Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Emulating a mesoscopic system using superconducting quantum circuits YU CHEN, R. BARENDS, J. BOCHMANN, B. CAMPBELL, B. CHIARO, E. JEFFREY, J. KELLY, M. MARIANTONI, A. MEGRANT, J. MUTUS, C. NEILL, P. O'MALLEY, S. OHYA, P. ROUSHAN, D. SANK, A. VAINSENCHER, J. WENNER, T. WHITE, A.N. CLELAND, J.M. MARTINIS, UC Santa Barbara —
We demonstrate an emulation of a mesoscopic system using superconducting quantum circuits. Taking advantage of our ReZQu-architectured quantum processor, we controllably splitted a microwave photon and manipulated the splitted photons before they recombined for detection. In this way, we were able to simulate the weak localization effect in mesoscopic systems - a coherent backscattering process due to quantum interference. The influence of the phase coherence was investigated by tuning the coherence time of the quantum circuit, which in turn mimics the temperature effect on the weak localization process. At the end, we demonstrated an effect resembling universal conductance fluctuations, which arises from the frequency beating between different coherent backscattering processes. The universality of the observed fluctuation was shown as the independence of the fluctuation amplitude on detailed experimental conditions.

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Date submitted: 08 Nov 2012 Electronic form version 1.4