INSTITUT JEAN LAMOUR

UNIVERSITÉ DE LORRAINE

Date : 24 january 2025

Ph.D. Position

Funded by the European Union

European Research Council
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MAGNETALLIEN

Intitulé de l'offre d'emploi

Harnessing spin-orbit coupling on low-symmetry epitaxial compounds

General information

Workplace: Nancy, FRANCE
Type of contract: PhD Student contract / Thesis offer
Contract period: 3 years
Expected date of employment: 2025
Proportion of work: Full time
Remuneration: ~ 2200 € gross/monthly.
Desired level of education: Master in Physics.
Experience required: Master.
European research program: Yes

Context

The exploration of new quantum materials that exhibit symmetries beyond the conventional ones could provide disruptive solutions for information technologies. This multidisciplinary line of research encompasses material sciences, deep understanding of solid state or condensed matter physics, and surface physics. Among its potential applications are spin-orbitronic devices which in turn will allow to reduce the growing energy consumption due to data treatment and storage, internet of things (IoT), connected objects, etc… In these emergent systems, interconversion operations between the charge current and the spin current are crucial, especially for the manipulation of a magnetic element.

A well-established method for quantifying the conversion of spin current to charge current, in "classical" systems or in new quantum materials, is based in Spin-Pumping FerroMagnetic Resonance (SP-FMR). In these types of measurements, a rectified DC voltage is measured at the resonance condition of a magnetic layer. This method, quite complex and rich in fundamental physics, enables the evaluation and quantification of various materials: metals, semiconductors, two-dimensional systems such as Rashba interfaces, topological insulator surfaces, and so on.

As part of the ERC CoG MAGETALLIEN project (ID grant 101086807), we are seeking for a young, motivated student to take up these challenges. The aim of the project is to measure and quantify various systems by SP-FMR, as well as to participate in the growth of epitaxial compounds quantum materials such as topological insulators, Weyl semi-metals or low-symmetry materials based on half-Heusler compounds, and B20 compounds integrated with other layers. Our research team benefits from various experimental set-ups for epitaxial growth, band-structure calculations and measurements such as Spin Angle-resolved photoemission spectroscopy (S-ARPES), as well as different state-of-the-art methods for studying and quantifying the efficiency of the inter-conversion between spin and charge currents.

The successful candidate will have to perform several activities. She/he will participate in epitaxial thin-film growth, structural (by XRD and HRTEM), magnetic and spectroscopic (by XPS, AES, ARPES) characterizations. She/he will be in charge of electrical and magnetotransport characterization, including clean room (lithography) and spin pumping measurements, analysis of results and its presentation in conferences or scientific articles.

Expected Skills

- Candidates must hold a Master degree in physics, materials or nanoscience, and have the following knowledges:
  - Strong ttheoretical background in physics and more precisely in solid-state physics and in magnetism. Knowledge in spintronics and magnetization dynamic is a plus
  - Background in material sciences including thin film deposition and crystallography.
- General skills: Programming in Python, Mathematica and/or LabVIEW will be considered as a plus. Good communication skills, scientific curiosity and a taste for experimental work will be highly considerate !
- Fluent English or French is mandatory

Work context

The successful candidate will work in the SPIN team, https://spin.ijl.cnrs.fr, Institut Jean Lamour, under the supervision of Dr. J.-Carlos Rojas-Sánchez, Dr. Sébastien Petit-Watelot and Prof. Stéphane Andrieu.

The Institut Jean Lamour (IJL) is a joint research unit of the CNRS and the University of Lorraine. The IJL has about 500 members including researchers, teacher-researchers, engineering, technical and administrative staff, doctoral students and post-doctoral fellows, and hosts about 80 internships per year. It collaborates with more than 150 industrial partners and its academic collaborations are deployed in some 30 countries. Its exceptional instrumental park is spread over 4 sites, the main one being a new building located on the Artem campus in Nancy.

The SPIN research group's subjects range from the development of innovative materials for implementation in spin electronics devices, to the development of magnetic sensors and the fundamental study of physical phenomena related to magnetism.

Nancy is a beautiful French city, with quick access to metropolises such as Paris, France.

Constraints and risks

No major risk. The selected candidate will have to work in cleanroom environments.

Constraints: the position you are applying for is under the protection of scientific and technical potential. It therefore requires, in accordance with regulations, that your arrival be authorized by the competent authority of the French Ministry of Higher Education, Research and Innovation.

Application

Interested candidates should apply through CNRS website

https://emploi.cnrs.fr/Offres/Doctorant/UMR7198-MELDOG-008/Default.aspx

Pre-selected candidates will be contacted for an interview.

Further information:

- J. Carlos Rojas-Sánchez (CNRS Researcher) : juan-carlos.rojas-sanchez@univ-lorraine.fr
- Sébastien Petit-Watelot (Associate Professor Lorraine University) : sebastien.petit@univ-lorraine.fr
- Stéphane Andrieu (Professor Lorraine University) : stephane.andrieu@univ-lorraine.fr

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