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Protected phase gates for superconducting qubits PETER BROOKS, JOHN PRESKILL, California Institute of Technology — Quantum systems with inherent error-correcting properties offer a powerful tool for building quantum computers to be insensitive to the effects of errors. Kitaev [arXiv:cond-mat/0609441] has proposed an intrinsically fault-tolerant qubit design based on superconducting systems. The phase gate $\Lambda(i)$ in this system is performed by coupling the qubit to a quantum LC oscillator for a period of time. The evolution of the oscillator can be understood as being protected by a family of continuous variable quantum codes at every point in its evolution, providing natural robustness against random variations in the duration and strength of the coupling. We present the results of numerical simulations of this system which investigate the fidelity of the phase gate operation as a function of the duration mistiming. We discuss the robustness of the gate under the effect of anharmonic perturbations to the oscillator and oscillator coupling, and adiabaticity requirements for this scheme to properly function.

Peter Brooks
California Institute of Technology

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