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Signature of chiral mixing in dilepton production at LHC energy

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Probing the chiral symmetry restoration (CSR) is one of the main goals in high-energy heavy-ion collisions. The key phenomenon for probing the CSR is chiral mixing, where the vector meson mixes with the axial-vector meson in a medium via the reactions of $a_1 + \pi \to \rho$ and $a_1 \to \rho + \pi$. In the upcoming experiments, probing the CSR via chiral mixing is highly prioritized.
In this work, we evaluate the signature of $\rho - a_1$ mixing on the dilepton yield at LHC energy with the relativistic viscous hydrodynamic model [1]. We study the dilepton production utilizing 3 scenarios: (A) without CSR, (B) with CSR, and (C) with false CSR. Scenario-B is the in-medium spectral function with degeneration of ρ and a_1 masses at high temperature. We newly include the effect of partial chemical equilibrium for a realistic study. Scenario-C is the case when the low-temperature theorem is extrapolated to high temperature. This scenario is argued to increase the dilepton yield, which is incorrect since the procedure does not capture the change of QCD ground state.
As a result, we find a smooth enhancement of dilepton yield at 1.1<M<1.4 MeV due to the degeneration of ρ and a_1 masses. Whereas the false CSR scenario overestimates at 1.2 GeV. Furthermore, we show the expected signal in experiments, investigating the centrality and pt dependence of dilepton yield.
[1] A. Sakai et al., arXiv:2308.03305, arXiv:2312.08770

Category

Theory

Collaboration

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