Abstract Submitted
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Many-body effects and ultraviolet renormalization in three-dimensional Dirac materials[1] ROBERT THROCKMORTON, University of Maryland, JOHANNES HOFMANN, University of Cambridge, EDWIN BARNES, Virginia Tech — We develop a theory for electron-electron interaction-induced many-body effects in three dimensional (3D) Weyl or Dirac semimetals, including interaction corrections to the polarizability, electron self-energy, and vertex function, up to second order in the effective fine structure constant of the Dirac material. These results are used to derive the higher-order ultraviolet renormalization of the Fermi velocity, effective coupling, and quasiparticle residue, revealing that the corrections to the renormalization group (RG) flows of both the velocity and coupling counteract the leading-order tendencies of velocity enhancement and coupling suppression at low energies. This in turn leads to the emergence of a critical coupling above which the interaction strength grows with decreasing energy scale. In addition, we identify a range of coupling strengths below the critical point in which the Fermi velocity varies non-monotonically as the low-energy, non-interacting fixed point is approached. Furthermore, we find that while the higher-order correction to the flow of the coupling is generally small compared to the leading order, the corresponding correction to the velocity flow carries an additional factor of the Dirac cone flavor number relative to the leading-order result.

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