Université catholique de Louvain **UCL** SECTEUR DES SCIENCES ET TECHNOLOGIES

Institut de la Matière Condensée et des Nanosciences

Invitation à la soutenance publique de thèse

Pour l'obtention du grade de Docteur en Sciences de l'Ingénieur

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Master en sciences physiques

Coherent transport and scanning gate microscopy in graphene devices

In the fields of condensed matter physics and electronics, the advent of new types of materials with novel and unusual charge carrier dynamics gives the possibility to design and fabricate new kinds of micro- and nano-devices for future applications or to explore peculiar physical phenomena. It is the case of graphene, a two-dimensional carbon material that has attracted a keen interest in the scientific community. One of the novelties causing the excitement of physicists is that charge carriers in graphene behave like massless relativistic particles. To benefit from the outstanding properties potentially offered by such a material, the first step is to understand how charge carriers propagate through graphene devices in order to control their motion inside the considered structures.

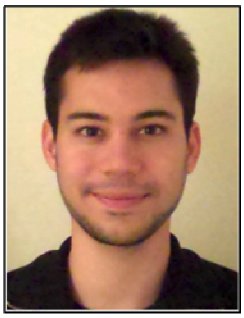
In this thesis, we present experimental results on the electronic transport inside two types of graphene-based devices : (I) nitrogen-incorporated graphene Hall bars and (II) graphene quantum ring (QR) interferometers. A particular attention was brought to the investigation of coherent effects, *i.e.* charge carrier interference phenomena, that arise when the charge carrier coherence length is comparable or larger than the device size. In addition to conventional electrical characterizations, a scanning probe technique, called scanning gate microscopy (SGM), was used to image and control at a local scale charge carrier dynamics inside mesoscopic graphene rings.

In nitrogen-incorporated graphene, our results evidence the substantial influence of the disorder induced by the presence of nitrogen atoms in the graphene lattice and/or by the surrounding environment on the quantum transport phenomena. In the case of disordered graphene rings, thanks to SGM imaging, we directly observe in real space the effect of disorder in the different transport phenomena at play.

Beside the influence of disorder, SGM mapping of the charge carrier wave functions inside graphene QRs reveals the formation of scarlike features which are found to be recurrent when varying the charge carrier energy. Patterns imaged in SGM are reminiscent of semiclassical periodic orbits scarring the local density of states along the QRs' arms. The recurrence periodicity in energy is consistent with theoretical predictions for relativistic quantum scars.

Lundi 19 décembre 2016 à 15h00

Auditoire BARB 93
Place Sainte Barbe
1348 Louvain-la-Neuve



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