LNCMI-Grenoble

Ultrasound in quantum materials

Master 1 / Master 2

Context

Superconducting materials enable technologies that would otherwise be unfeasible or impossible, such as medical Magnetic Resonance Image scanners, magnetic confinement in the ITER fusion reactor, and the magnets directing charged particles at the CERN accelerators. The materials class with the best current prospects for superconducting applications are the cuprates, which hold the record for highest ambient pressure transition temperature (T_c)-about 150 K. Those materials also host one of the greatest enigma of modern physics: the pseudogap phase. Determining the nature and origin of this mysterious phase is key to understand the mechanism of high-T_c superconductivity.

Subject

Recently, using high magnetic fields to suppress superconductivity, our team has recently made a fundamental discovery: the pseudogap phase hosts slowly fluctuating magnetic moments, that freeze into an antiferromagnetic glass at low temperatures and high magnetic field [1,2]. This discovery has profound implications for the nature of the pseudogap. The internship project aims at exploring the properties of this antiferromagnetic glass in different cuprate materials, and at studying the link between slow magnetic fluctuations and quantum criticality found around p*. To do so, we will perform ultrasound and electronic transport measurements at low temperature and high magnetic field.

Working environment

The intern will work in the ultrasound group. The intern will have access to all of the group's facilities, including a 20 T superconducting magnet and accompanying cryogenic inserts covering a large temperature range, and state-of-the-art ultrasound instrumentation. The intern will also be involved in experiments in high magnetic field, whether in continuous field up to 36 T in Grenoble, or in pulsed magnetic field up to 90 T in Toulouse.

Publications linked to the theme

[1] M. Frachet, I. Vinograd *et al.*, Nature Physics **16**, 1064 (2020),
See also article on CNRS website here.

[2] M. Frachet *et al.*, Phys. Rev. B **103** 115133 (2021)

Background and skills expected : motivation for experimental physics, background in solid state physics.

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