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Theoretical studies of quantum interference effects in graphene[1]

EDWARD MCCANN, Lancaster University

We review the recently-developed theory of weak localization in monolayer and bilayer graphene [Phys. Rev. Lett. 97, 146805 (2006); Phys. Rev. Lett. 98, 176806 (2007)]. Owing to the chiral nature of electrons in a monolayer of graphite (graphene) one can expect weak antilocalization and a positive weak-field magnetoresistance in it. For high-density monolayer graphene and for any-density bilayers, the dominant factor affecting weak localization properties is trigonal warping of graphene bands, which reflects asymmetry of the carrier dispersion with respect to the center of the corresponding valley. The suppression of weak antilocalization by trigonal warping is accompanied by a similar effect caused by random- bond disorder (due to bending of a graphene sheet) and by dislocation/antidislocation pairs. As a result, weak localization in graphene can be observed only in samples with sufficiently strong inter-valley scattering due to atomically sharp scatterers or by edges in a narrow wire, reflected by a characteristic form of conventional negative magnetoresistance. We show this by evaluating the dependence of the magnetoresistance of graphene on relaxation rates associated with various possible ways of breaking a "hidden" valley symmetry of the system.

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