

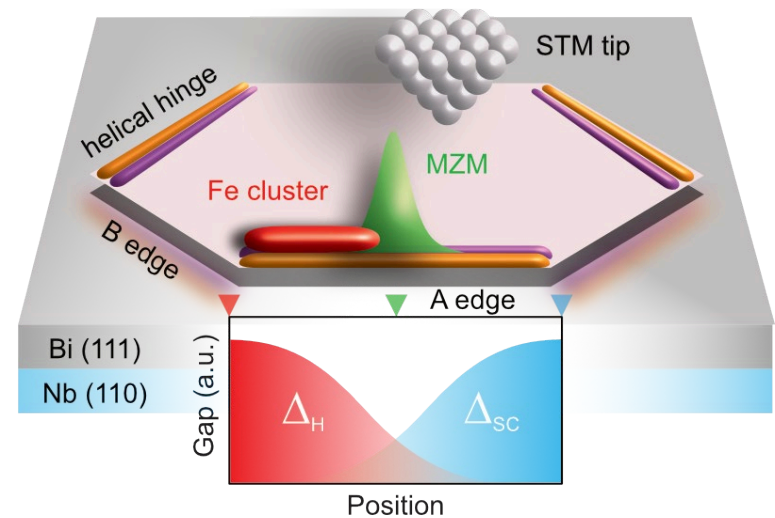
Materials Research Science and Engineering Centers

Majorana zero modes for topological quantum computation (IRG-1)

Majorana zero modes (MZMs) can serve as building blocks for topologically protected quantum computers, promising scalable and fault-tolerant quantum computation platforms in the future.

Princeton MRSEC investigator **Yazdani**, in collaboration with Princeton MRSEC investigator **Bernevig**, realized a novel material platform based on the topological hinge state of bismuth. Consistent with model calculations, their high-resolution STM experiments revealed the emergence of MZMs when the hinge state is influenced by ferromagnetic iron (Fe) clusters and superconductivity under suitable conditions. Spin-sensitive measurements detected the unique spin signature of MZMs, by which it can be distinguished from other states. Their work also presents perspectives to manipulate MZMs by controlling the magnetization of the Fe clusters, acting as nanoscale switches.

What is more, the developed material platform lends itself to realizations using device-type experiments based on bismuth nano-ribbons. Such an approach will offer enhanced flexibility towards testing different MZMs' manipulation and detection schemes in the future.



“Observation of a Majorana zero mode in a topological protected edge channel,” *Science* **364**, 1255-1259 (2019), B. Jäck¹, Y. Xie¹, J. Li^{2,3}, S. Jeon¹, B.A. Bernevig¹, A. Yazdani¹

¹Princeton University, ²Westlake IAS, ³Westlake University