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Towards Realization of a Tunable Josephson Superinductor

MATTHEW BELL, IVAN SADOVSKYY, LEV IOFFE, MICHAEL GERSHENSON, Department of Physics and Astronomy, Rutgers, the State University of New Jersey, ALEXEI KITAEV, Institute for Quantum Information, Caltech — Many Josephson circuits intended for quantum computing would benefit from the realization of the Josephson "superinductor": a phase-slip-free element whose inductive impedance at the plasma frequency exceeds the quantum of resistance, $h/(2e)^2$. With this aim, we have fabricated a chain of cells whose Josephson coupling can be frustrated by the magnetic field. These asymmetric dc-SQUID-like cells have several large Josephson junctions (JJs) in one arm shunted by a single small JJ in the other arm. The phase slips in this chain are suppressed by the phase rigidity across larger JJs, which remains strong even when the cell is frustrated by the magnetic field (while its Josephson inductance increases). Numerical simulations which explicitly take into account quantum fluctuations were used to optimize the JJ parameters. The inductance and phase rigidity of the device was probed by measuring the microwave response of the array coupled to a lumped-element microwave resonator. The resonance frequency of this circuit, f_r, and its quality factor Q were measured as functions of the magnetic field B. The observed dependences $f_r(B)$ and $Q(B)$ which reflects the variations of the Josephson inductance and phase rigidity of the array, will be compared with numerical simulations.

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