

Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Metamaterials for circuit QED: Quantum simulations and other applications BRUNO G. TAKETANI, FRANK K. WILHELM, Saarland University — The ability to design periodically structured materials not present in nature provides scientists with new tools, ranging from sub-wavelength imaging to well controlled band structures for wave propagation in photonic crystals. Superconducting metamaterials have been recently proposed to manipulate the density-of-modes of transmission lines [D. J. Egger and F. K. Wilhelm, Phys. Rev. Letters **111**, 163601 (2013)]. We further build on these ideas and develop a toolbox for environment manipulation based on nano-structured, periodic, lossless, superconducting circuits. In particular we show that high density of low energy states can be achieved using a superlattice arrangement of left-handed circuit elements. Multimode, ultra-strong coupling of superconducting qubits to such engineered environments thus allow for experimental implementation of quantum simulation of interesting new phenomena as well as for complex quantum state engineering.

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Date submitted: 13 Nov 2013

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