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Multi-messenger constraints on heavy-ion collision dynamics with hadrons and photons

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In this talk, we present a study of direct photons in relativistic nuclear collisions, along with the production of hadrons, from RHIC Beam Energy Scan (BES) to LHC energies. Thermal photons are soft and penetrating probes of the strongly-coupled nuclear matter created in relativistic heavy-ion collisions. Their spectrum and momentum anisotropies remember the QGP's chemistry evolution and its dynamical expansion. Using medium profiles well-calibrated with hadronic data at LHC energies, we highlight that photon observables can additionally reveal the chemical equilibration process and signal the formation of QGP in small systems [1]. At RHIC BES energies, a study of direct photon production in Au+Au collisions at 19.6 - 62.4 GeV will quantify the role of finite baryon chemical potential in thermal photon emission. Photon spectrum and anisotropic flow coefficients show strong sensitivity to the early-time dynamical initialization. This survey confirms photons as a powerful tool to elucidate QGP dynamics over a wide range of collision energies and serve as a necessary complement to hadronic measurements.

[1] C. Gale, J. F. Paquet, B. Schenke and C. Shen, "Multi-messenger heavy-ion physics," arXiv:2106.11216 [nucl-th]

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