Experimental report

16/02/2021

Proposal: 4-02-564 **Council:** 4/2019

Title: Study of high energy magnetic fluctuations in non-superconducting LSCO under applied magnetic field

Research area: Physics

This proposal is a resubmission of 4-02-546

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Samples: La_1.95 Sr_0.05 Cu O_4

Instrument	Requested days	Allocated days	From	To
IN8	4	4	27/08/2020	01/09/2020

Abstract:

The promoter of this proposed experiment is the result of our recent neutron scattering measurements which show a change in behavior of the magnetic signal across the transition from an insulator to a superconductor in LSCO. Our superconducting sample displayed a spectral weight shift, upon application of a magnetic field, of low energy fluctuations to even lower energies, picked up in the elastic channel. Interestingly enough, we observed a similar field suppression of the low energy fluctuations in a non-superconducting sample. However the lost spectral weight was not recovered in the elastic signal. We propose a search for a magnetic field enhancement of the spin fluctuations in the high energy regime for our non-superconducting LSCO sample at IN8.

Study of high energy magnetic fluctuations in non-superconducting LSCO (x = 0.05) under applied magnetic field, on IN8

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The aim of the experiment was to determine the effect of an applied magnetic field on the high energy fluctuations, as we expect the lost spectral weight, of the low energy inelastic signal, to shift towards higher energies.

Results

Spatial constraints in the experimental zone forced us to measure the magnetic signal in the second Brillouin zone around (1, 2, 0). In the chosen instrument configuration we were able to use one single outgoing wavevector, k_f = 4.1 Å^{-1}, for all the scans performed with energy transfer between 5 and 50 meV. The energy resolution for this outgoing wavevector is however considerably high (~6 meV) meaning that at low-energy transfers the signal is contaminated by the tail of the elastic line. For this reason we have used a smaller k_f=2.662 Å^{-1} for the lowest energies 5 and 7.5 meV, reducing thus the resolution ellipsoid.

The inelastic measurements performed at 2 K under 10 T applied magnetic field and in zero field showed no significant field effect. This leaves us with the prospect that spectral weight is shifted towards the quasi-elastic fluctuations, a possibility which needs to be experimentally confirmed.

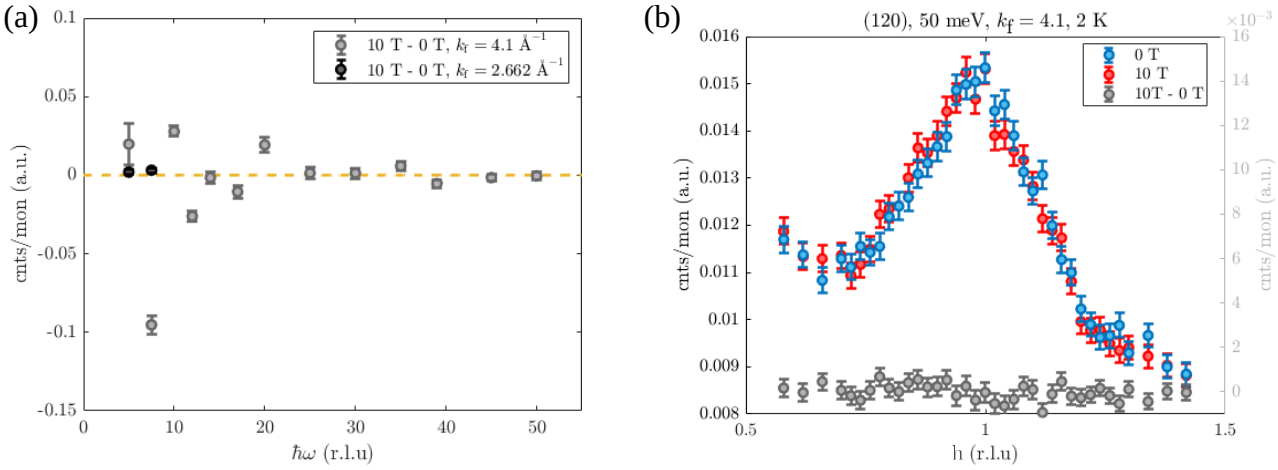

Fig. 1 (a) Variations of the intensity of high-energy fluctuations as a function of applied magnetic field measured at 2 K. A point by point subtraction of scans taken in 10 T applied magnetic field and zero field has been employed. **(b)** Representative inelastic scan with 50 meV energy transfer measured, as a function of applied magnetic field, in the second Brillouin zone at 2 K and with k_f = 4.1 Å^{-1}. In grey a point by point subtraction of the data taken under 10 T field and in zero applied magnetic field is shown.