Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

**Optimal electric control for two-spin single- and two-qubit operations in gated double quantum dots** GUY RAMON, Department of Physics, Santa Clara University, XUEDONG HU, Department of Physics, University of Buffalo, SUNY — We consider gate operations on qubits encoded in the singlet and unpolarized triplet states of pairs of spins localized in biased double quantum dots. Assuming a capacitively coupled pair of double dots, the Coulomb couplings between the two qubits are calculated by considering their charge distributions within a multipole expansion. For single qubit gates our proposed architecture builds on the recently demonstrated nuclear magnetic field gradient between the dots (for $X$-rotations) and the effective exchange energy that takes into account the presence of the second qubit (for $Z$-rotations). Our calculated entangling coupling between the two qubits demonstrates six orders-of-magnitude tunability with bias, allowing for efficient two-qubit gates. Our analysis highlights the distinct effects of the control qubit and fluctuating charge environment on the performance of the target qubit, where the former contributes to gate errors and the latter to spin dephasing. We are thus able to propose an optimal qubit design and working points for single- and two- qubit operations, as well as optimal idle positions.

Guy Ramon
Department of Physics, Santa Clara University

Date submitted: 19 Nov 2009 Electronic form version 1.4