Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Exchange coupling between hole qubits and between electron qubits in quantum dot molecules[1] ALEX GREILICH[2], STEFAN C. BADESCU[3], DANNY KIM[4], ALLAN S. BRACKER, DANIEL GAMMON, NRL, Washington, DC — The exchange interaction between electron spins has been a paradigm for solid-state implementation of quantum gates. Holes are receiving an increasing attention for their reduced hyperfine coupling as compared to electrons in III-V semiconductors. Besides the isotropic exchange, both electrons and holes couple through spin-nonconserving interactions. Here we present detailed experimental evidence of these interactions for electrons and for holes in stacked InAs/GaAs quantum dots, achieved through electrical and magnetic fields that induce energy level resonances. Particularly large spin-mixing effects are found for holes, which involve their multi-band structure. We provide a theoretical understanding of the essential mixing mechanisms involved, tracing them down to system asymmetries and inhomogeneities.

[1]This work was supported in part by DARPA and ONR
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Date submitted: 22 Dec 2010 Electronic form version 1.4