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Majorana fermions in semiconductor nanowires coupled to superconductors

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Majorana fermions are real solutions to the Dirac equation, meaning they are their own antiparticles. In the condensed matter context, they are quasiparticles that are equal superpositions of electrons and holes. A practical challenge of today is to generate, isolate and study individual Majorana fermions. Theory tells us that they may arise is topological superconductors characterized by spinless p-wave pairing. A particularly feasible approach to realizing this unconventional superconducting state is in hybrid structures of a conventional superconductor and a semiconductor with spin-orbit coupling. I will discuss our experiments on semiconductor nanowires that explore this approach, and present the signatures of Majorana fermions obtained by low temperature transport measurements. Interest in Majorana fermions is in part fueled by their predicted but not demonstrated non-Abelian property, which is key to applications in topological quantum computing. I will describe how we can study this in semiconductor-superconductor devices.