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Seminar

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Suppressing quasiparticle-noise of the environment in superconducting qubits

Superconducting qubits are among the most promising candidates for quantum information processing. An important decoherence mechanism for these qubits originates from an intrinsic type of environment noise: quasiparticle tunneling through the Josephson junction. In this talk, I will review qubit relaxation induced by quasiparticle tunneling and discuss some experiments showing that quasiparticles are limiting the qubit coherence. I then explain how a normal-metal island in tunnel contact with the superconducting electrode of a qubit can act as a sink for quasiparticles. We developed theoretically and validated experimentally a model for the effect of a single small trap on the dynamics of excess quasiparticles injected in a transmon-type qubit [1]. Optimizing quasiparticle traps is possible so long as the trap size is larger than a certain characteristic length. Such optimized traps lead to quick evacuation of the excess quasiparticle density and at the same time suppression of the steady-state density and its fluctuations- this can render the qubit longer-lived and more stable in time [2]. We then study superconducting proixmity effect due to trap-qubit contact. The competition between proximity effect and quasiparticle density suppression leads to an optimal trap-junction distance at which the qubit relaxation time is significantly enhanced. We find this optimal distance as a function of effective temperature and trap-qubit coupling [3].

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[1] R.-P. Riwar, A. Hosseinkhani, L. D. Burkhart, Y. Y. Gao, R. J. Schoelkopf, L. I. Glazman and G. Catelani, Phys. Rev. B 94, 104516 (2016) [2] A. Hosseinkhani, R.-P. Riwar, R. J. Schoelkopf, L. I. Glazman, and G. Catelani, Phys. Rev. Applied 8, 064028 (2017) [3] A. Hosseinkhani and G. Catelani, Phys. Rev. B 97 054513 (2018)