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Parity Protection in Flux-Pairing Qubits[1] WENYUAN ZHANG, Rutgers University, MATTHEW BELL, Rutgers University and University of Massachusetts, Boston, XIAOYUE JIN, Rutgers University, LEV IOFFE, Rutgers University and LPTHE, CNRS France, MICHAEL GERSHENSON, Rutgers University
— We have studied a novel qubit whose logical states are decoupled from the environment due to parity protection. The flux-pairing qubit (FPQ) is a superconducting loop consisting of a 4π periodic Josephson element (a Cooper pair box with the e charge on the central island) and a superinductor [1]. This device is dual to the charge-pairing qubit [2]. The FPQ design suppresses tunneling of single flux lines through the junctions in the Cooper pair box and enforces simultaneous tunneling of pairs of flux lines. The lowest-energy quantum states of the FPQ are encoded in the parity of the magnetic flux quanta inside the loop. Parity protection prohibits the mixing of these states, and reduces both the decay and dephasing rates. We will discuss the experimental aspects of the FPQ optimization and the possibility of fault-tolerant operations with these qubits.

[1] M.T. Bell, I.A. Sadovskyy, L.B. Ioffe, A.Yu. Kitaev, and M.E. Gershenson. *Phys. Rev. Lett.* **109,** 137003 (2012).
[2] M.T. Bell, J. Paramanandam, L.B. Ioffe, and M.E. Gershenson. *Phys. Rev. Lett.* **112,** 167001 (2014).

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