Correlation-driven topological semimetals

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The insight that nontrivial topology can be implemented in electronic materials via special configurations of their electronic bands has revolutionized condensed matter science. The broad bands of weakly interacting materials and their good description with density functional theory have been instrumental to visualize topological bandstructures (e.g. by ARPES). To pin down unique topological properties or even control them—the ultimate goal for topological quantum devices—however, remain a formidable challenges. This is where strongly correlated electron systems come into play. As evidenced for the noncentrosymmetric and nonsymmophic heavy fermion material $Ce_3Bi_4Pd_3$ [1], strong electron correlations can drive "extreme topological responses" [2-4]. Furthermore, the excellent tunability of strongly correlated electron systems in terms of their correlation physics [5] appears to also allow to control the topological characteristics of these systems [6]. In this talk I will discuss the background, with focus on strong correlation phenomena, present results on $Ce_3Bi_4Pd_3$, and discuss implications, noting also the possible involvement of quantum criticality in stabilizing correlation-driven topological phases [7].

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