

Topological charge and chiral density production in the early stage of high energy nuclear collisions

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We study the topological charge density and the chiral density correlations in the early stage of high energy nuclear collisions. Topological charge is related to the gauge invariant $E \cdot B$ where E and B denote the color-electric and color-magnetic fields, while the chiral density is produced via the chiral anomaly of Quantum Chromodynamics. We discuss how the correlation lengths are related to the collision energy, and how the correlated domains grow up with proper time in the transverse plane for a boost invariant longitudinal expansion. We estimate the correlation lengths of both quantities as well as the proper time for the formation of a steady state in which the production of the chiral density in the transverse plane per unit rapidity slows down, as well as the amount of chiral density that would be produced during the pre-equilibrium stage. Finally, we comment on one possible phenomenological impact of chiral density production in the early stage, namely photons that would be produced via the chiral magnetic effect.

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