

Quark Matter 2019 - the XXVIIIth International Conference on Ultra-relativistic Nucleus-Nucleus Collisions



Contribution ID: 445

Type: Oral Presentation

Kinetic theory for massive spin-1/2 particles from the Wigner-function formalism

Wednesday, 6 November 2019 15:00 (20 minutes)

We calculate the Wigner function for massive spin-1/2 particles in an inhomogeneous electromagnetic field to leading order in the Planck constant. Going beyond leading order in \hbar we then derive a generalized Boltzmann equation in which the force exerted by an inhomogeneous electromagnetic field on the particle dipole moment arises naturally. Furthermore, a kinetic equation for this dipole moment is derived. Carefully taking the massless limit we find agreement with previous results. The case of global equilibrium with rotation is also studied. Finally, we outline the derivation of fluid-dynamical equations from the components of the Wigner function. The conservation of total angular momentum is promoted as an additional fluid-dynamical equation of motion. Our framework can be used to study polarization effects induced by vorticity and magnetic field in relativistic heavy-ion collisions.

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Session Classification: Parallel Session - Chirality III

Track Classification: Chirality, vorticity and spin polarization