INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire Albert Fert
CNRS identification code: UMR 137
Internship director'surname: Villegas
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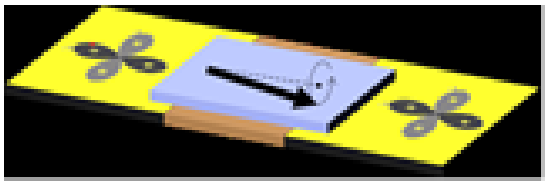
Internship location: 1 avenue A. Fresnel, 91767 Palaisuea
Thesis possibility after internship: YES
Funding: proposal submitted (ANR) If YES, which type of funding:

Coupling of Josephson currents and magnetization dynamics is S/F hybrids

The interplay between superconductivity and magnetism has attracted the attention of physicists for years. The coupling between magnetization dynamics and the superconducting state constitutes a pivotal topic, because of its fundamental interest and its relevance in the nascent field of "superconducting spintronics".



The spin dynamics can be excited by ferromagnetic resonance (FMR), particularly by shining microwaves that excite the magnetization precession of the macroscopic-magnetic moment. If the ferromagnet is connected to two superconducting electrodes, and these are close enough, this precession of the magnetization expectedly yields the condition for the generation of unconventional superconducting spin-triplets, thus allowing for Josephson coupling across the ferromagnet [1]. The internship is devoted to experimentally verifying this theoretical prediction, and investigating how spin pumping into the superconductor [2] interplays with Josephson coupling. The existing literature on S/F hybrids most often studies (low-Tc) s-wave superconductors. Instead, here we propose (high-Tc) d-wave ones, which are up to now unexplored in this context and display many unique properties. For example, an anisotropic gap results in a high density of QP (Andreev) bound states at the Fermi level.

This internship and the PhD thesis that should follow will focus on understanding the different mechanisms at play, and the potential of these effects for spintronic applications.

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

Applicant skills: Excellent team player, rigorous and enthusiastic, the candidate has a strong scientific curiosity.

[1] M. Houzet. Phys Rev Lett 101, 1 (2008).
[2] S. J. Carreira et al. , Phys Rev B 104, 144428 (2021).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: NO Theoretical Physics: NO