Electron-electron interactions in graphene field induced quantum dots in high magnetic field

Anna Orlof, Artsem Shylau, Igor Zozoulenko

Linköping University, 581-83 Linköping, Sweden
Anna.orlof@liu.se

Abstract

We study the effect of electron-electron interaction in graphene quantum dots defined by an external electrostatic potential and a high magnetic field. To account for the electron-electron interaction, we use the Thomas-Fermi approximation and find that electron screening causes the formation of compressible strips in the potential profile (red in Fig. 1(a)) and the electron density (red in Fig. 1(b)). We numerically solve the Dirac equations describing the electron dynamics in quantum dots, and we demonstrate that compressible strips lead to the appearance of plateaus in the electron energies as a function of the magnetic field (red in Fig. 2). Finally, we discuss how our predictions can be observed using the Kelvin probe force microscope measurements.

References


Figures

Fig. 1 (a) Electrons density vs distance; (b) potential profiles, with number of Landau Levels (LL) occupied indicated. Plateaus in the potential profile (b) and slopes in the electrons density (a) correspond to the compressible strips. Blue curves are for the model system and red ones for the screened one.

Fig. 2 Eigenenergies vs magnetic field. Energy plateaus are the result of the presence of the compressible strips in the system. The magnitude of the magnetic filed (B) is important, still due to scaling, bigger dots (bigger $l_0$ in lower magnetic field (bigger magnetic length $l_0$) lead to the same result.