Reconstruction of virtual photons with HADES*

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Introduction

The HADES [1] explores strongly interacting baryon-rich matter at moderate temperatures using rare and penetrating probes. It operates in the beam-energy range of $1-2A$ GeV where relatively long-lived states of compressed matter are formed. The challenge is to detect them in the laboratory by isolating their unambiguous signals. Among the observables for investigating the microscopic properties of such states of matter, virtual photons are one of the most promising. Baryon-driven medium effects influence significantly the ρ meson in-medium spectral function and are considered [2] to be the key for describing the low-mass dilepton spectra measured at low energies.

Au+Au data analysis

About seven billion Au+Au collisions at $1.23A$ GeV have been recorded in April/May 2012 with the mean data rate during the flat top of the extracted beam of 100 MBytes/s and an event rate of 10 kHz.

Data readout was triggered by a first-level (LVL1) decision requiring charged particle multiplicity MUL ≥ 20 in the Time-of-Flight wall, selecting the 40% most central Au+Au collisions. All events with a positive LVL1 decision were written to tape (in total $4.5 \cdot 10^9$ events). Track reconstruction, electron identification, and electron pair (opposite- and like-sign) reconstruction were performed as described in [3].

Combinatorial background (CB) was obtained from same-event like-sign pairs using the geometric mean $\frac{dN_{+-}^{CB}}{dM} \equiv 2\times\left(\frac{dN_{++}}{dM}\times\frac{dN_{--}}{dM}\right)^{1/2}$ to account for correlated background from double conversion of π^0 decay photons or conversion of the photon accompanying Dalitz decays, as well as for uncorrelated e^+e^- stemming from multi-pion decays. The final invariant-mass distribution was obtained by subtracting the CB pairs from all same-event opposite-sign pairs.

HADES does not provide data corrected for the geometrical acceptance. Only efficiency effects due to the analysis cuts and the intrinsic detection efficiency are corrected for directly during the data analysis, before comparing final measured spectra to theoretical models. The reconstruction efficiency of single tracks was determined using a track embedding technique.

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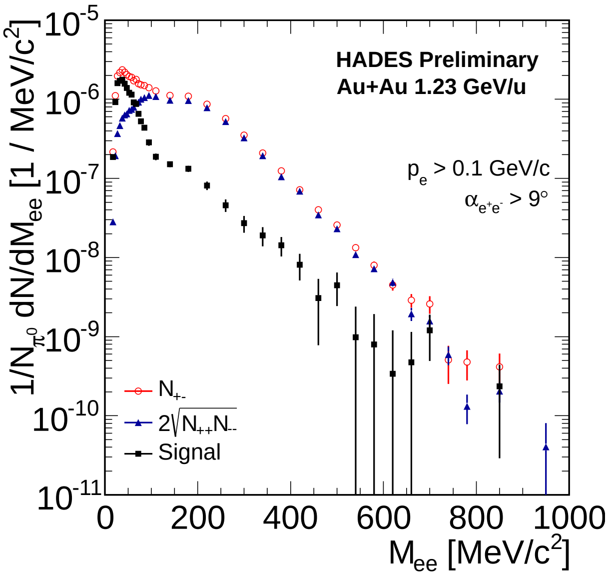

Figure 1: Invariant-mass distribution of all (open red circles), signal (black squares) lepton pairs measured with HADES in the $1.23A$ GeV Au+Au reactions. The background of uncorrelated combinations obtained from geometrical average of same-event like-sign pairs is shown as well (blue triangles).

The resulting invariant-mass spectrum of dielectrons, corrected for detector and reconstruction efficiencies, is shown in Fig. 1. In total, 1.3×10^5 signal pairs, 2×10^4 thereof in the region above 0.15 GeV/c^2 with a signal-to-CB ratio of 0.1, were reconstructed. This statistics is high enough to characterize the dielectron yield beyond the mass distribution and will allow to compare the data to predictions from various model calculations [4, 5, 6].

References

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