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Engineering and observation of Majorana zero modes

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Fault tolerant quantum computation can be realized by braiding Majorana zero modes which could be observed at the edge of one dimensional topological superconductors. A variety of condensed matter systems can be used to engineer topological superconductivity and Majorana zero modes (MZMs). To date, evidence for MZMs has come from experiments that have detected their zero-energy excitation signature in various spectroscopic measurements when the parameters of the system make it most likely to be in a topological superconducting phase. In this presentation, I will introduce newly discovered platforms to host MZMs and the signatures of MZMs. Using spin-polarized and spin un-polarized spectroscopic measurements studied on these platforms, we experimentally confirmed all the ingredients to host MZMs and found spectroscopic signature of MZMs. Moreover, observation of the spin signature of MZMs that exceeds the spin-polarization of the normal-state background of MZM platform display the topological properties of measured zero energy end states. This study establishes a root to engineer Majorana zero modes and also provides that spin-polarization measurement as a diagnostic tool to distinguish topological MZMs from trivial in-gap states of a superconductor.