Iranian Journal of Physics Research, Vol. 24, No. 2, 2024
DOI: 10.47176/ijpr.24.2.11827

Study of the linear and nonlinear optical properties of quantum dot molecules: Tunneling induced transparency

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(Received 19 January 2024 ; in final form 6 April 2024)

Abstract
In the present work, the linear and nonlinear optical properties of quantum dot molecules composed of two quantum dots as well as three quantum dots molecules, respectively known as double quantum dot (DQD) molecule and triple quantum dot (TQD) molecules are studied using the probability amplitude method, and the obtained results are discussed and compared. By solving the state equations of these systems in the interaction picture, under the rotating wave approximation and the dipole approximation, the first and third-order susceptibilities for DQD and TQD molecules are calculated. A phenomenon called tunneling-induced transparency (TIT) which is similar to electromagnetically induced transparency (EIT) is studied in these types of quantum dot molecules. The effect of key system parameters such as tunneling couplings between quantum dots and the tunneling intensity on the linear and nonlinear optical response of multiple quantum dot molecules DQD and TQD is investigated. It was shown that the position and the width of the TIT window created in these quantum dot molecules can be tuned by changing the physical parameters.

Keywords: quantum dot molecule, tunneling, tunneling induced transparency

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