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PANDA: Cold three axes spectrometer

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Abstract: The cold three axes spectrometer PANDA, operated by JCNS, Forschungszentrum Jülich, offers high neutron flux over a large dynamic range keeping the instrumental background comparably low.

1 Introduction

PANDA is situated on the cold neutron beam-tube SR-2 in the Experimental Hall. The high flux is achieved by neutron guide elements in the beam tube, a short source-to-monochromator distance, and the double-focussing monochromator and analyzer crystals. Options for high energy and high q-resolution are available. With dedicated sample environments for strong magnetic fields and very low temperatures, PANDA is ideally suited for the studies of magnetism and superconductivity on single crystals. Lattice dynamics and magnetic structures are investigated successfully, too.

A polarised neutron set-up using both Heusler monochromator and analyzer as well as a sample-space Helmholtz-coil set for longitudinal polarisation analysis is available.

2 Typical Applications

Magnetic properties
- Spin-waves
- Crystal field excitations
- Excitations in low dimensional systems
- Magnetic vs nuclear scattering

Figure 1: Instrument PANDA (Copyright by W. Schürmann, TUM).

Lattice dynamics
- Phonon dispersion
- Field dependent phonons

General
- Critical scattering at phase transitions
- Magnon - phonon interaction
- Soft mode
- Central peak
- Diffraction with analyser:
  dE close to 0
  high E & Q resolution
  extremely low background

3 Sample Environment

The sample table of PANDA allows for a variety of sample environments, and may easily be adapted to user specific devices. Among other, PANDA disposes routinely operated sample environment for:

Low temperature:
- Closed cycle cryostat (3 K $<$ T $<$ 300 K)
- Variox cryostat (1.6 K $<$ T $<$ 100 K)
- ^{3}He insert (0.5 K $<$ T $<$ 300 K)
- Dilution insert (50 mK $<$ T $<$ 1 K)

Vertical magnetic field:
- Cryomagnet V5T
  H_{max} = 5 T (1.5 K $<$ T $<$ 100 K)
- Closed-cycle magnet V7.5T
  H_{max} = 7.5 T
  field at low and high temperatures available
  ^{3}He and dilution inserts available

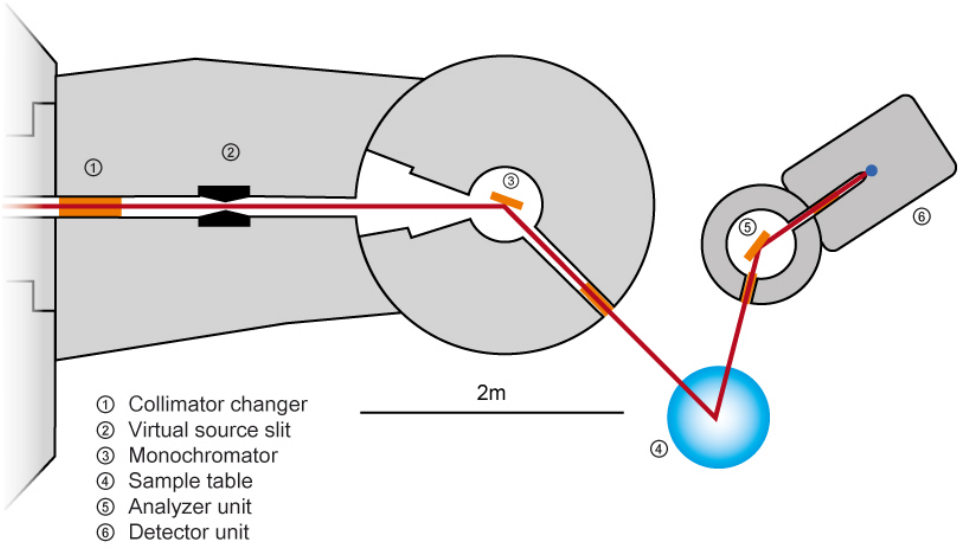

Figure 2: Schematic drawing of PANDA.

High temperature:

- High temperature furnace
  300 K < T < 2100 K
  sample space: Ø 50 mm, h = 50 mm

Typical dimensions for sample space:

- Ø 50 mm, h = 70 mm, for details contact instrument scientists

4 Technical Data

4.1 Monochromators

- PG(002) (d = 3.355 Å)
  $20° < 2\Theta_M < 132°$
  $1.05\ Å^{-1} < k_i < 4.0\ Å^{-1}$
  variable horizontal and vertical focussing
- Heusler (d = 3.35 Å, polarised neutrons)
  $20° < 2\Theta_M < 120°$
  $1.1\ Å^{-1} < k_i < 4.0\ Å^{-1}$
  variable vertical focussing

4.2 Analysers

- PG(002)
  $-130° < 2\Theta_A < 100°$
  $1.05\ Å^{-1} < k_f$
  variable horizontal focussing
- Heusler (polarised neutrons)
  $-130° < 2\Theta_A < 100°$
  $1.05\ Å^{-1} < k_f$
  variable horizontal focussing

4.3 Detectors

- 1" ^{3}He tube (focussing mode)
- 2" ^{3}He tube (collimated mode)

4.4 Flux at sample

PG monochromator vertically focussed, horizontal flat, no collimation:

- $1.9 \cdot 10^7$ n cm^{-2} s^{-1} for k_i = 1.55 Å^{-1} Be Filter
- $5.5 \cdot 10^7$ n cm^{-2} s^{-1} for k_i = 2.662 Å^{-1} PG Filter

4.5 Main parameters

- Scattering angle at the sample:
  $5° < 2\Theta_S < 125°$ (moveable beam-stop)
- Energy transfer
  up to 20 meV
- Momentum transfers
  up to Q = 6 Å^{-1} (depending on k_i)

4.6 Filters for higher order suppression:

- PG (l = 60 mm); k_f = 2.57 Å^{-1} or 2.662 Å^{-1}
- Be (closed-cycle cryostat, $T \leq 45$ K); k_f = 1.55 Å^{-1}
- BeO (liq.-N_2 cooled); k_f = 1.33 Å^{-1}