Experimental report

15/02/2018

Proposal: 5-53-248 **Council:** 10/2014

Title: Magnetic correlations in the spin-liquid state of Tb2Hf2O7, the forgotten analogue of the Tb2Ti2O7 puzzle

Research area: Physics

This proposal is a new proposal

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Samples: Tb2Hf2O7 powder
Tb2Hf2O7 single-crystal

Instrument	Requested days	Allocated days	From	To
D7	8	8	01/07/2015	09/07/2015

Abstract:

After 15 years of intense research efforts on Tb2Ti2O7 Ising antiferromagnet pyrochlore, its low-temperature spin-liquid state with power-law spin correlations and magnetoelastic excitations remains quite enigmatic. We are working on the characterization of a related compound, Tb2Hf2O7, for which we conduct a set of experiments based on neutron, synchrotron and muon radiations. As its titanate counterpart, Tb2Hf2O7 does not order down to the lowest investigated temperatures but presents significant differences with it. We want to characterize the spin correlations in Tb2Hf2O7 at very low temperature, capitalizing on the recent success of such measurements on the related dipolar spin-ice Ho2Ti2O7 and on spin-liquid Tb2Ti2O7.

Experimental report for experiment 5-53-248 on D7

"Magnetic correlations in the spin-liquid state of $Tb_2Hf_2O_7$, the forgotten analogue of the $Tb_2Ti_2O_7$ puzzle"

We have measured the magnetic scattering from a single-crystal of the anion-disordered pyrochlore $Tb_2Hf_2O_7$ on D7, at temperature of 0.07 K, 1.15 K, 5 K, 10 K and 100 K, using an incident wavelength of 3.2 Å. We have produced very high quality data that allow us to make new statements.

First, the data recorded at the base temperature confirm the Coulomb spin liquid ground state, characterized by power-law correlations, of this material – see Figure 1.

Second, the temperature dependence (Figure 2) demonstrates that while the sharp features build up only below T = 5 K, there is very little change of the diffuse scattering between 1.15 K and 0.07 K. This is important because it demonstrates that the spin glass transition observed in this material, at $T_{SG} \sim 0.8$ K, is not captured by the measurements of the power-law correlations.

The results were published in *Nature Communications, 8:892,* ***2017***.

Figure 1: In plane/non-spin flip (**c**) and out of plane/spin flip (**d**) scattering maps measured on D7 using a single-crystal sample of $Tb_2Hf_2O_7$.

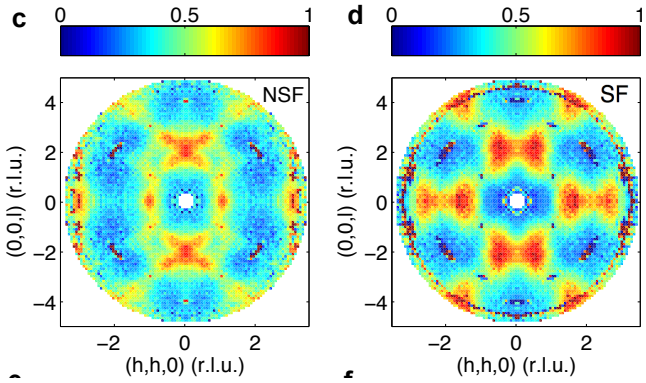

Figure 2: Spin-flip scattering of polarized neutrons at three different temperatures along the wave-vectors (0.59,0.59,l), showing the build-up of magnetic correlations below T = 5 K, but no change between T = 0.07 and T = 1.15 K.