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Effective spectral function of vector mesons via lifetime analysis

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We reconstruct effective spectral functions of the ρ-meson in different scenarios via lifetime analysis using the hadronic transport SMASH (Simulating Many Accelerated Strongly-interacting Hadrons). The theoretical interest in the behavior of in-medium spectral functions lies in the expected restoration of chiral symmetry at high energy densities, which may be accessed experimentally by studying dilepton mass spectra in heavy-ion collisions. Within SMASH, the phase space of all particles is available at all times, as well as information on interactions, allowing for a direct assessment of particle lifetimes and the mass distributions. Our reconstruction of the spectral function consists in using the total width – considering both decays and collisions – as input for a Breit-Wigner ansatz. The broadening of the spectral function in a thermalized system is shown to be consistent with model calculations, and the dependence of total width on local hadron density is provided. This broadening develops dynamically, since SMASH relies only on vacuum properties of resonances as an input. On the other hand, we present the effective ρ-meson spectral function for the dynamical evolution of heavy-ion collisions, finding a clear correlation of broadening to system size. Furthermore, we discuss the difference in the results between the thermal system and full collision dynamics, which may point to out-of-equilibrium effects. The results shown in this work are of interest to distinguish dynamical broadening from additional genuine medium-modified spectral functions.

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