MAR17-2016-020015

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Many-body quantum optics with superconducting circuits

NEEREJA SUNDARESAN, Princeton University

Circuit QED is a versatile experimental platform for building complex quantum systems that realize novel strong light-matter and many body interactions. Due to drive and dissipation, these circuits are fundamentally open systems and are intrinsically suited for studying non-equilibrium steady state physics. I will share a few recent experiments that capture some of the unique domains accessible with superconducting circuits. In one experiment we realize multimode strong coupling, where a single qubit is simultaneously coupled to a large, but discrete, number of microwave cavity modes, with qubit-mode coupling strengths comparable to the free spectral range. In a parallel effort, we strongly couple qubits to an effective 1D photonic bandgap crystal. In this structure, qubit-photon dressed bound states introduce a unique pathway to mediate qubit-qubit interactions via the tunable spatial overlap of their respective photonic wavefunctions. I will also present results from a larger system, a one-dimensional chain of 72 cavities coupled to qubits, where we coherently drive the system into a non-equilibrium steady state. In this system, we find experimental evidence for a dissipative phase transition. Combining the flexibility offered by circuit design and recent progress in characterizing and understanding quantum systems, these experimental directions are a few of the rich avenues ready for study.