# Experimental report

14/09/2025

**Proposal:** 5-54-376 **Council:** 4/2021

**Title:** Examining the Magnetic Spin Asymmetry arising from Skyrmion Single Crystals

**Research area:** Physics

**This proposal is a new proposal**


**Main proposer:** Grace CAUSER

**Experimental team:** Grace CAUSER

**Local contacts:** Thomas SAERBECK


**Samples:** MnSi

| Instrument | Requested days | Allocated days | From | To |
|---|---|---|---|---|
| D17 | 8 | 4 | 07/10/2021 | 11/10/2021 |


## Abstract:

The aim of the proposed work is to build a catalogue of experimental PNR data which charts the distinct magnetic phases exhibited by B20 MnSi, including the helical, conical, skyrmion and field polarised phases to elucidate the key features of (and any differences between) the resulting scattering patterns. Interestingly, through our work we have found that when observed "through the lens" of a PNR apparatus (which averages the in-plane component of magnetisation at each depth beneath the film surface), a skyrmion texture exhibits an equivalent scattering pattern to that of a trivial conical twist. This is a major technical detail which has been overlooked by several groups, and could suggest that previous conclusions of experimental PNR data are likely erroneous. Clarification of this question by means for further PNR investigations is now urgently required, and will have major implications for the entire field of skyrmion related research.

**Experimental Report: Examining the magnetic spin asymmetry arising from skyrmion single crystals**

**Proposal Number: 5-54-376**

**Main Proposer: Grace Causer**

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**Instrument Setup:**

D17, cryostat (2-50 K) and magnet (+/- 1 T).

**Aim:**

The aim of the proposed work was to build a catalogue of experimental PNR data to chart the distinct magnetic phases exhibited by B20 MnSi, including the helical, conical, skyrmion and field polarised phases to elucidate the key features of (and any differences between) the resulting scattering patterns.

Interestingly, through our work we have found that when observed "through the lens" of a PNR apparatus (which averages the in-plane component of magnetisation at each depth beneath the film surface), a skyrmion texture exhibits an equivalent scattering pattern to that of a trivial conical twist.

**Measurements Performed:**

Measurements were performed on a large 15 x 15 mm2 MnSi single crystal. The crystal was cut along the <110> axis, such that the orthogonal <110> and <100> axes span the in-plane directions, allowing to investigate the neutron polarisation parallel and perpendicular to the <111> easy axis.

PNR measurements were performed within each of the magnetic phases (i.e. field polarised, helical, conical, and skyrmion) of single crystal MnSi. Data were collected with spin analysis (i.e. measuring the R++, R— and R+- spin states) to discriminate between Néel and Bloch-type twisting in the magnetic helices.

Data were obtained following different field histories (i.e. zerofield cooling, high field cooling) and for neutron polarisation parallel and perpendicular to the <111> easy axis domain populations.

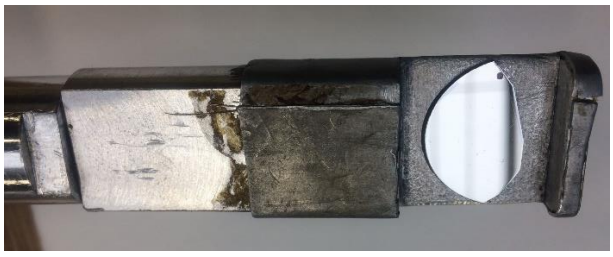

**Figure 1:** Photograph of the polished MnSi single crystal mounted prior to PNR measurements. The optical reflection of linear lines from the sample surface indicates the surface of the sample has a low roughness required for reflectometry measurements.

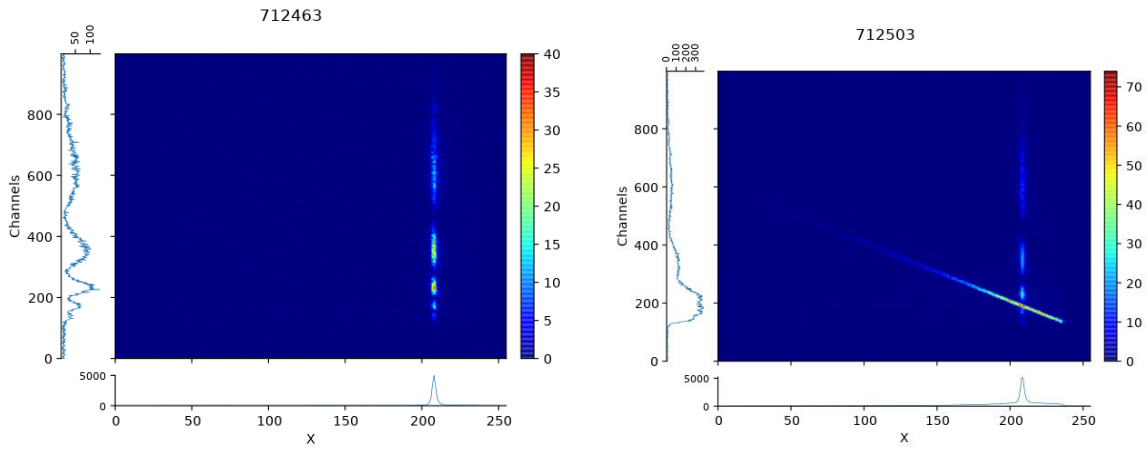


**Figure 2:** Scattering patterns measured in the (a) conical phase and the (b) skyrmion phase of single crystal MnSi. The appearance of off-specular scattering in the skyrmion phase is due to correlations along the x-direction, which are not present in the conical phase.