

# Observation of the bulk and surface electronic structure of the correlated Dirac semimetal $\text{CaIrO}_3$

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Perovskite iridates  $\text{AIrO}_3$  ( $\text{A}=\text{Ca}$ ,  $\text{Sr}$ , and  $\text{Ba}$ ) provide an intriguing platform for exploring the interplay between electron correlation and topology [1].  $\text{AIrO}_3$  hosts a Dirac-dispersion state in the vicinity of the Mott transition, where the combination of electron correlation and strong spin-orbit coupling yield nearly half-filled  $j_{\text{eff}}=1/2$  multiplet derived from  $5d$  orbitals of  $\text{Ir}^{4+}$  and a semimetallic state near the Fermi energy. Therein, the Dirac node is protected by the nonsymmorphic symmetry inherent to the orthorhombic perovskite structure and thus is robust against the symmetry-preserving perturbation. In particular,  $\text{CaIrO}_3$  exhibits the high electron mobility exceeding  $100,000 \text{ cm}^2/\text{Vs}$ , giant magnetoresistance, pronounced quantum oscillations, and anomalous transport behavior in the quantum-limit regime, suggesting the presence of the Dirac node very close to the Fermi energy [2, 3]. However, a direct spectroscopic observation of its electronic structure has remained elusive, largely due to the difficulty in growing high-quality, large single crystals.

In this work, we performed micro-beam-focused angle-resolved photoemission spectroscopy (ARPES) on bulk  $\text{CaIrO}_3$  single crystals to evaluate the degree of electron correlation and the associated effective-mass renormalization. We observed not only the  $k_z$  dispersion of the bulk electronic structure but also surface states. We discuss how electron correlation contributes to the formation of the Dirac-node state.

[1] M. Zeb et al., Phys. Rev. B 86, 085149 (2012).

[2] J. Fujioka et al., Nat. Commun. 10, 362 (2019).

[3] R. Yamada et al., npj Quantum Materials 7, 13 (2022).