Strangeness Production in ultrarelativistic p+p Collisions at 158 GeV from the NA49 Experiment[G,B]

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The interpretation of results from high energy nuclear collision experiments requires accurate knowledge about the corresponding reaction characteristics in elementary hadron-hadron interactions. This information is not always available with the wanted precision, as early particle physics experiments either did not cover full phase space or suffered from low statistics. The SPS experiment NA49 [1] has therefore started a program to study hadron production in p+p interactions at 158 GeV/c beam momentum. An important part of this program is the measurement of strangeness production in full phase space [2].

The NA49 experiment has recorded a total of 2.26 million p+p interactions at 158 GeV. After event selection cuts, which ensure that the interaction occurs in the liquid hydrogen target, 83 % of the total inelastic cross section remain for the analysis. The detection of the measured strange hadrons is based on the recognition of the characteristic V^0 topology, which arises from the decay of long lived neutral particles into two charged decay products. Λ and K^0_S decays are searched for by intersecting tracks from oppositely charged particles and by studying the resulting invariant mass distribution of those pairs which have a valid secondary vertex. Cuts on its position, the distance of the daughter particles in the target plane as well as the cm-decay angles are used to maximise the signal to noise ratio in these distributions. The double strange hyperon Ξ^- and its antiparticle $\overline{\Xi}^+$ were identified by combining the trajectories of all Λ and $\overline{\Lambda}$ candidates with those of negatively (Ξ^-) and positively ($\overline{\Xi}^+$) charged particles. The whole procedure is applied to equal-sized, non-overlapping intervals in rapidity and transverse momentum, which have been chosen according to signal statistics in these two variables. Detection efficiencies and acceptance corrections were determined in the same $y-p_T$ bins by processing simulated strange particle decay topologies using the complete analysis chain.

Figs. 1a,b and 2 show the rapidity distributions of K^0_S, Λ, and Ξ-hyperons in inelastic p+p interactions. Also shown for the neutral strange hadrons are previously measured data [3] at similar energies. The transverse momentum distributions (not shown) follow within experimental errors an exponential function with slope parameters of $\simeq$ 138, 142, 174 MeV for K^0_S, Λ, and Ξ hyperons respectively.

The scaling of the p+p spectra by the number of participants in Pb+Pb collisions at the same energy allows a direct comparison of both systems. Fig. 3 shows the rapidity distributions of K^0_S for both – central Pb+Pb data as well as the scaled p+p results together with a fit to the identified charged kaons [4]. A strangeness enhancement of a factor ≈ 2 in the Pb+Pb compared to p+p reactions is clearly visible.

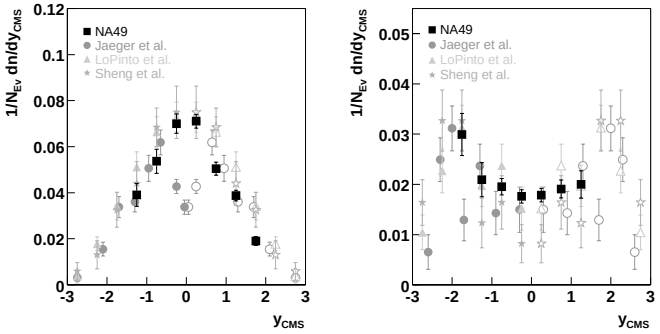

Figure 1: Rapidity distributions for K^0_S (left) and Λ (right) compared to reference data at similar energies [3]. The shape of the distributions is reproduced, the dip around midrapidity in the K^0_S spectra cannot be verified.

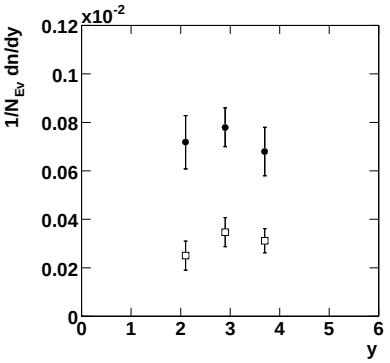

Figure 2: Rapidity distributions for Ξ^- (•) and $\overline{\Xi}^+$ (□).

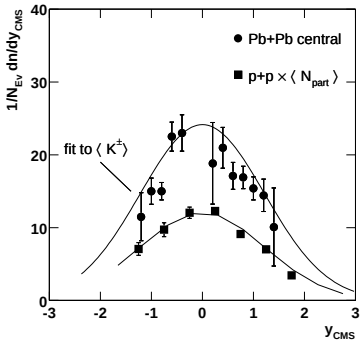

Figure 3: Comparison of the rapidity distribution for K^0_S in central Pb+Pb collisions with the scaled p+p results.

References

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