Experimental report

07/09/2022

Proposal: 5-41-1101 **Council:** 4/2020

Title: Magnetic and charge order of the cobalt oxide La{2-x}Ba{x}CoO{4}

Research area: Physics

This proposal is a new proposal

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Samples: La1.67Ba0.33CoO4
La1.5Ba0.5CoO4

Instrument	Requested days	Allocated days	From	To
D10	6	6	26/02/2021	04/03/2021

Abstract:

We propose an experiment to investigate the magnetic and charge order of the layered cobalt oxide La{2-x}Ba{x}CoO{4} for two different hole-doping concentrations x = 1/2 and x = 1/3. To our knowledge, this compound has not yet been studied by neutron scattering. It is structurally similar to high temperature superconducting cuprates. The mechanism and phase transitions leading to superconductivity in the cuprates are not well understood but do involve competition between the ordering of magnetic moments and charges. Here we intend to study this competition in La{2-x}Ba{x}CoO{4}: a material that shares an insulating parent phase with the cuprates, but does not become superconducting. Data obtained on D10 from superstructure reflections will allow us to compare the material to previously measured cobalt oxides such as La{2-x}Sr{x}CoO{4}, and develop an improved account of spin wave excitations in complex condensed matter systems.

Experiment 5-41-1101

Magnetic and charge order of the cobalt oxide $La_{2-x}Ba_xCoO_4$

The aim of this D10 experiment was to establish the magnetic order of the layered cobalt oxide, $La_{2-x}Ba_xCoO_4$, at two different doping levels x = ½ and x = 1/3. The doping induces a different ratio of Co^{2+} : Co^{3+} and thus affects the magnetic order as Co^{2+} is magnetic. The experiment measured both nuclear and non-nuclear reflections. Due to the small size of the samples (in particular the x = ½ sample) and diffuse, possibly incommensurate, nature of the magnetic ordering, it was challenging to measure magnetic peaks on D10. We searched the *hk* plane extensively, focussing on scans along the diagonals (*hh0)* and (*-hh0).* The area detector was useful to distinguish between background powder lines and the weak signal. The data from the larger x = 1/3 sample showed a temperature-dependent peak at (0.27, 0.27, 1), which disappeared entirely at 30K. This is consistent with measurements from the ISIS MERLIN instrument and also our magnetisation data, which shows the onset of AFM ordering around ~20K.