Electron-hole cooper pairing in graphene bilayer

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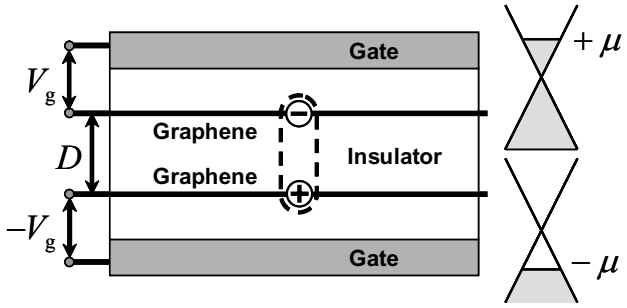
Monoatomic thickness of graphene [1] allows fabrication of bilayer structures with nanometer-scale separation between graphene layers [2, 3]. The gate electrodes can independently dope these two layers and create equal concentrations of electrons and holes in them. In these conditions, spatially separated electrons and holes can form Cooper pairs due to their Coulomb attraction [4–6].

The theory of this pairing is presented with taking into account peculiarities of electron dynamics in graphene described by the Dirac equation for massless fermions. At strong coupling, the pairing is multi-band [7, 8]. The factors leading to enlargement or reduction of gap and critical temperature are considered (static and dynamical screening of electron-hole interaction, self-consistent weakening of the screening and others). The critical temperature at achievable experimental conditions is estimated.



Schematic of graphene bilayer. Independent doping of two layers by gate voltages V_g and $-V_g$ allows to achieve equal concentrations of electrons and holes with chemical potentials μ and $-\mu$.

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