Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Sorting Category: 17.1.1 (T)

Pure dephasing in flux qubits due to flux noise with spectral density scaling as $1/f^{\alpha}$[1] STEVEN ANTON, UC Berkeley, C. MULLER, Univ de Sherbrooke, J.S. BIRENBAUM, S.R. O'KELLEY, A.D. FEFFERMAN, UC Berkeley, D.S. GOLUBEV, Karlsruhe Institute of Technology, G.C. HILTON, H.-M. CHO, K.D. IRWIN, NIST, Boulder, F.C. WELLSTOOD, Univ of Maryland, GERD SCHON, A. SHNIRMAN, Karlsruhe Institute of Technology, JOHN CLARKE, UC Berkeley — Magnetic flux noise is a major source of pure dephasing in superconducting flux qubits. This noise, common to SQUIDs, is believed to arise from localized electrons whose spins reverse randomly. We present representative measurements on dc SQUIDs over a range of temperatures showing, in general, $S_\Phi(f) = A^2/(f/(1\text{ Hz}))^\alpha$. In our measurements, A is of the order of 1 $\mu\Phi_0\text{Hz}^{-1/2}$ and $0.6 < \alpha < 1$. Motivated by these results, for arbitrary values of α we calculate pure dephasing times for both Ramsey and echo pulse sequences assuming linear coupling between the energy level splitting and the flux through the qubit. We find that the dephasing time τ_ϕ decreases dramatically as α is reduced. In addition, the frequency bandwidth to which the qubit is sensitive—defined by the infrared and ultra-violet cutoff frequencies—can significantly affect τ_ϕ in a manner depending on the type of sequence and value of α. For each sequence, τ_ϕ becomes independent of the ultraviolet cutoff frequency when its value exceeds $1/\tau_\phi$. Finally, we present calculated dephasing times corresponding to our measured spectra.

[1]This work was supported by ARO and IARPA.

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[X] Prefer Oral Session
[ ] Prefer Poster Session

Date submitted: 16 Dec 2011

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