Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Analog quantum simulation of the Rabi model in the ultra-strong coupling regime JOCHEN BRAUMÜLLER, MICHAEL MARTHALER, ANDRE SCHNEIDER, ALEXANDER STEHLI, HANNES ROTZINGER, MARTIN WEIDES, ALEXEY V. USTINOV, Karlsruhe Institute of Technology — The quantum Rabi model describes the fundamental mechanism of light-matter interaction. It consists of a two-level atom or qubit coupled to a quantized harmonic mode via a transversal interaction. In the weak coupling regime, a rotating wave approximation can be applied and the quantum Rabi Hamiltonian reduces to the well-known Jaynes-Cummings Hamiltonian. In the ultra-strong coupling regime, where the effective coupling strength g is comparable to the energy ω of the bosonic mode, the counter rotating terms can no longer be neglected, revealing remarkable features in the system dynamics. Here, we demonstrate an analog quantum simulation of the quantum Rabi model in the ultra-strong and close deep strong coupling regime. The quantum hardware of the simulator is a superconducting circuit embedded in a cQED setup. The simulation scheme is based on the application of two classical transversal microwave drive pulses used to engineer the desired effective Hamiltonian. We observe a fast quantum state collapse followed by periodically recurring quantum revivals of the initial qubit state, which is the most distinct signature of the synthesized model. We achieve a relative coupling ratio of $g/\omega \sim 0.7$, approaching the deep strong coupling regime.

Jochen Braumller
Karlsruhe Institute of Technology

Date submitted: 13 Nov 2016 Electronic form version 1.4