Experimental report

01/07/2022

Proposal:	**DIR-249**
Council:	4/2021
Title:	THRESHOLD EFFECT AND THE CONTINUUMOF SPIN EXCITATIONS IN THE OCTUPOLAR QUANTUM SPIN ICE CE2SN2O7
Research area:	Physics

This proposal is a continuation of 4-05-771

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Samples: Ce2Sn2O7

Instrument	Requested days	Allocated days	From	To
IN16B	3	3	13/09/2021	16/09/2021

Abstract:

Experiment # DIR-249: Threshold effect and the continuum of spin excitations in the octupolar quantum spin ice Ce2Sn2O7

This experiment was a follow-up from a previous IN16b beamtime (4-05-771), using the high-resolution mode of the instrument (instead of the previous BATS mode), in order to better investigate the lower part of the energy spectrum. A large powder sample of $Ce_2Sn_2O_7$ was loaded in a copper can with annular geometry (outer 15 mm, inner 10 mm). The reason for such a choice was the reduction of the sample's absorption, which in this geometry, plays a crucial role. The can was filled with few bars of He in order to have as efficient cooling as possible without bringing additional difficulties to the experiment. The sample was cooled down and once base temperature of the dilution fridge reached, additional time was needed so as to thermalize the sample. This step took a few hours due to the powder nature of the sample. The actual temperature of the sample was estimated based on fits performed on the inelastic spectrum of the sample using two Lorentzian functions weighted by the Bose factor. After complete stabilization of the inelastic signal, the sample's temperature was found to be approximatively 0.2 K. Data were recorded at three different temperatures, 0.2 K, 0.8 K and 5 K with similar statistics, allowing to track the signal's behavior and a direct comparison with previous experiments (on IN16b as well as IN5).

The data were reduced via Mantid routines, using carefully measured calibrations scans (Vanadium sheets, empty annular copper can and empty dilution refrigerator). The resulting spectra were then integrated over a $\|\vec{Q}\|$ window ranging from 0.4 $Å^{-1}$ to 1.7 $Å^{-1}$. The final spectra can be seen in Fig. 1, where the data obtained using the BATS mode are also showed for comparison. The imaginary part of the dynamical spin susceptibility was computed by subtracting high temperature data from the low temperature one (correcting each data-set for temperature effect using the so-called Bose factor). The resulting curves can be seen in Fig. 2.

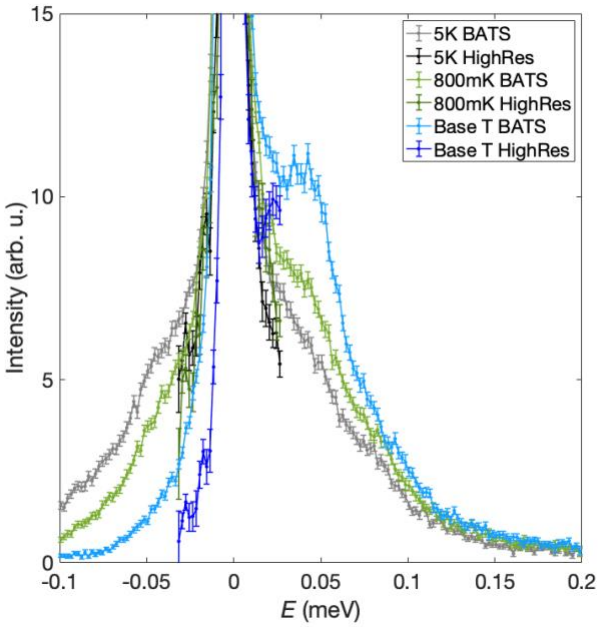

Figure 1: Spectra measured on Ce2Sn2O7 at various temperatures and using different instrumental modes (BATS and High-resolution as described in legend). These spectra were solely corrected for background, instrumental contributions and integrated over the Q-range mentioned in the text.

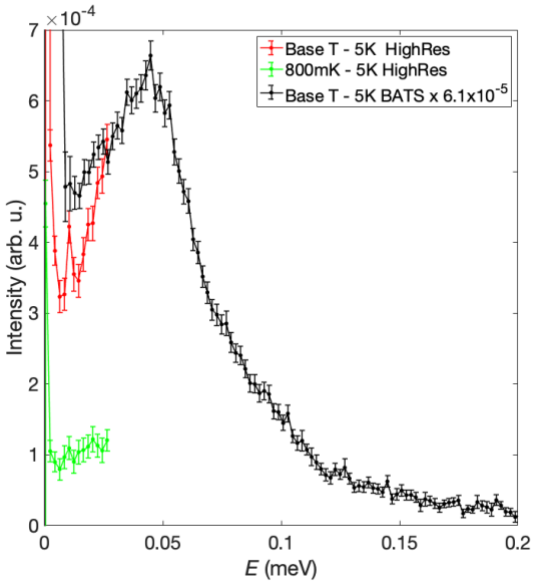

Figure 2: Imaginary part of the dynamic spin susceptibility obtained by subtracting data (showed in Fig. 1) recorded at 5K to data obtained at lower temperatures in the correlated regime, previously corrected for temperature effects. The same signal measured at low temperature in the BATS mode of the instrument is also showed for comparison.