Postdoctoral Position (18 months) in 2D Spintronics and Opto-Spintronics

Location: Laboratoire de Physique et Chimie des Nano-objets (LPCNO), Toulouse, France
Project: *Spin–charge interconversion in proximity-engineered graphene probed by opto-spintronics*

Scientific Context:

Two-dimensional (2D) materials and van der Waals heterostructures offer unprecedented opportunities to engineer electronic and spin-dependent properties through proximity effects[1]. Graphene stands out for its exceptional carrier mobility and long spin diffusion lengths, but its intrinsically weak spin–orbit coupling (SOC) limits its ability to perform efficient spin–charge interconversion, a key functionality for spin–orbitronic devices. Recent breakthroughs have demonstrated that interfacing graphene with high-SOC materials such as transition metal dichalcogenides (TMDCs) and ferromagnets can strongly modify its band structure and enable novel spin–orbit phenomena[2].

This postdoctoral position is part of a scientific project which aims to engineer graphene via proximity effects and to investigate charge-to-spin and spin-to-charge conversion using a unique combination of nanofabrication, electrical spin transport, and opto-spintronics techniques[3].

Objectives of the Project:

The main goals are to (i) fabricate and characterize high-quality graphene/TMDC/ferromagnet van der Waals heterostructures, (ii) quantify spin–orbit torques and spin–charge interconversion in proximity-engineered graphene using advanced magnetotransport and magneto-optical techniques, and (iii) develop original optical spin injection schemes based on TMDCs to probe spin transport and conversion in lateral device geometries. The project aims to establish proximitized graphene as a tunable, high-mobility platform for next-generation spin–orbitronic devices.

Main Responsibilities:

The successful candidate will:

- Fabricate van der Waals heterostructures by mechanically assembling 2D materials in controlled atmosphere and pattern nanodevices (exfoliation and polymer-assisted pick-up, optic and e-beam lithography, nanofabrication processes).
- Perform electrical spin transport and magnetotransport measurements (including harmonic Hall analysis of spin-orbit torque, Hanle effect in non-local spin valves).
- Carry out magneto-optical experiments (e.g., Kerr microscopy, optical spin injection in TMDC/graphene heterostructures),
- Analyze and interpret experimental data in close interaction with theory collaborators.
- Contribute to publications and presentations at international conferences.

Candidate Profile:

Applicants must hold a PhD in physics, materials science, or a closely related field. A strong background in experimental condensed matter physics and expertise with 2D materials nanofabrication. Experience in spintronics, low-temperature transport, or magneto-optics is a strong asset, but not strictly required. The candidate should be motivated, autonomous, and able to work in a collaborative, interdisciplinary environment.

What We Offer:

The position is for 18 months and based in LPCNO (Toulouse, France) within the Nanomagnetism team, in a dynamic research environment at the interface of spintronics, 2D materials, and opto-electronics. The postdoc will gain hands-on experience with state-of-the-art van der Waals heterostructures nanofabrication facilities and advanced experimental techniques using closed-cycle He magnetocryostat with superconducting vector magnets

Application:
Applicants should submit a CV, a short statement of research interests and motivation, and contact information for one or two references.

Contact:

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References:

1. Zollner, K. & Fabian, J. Proximity effects, topological states, and correlated physics in graphene heterostructures. *2D Mater.* **12**, 013004 (2024).
2. Sierra, J. F. *et al.* Room-temperature anisotropic in-plane spin dynamics in graphene induced by PdSe2 proximity. *Nat. Mater.* 1–7 (2025) doi:10.1038/s41563-024-02109-2.
3. Sierra, J. F., Fabian, J., Kawakami, R. K., Roche, S. & Valenzuela, S. O. Van der Waals heterostructures for spintronics and opto-spintronics. *Nat. Nanotechnol.* **16**, 856–868 (2021).