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Optical tuning of single quantum dots coupled to photonic crystal molecules using the optical Stark effect RANOJOY BOSE, University of Maryland,College Park, KAUSHIK ROY, TAO CAI, University of Maryland, College Park, GLENN S. SOLOMON, NIST-Gaithersburg, and Joint Quantum Institute, University of Maryland, College Park, EDO WAKS, University of Maryland, College Park — The interaction of semiconductor quantum dots (QD) with photonic crystal resonator systems provides a highly integrated, solid-state platform for studies in ultra-low energy nonlinear optics and quantum optical phenomena. Here, we present a method to tune a semiconductor quantum dot (QD) all-optically into resonance with a cavity mode using the non-resonant optical Stark effect. We use a system comprised of two evanescently coupled photonic crystal cavities containing a single QD in one of the cavities. One mode of the coupled cavity system is used to generate a cavity-enhanced optical Stark shift, enabling the QD to be resonantly tuned to the other cavity mode. We show that the optical tuning of the QD results in a large radiative enhancement of the QD photon emission via the Purcell effect. We will further discuss dynamic experiments in the system using a Stark laser that has a time-duration on the order of the system decay rates. We will show that under this scenario, the cavity-QD spectrum provides a rich array of information on the system dynamics. The experiments are promising for a variety of applications in highly-efficient single photon generation, cavity quantum electrodynamics, ultra-fast optical switching, and classical and quantum information processing.

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