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Hybrid Circuit QED with Double Quantum Dots[1]

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Cavity quantum electrodynamics explores quantum optics at the most basic level of a single photon interacting with a single atom. We have been able to explore cavity QED in a condensed matter system by placing a double quantum dot (DQD) inside of a high quality factor microwave cavity. Our results show that measurements of the cavity field are sensitive to charge and spin dynamics in the DQD.[2,3] We can explore non-equilibrium physics by applying a finite source-drain bias across the DQD, which results in sequential tunneling. Remarkably, we observe a gain as large as 15 in the cavity transmission when the DQD energy level detuning is matched to the cavity frequency. These results will be discussed in the context of single atom lasing.[4] I will also describe recent progress towards reaching the strong-coupling limit in cavity-coupled Si DQDs.

[1]In collaboration with Manas Kulkarni, Yinyu Liu, Karl Petersson, George Stehlik, Jacob Taylor, and Hakan Tureci. We acknowledge support from the Sloan and Packard Foundations, ARO, DARPA, and NSF.

[2]M. D. Schroer, M. Jung, K. D. Petersson, and J. R. Petta, "Radio frequency charge parity meter," Phys. Rev. Lett. **109**, 166804 (2012).

[3]K. D. Petersson, L. W. McFaul, M. D. Schroer, M. Jung, J. M. Taylor, A. A. Houck, and J. R. Petta,"Circuit quantum electrodynamics with a spin qubit," Nature (London) **490**, 380 (2012).

[4]Y.-Y. Liu, K. D. Petersson, J. Stehlik, J. Taylor, and J. R. Petta, "Photon emission from a cavity-coupled double quantum dot," (in preparation).