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Quantum Interference Channeling At Graphene Edges

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Abstract:

The influence of the edge structures on the electronic properties of graphene is a key problem for the operation of graphene nano-devices for sizes typically below 40 nm. Indeed, edge electronic states and electron scattering at edges can strongly modify the electron transport in graphene nanoribbons. Although recently electron scattering at defect sites of graphene has been studied in detail [1-3], electron scattering at graphene edges has received very little attention due to the difficulty in controlling the atomic-scale structure of graphene edges. We report the atomic-scale study of electron scattering at various edge structures of monolayer graphene by using the scanning tunneling microscope (STM) [4]. The main result is the discovery of « quantum interference channeling », whereby electron scattering at graphene edges creates quantum interference density of state patterns which are channeled along the C-C bond network. The exact shape of each quantum interference pattern depends on the edge structure and not on the electron energy. This property, unique to monolayer graphene, has important consequences for the electron transport in narrow nanoribbons. Two other aspects will be underlined. First, the quantum interference pattern observed in STM topography markedly depends on the edge structure, so it can be used to deduce the exact atomic-scale edge structure even if it is not directly visible in the STM topography. Second, we propose a completely new model for understanding quantum interferences in monolayer graphene. Previous models, used to explain quantum interferences at defect sites, are shown to fail when it comes to explaining quantum interferences at edges.

REFERENCES:

[1] G.M. Rutter, J.N. Crain, N.P. Guisinger, T. Li, P.N. First, J.A. Stroscio, "Scattering and Interference in Epitaxial Graphene", *Science*, vol. 317, 219-222, 2007.
[2] I. Brihuega, P. Mallet, C. Bena, S. Bose, C. Michaelis, F. Varchon, L. Magaud, K. Kern, J.-Y. Veuillen, "Quasiparticle Chirality in Epitaxial Graphene Probed at the Nanometer Scale", *Phys. Rev. Lett.*, vol. 101, 206802, 2008.
[3] L. Simon, C. Bena, F. Vonau, D. Auble, H. Nasrallah, M. Habar, J.C. Perruchetti, "Symmetry of standing waves generated by a point defect in epitaxial graphene", *Eur. Phys. J. B*, vol. 69, 351-355, 2009.
[4] H. Yang, A.J. Mayne, M. Boucherit, G. Comtet, G. Dujardin, Y. Kuk, "Quantun inteference channeling at graphene edges", Nano Letters, vol. 10, 943-947, 2010.