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**Fermion parity measurement and control in Majorana circuit quantum electrodynamics**[1] ERAN GINOSSAR, Advanced Technology Institute and Department of Physics, University of Surrey, Guildford, United Kingdom GU2 7XH, KONSTANTIN YAVILBERG, EYTAN GROSFELD, Department of Physics, Ben-Gurion University of the Negev, Be'er-Sheva 84105, Israel — Combining superconducting qubits with mesoscopic devices that carry topological states of matter may lead to compact and improved qubit devices with properties useful for fault-tolerant quantum computation. Recently, a charge qubit device based on a topological superconductor circuit has been introduced where signatures of Majorana fermions could be detected. This device stores quantum information in coherent superpositions of fermion parity states originating from the Majorana fermions, generating a highly isolated qubit whose coherence time could be greatly enhanced. We extended the conventional semi-classical method and obtain analytical derivations in the strong coupling regime of the device to cavity photons. We study the effect of the Majorana fermions on the quantum electrodynamics of the device embedded within an optical cavity and develop protocols to initialise, control and measure the parity states. We show that, remarkably, the parity eigenvalue is revealed via dispersive shifts of the optical cavity in the strong coupling regime and its state can be coherently manipulated via a second order sideband transition.

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