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Enhancement of thermal photon production in event-by-event hydrodynamics

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Thermal photon emission is widely believed to reflect properties of the earliest, hottest evolution stage of the medium created in ultra-relativistic heavy-ion collisions. Previous computations of photon emission have been carried out using a hydrodynamical medium description with smooth, averaged initial conditions. Recently, more sophisticated hydrodynamical models which calculate observables by averaging over many evolutions with event-by-event fluctuating initial conditions (IC) have been developed. Given their direct connection to the early time dynamics, thermal photon emission appears an ideal observable to probe fluctuations in the medium initial state. In this work, we demonstrate that including fluctuations in the IC may lead to an enhancement of the thermal photon yield of about a factor of 2 in the region $2 < p_T < 4$ GeV/c (where thermal photon production dominates the direct photon yield) compared to a scenario using smooth, averaged IC. Consequently, a better agreement with PHENIX data is found. This can be understood in terms of the strong temperature dependence of thermal photon production, translating into a sensitivity to the presence of 'hotspots' in an event and thus establishing thermal photons as a suitable probe to characterize IC fluctuations.
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