Disorder induced magnetoresistance in graphene and other materials

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In this work we address theoretically the classical and quantum magnetotransport in graphene [1], other two dimensional materials [2], as well as 3D Weyl semimetals [3]. At room temperature, the largest contribution to the magneto-transport is classical and we predict theoretically that a disorder induced carrier density inhomogeneity causes large classical magnetoresistance (MR) in these systems. Using effective medium calculations, we predict theoretically, and in the case of graphene demonstrate experimentally, that the characteristic signature of this effect is the crossover from quadratic dependence at low magnetic fields to linear magnetoresistance at larger field. At lower temperatures, quantum phase-coherent effects can be observed in the magnetotransport, and a careful study of available experiments reveals information about the dominant scattering mechanism in these materials. This work is supported by the Singapore National Research Foundation NRF-NRFF2012-01.

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