Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

The role of electron-hole exchange in the spin mixing of excited-shell excitons in quantum dots[1] STEFAN C. BADESCU, THOMAS L. REINECKE, U.S. Naval Research Laboratory — In semiconductor quantum dots (QDs) the long-range electron-hole exchange is known to lift the spin degeneracy of ground orbital state excitons for small lateral asymmetries. In the context of solid-state quantum computing recent developments in optical manipulation of spin involve the excited shells of charged excitons in single and coupled QDs. We demonstrate here that this electron-hole exchange is important in the mixing of spin states of excitons in higher shells in QDs, e.g., the p-shell exciton. In contrast to the ground states, no lateral asymmetry is necessary for simultaneous reversal of an electron and a hole spin in these excited shells. For charged excitons, this interaction competes with the asymmetric exchange between electrons or between holes. We discuss the optical selection rules and the role of decoherence from phonons for the dynamics of excited excitons. We conclude that the e-h exchange is an important factor in designing logical gates with excited states.

[1]This work is supported by the Office of Naval Research.

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Date submitted: 27 Nov 2007 Electronic form version 1.4