Effect of Helical Perturbation on Exciton Binding Energy in Semiconducting Carbon Nanotubes

BENJAMIN TAYO, SLAVA ROTKIN, Dept. of Phys., Lehigh University — Exciton binding energy in the presence of an external DNA-induced helical potential is studied. Exciton energies are obtained by solving the Bethe-Salpeter equation within the tight-binding approximation. The quasi-particle wavefunctions and energies which enter the Bethe-Salpeter equation are “dressed” by the one-electron helical potential. This external potential, produced by helical DNA-wrapping, is modelled by applying a perturbation operator of the Coulomb interaction which breaks both translational and rotational symmetry. This lowering of symmetry induced by DNA-wrapping has far-reaching effects: the DNA changes the band gap of the nanotube thus modulating its electronic and optical properties. For instance, the helical perturbation uplifts the degeneracy on the angular momentum quantum number $m$. The role of these effects for an exciton is elucidated.