Measurement of e^+e^- Pairs in C+C Collisions at E=1A GeV with HADES ◇

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The physics program of the HADES experiment at GSI, Darmstadt, consists in the investigation of e^+e^--pair production in collisions of hadrons and heavy ions at beam energies up to 2A GeV. Of particular interest are the decay channels of pseudoscalar (π^0, η) and vector (ρ, ω) mesons produced in these reactions, since they allow spectroscopic access to possible modifications of these mesons in the nuclear medium. Recently, we have published results for the collision system $C+C$ at a beam energy of 2A GeV showing noticeable excess yields in the invariant mass region above $200 MeV/c^2$ [1]. In this report we present results for the same system at 1A GeV incident energy. This dataset is of particular interest as data from previous measurements conducted by the DLS collaboration [2] still lack a satisfying theoretical description.

The analyzed experimental data set is equivalent to a total of 8.4×10^8 inspected collisions. After momentum reconstruction and particle identification [3] the reconstructed tracks of electrons and positrons where combined to like-sign and unlike-sign pairs from which invariant mass distributions where computed. The like-sign pairs where used to estimate the combinatorial background (CB) that needs to be subtracted from the unlike-sign pair signal to account for uncorrelated lepton-pairs. In the mass region of interest the average signal to background ration was $S/B > 1$.

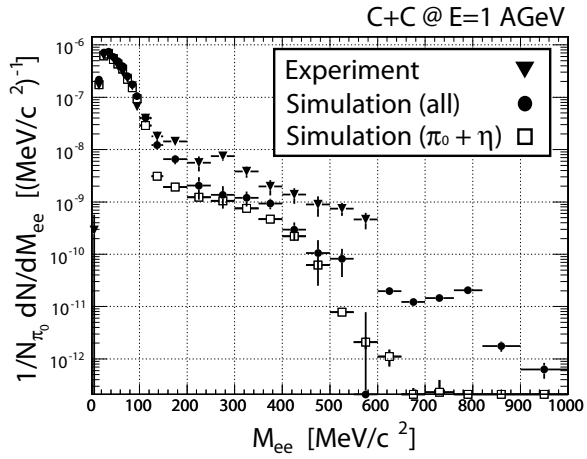

Fig. 1: Experimental e^+/e^- M_{inv} distributions in comparison to two simulation results. One simulated mass spetrum (squares) contains only pairs from the experimentally known sources π_0 and η. All spectra are corrected for combinatorial background and normalized to the number of neutral pions.

Figure 1 shows the pair signal after CB-subtraction for experimental and simulated data. The latter where created with the HADES event generator PLUTO [4] using measured cross sections and m_T-scaling arguments for all contributing $e+/e-$ sources (see also ref [1]). The e^+e^- cocktail from pure π_0 and η meson decays is shown separately, since the production cross sections for these two mesons are known from previous independent mesurements [5] of their 2 photon decay channel. At masses beyond the pion mass, the measured e^+e^- pair signal shows a significant excess. To allow for an indirect comparison with the DLS data, we have integrated the dielectron yield in the mass range 150 MeV/c^2 < M_{ee} < 550 MeV/c^2 and compare it to the expected Dalitz-decay contribution of the η-meson. The ratio of the total signal to the η-Dalitz content amounts to about $\simeq 5.8$, similar to that deduced from the DLS data.

Figure 2 shows the energy dependence of the π_0 and η production probability per collision in comparison to that of the extracted η Dalitz and the observed excess yields as measured in the DLS and the 2 HADES runs.

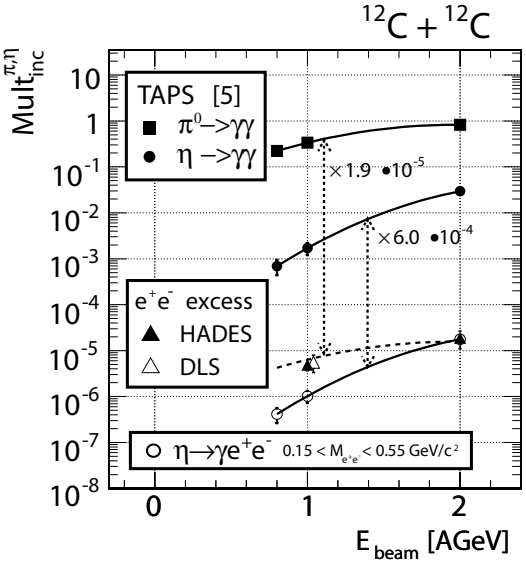

Fig. 2: Production rates of neutral mesons and e^+e^- pairs as a function of beam energy. The η Dalitz contribution is obtained by scaling the total η multiplicity with the Dalitz branching ratio and a reduction factor accounting for the restricted invariant mass range.

Within the preliminary estimate of our systematic errors ($\simeq 30\%$), the excitation function for the excess production (dashed line in Fig. 2) is similar to that of the π_0 production and does not show the close-to-threshold behaviour of the η meson. This hints to a e^+e^- production mechanism in this mass region which is different from that of the η meson. The nature of this mechanism has still to be verified in transport calculations. A comparison of our results to up-to-date transport calculations will be performed soon after the efficiency corrections for our data are completed.

References

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