Level of Charm expected in the CERES data

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We provide here an estimate of the contribution of lepton pairs from open charm to the e^+e^- spectra measured in the CERES apparatus. Calculations were done using the PYTHIA code. To calibrate the absolute scale and to assess the accuracy of the estimates we first compare in Fig. 1 the results of PYTHIA calculations with the Fermilab E769 data on charmed meson production in p+A collisions at 250 GeV [1]. The absolute normalization of

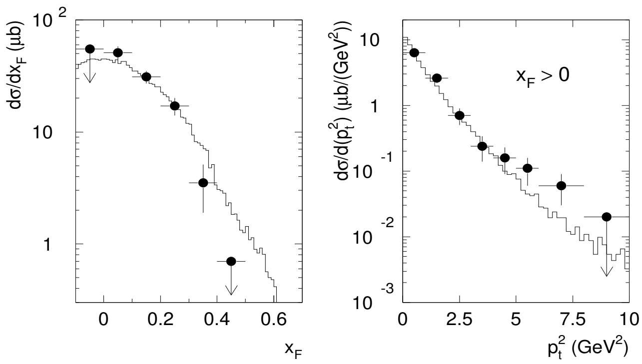

Figure 1: $D^+, D^-, D^0, \overline{D}^0, D_s^+, D_s^-$ production in pp at 250 GeV: comparison between experimental data [1] (black dots) and 5.0*PYTHIA (histograms).

the calculations has been adjusted to reproduce the data, yielding a K factor of 5.0. (The PYTHIA calculations must be up-scaled by K to account for the next-to-leading order effects.) The preliminary CERN WA92 data on π-Cu interactions at $\sqrt{s} = 26$ GeV and the available data on D meson production cross section in proton induced collisions as a function of beam energy up to $\sqrt{s} = 60$ GeV are also well reproduced by the calculations with K=5.0. This agreement, together with the observed A^1-scaling of the charm production in pA reactions [2], gives us confidence that the level of charm production and the resulting e^+e^- mass spectrum can be well calculated for pp and pA collisions. To use these results for an estimate of the expected yield of dielectron pairs in the CERES data one has to: 1) scale the data for pp collisions to the nucleus-nucleus case, including the appropriate centrality cuts, 2) apply the CERES filter and normalization. As there are no indications of any "nuclear" effects in the pA data, we scale the pp calculations from PYTHIA with the total number of nucleon-nucleon collisions obtained from the nuclear collision geometry [3]. To take into account the experimental acceptance we use the CERES filter as supplied by A. Drees. The resulting mass distributions into the CERES acceptance, normalized to the charged particle rapidity density, are shown in Fig. 2 for the four different systems studied so far. The level of e^+e^- pairs from open charm decay is, according to these calculations, more than 2 orders of magnitude below the observed dilepton mass spectra for all systems and energies. This rules out the possibility that the observed enhanced dilepton yield in nucleus-nucleus collisions is due

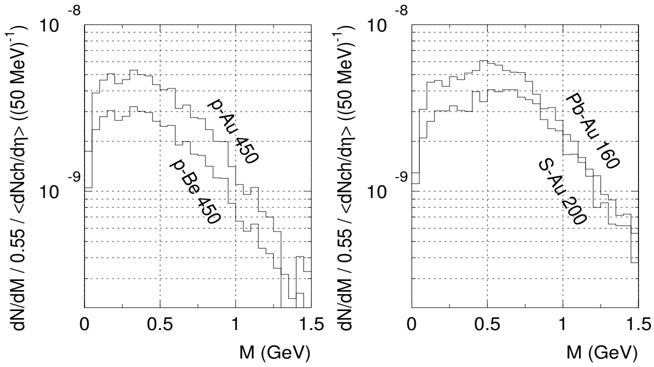

Figure 2: Invariant mass spectra of e^+e^- from charm decay in CERES acceptance in p-Be, p-Au, S-Au and Pb-Au.

to conventional scenarios for charm production. It is nevertheless not unreasonable to contemplate the possibility of a strong additional source of charm in nucleus-nucleus collisions. In order to assess the minimal size of such an enhancement needed to explain the data we start from the calculations of Li, Ko, and Brown for the dilepton continuum in S+Au including the standard nuclear cocktail plus pion annihilation without vector meson mass shifts. To this distribution we add a scaled dilepton continuum from charm (Fig. 3). A charm enhancement factor of 100 is needed to account for the CERES data. Even in this case the spectrum shape is not well reproduced. We conclude that the observed enhancement cannot be explained by the dielectrons from charm decay.

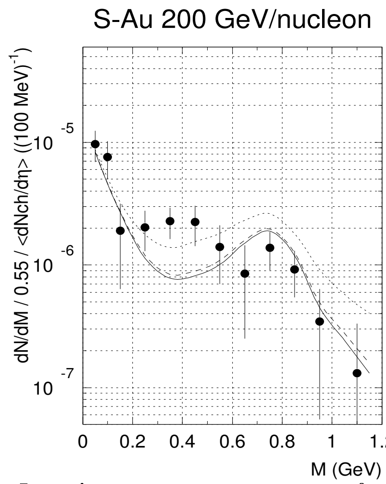

Figure 3: Invariant mass spectrum of dielectrons in CERES acceptance in S+Au at 200 GeV. Solid line: Li-Ko-Brown calculation with free mass. Dashed (dot) line – the same with added dielectrons from charm decay, scaled up by a factor of 10 (100).

References

[1] G. A. Alves et al., Phys. Rev. Lett. 77(1996)2392.
[2] G. A. Alves et al., Phys. Rev. Lett. 70(1993)722.
[3] K. J. Eskola et al., Nucl. Phys. B323(1989)37.