Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Decoherence and energy shift in phase qubits due to nonequilibrium quasiparticles M. LENANDER, R.C. BIALCZAK, E. LUCERO, M. MARIANTONI, A. O'CONNELL, M. NEELEY, D. SANK, H. WANG, M. WEIDES, J. WENNER, T. YAMAMOTO, Y. YIN, J. ZHAO, A.N. CLELAND, J.M. MARTINIS — Nonequilibrium quasiparticle excitations are thought to be an important source of decoherence in Josephson qubits. We present a model analogous to the Mattis-Bardeen theory wherein the effects of quasiparticles introduce a complex environmental impedance to the junction. The real part causes energy relaxation in the qubit while the imaginary part causes a frequency shift. We present experimental data comparing these effects while injecting nonequilibrium quasiparticles into the system. The theory is used to qualitatively check the injection process. Then by comparing the decay rate and frequency shift, we quantitatively verify the theory without the need to directly measure the quasiparticle density. Agreement between theory and experiment is observed to within experimental uncertainty, about 10%. We examine infrared radiation as a source of nonequilibrium quasiparticles. Using these new tools, we hope to develop methods for improving qubit performance and to bound the contribution to energy decay from quasiparticles.

Michael Lenander

Date submitted: 19 Nov 2010

Electronic form version 1.4