Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Asymmetric electron-electron exchange in a single quantum dot STEFAN C. BADESCU, NRL, Washington DC, YULI B. LYANDA-GELLER, Purdue Univ, West Lafayette IN, THOMAS L. REINECKE, NRL, Washington DC — Recent photoluminescence experiments on negative trions in a self-assembled quantum dot [1] reveal a high dephasing rate inconsistent with the electron-hole exchange mechanism. We find, however, that this rate can be explained by the asymmetric electron-electron exchange due to electron spin-orbit coupling in the excited singlet and triplet states. The necessary and sufficient condition for the existence of asymmetric exchange is the lack of inversion symmetry in the plane transverse to the growth direction. We develop a model that describes the two relevant cases of this asymmetry: when the system has a single reflection plane along the growth axis, and when the system has no reflection plane along the growth axis. These asymmetries are characteristic for shapes of self-assembled quantum dots. We find typical values for the dephasing part of the asymmetric exchange that are $\sim 10^{-1}$ of the symmetric exchange. We also find that the asymmetric exchange is important for electron spin relaxation when the triplet states with non-zero projection of spin are brought into resonance with the singlet. [1] Ware M.E. et al – Phys. Rev. Lett. 95(17), 177403 (2005)

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Date submitted: 30 Nov 2005 Electronic form version 1.4