DMR-1420451

2018

Majorana Spin Diagnostics

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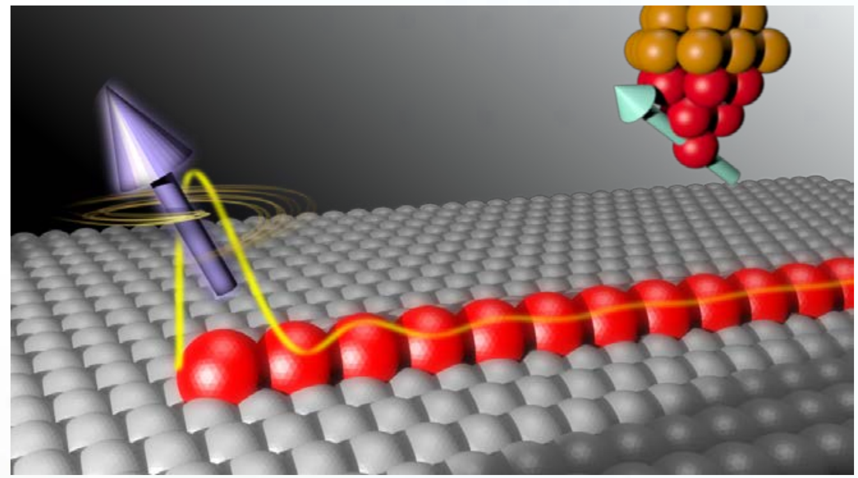
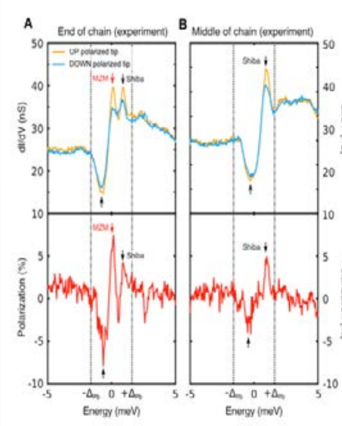
Majorana zero modes are exotic quasiparticles that can emerge at the ends of one-dimensional topological superconductors and may be used in creating fault-tolerant qubits for quantum computation. In 2014, Yazdani and Bernevig theoretically proposed and experimentally created a new platform for realization of Majorana zero modes in chains of magnetic atoms on the surface of a superconductor. While their work and the work of others in the field provided strong evidence for the emergence of these quasiparticles, there was still a possibility that a trivial zero energy state can accidentally occur at the end of such chains. To rule out this possibility, and to provide a unique signature of Majoranas in this system, this past year the team turned their attention to spin-polarized measurements with the scanning tunneling microscope. They showed theoretically that such measurements can provide a clear way to distinguish a true Majorana zero mode from a trivial state. The high-resolution spin-polarized experiments carried on Fe chains confirmed the theoretical prediction, thereby providing the first unique signature of these excitations besides their zero energy peak in spectroscopy measurements.

Jeon *et al.*, *Science* **358**, *772* (2017).





Top figure shows the schematic of the experiment in which a spin-polarized STM is used to probe spin signature of Majorana zero mode at the end of the chain. The figure on the right shows these measurements at the end and middle of the chain. The MZM shows a spin-polarization that exceeds the normal state background