NÉEL INSTITUT Grenoble

Topic for Master 2 internship – Academic year 2019-2020

Investigating Multiferroïcity in Doubly Ordered Perovskites

Keywords: Multiferroic materials, Structure, Magnetism

Context: We study a new class of multi-functional magnets called multiferroïcs, where magnetism and ferroelectricity are strongly coupled together. For example, electric polarization may be switched by applied magnetic fields, and vice-versa. These types of materials, currently at the cutting-edge of condensed matter research, are likely to form key components in the development of future technology, for example, in memories and logic devices [1]. Recently we have investigated a new family of doubly ordered perovskites with the general formula $NaLnTWO_6$ (Ln: lanthanide and T: magnetic transition metal) and have found that these materials were multiferroic by the virtue of a new mechanism, the so-called "Hybrid Improper Ferroelectricity" [2-5].

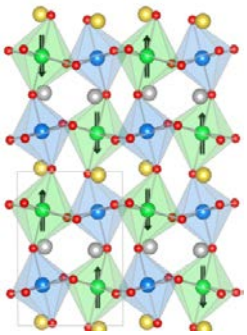

Fig. 1 : Magnetic structure of the $NaYCoWO_6$ [2]

Objective and available means: A proper understanding of the interplay between the various physical properties of these types of materials relies heavily on the knowledge of the detailed crystal and magnetic structures. The aim of this Master internship will be to synthesize new compounds with the doubly ordered perovskites structure and study their electrical, magnetic and structural properties. The structural investigation will be carried out using x-ray diffraction at the laboratory as well as at the nearby large facilities when needed. (European Synchrotron Radiation Facility and Institut Laüe Langevin high flux neutron reactor). An extended set of physical, magnetic and electrical measurement facilities (see for instance fig. 1 and 2) is available at Institut Néel and will be used to characterize the samples.

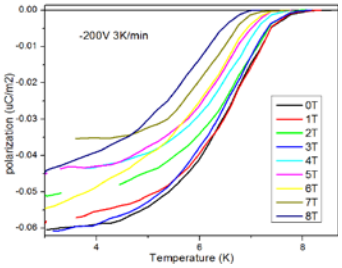

Fig. 2: Electric polarization developed under magnetic field in $NaYCoWO_6$

[1] S-W Cheong, M. Mostovoy, *Nat. Mater.*, **6**, 2007, 13. [2] P. Zuo, PhD thesis, UGA 2017. [3] P. Zuo, C.V. Colin, H. Klein, P. Bordet, E. Elkaim, E. Suard and C. Darie, Inorg. Chem. 2017, 56, 8478−8489 [4] P Zuo, H Klein, C Darie, CV Colin - Journal of Magnetism and Magnetic Materials, 2018, https://doi.org/10.1016/j.jmmm.2018.02.061. [5] Zuo, P., Darie, C., Colin, C. V. & Klein, H. Inorg. Chem. 58, 81–92 (2019).

Possible collaboration and networking: The student will be working within the Materials, Radiation and Structure (MRS) team of the Néel Institute. He/she will collaborate closely with several researchers of the MRS team (experienced chemists, crystallographers and physicists) and work with the technical staff of the laboratory (for Physical Characterizations, X-Ray and eventually neutron diffraction).

This Master internship could be extended into a PhD within the same research subject if a funding source for a PhD thesis is obtained (research project grant or PhD contract awarded by the Physics Graduate School of Grenoble).

Background and expected skills: The candidate must have a background in condensed matter physics, with good basis in materials Science and interest for exploratory experimental physics.

Possible period for the beginning of the internship: February 2020

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