ETH Zürich

Laboratory for Neutron Scattering

Paul Scherrer Institut

SINQ – Instrumentation and Sample Environment

http://sinq.web.psi.ch

TRICS
Single crystal diffractometer
Thermal neutrons

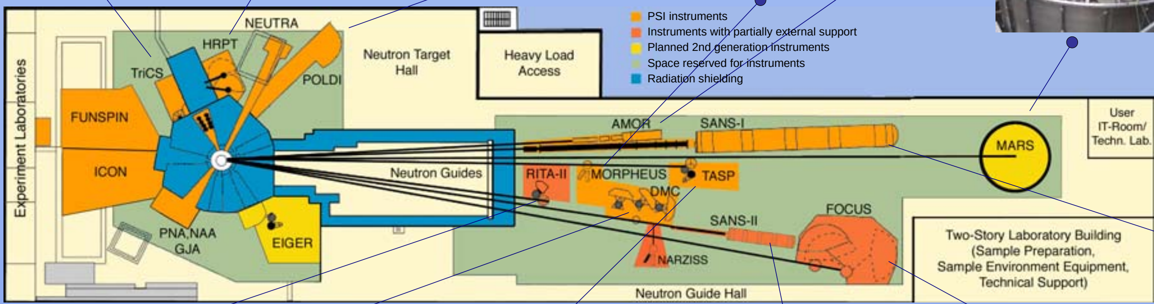
HRPT
Powder diffractometer
Thermal neutrons

POLDI
Residual stress diffractometer
Thermal neutrons

MORPHEUS
Two-axis diffractometer
Cold neutrons

AMOR
Reflectometer
Cold neutrons

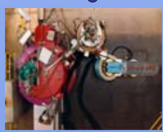
MARS
Time-of-flight
backscattering
spectrometer
(in commissioning)
Cold neutrons



SANS-I
40m SANS-facility
Cold neutrons

RITA-II (*)
Triple-axis spectrometer
Cold neutrons

DMC
Powder diffractometer
Cold neutrons



TASP
Triple-axis spectrometer
Cold polarized neutrons

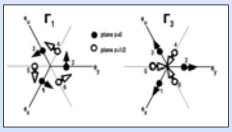
SANS-II (*)
12m SANS-facility
Cold neutrons

FOCUS (*)
Time-of-flight spectrometer
Cold neutrons

(*) RITA-II and SANS-II are operated in cooperation with *Risø National Laboratory, Denmark*, FOCUS in cooperation with the *Saarland University, Germany*.

Spherical polarization analysis with MuPAD (mu-metal polarization analysis device)

Magnetic structure determination $YMnO_3$



Neutron powder diffraction experiments (Bertaut, Munoz) showed that there are two possible magnetic structures Γ_1 and Γ_3 which explain the data equally good.

Aim: determination of the antiferromagnetic structure factors and hence the magnetisation distribution leading to magneto-electricity in this compound.

Method: Simulation of polarization matrices for given models Γ_1 and Γ_3.

$$P_{\Gamma_1} = \begin{pmatrix} \beta & 0 & 0 \\ \eta\xi & 1+\eta\xi & \eta\xi \\ 0 & 0 & \beta \end{pmatrix} \qquad P_{\Gamma_3} = \begin{pmatrix} \beta & 0 & \eta\xi \\ 0 & 1 & 0 \\ -\eta\xi & 0 & \beta \end{pmatrix}$$

$\beta = (1-\gamma^2)/(1+\gamma^2)$, $\xi = \gamma/(1+\gamma^2)$ and $\gamma = \|\vec{F}_{\perp\vec{Q}}\|/N_{\vec{Q}}$

$\vec{F}_{\perp\vec{Q}}$ magnetic interaction vector $N_{\vec{Q}}$ nuclear structure factor

η domain unbalancing factor for 180° domains.

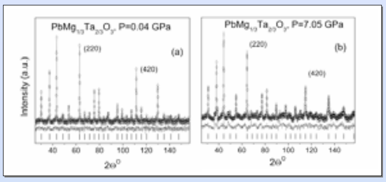
Measuring only a few Bragg peaks with MuPAD will resolve the magnetic structure of $YMnO_3$!

SNP setup on TASP:
The sample is contained in a Mu-Metal zero field chamber to guide the beam polarization through the whole instrument without guide fields. The polarization vector of the beam can be manipulated in 3D by high precision precession coils.

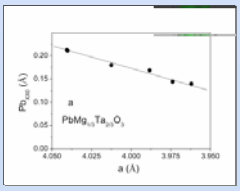
M. Janoschek , master thesis (2004).

Angle-dispersive high-pressure powder diffraction up to 10 GPa (100 kbar)

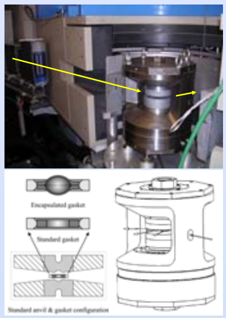
Atomic displacements in the relaxor ferroelectric $PbMg_{1/3}Ta_{2/3}O_3$



Diffraction patterns after 15h data acquisition
(λ = 1.494 Å)



Aim: identifying microscopic origin of relaxor behavior (also suppressed by pressure).
Requirements: hydrostatic conditions, large Q range, good instrumental resolution.



Room temperature experimental setup at HRPT: The sample (100 mm³) is contained in an encapsulating gasket between two opposed anvils (cBN). The press generates forces up to 130 tn. Extensions to sub-10 K in development for DMC/HRPT.

S.N.Gvasaliya et al., Phys. Rev B (accepted).

S.Klotz et al., Appl.Phys.Lett. 86 (2005).

Magnetic field - temperature - pressure: Sample environment at SINQ

Cryomagnets: H < 15 T

Cooling devices: 0.08 K < T < 300 K

Furnaces: 300 K < T < 1800 K

Pressure cells: P < 1.5 GPa