The finite-flake graphene quantum dots in the presence of spin-orbit coupling

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Due to the long spin decoherence time, graphene is considered as a good candidate for spintronic applications [1]. However, the spin-orbit interaction, that allows for operations on the electron spin, is very weak in the pristine graphene [2]. Hopefully, recent studies showed that adsorbed atoms on the graphene surface give rise to enhanced spin-orbit coupling [2]. The particularly important element is fluorine. Adsorbed on the graphene surface in dilute limit increases the magnitude of the spin-orbit coupling about 1000 times [3].

In this work we present the theoretical study of the quantum dots made of finite graphene flakes. We consider flakes with the top-positioned fluorine adatoms in dilute limit. We use the tight-binding model with p_z orbitals only. It has been shown that these orbitals are sufficient to description the electronic structure near the Fermi level [3]. The one electron wave function are used as a basis to build many-electron wave function in the Slater determinant form. The set of Slater determinants serves as a basis for the many-electron calculations treated by the Configuration Interaction (CI) method.

We show the one- and two- electron energy spectrum in the function of magnetic field and size of the flake. We study the spin structure of the confined states in the dots. We perform the time-dependent calculations in order to simulate the spin-valley transitions driven by the alternating electric field.

References

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