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Designing high-impedance/low-noise superinductances for quantum electronics[1] IOAN POP, ZLATKO MINEV, NICHOLAS MASLUK, ARCHANA KAMAL, MICHEL DEVORET, Yale University, Applied Physics —
Superinductances are essential circuit elements which enable the suppression of charge fluctuations in superconducting fluxonium qubits [1] and in other Josephson junction devices [2]. Commonly implemented as an array of Josephson junctions, superinductances have two main limitations. Firstly, the spurious capacitive coupling of the chain islands to ground lowers the plasma frequency of the chain, and consequently limits the operational bandwidth. Secondly, coherent quantum phase-slips (CQPS) [3] in the Josephson junction chain induce time dependent inductance fluctuations via the Aharonov-Casher effect [4]. We present the application of a novel lithographic technique [5] which enables the fabrication of arrays with optimal junction-capacitance to ground-capacitance ratio. We also present new superinductance designs which topologically suppress the CQPS, allowing the implementation of practically phase-slip free high inductance Josephson junction.

[1] Manucharyan et al., Science, 326 (2009)
[2] Guichard and Hekking, PRB, 81 (2010)
[3] Matveev et al. PRL, 89 (2002)
[4] Pop et al., arXiv:1105.6204 and Manucharyan et al., arXiv:1012.1928
[5] Lecocq et al., Nanotechnology, 22 (2011)

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