A Non-Fermi Liquid with Strong Spin-orbit Coupling

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Abstract

We consider the possibility of distinct non-Fermi liquid states in the strong spin-orbit coupling regime, starting from the specific context of the pyrochlore iridates. Utilizing prior studies of the electronic structure of the Ir bands, we show that a minimal description for the electronic states in their paramagnetic phase is a storied Hamiltonian from semiconductor physics: the Luttinger model of inverted band gap semiconductors. Taking into account the Coulomb force, we update a classic analysis due to Abrikosov, showing that interactions induce a quantum critical non-Fermi liquid "Luttinger Abrikosov Beneslavskii" (LAB) state, and determining all its critical properties. Further, we show that the LAB is a parent state for topological insulator, Weyl semimetal, and anomalous Hall phases.

About the speaker

Leon Balents is a theoretical physicist working broadly in the area of correlated electron systems, quantum magnetism, and complex materials. He is a permanent member of the Kavli Institute for Theoretical Physics, and Professor of Physics at the University of California, Santa Barbara. He is known for contributions to a remarkable breadth of subjects in condensed matter physics. This includes seminal work on correlation effects in carbon nanotubes and other one dimensional conductors, on exotic quantum critical phenomena, and on spin liquids in frustrated magnets. He coauthored, in 2007, the first paper to predict the three-dimensional topological insulator, now arguably the hottest research topic in the field. Balents is the recipient of an NSF Career Award, the AP Sloan Fellowship, the David and Lucile Packard Fellowship, and several visiting chairs. He is the author of over 120 refereed journal publications, and has an h-index of 40 according to Web of Science.