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Comparison of optical bistability in two different hybrid optomechanical systems: Impact of quantum dot molecules

N Daneshfar and H R Foroughi*
Department of Physics, Faculty of Science, Razi University, Kermanshah, Iran

E-mail: hamidrezaforoughi477@gmail.com
ndaneshfar@razi.ac.ir

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Abstract
In this paper, optical bistability in hybrid optomechanical systems consisting of two cavities (optomechanical and conventional) coupled to each other, which contain quantum dot molecules (QDMs), is investigated and compared. For this purpose, two different configurations are studied: in the first configuration, the quantum dot molecules (QDMs) are inside the optomechanical cavity, and in the second configuration, the quantum dot molecules are inside the conventional cavity. To calculate the dynamics of the system operators, the Heisenberg-Langevin approach is used under the mean field approximation. To achieve the phenomenon of optical bistability, which is used in optical switches and optical memories, the dynamic equations of the system are solved in a steady state. The effect of the system's physical parameters, including the detuning, the number of quantum dot molecules, and the tunneling intensity of the external field, on the phenomenon of optical bistability is studied. In addition, the switching threshold and the width of the optical bistability region in two different configurations are compared. Considering that the phenomenon of optical bistability can have potential applications in all-optical switches, optical transistors, quantum computing, and quantum communication, the obtained results can be useful for the mentioned applications and system optimization.

Keywords: hybrid optomechanical cavity, optical bistability, quantum dot molecule

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