Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

Laboratory name: Jeunes Equipes de l'Institut de Physique du College de France/ Laboratoire Léon Brillouin, CEA Saclay
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Internship location: Paris/Saclay
Thesis possibility after internship: YES
Funding:NO

Bad metals and soft mode in the quantum paralectrics

Doped SrTiO3 is a bad metal where the electrical resistivity does not saturate at high temperature when the mean free path is of the order of interatomic distances. Our recent preliminary results of neutron scattering show that the proximity of the ferroelectric instability, so-called quantum paraelectric phase, play an essential role in the increase of the carriers mass at high temperature (C. Collignon, Ph. Bourges, B. Fauqué and K. Behnia, Phys. Rev. X 10, 031025 (2020)). Further, the tendency towards that structural instability (associated with a soft phonon) is assumed to favour superconductivity in SrTiO3 for dilute doping, even if both types of orders have a priori nothing in common. Motivated by these results, we propose to study the effect of electronic doping in quantum paraelectric systems in this internship, that will follow two research paths: i) study of the electronic structure via electric and thermoelectric transport measurements ii) study the atomic structure and lattice dynamics by neutron scattering measurements. We will first focus on the doped SrTiO3 compound (substitution with La and Nb, reduction in oxygen) and next to doped compounds of KTaO3 and PbTe. These measurements will allow to understand the nature of the new electronic states of matter that occur in doped quantum paraelectric materials.

For more informations see our last paper on the subject : C. Collignon, Ph. Bourges, B. Fauqué et K. Behnia, Phys. Rev. X 10, 031025 (2020), Xiaokang Li and al., Phys. Rev. Lett. 124, 105901 (2020), C. W. Rischau and al., Nature Physics, 3, 643–648(2017), X. Lin and al., NPJ Quantum Materials 2: 41 (2017), X. Lin and al., Science 349, 945 (2015)

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: YES Theoretical Physics: NO