INTERNSHIP PROPOSAL

Laboratory name: LPENS
CNRS identification code: UMR8023
Internship director'surname: Gauthier Krizman & Louis-Anne de Vaulchier
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Internship location: 24 rue Lhomond 75005 Paris
Thesis possibility after internship: YES
Envisaged funding? Doctoral school or research grant

Energy harvesting using topological quantum materials in the THz regime

Today, the need of low-consumption and eco-friendly technologies has become crucial. This internship offers to study and optimize the recycling of a THz radiation into a DC current. This investigation relies on a recently discovered Hall effect – the nonlinear Hall effect – that appears in certain quantum materials. It refers to the emergence of a transverse DC current under an AC excitation, without the need of external power supply. The nonlinear Hall effect triggered by a THz radiation relies on fundamental quantum phenomena such as topology and chirality that we propose to investigate.

Terahertz optoelectronics is a growing field of research motivated by the tremendous number of potential applications in terms of telecommunications, sensors, space spectroscopy and quantum computation. However, the study of interactions between THz light and quantum effects is still in its infancy and represents a new field in condensed matter physics.

The intern will carry AC transport and THz photoconductivity measurements in order to fully demonstrate and characterize the new nonlinear Hall effect in the topological quantum material Pb1-xGexSe. By etching specific structures in the ENS cleanroom, the transverse DC and second order currents emerging from the nonlinear Hall effect will be studied from an AC field excitation. The effect of temperature and Ge content will be measured and analysed. In a second time, the electric field excitation will be replaced by the THz radiation and the nonlinear Hall effect will be observed using THz photoconductivity measurements. The candidate will also participate to setting up the THz photoconductivity experiment.

The desired candidate should show experimental skills and motivations for experimental work at the interface between electrical transport and optical spectroscopy.

Refs: N. P. Armitage, E. J. Mele, A. Vishwanath, Rev Mod Phys. 90, 15001 (2018).
N. P. Ong, S. Liang, Nature Reviews Physics. 3, 394–404 (2021).

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