Nanotube exciton spectrum: Triangular quantum well model. SLAVA V. ROTKIN, Lehigh University, Physics Department, 16 Memorial Dr E, Bethlehem, PA 18015, e-mail: rotkin@lehigh.edu, ALEXEY G. PETROV, Ioffe Institute, St.Petersburg, Russia — The analytical solution for the problem of NT-exciton is found using the approximation for the screened Coulomb potential between the electron and hole. We derive the screening via calculating a self-consistent dielectric function with both spatial and time dispersion taken into account, $\varepsilon(q,\omega)$, which characterizes the response to the $q$ component of the Coulomb potential at the frequency $\omega$. The latter corresponds to the energy of the exciton and is to be sought. We calculated the RPA dielectric function of the SWNT in the orthogonal tight-binding approach. Then, the inverse Fourier transform of the screened Coulomb potential gives the shape of the potential well for the electron-hole pair (direct Coulomb interaction term). We show that this screened potential can be approximated by a triangular quantum well, which model allows analytical solutions for the exciton wavefunction and the binding energy. The exchange term is short-ranged and can be added as the delta-function barrier in the middle of the well. The exciton binding energy is calculated to be a universal function of $E_g$, the one-particle band gap, $R$, the NT radius and $\lambda$, the electric length in the triangular quantum well potential. The effective Bohr radius is also a universal function of $R$ and $\lambda$. The analytical expression for the oscillator strength of the optical transition is presented.

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