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Effect of an inverse parabolic confining electric potential on third harmonic generation in cylindrical quantum wires

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Advances in nanofabrication techniques have endowed the scientific community with an avenue of obtaining nanostructures of different sizes and geometries with applications in many disciplines like medicine, optoelectronics and energy physics. Some of the interesting quantum phenomena that occur in these structures are non-linear optical processes. Examples are second harmonic generation (SHG), wherein the frequency of the incident radiation is doubled, third harmonic generation (THG), where the frequency is tripled, and so forth. A theoretical investigation of the effect of an inverse parabolic potential on third harmonic generation in cylindrical wires is presented, following Khodard R's work. The Schrödinger equation is solved within the effective mass approximation. Figure 1 depicts the THGS involving the first three low-lying states as a function of the photon energy for cylindrical wires of 100 Å (solid curve) and 120 Å (dashed curve). It turns out that peaks of the third harmonic generation susceptibility (THGS) associated with nanowires of small radii occur at larger photon energies as compared to those associated with quantum wires of larger radii. The inverse parabolic potential red-shifts peak of the THGS, and suppress the amplitude of the THGS. THGS associated with higher radial quantum numbers is diminished in magnitude and blue-shifted, as a function of the photon energy. As a function of the inverse parabolic potential, the THGS are still characterized by peaks, and the peaks shift to lower values of the potential as the photon energy increases.

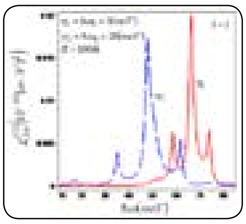

Figure 1: The variation of the THGS with the photon energy for a quantum wire of radius *R=100Å* without the inverse parabolic potential $\hbar\omega_0 = 0(meV)$ (solid plot) and with the inverse parabolic potential of strength $\hbar\omega_0 = 20\ (meV)$ (dashed plot).

Recent Publications

1. Wu J, Wang K and Peng Y (2018) Advances in synthesis and application of nanometer drug carriers. Characterization and Application of Nanomaterials 1(1):12–18.
2. Litvin A P, Martynenko I V, Purcell-Milton F, Baranov A V, Fedorov A V, et al. (2017). Colloidal quantum dots for optoelectronics. J. Mater. Chem. A 5:13252–13275.
3. Ding W-L, Peng X-L, Sun Z-Z and Li Z-S (2017) Novel bifunctional aromatic linker utilized in CdSe quantum dots-sensitized solar cells: boosting the open circuit voltage and electron injection. J. Mater. Chem. A 5:14319–14330.
4. Khordad R (2017) Third-harmonic generation in a double ring-shaped quantum dot under electron-phonon interaction. Opt. Commun. 391:121–127.
5. Santos A, Deen M J and Marsal L F (2015) Low-cost fabrication technologies for nanostructures: state-of-the-art and potential. Nanotechnology 26:042001.

Biography

Moletlanyi Tshipa earned his MSc from the University of Botswana in 2008. He served as a Teaching Assistant from 2004–2005, and as a Demonstrator from 2005–2009 at the University of Botswana. He then continued to serve as a Lecturer from 2009 to present, in the same university. As a Theoretical Physicist, his research interest range from quantum wires, quantum dots to special relativity.

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