**Master 2:** ***International Centre for Fundamental Physics***

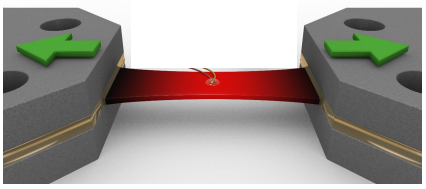
## ***INTERNSHIP PROPOSAL***

Laboratory name: Matériaux et Phénomènes Quantiques
CNRS identification code: UMR 7162
Internship director'surname: Yann Gallais
e-mail: yann.gallais@u-paris.fr Phone number: 01 57 27 69 89
Web page: https://www.mpq.univ-paris-diderot.fr/?-Spectroscopie-de-QUAsi-Particules-SQUAP-
Internship location: Université Paris Diderot - CNRS UMR 7162
Bât Condorcet - 10, rue Alice Domon et Léonie Duquet
75205 PARIS CEDEX 13, France
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ED

# Uni-axial strain control of quantum nematic superconductors

The control of correlated electronic phases has emerged as a central challenge in the research on quantum materials. In these materials many intertwinned electronic orders compete or cooperate, making them an attractive playground to discover or engineer novel quantum phases. Recently, electronic nematicity, a novel state with spontaneous rotational-symmetry breaking and the emergence of a special direction in electron liquids, has attracted significant attention because it coexists with superconductivity in several recently discovered materials, like iron-based superconductors and doped topological insulators. The nature of the coupling between nematicity and superconductivity remains poorly understood because of a lack of experimental techniques capable of probing or controlling both electronic orders. A promising tool to study the interplay between nematicity and superconductivity is uni-axial strain because it couples directly to the nematic order parameter, providing a novel way to control it and reveal its coupling to the superconducting ground state.

In this internship we propose to combine a tunable uni-axial strain device with low temperature optical spectroscopy to study the coupling between the superconducting and quantum nematic order parameter. The materials studied will be iron-based superconducting materials like $BaFe_2As_2$ and FeSe. During the internship the student will also have the opportunity to participate in the development a new optical set-up, where ultrafast light pulses are used to control these intricate orders.



The intern will thus be part of a broader project which aims at developing new platforms to tune quantum electronic phases in materials using static means like strain, but also dynamical one like light pulses.

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

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