Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Time-resolved nonlinear dynamics of quantum dots coupled to a photonic crystal cavity in the Purcell regime JIEUN LEE, TIMOTHY SAUCER, Department of Physics, University of Michigan, ANDREW MARTIN, JOANNA MILLUNCHICK, Department of Materials Science and Engineering, University of Michigan, VANESSA SIH, Department of Physics, University of Michigan
— Recently, there has been great interest in studying the optical nonlinearities of light confined in a solid-state nano-cavity interacting with a quantum emitter for on-chip applications. The nonlinearity in the strong coupling regime has enabled ultrafast all-optical switching at low incident power using exciton-photon coupled systems. In this report, we show that nonlinear optical properties can also be observed in the Purcell regime using a cavity with a moderate quality factor (Q), which arises from the saturation of a single quantum dot and describes the time-resolved dynamics of two transitions (exciton and biexciton) exhibiting different nonlinearities. In order to conduct these investigations, we used the luminescence intensity autocorrelation method and measured the variation of nonlinear emission dynamics while varying the incident power over nearly three orders of magnitude and found excellent agreement with a numerical simulation. We expect the method and the theoretical model will be applicable for understanding other nonlinear effects such as lasing and cavity-QED.

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Date submitted: 06 Nov 2012 Electronic form version 1.4