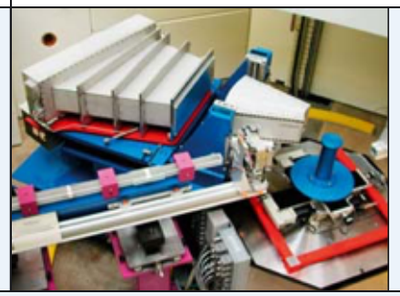


Elephant is:
Shielding of the direct beam also from fast neutrons for diffraction instruments

HRPT
High resolution powder diffractometer
Thermal neutrons
Contact: Vladimir Pomjakushin,
vladimir.pomjakushin@psi.ch

NEUTRA
Neutron radiography
Thermal neutrons
Contact: Peter Vontobel,
peter.vontobel@psi.ch

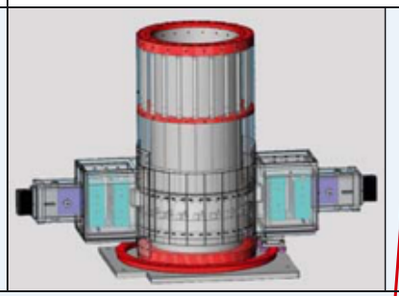
POLDI
Residual stress diffractometer
Thermal neutrons
Contact: Alexander Evans,
alexander.evans@psi.ch

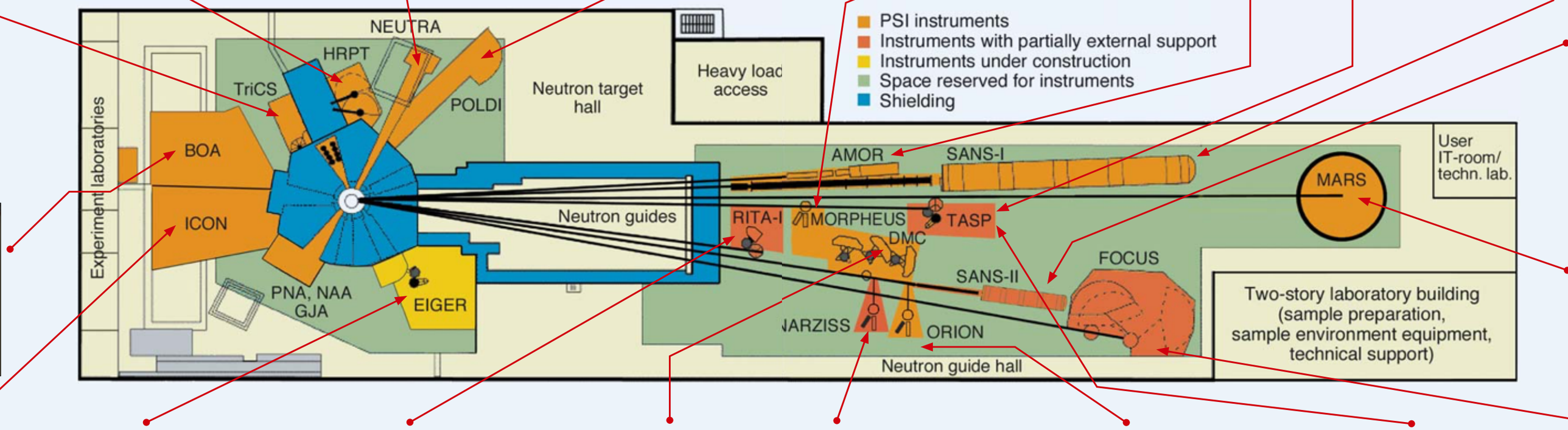


MORPHEUS
Two-axis diffractometer
Cold neutrons
Contact: Cecile Marcelot,
cecile.marcelot@psi.ch

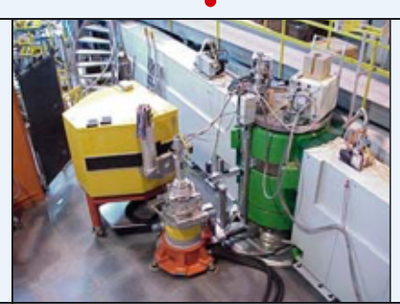
AMOR
Reflectometer
Cold neutrons
Contact: Jochen Stahn,
jochen stahn@psi.ch

MuPAD
Mu-metal Polarization Analysis Device
Cold polarized neutrons
Contact: Bertrand Roessli,
bertrand.roessli@psi.ch





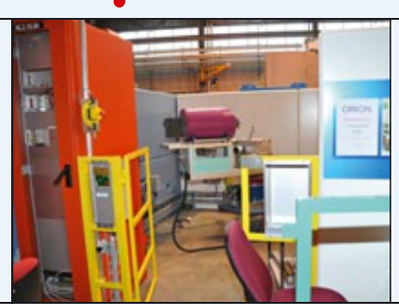
EIGER
Triple-axis spectrometer
Thermal neutrons
Contact: Severian Gvasaliya
severian.gvasaliya@psi.ch



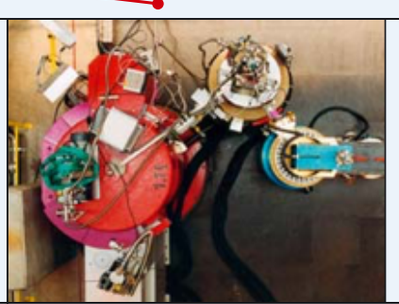
RITA-II
Triple-axis spectrometer
Cold neutrons
Contact: Christof Niedermayer,
christof.niedermayer@psi.ch

DMC
High intensity powder diffractometer
Cold neutrons
Contact: Lukas Keller,
lukas.keller@psi.ch

NARZISS
Polarized neutron reflectometer
Contact: Michael Schneider,
michael.schneider@psi.ch



ORION
Two-axis diffractometer
Contact: Cecile Marcelot,
cecile.marcelot@psi.ch



TASP
Triple-axis spectrometer
Cold polarized neutrons
Contact: Andrey Zheludev,
zheludev@ethz.ch

Cold neutron guide hall

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Diffraction instruments at swiss spallation source SINQ

Diffraction instruments at swiss spallation source SINQ

- HRPT - High Resolution Powder Diffractometer for Thermal Neutrons, λ=0.94 - 2.96 Å
- DMC – High Intensity Powder Diffractometer for Cold Neutrons, λ=2.35 - 6 Å
- TriCS - Single crystal diffractometer, λ=1.18, 2.3 Å

Diffraction instruments at swiss spallation source SINQ

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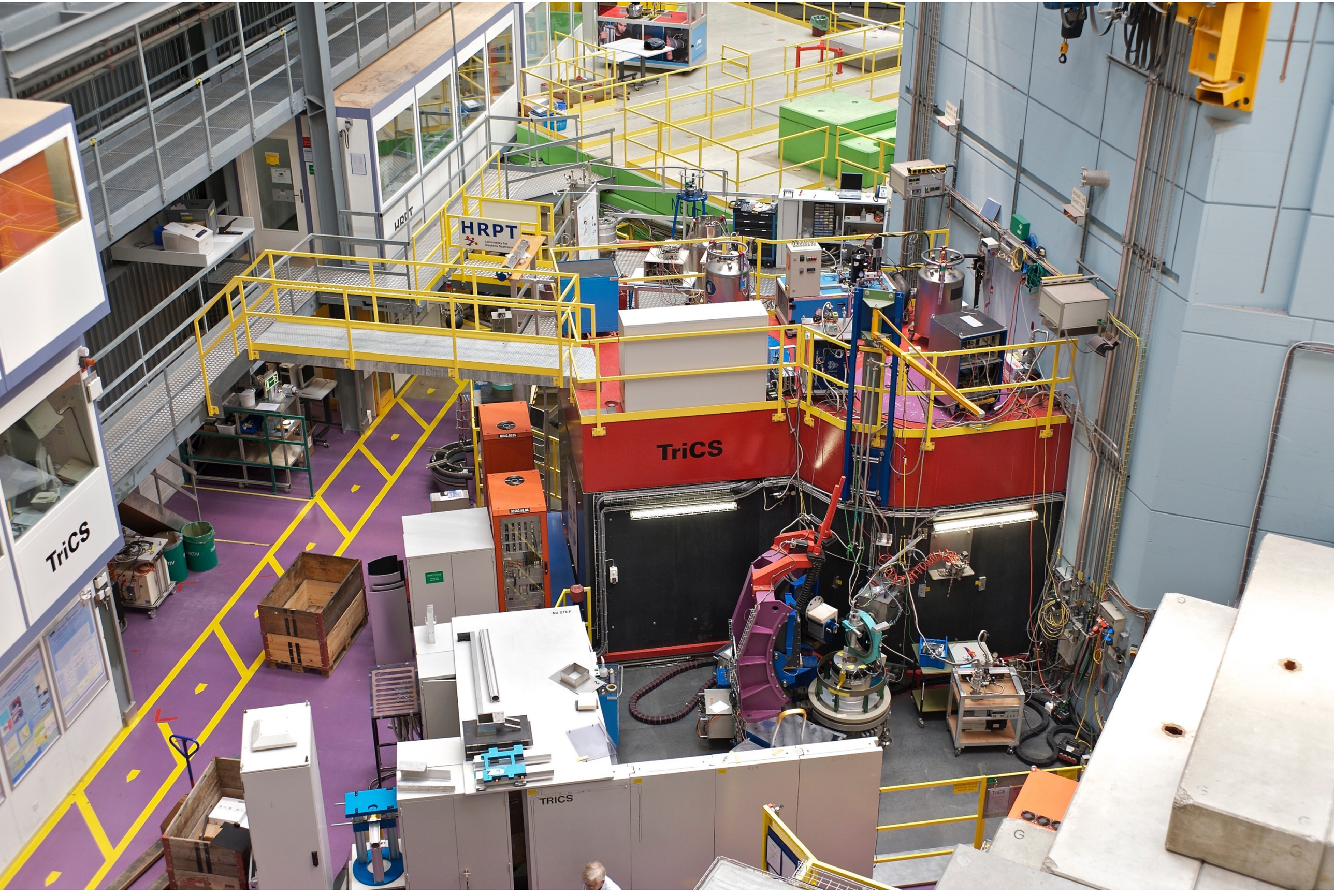
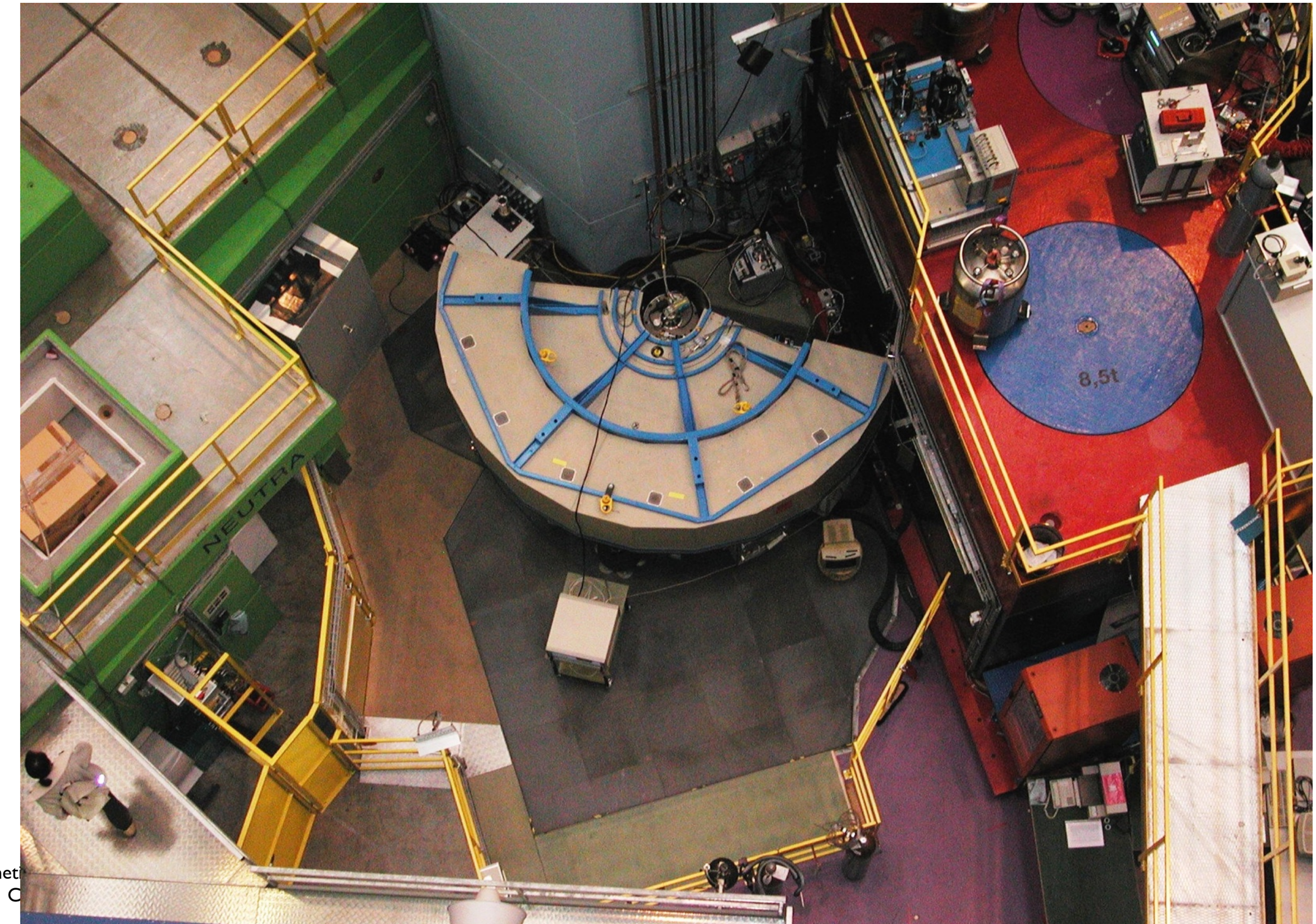
- DMC – High Intensity Powder Diffractometer for Cold Neutrons, λ=2.35 - 6 Å
- TriCS - Single crystal diffractometer, λ=1.18, 2.3 Å
- TASP (triple axes) with MUPAD for polarised ND


HRPT
TriCS
TRICS

HRPT areal



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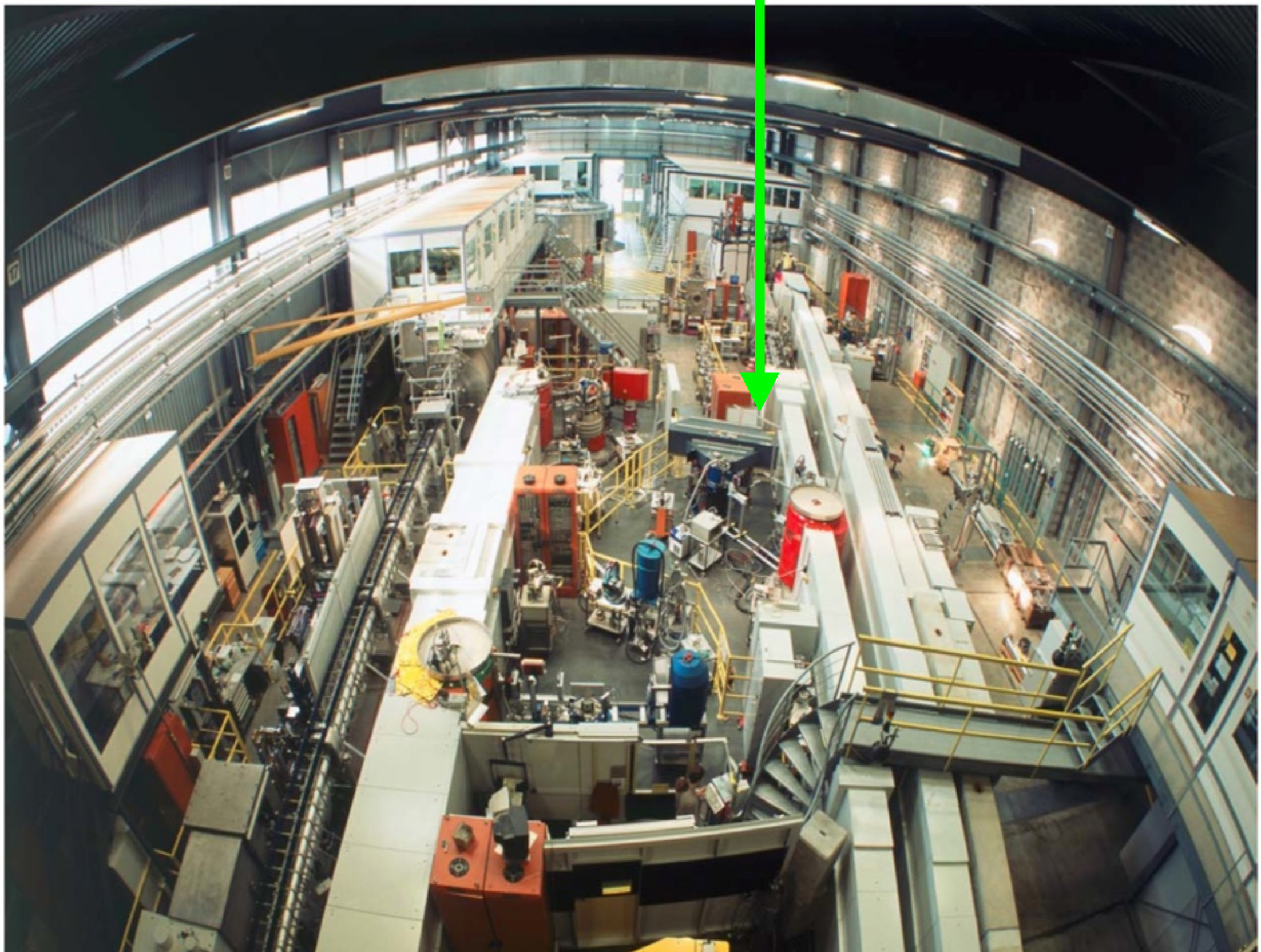
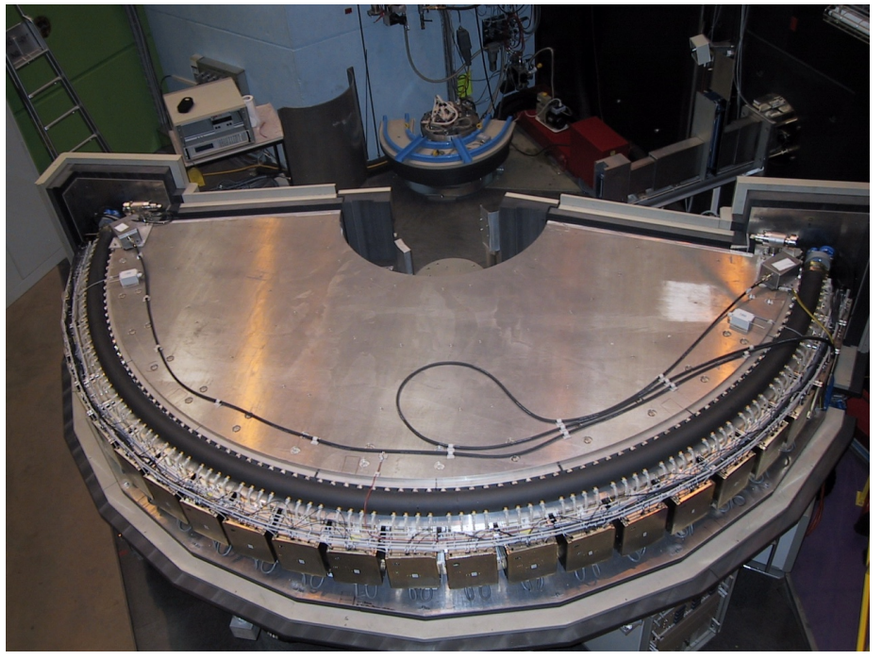
Cold neutron guide hall. DMC diffractometer

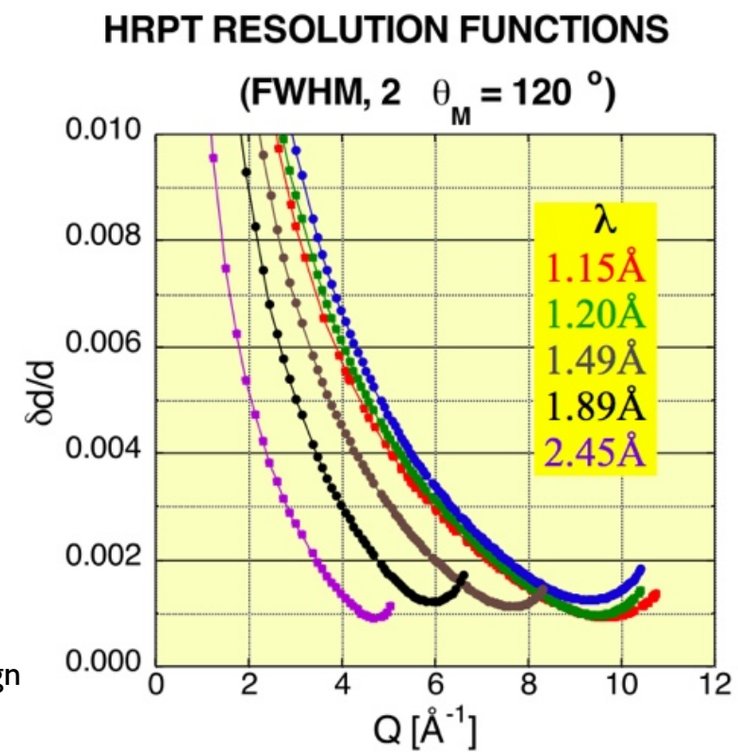


Powder ND at SINQ/PSI

HRPT - High Resolution Powder Diffractometer for Thermal Neutrons.
linear detector with 1600 channelss, 0.1°

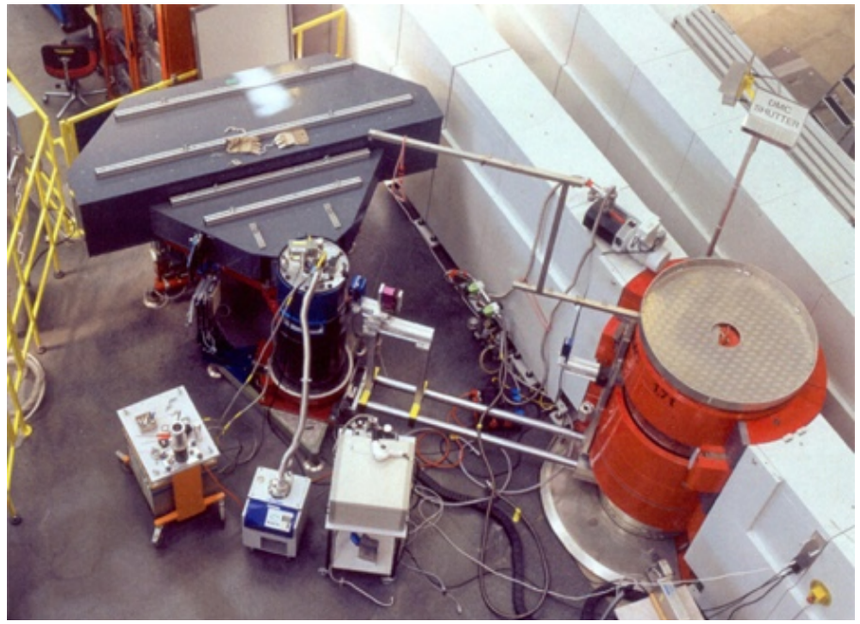
Responsible: Vladimir Pomjakushin, Denis Sheptyakov

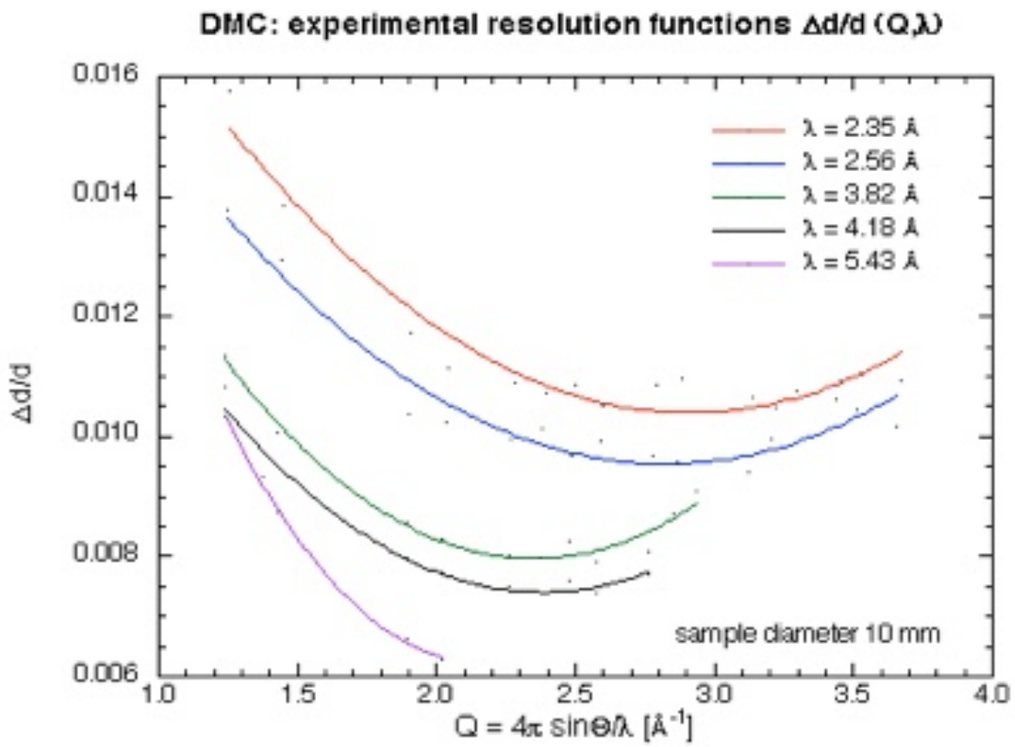




DMC - cold neutron powder diffractometer
linear detector with 400 channels, 0.2°

Responsible: Lukas Keller, Matthias Frontzek





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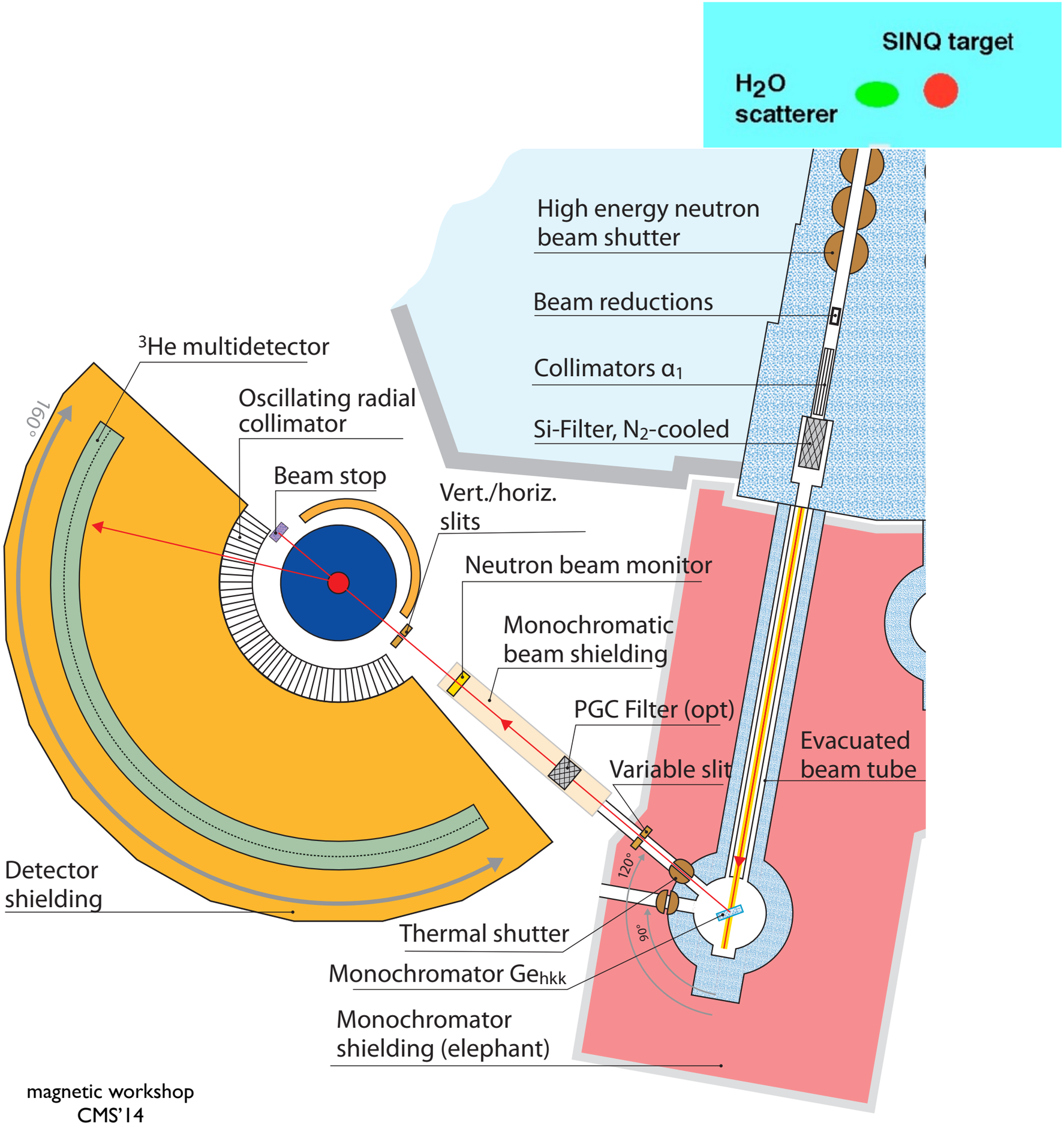
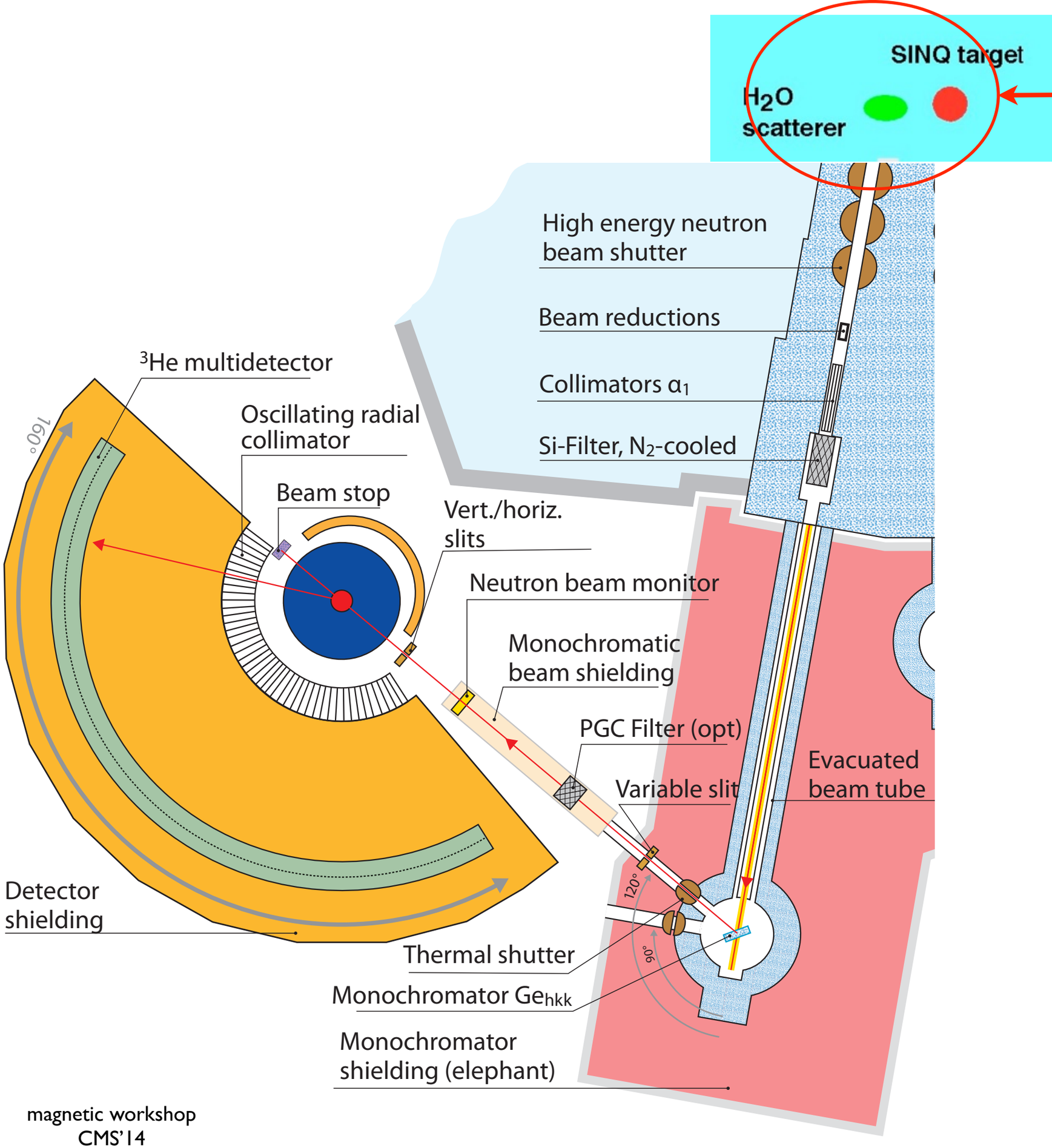
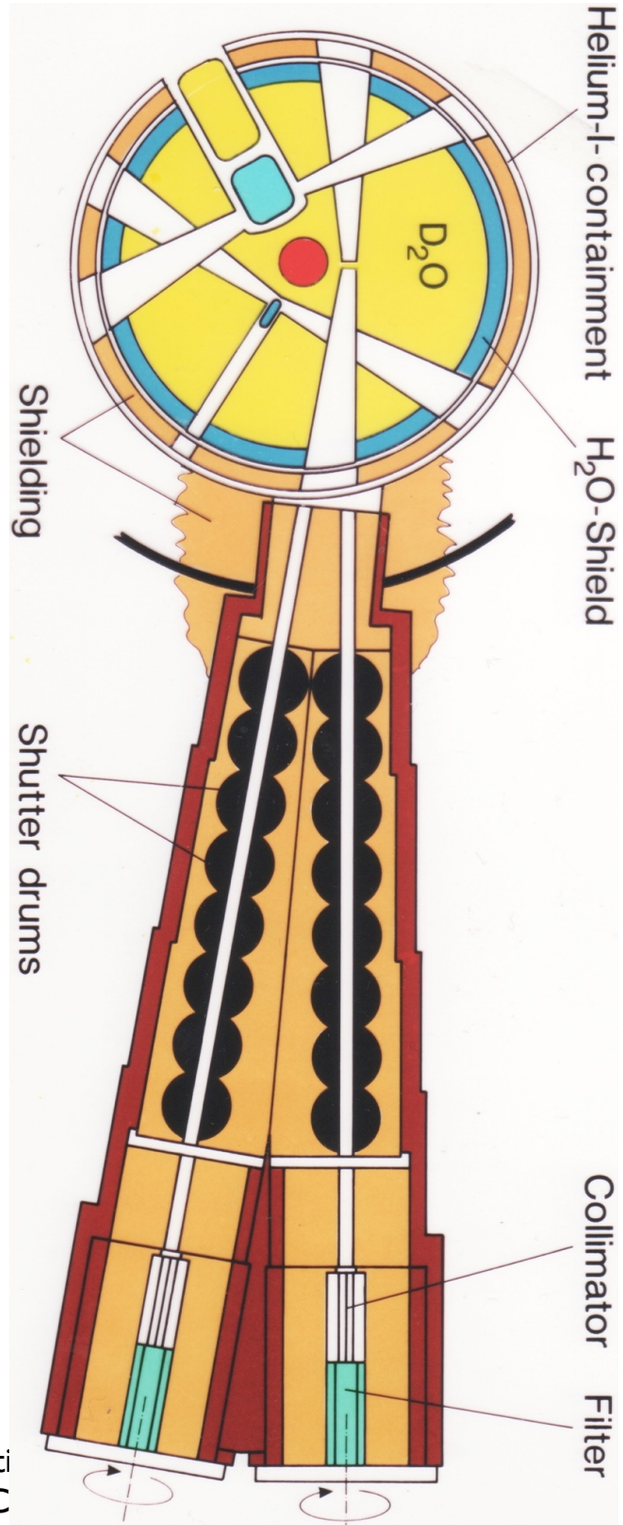
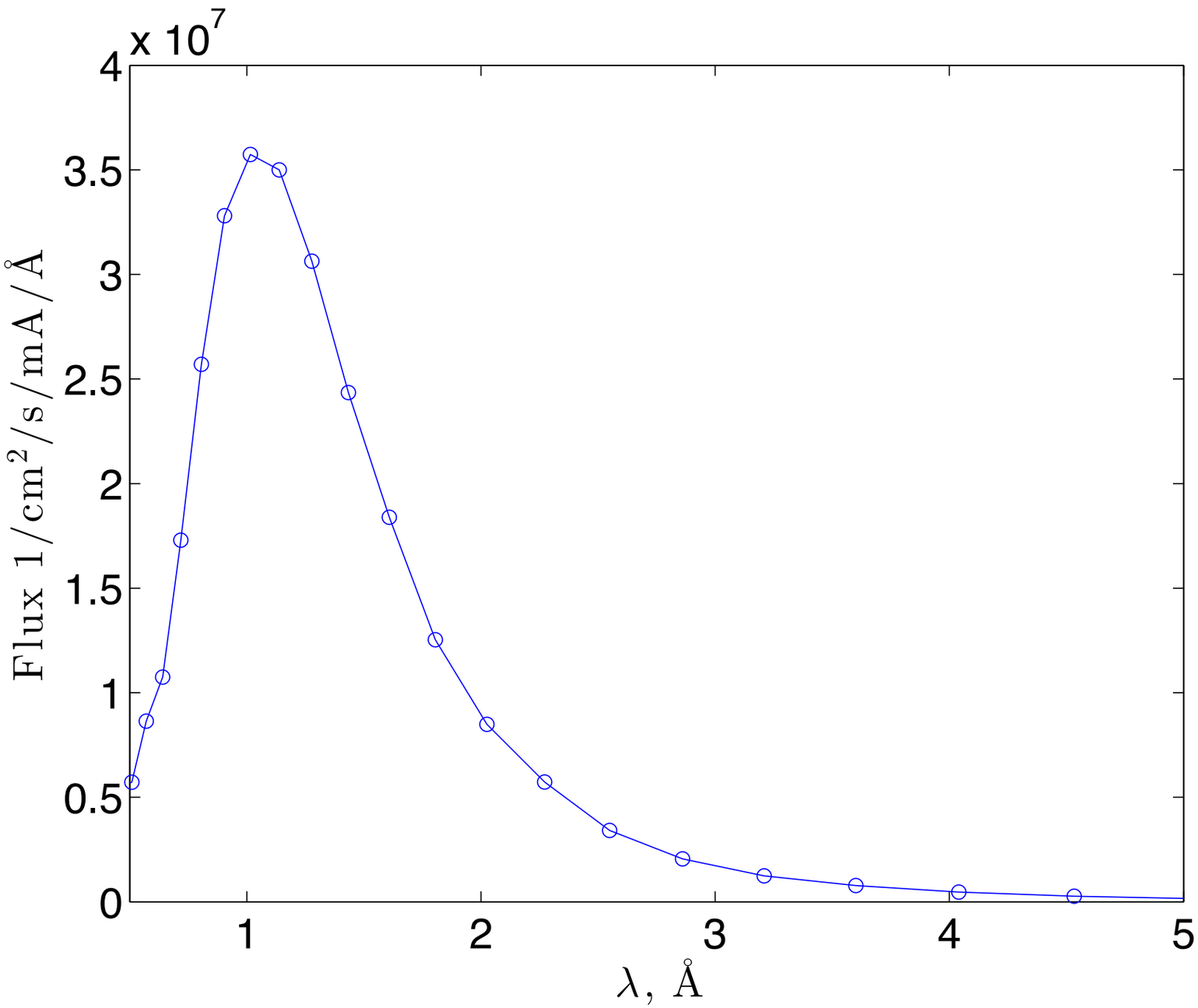

SINQ target
H_2O scatterer
High energy neutron beam shutter
Beam reductions
Collimators α_1
Si-Filter, N_2-cooled
^{3}He multidetector
Oscillating radial collimator
Beam stop
Vert./horiz. slits
Neutron beam monitor
Monochromatic beam shielding
PGC Filter (opt)
Variable slit
Evacuated beam tube
160°
120°
90°
Detector shielding
Thermal shutter
Monochromator Ge_{hkk}
Monochromator shielding (elephant)



neutron flux from the moderator

Neutron flux from the D_2O moderator at HRPT/NEUTRA (white beam)





Total: 5 ·10^7 1/cm^2/s/mA
at SINQ current 2mA: 10^8

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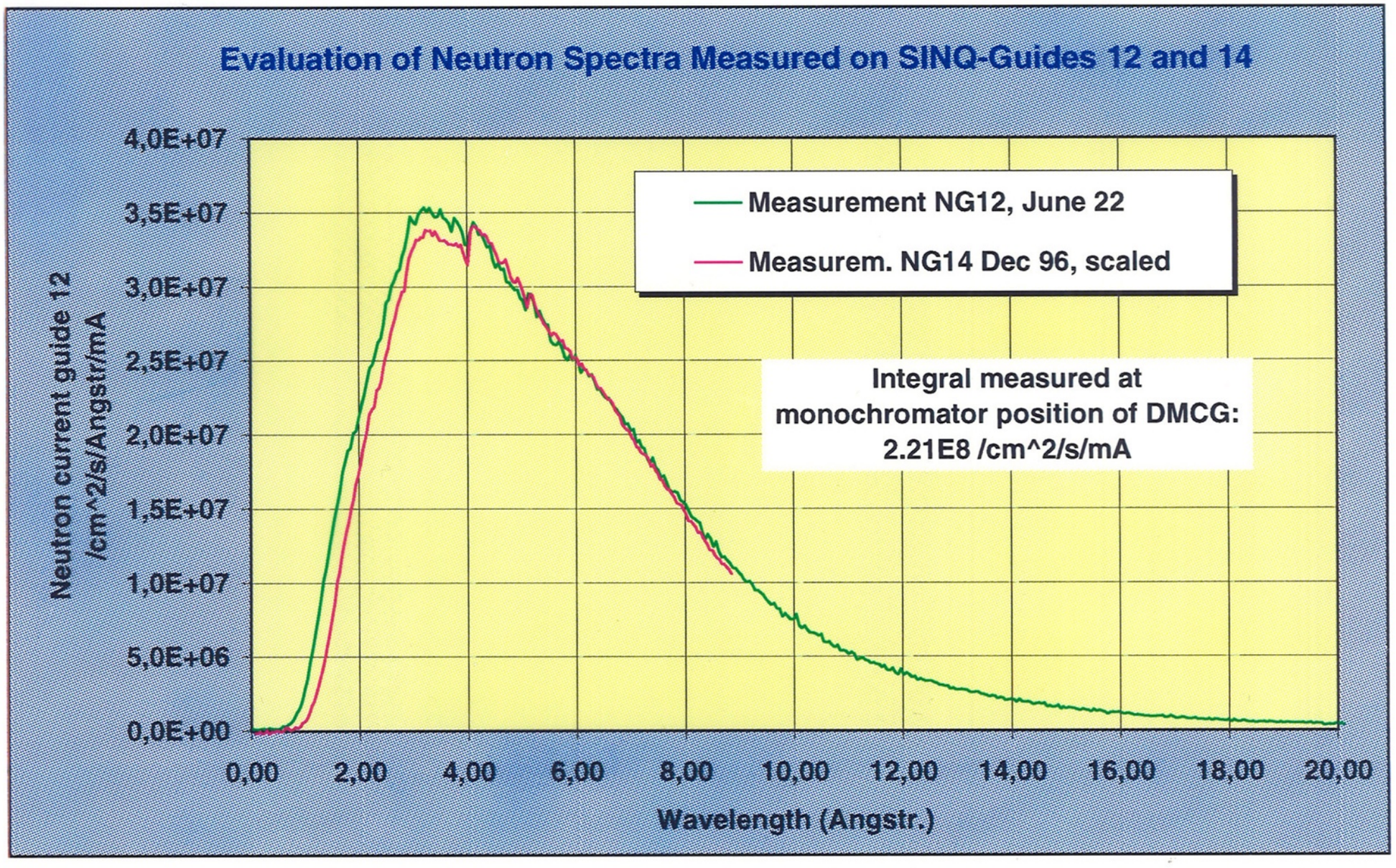
DMC flux

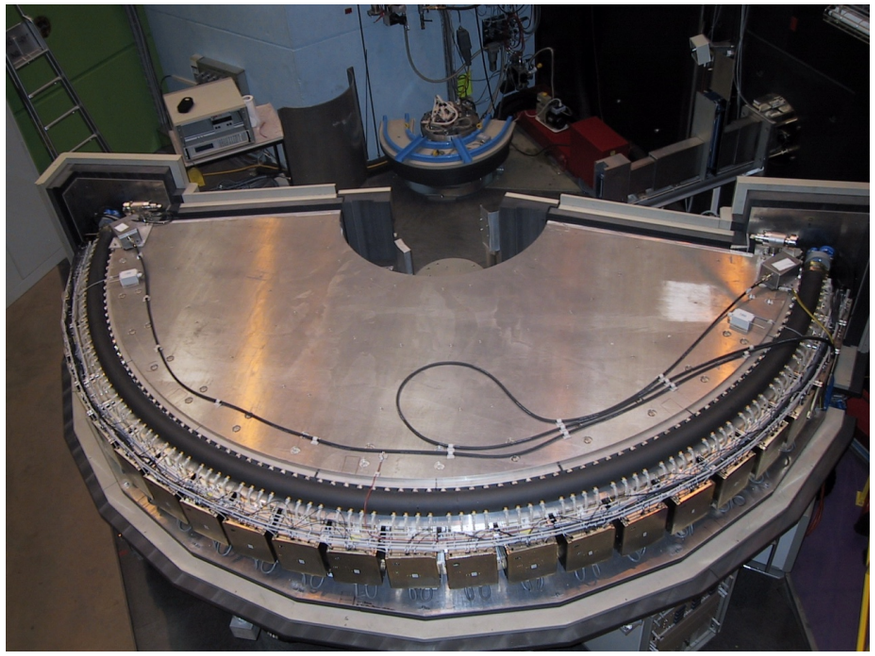


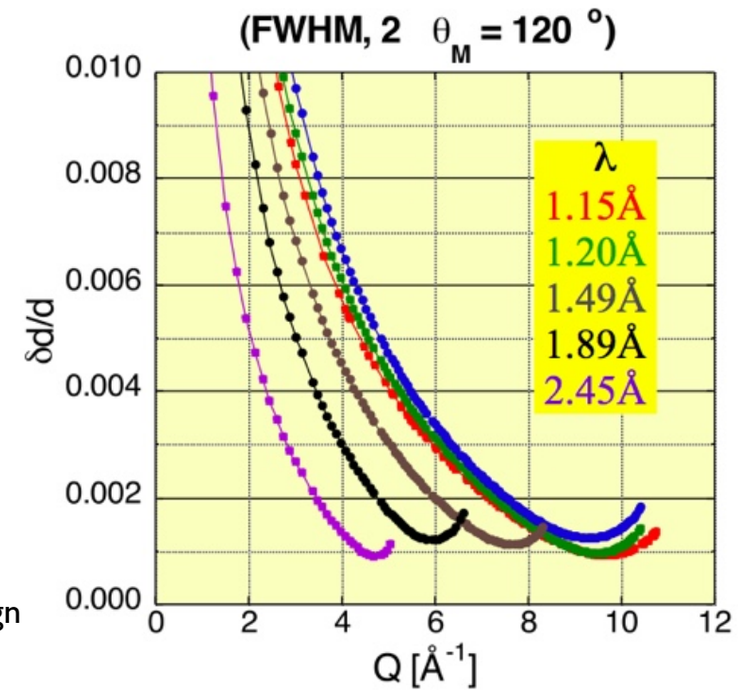
BQ36 / 23.07.1997 SINQ-NL12_tof.xls Diagramm4

Powder ND at SINQ/PSI

HRPT - High Resolution Powder Diffractometer for Thermal Neutrons.
linear detector with 1600 channelss, 0.1°

Responsible: Vladimir Pomjakushin, Denis Sheptyakov





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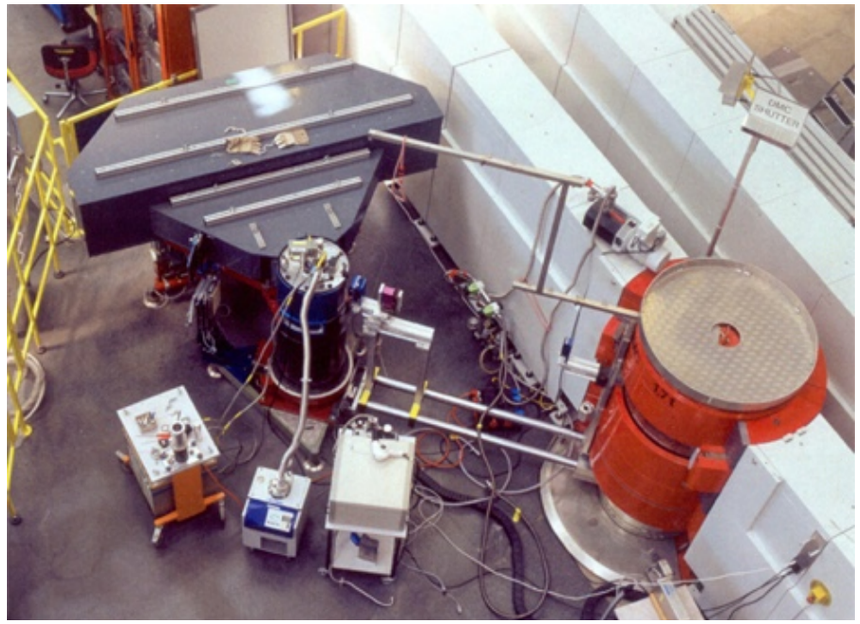

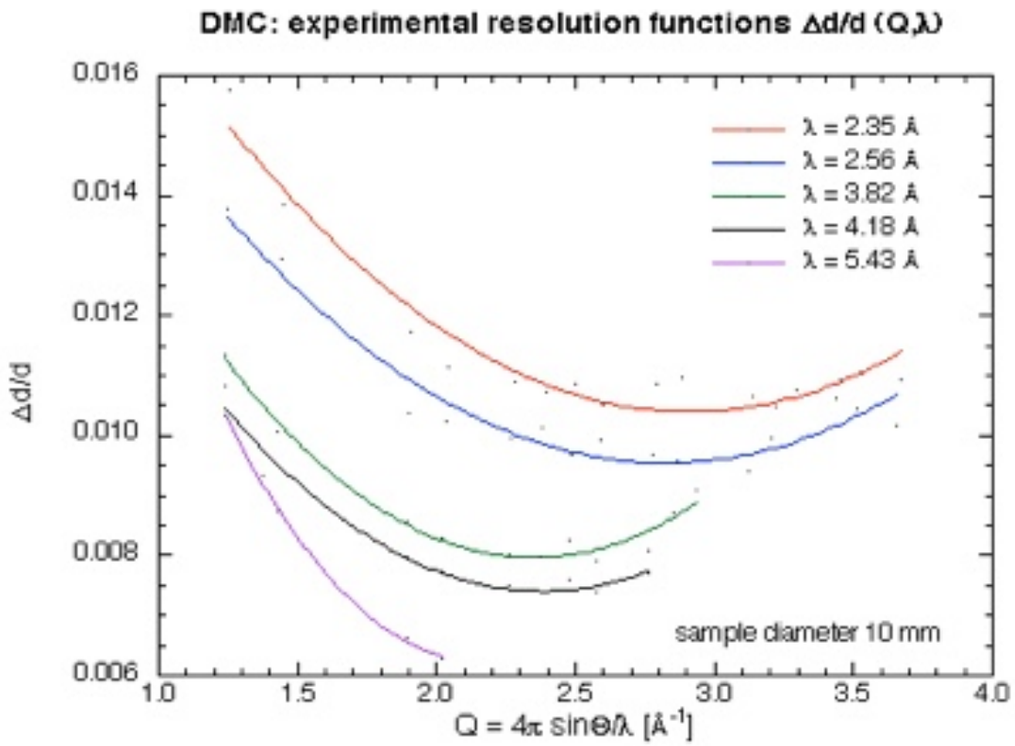

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HRPT - High Resolution Powder Diffractometer for Thermal Neutrons

linear detector wi

DMC - cold neutron powder diffractometer

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Responsible: Vladimir P

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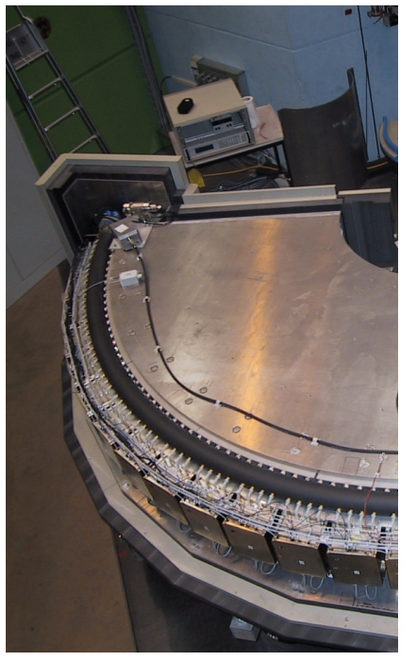

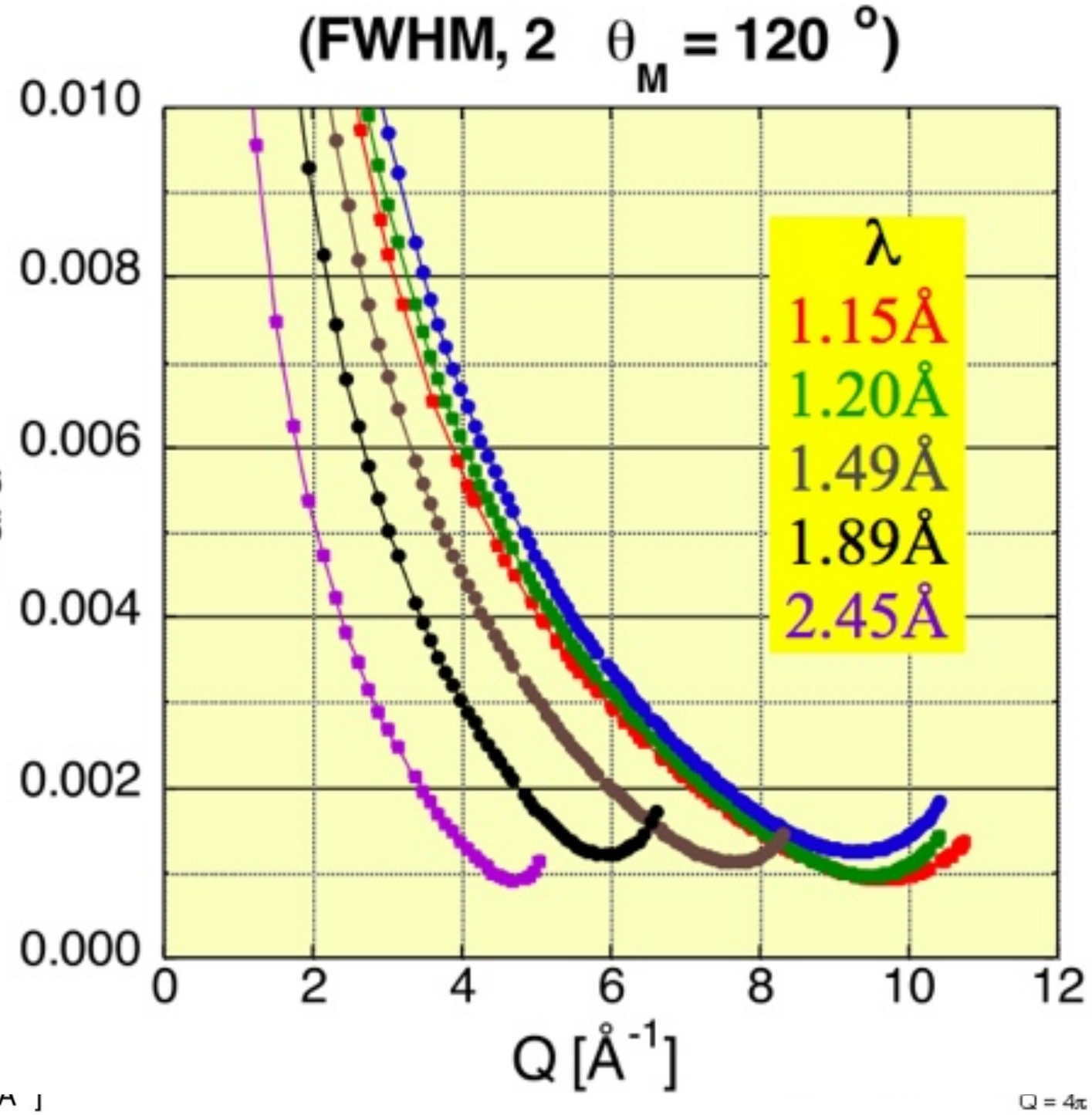

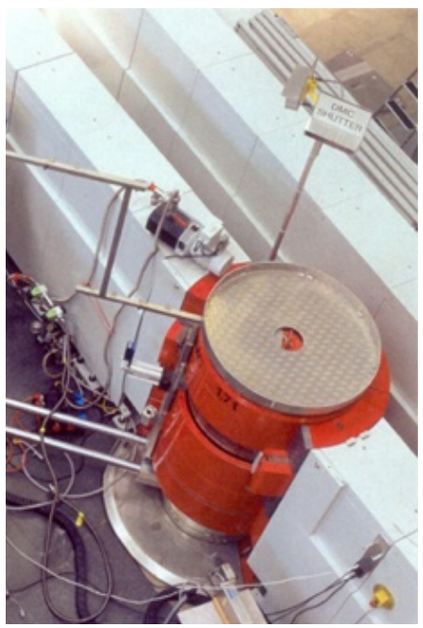

HRPT RESOLU

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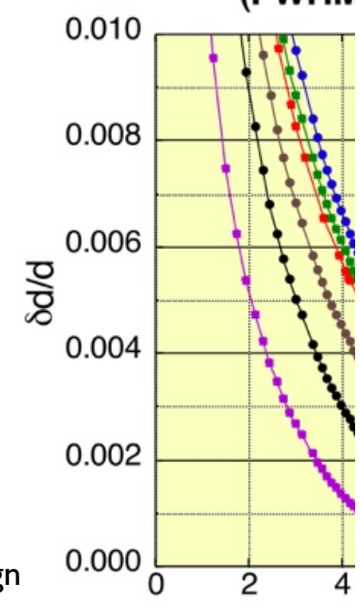

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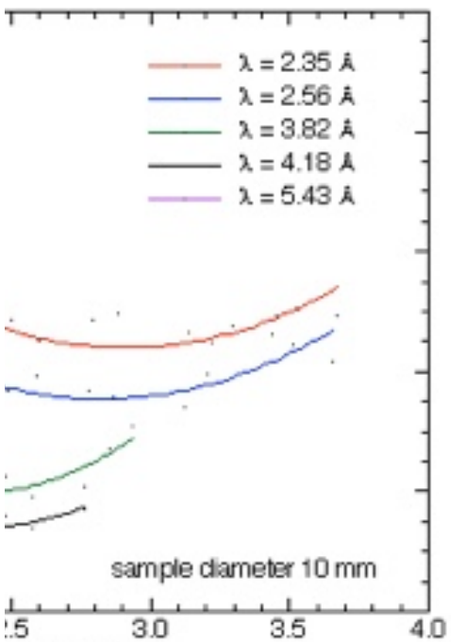
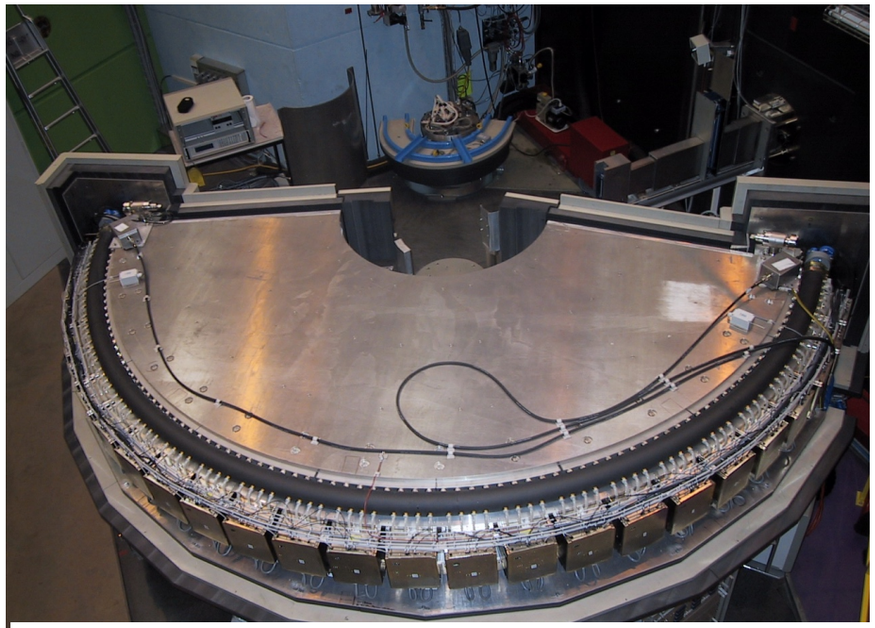
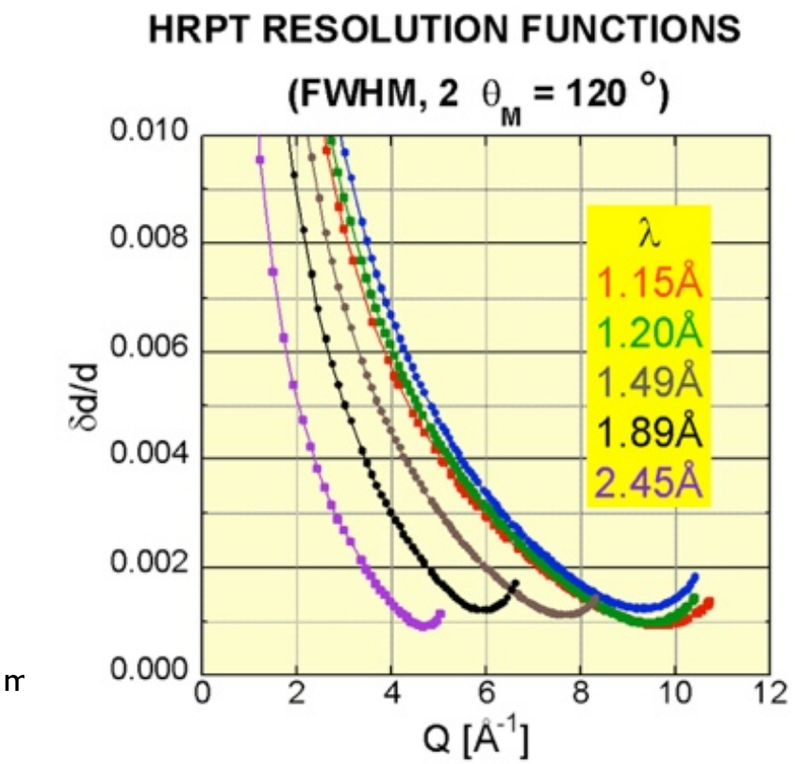
ution functions Δd/d (Q,λ)



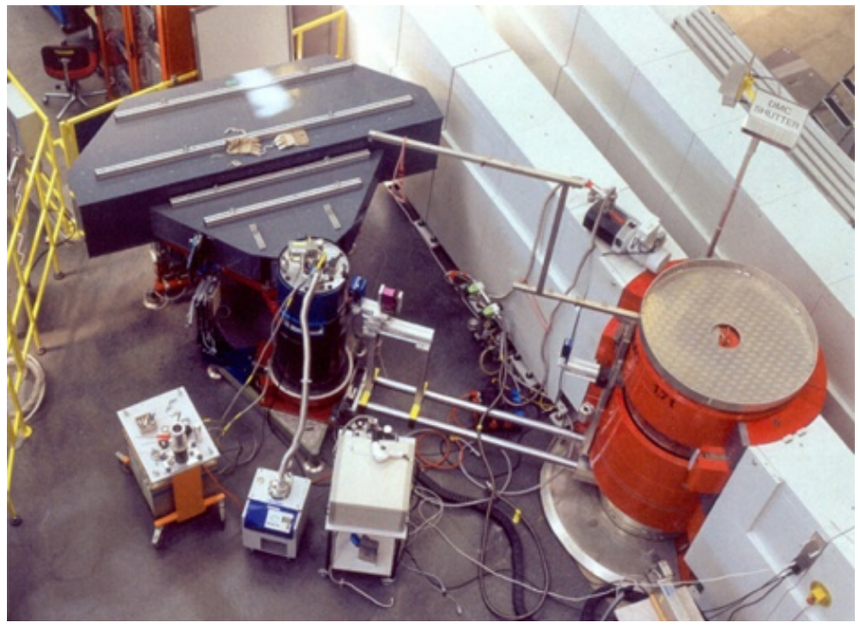
Powder ND at SINQ/PSI

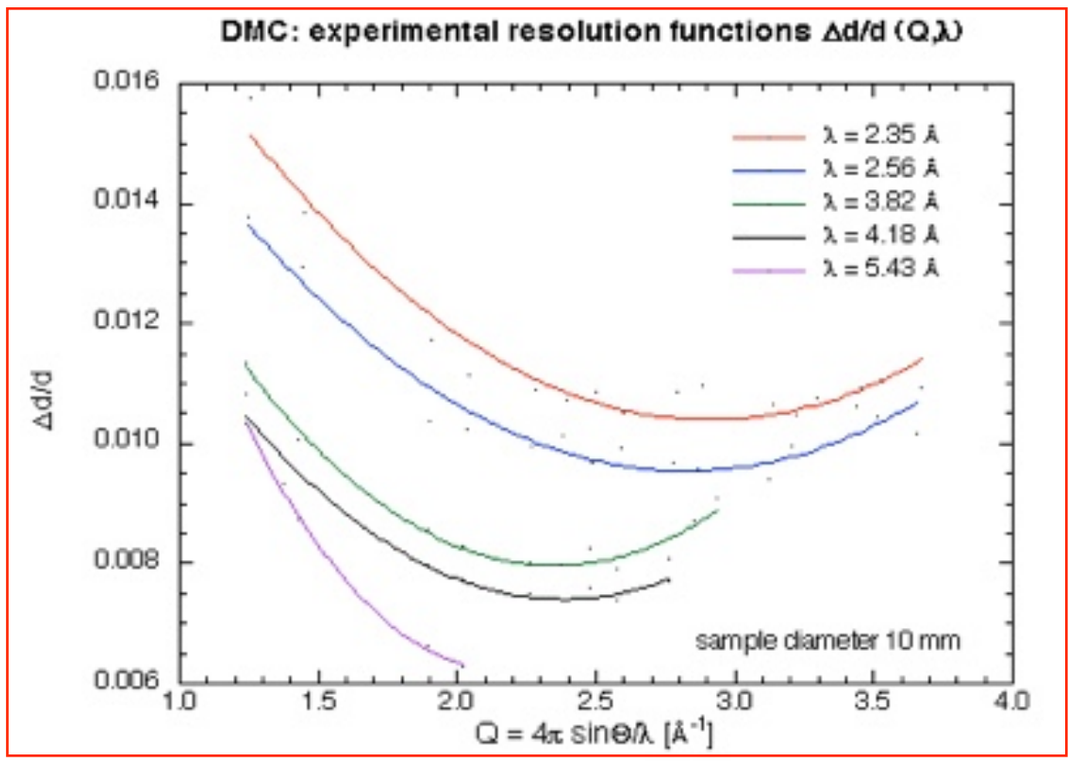
HRPT - High Resolution Powder Diffractometer for Thermal Neutrons at SINQ



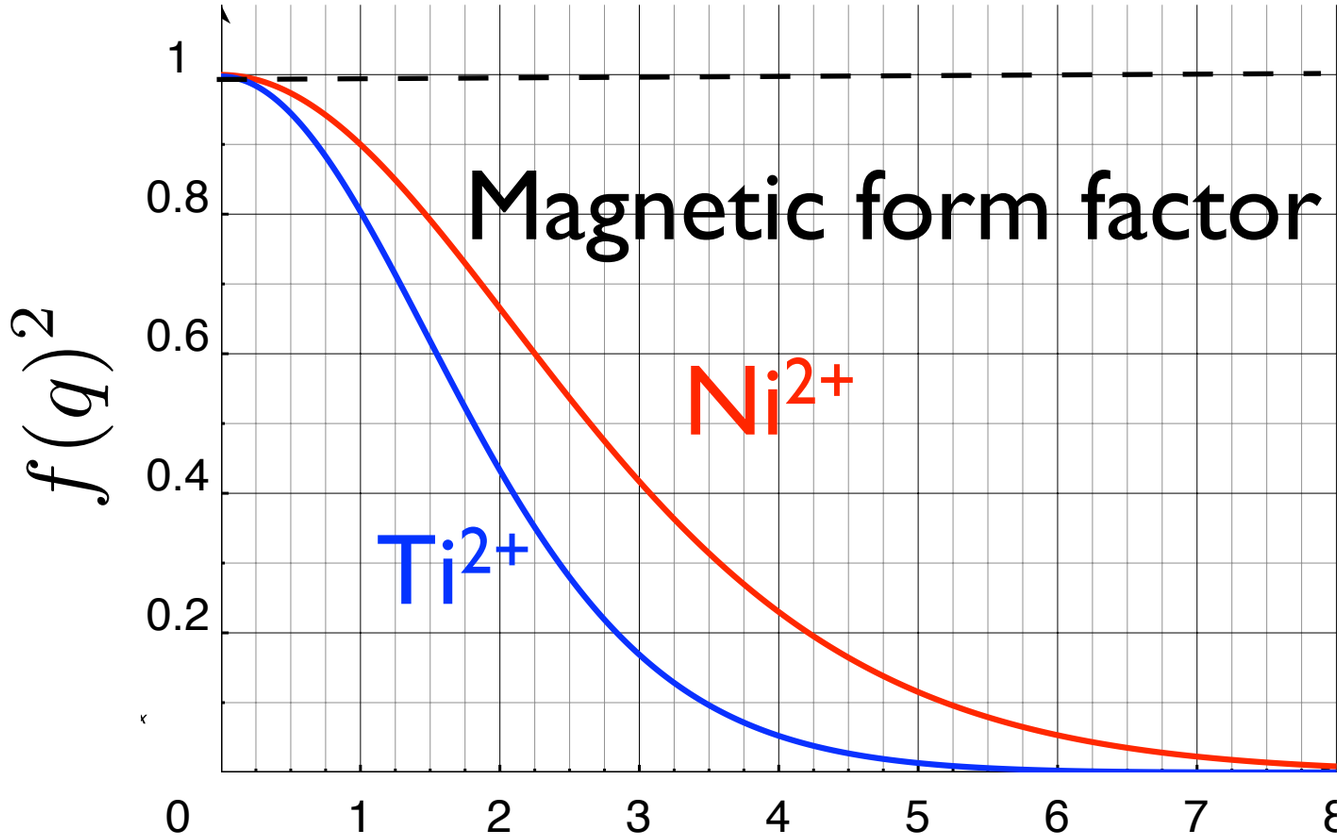


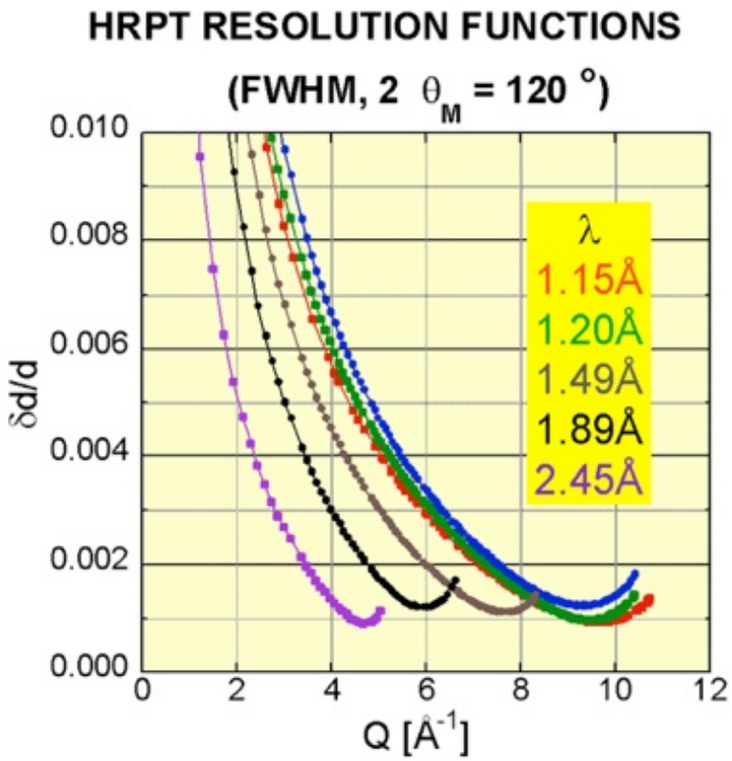
DMC - cold neutron powder diffractometer

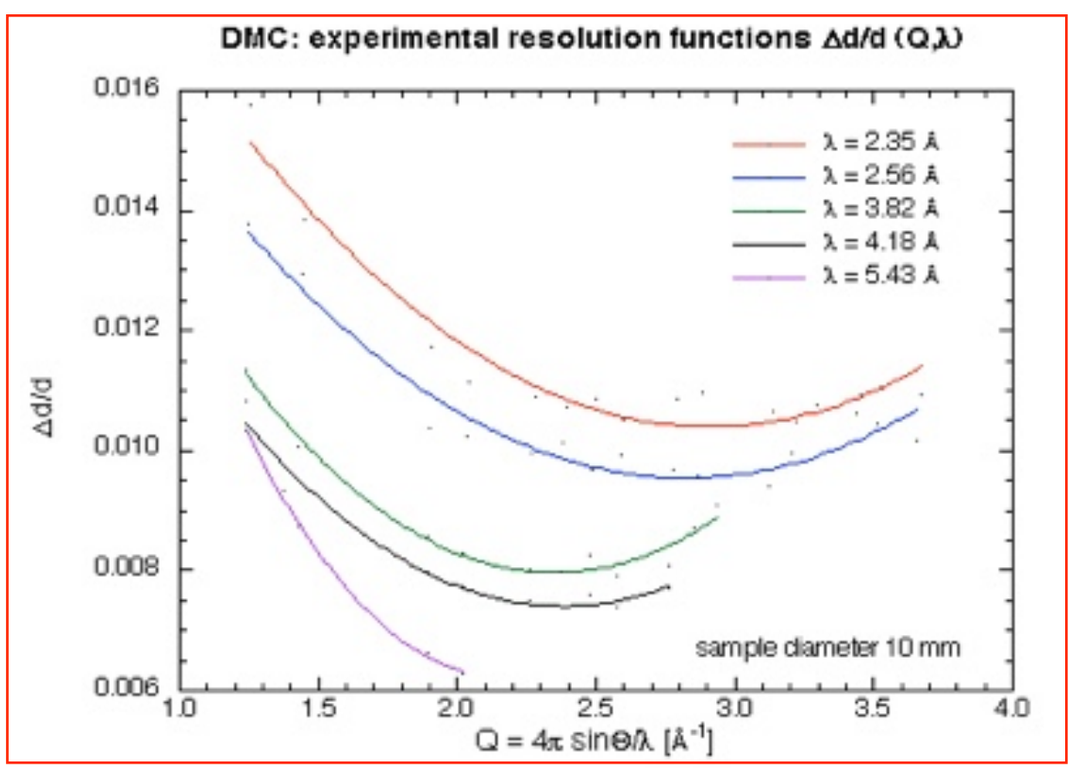




Powder ND at SINQ/PSI

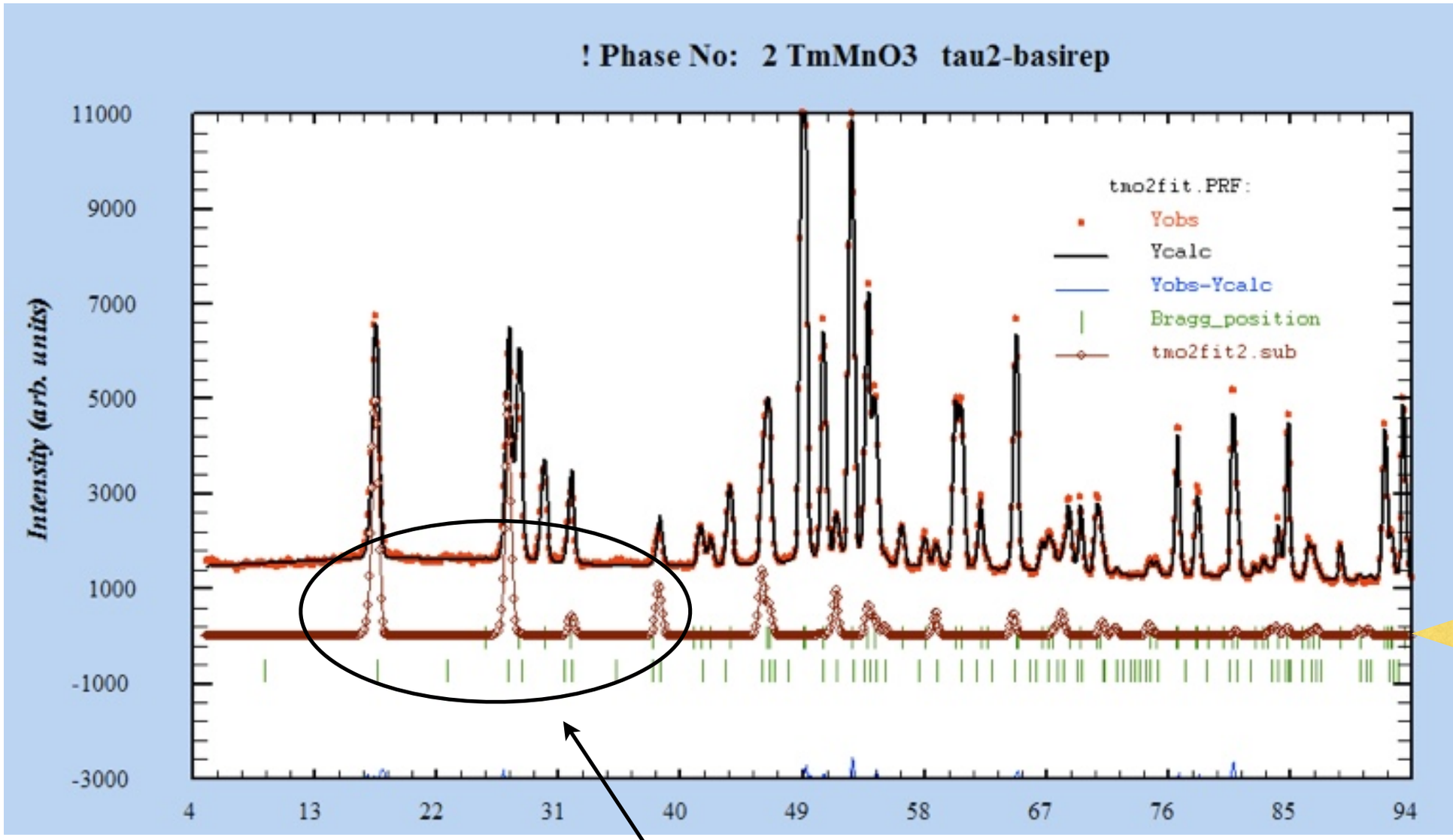






cf. resolution/q-range

HRPT 1.9Å

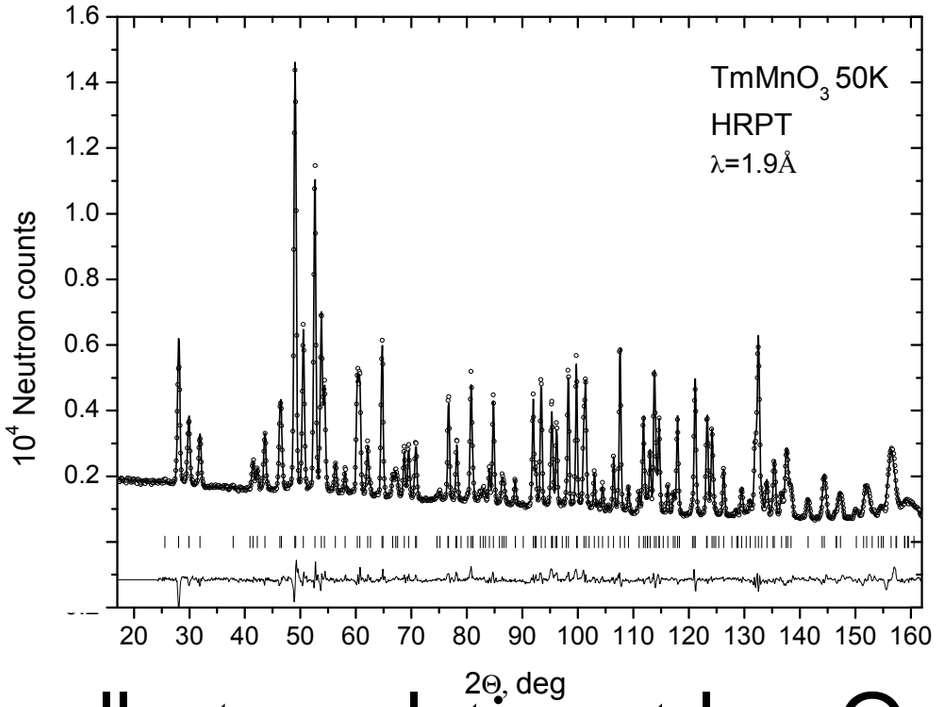


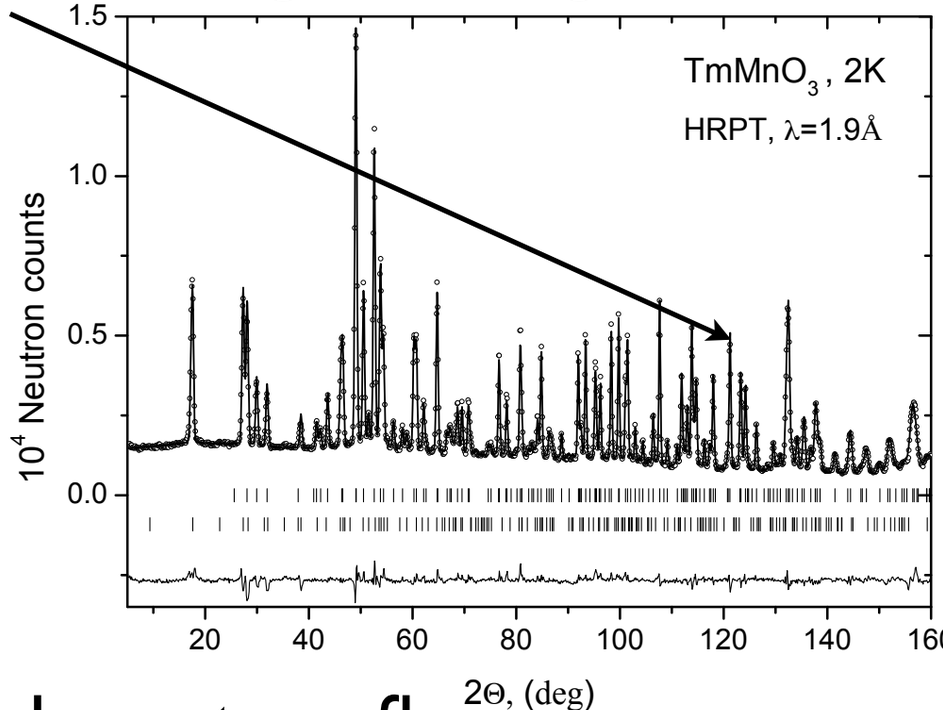
magnetic contribution

DMC range at 4.5Å

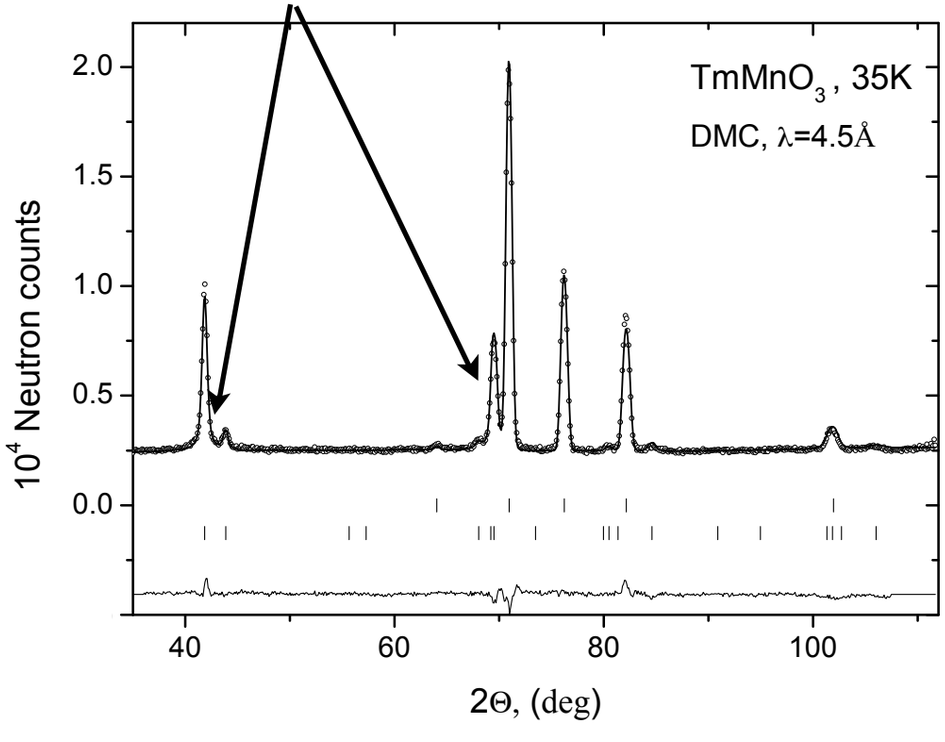
Complementarity 1.9Å HRPT and 4.5Å DMC

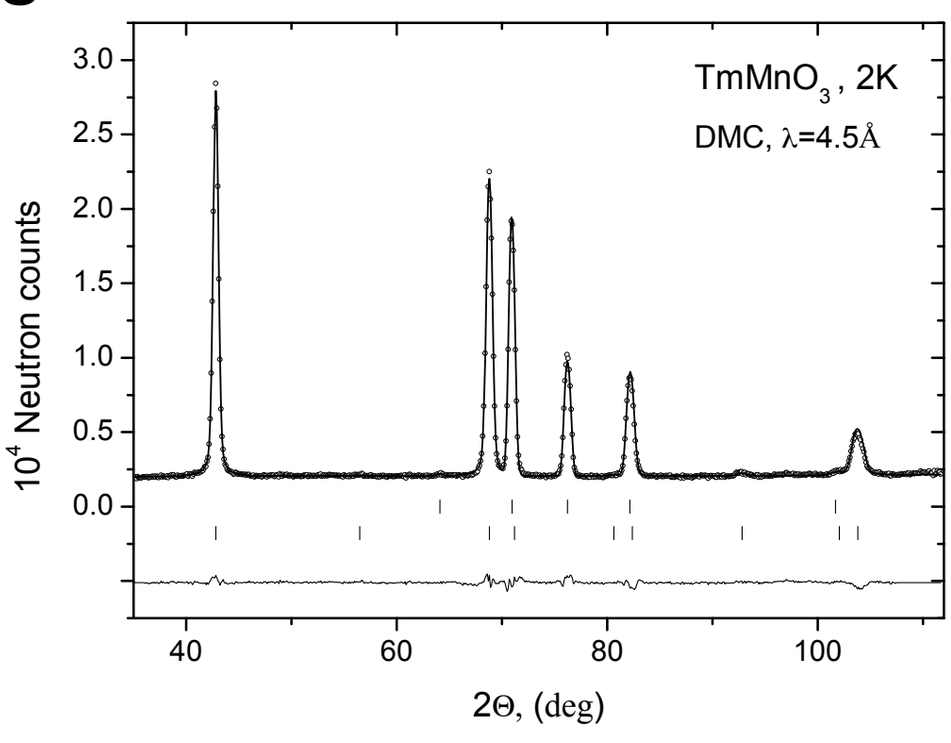
excellent resolution and high Q-range





excellent resolution at low Q and high neutron flux





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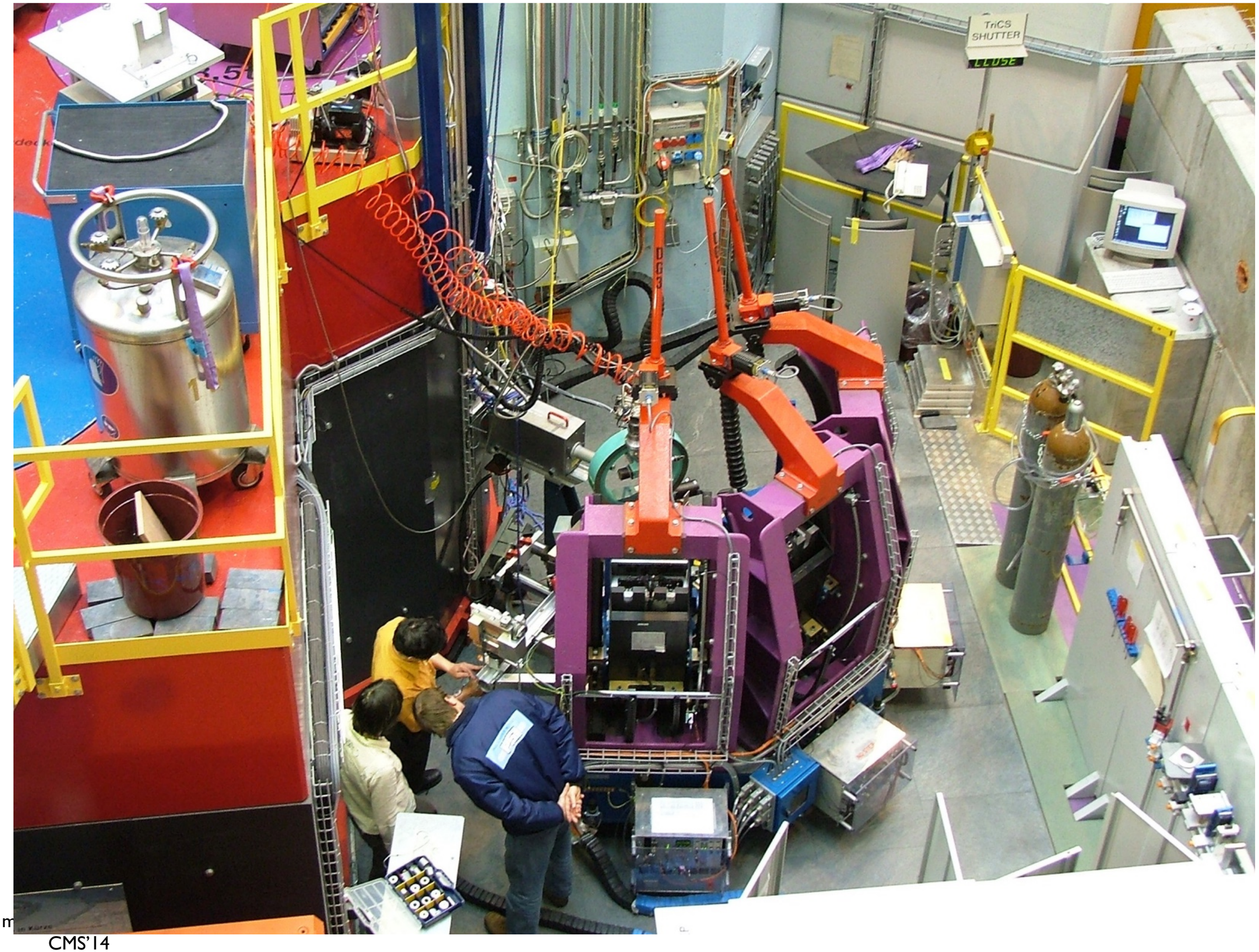
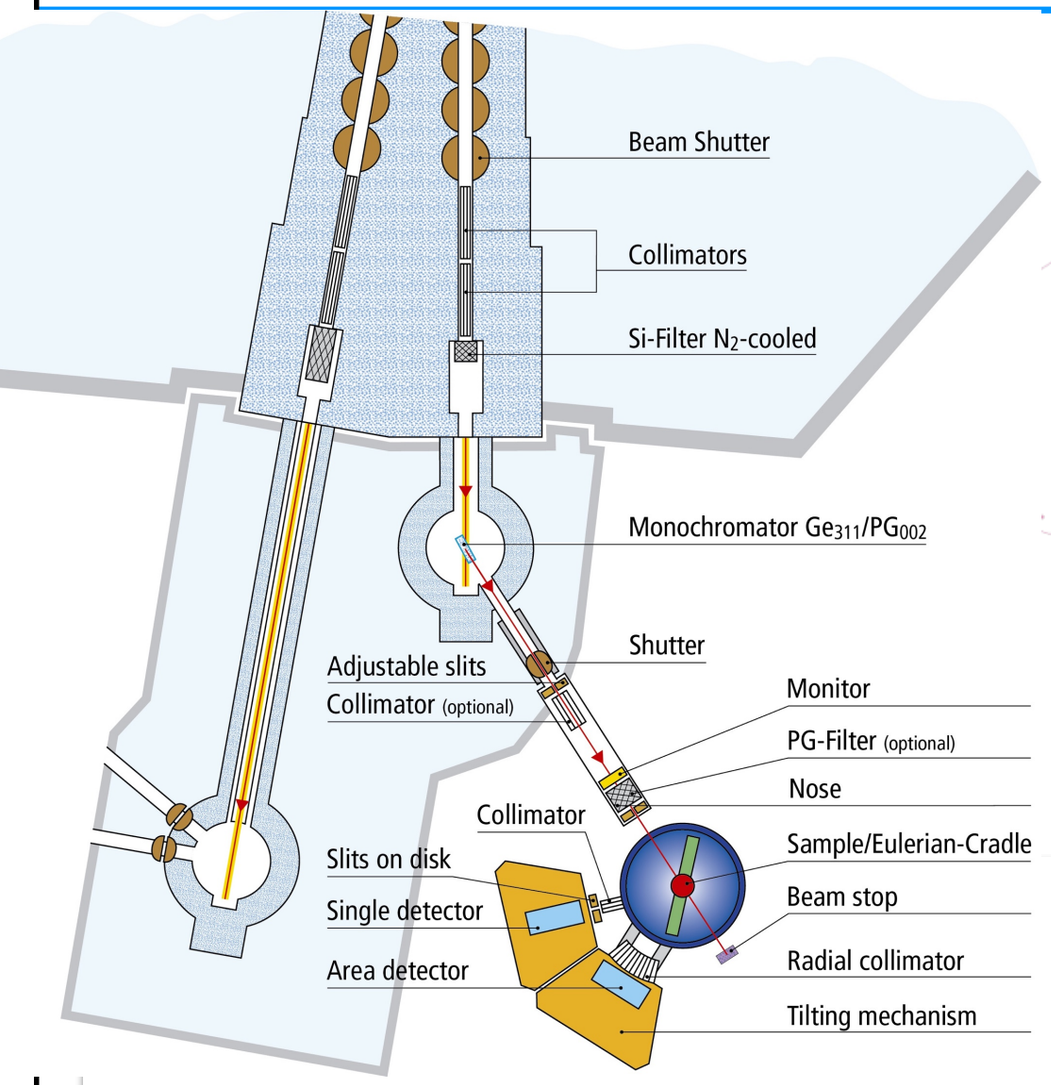
Single crystal diffractometer TriCS at SINQ



Single crystal diffractometer at SINQ

PAUL SCHERRER INSTITUT

TriCS: instrument layout and specialities



Responsible: O. Zaharko, N. Aliouane, J. Schefer

Key components:

Modes: 4-circle (collect datasets) and tilt (auxiliary equipment)

Wavelengths: short (1.18 Å) and long (2.31 Å)

Detectors: single tube, 160x160 mm^2 area detector

each with dedicated collimators

Fast change between the complementary components

Speciality 1: phase transitions

As a function of temperature, magnetic/ electric field, pressure

Speciality 2: superstructures and complex magnetic structures

Multiferroic $CuCrO_2$ M. Frontzek et al. JPhysCondMat 24(2012)16004

low temperature magnetic structure is unambiguously helical:

Some specific features

Samples, T, P, H and other equipment

- standard sample container: 6-10 mm dia x 50 mm (<4cm^3)
- due to low background small samples can be measured (30 mm^3)
- zero matrix high pressure cells:
  - clamp cells for 9 and 15 kbar
  - Paris Edinburgh cell 100 kbar
- standard LNS sample environment:
  - Temperature = 50 mK—1800K,
  - Magnetic field H = 4 T (vertical)
  - Automatic He, N_2 refilling systems
- **Sample changers 4-8 samples, T=1.5-300 K**

HRPT room temperature 8-sample changer

- Eight samples mounted on a caroussel-type changer, few seconds to bring the next one into the measurement position;

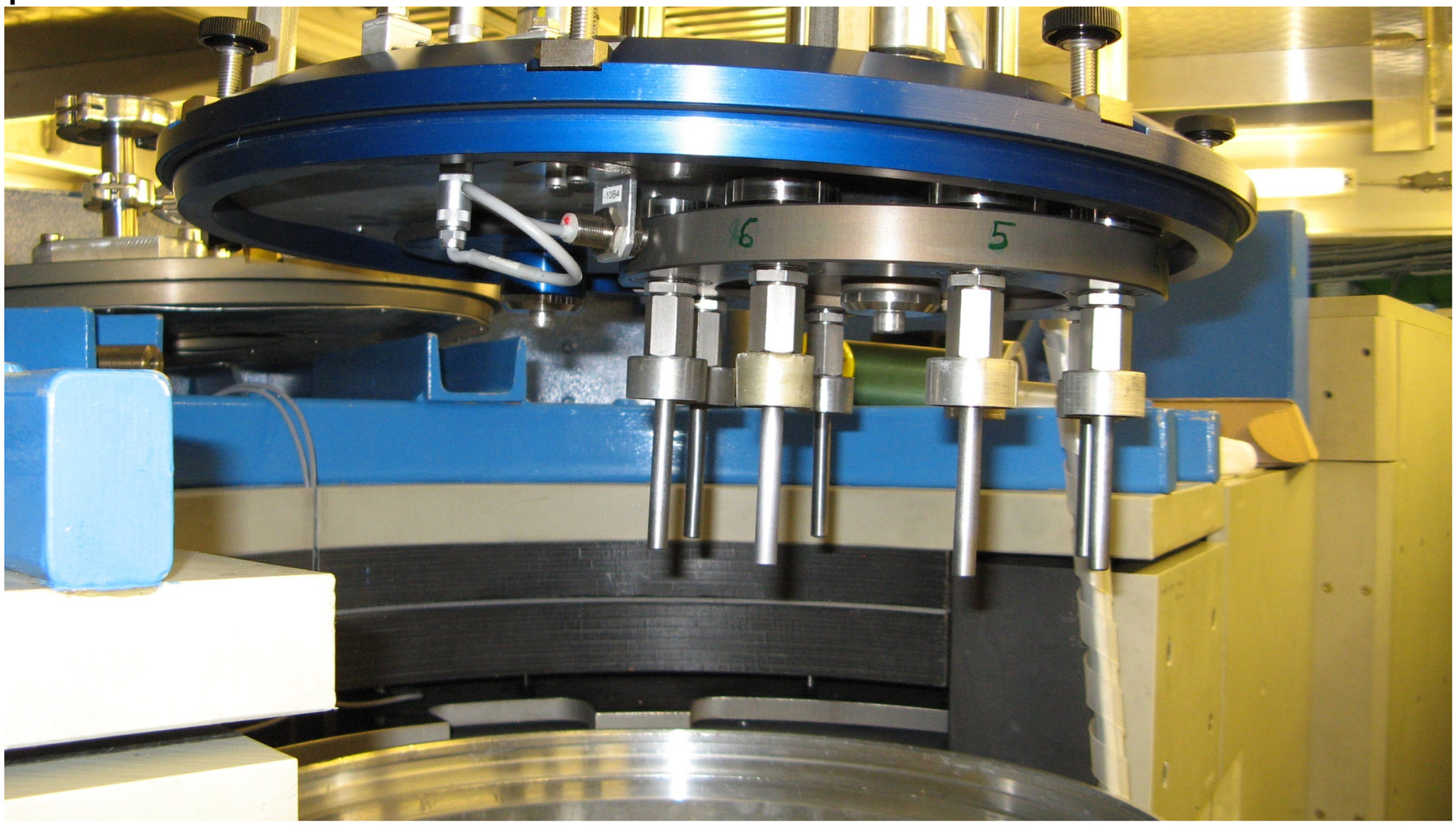
- Independent sample rotation mechanism – for reducing the preferred orientation aberrations.

Fully loaded with 8 samples, the sample changer is ready to be installed in-place on the HRPT sample table.

HRPT room temperature 8-sample changer

- Eight samples mounted on a caroussel-type changer, few seconds to bring the next one into the measurement position;

- Independent sample rotation mechanism – for reducing the preferred orientation aberrations.

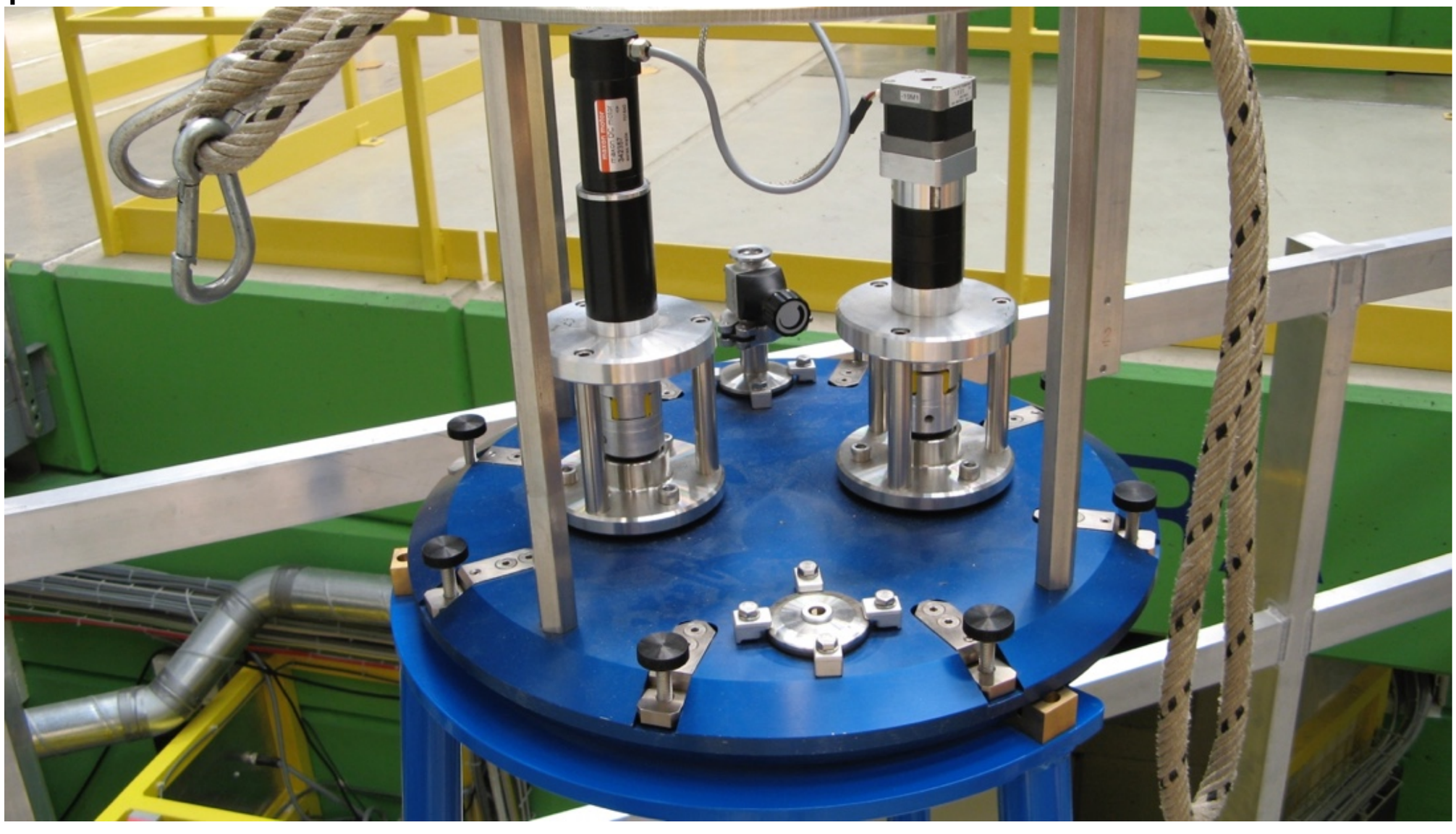


Fully loaded with 8 samples, the sample changer is ready to be installed in-place on the HRPT sample table.

HRPT room temperature 8-sample changer

- Eight samples mounted on a caroussel-type changer, few seconds to bring the next one into the measurement position;

- Independent sample rotation mechanism – for reducing the preferred orientation aberrations.

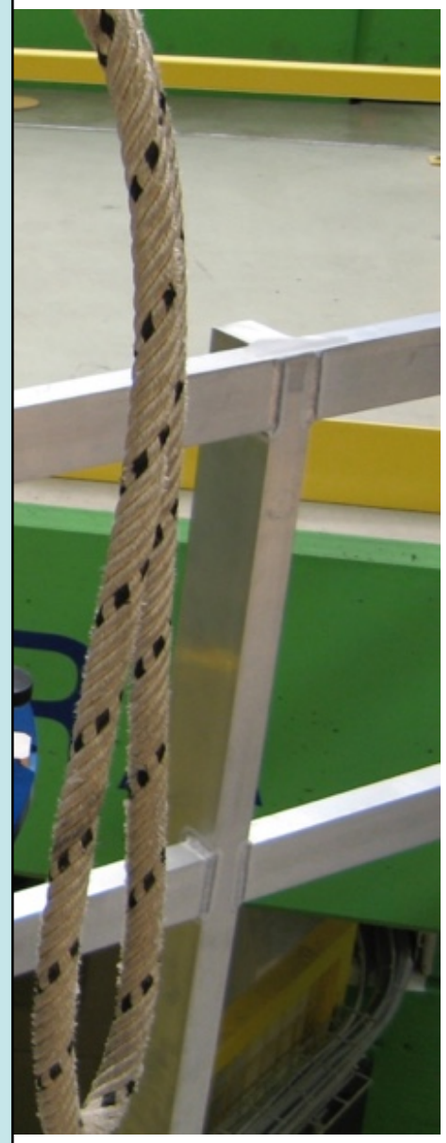


Fully loaded with 8 samples, the sample changer is ready to be installed in-place on the HRPT sample table.

HRPT room temperature 8-sample changer

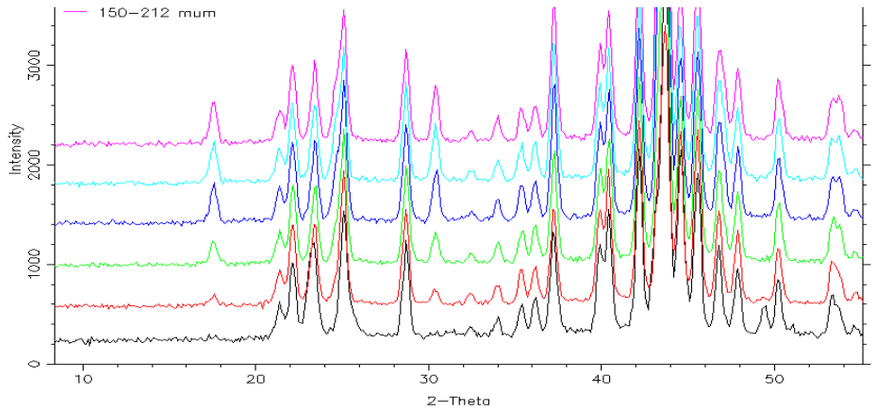
- Eight samples mounted on a caroussel-type changer, few seconds to b position;

- Independe cing the preferred ori



User Experiment 20061119
"Structure of leached Raney Ni alloys" (Nov. 2007):
~80 samples measured in 4 beam days:

20 samples/day!

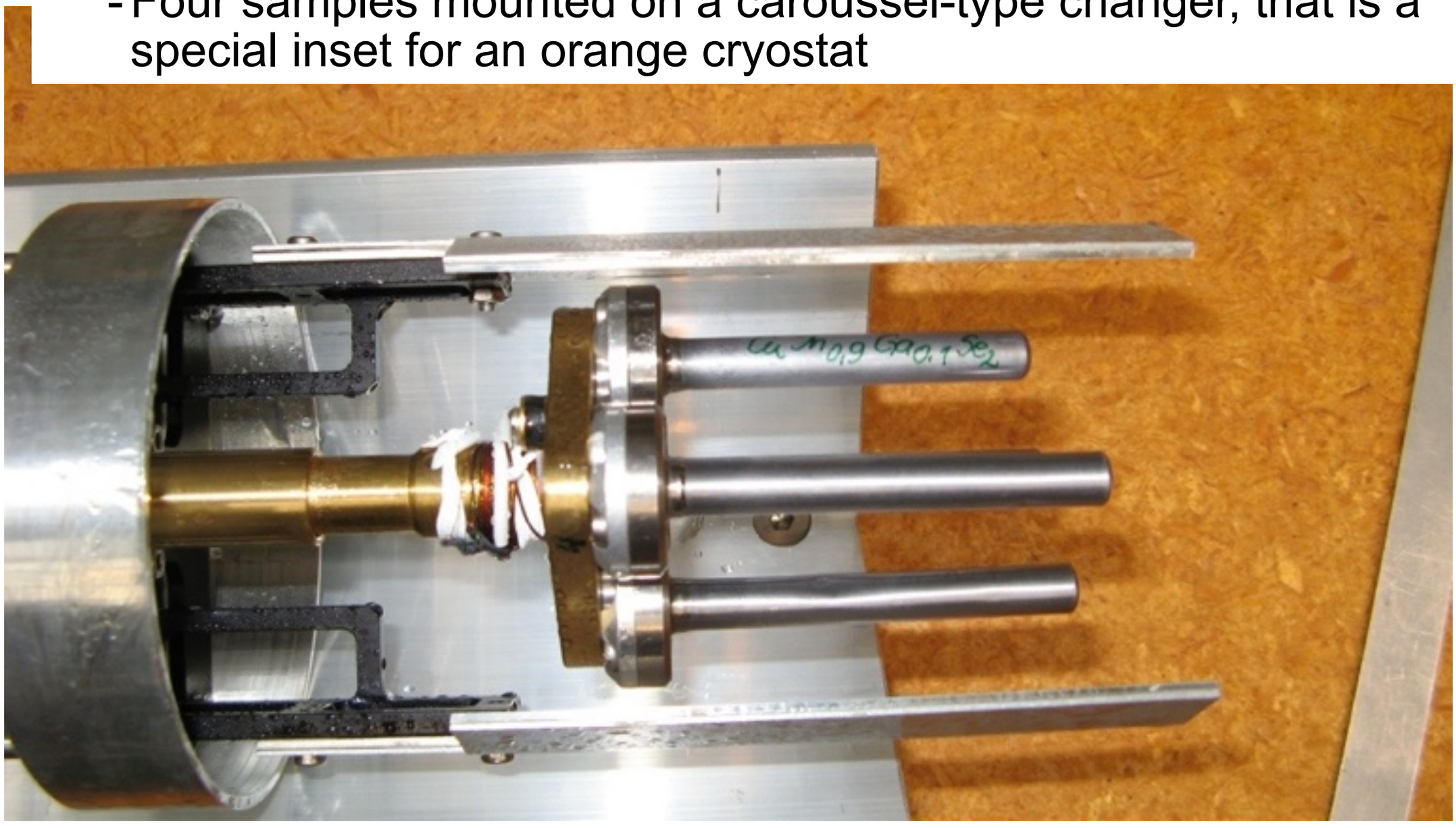


Fully loaded with 8 samples *HRPT sample table.*

HRPT low temperature 4-sample changer

A device for routine powder diffraction measurements at temperatures between 1.5K -300K.

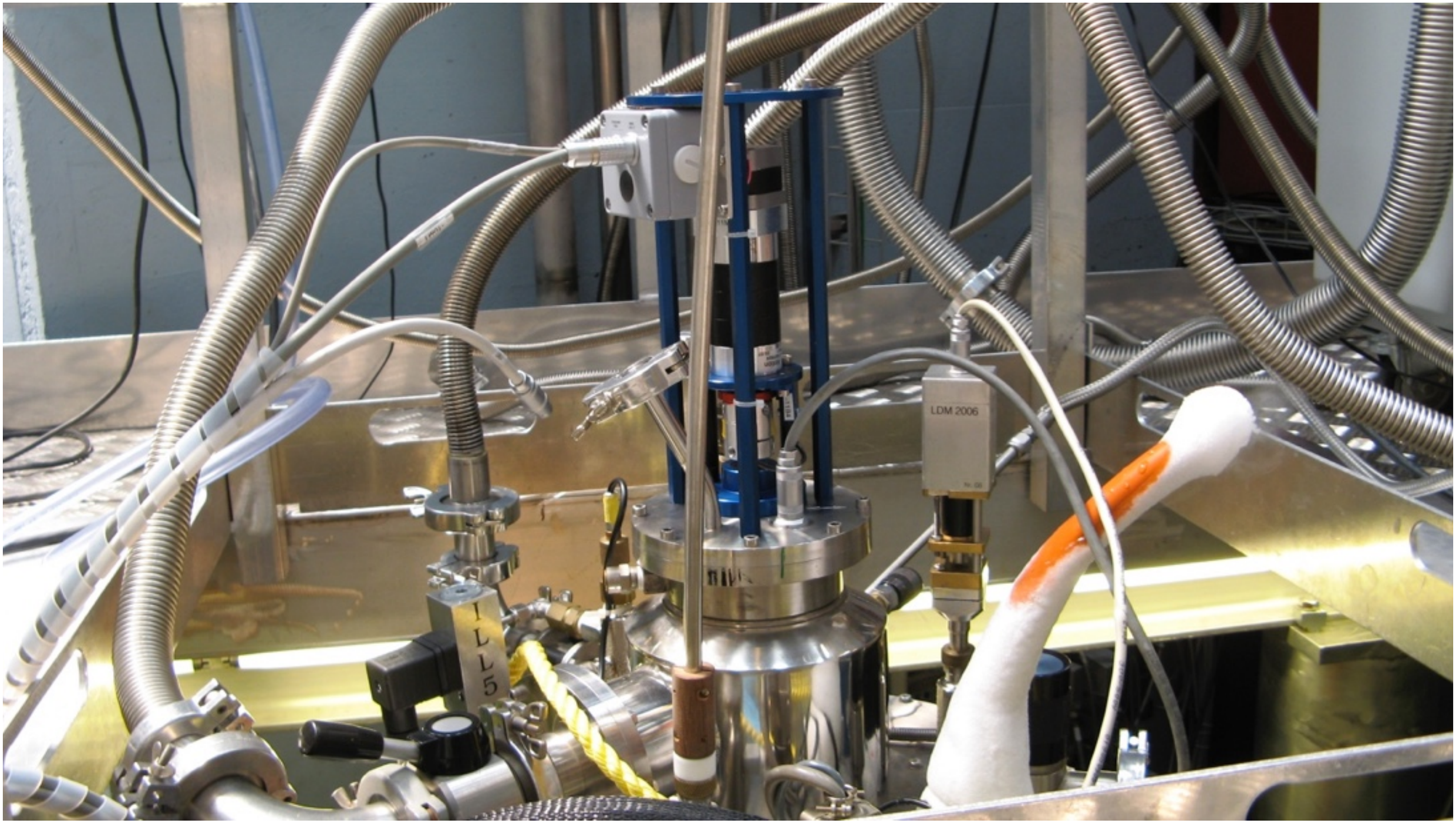
- All samples have the same temperature, i.e. time for temperature change is saved;
- Four samples mounted on a caroussel-type changer, that is a special inset for an orange cryostat



HRPT low temperature 4-sample changer

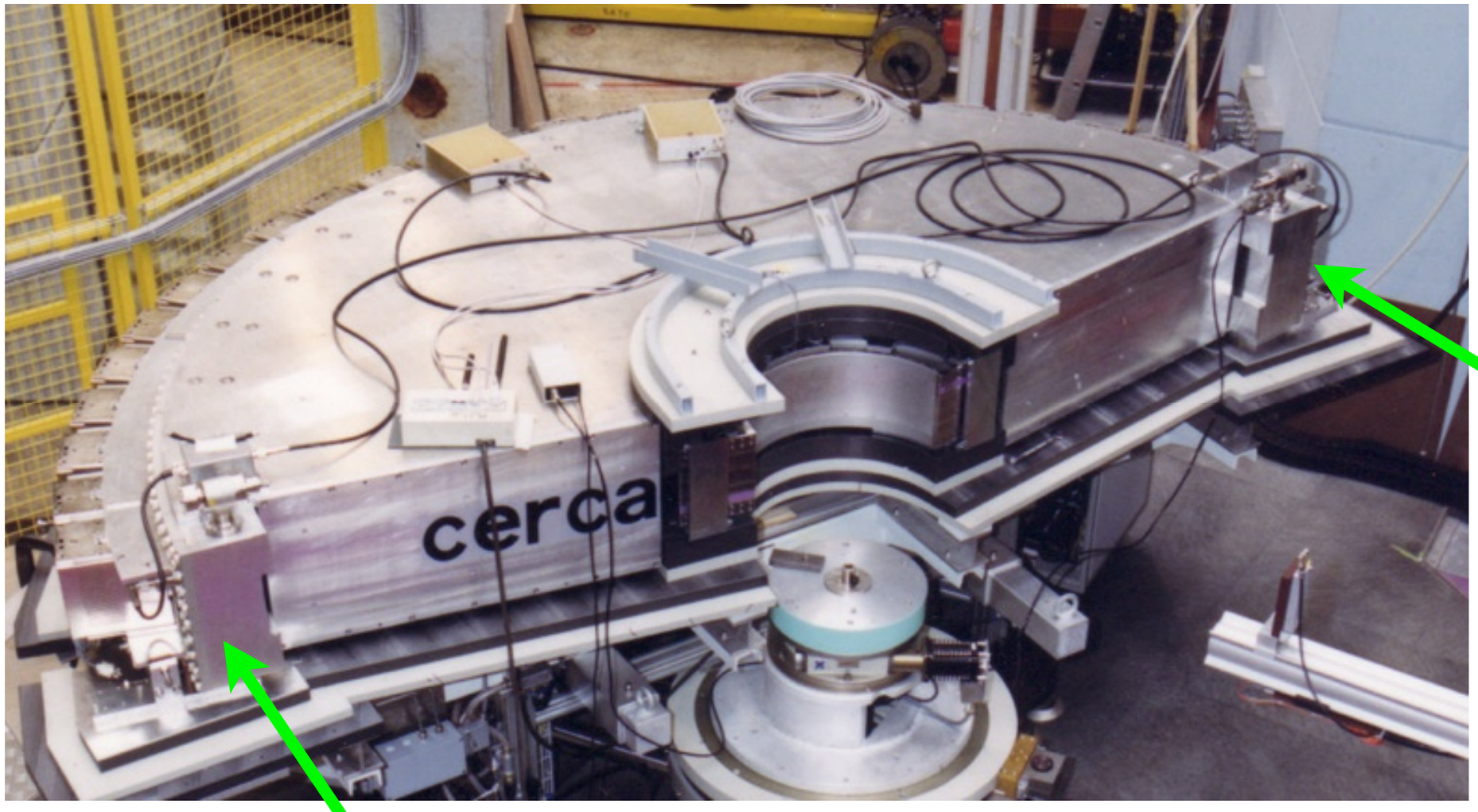
HRPT low temperature 4-sample changer

HRPT low temperature 4-sample changer



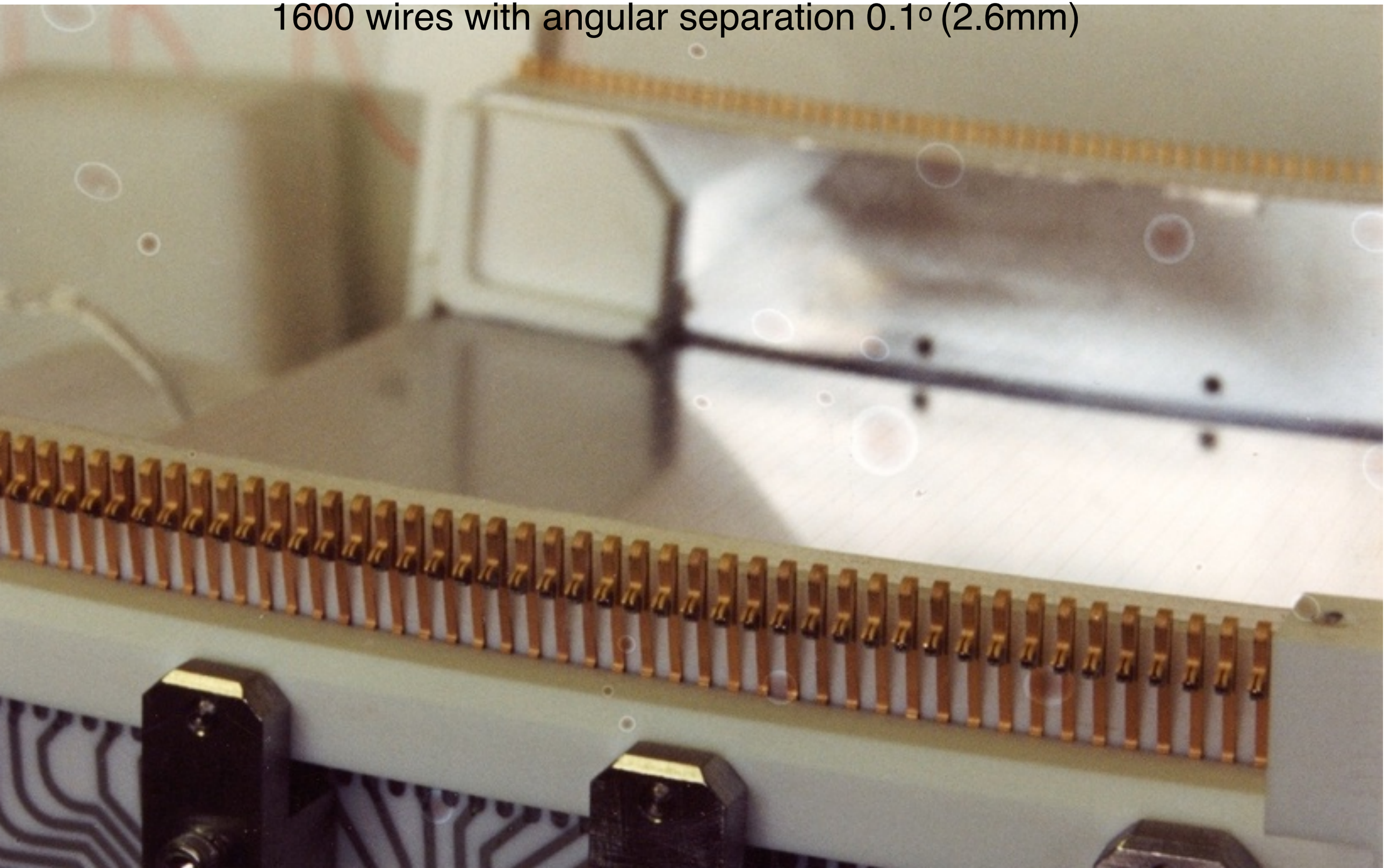
HRPT Detector

- ^{3}He (3.6 bar) + CF_4 (1.1 bar), effective detection length 3.5 cm, 15 cm hight
- Volume 100L, Voltage -6.7kV
- Efficiency 80% @ 1.5 Å
- 1600 wires with angular separation 0.1^o (2.6 mm), 1500 mm to sample

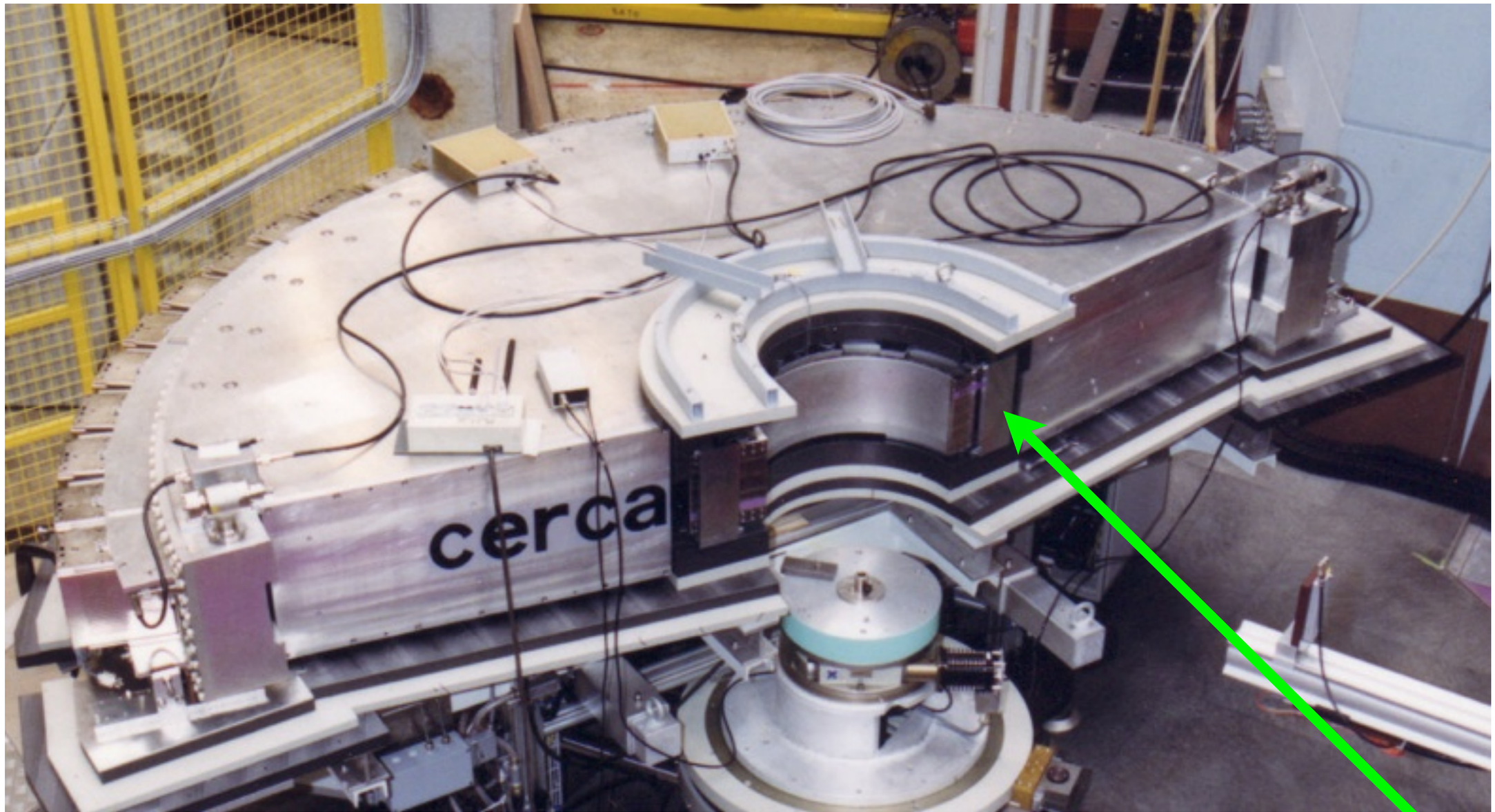


Detector chamber. 1600 wires

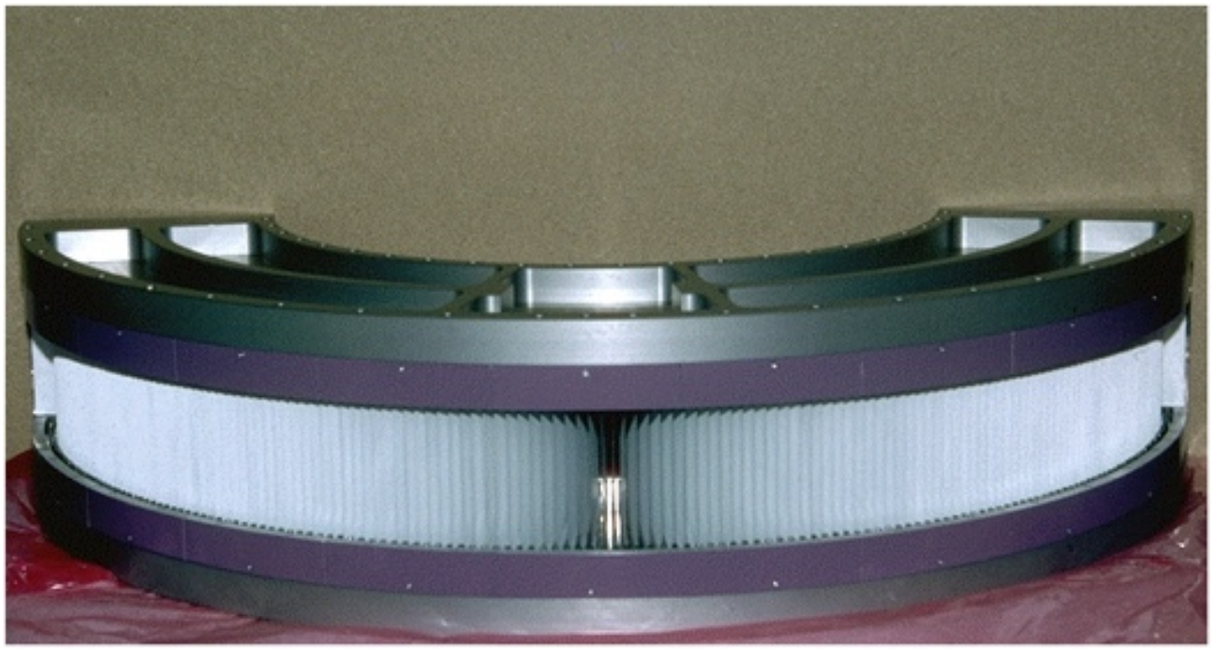
1600 wires with angular separation 0.1º (2.6mm)

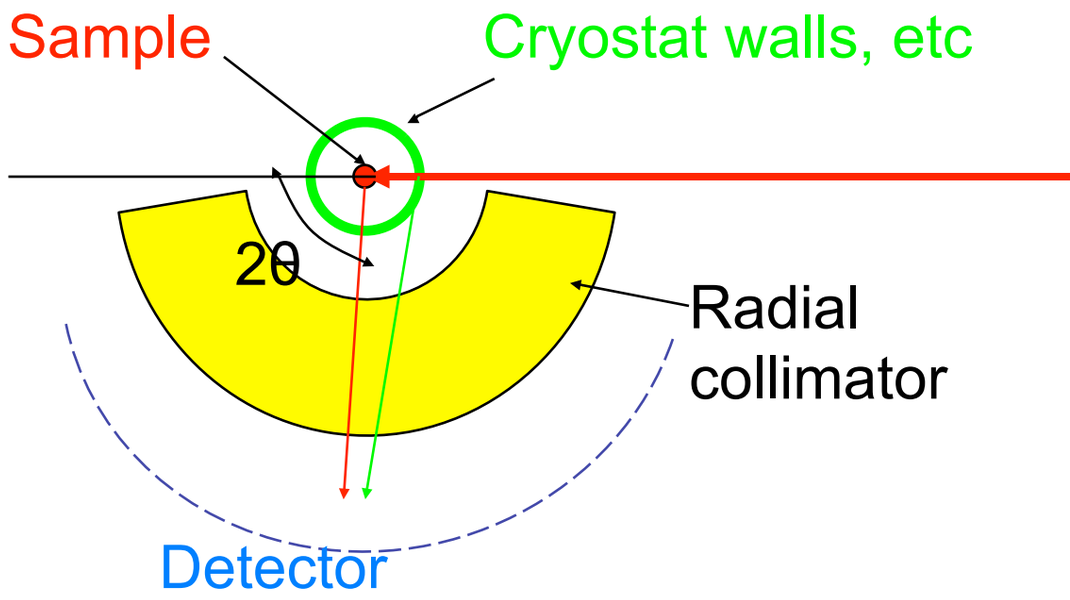


Oscillating radial collimator to avoid scattering from sample environment.



HRPT radial collimators

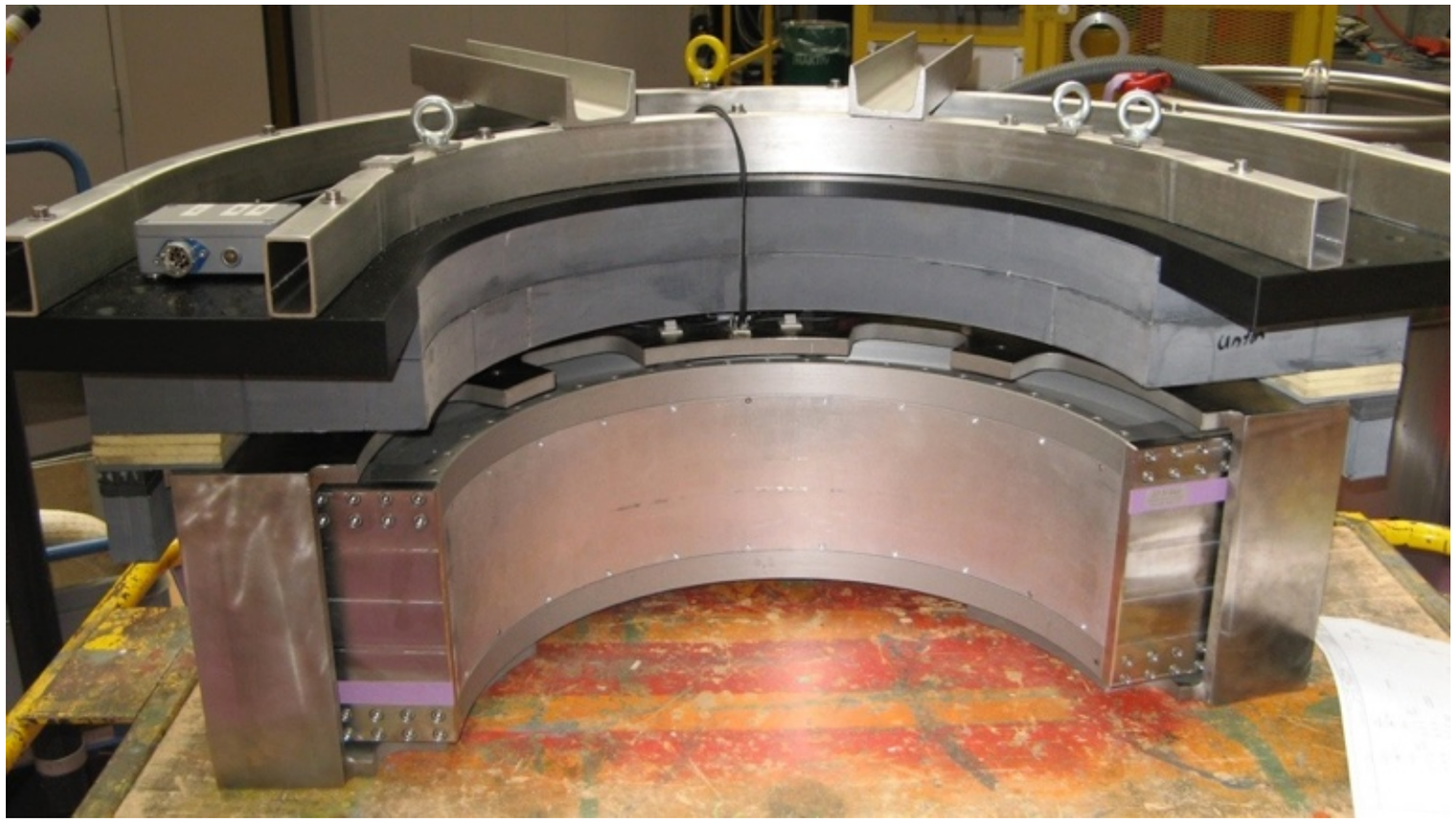




<0.03% for spurious Bragg peaks

Radial collimator with the shielding.

There are two radial collimators with 14mm and 28mm full width full maximum triangular transmission function.



Thank you