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Quantum memristor in a superconducting circuit[1] JUHA SALMILEHTO, Department of Physics, Yale University, New Haven, Connecticut 06520, USA, MIKEL SANZ, University of the Basque Country UPV/EHU, Apartado 644, E-48080 Bilbao, Spain, MASSIMILIANO DI VENTRA, Department of Physics, University of California, San Diego, La Jolla, CA 92093, USA, ENRIQUE SOLANO, University of the Basque Country UPV/EHU, Apartado 644, E-48080 Bilbao, Spain — Memristors, resistive elements that retain information of their past, have garnered interest due to their paradigm-changing potential in information processing and electronics. The emergent hysteretic behaviour allows for novel architectural applications and has recently been classically demonstrated in a simplified superconducting setup using the phase-dependent conductance in the tunnel-junction-microscopic model[1]. In this contribution, we present a truly quantum model for a memristor constructed using established elements and techniques in superconducting nanoelectronics, and explore the parameters for feasible operation as well as refine the methods for quantifying the memory retention. In particular, the memristive behaviour is shown to arise from quasiparticle-induced tunneling in the full dissipative model and can be observed in the phase-driven tunneling current. The relevant hysteretic behaviour should be observable using current state-of-the-art measurements for detecting quasiparticle excitations. Our theoretical findings constitute the first quantum memristor in a superconducting circuit and act as the starting point for designing further circuit elements that have non-Markovian characteristics. [1] S. Peotta and M. Di Ventra, Phys. Rev. Applied 2, 034011 (2014).

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