Stage de recherche pour les étudiants ARTEQ

Stage de recherche de 6 mois, à partir de début février 2022

Proposition de stage (ne pas dépasser 1 page)

Responsable du stage :
João Sampaio
Courriel : joao.sampaio@universite-paris-saclay.fr

Nom du laboratoire : Laboratoire de Physique des Solides (CNRS/U. Paris-Saclay)
Site Internet : lps.u-psud.fr , equipes2.lps.u-psud.fr/idmag/
Adresse : Bâtiment 510, Campus d'Orsay
Lieu du stage : idem

Magnetic interactions in van der Waals 2D crystals

The theory of statistical physics developed by Mermin, Wagner, Ising, Onsager and others in the twentieth century predicts that the ferromagnetic order in a 2D system can only exist in certain restricted cases. Lacking a real 2D system, these questions could not be experimentally tested until the recent discovery of the ferromagnetic order in van der Waals crystals, such as Fe_3GeTe_2 or CrI_3. These crystals are composed of atomic-thick layers weakly coupled by the van der Waals force, and can be mechanically exfoliated down to a single layer to achieve the ultimate 2D magnet. The discoveries of the last two years in this class of materials (e.g., ferro/ antiferromagnetic order depending on the number of layers, dependence of the magnetic properties on the adjacent layers, ...) show their interest for understanding 2D magnetism at the microscopic / quantum level. Moreover, magnetic textures such as domain walls or skyrmions have been observed in some of these 2D magnets, which increases their interest for spintronic applications.

For this internship, we are interested in the origin of the asymmetric exchange ('Dzyaloshinskii-Moriya') in these systems and the chiral and topological magnetic textures that this interaction stabilizes: the skyrmions. For this, we will study systems with different interfaces and compositions, and under varying gate voltages, which allows us to modulate the exchange interactions in the material.

Methods and techniques. We will manufacture different 2D systems by mechanical exfoliation and metal evaporation, at our nanofabrication lab. Then, we will study the asymmetric exchange by measuring the differences between spin waves of different chirality by Brillouin scattering spectroscopy, and by observing the magnetic textures by different imaging techniques (Kerr effect optical imaging, imaging magnetic force). Nanofabricated contacts will allow the application of gate voltages.

Stage proposé à des étudiants de toute formation M1 (physique, chimie, informatique, ingéniérie)
~~Oui~~ —Non
Commentaire : Financement disponible.
Stage proposé de préférence à des étudiants ayant un M1 en : Physique

Le stage peut-il faire l'objet d'une ouverture internationale ? Avec quelle équipe ?