LNCMI-Grenoble

Ultrasound investigation of high temperature superconductivity in high magnetic field

Master 1 and Master 2

Summary

The standard model of electrons in solids is based on the BCS theory of superconductivity, Landau theory of Fermi liquids, and band theory. Those theories break down in part of the phase diagram of a class of material known as high temperature cuprate superconductors. Why and how this happens remains a mystery. In order to improve our understanding of those materials the focus of this project will be to suppress superconductivity with a magnetic field in order to study the normal state of those materials with sound velocity.

Detailed subject

Magnetic fields are a central tool in the study of high temperature superconductivity. They indeed allow reaching the non-superconducting state at low temperature, offering a unique window on the "normal" state electronic properties. By observing and understanding this normal state, we should be able to identify the electronic correlations at play in the pairing mechanism. In this project we will use magnetic field in combination with sound velocity measurements to study this non-superconducting electronic state. Sound velocity is a thermodynamic probe that can be measured with high sensitivity, hence allowing detecting the most subtle change in the free energy of the system.

The student will be involved in all aspects of the project: in the preparation of samples and sound velocity experiment, data acquisition and analysis. Cryogenics and vacuum techniques, radio-frequency and DC electronics will be used.

For further information, do not hesitate to contact us!

Publications linked to the theme

- **F. Laliberté *et al.*, High field charge order across the phase diagram of YBCO, npj Quantum Materials 3, 11 (2018)**
- **D. LeBoeuf *et al.*, Thermodynamic phase diagram of static charge order in underdoped YBCO, Nat. Phys. 9 79 (2013)**

Background and skills expected : motivation for experimental work, collaborative skills, curiosity, bricolage, labview, data analysis, electronics, and a background in condensed matter physics

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