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Improved Phase Qubit with Low-Loss Shunt Capacitance DAVID HOVER, YUNG-FU CHEN, STEVEN SENDELBACH, ROBERT MCDERMOTT, Department of Physics, University of Wisconsin-Madison — Superconducting circuits containing Josephson junctions are a leading candidate for scalable quantum information processing in the solid state. Qubit energy relaxation times are limited by microwave loss induced by a continuum of two-level state (TLS) defects in the dielectric materials of the circuit. State-of-the-art phase qubit circuits employ a micron-scale Josephson junction shunted by an external capacitor. In this case, the qubit T_1 time is directly proportional to the density of TLS defects in the capacitor dielectric. Here, we explore an alternative design that replaces the lossy lumped-element capacitor with a loss-loss effective capacitance. By minimizing the presence of the offending lossy amorphous dielectrics, we can extend the qubit T_1 times significantly. Here we show the results of this redesign and discuss it's impact on qubit performance.

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