Investigation of multilevel interference resonances via transition rates in strongly driven six-level systems

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Abstract
In this paper, we study a new kind of multiphoton resonances in a strongly driven six-level quantum system, where one of its levels is coupled individually with the other two levels that have the constant energy separation $E$. Near the multiphoton resonance condition, a different behavior for the number of even or odd photons was found qualitatively, which could be explained by considering two certain interfering trajectories and computing the interference phase of system. In the regime of strong dephasing, we calculated the rates of interlevel transitions, showing that multilevel Landau-Zener (LZ) interferences between first and third order processes could lead to resonances with characteristics differing markedly from those of familiar two-level resonances that first arose at the fourth order in the couplings of the energy levels. The rates displayed resonant features at the number of integer photons. Finally, we could explicitly connect our model to the experiments, showing that it captured all relevant features of the experimental data. This paper can be relevant for a variety of solid state and atomic or molecular systems. In particular, it provides a clear mechanism to explain the puzzling experimental observations in strongly driven double quantum dots.

Keywords: double quantum dot, interference phase, strong dephasing regime, transition rate, multilevel interference resonances

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