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Visualizing Fermi arcs by their weakly bound wave function in the Weyl semimetal TaAs NOAM MORALI, RAJIB BATABYAL, NURIT AVRAHAM, Weizmann Institute of Science, YAN SUN, MARCUS SCHMIDT, CLAUDIA FELSER, Max Planck Institute for Chemical Physics of Solids, ADY STERN, Weizmann Institute of Science, BINGHAI YAN, Max Planck Institute for Chemical Physics of Solids, HAIM BEIDENKOPF, Weizmann Institute of Science — The topological nature of Weyl semimetals guarantees the existence of surface Fermi arc states. The surface of tantalum arsenide, similar to that of other members of the Weyl semimetal class, hosts non-topological bands that obscure the exploration of the Fermi arc states. We use the spatial structure of the surface states wave function visualized by scanning tunneling microscopy to distinguish and characterize the surface Fermi arc bands [1]. The trivial states have a complex structure within the unit cell, which further evolves in the presence of an external magnetic field. In contrast, the Fermi arc wave function is essentially plane-wave like. It is weakly affected by the surface potential and thus spreads rather uniformly within the unit cell. We obtain these results using an analysis technique, based on the role of the Bloch wave function in shaping quantum electronic interference patterns. It thus carries broader applicability to the study of other electronic systems and other physical processes.
Batabyal, Rajib; Morali, Noam; Avraham, Nurit; Sun, Yan; Schmidt, Marcus; Felser, Claudia; Stern, Ady; Yan, Binghai; Beidenkopf, Haim (2016). Visualizing Weakly Bound Surface Fermi Arcs and Their Correspondence to Bulk Weyl Fermions. Science Advances. 2:e1600709.

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