Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

Laboratory name: Unité Mixte de Physique CNRS/Thales
CNRS identification code: UMR 137

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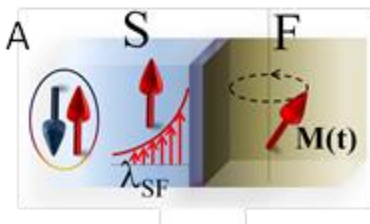
Thesis possibility after internship: **YES**
Funding: Not yet secured, proposal submitted which type of funding: ANR

Spin dynamics in d-wave superconductors

The interplay between superconductivity and magnetism has attracted the attention of physicists for years. Spin injection and dynamics in superconductors constitutes a pivotal topic, because of its fundamental interest and its relevance in the nascent field of "superconducting spintronics" [10].

The spin dynamics can be studied by **ferromagnetic resonance (FMR)**, in which spin is pumped[17] into a **superconductor (S)** by the microwave-excited magnetization precession in an adjacent **ferromagnet[18] (F)** (see Figure). The capacity of the S to sink the non-equilibrium spin population at the interface affects the damping of the magnetization oscillations. The resulting FMR linewidth narrowing or broadening across the superconducting transition reflects variations of i) the spin transmission across the S/F interface and ii) the relaxation mechanisms in the S[5,8].



The existing literature studies (low-T_c) s-wave superconductors. Instead, here we propose (high-T_c) d-wave ones, which are up to now unexplored in this context and display many unique properties. For example, an anisotropic gap which results in a high density of QP (Andreev) bound states at the Fermi level. Preliminary FMR experiments on d-wave/metallic F interfaces carried at UMPhy have revealed their fingerprint in the magnetization dyanmics[21]. This internship and the PhD thesis that should follow will take on this work to undestand the different mechanism microscopic mechanism at play, and the potential of these effects for spintronic applications.

Experimental techniques: This is an experimental internship. The student will characterize d-wave superconductor/ferromagnets heterostructures using transport measurements and FMR experiments in cryogenic environment. The student will interact and work with postdocs, permanent researches, as well collaborators experts in theoretical modelling-

Required skills: interested in experimental physics, in a PhD in physics, and a good team player. Knowledge of condensed matter physics.

Adapted to the subject:

Condensed Matter Physics: YES Macroscopic Physics and complexity: NO
Quantum Physics: YES Theoretical Physics: NO