

Abstract Submitted
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Interacting Dirac liquid in three-dimensional semimetals¹ JOHANNES HOFMANN, EDWIN BARNES, Univ of Maryland-College Park, CONDENSED MATTER THEORY CENTER TEAM — We study theoretically the properties of the interacting Dirac liquid, a novel three-dimensional many-body system which was recently experimentally realized and in which the electrons have a chiral linear relativistic dispersion and a mutual Coulomb interaction. We find that the “intrinsic” Dirac liquid, where the Fermi energy lies exactly at the nodes of the band dispersion, displays unusual Fermi liquid properties, whereas the “extrinsic” system with finite detuning or doping behaves as a standard Landau Fermi liquid. We present analytical and numerical results for the self-energy and spectral function based on both Hartree-Fock and the random phase approximation (RPA) theories and compute the quasiparticle lifetime, residue, and renormalized Fermi velocity of the extrinsic Dirac liquid. A full numerical calculation of the extrinsic RPA spectral function indicates that the Fermi liquid description breaks down for large-energy excitations. Furthermore, we find an additional plasmaron quasiparticle sideband in the spectral function which is discontinuous around the Fermi energy. Our predictions should be observable in ARPES and STM measurements.

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