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Topological Kondo Insulator (TKI) and related candidate materials: High-resolution ARPES studies

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In this talk, I plan to present ARPES (synchrotron and laser-based) studies of several mix valence and Kondo insulator phenomena in some of the rare earth heavy fermion compounds in connection to their non-trivial topology of band structures. Focus will be on SmB6 which has been predicted to be a TKI recently. By combining low-temperature and high energy-momentum resolution of the laser-based ARPES technique, for the first time, we accessed the surface electronic structure of the anomalous conductivity regime. At low T, we observe in-gap states within a 4 meV energy window of the Fermi level, which lie clearly within the bulk insulating gap. The in-gap states are found to be suppressed and eventually disappear, as the temperature is raised in approaching the coherent Kondo lattice hybridization (30 K), which proves that the in-gap states strongly depend on the existence of Kondo lattice hybridization and the effective Kondo gap, in agreement with their theoretical predicted origin of topological surface states within the Kondo insulating gap . Our Fermi mapping at the energy corresponding to these in-gap states shows distinct Fermi pockets that enclose the three Kramers' points the surface Brillouin zone, which are remarkably consistent with the theoretically predicted topological surface Fermi surface in the topological Kondo insulating phase within the level of energy resolution. The observed Fermi surface topology of the in-gap states, their temperature dependence across the transport anomaly and Kondo lattice hybridization temperatures, as well as their robustness against repeated thermal recycling, collectively not only provide a unique insight illuminating the nature of the residual conductivity anomaly but also serve as a strong experimental evidence to the predicted topological Kondo insulator phase. I also plan to present results on YbB6 and YbB12 both of which are mix valence compounds. This work is in collaboration with **Madhab Neupane**, N. Alidoust, S.-Y. Xu, T. Kondo, Y. Ishida, D.-J. Kim, Chang Liu, I. Belopolski, T.-R. Chang, H.-T. Jeng, T. Durakiewicz, L. Balicas, H. Lin, A. Bansil, S. Shin and Z. Fisk and primarily supported by U.S. DOE and Princeton University.