Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Qubit extraction and manipulation in optically-driven self-assembled quantum dot molecules.[1] J.E. ROLON, S.E. ULLOA, Ohio University — Semiconductor quantum dot molecules (QDMs) allow studies of different mechanisms of coherent optoelectronic control of excitonic states in the pursuit of stable and well characterized qubits. In this work, we develop a realistic calculation of the dressed spectrum and exciton dynamics of InAs/GaAs QDMs. The dressed spectrum contains electron and hole tunneling as well as exciton Förster resonant energy transfer (FRET) level anticrossing signatures, from which we derive an effective Hamiltonian using a projection operator formalism. The state dynamics is analyzed using a multilevel Lindblad master equation, in which the projected density matrix is obtained by partial tracing of the irrelevant exciton degrees of freedom. We find that the interplay of FRET and carrier tunneling can produce a charge qubit subspace whose indirect exciton character makes it resilient to lifetime limited decoherence. Furthermore, it is shown that a set of universal quantum gates can be constructed and its unitarity assured by the application of an external electric field that prevents the mixture of qubit subspace dynamics with other excitonic degrees of freedom, present upon optical excitation.

[1]Supported by NSF-DMR MWN and OU-BNNT.

Juan E Rolon
Ohio University

Date submitted: 21 Nov 2008 Electronic form version 1.4