Experimental report

21/06/2016

Proposal: 5-31-2363 **Council:** 10/2014

Title: Magnetic structure of spin orbit coupled transition metal chains in Ca4RhO6 and Sr4IrO6

Research area: Physics

This proposal is a new proposal

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Samples: Ca4RhO6
Sr4IrO6

Instrument	Requested days	Allocated days	From	To
D2B	2	1	21/07/2015	22/07/2015

Abstract:

We are interested in the physics of strongly spin orbit coupled transition metal oxides. For this class of materials, theoretical studies have predicted a plethora of unconventional electronic states, ranging from non-trivial band topology and novel emerging quasiparticle excitations over quantum spin liquid states to unconventional superconductivity. We have synthesised two heavy transition metal oxides powder samples Ca4RhO6 and Sr4IrO6. Presently, very little is known about these rhombohedral compounds. In contrast to commonly investigated 4d and 5d transition metal oxide pyrochlores, honeycomb lattices and perovskites, the rhodium and iridium ions of the present study are arranged in quasi one-dimensional polyhedral chains. We believe that this low dimensionality adds to the potential for unconventional electronic phenomena. We here propose the first attempt to determine the magnetic structure of these correlated, spin orbit coupled, metallic chains. Our study will form a basis to perform more advanced investigations (e.g. of the magnetic excitation spectrum).

Magnetic structures of Ca4RhO6 and Sr4IrO6

neutron powder diffraction experiments have been performed at the instruments D2B and D20.

1. Instrument D2B, with a high take-off angle (Ge (335) monochromator at 2th=135 deg, λ=1.594 Å) is optimised for the resolution of structural details. We used this instrument for a high quality structural refinement of Ca4RhO6.
2. With its high flux of cold neutrons at a low take-off angle (HOPG (002) monochromator at 2th=42 deg., λ=2.41 Å), instrument D20 is ideal for the detection of small ordered magnetic moments. We used this instrument for a characterisation of the magnetic order in Ca4RhO6 and Sr4IrO6.

Structural refinement of Ca4RhO6 on D2B

- Datasets were obtained at 1.5 K, 20 K and 200 K.
- A satisfactory refinement of lattice parameters and atomic positions was achieved for all datasets (FullProf Suite).
- There was no evidence of structural symmetry breaking down to 1.5 K. This is consistent with previous reports on the corresponding iridate Ca4IrO6 (Calder et al., PRB **89**, 081104(R), 2014)

M. Rahn Nov. 2015