Di-Electron Production in C+C Reactions at E = 1 AGeV and 2 AGeV. ◇

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We have continued our systematic study of e^+e^- pair production in the invariant mass range up to 1000MeV/c^2 in proton and heavy ion induced reactions. The collision system C+C was measured at two bombarding energies with the e^+e^- pair spectrometer HADES [1] at GSI, Darmstadt. Goal of these measurements is the comparison of inclusive invariant mass distributions of e^+e^--pairs to theoretical predictions for the direct electromagnetic decays of the light vector mesons as well as for Dalitz decays of light scalar mesons (i.e. η or the π^0). So far, we have recorded and analyzed $\simeq 1.5 \cdot 10^9$ and $\simeq 6 \cdot 10^8$ collisions for E = 1 AGeV and E = 2 AGeV, respectively.

For the higher incident energy, the data analysis has already progressed considerably. The invariant mass distribution of the measured net (i.e. after background subtraction) signal S_{+-} is shown in Fig. 1 [2]. The signal S_{+-} consists of about 16000 e^+e^--pairs , most of them from π^0-Dalitz decays with $M_{inv} < 140$ MeV/c^2. The signal-to-background ratio S_{+-}/B_{+-} is on average 4:1 for $M_{inv} < 100$ MeV/c^2 and 1:2 for the higher masses. The systematic errors (light grey band) due to the various steps in the signal reconstruction were estimated by systematically switching off one cut in the analysis chain while keeping all others active. At this stage, the data are not yet corrected, neither for acceptance nor for efficiency.

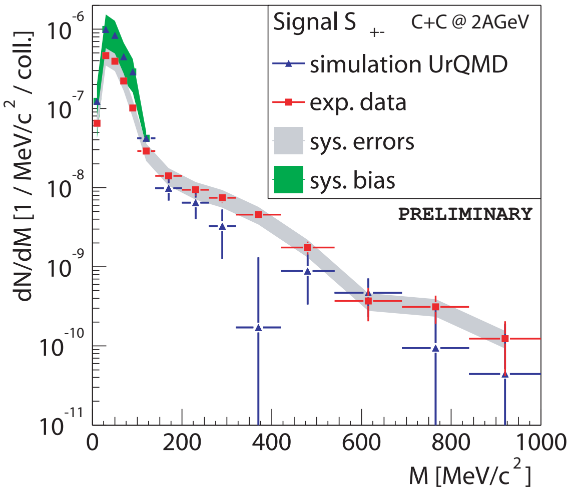

Fig. 1: Invariant mass distributions (prelim.) of e^+e^--pairs for $^{12}C + ^{12}C$ at 2 GeV·A in comparison to UrQMD simulations. See text for a discussion of the error bands.

The distribution is compared to a full scale simulation using UrQMD as event generator, HGEANT for particle propagation to the detectors, and the identical analysis chain. Both, measured and simulated data sets are normalized to the total number of analyzed collisions with the same trigger condition. Note that in the UrQMD simulation vector mesons were not yet part of the event generation and hence do not contribute to the e^+e^--pair signal.

For small invariant masses $M_{inv} < 100$ MeV/c^2 the experimental data exhaust only about 60% of the simulation yield, while reasonable agreement is observed for higher masses. The difference in the low mass region can partly be attributed to a systematically different response of the simulated distributions to the cuts applied in the pair analysis. Its magnitude (dark grey band) was estimated by comparing the reductions of unlike-sign and like-sign pairs when applying the various analysis cuts. In contrast to the expectation, we observe a smaller reduction of unlike-sign pairs and a larger reduction for like-sign pairs. Since the combinatorial background is calculated from the like-sign pairs, this leads consequently to a larger net signal in the simulation. The reasons for this difference and its (much smaller) magnitude at higher masses are still under investigation.

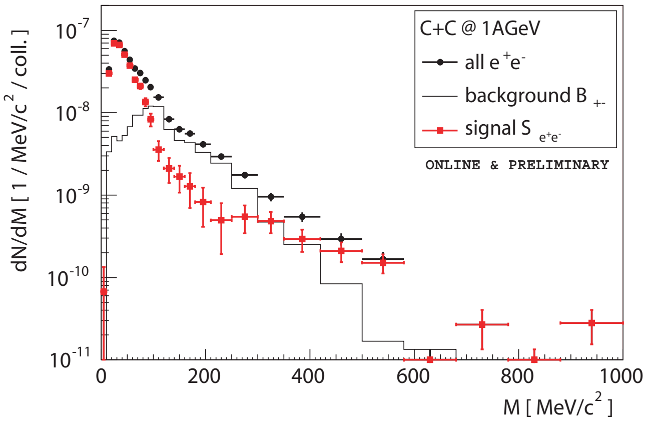

Fig. 2: Invariant mass distributions of e^+e^--pairs for $^{12}C + ^{12}C$ at 1 GeV·A obtained "online" during the experiment.

The experiment at E = 1 AGeV was conducted in september 2004. Fig. 2 shows the preliminary mass spectrum of e^+e^--pairs obtained from a fast online analysis with preliminary calibration parameters for all detectors. The black dots represent the distribution of all measured opposite sign pairs. The combinatorial background (black line) was calculated from the geometrical average of the like-sign pair distributions. The red symbols show the resulting net signal distribution. The measured yield amounts to roughly 5000 e^+e^--pairs in the range $0 \leq M_{inv} < 150$ MeV/c^2, 300 in $150 \leq M_{inv} < 610$ MeV/c^2 and 20 up to 1000 MeV/c^2. The analysis of this data set is in progress.

References

[1] J. Friese *et al.*, Nucl.Phys. **A654** (1999) 1017c-1020c
[2] T. Eberl *et al.*, Nucl.Phys. **series A** (2005) in press

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