Electron-electron correlation in silicene double quantum dots

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Silicene, similar to bilayer graphene [1], posses controllable band gap [2]. This allows creating the quantum dots in a controllable manner by means of electrostatic potential originating from external gates. Additionally, the spin-orbit coupling in this material is significantly enhanced [2]. These two properties make silicene a good candidate material for the study of electron-electron correlation in quantum dots.

In this work, we consider a system that consists of the finite flake of silicene with double quantum dots defined electrostatically within. We determine the confined states with the energy levels that lie in the band gap using the continuum approach with the effective Dirac equation. The considered flake is large enough to ensure the vanishing of the wave functions on the edges. Moreover, the perpendicular electric field shifts the possible edges states higher/lower in the energy out of our range of interest, making the quantum dots completely separated from the influence of the edge.

We analyze the quantum dots states as functions of the size/depth of the dots as well as the distance between them and describe the creation of the bonding/antibonding orbitals extended over the double dot system. Next, we use the one-electron states as a basis for the two-electron calculations with the configuration-interaction approach. For the electron pair we present the results as functions of the external magnetic field. We consider both, weak and strong interdot coupling limits to investigate the effects of the electron-electron interaction.

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