On the properties of suspended graphene films as studied within relativistic Dirac model

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Relativistic Quantum field Theory (QFT) is known to be readily applicable to description of graphene optical and electronic properties [1]. It is due to the fact that quasi-particles in graphene monolayer in the low-energy approximation are described by the relativistic quasi-massless Dirac equation. Purely QFT techniques can be employed to reconstruct the ac/dc conductivity of graphene monolayer which is given in this approach by the polarization operator – the one-loop correction to the photon propagator.

The presence of parity-odd terms in the polarization tensor (equivalently the none-zero off-diagonal part of the ac conductivity) leads to rotation of polarization of light passing through suspended graphene films [2]. In external magnetic field, this corresponds to a quantum Faraday Effect. We show [3] that at low temperatures (or high magnetic fields) the angle of rotation exhibits clear Landau quantization. The magnitude of the effect is up to 10^{-2} rad which is well above the sensitivity limits of modern optical instruments. Moreover, the effect is enhanced by more then an order of magnitude at the frequencies corresponding to the transition between neighbouring Landau levels.

It appears that in QFT approach the Casimir interaction between graphene films and/or ideal conductors is defined by the same polarization tensor mentioned above. We calculate [4] the Casimir force between suspended graphene mono-layer and parallel plane ideal conductor which appears to be strongly depended on the mas gap of quasi-particles. Developing previous calculations we reveal here the influence of the non-vanishing density of carriers in graphene (the chemical potential) and non-zero temperature. The force is found to be experimentally measurable though being rather weak. Different limiting cases are also considered.

Keywords: suspended graphene, Dirack model, Faraday rotation, Casimir effect

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