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Quasiparticle interference from different impurities on the surface of pyrochlore iridates: Signatures of the Weyl phase

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Abstract

© 2016 American Physical Society.Weyl semimetals are gapless three-dimensional topological materials where two bands touch at an even number of points in the bulk Brillouin zone. These semimetals exhibit topologically protected surface Fermi arcs, which pairwise connect the projected bulk band touchings in the surface Brillouin zone. Here, we analyze the quasiparticle interference patterns of the Weyl phase when time-reversal symmetry is explicitly broken. We use a multiband d-electron Hubbard Hamiltonian on a pyrochlore lattice, relevant for the pyrochlore iridate R2Ir2O7 (where R is a rare earth). Using exact diagonalization, we compute the surface spectrum and quasiparticle interference (QPI) patterns for various surface terminations and impurities. We show that the spin and orbital texture of the surface states can be inferred from the absence of certain backscattering processes and from the symmetries of the QPI features for nonmagnetic and magnetic impurities. Furthermore, we show that the QPI patterns of the Weyl phase in pyrochlore iridates may exhibit additional interesting features that go beyond those found previously in TaAs.

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