Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique de Solides
CNRS identification code: LPS – UMR 8502
Internship director's surname: Marsi
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Internship location: Orsay

Thesis possibility after internship: YES
Funding YES If YES, which type of funding: Ministry fellowship

Ultrafast dynamics of Dirac and Weyl electronic systems

The unique transport properties of Dirac and Weyl materials offer unprecedented opportunities for out-of-equilibrium studies using femtosecond light pulses. The interest of these studies is twofold: from the fundamental point of view, the use of ultrafast light makes it possible to create transient states of matter where the topological properties are different from equilibrium, disclosing the possibility of studying topological phase transitions ; on the other hand, it represents a promising and exciting approach in the perspective of exploiting the functional properties of these systems, like the photoconductive control of topological surface states.
This internship will be focused on photoinduced topological phase transitions using time-resolved ARPES. This technique is well adapted to the study of out-of-equilibrium topological materials and in particular of their surface Dirac or Weyl states [1-2], and it will be applied to prototype systems that can give access to the basic physical mechanisms underlying these transitions. A specific target for this internship will be the original interplay between Dirac physics and electron correlation effects [3], resulting in surprising tunability effects that can be exploited in ultrafast pump-probe experiments. These results will be also compared to other prototype two-dimensional topological systems [4] where correlation effects are not relevant.

[1] M. Hajlaoui et al., « Transient Dirac cone charge asymmetry in a photoexcited topological insulator", Nature Comm. 5, 3003 (2014)
[2] M. Caputo et al., « Dynamics of out-of-equilibrium electron and hole pockets in the type-II Weyl semimetal candidate WTe_2 », Phys. Rev. B 97, 115115 (2018)
[3] D. Santos-Cottin et al., « Rashba coupling amplification by a staggered crystal field », Nature Communications 7, 11258 (2016)
[4] E. Papalazarou et al. « Unraveling the Dirac fermion dynamics of the bulk-insulating topological system Bi_2Te_2Se », Phys. Rev. Mat. 2, 104202 (2018)

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