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Sensitivity of the elliptic flow coefficient to a temperature-dependent shear viscosity-to-entropy density ratio in ultrarelativistic heavy-ion collisions at RHIC and LHC

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We investigate the effects of a temperature-dependent shear viscosity-to-entropy density ratio η/s on the elliptic flow of hadrons in ultrarelativistic heavy-ion collisions [1]. We use relativistic dissipative fluid dynamics to model the space-time evolution of the hot and dense system formed in such collisions. The final hadron spectra are calculated using the Cooper-Frye freeze-out procedure.

By studying different parametrizations for the temperature dependence of η/s, we found that the viscous suppression of the elliptic flow coefficient in $\sqrt{s_{NN}} = 200$ GeV Au+Au collisions at the Relativistic Heavy Ion Collider (RHIC) is dominated by the viscosity in the hadronic phase and in the phase transition region. However, the elliptic flow at RHIC is largely insensitive to the viscosity of the quark-gluon plasma (QGP).

On the other hand, we found that sensitivity of the elliptic flow to the high-temperature η/s increases with increasing multiplicity and simultaneously the sensitivity to the hadronic viscosity decreases. At the highest LHC energy, the elliptic flow becomes sensitive to the QGP viscosity and insensitive to the hadronic viscosity.

The change of the sensitivity from hadronic to QGP viscosity from RHIC to LHC can provide access to determining the temperature dependence of η/s from elliptic flow data.

[1] H. Niemi, G. S. Denicol, P. Huovinen, E. Molnar, D. H. Rischke, [arXiv:1101.2442 [nucl-th]].

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