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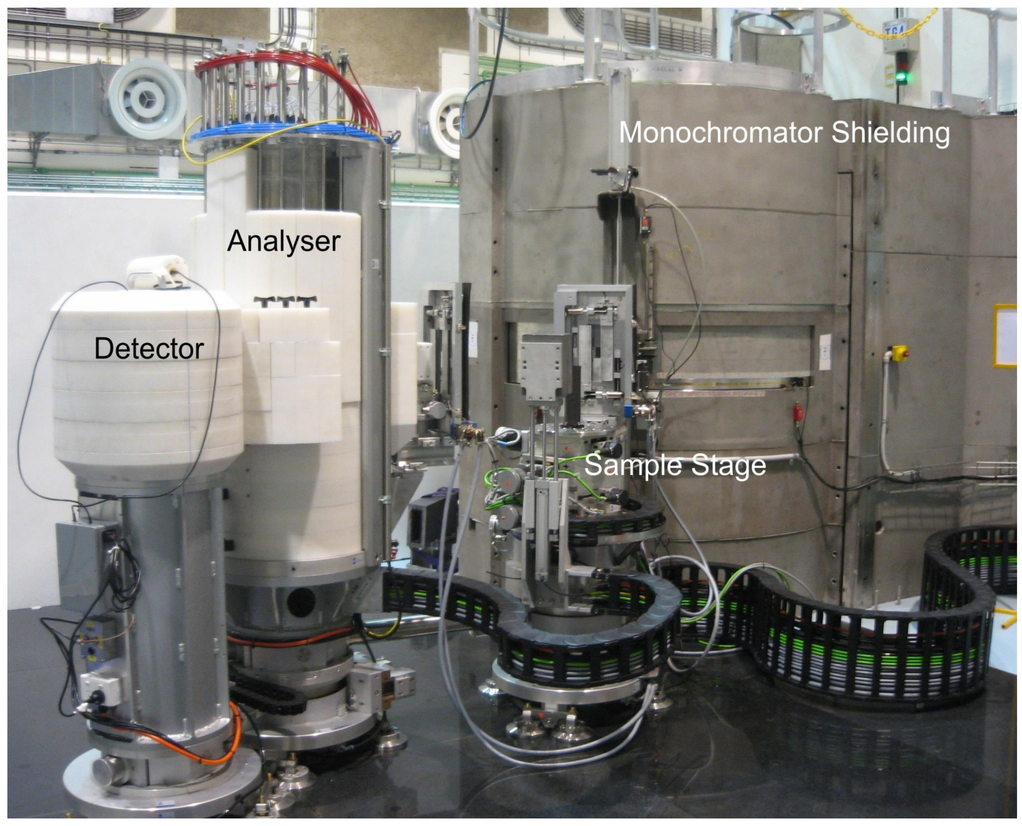
Australian Centre for Neutron Scattering (ACNS)

Taipan

Thermal Triple-Axis and Filter Spectrometers

Taipan is used to study the collective motion of atoms, phonons and magnons in materials, and phase transitions and processes involving thermal energy. When the filter spectrometer is used instead of the triple-axis spectrometer vibrational density of states may be directly measured.



Inelastic scattering

Neutrons penetrating a sample lose or gain energy during scattering which provides information on interatomic forces and movement of atoms in the sample.

What makes Taipan special?

Triple-axis spectrometer:

- Measures how much energy has been lost or gained by neutrons in the scattering process, providing information on the energy spectrum of the solid sample and hence vibrational dynamics
- Analyse the energy of the scattered neutrons allowing purely elastic scattering to be measured with very low background signal.

Filter spectrometer:

- Integrates scatter over a larger solid angle over a fixed energy window. The spectrometer is ideal for measuring molecular vibrations in powders that involve hydrogen. A weighted vibrational density of states is obtained.

Applications

- How materials change structure (phase transitions, eg. from liquid to solid)
- Other thermodynamic properties of solids (eg. specific magnetic susceptibility)

Taipan is highly configurable and versatile, and has the most intense thermal beams at ANSTO, together with the lowest background levels.

SPECIFICATIONS

Taipan is located on the thermal neutron guide TG4 in reactor beam hall

Beam size:
50 x 180 mm high at the reactor face

Angular angles:

- $16° < 2\theta_m < 85°$
- $-145° < 2\theta_s < 115°$
- $-110° < 2\theta_A < 110°$

Monochromators:

- Pyrolytic Graphite (002) with Energy Range: ~ 5 – 70 meV
- Copper (200) with Energy Range: ~ 14 – 160 meV
- 200 x 200 mm^2 in 9 x 11 segments (W x H) with continuous horizontal and vertical focussing

Sample area:

- Beam size at monochromator shielding exit 50 x 130 mm (w x h)
- Flux at sample position ~ 2 x 10^8 $ncm^{-2}s^{-1}$ at 50 meV

Analyser:

- Pyrolytic Graphite (002) 24' mosaic
- 160 x 140 mm in 5 x 7 segments (W x H) with continuous horizontal and vertical focusing

Polarisation analysis:

- Provided by 3He spin filters before and after the sample.

Soller collimators:

- Pre-monochromator collimators: 15', 30', Open; 90 x 185 mm^2 (w x h)
- Post-monochromator, pre-analyser and pre-detector, collimators: 20', 40', Open; 50 x 130 mm^2 (w x h)

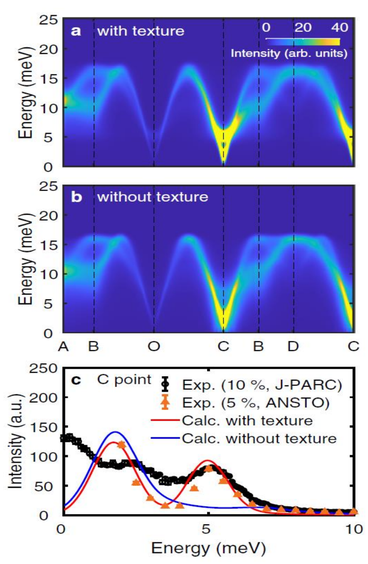
Detector:

- 3He detector, Ø25 mm x 100 mm, p=10 bars
- or Ø50 mm x 100 mm, p=5 bars

CASE STUDIES

Spin texture in frustrated h-$Y(Mn,Al)O_3$

We demonstrate how non-magnetic impurities can produce extended spin structures in h-$YMnO_3$, a triangular antiferromagnet with noncollinear magnetic order. The impurity partially relieves the geometric frustration allowing stable, extended spin textures to be induced in frustrated spin topologies. The key to observing the impact of non-magnetic impurities in frustrated magnets is to measure the magnetic dynamics via inelastic neutron scattering. This figure reveals the role of spin textures in the spin dynamics of h-$YMn_{1-x}Al_xO_3$.

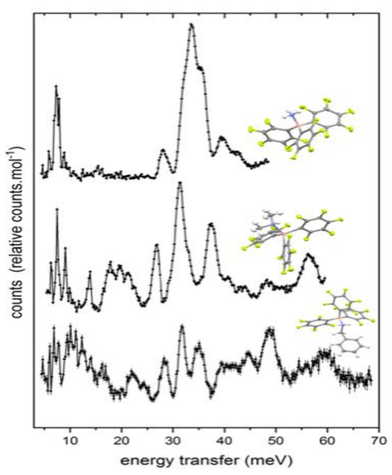


Park *et. al.*, Nat. Comms. **12,** 2306 (2021)

The mechanics of aminoboranes

Aminoboranes are used as a basis in many chemical synthetic processes. They are also interesting to study in terms of hydrogen bond accepting groups.

- Nice examples of relatively isolated rotors & associated groups.
- The strong Me group rotor at ~33 meV shows very little temperature dependence (a very slight softening as T rises).
- The dimethyl has strong additional rotor features - Me coupling?
- The benzyl has a far more complicated spectrum with intensity distributed across many modes as the larger amino-chain moves.



Stride and Stampfl: 2018

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