Experimental report

06/12/2016

Proposal: DIR-148 **Council:** 4/2016

Title: Spinon Fermi surface in a triangular lattice quantum spin liquidYbMgGaO4

Research area:

This proposal is a continuation of 4-05-648

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Samples: YbMgGaO4

Instrument	Requested days	Allocated days	From	To
THALES	2	2	29/08/2016	01/09/2016

Abstract:

Experimental Report of DIR-148

Spinon Fermi surface in a triangular lattice quantum spin liquid $YbMgGaO_4$

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A conclusive experimental confirmation of a quantum spin liquid (QSL) remains an outstanding issue in condensed matter physics in spite of a variety of theoretical predictions [1]. Our recent neutron scattering experiment on a QSL candidate $YbMgGaO_4$ have revealed clear spinon excitation at zero temperature limit (70 mK), which is a hallmark of a QSL state (see experiment report for proposal 4-05-648) [2]. However, high temperature data is needed to clarify the characteristic of the spinon excitation.

In this experiment, we co-aligned three pieces of $YbMgGaO_4$ single crystals with total mass of 5 grams in *ab* plane with mosaic of around 1 degree. Flatcone was used to cover a wide range of the reciprocal space. We measured the spin excitations at high temperature (20 K) which is above the QSL regime. Clear but much weaker signal is revealed from the lowest measured energy to the band boundary (Fig. 1). The broadened and weakened excitation is consistent with paramagnetic excitation in which spectral weight becomes more diffusive due to the loss of quantum coherence caused by increasing thermal superposition of excited states. Such results give further support for our findings of spinon excitations in QSL candidate $YbMgGaO_4$.

The data has been published on Nature (doi:10.1038/nature20614) [2].

1. L. Balents, *Nature* **464**, 199–208 (2010).
2. Yao Shen *et al.*, *Nature*, doi:10.1038/nature20614 (2016).

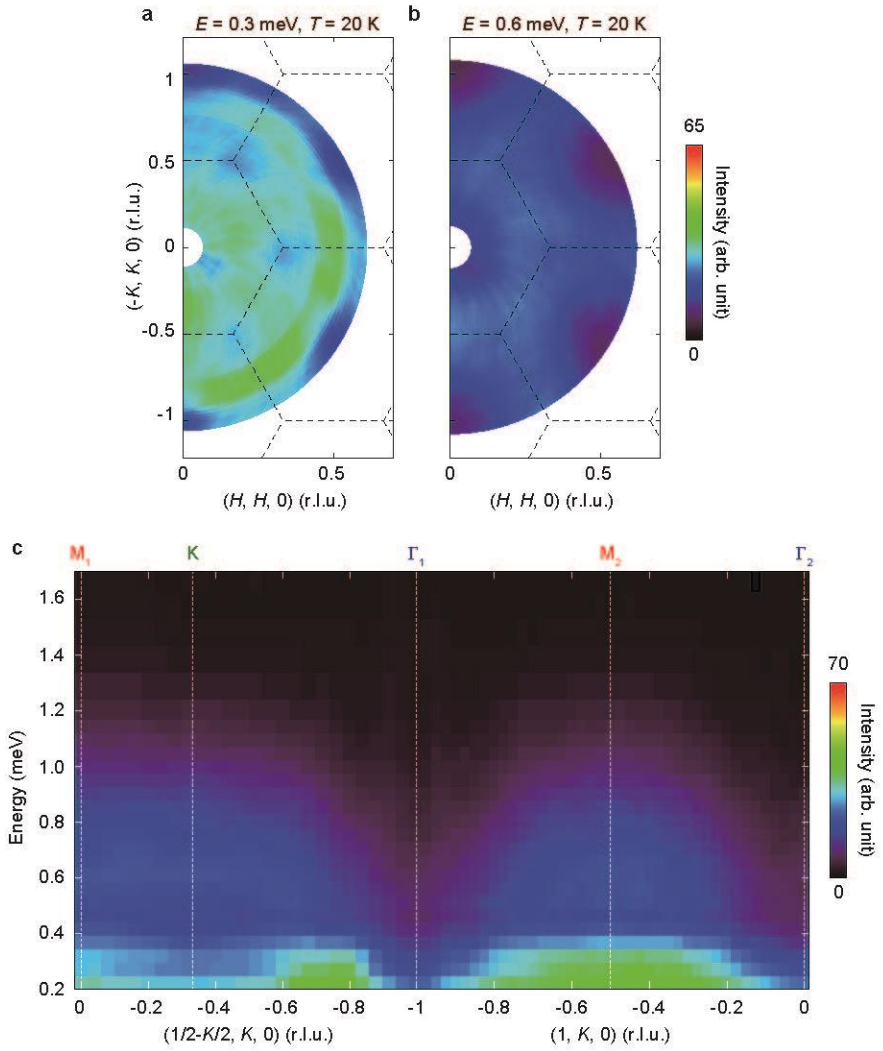

Figure 1 a, b, Constant-energy images at 0.3 meV (a) and 0.6 meV (b) at 20 K. **c,** Intensity contour plot of the spin excitation spectrum along the high-symmetry momentum directions at 20 K.