Contribution ID: **741** Type: **Oral**

Understanding the properties of the fireball with the polarization signature of thermal dileptons

Wednesday 6 September 2023 15:40 (20 minutes)

As dileptons are radiated from the extreme states of matter created in heavy-ion collisions with negligible final-state interactions, they retain the information imprinted on them at the time of their creation. Multi-differential measurements of dilepton invariant mass, momentum, and angular distributions can therefore serve as a unique tool to characterize the properties of matter in the interior of the hot and dense fireball.

An important property of virtual photons is their spin polarization defined in the rest frame of the virtual photon with respect to a chosen quantization axis. Even an isotropic thermal medium can exhibit nontrivial anisotropies in the angular distributions of the produced lepton pairs. While the total yield and observable spectra are proportional to the sum of the longitudinal and transverse components of the spectral function, the polarization depends on their difference. As the processes that drive the medium effects in the spectral function change with invariant mass and momentum, this becomes a powerful tool to study the composition and degrees of freedom of the hot and dense medium.

In this contribution, we utilize a coarse-grained hadronic transport approach to model the space-time evolution of the fireball. We calculate the polarization observables of thermal virtual photons as a function of mass and momentum and compare the results to existing measurements from HADES and NA60. Finally, we discuss the prospects of using an excitation function of virtual photon polarization to disentangle the contributions to the thermal dilepton radiation of hadronic and partonic origin.

Category

Theory

Collaboration (if applicable)

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Session Classification: EM Probes

Track Classification: EM Probes