MAR16-2015-007684

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Increasing error resilience in superconducting qubits based on symmetries and parametric protocols[1]

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The field of superconducting quantum computing has seen remarkable advances in the past decade, and is getting closer to realizing logical qubits partially stabilized by error correction. However, achieving full scalability necessary to build a universal quantum computer remains a significant challenge which calls for new ideas to make superconducting qubits even more resilient with respect to external noise and fabrication imperfections. Past breakthroughs in this direction include circuit QED enabled measurement and long-range interactions; reliably long coherence times in transmon qubits; and additional coherence improvements by the use of 3D cavities. Here we review previous work on topological protection in superconducting circuit networks, and report on new efforts, in experiment and theory, to increase autonomous error protection of superconducting qubits by harnessing symmetry properties of circuit Hamiltonians and employing parametric processes for robust manipulation and storage of quantum information.

[1]This talk is based on joint work with Andrew Houck and David Schuster.
[2]This is joint work with Jens Koch and Andrew Houck