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Effect of cross sectional-shape on electronic states in quantum wires with and without impurity: Arnoldi algorithm

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Abstract

We have studied the influence of cross sectional shape on electronic properties of various quantum wires. For this purpose, we have considered quantum wires with different cross sectional-shapes such as circular, square, hexagonal and triangular. We have calculated the ground and the first 9 excited-states energies, the binding energy and wave functions with central impurity employing the finite element method (FEM) and Arnoldi algorithm. To study effect of impurity position, we have calculated the binding energy for the triangular quantum wire with off-center impurity. There is degeneracy between energy levels without impurity. But, the degeneracy is removed between the energy levels in the presence of impurity. The energy levels and binding energy are decreased with increasing cross section area for all the quantum wires. In calculating energy levels and binding energy, the cross sectional-shape is not so important at large cross section area. The main parameter is the cross section area not size of side length.

Keywords: Quantum wires, Binding energy, Cross section

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