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C5 Polarized Beam Triple-Axis Spectrometer

The DUALSPEC facility was jointly funded by NSERC and AECL, and was transferred to NRC in 1997. It comprises the two spectrometers C2 and C5. The C5 spectrometer is a polarized beam triple-axis spectrometer which can operate also as a diffractometer and neutron reflectometer. In addition, conventional non-polarized neutron experiments can be carried out on this instrument.

Typical Experiments

- Polarized beam triple-axis neutron spectroscopy
- Neutron reflectometry from surfaces and thin films
- Double-axis neutron diffraction

Ancillary Equipment Specifically Available to C5 in the Polarized neutron setup

- Monochromator and analyzer: single-crystals of Cu₂MnAl Heusler alloy
- Neutron spin flippers: Mezei-type spin rotators in the incident and scattered beams
- Guide fields: Horizontal or vertical using permanent magnets (maximum field ~ 200 gauss) or superconducting magnet cryostats, M2 and M4. In order to avoid beam depolarization M2 and M4 must operate in asymmetric mode, leading to lower maximum fields of 2.7 T (horizontal) and 6.5 T (vertical).
- Choice of neutron filters: Higher order rejection, and hence the filters, are very important for polarized neutron experiments. The following filters are available on C5.
 - Pyrolytic graphite: works most efficiently at 2.37 Å (equivalent to 3.52 THz neutron energy) and also at 1.55 Å (8.23 THz)
 - Cooled Be filter: works for wavelength >4 Å (equivalent to < 1.2 THz neutron energy)
 - Cooled Sapphire: works for wavelength <0.8 Å (equivalent to >30 THz neutron energy)

Typical figures of merit (at 2.37 Å):

- flipping ratio = 24:1
- Heusler polarization efficiency = 96.5 percent
- Flipper efficiency ~ 99.5 percent

Ancillary Equipment Specifically Available to C5 in the Neutron Reflectometry setup

- Adjustable slit system to define the direction of incident and scattered beam
- Most experiments carried out at neutron wavelength 2.37Å , to a dynamic range of >=6 orders of magnitude
- Optimum sample size = 50 x 50 mm
- Smallest sample size that has provided data of sufficient quality for least-squares analysis = 10 × 10 mm (a magnetic multilayer of thickness 35 Å/period x 12 periods)

Technical Specifications

Beam Size at sample position: 1.5" wide, 3" high (maximum)

Available monochromators and analyzers:

- Vertically focussing monochromators, graphite (002), and Si (111).
- Heusler monochromator and analyzer for polarized neutrons (flipping ratio 20-40 depending on wavelength), with Mezei flippers.
- Be, Cu, Ge, graphite, Si available (these monochromating and analyzing crystals are shared among the spectrometers, several crystals of each type are available).

Filters:

- Liquid N2 cooled sapphire or Be before the monochromator
- Pyrolytic graphite in monochromatic beams
- Neutron velocity selector as a tunable, higher-order rejection filter in range 4 Å (1.2 THz) to 2.37 Å (3.52 THz)

Monochromator take-off Angle: Continuously variable, 20 – 115° controlled to 0.001°

Specimen scattering angle: Continuously variable from 0 – 115° controlled to 0.001°

Collimators:

- Source to monochromator collimations are selectable:
 - Fine: ~ 0.2°
 - Coarse: ~ 0.4°
 - None: ~ 0.6° (effective)
- Monochromator to sample, interchangeable, fixed soller collimators are available: 0.2, 0.4, 0.5, 0.6 and 0.8°.
- Sample to analyzer, interchangeable, fixed soller collimators are available: 0.2, 0.4, 0.5, 0.6 and 0.8°.

Detector:

- Cylindrical He3, 1.5" diameter, 5" high.

Physical dimensions:

- source to monochromator, 260"
- monochromator to specimen, adjustable from 70.25" to 85"
- specimen to analyzer, adjustable from 40-56"
- analyzer to detector, 10.5"



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CINS is a not-for-profit, voluntary organization that represents the Canadian scientific community of neutron beam users and promotes scientific research using neutron beams.