Manifestation of electron-electron interaction in the magnetoresistance of graphene

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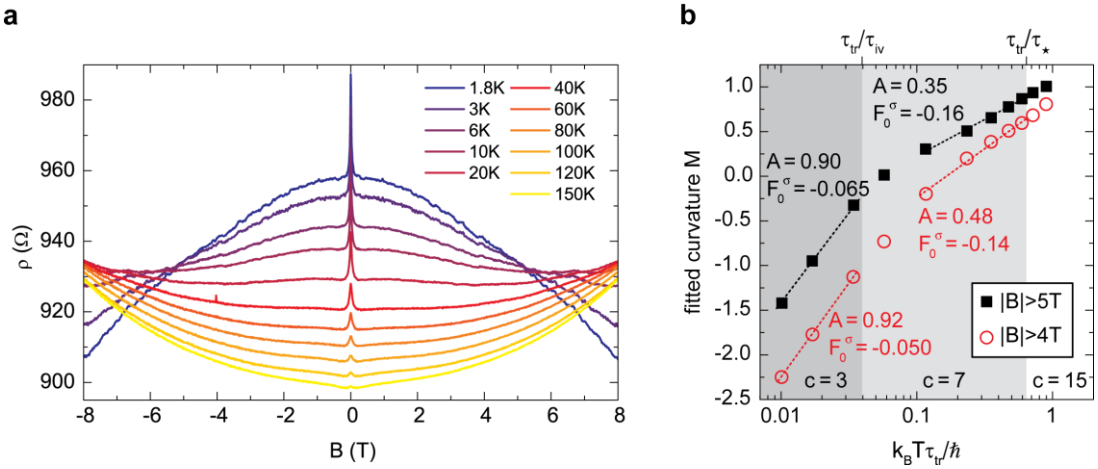
We investigate the magnetotransport in large-area graphene Hall bars epitaxially grown on silicon carbide [1]. In the intermediate field regime between weak localization and Landau quantization the observed temperature-dependent parabolic magnetoresistivity (MR) is a manifestation of the electron-electron interaction (EEI). Using the scattering times gained from a detailed analysis of the weak localization anomaly, we can consistently describe the data with a model for diffusive (magneto)transport. We find excellent agreement between the experimentally observed temperature dependence of MR and the theory of EEI in the diffusive regime. We can further assign a temperature-driven crossover to the reduction of the multiplet modes contributing to EEI from 7 to 3 due to intervalley scattering. In addition, we find a temperature independent ballistic contribution to the MR in classically strong magnetic fields. The compelling similarity of recent experiments [2] (which were attributed to Kondo physics) to the well-controlled corrections due to EEI is critically discussed.

References

[1] J. Jobst, D. Waldmann, I. V. Gornyi, A. D. Mirlin, and H. B. Weber: arXiv:1110.5893v2, accepted for publication in Phys. Rev. Lett.

[2] J.-H. Chen, L. Li, W.G. Cullen, E. D. Williams, and M. S. Fuhrer, Nature Physics 7, (2011) 535–538

Figures



***a** The magnetoresistivity displays a parabolic magnetic field dependence in between the weak localization and the Landau quantization regime. Its temperature dependent part is caused by electron-electron interaction. A detailed analysis displays a consistent description of the purely diffusive regime at not too high fields, and **b** a graphene-specific crossover to a higher number of contributing multiplet channels. Further, a crossover in strong magnetic fields (|B|>5T) is observed.*