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Majorana fermions and where to find them

Majorana fermion

In physics, a Majorana fermion is a particle that is its own antiparticle

Mathematical definition

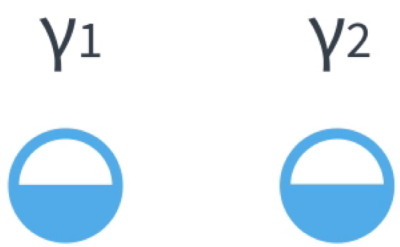
$$\gamma = \gamma^{\dagger}$$

Candidates

- Neutrinos
- As a quasiparticle in condensed matter

$$c^\dagger$$

$$c$$



- Two Majorana fermions form an ordinary fermion
- When arising as quasiparticles, they must come in pairs

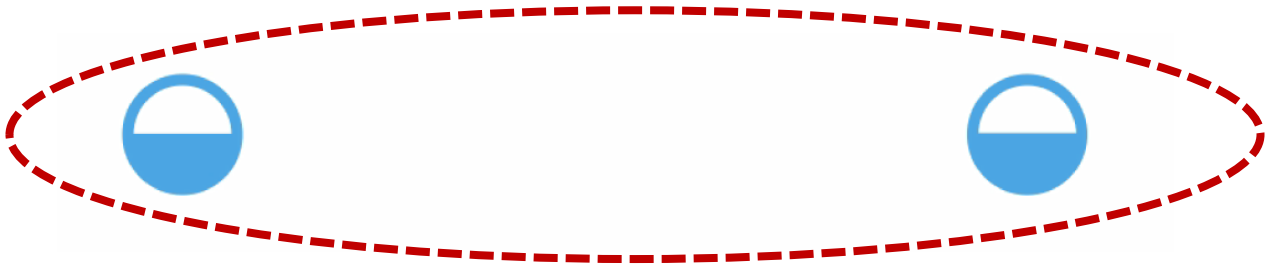
Encode a qbit in a fermionic state:

 $|0\rangle$  $|1\rangle$

Problem:

Very sensitive to local perturbations

A *topological qbit* from Majoranas



$|0\rangle, |1\rangle$

Fermion encoded in a *non-local* way

→protected from local perturbations

In condensed matter, the equivalent of particle and anti-particle are *electron and hole*

Need to form a superposition

$$|electron\rangle + |hole\rangle$$

Natural to look for them in

superconductors!