

Poster-2-9

Designing Berry curvature dipoles and the quantum nonlinear Hall effect at oxide interfaces

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Quantum materials can display physical phenomena rooted in the geometric properties of their electronic wave- functions, and regulated by an emergent magnetic field known as Berry curvature [1-3]. In materials with acentric crystalline structures that do not exhibit long-range magnetic order, the appearance of the Berry curvature is often linked to electronic band structures resembling the dispersion relation of relativistic particles. However, this characteristic is also a major roadblock, as it prevents the manifestation of quantum geometric effects and correlation-induced many-body quantum phases in the same material. Here, we overcome this limitation by de- signing very large dipoles of Berry curvature in a correlated two-dimensional electron system. We unveil a rich interplay between quantum confinement, spin-orbit coupling and crystal fields in (111)-oriented oxide heterostructures, bringing forth the appearance of Berry cur- vature concentrations that we directly probe through an unconventional Hall effect arising from an external in-plane magnetic field [4, 5]. We then report the appearance of a quantum nonlinear Hall effect under time-reversal symmetric conditions [6-10] that provides a direct measure of the Berry curvature dipole. The quadratic current-voltage characteristic of the nonlinear Hall effect paves the way to rectifiers and terahertz detectors [11] by oxide interface design.

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