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Optimal quantum control via numerical pulse shape optimization for two exciton qubits confined to semiconductor quantum dots REUBLE MATHEW, HONG YI SHI YANG, KIMBERLEY HALL, Department of Physics and Atmospheric Science, Dalhousie University, Halifax, Nova Scotia, Canada — Optimal quantum control (OQC), which iteratively optimizes the control Hamiltonian to achieve a target quantum state, is a versatile approach for manipulating quantum systems. For optically-active transitions, OQC can be implemented using femtosecond pulse shaping which provides control over the amplitude and/or phase of the electric field. Optical pulse shaping has been employed to optimize physical processes such as nonlinear optical signals [1], photosynthesis [2], and has recently been applied to optimizing single-qubit gates in multiple semiconductor quantum dots [3]. In this work, we examine the use of numerical pulse shape optimization for optimal quantum control of multiple qubits confined to quantum dots as a function of their electronic structure parameters. The numerically optimized pulse shapes were found to produce high fidelity quantum gates for a range of transition frequencies, dipole moments, and arbitrary initial and final states. This work enhances the potential for scalability by reducing the laser resources required to control multiple qubits.

[1] Bartels, R. et al., Nature 2000, 406, 164-166.
[2] Herek, J. L. et al., Nature 2002, 417, 533-535.
[3] Gamouras, A. et al; Nano Lett. 2013, 13(10), 4666-4670.

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