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

T. Christ, M. Böhmer, T. Eberl, L. Fabbietti, J. Friese, R. Gernhäuser, J. Homolka, M. Jurkovic, R. Krücken, B. Sailer, and S. Winkler

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 a few GeV per nucleon. Of special interest are the electronic decay channels of pseudoscalar (π^0, η) and vector (ρ, ω) mesons produced in these reactions. In continuation of earlier measurements of elementary $p + p$ reactions at E= 2.2 GeV [1] and those for the light collision system C+C at E= 2·A GeV [2] we have conducted an experiment for $C + C$ at a beam energy of 1·A GeV. This energy is well below the free nucleon-nucleon threshold for η and ρ/ω production and should allow to observe effects of the particular ion-ion collision dynamics.

We report here the present status of the data analysis. The experimental data set comprises $7.7 \cdot 10^6$ events with e^+/e^-- content out of a total of $8.4 \cdot 10^8$ recorded collisions. After reconstruction of particle momenta we have applied the particle identification method as described in ref. [3] to generate single e+/e- tracks of high purity. The e+/e- tracks where then combined to unlike-sign and like-sign pairs to generate invariant e^+e^--pair mass distributions. The like-sign pairs were used to estimate the unavoidable combinatorial background (CB) which results mainly from abundant but incompletely reconstructed closed pairs of γ conversion and π^0- Dalitz decays.

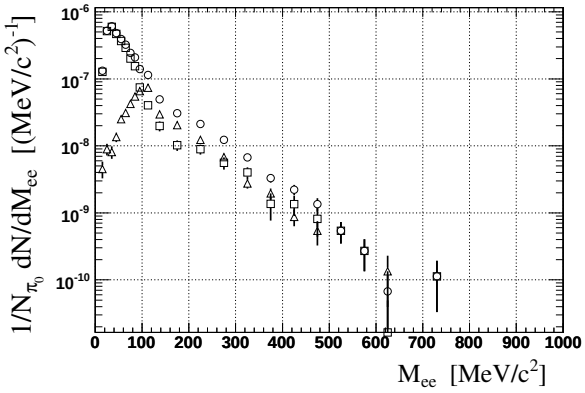

Fig. 1: Invariant mass distributions of e^+e^- pairs for C+C at E=1·A GeV before (*circles*) and after (*squares*) CB subtraction. The CB distribution (*triangles*) is computed from like-sign pairs.

Figure 1 shows the unlike-sign pair signal before CB-subtraction, the CB obtained with geometrical averaging of like-sign pairs, and the net-signal after CB-subtraction. All spectra have been normalized to the number of neutral pions produced in these collisions. This number was estimated from the simultaneously measured multiplicity of charged pions and from systematics of earlier heavy ion measurements. A very good signal to background ratio is obtained up to the η-mass region as shown in figure 2. For higher masses the event statistics is still insufficient.

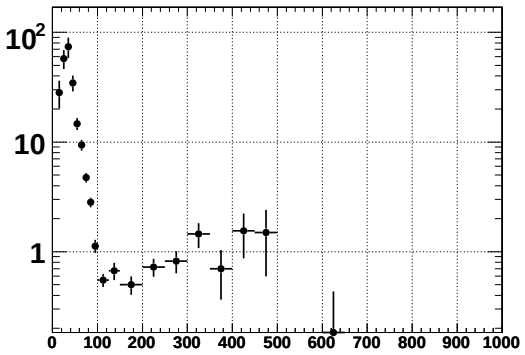

Fig. 2: Signal to background (S/B) ratio of e^+e^- pairs for C+C at E=1·A GeV. Above the η-mass background and signal suffer from low statistics.

We have performed extensive Monte Carlo simulations to determine the detector and analysis efficiencies and to compute efficiency corrected e^+e^- pair distributions. These can then be compared to theoretical calculations corrected for the geometrical acceptance of the HADES spectrometer.

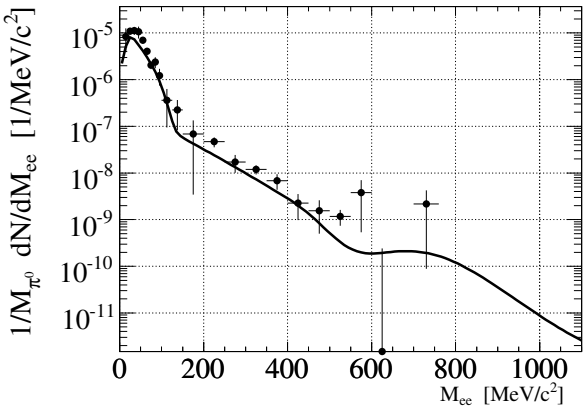

Fig. 3: e^+e^- pair spectrum for C+C at E=1·A GeV compared to a HSD transport code prediction [4]. Only statistical errors are shown.

One - still preliminary - example of such a comparison is depicted in figure 3. Here we compare the experimental e^+e^- pair signal to a calculation within a transport code [4] neglecting possible in-medium effects. However, before any conclusions can be drawn, the systematic errors and effects of analysis cuts on the theoretical data need to be investigated. This work is presently ongoing.

References

[1] B. Sailer *et al.*, 70
[2] J. Friese *et al.*, Annual report 2002, p. 40
[3] T. Christ *et al.*, Annual report 2004, p. 99
[4] W. Cassing, E.L. Bratkovskaya, Phys.Rep. **308** (1999) 65

◇ supported by MLL, BMBF and GSI