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The merge of superconducting qubits with topological superconductors: microwave transitions as a signature of coherent parity mixing effects[1] ERAN GINOSSAR, Advanced Technology Institute and Department of Physics, University of Surrey, Guildford GU2 7XS, United Kingdom, EYTAN GROSFELD, Department of Physics, Ben-Gurion University of the Negev, Be'er-Sheva 84105, Israel — In this talk we will discuss the light-matter effects that could arise if Majorana fermions are added to a superconducting charge qubit. Coupling Majorana fermion excitations to coherent external fields is an important stepping stone towards their manipulation and detection. We argue that such a device could contribute to the spectroscopic detection of topological-superconductor Majorana excitations. We analyse the charge and transmon regimes of a topological nano-wire embedded within a Cooper-Pair-Box, where the superconducting phase difference is coupled to the zero energy parity states that arise from Majorana quasi-particles. We show that at special gate bias points, the microwave photon-qubit coupling can be switched off via quantum interference, and in other points it is exponentially dependent on the control parameter E_J/E_C. We propose that this type of device could perform as a high coherence four-level system in the superconducting circuits architecture with tunability of the coupling to photons, a coveted property which is difficult to achieve with regular devices.

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