Kaon Production via High Mass Resonances in UrQMD^{B,G}

H. Weber, S.A. Bass[‡], S. Soff[§], H. Stöcker and W. Greiner
Institut für Theoretische Physik, Universität Frankfurt am Main, Germany

The investigation of strange matter in heavy ion collisions is of great interest, as the s and $\bar{s}$-quarks are not present in the initial projectile and target matter. Therefore the measurement of strange particles might yield deep insight into the reaction dynamics during the high density phase.

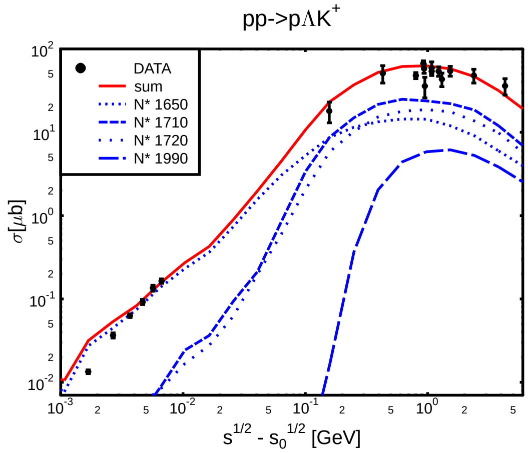

Figure 1: $pp \to p\Lambda K^+$ cross section in UrQMD compared to data.

For our investigation, we use the Ultrarelativistic Quantum Molecular Dynamics model (UrQMD) [1]. UrQMD provides a good description of NN and A+A collisions over a wide range of energies from a few hundred MeV/A up to hundreds of GeV/A. The production threshold for the lightest strange particle (K^+) via the process $NN \to N\Lambda K^+$ is 1.58 GeV. Particularly for SIS energies, the correct description of the production cross section near the threshold is very important. In contrast to most other models, UrQMD treats the elementary K^+ production via two-step processes

$$pp \to pB^* \to p\Lambda K^+, \qquad pp \to pB^* \to p\Sigma K$$

B^* are the high mass resonances N^*_{1650}, N^*_{1710}, N^*_{1720}, N^*_{1990} and Δ^*_{1920}. For the decay into the hyperon-kaon channel we use the experimental branching ratios, where available.

Figure 1 shows the cross section for the reaction $pp \to p\Lambda K^+$ as a function of energy above threshold. The dotted lines are contributions of the five resonances to the total cross section (solid line). With this approach we are able to describe the experimental data (dots) reasonably well, even a few MeV above the threshold (COSY data [2])

The $pp \to p\Sigma^0 K^+$ and the $pp \to p\Sigma^+ K^0$ channel can be described as well with this approach. Figure 2 shows these channels in UrQMD compared to data.

For higher collision energies, kaon production via string fragmentation becomes important. Figure 3 shows an excitation function of the K^+ to K^- ratio for central Pb+Pb

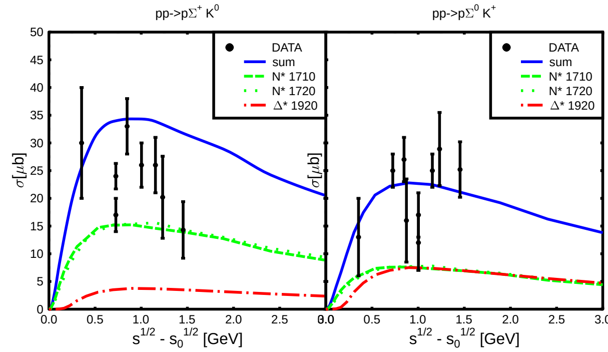

Figure 2: $pp \to p\Sigma^+ K^0$ and $pp \to p\Sigma^0 K^+$ cross section in UrQMD compared to data.

events calculated with the UrQMD model. The dots are experimental data from E802, E866/E917 [3] and NA49 [4, 5]. The model shows a good overall agreement with the experiments, except for the preliminary 40 GeV measurement from NA49 [5] which is slightly underestimated. Interestingly this good agreement for the K^+ to K^- ratio with the data can be obtained without invoking any medium dependent effects, such as in-medium masses.

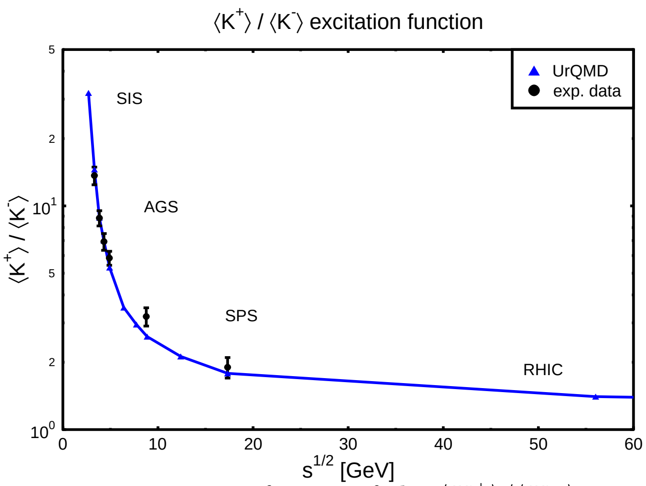

Figure 3: Excitation funtion of the $\langle K^+\rangle/\langle K^-\rangle$ ratio in central Pb+Pb or Au+Au collisions compared to data from E802, E866, E917 and NA49

References

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‡ Duke University and RIKEN BNL Research Institute, USA
§ LBL Berkeley, USA (Lynen-Fellow of the Humboldt-Foundation)