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Illuminating early-stage dynamics of heavy-ion collisions through photons at RHIC BES energies

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Heavy-ion collisions at $\sqrt{s_{\mathrm{NN}}} \sim 10$ GeV probes the QCD phase diagram at large baryon densities. However, because the longitudinal Lorentz contraction is small at these collision energies, understanding the dynamics during the early phase of the collision is essential for the subsequent modeling of the system evolution, and for constraining the QGP transport properties at finite baryon densities. Direct photons are multi-messengers in heavy-ion collisions, providing undistorted information about early-stage dynamics. In this talk, we model relativistic heavy-ion collisions at RHIC Beam Energy Scan energies with a hybrid dynamical approach which consists of a 3D-Glauber initial state followed by viscous hydrodynamics and finally by transport theory (MUSIC + UrQMD). Thermal photon emission takes into account the enhancement from finite baryon chemical potentials. We will show that direct photon spectra and their anisotropic flow coefficients have a strong sensitivity to the early stage of heavy-ion collisions and thus provide constraints on QGP dynamics complementary to those obtained from hadronic observables.

Experiment/Theory

Theory/Phenomenology

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