Experimental report

07/09/2022

Proposal: **4-01-1684**

Council: 4/2020

Title: Magnon spectrum in a candidate topological semi-metal with magnetic order

Research area: Physics

This proposal is a new proposal

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Samples: YbMnSb2

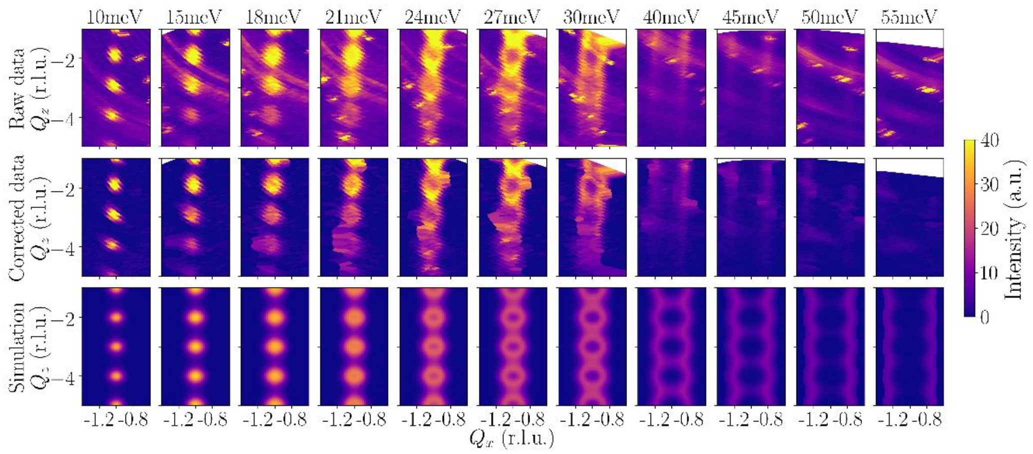
Instrument	Requested days	Allocated days	From	To
IN8 Flatcone	8	8	08/02/2021	17/02/2021

Abstract:

We propose to investigate the magnon spectrum in the antiferromagnetic phase of YbMnSb2. This material has recently been identified as a candidate topological semi-metal driven by time-reversal symmetry breaking. Magnetic order is therefore key to its behaviour as a topological material, and the magnon spectrum and exchange parameters derived from it could reflect the presence of Weyl fermions near the Fermi energy. We shall use IN8 with the flatcone analysers to map out the magnon dispersion in all high symmetry directions. To identify any anomalies associated with the presence of relativistic fermions we shall compare the observed magnon spectrum with that in YbMnBi2, which we have studied previously on IN8 and which does not host Weyl fermions.

Exp. 4-01-1684, the magnons of $YbMnSb_2$ on IN8.

We measured an assembly of 20 crystals of $YbMnSb_2$ on the IN8 triple-axis spectrometer with the FLATCONE multiplexed analyser detector system. The aim of the experiment was to chart to spin waves present in this material in its magnetically ordered phase (T_N = 345K), both in-plane and out-of-plane. Measurements were taken at two different crystal orientations giving access in the to the *(h0l)* and *(hhl)* sections in reciprocal space, respectively. A fixed outgoing neutron wavevector of 3 Å^{-1} was selected by Bragg reflection from the silicon (Si) *(111)* analyser crystals built into FLATCONE, and the incident wavevector was varied to give a range of neutron energy transfers from 0 to 70 meV. Either a double-focusing Si *(111)* monochromator (energy transfer < 40 meV), or a double-focusing pyrolytic graphite *(002)* monochromator (energy transfer ≥ 40 meV) was used to set the incident wavevector. The FLATCONE tilt was maintained at 0 degrees throughout, and the sample was held at a temperature of 1.5 K in a liquid helium `orange' cryostat. The excellent quality of the data has enabled us to fit a linear spin wave theory model to describe the exchange parameters for this system. In particular, the dispersion along the *c* axis is interesting as it is much stronger than for other similar compounds in the family of magnetic topological materials with square Sb or Bi nets.



Above: (*h0l)* scattering plane data and spin wave model.

Below: (*hhl)* scattering plane data and spin wave model.