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Minimizing environmental decoherence for a superconducting phase qubit - transmon architecture RAMI BARENDS, J. WENNER, M. LENANDER, Y. CHEN, J. KELLY, J. BOCHMANN, B. CHIARO, E. LUCERO, P. O'MALLEY, M. MARIANTONI, A. MEGRANT, C. NEILL, D. SANK, P. ROUSHAN, A. VAINSENCHER, H. WANG, T. C. WHITE, Y. YIN, A. N. CLELAND, JOHN M. MARTINIS, UC Santa Barbara, J. J. A. BASELMANS, SRON Netherlands Institute for Space Research — The coherence of superconducting quantum systems is currently a major obstacle towards high gate fidelity and long-lived memory. We found that quasiparticle generation from stray infrared light is a significant source of energy relaxation. We show that resonator quality factors and phase qubit energy relaxation times are limited by a quasiparticle density of approximately 200 μm^{-3}, induced by 4 K blackbody radiation from the environment. We demonstrate how this influence can be fully removed by isolating the devices from the radiative environment using multistage shielding. In addition, we analyze the decoherence due to circuitry in our new phase qubit-transmon architecture. This architecture - consisting of transmon qubits, resonators, and phase qubits using a frequency domain multiplexed readout - is less affected by Purcell decay. At present, fabrication of samples is ongoing.

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