

Highlights

RESEARCH AREA 2 - Superconductors and Innovative materials for Energy and Environment - 2024

Signatures of a surface spin-orbital chiral metal

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This work reports the experimental detection of a surface spin-orbital chiral metal, a conducting state with a defined handedness caused by symmetry-breaking electronic currents with quadrupolar structure. Using the archetypal quantum material Sr_2RuO_4 as a test bed, we developed and applied a methodology based on circularly polarized, spin-selective, angular-resolved photoelectron spectroscopy (CP-spin-ARPES). The study reveals that while standard circular dichroism shows a negligible asymmetry, the spin-resolved channels exhibit a significantly larger signal which indicates a breaking of time-reversal and mirror symmetry. These spectroscopic signatures are compatible with the formation of spin-orbital quadrupole currents at the material's surface, where the combined spin and orbital degrees of freedom break time-reversal symmetry. These findings provide a new experimental tool for identifying hidden magnetic orders and unconventional metallic phases in quantum materials.

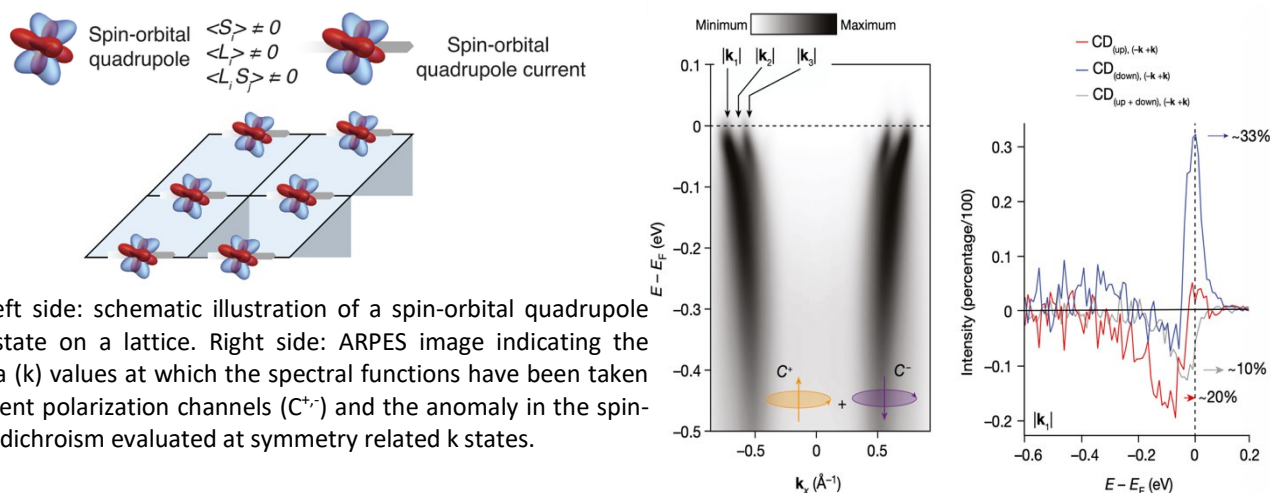


Fig. 1: Left side: schematic illustration of a spin-orbital quadrupole current state on a lattice. Right side: ARPES image indicating the momenta (k) values at which the spectral functions have been taken for different polarization channels (C^\pm) and the anomaly in the spin-resolved dichroism evaluated at symmetry related k states.