

## **Donor impurity related linear and nonlinear optical properties of symmetric and asymmetric double triangular quantum dots**

### **Abstract**

Linear and third-order nonlinear optical absorption coefficients and relative refractive index changes in symmetric and asymmetric double triangular quantum dots are explored theoretically. The dependence of these optical properties on the presence and position of the impurity is explored. After the computation of energies and wave functions in the framework of the effective mass and parabolic band approaches, analytical formulas for linear and nonlinear optical properties are obtained using the compact density matrix technique and the iterative method. Numerical computations for a typical GaAs/AlGaAs material are presented. The results demonstrate that the donor binding energy substantially depends on the position of the impurity and the geometry of the quantum dot and the presence and position of the donor atom has various impacts on the  $\pi$  and  $\sigma^\pm$  transitions. In addition, the estimated findings clearly reveal that the resonant frequency and the nonlinear contribution to the optical characteristics are different in symmetric and asymmetric systems. It can be inferred that the hydrogenic donor impurity plays a crucial and important function in the electrical and optical properties of the system and can be used to modify the inter-subband transitions and change the corresponding optical sensitivities.

### **Keywords**

Double triangular quantum dots; electrical properties; hydrostatic pressure; optical properties; temperature