THz detection by graphene field-effect transistor in magnetic fields

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Recent works (see review Ref. [1]) demonstrated the possibility of terahertz (THz) radiation detection by field effect transistor (FET), based on plasma-wave oscillation in the transistor channel. Such THz FETs can be used to create selective detectors, broadband radiation mixers, and mono-chip spectrometers. The graphene is a perspective material for the FET channel because we can expect long-lived electrically tunable plasmons in the graphene FET's channel as was shown in Ref [2].

In the present work, we study graphene nanoribbon which was used as the channel of field effect transistor. The graphene flake was exfoliated by hexagonal boron nitride. The doped Si/SiO2 was used as a substrate and is also used as a back gate. The planar log periodic antenna was connected between the source and top gate of the device as shown in Fig. 1(a).

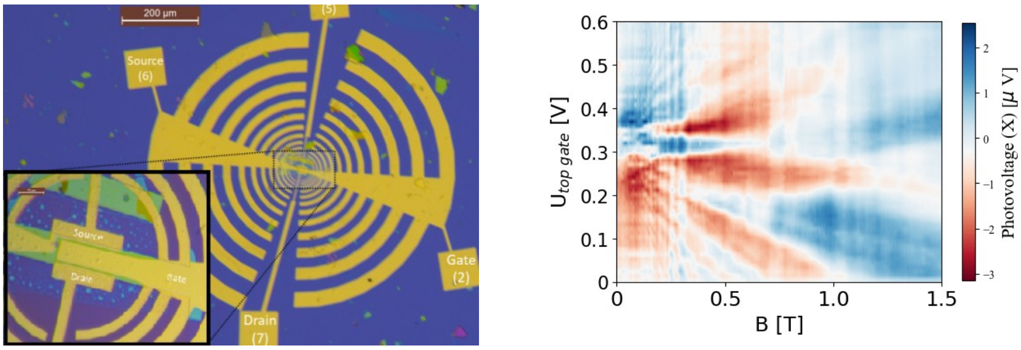

Fig. 1. a) The graphene-based FET with an antenna for THz range; b) The experimental LLs fan charts obtained by reporting the maxima of PCs as a function of the top gate voltages and magnetic field, *B*.

The peculiar band structure of the graphene translates at a sufficiently low magnetic field into specific Landau levels (LLs) spectra with linear dispersion around K-point. Energies between these LLs are non equidistant and proportionate to $(B)^{1/2}$. In the presence of pronounced Shubnikov-de Haas oscillations, an important source of nonlinearity is the oscillating dependence of the mobility on the radiation induced ac gate voltage [3]. This results in a photoresponse (PR) oscillating as a function of the magnetic field as shown in Fig. 1(b). The PR should be enhanced in the vicinity of the cyclotron resonance, in accordance with recent experiments with GaAs/AlGaAs heterostructures [4].

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