Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Suppression of dephasing by qubit motion in superconducting circuits[1] D.V. AVERIN, Dep-t of Physics and Astronomy, Stony Brook University, SUNY, K. HU, Y. P. ZHONG, C. SONG, H. WANG, Dep-t of Physics, Zhejiang University, China, S. HAN, Dep-t of Physics and Astronomy, University of Kansas
— We suggest and demonstrate a protocol which suppresses dephasing due to the low-frequency noise by qubit motion, i.e., transfer of the logical qubit of information in a system of $n \geq 2$ physical qubits. The protocol requires only the nearest-neighbor coupling and is applicable to different qubit structures. Motion of a logical qubit limits the correlation time of the effective noise seen by this qubit and suppresses its decoherence rate. This effect is qualitatively similar to the dynamic decoupling, but relies on the different resource: additional physical qubits, not extra control pulses. In this respect, suggested protocol can serve as the basis for an alternative approach to scalable quantum circuits. We further analyze its effectiveness against noises with arbitrary correlations. Our analysis, together with experiments using up to three superconducting qubits, shows that for the realistic uncorrelated noises, qubit motion increases the dephasing time of the logical qubit as $\sqrt{n}$. In general, the protocol provides a diagnostic tool for measurements of the noise correlations.

[1]This work was supported by the National Basic Research Program of China (2014CB921200, 2012CB927404), US NSF grants PHY-1314758 and PHY-1314861, the National Natural Science Foundation of China, and Zhejiang Provincial Natural Science Foundation

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Date submitted: 05 Nov 2015 Electronic form version 1.4