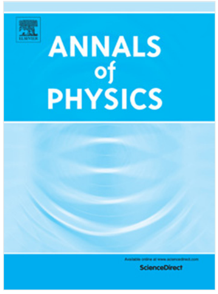

The S-matrix for surface boundary states: An application to photoemission for Weyl semimetals

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The S-matrix for surface boundary states: an application to photoemission for Weyl semimetals

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Abstract

We present a new theory of photoemission for Weyl semimetals. We derive this theory using a model with a boundary surface at $z = 0$. Due to the boundary, the self adjoint condition needs to be verified in order to ensure physical solutions. The solutions are given by two chiral zero modes which propagate on the boundary. Due to the Coulomb interaction, the chiral boundary model is in the same universality class as interacting graphene. The interactions cause a temperature dependence of the velocity and and life time. Using the principle of minimal coupling, we identify the electron-photon Hamiltonian. The photoemission intensity is computed using the S-matrix formalism. The S-matrix is derived using the initial photon state, the final state of a photoelectron and a hole in the valence band. The photoemission reveals the final valence band dispersion $\hbar v(\pm k_y - k_0) + \hbar\Omega$ after absorbing a photon of frequency Ω (k_0 represents the shift in the momentum due to the crystal potential). The momentum in the z direction is not conserved, and is integrated out. As a result, the scattering matrix is a function of the parallel momentum . We observe two dimensional contours, representing the ″Fermi arcs ″, which for opposite spin polarization have opposite curvature. This theory is in agreement with previous experimental observations.