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Cavity QED in a Quantum Dot Molecule Coupled to a Photonic Crystal Cavity PATRICK VORA, NRC Postdoctoral Associate at the Naval Research Laboratory, SAMUEL CARTER, CHUL SOO KIM, Naval Research Laboratory, MIJIN KIM, Sotera Defense Solutions, TIMOTHY SWEENEY, LILY YANG, NRC Postdoctoral Associate at the Naval Research Laboratory, PETER BRERETON, US Naval Academy, ALLAN BRACKER, DANIEL GAMMON, Naval Research Laboratory — Semiconductor quantum dots (QDs) are a promising system for quantum information. InAs QDs grown within a GaAs diode heterostructure can be charged with a single electron, thereby serving as a spin qubit, and can easily be integrated with photonic circuits. An alternative qubit is the quantum dot molecule (QDM), a pair of QDs separated by a tunnel barrier. QDMs can be charged with two electrons that form spin singlet and triplet ground states which are less susceptible to nuclear spin effects. Furthermore, QDMs allow radiative recombination between carriers localized on different QDs. These interdot transitions can be tuned over a large range with applied voltage making them attractive as single photon sources. We have demonstrated coupling between a QDM and a two-dimensional photonic crystal cavity. A number of novel cavity-QED phenomena have been observed such as Purcell enhancement of interdot transitions, cavity-assisted Raman scattering, Autler-Townes splitting, and a cavity-induced AC Stark effect in a solid state Λ system. These results have important implications for highly tunable single photon sources and also the development of a quantum network within a photonic crystal structure.

Patrick Vora
NRC Postdoctoral Associate at the Naval Research Laboratory

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