

Master thesis proposal

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Studies of the Spin dynamics and Current in Topological Insulators

Keywords: topological insulator, spin physics, 2D electron states

Scientific description:

Spin physics and particularly spin dynamics are the object of a great attention in condensed matter and particularly spintronics. In this framework, the topological Insulators offer a new interesting field of research. Topological insulators are characterized by the simultaneous presence of massive semiconductor electronic states and massless surface states. These bidimensional surface states are associated with a Dirac cone, protected by invariance by reversal of the time. Two surface spin currents then appear, protected from defects, and forming helical states of opposite polarization and directions of propagation.

More recently, magnetic topological insulators have been discovered, either ferromagnetic or antiferromagnetic (such as $\text{Bi}_{2-x}\text{Cr}_x\text{Se}_3$, MnSb_2Te_4). Thanks to the coupling between carriers and localized spins (Mn, Cr), they open the door to the creation of chiral polarized currents.

The purpose of this internship will be to study the dynamic of localized and delocalized spins using ultrafast optical spectroscopy, with a picosecond pump-probe set-up. The studies will be conducted at low temperature (down to 5K), on thin films grown by epitaxy in the laboratory. Non magnetic and magnetic topological materials will be explored.

At the same time, we will explore the light-matter coupling and the possibility to selectively inject spin-polarized current at the surface. This polarized photocurrent will be jointly studied on the pump-probe set-up, and will give a valuable insight on the possibility to control 2D electronic spin states.

Techniques/methods in use: Optical spectroscopy, Optical pump-probe experiment

Applicant skills: Good background in solid physics and quantum physics, not mandatory but appreciated. Interest for experimental activities and particularly optics.

Industrial partnership: N

Internship supervisor(s): Maurizio MONTI, maurizio.monti@insp.upmc.fr
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Internship location: Equipe "Photonique et Cohérence de Spin »
Campus Pierre et Marie Curie, Tour 22, couloir 22-23

Possibility for a Doctoral thesis: Y (ED PIF contract)