Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Towards isolating a single impurity-bound hole RUSSELL BARBOUR, TODD KARIN, KAI-MEI FU, University of Washington, YOSHIRO HIRAYAMA, Tohoku University, ARNE LUDWIG, ANDREAS WIECK, Ruhr-Universität Bochum — Single acceptor-bound holes embedded in III-V semiconductor quantum wells could provide an ideal qubit system for scalable quantum information processing and quantum computation. This system combines strong homogenous optical transitions and millisecond long spin coherence times in a fabrication ready material (GaAs). However, single acceptor-bound excitons (A^0X) have yet to be optically isolated even in the purest bulk GaAs samples. This is primarily due to the high acceptor density (10^{14} cm^{-3}) and exceptional optical homogeneity. We propose using stimulated emission depletion microscopy (STED) to increase our optical resolution far beyond the diffraction limit in order to spatially isolate a single acceptor-bound exciton. We report the first demonstration of stimulated emission of acceptor-bound excitons at 4.2K. We resonantly excite the $A^0$1s-A^0X transition and apply a second laser with high power (P=10mW) resonant with the 2s two-hole transition (THT). We observe a 30 percent reduction in the 1s PL intensity when the STED laser is resonant with the THT's. We will present our two-laser spectroscopy work that explores this coherent system and discuss our progress towards isolating a single acceptor-bound exciton using STED microscopy.

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Date submitted: 17 Nov 2012