NÉEL INSTITUTE Grenoble

PhD position

CROSS-COUPLING EFFECTS IN SPINEL FERRITES: A VERSATILE MODEL FOR MANIPULATING MULTIFERROICITY

Context and objectives: The term "multiferroics" refers to an original class of solid materials where both the magnetic [*i.e.* (anti)ferromagnetism] and the electric [*i.e.* (anti)ferroelectricity] orders coexist and are strongly intertwined. In multiferroics, the cross-coupling effect, the so-called magnetoelectric (ME) coupling (*i.e.* between spin and charge degrees of freedom) is a playground for many applications. It can lead to the control of the polarization **P** (magnetization **M**) by applying a magnetic **H** (electric **E**) field and is a key feature for future information technologies [1]. This PhD thesis will explore two aspects of the multiferroicity: the **magnetic frustration** and the **charge ordering**, through the study of one particular family of compounds: the spinel ferrite. This PhD will aim at characterizing and understanding the properties of two members of this family: the magnetic frustrated spinel $GeFe_2O_4$ [2] and the mixed-3d-ion spinel $NiFe_2O_4$ [3]. The implementation of this project is driven by the wish to:

- **Objective 1:** explore new promising multiferroic candidates,
- **Objective 2:** identify the ME effects (static ?, dynamic ?),
- **Objective 3:** clarify the microscopic mechanisms at the origin of these properties.

References:

[1] M. Fiebig, J. Phys. D: Appl. Phys. **38**, R123 (2005); M. Bibes and A. Barthelemy, IEEE Trans. Electron Devices **54**, 1003 (2007).
[2] G. Perversi, *et al.*, Communications Physics **1**, 1 (2018).
[3] J. K. Dey, *et al.*, Phys. Rev. B **99**, 144412 (2019).

Methods: This PhD project will combine macroscopic characterizations at the laboratory and two cutting-edge techniques on large-scale facilities: **neutron scattering** and **resonant X-rays.** These two techniques will constitute a powerful approach to reveal the coupling between magnetic and charge degrees of freedom in these systems. This project involves researchers from the MRS and MagSup teams of the Institut Néel as well as the SIMaP laboratory.

Profile and skills required: The candidate should have a master degree or equivalent in condensed matter physics with a strong interest for experimental physics addressing fundamental questions. She/He should be well organized and meticulous, motivated by large-scale facilities experiments and interested in both performing the experiments and analyzing the data. Experience on coding will be appreciated. The candidate should also have a good level in English (for writing publications and participate to international conferences).

Practical aspects: The PhD thesis will start on the **01/10/21** at the **Institut Néel,** Université Grenoble Alpes and Centre National de la Recherche Scientifique.
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Application and contacts: The candidates should send their CV, cover letter, copy of the highest diploma with their grades, and recommendation letters at: **Laura Chaix** (laura.chaix@neel.cnrs.fr) and **Claire Colin** (claire.colin@neel.cnrs.fr).

Deadline for submitting an application 07/07/2021