Experimental report

18/06/2020

Proposal: **4-05-712** **Council:** 4/2018

Title: Field induced pinch points in the quantum spin liquid Ca10Cr7O28

Research area: Physics

This proposal is a new proposal

Main proposer: **Bella LAKE**

Experimental team: Bella LAKE

Local contacts: Martin BOEHM
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Samples: Ca10Cr7O28

Instrument	Requested days	Allocated days	From	To
IN5	8	6	24/07/2019	30/07/2019
THALES	0	0		

Abstract:

Ca10Cr7O28 is a quantum spin liquid – characterised by the absence of static magnetic order where the spins are in coherent dynamical motion in the ground state. This state originates from the frustrated breathing kagome bilayer lattice of spin-1/2 Cr5+ ions which hosts competing interactions. The excitations are broad and diffuse reminiscent of spinons, however in a magnetic field they sharpen into spin-waves modes. Three pairs of gapped modes exist, the lowest energy pair condenses into the ground state at low field and is responsible for the spiral spin liquid behaviour. Theory predicts that the other modes host unusual dynamical spin liquids which would give a kagome spin liquid characterised by a pinch-point pattern if they were to become gapless e.g. by tuning the interactions. The aim of this proposal is to test these ideas by measuring the gapped and dispersionless pinch point modes predicted at high fields.

Title: Field induced pinch points in the quantum spin liquid $Ca_{10}Cr_7O_{28}$**.**
Proposal number 4-05-712
IN5 Spectrometer of ILL.
24.07.2019 until 29.07.2019.

Introduction:

$Ca_{10}Cr_7O_{28}$ is a quantum spin liquid – characterized by the absence of static magnetic order where the spins are in coherent dynamical motion in the ground state. This state originates from the frustrated breathing kagome bilayer lattice of spin-1/2 Cr^{5+} ions which hosts competing interactions. The excitations are broad and diffuse reminiscent of spinons, however in a magnetic field they sharpen into spin-waves modes. Three pairs of gapped modes exist, the lowest energy pair condenses into the ground state at low field and is responsible for the spiral spin liquid behaviour. Theory predicts that the other modes also host unusual dynamics. The aim of this proposal is to test these ideas by measuring the gapped modes predicted at high fields.

Experimental setup:

We used the IN5 spectrometer at ILL and the 10T vertical magnet along with a dilution fridge. The incident neutron wavelength was 5.25 Å, the sample was oriented with the kagome bilayer plane horizontal. The sample was rotated about the vertical c-axis in steps in 1 or 2 degrees, counting for 10-15 minutes a point. Measurements took place at a temperature of 0.04K and with applied magnetic field of 10T, 1T and 0T. The data was recombined into .sqw files using using the Horace software

Results:

We successfully observed the excitations and followed how they developed with field (see figure)

Conclusion

This 6-day experiment was successful and the data analysis is ongoing. The results are currently being compared to theoretical models.

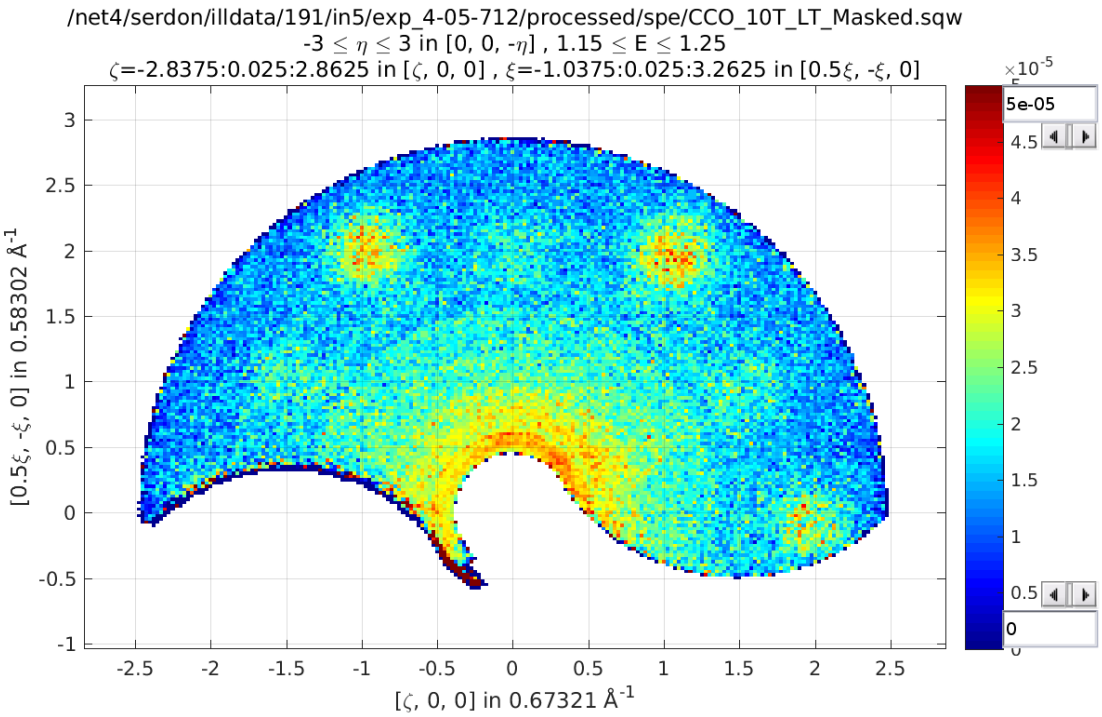

Figure 1: Inelastic Neutron scattering as a function of wavevector in the kagome bilayer plane.