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Probing the non-equilibrium dynamics of hot and dense QCD with dileptons

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Much work has been devoted to the determination of an effective value of the shear viscosity coefficient from analyses of the hadronic final states in relativistic heavy-ion collisions. Electromagnetic radiation, however, constitutes a class of complementary and penetrating probes that are sensitive to the entire space-time history of nuclear collisions including its very early stages. We show that thermal dileptons (and photons) are affected by the transport properties of the fluid and by the non-equilibrium aspects of the initial state that are usually inaccessible to hadronic probes. For the first time, we explicitly demonstrate that electromagnetic spectra and azimuthal momentum anisotropy can be used not only to investigate the magnitude of the shear relaxation time and to differentiate between possible initial shear-stress tensors, but also to reveal the temperature dependence of the shear viscosity coefficient. We further show that the dependence of electromagnetic probes on these quantities comes mostly from processes occurring in the QGP phase. Our approach utilizes event-by-event 3+1D viscous hydrodynamic simulations (MUSIC) [1], and the dilepton emission sources include contributions from charm decay and hadronic rates extracted from in-medium spectral functions [2].

[1] Bjoern Schenke, Sangyong Jeon, Charles Gale, Phys.Rev. C82 (2010) 014903

[2] Gojko Vujanovic, Clint Young, Bjoern Schenke, Ralf Rapp, Sangyong Jeon, and Charles Gale, arXiv:1312.0676, PRC in press.

On behalf of collaboration:

None

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