Experimental Report

Proposal: **4-04-465** **Council:** 10/2012

Title: Dynamical spin correlations of a frustrated Cr9 antiferromagnetic ring

This proposal is a new proposal

Researh Area: Physics

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Samples: C99 H185 Cr9 F11 N3 O35

Instrument	Req. Days	All. Days	From	To
IN5	8	8	09/10/2014	17/10/2014

Abstract:

Molecular nanomagnets characterized by competing exchange interactions provide a new way for exploring some fundamental issues of frustration as their modeling is simpler than that of bulk magnetic materials. Their small size enhances quantum effects with respect to bulk systems, and the resulting magnetic correlations and the spin dynamics are particularly complex. In fact, the magnetic energy spectrum has a structure which cannot be rationalized in terms of simple paradigms (like giant spins or rotational bands).

We intend to extract dynamical spin correlations in a single-crystal of the frustrated odd-membered Cr9 AF ring by exploiting the position-sensitive detectors of IN5. We expect the results to reveal the effects of frustration on the dynamics with a very high degree of discernment.

Dynamical spin correlations of a frustrated Cr9 antiferromagnetic ring

We investigated the Cr9 AF ring (Fig. 1), which is of great interest as a model molecular nanomagnet with magnetic frustration. Our aim was to directly extract dynamical spin correlations by exploiting the position-sensitive detectors of IN5, given that the expected value for exchange (of the order of 1.5 meV) yields relevant excitations in the range of a few meV.

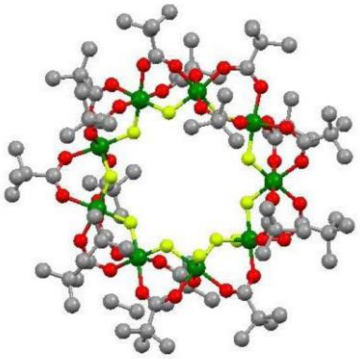

Fig. 1: The $(iPro)_2NH_2$ $Cr_9F_{11}(O_2CtBu)_{17}$ molecule contains a ring of nine Cr^{3+} ions (spin 3/2) with nearest-neighbor antiferromagnetic coupling. Cr: green, O: red, F: yellow, C: gray, H: omitted.

In the first days of the experiment we used the largest single-crystal out of the batch. We determined the energies of the main cold magnetic excitations which are close to 1.3 and 1.6 meV. More excitations are expected at about 0.1 meV and between 2 and 5 meV.
However, the mass of the crystal turned out to be not large-enough to extract the Q-dependence of several peaks (using different wavelengths) with enough statistics. For this reason in the second part of the experiment we tested the possibility of using a collection of few aligned single crystals. The results shown in Figures 2 and 3 are promising. We intend to resubmit this proposal as a continuation using such a collection in the new experiment.

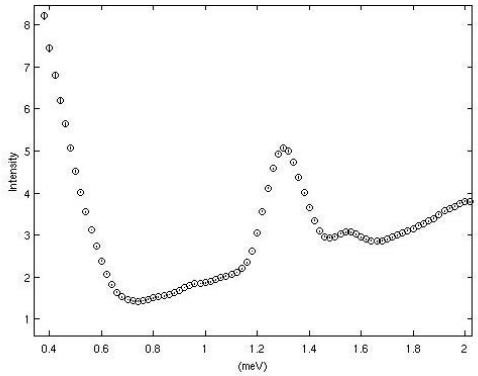

*Fig. 2: **Q**-integrated energy spectrum measured on Cr9 with a wavelength of 4.5 A. The main peak corresponds to the transitions from the two degenerate ground doublets to the first-excited S=3/2 quartets .These data were collected on a collection of six aligned single-crystals.*

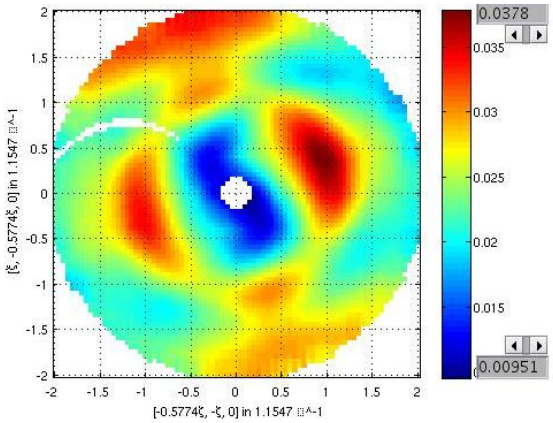

*Fig. 3: Measured **Q**-dependence (raw data) for the intensity of the 1.3 meV peak in Fig2.*