

Dielectron production: QGP versus photon – photon mechanism

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We calculate cross sections for di-lepton photoproduction in ultrarelativistic heavy-ion collisions from low (SPS) to high (LHC) energy.

We study the invariant-mass distributions of dileptons produced in ultrarelativistic heavy-ion collisions at very low pair transverse momenta, $P_T < 0.15$ GeV. Specifically, we investigate the interplay of thermal radiation with initial photon annihilation processes, $\gamma\gamma \rightarrow \ell^+\ell^-$, triggered by the coherent electromagnetic fields of the incoming nuclei. For the thermal radiation, we employ the emission from the QGP and hadronic phases with in-medium vector spectral functions which describes the inclusive excess radiation observed over a wide range of collision energies. For the coherent photon fusion processes, whose spectrum is much softer than for thermal radiation, we employ initial fluxes from the Fourier transform of charge distributions of the colliding nuclei in the equivalent-photon approximation.

We first verify that the combination of photon fusion, thermal radiation and final-state hadron decays gives a fair description of the low- P_T invariant-mass as well as P_T spectra as recently measured by the STAR collaboration in $\sqrt{s_{NN}} = 200$ GeV Au+Au collisions for different centrality classes, including experimental acceptance cuts. The coherent contribution dominates in peripheral collisions, while thermal radiation shows a markedly stronger increase with centrality. We extend the calculations to lower collision energies ($\sqrt{s_{NN}} = 17.3$ GeV) and compare to the acceptance-corrected dimuon excess spectra measured by the NA60 experiment at the CERN SPS; the contribution from photoproduction turns out to be negligible. We also provide predictions for the ALICE experiment at the LHC. The resulting excitation function from SPS to LHC energies reveals a nontrivial interplay of photoproduction and thermal radiation.

[1] M. Klusek-Gawenda, R. Rapp, W. Schäfer, A. Szczurek
 "Dilepton Radiation in Heavy-Ion Collisions at Small Transverse Momentum",
 Phys. Lett. B790 (2019) 339-344.

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