PhD position: Exploring emergent properties of antiferromagnets

Research project

Historically, magnets have been classified in two categories: ferromagnets and antiferromagnets (AFM). While typical AFM host 2 oppositely oriented magnetic sublattices, non-collinear AFM like Mn_3Sn possess a more complicated magnetic texture with more sublattices, which can lead to the emergence of new phenomena like anomalous Hall effect. Besides these exotic AFM, another class of magnets has recently been introduced: altermagnets. They have the magnetic order of collinear AFM, but also exhibit large magneto-optic or Hall effects, as if they had a significant net magnetization, and seem therefore very promising for applications in spintronics [1].
Up to now, most of the knowledge about these materials comes from macroscopic characterization. The goal of the proposed project is to investigate them at the nanoscale with the help of a very sensitive scanning probe technique: scanning NV center magnetometry [2]. This method employs a single nitrogen-vacancy (NV) defect in diamond as a quantum sensor and provides non-invasive and quantitative stray field measurements, with an unprecedented combination of spatial resolution (~ 50 nm) and magnetic sensitivity ($\sim \mu T/\sqrt{Hz}$). We will in particular examine domain walls, as their internal structure should give us insight about the balance of magnetic interactions in these systems.

The recruited student will operate two differents types of scanning NV center microscopes: a commercial one at room temperature and a low-temperature setup, perform advanced data analysis, interact with collaborators providing samples and integrate in a mixed team working on various topics related to quantum technologies and condensed matter physics.

[1] Q. Liu, X. Dai, and S. Blügel. Different Facets of Unconventional Magnetism. *Nat. Phys.* (2025).

[2] A. Finco and V. Jacques. Single Spin Magnetometry and Relaxometry Applied to Antiferromagnetic Materials. *APL Materials* 11, 100901 (2023).

Profile of the candidates

We are looking for a highly motivated student with strong team spirit and training in solid state physics and quantum mechanics. Programming skills (especially in Python) will be appreciated but are not mandatory (we will teach you!). As we are an international team, a good level in English is also expected.

Practical details

Location: Laboratoire Charles Coulomb, Montpellier, France
Team: Solid State Quantum Technologies (S2QT)
Contact: Aurore Finco (aurore.finco@umontpellier.fr)
Starting date: October 2025
Duration: 3 years
Funding: Institut Quantique Occitan
Gross salary: $\sim$ 2200 € per month