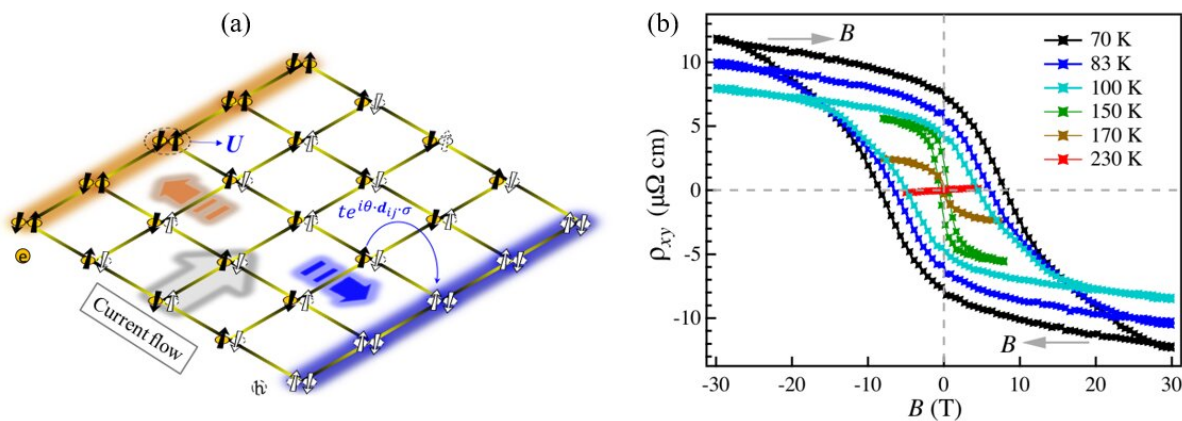


# Researchers find novel topology-correlation interplay in toy model system built from iridate superlattice

August 25 2022, by Zhang Nannan



(a) Schematic of anomalous Hall effect in the intermediate coupling regime; (b) Magnetic field dependent Hall measurements at different temperatures. Credit: Hao Lin

In topological physics, band topology often originates from spin-orbit interaction, which gives rise to complex hopping parameters. While this approach has enjoyed great success in non-interacting or weakly interacting electronic materials, the consequences of complex hopping was understood in a drastically different context in strongly correlated systems due to fundamentally different views of electronic structure.

More importantly, the combined effect of electronic correlation with nontrivial complex hopping remains poorly understood in the intermediate regime, which calls for real experimental systems that could simulate and unveil correlation-topology interplay.

Researchers led by Prof. Hao Lin from the Hefei Institutes of Physical Science (HFIPS) of the Chinese Academy of Sciences (CAS) revealed the rich topology-correlation interplay and demonstrated a controllable material platform for such investigations. Results were published in *Physical Review X*.

In this study, the researchers experimentally realized a square-lattice Hubbard model-system in  $[(\text{SrIrO}_3)_1/(\text{CaTiO}_3)_1]$  superlattices.

They proved that the nontrivial electronic topology anticipated at the weak coupling limit led to an anomalous Hall effect (AHE), and a giant magnon gap in the Mott insulating state due to the finite correlation.

By performing high-field AHE measurements at the Steady High Magnetic Field Facility of HFIPS, they revealed that the AHE not only signified Berry curvatures in the Hubbard bands, but also was subjected to the self-competition of the electron-hole pairing.

Moreover, the magnon gap driven by the  $\text{SU}(2)$  gauge-invariant field was too large for the superexchange approach to account for. The intertwining of phenomena that were usually captured in drastically different pictures of the electronic state highlighted the rich and complex interplay between correlation and topology in the intermediate coupling regime.

The strategy of controlling gauge-dependent/-invariant complex hoppings through artificial design provides valuable insights for investigating topology-related physics in other correlated materials.

**More information:** Junyi Yang et al, Quasi-Two-Dimensional Anomalous Hall Mott Insulator of Topologically Engineered Jeff=1/2 Electrons, *Physical Review X* (2022). [DOI: 10.1103/PhysRevX.12.031015](https://doi.org/10.1103/PhysRevX.12.031015)

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