

Abstract Submitted
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Tunneling, dipole interactions and coherent Rabi oscillations in quantum dot molecules.¹ JUAN E. ROLON, JOSE M. VILLAS-BOAS, SERGIO E. ULLOA, Ohio University — Quantum dot molecules (QDMs) - coupled quantum dot systems - have proved to be a promising optoelectronic circuit element for future implementation of quantum computation at the nanoscale. Here we investigate theoretically the coherent manipulation between exciton states in a single QDM. In particular, we study Rabi oscillations induced via strong laser pumping and their dependence on the interdot quantum coupling strength, including particle interdot tunneling and Coulomb interactions. The dynamics of the system is extracted by solving a quantum master equation using a multilevel density matrix that considers direct and indirect excitons in a rotating wave approximation. Possible decoherence mechanisms, such as coupling to wetting layer states and non-radiative recombination, are incorporated into the master equation using a Lindblad formulation. Careful control of the interdot coupling strength, laser detuning, and intensity, results in different population level dynamics. These are found to be critical for the entanglement between exciton states and the ultimate realization of Bell states for potential quantum information processing.

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Sergio Ulloa
Ohio University

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