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Thermal dilepton radiation at low and intermediate collision energies from a coarse-graining approach

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Electromagnetic radiation emanates over the entire course of a heavy-ion collision, decoupling from the matter once produced, thus providing unique information about the interacting QCD medium. Specifically, the yield of low-mass thermal dileptons was identified as a measure of the fireball lifetime, while the slope of intermediate-mass dilepton spectra can serve as a thermometer unaffected by blue-shift effects of collective expansion which distort p_T spectra. Here, we couple in-medium thermal dilepton rates, which reproduce existing data at ultrarelativistic collision energies, with a coarse-graining method of hadronic transport simulations to compute dilepton spectra at lower energies, $\sqrt{s_{NN}} \leq 10$ GeV, where hydrodynamic simulations may be less reliable. By extracting local temperature, baryon and pion densities the convolution with thermal rates can be readily carried out. Our calculations suggest that also at lower energies the ρ-meson melting in a near-thermal source prevails and that the emission duration closely correlates with the build-up of the transverse flow in the fireball. The resulting yields and slopes of the invariant-mass spectra extend previous excitation functions of the fireball lifetimes and temperatures to lower energies. We use this as a baseline to analyze signatures of a putative critical point on dilepton observables, to facilitate its search in future campaigns with the HADES and CBM experiments at GSI/FAIR, as well as in the RHIC beam energy scan phase II with STAR.

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Primary author: SECK, Florian (TU Darmstadt)

Co-authors: GALATYUK, Tetyana (TU Darmstadt / GSI); RAPP, Ralf (Texas A&M University); STROTH, Joachim (Goethe-University and GSI)

Presenter: SECK, Florian (TU Darmstadt)

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