Optimal control of a charge qubit in a double quantum dot with a Coulomb impurity

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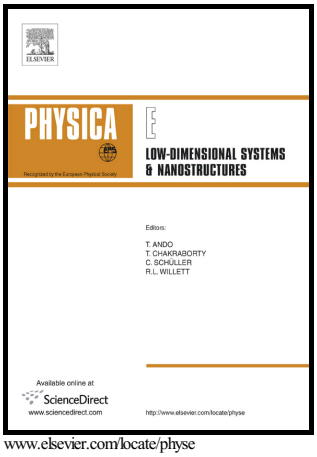

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Optimal control of a charge qubit in a double quantum dot with a Coulomb impurity

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Abstract. We study the efficiency of modulated external electric pulses to produce efficient and fast charge localization transitions in a two-electron double quantum dot. We use a configuration interaction method to calculate the electronic structure of a quantum dot model within the effective mass approximation. The interaction with the electric field is considered within the dipole approximation and optimal control theory is applied to design high-fidelity ultrafast pulses in pristine samples. We assessed the influence of the presence of Coulomb charged impurities on the efficiency and speed of the pulses. A protocol based on a two-step optimization is proposed for preserving both advantages of the original pulse. The processes affecting the charge localization is explained from the dipole transitions of the lowest lying two-electron states, as described by a discrete model with an effective electron-electron interaction.