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Coherent oscillations between single fluxonium qubit and Majorana fermion qubit CHANG-YU HOU, Caltech and UC Riverside, DAVID PEKKER, Caltech, VLADIMIR MANUCHARYAN, EUGENE DEMLER, Harvard University — We propose a hybrid device that couples a Majorana qubit to a superconducting fluxonium qubit. The devices consists of a conventional s-wave superconductor (e.g. Nb) ring interrupted by a narrow gap and a section of topological 1D wire bridging across the gap. Such topological 1D wire can be realized by using a semiconducting nanowire with strong spin orbit scattering (e.g. InSb) subjected by magnetic field. The nanowire hosts a topological qubit formed by four Majorana fermions and acts as a Josephson junction that completes the superconducting ring and makes a fluxonium qubit. As the current-phase relation of the Josephson junction is controlled by the state of the Majorana qubit, the fluxonium and Majorana qubit are naturally coupled. We demonstrate how this coupling can be exploited to construct two qubit operations. Remarkably, quantum information can be transformed between two distinct types of qubits solely using well-controlled operations on the fluxonium qubit.

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