CEA - Saclay 91191 Gif-sur-yvette Cedex
Service de Physique de l'Etat Condensé
SÉMINAIRE

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Mercredi 29 septembre 11h15

Orme des Merisiers SPEC Salle Itzykson, Bât.774

Current-Phase relation and Josephson inductance in graphene

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Graphene is a 2D crystal made of carbon atoms packed in a honeycomb structure. Ballistic transport in this outstanding material has been demonstrated either in short sample or suspended sample, by means of conductance and shot noise measurements [1-3]. We have probed recently with another powerful method the distribution of transmission eigenmodes in graphene by investigating the supercurrent phase relation (CPR) of a superconductor-graphene-superconductor junction [4]. The supercurrent corresponds to a non-dissipative current which originates from the proximity effect at the superconductor/graphene interface. So far, only switching current measurements in graphene junctions have been reported [5,6]. The CPR measurement allows us to extract the true critical current defined as the maximum of the supercurrent. The experimental setup consists of a graphene junction embedded in an LC tank circuit terminating a 50 Ohm coaxial line. Using reflection measurement of a 700 MHz signal, we have extracted the phase (φ) dependence of the Josephson inductance L_J, and successively deduced the CPR via the relation $L_J = \Phi_0.(dIs/d\varphi)^{-1}$, where Φ_0 is the flux quantum. At the charge neutrality point (CNP), we find a non-sinusoidal CPR that matches the CPR calculated from Usadel equations for a diffusive, intermediate-length junction. With increasing temperature, we observe a decrease of the non-sinusoidal character of the CPR which agrees with the diffusive calculation. Far away from the CNP, the non-sinusoidal character of the CPR increases linearly with the product $R_N I_C$ (R_N is the normal resistance), reaching close to the ballistic prediction at high charge density, in accordance with an increase of the mean free path governed by screened Coulomb impurities.

[1] F. Miao, S. Wijeratne, Y. Zhang, U.C. Coskun, W. Bao, and C.N. Lau, Science 317, 1530 (2007).
[2] R. Danneau et al., Phys. Rev. Lett. 100, 196802 (2008); J. Low Temp. Phys. 153, 374 (2008).
[3] A.F. Young and P. Kim, Nat. Phys. 5, 222 (2009).
[4] A. Fay, M. Wiesner, M.Y. Tomi, P. Lähteenmäki, and P.J. Hakonen, submitted.
[5] H.B. Heersche, P. Jarillo-Herrero, J. Oostinga, L.Vandersypen, and A. Morpurgo, Nature 446, 56 (2007).
[6] X. Du, I. Skachko, and E. Y. Andrei, Phys. Rev. B 77, 184507 (2008).

The seminar will be given in English. A coffee break will be served at 11h00.
