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## Magnetoresistance of disordered graphene at high temperatures

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In graphene, the key parameter determining magnetotransport properties, a product of the cyclotron frequency and scattering time, $\omega_c \tau_q$, depends not only on magnetic field, but also on electron energy. As a result, a strong magnetoresistance arises already at the semiclassical level within the Drude-Boltzmann approach. Furthermore, for the same reason, quantum (separated Landau levels) and classical (overlapping Landau levels) regimes may coexist in the same sample at a fixed magnetic field, giving rise to an additional contribution to magnetoresistance.

We have theoretically studied magnetoresistance of graphene, focusing on the disorder-dominated transport regime with short-range impurities [1]. For short short-range impurities, the scattering time is inversely proportional to the energy: $\tau_q \sim \varepsilon^{-1}$, which gives the square-root magnetoresistance. We have calculated the conductivity tensor within the self-consistent Born approximation for graphene [2] for the case of relatively high temperature, when Shubnikov-de Haas oscillations are suppressed by thermal averaging. We demonstrate that both at very low and at very high magnetic field the longitudinal resistivity depends on magnetic field as a square root: $[\rho_{xx}(H) - \rho_{xx}(0)]/\rho_{xx}(0) = C\sqrt{H}$ , where $C$ is a temperature-dependent factor, different in the low- and strong-field limits. The cases $T >> \mu$ and $T << \mu$ were examined in details (here $T$ is the temperature and $\mu$ is the chemical potential of carriers in graphene). We also predict a non-monotonic dependence of the Hall coefficient both on magnetic field and on the electron concentration. Finally, we discuss the case of screened charged impurities, where we also predict a square-root low-field dependence of magnetoresistance.

The experimental evidence of square-root MR in monolayer grapheme was reported recently in paper [3].

[1] P. S. Alekseev, A. P. Dmitriev, I. V. Gornyi, and V. Yu. Kachorovskii arXiv 1210.6081v1 [cond-mat.dis-nn].
[2] N. H. Shon and T. Ando, Journ. of the Phys. Soc. of Japan **67**, 2421 (1998).
[3] G. Yu. Vasileva, P. S. Alekseev, Yu. L. Ivanov, Yu. B. Vasilev, D. Smirnov, H. Schmidt, R. J. Haug, F. Gouider, and G. Nachtwei, Pis'ma v ZhETP **96**, 519 (2012) [JETP Letters **96**, 471 (2012)].