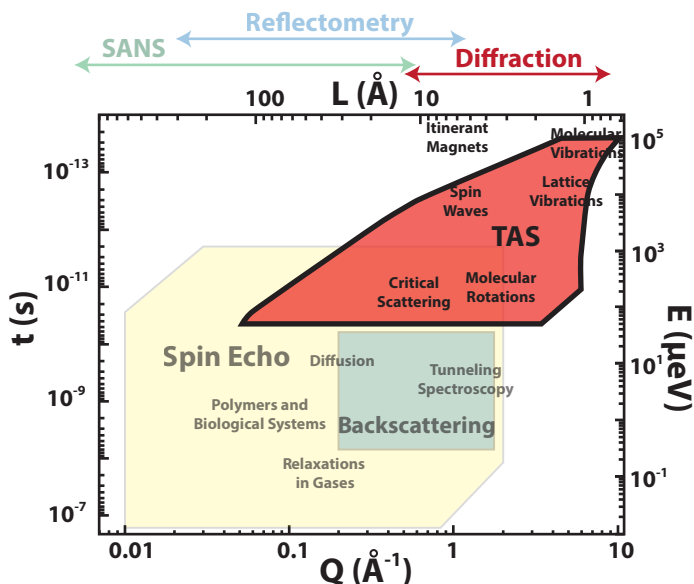
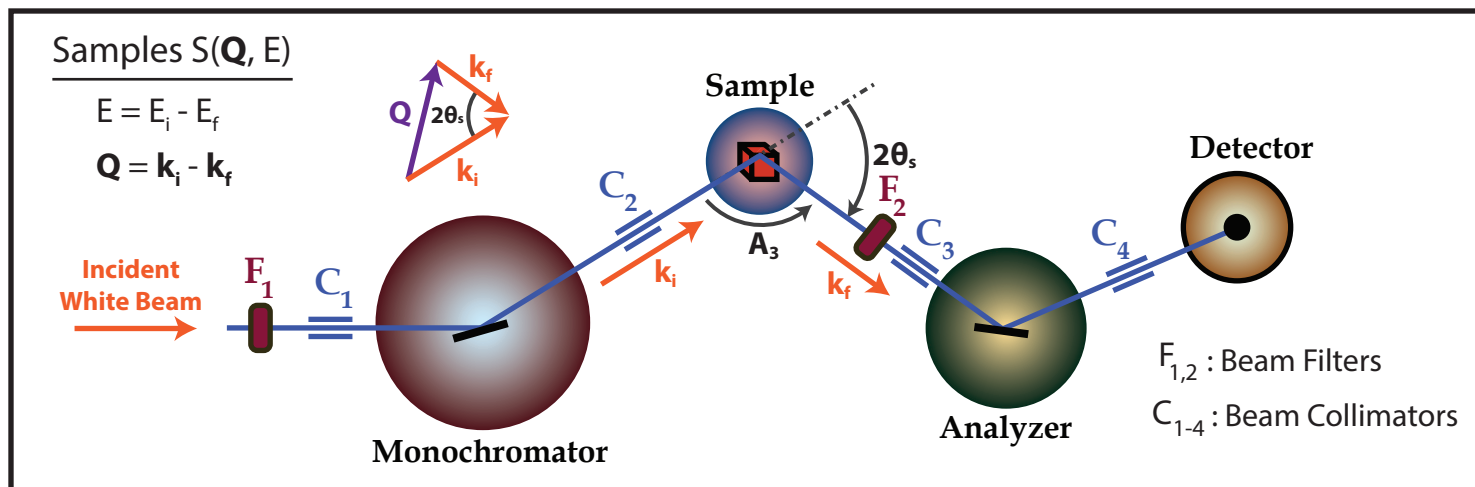




Triple-Axis Spectrometer

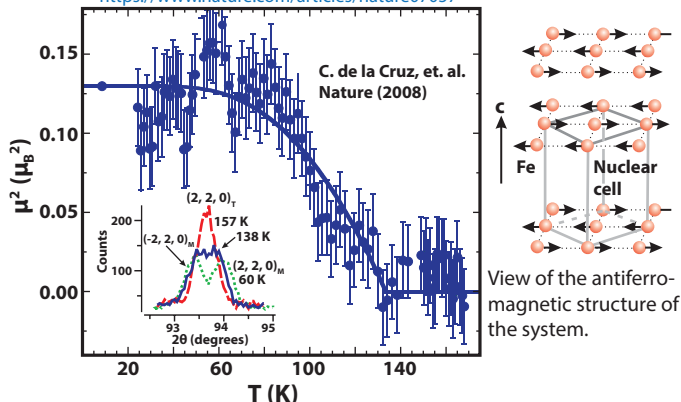


Operating Principles

- 1) The crystal monochromator and analyzer reflect neutrons with incident energy (E_i) and final energy (E_f).
Elastic measurements ($E_i = E_f$): Resolves structure
Inelastic measurements ($E_i \neq E_f$): Resolves excitations
- 2) E_f typically fixed for an experiment, changing E_i selects the desired excitation energy: $E = E_i - E_f$
- 3) Rotation of the $2\theta_s$ angle selects the desired $|Q|$:
 $Q = k_i - k_f \longrightarrow |Q|^2 = |k_i|^2 + |k_f|^2 - 2|k_i||k_f|\cos(2\theta_s)$
- 4) Rotation of the sample table, A_3 , (single crystals) selects the desired reciprocal lattice coordinates: $[H, K, L] = Q$

Example: Order Parameter Measurement

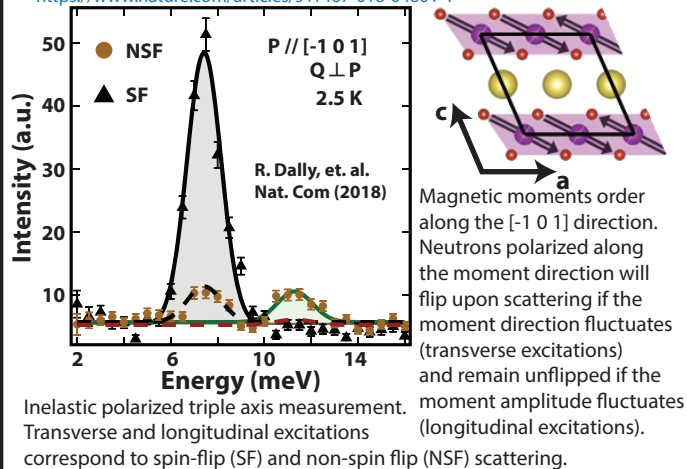
<https://www.nature.com/articles/nature07057>



Elastic triple axis measurement of magnet moments forming a stripe antiferromagnetic order in the Fe-based superconductor $\text{LaO}_{1-x}\text{F}_x\text{FeAs}$.

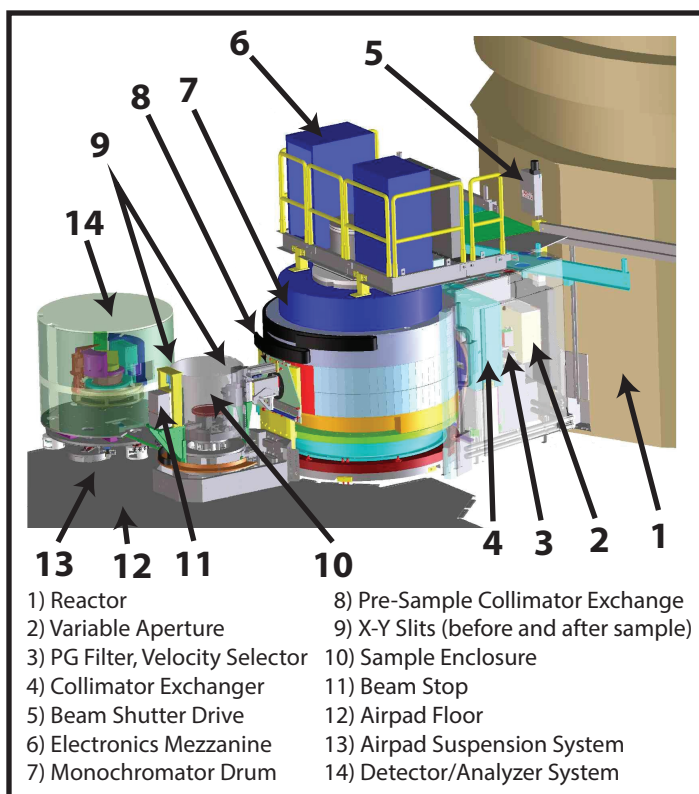
Example: Moment Amplitude Fluctuations

<https://www.nature.com/articles/s41467-018-04601-1>





BT-7 Triple Axis

Instrument Paper: <http://dx.doi.org/10.6028/jres.117.002>
<https://www.nist.gov/ncnr/bt-7-double-focusing-triple-axis-spectrometer>


Cryostats

System	Range
Dilution Fridge	50mK - 30K
He3 Dipper	300mK - 40K
ILL Orange Cryostat	1.5K - 300K
Closed Cycle Fridge (CCR)	2.5K - 700K
Cryofurnace	300K - 1900K

Magnetic field

(Split Coil, Vertical field)

System	Restrictions
0 - 7T Magnet	50mK - 700K
0 - 10T Magnet	50mK - 700K
0 - 12T Magnet	50mK - 300K
0 - 15T Magnet	50mK - 30K

Electric field

System	Restrictions
±[0.1, 5]kV Power Supply	1.5K - 600K and 0T - 10T
- Current Limiting Switch	
- 5 mA max current	

Pressure

System	Restrictions
Ambient - 2.5GPa	1.5K - 300K (No Field)
Ambient - 0.6 GPa	4K - 300K and 0 - 7T

Monochromator

- **20 x 20 cm² area:** comprised of 100 - 2 x 2 cm² squares
- **Double focusing capability:** $5 < E_i < 500$
- **Two crystal options (30' mosaic):**
 - PG(002/004) ($d_{002} = 3.354\text{\AA}$, $d_{004} = 1.677\text{\AA}$)
 - Cu(220) ($d_{220} = 1.273\text{\AA}$)

Sample Stage

- **Beam Size:** 1.5 x 5cm (Horiz. Focused)
- **Sample Translation:** ±1.5cm (X, Y), -7.5 to 2.5cm (Z)
- **Sample Tilt:** ±20° (Sample environment dependent)
- **Scattering Angle:** $0^\circ < 2\theta_s < 120^\circ$

Analyzer

- **PG (30' mosaic) assembly:** 13 blades, each 2 x 15 cm
- **Analysis Modes:**
 - Single Det. : Flat, Horizontally focused
 - PSD: Flat, Seethrough, Fixed E_f

Detector

- Single Detector
- 48 wire Position Sensitive Detector
- Diffraction Detectors:
 - 11 fixed behind analyzer
 - Optional before analyzer (2-axis mode)

Collimation

- **Source to Mono:** Soller: 10', 25', 50', Open
- **Mono to Sample:** Soller: 10', 25', 50', 80', Open
- **Sample to Analyzer:** Soller: 10', 25', 50', 80', Open
Radial: 40', 80'
- **Analyzer to Detector:** Soller: 25', 50', 120', Open
Radial: 80'

Filtration

- **Upstream:**
 - PG Filter
 - Velocity Selector: $11.5 < E_i < 60\text{ meV}$ or $E_i \approx 5\text{ meV}$
- **Downstream:**
 - PG Filter
 - Cold Be Filter: $E_f < 5\text{ meV}$

Polarization

- ³He polarizers before and after sample
- Pol. Modes: **P//Q**, **P⊥Q**

Fluxes

Configuration	n/cm ² /s
- PG(002) Monochromator	
40meV, Open - 80' (no filter)	1.4×10^8
40meV, Double Focused	1.8×10^8
14.7meV, Open - 80' (PG filter)	3.4×10^7
- Cu(220) Monochromator	
100meV, Open - 50' (no filter)	2.0×10^7
50meV, Double Focused	6.1×10^7