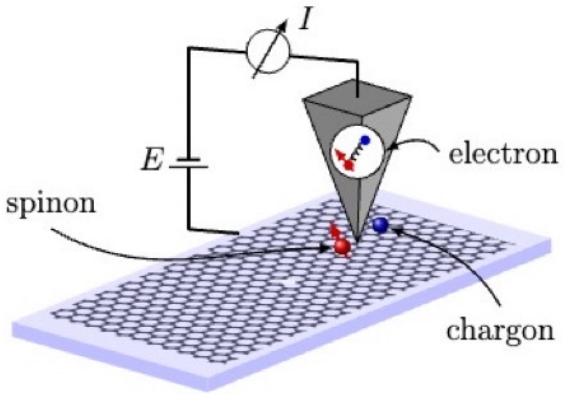
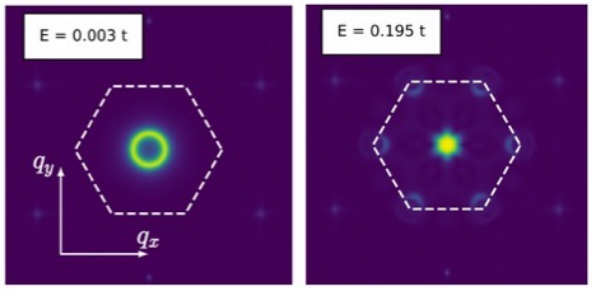
Quasiparticle Interference in Kitaev Quantum Spin Liquids

Scientific Achievement

Development of the first theoretical framework for understanding quasiparticle interference in Kitaev quantum spin liquids and revealing how electron tunneling signatures can directly probe fractionalized excitations like spinons and visons.





Significance and Impact

This work provides a novel method for identifying and characterizing Kitaev spin liquids through scanning tunneling microscopy. The approach opens a pathway to measure spinon dispersions and detect elusive vison excitations, advancing the search for topological quantum matter and potential platforms for quantum computing.

Research Details

- Establishes a parton mean-field theory for electron tunneling into Kitaev spin liquids.
- Demonstrates that electron tunneling spectra are governed by the convolution of spinon and chargon densities of states and that the energy derivative of tunneling conductance directly reflects spinon properties.
- Identifies distinct quasiparticle interference patterns around impurities — signatures of visons and spinons.

This work was performed, in part, at The Center for Integrated Nanotechnologies.

Jahin, A.; Zhang, H.; Halász, G. B.; Lin, S.-Z. Quasiparticle Interference in Kitaev Quantum Spin Liquids. *Physical Review Letters* **2025**, *134* (12). DOI:10.1103/physrevlett.134.126501.