Experimental report

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Proposal: 4-01-1524 **Council:** 4/2016

Title: Magnetic excitations in the double-perovskite La2CuIrO6.

Research area: Physics

This proposal is a new proposal

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Samples: La2CuIrO6

Instrument	Requested days	Allocated days	From	To
IN4	4	5	05/12/2016	09/12/2016

Abstract:

We propose to study magnetic excitations in the double perovskite 3d-5d system La2CuIrO6 using IN4 time-of-flight spectrometer. Our specific aim is to establish the presence of spin gap and to estimate the magnon band width on a 5 g powder sample of this material.
The crystal structure is determined by two interpenetrating fcc lattices of octahedra centred around copper and iridium ions. Previous characterisation reveals AFM phase transition at 74 K followed by FM transition at 55 K, resulting in a complex non-collinear low-temperature magnetic structure.

Introduction

The double perovskite (DP) La_2CuIrO_6 is a complex material containing 3d and 5d ions. These materials attracts a lot of attention due to the variety of exotic magnetic behaviour. Materials with this structure show diverse magnetic behavior as a result of magnetic frustration, spin-orbit coupling, and highly correlated electrons. There are two interpenetrating magnetic sublattices centered around Ir^{4+} and Cu^{2+} ions. Both sublattices arrange antiferromagnetically below the AFM transition at $T = 74$ K. Recently, other Ir-based DP compounds were considered as materials [1, 2] realizing Kitaev interactions. Due to structural and magnetic similarity our compound can be a good candidate for the Kitaev model. The Rietveld refinement of the data from the follow up neutron powder diffraction experiment at DMC instrument (PSI, Switzerland), reveals triclinic $P\bar{1}$ symmetry group. Here we proposed to measure the magnetic excitation spectrum on the powder sample of La_2CuIrO_6 in order to establish the presence of the anisotropy gap, estimate its magnitude, and measure the magnon band width that would provide us information about the energy scale of the dominant exchange interactions.

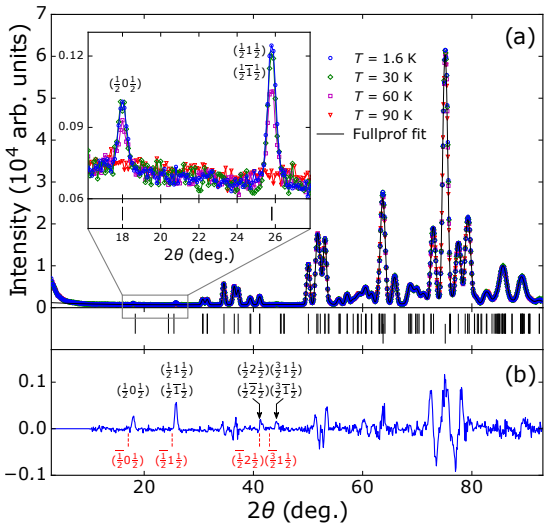

Fig. 1: Magnetic excitations in the double-perovskite La_2CuIrO_6

Experimental configuration

We have used the same powder sample of La_2CuIrO_6 with the total mass of ~ 5 g, which we already used for DMC experiment. The sample was placed into envelope made from thin aluminium foil. We have mounted the sample in the standard orange cryostat. The sample was cooled down to 1.5 K and measured with the following wavelengths: 1.45, 2.22, 3.21 and 3.63 Å. In the case of 1.45 Å graphite monochromator PG(004) was used. For other wavelengths we used PG(002). In order to subtract nonmagnetic signal, a measurement at 100 K was performed, which is above the AFM transition.

Experimental results

First, we performed an overview scan with incoming energy $E_i = 38.91$ meV, wavelength $\lambda = 1.45$ Å (Fig. 2 (a)). As one can see we have not found any magnetic signal with this configuration. During the beamtime we tried to resolve the magnetic signal using different wavelengths and resolutions (Fig. 2). The result is drastically different from recently published measurements on related Ir-based DP compounds [2], in which a clear magnetic signal is present around 2 meV.

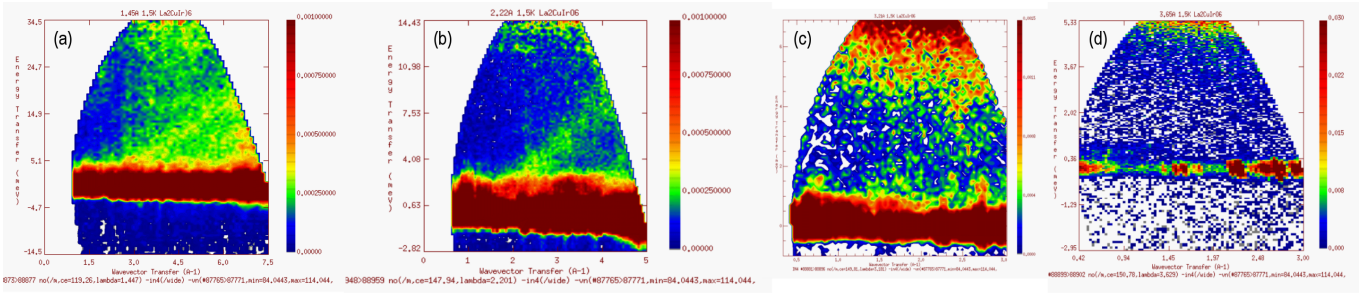

Fig. 2: IN4 data for different incoming wavelengths: (a) $\lambda = 1.45$ Å, (b) $\lambda = 2.22$ Å, (c) $\lambda = 3.21$ Å, (d) $\lambda = 3.65$ Å.

Despite the structural similarity with materials mentioned above, in La_2CuIrO_6 we have found an absence of any magnetic signal in a range between 0.5 and 35 meV. The sharp difference in the results may be explained by the fact that in contrast to other investigated DP, in our sample Cu ions have a magnetic moment. The additional magnetic moment increases system frustration and as a result can lead to suppression of the magnetic signal to a lower energy range which can be reached by using cold neutrons.

[1] S. K. Choi *et al.*, PRB **92**, 020417(R) (2015).
[2] A.A. Aczel *et al.*, PRB **93**, 214426 (2016).