

World-line Approach to Chiral Kinetic Theory and the Chiral Magnetic Effect

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Recent searches for CP- and P- odd phenomena in ultra relativistic heavy-ion collisions have attracted much interest and are a prime motivation for significant theoretical effort.

Anomalous and topological effects, such as the Chiral Magnetic Effect (CME), receive important contributions from the pre-equilibrium phase of a collision. While real-time lattice

simulations can be used to study the earliest stage, quantitative predictions of experimental signatures are only feasible once the subsequent transport of the messengers

of the CME through the fireball are understood. An interesting question is how the chiral imbalance generated at early times persists through a fluctuating background of sphalerons in addition to other “non-anomalous”

interactions with the QGP. To address this question, we construct a relativistic chiral kinetic theory using the world-line formulation of quantum field theory. Using this framework we clarify the role of a possible

Berry’s phase and that of the chiral anomaly. We discuss how the fate of the Chiral Magnetic Effect could be understood by matching our framework to the results of real-time lattice simulations at early times and to

Chiral MagnetoHydrodynamics at late times.

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