

Experimental report

09/02/2016

Proposal: 5-32-809

Council: 10/2014

Title: Investigation of the exotic low temperature groundstate of the $S_{\text{eff}}=1/2$ pyrochlore antiferromagnet $\text{Ce}_2\text{Sn}_2\text{O}_7$

Research area: Physics

This proposal is a new proposal

Main proposer: Romain SIBILLE

Experimental team: Tom FENNELL
Romain SIBILLE
Elsa LHOTEL

Local contacts: Goran NILSEN

Samples: $\text{Ce}_2\text{Sn}_2\text{O}_7$ powder

Instrument	Requested days	Allocated days	From	To
D7	5	5	25/06/2015	30/06/2015

Abstract:

We have recently discovered an exotic magnetic state developing at subKelvin temperatures in the Ce^{3+} pyrochlore stannate. The spin system of this compound is characterized by a thermally isolated $J_z=1/2$ Kramers' doublet at low temperature, providing effective spin $1/2$ moments on a pyrochlore lattice. We have observed that these spins are characterized by a strong Ising $\langle 111 \rangle$ anisotropy. The system does not order down to the lowest investigated temperature (70 mK). However, it develops a correlated regime for temperatures below 1 K, due to antiferromagnetic interactions one order of magnitude larger than the expected ferromagnetic dipolar couplings. We would like to characterize this low temperature phase using XYZ polarization analysis on D7 using a powder sample. We will be able to efficiently separate the magnetic signal from non-magnetic contamination, which is particularly important since we will require ultra-low temperature sample environment, which increases background, and because the magnetic signal is inherently weak ($S_{\text{eff}}=1/2$).

Experimental report for ILL experiment 5-32-809 on D7:

Investigation of the exotic low temperature groundstate of the $S_{\text{eff}}=1/2$ pyrochlore antiferromagnet $\text{Ce}_2\text{Sn}_2\text{O}_7$

We have measured a powder sample of 28 grams of $\text{Ce}_2\text{Sn}_2\text{O}_7$ on D7 using a dilution fridge and XYZ polarization analysis.

The sample was wrapped into Copper foils in order to improve thermalization within the copper can which contained an overpressure of a few bars of ^4He .

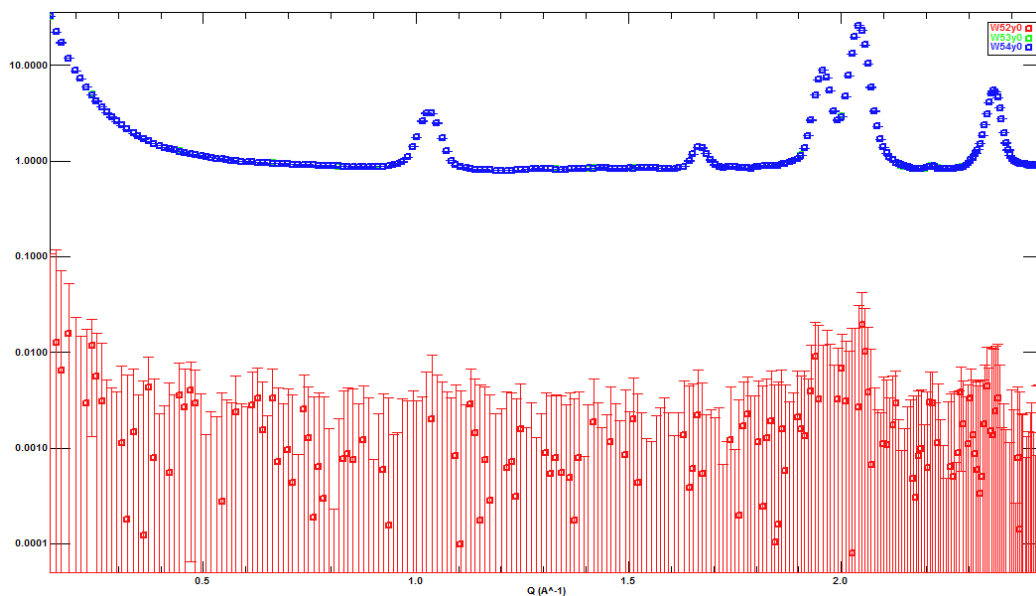
We used a wavelength of 4.8 Å and the sample's transmission was measured (81.5%).

Standards (Quartz and Vanadium) were measured and used to calibrate our data.

We have performed the following measurements:

- 0.07 K (# 168979-169506)
- 1.20 K (# 169508-169661)
- 20.0 K (# 169665-169708) – reduced statistics
- Empty sample holder for background subtraction (# 169709-169884)

The figure below shows the total signal obtained at 0.05 K (blue), 1.2 K (green – perfectly hidden by the blue points...) and the difference between those two (red). This shows that the eventual signal coming from magnetic correlations is either very weak or absent.



The XYZ polarization analysis allows extracting the magnetic part of the above scattering, which turned out to appear as having the momentum dependence of the Ce^{3+} magnetic form factor, independently of the temperature, in agreement with the absence of the diffuse scattering that would originate from the magnetic correlations.