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PRODUCTION OF ρ^0 AND f IN K^-p INTERACTIONS AT 10 AND 16 GeV/c:

ESTIMATION OF THE CENTRAL AND FRAGMENTATION PARTS OF ρ^0

PRODUCTION AND COMPARISON WITH THE QUARK MODEL

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ABSTRACT

Inclusive production of $\rho^0(770)$ and $f(1270)$ is studied in $\bar{K}p$ interactions at 10 and 16 GeV/c. Compared to ρ^0 , the production of f is smaller by a factor of about 5. The average numbers, per inelastic interaction, of ρ^0 and f mesons associated with a Λ hyperon are comparable to those found inclusively in $\pi^\pm$ interactions at 16 GeV/c. In events associated with a $\bar{K}^0$, instead, the average multiplicity of ρ^0 and f is considerably smaller. It is found that, of the total inclusive cross section for $\bar{K}p \rightarrow \rho^0 + \text{anything}$ at 10-16 GeV/c, 1.5 ± 0.5 mb arise from central production and 1.4 ± 0.6 mb from the fragmentation of the beam $\bar{K}$. The ratio of the inclusive ρ^0 yields in $\bar{K}p$ and in $\pi^\pm p$ interactions is in agreement with a quark model prediction. The pions deriving from ρ^0 decays in $\bar{K}p$ interactions are $(11 \pm 2)\%$ of all charged pions produced.

1. INTRODUCTION

Recent studies of inclusive particle production in πp , $K p$ and pp interactions [1] have provided evidence for copious resonance production throughout the energy range investigated, from CERN PS energies up to CERN ISR energies. The $\rho^0(770)$ resonance has been most widely studied simply because it has a large production cross section and it is generally easy to detect. However, no inclusive investigation of ρ^0 production in $K^\pm p$ interactions has been published so far, mostly because of the severe K/π ambiguity problems encountered in bubble chamber studies, where most inclusive resonance data have been obtained.

In this paper we study ρ^0 and f inclusive production in $K^- p$ interactions at 10 and 16 GeV/c, restricting the investigation to the cases where the K/π ambiguity problems either do not exist or are greatly reduced. This was accomplished in two ways, namely by considering only: (i) events with an observed $\bar{K}^0$ or Λ decay, or (ii) events where the ρ^0 is produced backwards. An appropriate extrapolation was then carried out to obtain the total inclusive cross section. In case (i), practically all negative particles are pions, because multiple strange particle or baryon production is rare at the energies studied here [2]. In case (ii), we note that charged particles with lab. momentum below 0.8 GeV/c are identified unambiguously by ionisation; furthermore, the backward production of $\bar{K}^{*0}(890)$ is known to be rare in $K^- p$ interactions at 10 and 16 GeV/c [3], and will thus give no significant reflection into the $\pi^+\pi^-$ mass spectrum. This is important, because the present method of deducing ρ^0 (and f) cross sections (sect. 3) is useful only when the background due to particle misidentification behaves smoothly in the vicinity of the resonance signal.

In this paper we present data on the inclusive reactions

$$K^- p \rightarrow \rho^0 + \text{anything} \quad (1)$$

$$K^- p \rightarrow f + \text{anything}, \quad (2)$$

derived from experiments with the 150 cm British and the 200 cm CERN hydrogen bubble chambers. The investigation is based on a total of 200 000 inelastic events at 10 GeV/c (~ 10 events/ μb) and 301 000 inelastic events at 16 GeV/c (~ 16 events/ μb). These samples contain 16 600 events associated with a seen lambda decay at 10 GeV/c and 17 100 such events at 16 GeV/c; the number of events associated with a seen $\bar{K}^0$ decay are 27 500 and 37 200 at 10 GeV/c and 16 GeV/c, respectively. Events with more than one identified strange particle were excluded, but all cross sections given below have been corrected for them. The procedures used to identify the neutral kaons and hyperons, and to account for experimental biases, etc. are described in ref. [4].

The paper is arranged as follows: in sect. 2, the $\pi^+\pi^-$ effective mass spectra are presented for events associated with a lambda or a $\bar{K}^0$ decaying in the chamber. In sect. 3, cross sections are given and sects 4 and 5 deal with longitudinal momentum and transverse momentum distributions of the ρ^0 . In sect. 6 comparisons are made with the inclusive reactions

$$\pi^\pm p \rightarrow \rho^0 + \text{anything} \quad (3)$$

$$\pi^\pm p \rightarrow f + \text{anything} . \quad (4)$$

Sect. 7 summarises the conclusions.

2. DIPION MASS SPECTRA

Fig. 1 shows the dipion mass spectrum dN/dM , where M is the $\pi^+\pi^-$ effective mass for the reaction

$$K^- p \rightarrow V^0 + \pi^+\pi^- + \text{anything} \quad (5)$$

at 10 and 16 GeV/c. The V^0 in eq. (5) means either a $\bar{K}^0$ seen to decay in the bubble chamber ($\bar{K}_{\text{seen}}^0$) or a lambda seen to decay into $p\pi^-$ (Λ_{seen}).

All mass spectra in fig. 1 rise rapidly from threshold, reaching maximum value at M close to 0.45 GeV, and then fall roughly exponentially with increasing mass. The slope of the fall-off is smaller at the higher energy. These features are very similar to those observed in π^+p [5] and π^-p interactions at 16 GeV/c [6]. Another interesting observation is that the slope of the fall-off has a stronger energy dependence in events with a $\bar{K}_{\text{seen}}^0$ than in events with a Λ_{seen} .

A clear ρ^0 signal is visible in each mass distribution of fig. 1, and there are also indications of the f meson. The resonance signals are clearer in fig. 2, where the $\pi^+\pi^-$ mass spectra are multiplied by a factor $\exp(kM)$, with values of k of approximately 3 GeV^{-1} , as indicated. This multiplication by $\exp(kM)$ with the given k values compensates for the sharply falling background and enhances the structure in the high mass region with respect to the low mass region. Thus, in fig. 2, the f signal is artificially enhanced relative to the ρ^0 signal.

3. INCLUSIVE AND SEMI-INCLUSIVE CROSS SECTIONS

The method employed to deduce the resonance cross section is essentially the same as described in ref. [5]. To facilitate comparisons with the π^+p reactions (3) and (4) at 16 GeV/c, the same range of fitting and the same values for the masses and widths of the ρ^0 and f were used as in refs [5,6].

Table 1 summarises the results for the ρ^0 production cross sections, in association with $\bar{K}^0$ or Λ , at 10 and 16 GeV/c, obtained inclusively and also by summing up the partial cross sections determined in bins of the charged multiplicity (n_c), the transverse momentum squared (p_T^2), the Feynman variable (x) and the c.m.s. rapidity (y^*). The overall consistency of the fits is good: the fluctuation of the different ρ^0 cross sections around the average value are always less than 5%. Cross sections for

the f are given in table 2. The errors in tables 1 and 2 (and throughout this paper, unless otherwise stated) are statistical only. All cross sections have been corrected for unseen $\bar{K}^0/\Lambda$ decays. The numbers for f production are obtained from the observed $f \rightarrow \pi^+\pi^-$ mode by multiplying by the factor 1.85 to take into account the other decay modes.

No strong energy variation of the cross sections is seen in tables 1 and 2. It is interesting to note that the average number of ρ^0 and f mesons per event, $\langle \rho^0 \rangle$ and $\langle f \rangle$, are generally larger for events associated with a Λ than with a $\bar{K}^0$. This subject will be discussed in more detail in sect. 6, in the context of comparisons with reactions (3) and (4).

In tables 3 and 4, cross sections and average numbers of ρ^0 per event are presented for different charged multiplicities. At 16 GeV/c the bulk of the ρ^0 production (in terms of cross section) takes place in 4- and 6-prong events; at 10 GeV/c, the 2-prong cross section is relatively large, too. The average multiplicity of ρ^0 increases with increasing charged multiplicity.

The average numbers of ρ^0 and f , per inelastic collision, given in tables 1 and 2, can be used to estimate the total inclusive yields of the ρ^0 and f . The assumption made is that $\langle \rho^0 \rangle$ and $\langle f \rangle$ do not strongly depend on the kind of hyperon or on the charge of kaon found in the final state. At the energies studied here, about 4.0 mb of the total inelastic cross section is shared by events with a hyperon in the final state [2] and will now be assigned to have $\langle \rho^0 \rangle = 0.19 \pm 0.02$ at 10 GeV/c and $\langle \rho^0 \rangle = 0.22 \pm 0.02$ at 16 GeV/c (Λ -like interactions). The remaining part of the inelastic K^-p cross section is assumed to have $\langle \rho^0 \rangle = 0.14 \pm 0.01$ at 10 GeV/c and $\langle \rho^0 \rangle = 0.13 \pm 0.01$ at 16 GeV/c ($\bar{K}^0$ -like interactions). The resulting estimates for the inclusive ρ^0 cross section are

$$\begin{aligned} \sigma(\rho^0) &= 2.8 \pm 0.4 \text{ mb} && \text{at 10 GeV/c} \\ \sigma(\rho^0) &= 2.9 \pm 0.4 \text{ mb} && \text{at 16 GeV/c} \end{aligned} \quad (6)$$

For the f meson we obtain similarly

$$\begin{aligned}\sigma(f) &= 0.5 \pm 0.2 \text{ mb} && \text{at } 10 \text{ GeV/c} \\ \sigma(f) &= 0.6 \pm 0.2 \text{ mb} && \text{at } 16 \text{ GeV/c.}\end{aligned}\tag{7}$$

The errors in eqs (6) and (7) have been increased to take into account uncertainties in the extrapolation, fitting and cross sections used for normalization.

An interesting quantity is the fraction of pions coming from ρ decays. It is found, by using the average of eq. (6), that $(11 \pm 2)\%$ of all charged pions produced [2] are accounted for by ρ^0 decays. Provided that $\langle \rho^+ \rangle + \langle \rho^- \rangle = 2 \langle \rho^0 \rangle$, then $(22 \pm 4)\%$ of all pions in K^-p interactions at 10-16 GeV/c are decay products of ρ . This is to be compared with $(25 \pm 4)\%$ found for π^-p interactions at 16 GeV/c [6].

4. LONGITUDINAL MOMENTUM DISTRIBUTION FOR ρ^0

To determine the distributions of ρ^0 as functions of x and p_T^2 data were divided into bins in the corresponding variable and the ρ^0 signal was then fitted in each bin on the corresponding $\pi^+\pi^-$ mass spectrum.

Fig. 3 shows the x distribution of ρ^0 for $\bar{K}^0$ events and Λ events separately^(*). Both distributions exhibit a broad maximum around $x = 0.1 - 0.3$, which is characteristic of central ρ^0 production. However, there is a noticeable excess of cross section in the forward direction, in comparison to the backward direction, suggesting a noteworthy production of ρ^0 through fragmentation of the incident $\bar{K}^-$ meson. The x distribution of ρ^0 appears to be somewhat flatter for Λ events than for $\bar{K}^0$ events. This can be understood qualitatively on the following

(*) To improve statistics, combined data of 10 and 16 GeV/c have been used. Treating the 10 and 16 GeV/c samples separately did not reveal any statistically significant differences between them.

basis: both fast forward and fast backward (in the c.m.s.) lambdas are frequently produced in K^-p interactions at these energies [4], and so the accompanying mesons may also be fast. In $\bar{K}^0$ events (and in K^- events as well) there are a (fast) forward moving kaon and a (fast) backward moving nucleon, and hence the accompanying mesons are unlikely to be fast.

Fig. 3 includes also the fully inclusive x distribution of ρ^0 . The backward part ($x < 0$) of it is obtained directly by taking as π^- 's all negative tracks consistent with being a pion. The integrated cross section thus obtained is

$$\int_{-1}^0 \frac{d\sigma(\rho^0)}{dx} dx = 1.05 \pm 0.04 \text{ mb.} \quad (8)$$

The $\bar{K}^0$ sample represents (after correcting for unseen $\bar{K}^0$'s) one half of the total strange meson production in 10-16 GeV/c K^-p interactions, and the Λ sample covers, correspondingly, about two-thirds of the total hyperon production. Thus, the cross section for $\bar{K}^0$ events has to be multiplied by a factor of 2 and that for Λ events by a factor of 3/2 to obtain the total yield. By doing so, a cross section value of 1.07 ± 0.09 mb is obtained for backward ρ^0 production, in excellent agreement with eq. (8). When more stringent x cuts ($x(\rho^0) < -0.2$ or $x(\rho^0) < -0.4$) were used, equally good agreement was found. This lends credibility to the extrapolation procedure used in sect. 3. It also encourages us to estimate the differential cross section $d\sigma(\rho^0)/dx$ for the forward region: the open circles in fig. 3 present the inclusive cross section, this being twice the cross section for ρ^0 in $\bar{K}^0$ events added to 1.5 times the ρ^0 cross section in Λ events. The forward part of the fully inclusive x distribution of ρ^0 remains to some degree uncertain; this will not, however, affect the conclusions to be made.

The total inclusive ρ^0 production cross section from fig. 3 is

$$\int_{-1}^{+1} \frac{d\sigma(\rho^0)}{dx} dx = 2.9 \pm 0.15 \text{ mb}$$

in agreement with the values given in eq. (6). The error quoted is statistical only.

5. TRANSVERSE MOMENTUM DISTRIBUTIONS FOR ρ^0

The distribution in p_T^2 , the square of the transverse momentum, of the ρ^0 is shown in fig. 4 for different data samples. The fully inclusive p_T^2 distribution has been obtained by an extrapolation similar to that used in the preceding section to calculate $d\sigma(\rho^0)/dx$. The lines are fits with the formula

$$\frac{d\sigma}{dp_T^2} = A \exp(-B p_T^2), \quad (9)$$

in the range $0.2 < p_T^2 < 2.0 \text{ (GeV/c)}^2$. The small p_T^2 values were excluded from the fits since there may be an additional contribution in that region due to peripheral two-body channels, as seen also in the p_T^2 distribution for reaction (3) at 16 GeV/c [5,6]. The values of the slope parameter B, obtained from fits of different data samples with eq. (9), are listed in table 5. They are all consistent with the value of $B = 3.40 \pm 0.06 \text{ (GeV/c)}^{-2}$, which was shown in ref. [7] to describe the p_T^2 dependence of various particles produced in a large variety of experiments.

The mean squared transverse momentum for the ρ^0 is $0.28 \pm 0.02 \text{ (GeV/c)}^2$ and the mean transverse momentum is $0.47 \pm 0.02 \text{ GeV/c}$ at 10-16 GeV/c. The same values, within errors, were obtained for $K^{*-}(890)$ and $\bar{K}^{*0}(890)$ in our previous study of K^-p interactions at 10 and 16 GeV/c [3].

6. COMPARISONS WITH $\pi^\pm p \rightarrow \rho^0 + \text{ANYTHING}$ AND $pp \rightarrow \rho^0 + \text{ANYTHING}$

Comparison of the present data on ρ^0 production in 10-16 GeV/c K^-p interactions with data from the inclusive reaction $\pi^\pm p \rightarrow \rho^0 + \text{anything}$ at 16 GeV/c [5,6] reveals some interesting features of ρ^0 production.

In sect. 3 it was seen that the average numbers of ρ^0 's and f's per inelastic collision are generally smaller in $\bar{K}^0$ events than in Λ events. Table 6 shows a comparison of $\langle \rho^0 \rangle$ and $\langle f \rangle$ in K^-p , π^+p [5] and π^-p interactions at 16 GeV/c [6]. The values obtained for lambda events in K^-p interactions agree strikingly well with those obtained for the totality of inelastic $\pi^\pm p$ collisions, whereas in $\bar{K}^0$ events, $\langle \rho^0 \rangle$ is lower nearly by a factor of two, and $\langle f \rangle$ is also appreciably smaller. These features can be understood qualitatively by considerations similar to those of sect.4 concerning the energy available for non-strange meson production. The lambda events resemble πp collisions in that all the energy remaining after subtracting the nucleon energy is available to non-strange mesons; in the case of $\bar{K}^0(K^-)$ events, on the contrary, only the energy left over by the (leading) nucleon and the (leading) kaon is available for meson production. Additional support to this interpretation is given by the ratio $\langle f \rangle / \langle \rho^0 \rangle$ (table 6), which has in each case the same value of about 20%.

Fig. 5 shows the similarity of the p_T^2 dependence of ρ^0 production in K^-p and π^-p interactions. The values obtained for $\langle p_T^2 \rangle$ and $\langle p_T \rangle$ are the same, within errors, in K^-p and $\pi^\pm p$ interactions at 16 GeV/c [5,6].

In sect. 4 it was mentioned that fig. 3 gives evidence for two sources for the production of ρ^0 , namely a central process and the beam fragmentation. It is not possible, however, to estimate their relative magnitudes directly from fig. 3, because of the considerable overlap in x. Nor does the differential cross section $d\sigma(\rho^0)/dx$ show any clear structure which might serve as a clue.

Quantitative estimates can, however, be achieved by comparing the production of ρ^0 in K^-p interactions and in π^-p interactions.

In ref. [6] it was concluded that in 16 GeV/c π^-p interactions, 3.1 ± 0.3 mb of the total inclusive ρ^0 cross section arises from beam fragmentation and 1.6 ± 0.5 mb from central production. Fig. 6 presents a comparison of the ρ^0 density $(1/\sigma_{\text{inel}})(d\sigma(\rho^0)/dx)$ as a function of x in K^-p and π^-p interactions. It is interesting to note that: (i) the densities are (within errors) identical in the entire backward region ($x < 0$), but (ii) in the forward direction an excess of density in π^-p interactions over that in K^-p interactions develops, such that at $x = 0.9$ the latter is only one tenth of the former. We conclude that the densities due to the central components are about equal. Thus, the cross section for the central production of ρ^0 in the reaction $K^-p \rightarrow \rho^0 X^0$ at 10-16 GeV/c is given by

$$\sigma_C(K^-p \rightarrow \rho^0 X^0) = 1.5 \pm 0.5 \text{ mb.} \quad (10)$$

The error quoted in eq. (10) covers differences in the K^-p and π^-p densities up to 20%. If the total ρ^0 cross section is taken to be 2.9 ± 0.4 mb (eq. (6)), the inclusive ρ^0 beam fragmentation cross section is given by

$$\sigma_F(K^-p \rightarrow \rho^0 X^0) = 1.4 \pm 0.6 \text{ mb.}$$

Finally, fig. 7 shows a comparison of the ρ^0 density as a function of c.m. rapidity (y^*) in K^-p and π^-p [6] interactions at 16 GeV/c and in pp interactions at 24 GeV/c [8]. The densities are all approximately equal for $y^* < 0$. In the region $y^* > 0$, on the contrary, the densities are very different from one another: the π^-p data show the greatest density, pp density is the smallest and the K^-p density is in between. This reflects the decreasing importance of the beam fragmentation component of ρ^0 production when moving from π^-p interactions to K^-p interactions and finally to pp interactions.

To summarise, at 16 GeV/c the central production cross section of ρ^0 appears to be about the same in K^-p and π^-p interactions, whereas the ρ^0 beam fragmentation cross section is in K^-p interactions about one half of that in π^-p interactions.

7. DISCUSSION AND CONCLUSIONS

The effective mass spectra for $\pi^+\pi^-$ pairs produced in K^-p interactions at 10 and 16 GeV/c show clear ρ^0 and f signals when these mesons are associated with a lambda particle, or a $\bar{K}^0$. From a study of these signals, the following conclusions can be drawn:

(a) The inclusive ρ^0 cross section is

$$\sigma(K^-p \rightarrow \rho^0 X^0) = \begin{cases} 2.8 \pm 0.4 \text{ mb} & \text{at 10 GeV/c} \\ 2.9 \pm 0.4 \text{ mb} & \text{at 16 GeV/c} \end{cases},$$

i.e. approximately one ρ^0 is produced in every six or seven inelastic interactions. The average numbers of ρ^0 and f per event, associated with a lambda, are about the same as the values of $\langle \rho^0 \rangle$ and $\langle f \rangle$ found for π^+p and π^-p interactions at 16 GeV/c. In events associated with a $\bar{K}^0$, $\langle \rho^0 \rangle$ and $\langle f \rangle$ are considerably lower. Provided that $\langle \rho^+ \rangle + \langle \rho^- \rangle = 2\langle \rho^0 \rangle$, then $(22 \pm 4)\%$ of all pions are products of ρ decays. A similar value, i.e. $(25 \pm 4)\%$, has been found for π^-p interactions at 16 GeV/c.

(b) The inclusive cross section for f is

$$\sigma(K^-p \rightarrow fX^0) = \begin{cases} 0.5 \pm 0.2 \text{ mb} & \text{at 10 GeV/c} \\ 0.6 \pm 0.2 \text{ mb} & \text{at 16 GeV/c} \end{cases},$$

i.e. $\sim 20\%$ of the ρ^0 cross section.

(c) Over the range $0.2 < p_T^2 < 2.0 \text{ (GeV/c)}^2$, the p_T^2 distribution of the ρ^0 is well represented by an exponential with slope $\sim 3.3 \text{ (GeV/c)}^{-2}$.

(d) There is clear evidence that at least two processes contribute to ρ^0 production in 10-16 GeV/c $\bar{K}p$ interactions, namely central production and fragmentation of the beam $\bar{K}$. It is found, by comparison with data from πp collisions at 16 GeV/c, that the central production cross section is $\sigma_C(\bar{K}p \rightarrow \rho^0 X^0) = 1.5 \pm 0.5$ mb and the beam fragmentation cross section $\sigma_F(\bar{K}p \rightarrow \rho^0 X^0) = 1.4 \pm 0.6$ mb. These cross section values are reproduced in table 7, together with results reported for ρ^0 and $K^*(890)$ production in $\bar{K}p$ and πp interactions at 16 GeV/c and in pp interactions at 24 GeV/c [3,6,8,9], in order to compare them with the quark model predictions of Anisovich and Shekhter [10], shown also in the same table.

The agreement between the experimental results and the model predictions in table 7 is good. It is remarkable that ratios predicted for ρ^0 yields at very high energy are (at least approximately) already valid at 16 GeV/c.

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TABLE CAPTIONS

- Table 1 Cross sections for ρ^0 production in association with $\bar{K}^0$ or Λ in K^-p interactions at 10 and 16 GeV/c, deduced in different ways, and average number of ρ^0 per interaction calculated from the average cross section.
- Table 2 Cross sections and average multiplicities for f production in association with $\bar{K}^0$ or Λ in K^-p interactions at 10 and 16 GeV/c.
- Table 3 $\sigma(\rho^0)$ and $\langle\rho^0\rangle$ for different charged multiplicities in K^-p interactions associated with a $\bar{K}^0$ at 10 and 16 GeV/c.
- Table 4 $\sigma(\rho^0)$ and $\langle\rho^0\rangle$ for different charged multiplicities in K^-p interactions associated with a lambda at 10 and 16 GeV/c.
- Table 5 Slope $d\sigma/dp_T^2$, average squared transverse momentum and average transverse momentum for ρ^0 in K^-p interactions at 10-16 GeV/c.
- Table 6 Average number of ρ^0 and f per inelastic collision in K^-p , π^-p and π^+p interactions at 16 GeV/c. The ratio $\langle f \rangle / \langle \rho^0 \rangle$ is also given.
- Table 7 Cross sections for ρ^0 and $\bar{K}^{*0}$ production in K^-p , π^-p and pp interactions at 10-24 GeV/c, together with quark model predictions [9] for their ratios at high energies.

TABLE 1

Fitting Procedure	$\bar{K}^- p \rightarrow \bar{K}^0 + \text{anything}$ $\sigma(\rho^0)$ (mb)		$\bar{K}^- p \rightarrow \Lambda + \text{anything}$ $\sigma(\rho^0)$ (mb)	
	10 GeV/c	16 GeV/c	10 GeV/c	16 GeV/c
Multiplicity bins	1.10 ± 0.10	1.17 ± 0.11	0.50 ± 0.06	0.47 ± 0.05
P_T^2 bins	1.08 ± 0.08	1.12 ± 0.08	0.51 ± 0.05	0.47 ± 0.04
x bins	1.07 ± 0.10	1.13 ± 0.13	0.50 ± 0.04	0.49 ± 0.04
y* bins	1.13 ± 0.08	1.07 ± 0.10	0.49 ± 0.05	0.47 ± 0.03
Inclusive fit	1.06 ± 0.11	1.11 ± 0.11	0.50 ± 0.05	0.49 ± 0.05
Average	1.09 ± 0.09	1.12 ± 0.11	0.50 ± 0.05	0.48 ± 0.04
$\langle \rho^0 \rangle / \text{event}$	0.14 ± 0.01	0.13 ± 0.01	0.19 ± 0.02	0.22 ± 0.02

TABLE 2

Quantity	$\bar{K}^- p \rightarrow \bar{K}^0 + \text{anything}$		$\bar{K}^- p \rightarrow \Lambda + \text{anything}$	
	10 GeV/c	16 GeV/c	10 GeV/c	16 GeV/c
$\sigma(f)$ (mb)	0.17 ± 0.03	0.24 ± 0.06	0.11 ± 0.03	0.09 ± 0.03
$\langle f \rangle / \text{event}$	0.02 ± 0.01	0.03 ± 0.01	0.04 ± 0.01	0.04 ± 0.01

TABLE 3

Prongs	2	4	6	8
$\sigma(\rho^0)$ (mb)	10 GeV/c 0.23 $\pm$ 0.04	0.64 $\pm$ 0.08	0.19 $\pm$ 0.03	0.03 $\pm$ 0.03
	16 GeV/c 0.13 $\pm$ 0.03	0.57 $\pm$ 0.07	0.38 $\pm$ 0.07	0.09 $\pm$ 0.03
$\langle \rho^0 \rangle / \text{event}$	10 GeV/c 0.06 $\pm$ 0.01	0.22 $\pm$ 0.03	0.31 $\pm$ 0.05	0.6 $\pm$ 0.6
	16 GeV/c 0.04 $\pm$ 0.01	0.16 $\pm$ 0.02	0.28 $\pm$ 0.05	0.4 $\pm$ 0.2

TABLE 4

Prongs	2	4	6	8
$\sigma(\rho^0)$ (mb)	10 GeV/c 0.10 $\pm$ 0.02	0.26 $\pm$ 0.04	0.12 $\pm$ 0.04	0.03 $\pm$ 0.02
	16 GeV/c 0.05 $\pm$ 0.01	0.18 $\pm$ 0.03	0.20 $\pm$ 0.02	0.05 $\pm$ 0.01
$\langle \rho^0 \rangle / \text{event}$	10 GeV/c 0.09 $\pm$ 0.02	0.23 $\pm$ 0.03	0.37 $\pm$ 0.13	0.9 $\pm$ 0.5
	16 GeV/c 0.07 $\pm$ 0.02	0.19 $\pm$ 0.03	0.42 $\pm$ 0.05	0.5 $\pm$ 0.3

TABLE 5

Reaction	$B \text{ (GeV/c)}^{-2}$	$\langle p_T^2 \rangle \text{ (GeV/c)}^2$	$\langle p_T \rangle \text{ (GeV/c)}$
$K^- p \rightarrow \bar{K}^0 + \rho^0 + X$	3.2 ± 0.2	0.28 ± 0.02	0.47 ± 0.02
$K^- p \rightarrow \Lambda + \rho^0 + X^0$	3.5 ± 0.2	0.27 ± 0.02	0.46 ± 0.02
$K^- p \rightarrow \rho^0 (x < 0) + X^0$	3.4 ± 0.1	0.26 ± 0.01	0.45 ± 0.01
$K^- p \rightarrow \rho^0 + \text{anything}$	3.2 ± 0.2	0.28 ± 0.02	0.47 ± 0.02

The data are the same as in fig. 4. The value of B is obtained from a fit with formula (9) in the text.

TABLE 6

Reaction	$\langle f \rangle$	$\langle \rho^0 \rangle$	$\langle f \rangle / \langle \rho^0 \rangle$
$K^- p \rightarrow \bar{K}^0 + X^0$	0.029 ± 0.007	0.13 ± 0.01	0.22 ± 0.06
$K^- p \rightarrow \Lambda + X^0$	0.042 ± 0.012	0.22 ± 0.02	0.19 ± 0.06
$\pi^- p \text{ (all inel.) [6]}$	0.043 ± 0.007	0.23 ± 0.02	0.19 ± 0.03
$\pi^+ p \text{ (all inel.) [5]}$	0.050 ± 0.005	0.24 ± 0.02	0.21 ± 0.03

TABLE 7

Reaction	P_{lab} (GeV/c)	Experimental cross section (mb)	Relative weight ^(a) from quark model [10]
(I) via meson fragmentation			
$K^- \rightarrow \bar{K}^{*0}$	16	$3.3 \pm 0.4^{(b)}$ [3]	3
$\pi^- \rightarrow \rho^0$	16	3.1 ± 0.3 [6]	3
$K^- \rightarrow \rho^0$	10-16	1.4 ± 0.6 this work	3/2
(II) via central production			
$pp \rightarrow \rho^0$	24	$3.5 \pm 0.4^{(b)}$ [8]	3
$\pi^- p \rightarrow \rho^0$	16	1.6 ± 0.5 [6]	2
$K^- p \rightarrow \rho^0$	10-16	1.5 ± 0.5 this work	2

(a) The relative weights from quark model have a different scale for (I) and (II).

(b) Total inclusive production cross section.

FIGURE CAPTIONS

- Fig. 1 Effective mass spectra for $\pi^+\pi^-$ production in 10 and 16 GeV/c $\bar{K}^-p$ interactions.
- Fig. 2 The effective mass spectrum $d\sigma/dM(\pi^+\pi^-)$ multiplied by a factor $\exp(kM)$ with: $k = 3.4 \text{ GeV}^{-1}$ for $\bar{K}_{\text{seen}}^0$ events at 10 GeV/c, $k = 2.9 \text{ GeV}^{-1}$ for $\bar{K}_{\text{seen}}^0$ events at 16 GeV/c, $k = 3.0 \text{ GeV}^{-1}$ for Λ_{seen} events at 10 GeV/c, $k = 2.8 \text{ GeV}^{-1}$ for Λ_{seen} at 16 GeV/c.
- Fig. 3 The differential cross section for ρ^0 as a function of x at 10-16 GeV/c.
- Fig. 4 The distribution of the squared transverse momentum for ρ^0 produced at 10-16 GeV/c.
- Fig. 5 Comparison of the p_T^2 distribution of ρ^0 in 10-16 GeV/c $\bar{K}^-p$ interactions with the same in 16 GeV/c π^-p interactions [6].
- Fig. 6 Comparison of x distributions for ρ^0 cross section in 10-16 GeV/c $\bar{K}^-p$ and 16 GeV/c π^-p interactions [6].
- Fig. 7 Comparison of the c.m. rapidity distribution of ρ^0 in 16 GeV/c $\bar{K}^-p$ interactions with the same in 16 GeV/c π^-p [6] and 24 GeV/c pp interactions [8].

fig. 1

fig. 2

fig. 3

fig. 4

fig. 5

fig. 6

fig. 7

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