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Quantum Engineering of Superconducting Qubits

We revisit the design, fabrication, and control of the superconducting flux qubit. By adding a high-Q capacitor, we dramatically improve its reproducibility, anharmonicity, and coherence, achieving T1 = 55 us and T2 = 90 us [1]. We identify quasiparticles as a leading cause of temporal variability in T1. We introduce and demonstrate a stochastic control technique that effectively pumps away these quasiparticles and thereby stabilizes and improves T1 [2]. We discuss the 3D integration of this qubit into architectures of interest for quantum annealing applications.
For more information:
[1] F. Yan et al., Nature Communications 7, 12964 (2016)
[2] S. Gustavsson et al., Science 354, 1573 (2016)