Centre de Nanosciences et de Nanotechnologies

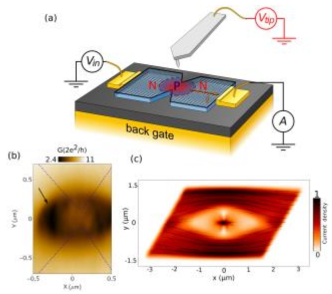
Séminaire

Jeudi 05 juillet
10 heures 30
Salle Richard Planel du C2N site Marcoussis

Boris BRUN

Université Catholique de Louvain, IMCN/NAPS, Louvain-La-Neuve (Belgium)

"Controlling Dirac fermions optics in high mobility graphene by scanning gate microscopy"



Abstract:
With the recent progresses in building high mobility graphene samples, new electron optics devices have been envisioned, mostly based on the use of p-n interfaces. At p-n boundaries Dirac fermions behave as would photons encountering a negative index media, therefore experiencing a peculiar refraction known as Veselago lensing. However the lack of tunability of p-n interfaces is an obstacle on the way towards experimental control of Dirac optics. We present a way to create a movable and highly tunable circular Veselago lens in graphene, using the polarized tip of a scanning gate microscope. We image the electron flow through this lens, and observe two points of anti-focusing along transport axis, at a distance from the lens center that depends on the incident particles energy. We explain these features using tight-binding simulations, and show that a circular n-p-n junction induces a low current density away from the junction, interpreted as anti-focusing points. We show that scanning the polarized tip in the vicinity of the constriction allows to map out the behavior of charge carriers around the tip-induced perturbation. Our work paves the way towards a deep understanding of Dirac fermions optical elements, a prerequisite to engineer relativistic electron optics devices.

The figure is in attached file, if a caption is needed:
(a) Scheme of the SGM experiment: a polarized tip is scanned above an encapsulated graphene constriction while recording its conductance.
(b) Scanning gate image obtained in a n-p-n configuration. The tip and backgate voltages are chosen to create a circular n-p-n junction. The conductance as a function of this perturbation position is shown, and highlights a spot of high conductance when the tip is at the very center of the constriction, and two spots of reduced conductance when it is placed at both entrances.
(c) Tight binding simulations of the current density around a ciruclar smooth n-p-n junction. Two spots of reduced current density are visible away from the junction, interpreted as anti-focusing points.

Other authors: N. Moreau [1] , S. Somanchi [2] , V.-H. Nguyen [1] , K. Watanabe [3] , T. Taniguchi [3] , J-C. Charlier [1] , C. Stampfer [2] & B. Hackens [1]

[1] IMCN/NAPS, Université catholique de Louvain, B-1348 Louvain-la-Neuve, Belgium
[2] ARA-FIT and 2nd Institute of Physics - RWTH Aachen, Germany
[3] National Institute for Materials Science, Namiki, Japan

Contact: rebeca.ribeiro@c2n.upsaclay.fr

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