ESRF	**Experiment title:** **On the nature of the magnetoelectric effect in the Kagome staircase compound Ni3V2O8**	**Experiment number**: HE 2767
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Report:

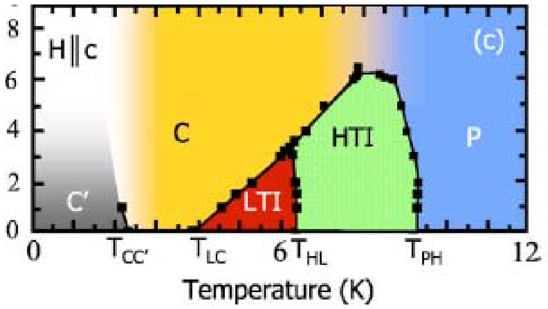
The Kagome staircase compound $Ni_3V_2O_8$ is a multiferroic magnetoelectric material that has been the subject of much recent research effort, because of the complex sequence of several magnetic transitions upon decreasing temperature, and the appearance of ferroelectricity in one of the magnetic phases. The multitude of magnetic interactions and the geometrical frustration give rise to the phase diagram depicted in figure 1. In particular, in the so-called Low Temperature Incommensurate phase (LTI), the spin structure changes to a spin spiral that breaks the spatial symmetry with the onset of a ferroelectric order [1].

In this experiment, a further study of the magnetic structure had been planned, using the capabilities of X-Ray magnetic diffraction (element and shell specificity) to get an insight of the different magnetic configurations.

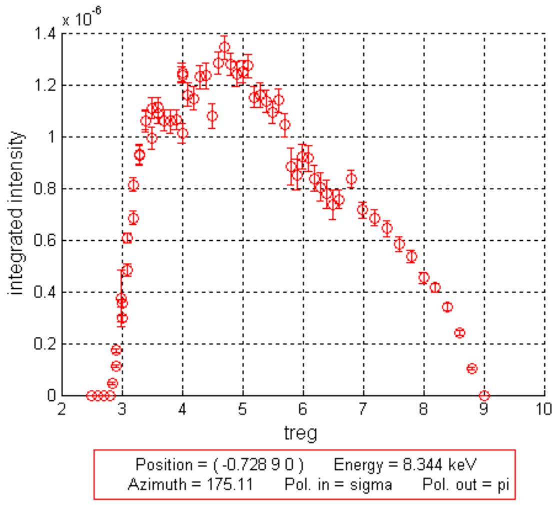
The magnetic peak (-1+q 9 0) has been aligned in the incommensurate phases, as well as the peak (1 9 0) for the commensurate ones. The setup that we used consisted in a He flux cryostat, mounted on the 4-circle diffractmeter. A detailed analysis of the various phase transitions was our first aim. Due to the articulated succession of transitions that characterises the phase diagram, a precise temperature control is important in achieving such objective. The main technical difficulty that we faced consisted in the loss of control in the temperature of the cryostat, that occurred several times during the experiment. Also, an issue to be overcome regarded a calibration of the difference between the temperature measured by the sensor and the one on the surface of the sample, which turned out to be considerably higher, due to beam heating effects.

We measured the complete temperature dependence, shown in figure 2, where all four phase transitions are clearly visible, namely the paramagnetic, two incommensurate and the commensurate phase. Towards the end of the experiment, we measured a set of Stokes scans (rotation of the polarisation analyser around the axis of the diffracted beam), in order to gain information about the geometrical arrangement of the spins. This was repeated at non resonant and quadrupolar resonant energy for the HTI phase, and at non resonant energy for the LTI phase. All these measurements are compatible with the spin structure reported from neutron data. A more detailed analysis is ongoing.

In summary, the application of X-ray diffraction to $Ni_3V_2O_8$ will provide important information to obtain a full understanding of the magnetic structure. From the technical point of view, a different choice of the cryogenic setup (e. g. the Orange cryostat or the cryomagnet available at ID20) is probably indicated for such measurements. Future work may build on the basis of this experiment to complete the study of the helical magnetic phase at resonant regime.



Figur 1 : H-T phase diagram of Ni3V2O8



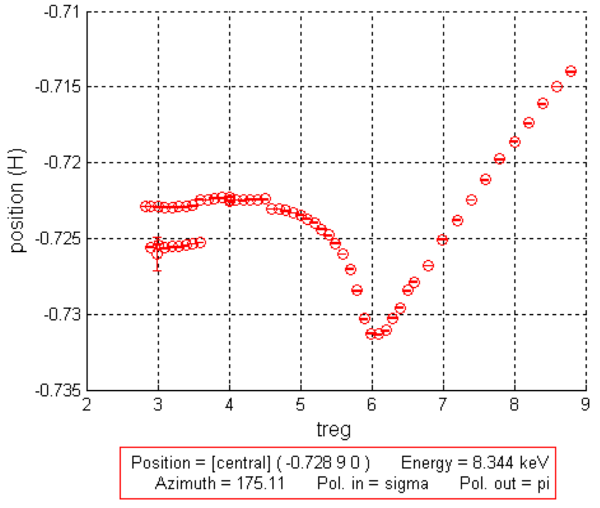


Figure 2 : temperature dependence of the magnetic peak (1-q 9 0): integrated area (left) and position (right) of the scans along the H direction of the reciprocal lattice. All the phase transitions are visible, and in particular, the HTI/LTI phase transition at 6 K (change of slope).

[1] M. Kenzelmann et al., Phys. Rev. B 74, 014429 (2006).