Experimental report

02/03/2019

Proposal: 4-05-683 **Council:** 4/2017

Title: Spin Freezing in La(5/3)Sr(1/3)CoO4, a layered cobalt oxide

Research area: Physics

This proposal is a new proposal

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Samples: La(5/3)Sr(1/3)CoO4

Instrument	Requested days	Allocated days	From	To
IN15	7	6	05/04/2018	11/04/2018

Abstract:

Spin freezing is one of the most common but least understood regimes of spin ordering in magnetic materials. Unlike conventional ordering, which results in the long-range magnetic structure and appearance of elastic magnetic scattering and Bragg peaks, spin freezing results in a short-range order characteristic of a correlated glass.
With the proposed experiment we will extend the temperature and energy range, towards lower energy, in which spin fluctuations of a layered cobalt oxide have been studied, a system that shows stripe-like charge order and quasi-1D antiferromagnetic short range order. This is significant for understanding the ground state of this particular system, and has implications for copper-oxide high-Tc superconductors which are isostructural materials.
A single crystal of the title compound, that has been characterized with neutron scattering methods before, will be used for this study.

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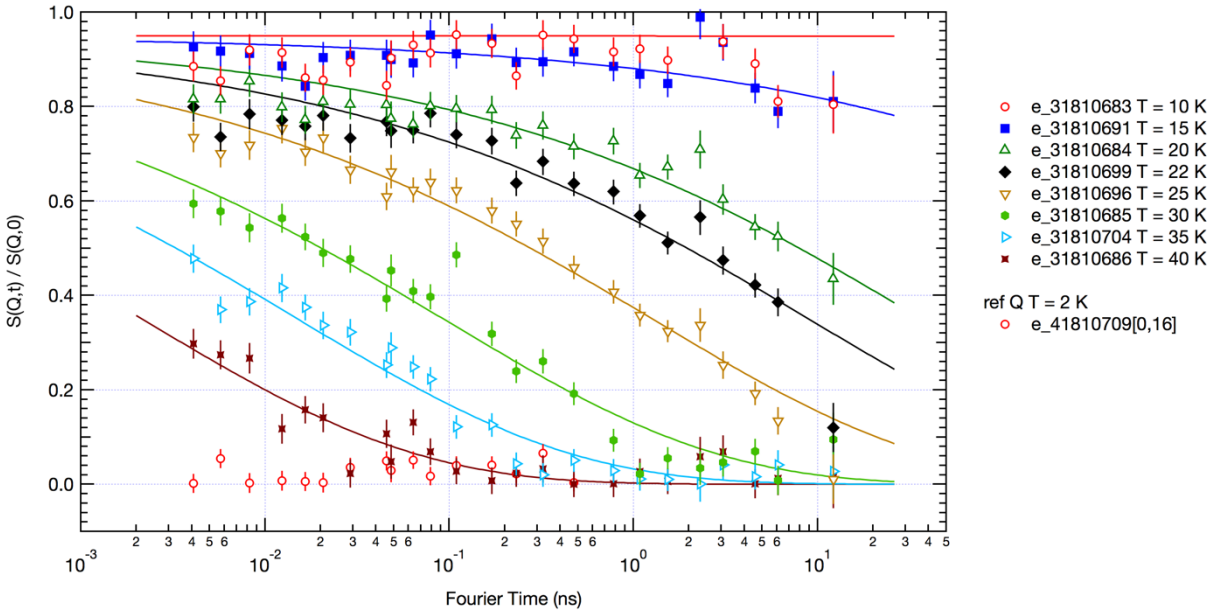
The sample

We used the sample shown in the photograph for this experiment.
The sample was aligned in the (HHL) plane.

Experimental details

We set up magnetic echo and xyz polarization analysis with 6Å neutrons at 30° and 40° and then extrapolated to the scattering angle 47° where the Q=(0.3,0.3,1) vector is that we needed to see the dynamics of interest. Then we performed a 360° rotation scan of the sample at that scattering angle to determine the UB matrix for our experiment. We were able to do this by matching the recorded magnetic intensity with the previously measured and published stripe/checkerboard intensity pattern in the (HHL) plane. Then we spent a few days recording echo spectra in the temperature range 10–40 K. This range covers the transition from fully elastic scattering (within resolution) at 10 K to almost fully dynamic scattering at 40 K. We also measured at a “reference Q” with the sample rotated by 24° where no magnetic dynamics is expected. We spent the last day with a verification measurement to confirm that an apparent elastic contribution to the scattering (only at the “reference Q”) at high temperature is in fact an experimental artifact (“direct echo”) due to the nearby presence of a nuclear Bragg peak that selects 5Å neutrons at the very edge of our wavelength band.



Echo spectra measured at IN15 during the experiment and initial fits to a meaningful spin relaxation function. The “reference Q” is set by rotating the crystal by 24 degrees away from the Q=(0.3,0.3,1) position. No magnetic dynamics is expected at this position.