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STRANGENESS PRODUCTION IN SULPHUR-TUNGSTEN INTERACTIONS AT 200 GeV/c PER NUCLEON

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WA85 Collaboration

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Preliminary results from the WA85 Experiment at the CERN Omega Spectrometer are presented. A 200 A GeV/c beam of ^{32}S ions was used with a tungsten target. The apparatus is used to detect V^0 s and charged tracks in the range $p_T > 0.9$ GeV/c and $2.3 < Y_{\text{lab}} < 3.0$. Production of Λ , $\bar{\Lambda}$ and cascade particles is discussed. A study of the multiplicity dependence of Λ , $\bar{\Lambda}$ and negative hadron production is presented.

1. INTRODUCTION

The WA85 Experiment [1] was performed using the CERN Omega spectrometer with a 200 A GeV/c beam of ^{32}S ions on a tungsten target. The experiment studies strangeness production at $p_T > 1$ GeV/c and central rapidity in order to probe the dynamics of hadronic matter under extreme conditions where it has been suggested that a Quark-Gluon Plasma (QGP) may be formed.

Strange particle [2-4] and in particular strange antibaryon [3] production is expected to be a useful probe for the dynamics of hadronic matter in heavy ion collisions. In addition, it has been proposed [5] that in the event of plasma formation strange particles with medium p_T (> 1 GeV/c) would originate from the early stages of the QGP, allowing a more direct observation of the QGP than via the large number of particles produced at low p_T during hadronisation.

In this paper we present a study of the multiplicity dependence of both Λ and $\bar{\Lambda}$ at $p_T > 0.9$ GeV/c and central rapidity thus allowing a direct comparison of baryons and anti-baryons. We also present the multiplicity dependence for negative hadrons (mainly pions) in the same kinematic region.

It has been suggested that multi-strange baryon and antibaryon production are of particular interest in the search for the QGP [3]. As yet no results have been presented on production of these particles. We show that Ξ^- and $\bar{\Xi}^-$ decays can be reconstructed in the high multiplicity heavy ion environment and present a preliminary $\bar{\Xi}^-$ to Ξ^- production ratio.

2. THE EXPERIMENTAL SET-UP

The WA85 set-up is designed to enable the central rapidity, medium p_T region to be studied.

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ed at high rates. A handful of tracks are recorded out of several hundred produced in a central collision making reconstruction of both strange and multi-strange baryons possible in this kinematic region. 10^7 triggers were recorded in ten days of data taking.

The apparatus and trigger have been described previously [6]. A system of multiwire proportional chambers with a "butterfly" geometry [7] was used to measure tracks with $p_T > 0.6$ GeV/c and $2.2 < Y_{lab} < 3.2$.

Two arrays of 50 μ m pitch silicon microstrips, each with 512 channels, were placed above and below the beam 15 cm downstream from the target in order to sample the overall multiplicity for central rapidities, i.e. in the pseudorapidity range $2.1 < \eta < 3.4$. Microstrip multiplicity, henceforth called multiplicity, is defined as the total number of strips hit in the upper and lower microstrip arrays.

3. MULTIPLICITY DEPENDENCES

We have made a preliminary study of Λ , $\bar{\Lambda}$ and π^- production as a function of the charged multiplicity measured by the silicon microstrips. For this paper we consider the multiplicity region from 24 to 70 where statistics are good. We note that the multiplicity range from 24 to 35 is contaminated by interactions taking place in the silicon microstrips rather than the tungsten target.

The method used to select Λ and $\bar{\Lambda}$ candidates has been described previously [8]. For this study we consider the region $2.3 < Y_{lab} < 3$ and $p_T > 0.9$ GeV/c where the acceptance is good. The effective mass distributions for the candidates interpreted as $p\pi^-$ and $\bar{p}\pi^+$ are shown in fig. 1. We select events in a 50 MeV mass interval centred on the Λ mass, giving 8671 Λ and 2103 $\bar{\Lambda}$ candidates. We have also studied the production of negative hadrons in the same $Y - p_T$ region.

FIGURE 1
Mass distributions for Λ and $\bar{\Lambda}$ candidates

Fig. 2 shows the Λ , $\bar{\Lambda}$ and negative hadron yields as a function of multiplicity. The data are corrected for geometrical acceptance, including correction for decays outside the fiducial region and unseen decay modes (triangles) and in addition for reconstruction efficiency (circles). The reconstruction efficiencies are good over the multiplicity range considered, decreasing from $\sim 90\%$ to $\sim 60\%$ for single tracks and from $\sim 85\%$ to $\sim 40\%$ for Λ s and $\bar{\Lambda}$ s as the multiplicity increases from 24 to 70.

The yield for negative hadrons rises linearly over the multiplicity range considered. The Λ and $\bar{\Lambda}$ yields are also compatible with a linear rise in the multiplicity region 35 to 70. A study of the effect of the contamination in the low multiplicity region is in progress.

A preliminary simulation study using the FRITIOF 3.1 Monte Carlo program [9] adapted for our set-up shows that the rapidity density for tracks in the region $2.3 < Y_{lab} < 3$ is proportional to the multiplicity. This is shown in the lower scale of fig. 2.

FIGURE 2
 $\langle n_- \rangle$, $\langle n_\Lambda \rangle$ and $\langle n_{\bar{\Lambda}} \rangle$ as a function of multiplicity

The simulation predicts, under our experimental conditions, a linear rise with multiplicity for Λ , $\bar{\Lambda}$ and negative hadron production in the range considered, as expected for models based on a superposition of independent NN collisions.

A comparison of the Λ and $\bar{\Lambda}$ yields with proton-tungsten reference data is underway.

4. Ξ^- and $\Xi^=$ PRODUCTION

High p_T multi-strange baryon and antibaryon production are considered to be of particular interest in the search for the QGP [3]. The method used to select Ξ^- and $\Xi^=$ cascade decay candidates has been described previously [10]. Fig. 3 shows a fully reconstructed $\Xi^=$ candidate.

The effective mass distributions for the candidates, interpreted as $\Lambda\pi^-$ and $\bar{\Lambda}\pi^+$ are shown in fig 4; clear peaks are seen at the Ξ^- and $\Xi^=$ positions.

FIGURE 3
 A reconstructed $\Xi^=$ candidate.

FIGURE 4

Mass distributions for cascade candidates.

The acceptances and reconstruction efficiencies for the cascade candidates are being calculated but are similar for Ξ^- and Ξ^+ . The uncorrected Ξ^+ to Ξ^- ratio is 0.44 ± 0.10 .

5. CONCLUSIONS

We present a preliminary study of $p_T > 0.9$ GeV/c central Λ , $\bar{\Lambda}$, Ξ^- and Ξ^+ production in 200 A GeV/c sulphur-tungsten interactions.

The multiplicity dependence for Λ , $\bar{\Lambda}$ and negative hadrons has been studied in the same Y - p_T region. The average number of negative hadrons shows a linear rise over the whole multiplicity region. In this preliminary study the Λ and $\bar{\Lambda}$ ratios are compatible with this behaviour. We note that the Fritiof model, which is based on a superposition of independent NN collisions, predicts a linear rise in all three cases.

It is shown that the Ξ^- and Ξ^+ decays can be reconstructed with little background. The Ξ^+ to Ξ^- ratio is 0.44 ± 0.10 .

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