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Second-order Charge Currents and Stress Tensor in Chiral System

We solve the Wigner equation for massless spin-1/2 charged fermions near global equilibrium. The Wigner function can be obtained order by order in the power expansion of the vorticity and electromagnetic field. The Wigner function has been derived up to the second order from which the non-dissipative charge currents and the stress tensor can be obtained. The charge and energy densities and the pressure have contributions from the vorticity and electromagnetic field at the second order. The vector and axial Hall currents can be induced along the direction orthogonal to the vorticity and electromagnetic field at the second order. We also find that the trace anomaly emerges naturally in renormalizing the stress tensor by including the quantum correction from the electromagnetic field.

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