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Probing Coherent Optical Response of Coupled Excitons and Spin States in a Quantum Dot Molecule

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Abstract

Measurement-based protocols for quantum technologies require on-demand sources of multi-dimensional photonic cluster states. Photonic cluster states with two-dimensional entanglement structure can be generated using a pair of vertically stacked and tunnel-coupled quantum dots known as a quantum dot molecule (QDM). The protocols to create these cluster states rely on the coherent excitation of tunnel-coupled and spatially indirect excitonic transitions from well-defined few-spin states. Here, we explore the coherent response of spatially direct and indirect excitons to a pulsed Rabi drive as the degree of hybridization of the electron wave function is electrically tuned. In addition, we also show that the phonon-mediated orbital relaxation from antibonding to bonding coupled orbitals is spin conserving.