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

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: SPEC
CNRS identification code: UMR 3680
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Internship location: CEA Saclay
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: Europe

Flying Qubit in Graphene

The solid-state systems, presently considered for quantum computation, are built from localized two-level systems, prime examples are superconducting qubits or semiconducting quantum dots. Due to the fact that they are localized, they require a fixed amount of hardware per qubit.

Propagating or "flying" qubits have distinct advantages with respect to localised ones: the hardware footprint depends only on the gates and the qubits themselves (photons) can be created on demand making these systems easily scalable.

A qubit that would combine the advantages of localised two-level systems and flying qubits would provide a paradigm shift in quantum technology. In the long term, the availability of these objects would unlock the possibility to build a universal quantum computer that combines a small, fixed hardware footprint and an arbitrarily large number of qubits with long-range interactions. A promising approach in this direction is to use electrons rather than photons to realise such flying qubits. The advantage of electronic excitations is the Coulomb interaction, which allows the implementation of a two-qubit gate [1].

The aim of the present internship will be the development of the first quantum-nanoelectronic platform for the creation, manipulation and detection of flying electrons on time scales down to the picosecond and to exploit them for quantum technologies. In particular, the student will characterize a Graphene optical-to-electrical converter.

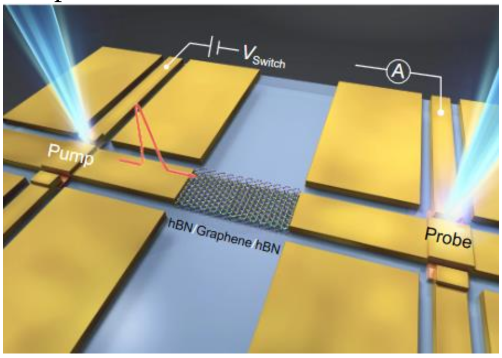

Figure 1 The pump and probe experiment. A THz laser illuminates the optical-to-electrical converter. In return, a picosecond voltage pulse propagates through the graphene sample.

[1] C. Bäuerle, D. Glattli, T. Meunier, F. Portier, P. Roche, P. Roulleau, S. Takada and X. Waintal, Coherent control of single electrons: a review of current progress, 2018 Rep. Prog. Phys. 81 056503.

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	YES	Theoretical Physics:	YES