Discovery of electronic nematicity in kagome metals

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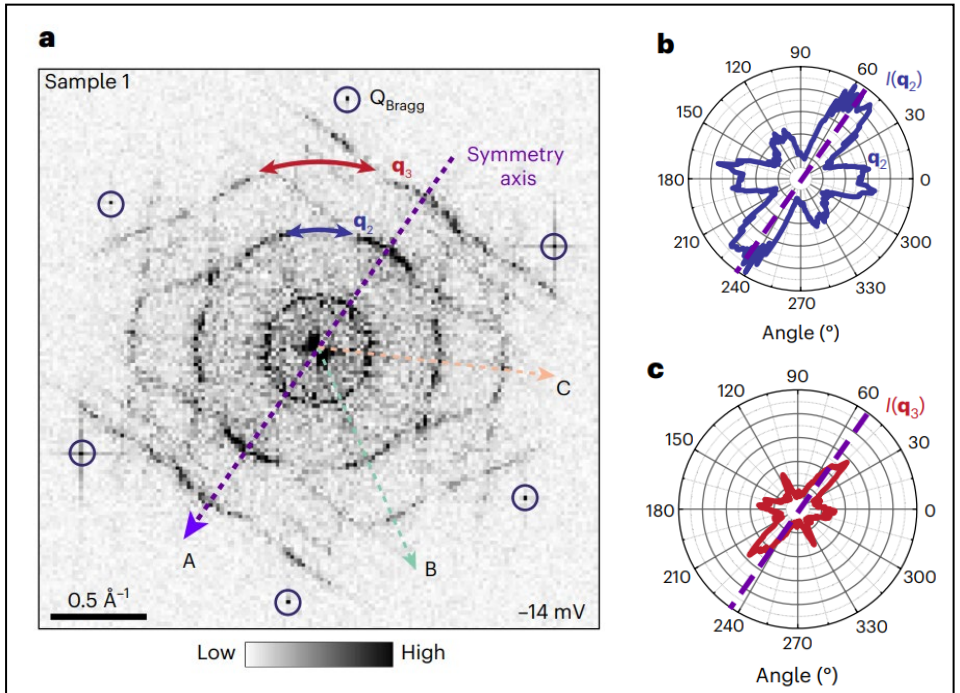
- Quantum materials composed of atoms arranged on a kagome net of corner-sharing triangles present an exciting platform to realize novel electronic behavior.
- We used scanning tunneling microscopy and spectroscopy to study a kagome metal with a Ti-based kagome network, $CsTi_3Sb_5$, to discover a spontaneous unidirectionality in the electronic structure. Electronic unidirectionality can be viewed as electrons being able to travel faster or slower along nominally equivalent crystalline directions.
- By comparing the amplitudes of scattering wave vectors along different directions in Fourier transforms of STM data (panel (a)), we discovered an electronic anisotropy that breaks the six-fold symmetry of the lattice (panels (b,c)).
- This unidirectionality in quantum materials is often referred to as electronic 'nematicity', the first such occurrence disentangled from other phases in kagome metals.



(a) Fourier transform of STM differential conductance dI/dV map at -14 meV. (b,c) Intensity of scattering wave vectors q_2 and q_3 labeled in panel (a) as a function of angle from 0 to 360 degrees.

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The grant supported three graduate students and three undergraduate students working on data acquisition and analysis on the project. The PI continues to contribute to professional development of all his students, by holding weekly one-on-one meetings and group meetings, including a “journal club”, where each student is assigned a relevant journal (Nature, Science, Physical Review, etc), and briefly presents manuscripts published in the past week.

In addition to publishing the results in peer-reviewed journals, the PI presented the research supported by the project at conferences and seminars to more broadly disseminate the results, including an invited talk at the APS March Meeting in Las Vegas, invited talk at the Gordon Conference on correlated and topological materials, and international invited talk in Milano, Italy and talks at University of Washington, UCLA and MIT.