# Non-Fermi liquid and topological states with strong spin-orbit coupling

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We argue that a class of strongly spin-orbit coupled materials, including some pyrochlore iridates and the inverted band gap semiconductor HgTe, may be described by a minimal model consisting of the Luttinger Hamiltonian supplemented by Coulomb interactions, a problem studied by Abrikosov and collaborators. It contains two-fold degenerate conduction and valence bands touching quadratically at the zone center. Using modern renormalization group methods, we update and extend Abrikosov's classic work and show that interactions induce a quantum critical non-Fermi liquid phase, stable provided time-reversal and cubic symmetries are maintained. We determine the universal power-law exponents describing various observables in this Luttinger-Abrikosov Beneslavskii state, which include conductivity, specific heat, non-linear susceptibility and magnetic Gruneisen number. Furthermore, we determine the phase diagram in the presence of cubic and/or time-reversal symmetry breaking perturbations, which includes topological insulator and Weyl semi-metal phases. Many of these phases possess an extraordinarily large anomalous Hall effect, with the Hall conductivity scaling sub-linearly with magnetization.