Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Coupling a Transmon Qubit to a Superconducting Metamaterial Resonator HAOZHI WANG, M. HUTCHINGS, SAGER INDRAJEET, FRANCISCO ROUXINOL, MATTHEW LAHAYE, B.L.T. PLOURDE, Syracuse Univ, BRUNO G. TAKETANI, FRANK K. WILHELM, Saarland University — Arrays of lumped circuit elements can be used to form metamaterial resonant structures that exhibit significantly different mode structures compared to resonators made from conventional distributed transmission lines. In particular, it is possible to produce a high density of modes in the microwave regime where a superconducting qubit can be operated and coupled to the various modes. We will present our low-temperature measurements of such a superconducting metamaterial resonator coupled to a tunable transmon qubit. By tuning the magnetic flux biasing the qubit, we observe vacuum Rabi splittings in the modes that the qubit transition passes through. We will also discuss our measurements of an interaction between neighboring modes of the metamaterial system that is mediated by the qubit. Because of the dispersive coupling of the qubit to the various modes of the system, driving a microwave tone near one mode of the system can have a significant influence on the transmission through another mode, with a strong dependence on the bias point of the qubit. We will compare these measurements with a theoretical model of the system.

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Date submitted: 06 Nov 2015 Electronic form version 1.4