Michael Wimmer

Majorana bound states in superconductors

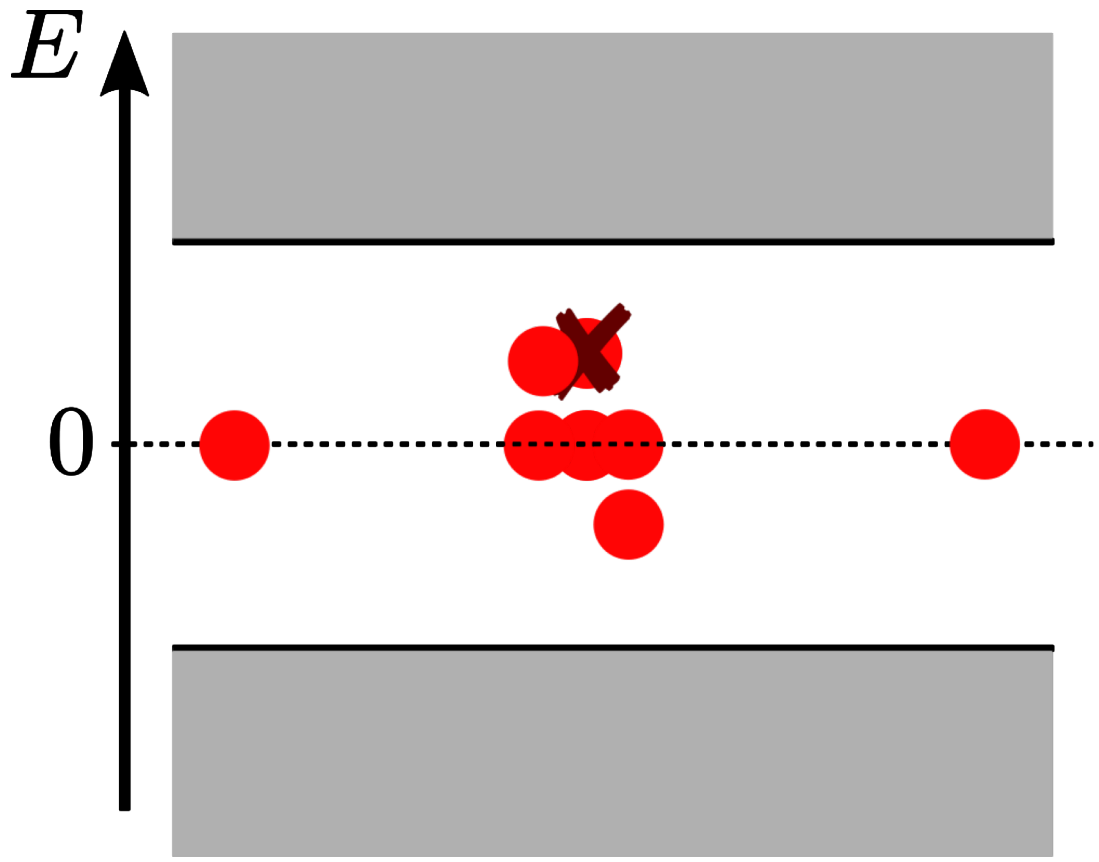
Superconductors: particle-hole symmetry

$$\gamma(E) = \gamma^{\dagger}(-E)$$

At $E = 0$: Majorana bound states

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

Consequences of particle-hole symmetry



Trivial superconductor: no Majoranas

Topogical superconductor: with Majoranas

One Majorana bound state: $E = 0$

Multiple Majorana bound states: still $E = 0$

N Majorana pairs

$\rightarrow 2^N$-fold degenerate ground state

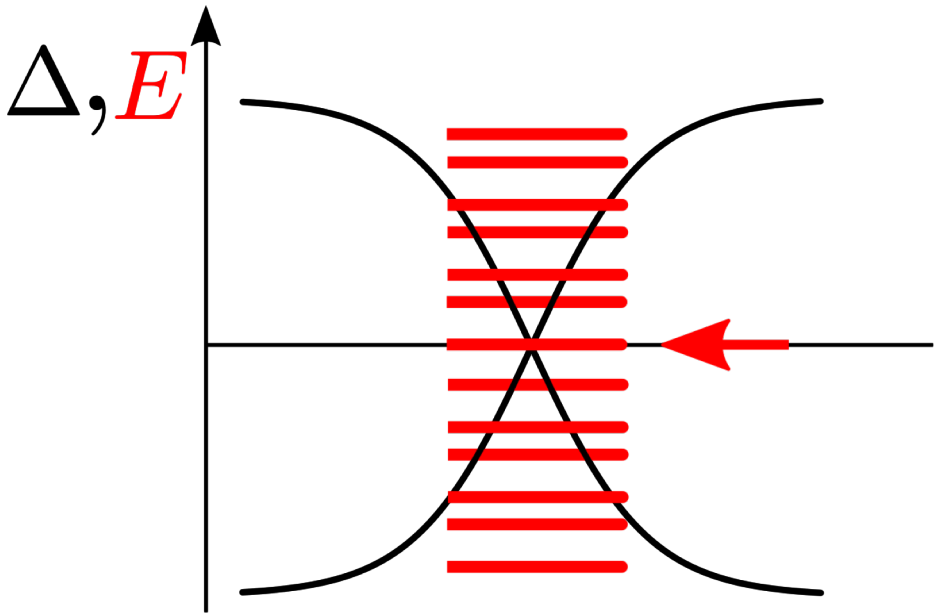
In a real system: not exactly $E = 0$, but *exponentially* close to 0

Superconductors: particle-hole symmetry

$$\gamma(E) = \gamma^{\dagger}(-E)$$

At $E = 0$: Majorana bound states, $\gamma = \gamma^{\dagger}$

Vortices in superconductors

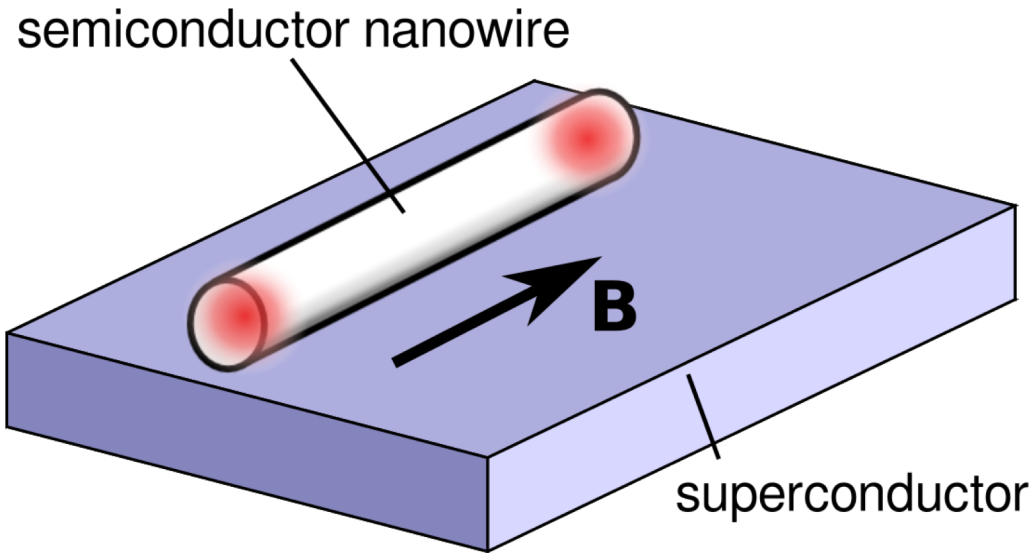


Need a p-wave superconductor!

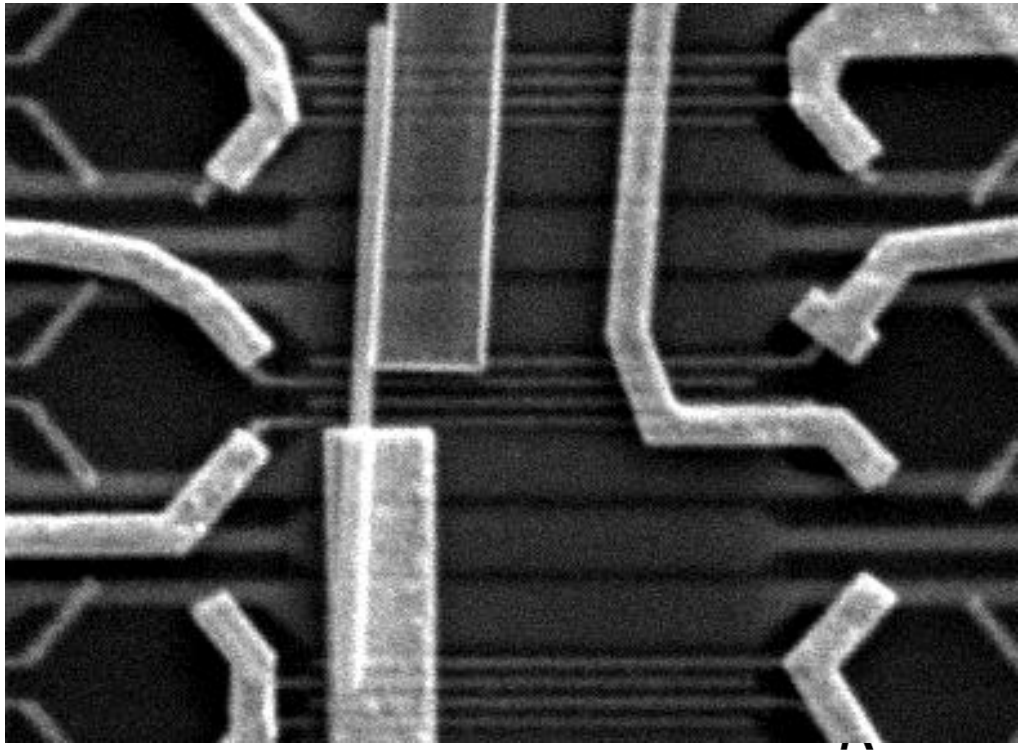
Alternative:

p-wave superconductor nanowires

Engineering a topological superconductor



Theory: Lutchyn et al. PRL 105, 077001 (2010)
Oreg et al. PRL 105, 177002 (2010)



V. Mourik et al., Science 336, 1003 (2012)

- Spin-orbit + superconductor + magnetic field = **topological superconductor**
- Device must be *tuned* into the topological phase