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INCLUSIVE K^{*+} (892) PRODUCTION IN pp AND π^+p INTERACTIONS

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and

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ABSTRACT

A study is presented of the inclusive production cross sections of $K^{*\pm}(892)$ vector mesons in pp interactions at 12 and 24 GeV/c and in π^+p interactions at 16 GeV/c. The $K^{*\pm}$ inclusive cross section is ~ 0.9 mb for both pp at 24 GeV/c and π^+p interactions at 16 GeV/c. For pp interactions, $\sigma(K^{*+})$ and $\sigma(K^{*-})$ are seen to rise with energy, showing a threshold behaviour. In both pp and π^+p interactions, $\sigma(K^{*+})$ largely exceeds $\sigma(K^{*-})$ at these energies and this excess is interpreted as K^{*+} production by beam and target fragmentations. The decays of $K^{*\pm 0}$ yield $\sim 30\%$ of the K^0 observed in the final states. The p_T^2 dependence of both K^{*+} and K^{*-} cross sections is described by an exponential with slope of ~ 3.3 (GeV/c) $^{-2}$. The longitudinal momentum spectra for K^{*+} in 16 GeV/c π^+p and 24 GeV/c pp interactions are similar in shape in the target hemisphere. The K^{*-} spectra are similar over the whole kinematic region when viewed in the quark c.m.s. and point to a central production mechanism. Comparing K^{*+} and ρ^0 production, striking similarities are found.

1. INTRODUCTION

In recent years it has been realized that a considerable fraction of the stable particles is produced indirectly through the decay of heavier resonances (e.g. [1]). This observation has stimulated the investigation of inclusive resonance production. In fact, since resonances are produced more directly, they are expected to exhibit the characteristics of particle production in hadronic interactions more clearly, and hence to yield a deeper understanding of stable particle spectra.

Many data on the inclusive production of resonances have been published so far (e.g. [2,3]). For the vector meson $K^*(892)$, however, the investigations have been restricted mainly to K^+ induced reactions [4,5], whereas data on K^* production induced by non-strange (p and π^+) particles [1(a),6,7] are still rather limited. In the present paper we study the inclusive reactions

$$\pi^+ p \rightarrow K^{*+}(892) + X$$

$$\pi^+ p \rightarrow K^{*-}(892) + X$$

at 16 GeV/c and

$$pp \rightarrow K^{*+}(892) + X$$

$$pp \rightarrow K^{*-}(892) + X$$

at 12 and 24 GeV/c in high statistics bubble chamber experiments. The results on K^* production in the 12 and 24 GeV/c pp experiments previously published [1(a)] are based on subsamples of the data used here. The dependence of $K^*(892)$ production on the beam particle is investigated and K^* production is compared with the production of the vector meson ρ^0 , which has similar mass (776 MeV [8]) but strangeness zero.

The paper is arranged as follows. The experimental procedure is outlined in sect. 2. The total inclusive cross sections for $K^*(892)$ production are presented and discussed in sect. 3, and the transverse and longitudinal momentum distributions in sects 4 and 5. The comparison of K^* and ρ^0 productions is in sect. 6. In sect. 7 the conclusions are summarized.

2. EXPERIMENTAL PROCEDURE

The present data come from exposures of the CERN 2 m hydrogen bubble chamber to π^+ and p beams. The π^+p pictures have been scanned and measured by the Aachen-Bonn-CERN-Cracow Collaboration and the pp ones by the Bonn-Hamburg-München Collaboration. The investigation is based on totals of approximately 330 000 π^+p events at 16 GeV/c and 280 000 (400 000) pp events at 12 (24) GeV/c.

A detailed description of the experimental procedure is given in ref. [9] for the π^+p experiment and in ref. [10] for the pp experiment.

The $K^{*+}(892)$ and $K^{*-}(892)$ mesons are detected by the decays

$$K^{*\pm}(892) \rightarrow K_S^0 \pi^\pm,$$

where the neutral kaons are identified by their decays into $\pi^+\pi^-$.

The effective mass spectra obtained for the $K_S^0 \pi^+$ and $K_S^0 \pi^-$ combinations are presented in fig. 1. They all show clear signals at the position of $K^*(892)$, with the only exception of the $K_S^0 \pi^-$ distribution for 12 GeV/c pp interactions where the signal is weak. No evidence is observable for $K^*(1420)$ production, either in π^+p or pp interactions. From here on, the symbol K^* will always mean $K^*(892)$.

For the fit of the resonance signals, the mass spectra were taken to have the form [11]

$$\frac{d\sigma}{dM}(M) = BG(M) + BW(M) \times PS(M),$$

where BG, BW and PS represent background, Breit-Wigner function and phase space, respectively.

The resonance signals were described by the relativistic Breit-Wigner function with mass dependent width and additional suppression factor for high mass tails [12].

$$BW(M) = \frac{M M_0 \Gamma(M)}{(M^2 - M_0^2)^2 + M_0^2 \Gamma^2(M)}$$

with

$$\Gamma(M) = \Gamma_0 \left(\frac{q}{q_0}\right)^3 \frac{2 q_0^2}{q_0^2 + q^2},$$

where M_0 is the mass of the resonance, Γ_0 its width, q the momentum of the decay products in the rest frame of the resonance and q_0 its value at $M = M_0$.

The background has been parametrized by an exponential with a third order polynomial as the argument

$$BG(M) = A \exp (BM + CM^2 + DM^3).$$

In the pp case, an additional threshold term has been introduced because of the stronger fluctuations of the background. This threshold term was generated from the experimental single particle momentum distributions for K_S^0 , π^+ and π^- by a Monte-Carlo calculation (for details see ref. [10(b)]). The phase space term PS was taken to have the same mass dependence as the background [11].

The fits were then carried out over the range from 0.7 GeV to 1.1 GeV in the π^+p case and from threshold to 1.6 GeV/c in the pp case, because of the stronger background fluctuations. The Particle Data Group value [8] was used for the resonance mass ($M_0 = 892$ MeV) and a value of $\Gamma_0 = 55$ MeV for the width, to account for the experimental mass resolution (~ 25 MeV).

For the determination of the differential distributions (in x , y^* and p_T^2), the range of the variable considered was first divided into suitable intervals and the effective $K_S^0\pi$ mass spectrum obtained for each of these intervals was then fitted in the way described above.

Because the K^{*-} signal for 12 GeV/c pp interactions is very weak, the procedure described above was not used, and the signal was simply estimated above a hand-drawn background. The considerable uncertainty was taken into account in the error.

The quality of the fits can be seen from fig. 1, where the curves represent the results of the fits to the overall mass spectra. The numbers of K^* deduced from these overall fits are all in good agreement with the corresponding numbers calculated by summing the partial numbers obtained from fitting the mass spectra in the individual intervals of x , y^* and p_T^2 . The K^{*+} and K^{*-} numbers obtained amount to ~ 2500 and 600 , respectively, in the π^+p experiment and to ~ 360 (910) and 50 (260), respectively, in the pp experiment at 12 (24) GeV/c .

3. CROSS SECTIONS

The inclusive cross sections obtained for K^* production are presented in table 1. These values contain corrections for unobserved decay modes, for losses of K^0 decaying outside the chamber or too close to the interaction vertex, and for scanning inefficiency. The errors given take into account the statistical errors and the uncertainties arising from the corrections and the fitting procedure. It can be seen that:

- (a) K^* production is relatively abundant, $\sigma(K^{*+}) + \sigma(K^{*-})$ being 0.85 mb in pp interactions at 24 GeV/c and 0.89 mb in π^+p at 16 GeV/c .
- (b) The inclusive K^{*+} and K^{*-} cross sections in pp interactions increase sharply from 12 to 24 GeV/c . In fig. 2 our results are plotted together with the values reported at 69 GeV/c [6(a)] and 405 GeV/c [6(c)]. The K^* inclusive cross sections show the typical threshold behaviour. In K^-p interactions, instead, the K^* inclusive cross section is known to be approximately constant over the range 8 - 32 GeV/c .
- (c) There is a large excess of K^{*+} over K^{*-} production, at the energies investigated in this work. In pp interactions at 24 GeV/c , the difference $\sigma(K^{*+}) - \sigma(K^{*-})$ is 0.47 ± 0.06 mb. This can be understood, qualitatively, by the fact that K^{*-} production can occur only centrally,

i.e. by recombination of the sea quarks, while the K^{*+} , having a quark in common with the proton, can also derive from proton fragmentation. This interpretation is supported by the observation, reported below, that a high fraction of the K^{*+} is produced in association with hyperons.

K^* decays are an important source of neutral kaon production. The values of fraction $F = \sigma(K^{*\pm}) \cdot \text{BR}(K^{*\pm} \rightarrow K^0 \pi^\pm) / \sigma(K^0)$ given in table 2 indicates that $\sim 18\%$ of all neutral kaons are produced by the decays of $K^{*\pm}$ vector mesons. Assuming in addition that the sum of the cross sections for K^{*0} and $\bar{K}^{*0}$ is equal to the sum of $\sigma(K^{*+})$ and $\sigma(K^{*-})$, this fraction rises to $\sim 27\%$.

The cross sections for the production of K^{*+} in association with a Λ hyperon, $\sigma(K^{*+} \Lambda)$, have been determined using those events where, in addition to the K_S^0 from the K^{*+} decay, also a Λ was observed^(*). The results are listed in table 1. It can be seen that, in particular for pp, the fraction of K^{*+} produced together with a Λ is large: $(44 \pm 10)\%$ for pp at 24 GeV/c and $(30 \pm 7)\%$ for π^+p at 16 GeV/c. These values are about the same as the corresponding fractions reported for K^+ : $(41 \pm 2)\%$ for pp [10] and $(21 \pm 3)\%$ for π^+p [9]. Thus, assuming that the ratio $\sigma(KY)/\sigma(K\Lambda)$ is the same for K^{*+} and K^+ at our energies, the fraction of K^{*+} produced in association with hyperons is $(70 \pm 20)\%$ in pp interactions and $(55 \pm 20)\%$ in π^+p interactions, corresponding to $\sigma(K^*Y)$ of 0.46 ± 0.13 mb and 0.39 ± 0.14 mb, respectively.

4. TRANSVERSE MOMENTUM DISTRIBUTIONS

The K^* transverse momentum distributions are presented in fig. 3. All spectra are approximately exponential.

Fitting to them the expression

$$d\sigma/dp_T^2 = A \exp(-B p_T^2)$$

(*) The Λ 's from $\Sigma^0 \rightarrow \Lambda \gamma$ are also counted and represent $\sim 10\%$ of all Λ 's. The value of $\sigma(\Lambda) = 2.07 \pm 0.08$ mb in pp interactions at 24 GeV/c is about 20% higher than that given in ref. [10(a)].

over the whole p_T^2 range, one obtains the slope parameters B listed in table 3. The values for K^{*+} and K^{*-} in the pp experiment at 24 GeV/c agree with each other and with the value for K^{*+} in the π^+p experiment. The π^+p slope for K^{*-} is also compatible with these values within the large errors. The higher value for K^{*+} in the pp experiment at 12 GeV/c can be explained by phase space limitations. For K^{*-} , no differential cross sections could be obtained at this energy because of the small total cross section.

For further comparison, the slopes for K^* in a K^-p experiment at 16 GeV/c [5(b)] are added in table 3. There, the region of low p_T^2 ($p_T^2 < 0.4$ (GeV/c)²) had been excluded from the fit, as the distributions are steeper in this region because of quasi two-body processes. In the pp case, however, quasi two-body processes including $K^*(892)$ do not occur, and also in the π^+p case no significantly steeper rise is to be seen at low p_T^2 , so that it is reasonable to perform the fit over the entire range of p_T^2 . It can be seen in table 3, that the slopes for $K^*(892)$ in pp, π^+p and K^-p interactions at comparable energies all agree with one another and with the value of $B \approx 3.4$ (GeV/c)⁻² which was found to hold for all hadrons with mass of the order 1 GeV, at medium energies [1].

5. LONGITUDINAL MOMENTUM DISTRIBUTIONS

The K^* longitudinal momentum distributions are studied in terms of the rapidity $y^* = \frac{1}{2} \ln(E + p_L)/(E - p_L)$ and of the Feynman variable $x^* = p_L^*/p_{\max}^*$, where $p_{\max}^*$ is the maximum possible c.m. momentum of the K^* (figs 4 and 5, respectively).

K^{*+} and K^{*-} productions in pp interactions are concentrated in the central region and decrease steeply with increasing $|x|$ and $|y^*|$. For K^{*-} , the distributions are narrower. Peripheral processes are of no importance (*).

In the π^+p experiment, K^{*-} production is again concentrated in the central region, but the maximum is shifted towards x and y^* values somewhat

(*) These distributions are slightly different in shape from those published previously based on lower statistic [1(a)].

larger than zero. In particular, we note that the y^* distribution (fig. 5(c)) is approximately symmetric about $y^* \approx 0.2$. A simple explanation for this behaviour is provided by the quark model. The model suggests presenting the data, not in the c.m. system, but in a Lorentz frame where the ratio of proton to meson incident momenta is $R = 3/2$ and thus the momenta per constituent quark are the same for the incoming pions and protons. This frame, called the quark centre of mass system (Q-system), is connected to the overall c.m. system by the transformation $y^Q = y^* - 0.2$. The rapidity distribution of K^{*-} of fig. 5(c) is not inconsistent with forward-backward symmetry in the Q-system.

The production of K^{*+} (figs 4(c) and 5(c)) in π^+p interactions has a different longitudinal distribution. While in the backward hemisphere ($x, y^* < 0$) it decreases again steeply with decreasing x and y^* , in the forward direction a broad maximum is observed.

To investigate the dependence of K^* production on the nature of the incident particle, in fig. 6 are presented the K^* spectra from pp , π^+p and K^-p experiments at comparable available energies in the c.m. system (pp at 24 GeV/c, π^+p and K^-p at 16 GeV/c). The pp cross sections have been scaled down by 2/3. This factor follows from the different numbers of constituent quarks in protons and pions, if one assumes that the amplitudes for hadron-hadron interactions are equal to the sum of individual quark-quark amplitudes, and also that these amplitudes add incoherently and are the same for all quark-quark interactions [13].

The y^* distributions for K^{*+} produced in the pp and π^+p interactions, fig. 6(a), show that the two K^{*+} distributions are similar in the backward hemisphere ($y^* < 0$), whereas a significant excess of K^{*+} production is present for π^+p interactions in the forward hemisphere, probably due to beam fragmentation. In the quark language, this is interpreted as reflecting the fact that the quark momentum distributions are peaked at higher values in the pion than in the proton.

In fig. 6(b) the y^Q distribution for K^{*-} in π^+p interactions is presented together with the pp data, again scaled down by the factor 2/3. There is good agreement over the whole kinematic region, thus indicating a production mechanism essentially independent of the nature of the beam particle (central production).

Parametrizing the x distributions for K^{*+} by the expression $d\sigma/dx \propto (1 - |x|^n)$, one obtains for the exponent the value $n = 3.1 \pm 0.3$ in the 24 GeV/c pp experiment, and the same value holds for the backward hemisphere in the 16 GeV/c π^+p experiment.

6. COMPARISON OF K^{*+} AND ρ^0 PRODUCTION

An interesting question is whether or not all the vector mesons ρ , ω , ϕ and $K^*(892)$ have similar production characteristics. Of these, the ρ^0 meson is the most extensively studied (e.g. [2]). Consequently, a comparison is made here of inclusive K^{*+} and ρ^0 production. The ρ^0 data for pp interactions are taken from ref. [14] and those for π^+p interactions from ref. [11].

The production of the strange K^{*+} meson is suppressed in comparison to that of the non-strange ρ^0 meson. In the pp experiment the suppression factor $\lambda = \sigma(K^{*+})/\sigma(\rho^0)$ amounts to

$$\lambda = 0.15 \pm 0.02 \text{ at } 12 \text{ GeV/c,}$$

and

$$\lambda = 0.18 \pm 0.02 \text{ at } 24 \text{ GeV/c.}$$

The value obtained in the π^+p experiment,

$$\lambda = 0.20 \pm 0.04,$$

is similar, if one restricts oneself to the backward hemisphere ($x < 0$) where beam fragmentation is less important. In the framework of the additive quark model, this factor λ can be interpreted as the relative

probability of strange to non-strange quark production^(*) [15]. The energy dependence of λ in pp interactions is further studied in fig. 7. The data are compatible with a slight increase of λ over the range from 12 to 400 GeV/c.

Apart from the K^* suppression, K^{*+} and ρ^0 production show remarkable similarities in our experiments. In ref. [14] it has been shown that in the pp experiment the p_T^2 distributions for ρ^0 are approximately exponential over the whole range of p_T^2 , like those for K^{*+} , and that the slopes for ρ^0 (given in table 3) are in good agreement with those for K^{*+} at 12 and 24 GeV/c. In the π^+p experiment, the p_T^2 distribution for ρ^0 [11] peaks at small p_T^2 ($p_T^2 \lesssim 0.08$ (GeV/c)²) because of quasi two-body processes and resonance decays ($\pi^+p \rightarrow \rho^0 \Delta^{++}$; $A_{1,2} \rightarrow \rho^0 \pi$), whereas for K^{*+} no significantly steeper rise at small p_T^2 has been seen, as discussed in sect. 4. Above ~ 0.1 (GeV/c)² however, the p_T^2 spectra for ρ^0 and K^{*+} are similar in shape and the slopes given in table 3 are compatible with one another.

For comparison of the longitudinal momentum behaviour, the x distributions for K^{*+} and ρ^0 are presented in fig. 8. The ρ^0 data are scaled down by the overall cross sections ratios of $\lambda = 0.15$ and $\lambda = 0.18$ for pp at 12 and 24 GeV/c, respectively, and by the cross section ratio in the backward hemisphere of $\lambda = 0.20$ for π^+p . We see that, in general, the K^{*+} and ρ^0 distributions are similar in shape. For pp and in the backward hemisphere for π^+p , they steeply decrease with decreasing x and in the forward hemisphere of π^+p they are only weakly dependent on x . In particular we observe that apart from the K^{*+} suppression, the

(*) One might argue that a more meaningful determination of the suppression factor λ would be derived if one compared ρ^0 production not with K^{*+} but with the production of the neutral K^* . If one assumes that $[\sigma(K^{*0}) + \sigma(\bar{K}^{*0})] = [\sigma(K^{*+}) + \sigma(K^{*-})]$, and then compares ρ^0 to $\frac{1}{2}[\sigma(K^{*0}) + \sigma(\bar{K}^{*0})]$, the suppression is found to be stronger, the λ values for pp interactions being 0.09 ± 0.02 at 12 GeV/c and 0.12 ± 0.02 at 24 GeV/c.

longitudinal momentum distributions of the two vector mesons are in good agreement within errors, in the whole kinematic region for pp at 12 and at 24 GeV/c and, in the region $x < 0.3$, also for π^+p . Thus, the production mechanisms of $K^{*+}(892)$ and ρ^0 seem similar in pp and π^+p reactions, apart from the fact that in π^+p interactions there exists another mechanism (not present in the pp case) that produces ρ^0 in the forward direction.

7. SUMMARY AND CONCLUSIONS

We have investigated the inclusive production of $K^{*+}(892)$ and $K^{*-}(892)$ vector mesons in pp and π^+p interactions at comparable energies (π^+p at 16 GeV/c, pp at 12 and 24 GeV/c). The main results are:

- (a) $K^*(892)$ production is relatively abundant: the sum of the inclusive K^{*+} and K^{*-} production cross sections is of ~ 0.9 mb both in pp interactions at 24 GeV/c and in π^+p interactions at 16 GeV/c. In pp interactions, K^* production increases with increasing energy, showing a threshold behaviour.
- (b) K^{*0} decays yield a considerable fraction of the neutral kaons in the final states. Assuming that $\sigma(K^{*0}) + \sigma(\bar{K}^{*0}) = \sigma(K^{*+}) + \sigma(K^{*-})$, this fraction amounts to 27%, both in pp at 24 GeV/c and in π^+p interactions at 16 GeV/c.
- (c) A large excess of K^{*+} over K^{*-} is observed both in pp and π^+p interactions at the energies here investigated. In the pp case, the excess is interpreted as mostly due to K^{*+} production by proton fragmentation, as evidenced by the very frequent occurrence of associated production of a K^{*+} and a hyperon ($\sim 70\%$ of the cases for 24 GeV/c pp interactions). In the π^+p case, pion fragmentation adds an important contribution of K^{*+} in the forward direction.
- (d) K^* production decreases exponentially with increasing p_T^2 . The slopes B obtained by fitting the distributions with $d\sigma/dp_T^2 = A \exp(-B p_T^2)$ are equal within errors for K^{*+} and K^{*-} in pp and π^+p interactions at 24 and 16 GeV/c, respectively, and are consistent with the "universal" value of ~ 3.4 (GeV/c) $^{-2}$ found to describe the distributions of many hadrons of mass ≈ 1 GeV, in this energy range.

- (e) K^{*-} production in pp interactions is concentrated in the central region. In π^+p interactions, the same is true for K^{*-} , while for K^{*+} there is a strong excess in the forward hemisphere. In the backward hemisphere, K^{*+} production for both pp and π^+p interactions (at 24 and 16 GeV/c, respectively) is equal within errors, apart from a factor of $\sim 3/2$ in favour of production by protons which can be explained by the different numbers of constituent quarks in protons and pions. Furthermore, K^{*-} production in both experiments is approximately the same in the entire longitudinal momentum region in the so-called quark centre of mass system, indicating a production mechanism independent of the incident particle.
- (f) K^{*+} production is suppressed relative to ρ^0 production by a factor of $\sim 1/5$ for pp, and in the backward hemisphere also for π^+p . Apart from this suppression, the transverse and longitudinal momentum spectra of $K^{*+}(892)$ and ρ^0 are equal within errors in pp interactions at both energies. In π^+p interactions the same approximately holds for squared transverse momenta above 0.1 (GeV/c)^2 and for longitudinal momenta in the region where the influence of the incident particle is less important ($x < 0.3$).

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REFERENCES

- [1] (a) V. Blobel et al., Phys. Lett. 63B (1974) 73;
(b) H.G. Kirk et al., Nucl. Phys. B128 (1977) 397;
(c) H. Grässler et al., Nucl. Phys. B132 (1978) 1.
- [2] K. Böckmann, Inclusive Vector Meson Production in Hadronic Interactions, Report BONN-HE-76-25 and Inclusive Vector Meson Production and Hadron Structure, Proceedings of the I. Symposium on "Hadron Structure and Multiparticle Production", Warszawa (1977) p. 25 and BONN-HE-77-24.
- [3] W. Kittel, Inclusive Resonance Production and Fireballs, Report, Proc. of the 8th Int. Symposium on Multiparticle Dynamics, Kaysersberg 1977.
- [4] P. Chliapnikov et al., Nucl. Phys. B37 (1972) 336 and Nucl. Phys. B88 (1975) 189;
P. Granet et al., Nucl. Phys. B140 (1978) 389.
- [5] (a) A. Vayaki et al., Nucl. Phys. B58 (1973) 178;
(b) H.G. Kirk et al., Nucl. Phys. B116 (1976) 99;
(c) K. Paler et al., Nucl. Phys. B96 (1975) 1;
(d) U. Gensch et al., Inclusive Production of K^{*-} (890), Δ^{++} (1236) and $\Sigma^{\pm}$ (1385) in K^-p Interactions at 32 GeV/c, Institut für Hochenergiephysik der Akademie der Wissenschaften der DDR, MIR 31 PHE 77-1 (1977);
(e) F. Dibianca et al., Phys. Lett. 63B (1976) 461;
(f) R.L. Eisner et al., Nucl. Phys. B119 (1977) 1.
- [6] (a) V.V. Ammosov et al., Incl. Production of ρ^0 and K^{*-} resonances in pp interactions at 69 GeV/c, Saclay preprint DphPE 75-08 M-19;
(b) R. Singer et al., Nucl. Phys. B135 (1978) 265;
(c) H. Kichimi et al., Observation of K^{*+} (890) production in 405 GeV/c pp interactions, KEK preprint (1978), to be submitted to Physics Letters;
(d) G. Jansco et al., Nucl. Phys. B124 (1977) 1.
- [7] C. Evangelista et al., Phys. Lett. 70B (1977) 373.
- [8] Particle Data Group, Review of Particle Properties, Phys. Lett. 75B (1978) 1.

REFERENCES

- [9] P. Bosetti et al., Nucl. Phys. B94 (1975) 21;
J. Lowsky, Thesis, Bonn University, BONN-IR-76-33 (1976).
- [10] (a) V. Blobel et al., Nucl. Phys. B69 (1974) 454;
(b) J. Hofmann, Thesis, Bonn University, BONN-IR-77-34 (1977).
- [11] M. Deutschmann et al., Nucl. Phys. B103 (1970) 426.
- [12] J.D. Jackson, Nuovo Cimento 34 (1964) 1644;
F. Selleri, Phys. Lett. 3 (1962) 76.
- [13] H.T. Lipkin and F. Scheck, Phys. Rev. Lett. 16 (1966) 71;
H. Satz, Phys. Rev. Lett. 19 (1967) 1453 and Phys. Lett. 25B
(1967) 220.
- [14] H. Nussbaumer, Diplomarbeit, BONN-IR-77-28 (1977).
- [15] V.V. Anisovich and V.M. Shekhter, Nucl. Phys. B55 (1973) 455.

TABLE CAPTIONS

- Table 1 Total inclusive cross sections for $K^{*\pm}(892)$ production in pp interactions at 12 and 24 GeV/c and π^+p interactions at 16 GeV/c, and inclusive cross sections for $K^{*+}(892)$ produced together with Λ hyperon.
- Table 2 Cross sections for K^0 and $\bar{K}^0$ production and fraction of neutral kaons resulting from $K^{*\pm}$ decays, $F = \sigma(K^{*\pm}) \cdot \text{BR}(K^{*\pm} \rightarrow K^0 \pi^\pm) / \sigma(K^0)$.
- Table 3 Values of the slope parameter B obtained from the fit of the expression $d\sigma/dp_T^2 = A \exp(-B p_T^2)$ to the $K^*(892)$ and $\rho^0 p_T^2$ -distributions in pp, π^+p and K^-p interactions.

TABLE 1

	$\sigma(K^{*+})$ [mb]	$\sigma(K^{*-})$ [mb]	$\sigma(K^{*+} \Lambda)$ [mb]
pp 12 GeV/c	0.27 ± 0.03	$0.04 \pm \begin{smallmatrix} 0.02 \\ 0.03 \end{smallmatrix}$	
pp 24 GeV/c	0.66 ± 0.06	0.19 ± 0.04	0.29 ± 0.06
$\pi^+ p$ 16 GeV/c	0.71 ± 0.10	0.18 ± 0.05	0.21 ± 0.04

TABLE 2

	$\sigma(K^0) + \sigma(\bar{K}^0)^{(a)}$ [mb]	F
pp 12 GeV/c	1.18 ± 0.05	0.17 ± 0.03
pp 24 GeV/c	3.10 ± 0.12	0.18 ± 0.02
$\pi^+ p$ 16 GeV/c	3.06 ± 0.14	0.19 ± 0.03

(a) Calculated under the assumption that $\sigma(K^0)^{\text{short}} = \sigma(K^0)^{\text{long}}$.

TABLE 3

Interaction	P_{lab} [GeV/c]	Produced particle	p_T^2 -Slope B [(GeV/c) ⁻²]	Reference
pp	12	K^{*+}	3.6 ± 0.4	This work
	24	K^{*+}	3.2 ± 0.3	"
		K^{*-}	3.3 ± 0.5	"
$\pi^+ p$	16	K^{*+}	3.1 ± 0.2	"
		K^{*-}	3.8 ± 0.5	"
$K^- p$	16	K^{*-}	2.9 ± 0.2	[5(b)] ^(a)
		$\bar{K}^{*0}$	3.15 ± 0.20	"
pp	12	ρ^0	3.52 ± 0.26	[14]
	24	ρ^0	3.12 ± 0.24	"
$\pi^+ p$	16	ρ^0	3.45 ± 0.10	[11] ^(a)

(a) In this work the region of low p_T^2 has been excluded for the fitting because of peaks produced by quasi two-body processes.

FIGURE CAPTIONS

- Fig. 1 Effective mass spectra for $K_S^0\pi^+$ and $K_S^0\pi^-$ in pp interactions at 12 GeV/c, 24 GeV/c and in π^+p interactions at 16 GeV/c. The curves represent the fits with the background dashed below $K^{*+}(892)$ signals.
- Fig. 2 Inclusive cross sections for $K^{*+}(892)$ production in pp interactions at 12, 24, 69 [6(a)] and 405 GeV/c [6(c)].
- Fig. 3 Distributions of the transverse momentum squared for $K^{*+}(892)$ in pp interactions at 12 GeV/c (a) and 24 GeV/c (b) and in π^+p interactions at 16 GeV/c (c). The straight lines result from the fits of the expression $d\sigma/dp_T^2 = A \exp(-Bp_T^2)$ with the slope parameter values given in table 3.
- Fig. 4 Distributions of the Feynman variable $x = p_L^*/p_{\max}^*$ for $K^{*+}(892)$ in pp interactions at 12 GeV/c (a) and 24 GeV/c (b) and π^+p interactions at 16 GeV/c (c).
- Fig. 5 Distributions of the centre of mass rapidity for $K^{*+}(892)$ in pp interactions at 12 GeV/c (a) and 24 GeV/c (b) and in π^+p interactions at 16 GeV/c (c).
- Fig. 6 (a) Comparison of the c.m. rapidity distributions for $K^{*+}(892)$ in pp interactions at 24 GeV/c and in π^+ interactions at 16 GeV/c and for $K^{*-}(892)$ in K^-p interactions at 16 GeV/c [5(b)]. The pp data are scaled down by the factor 2/3.
- (b) Comparison of the rapidity distributions of $K^{*-}(892)$ in pp and π^+p interactions at 24 and 16 GeV/c in the so-called quark c.m. system (sect. 5). The pp data are scaled down by the factor 2/3.

FIGURE CAPTIONS (Cont'd)

- Fig. 7 Suppression factor $\lambda = \sigma(K^{*+})/\sigma(\rho^0)$ in pp interactions at 12, 24, 69 [6(a)] and 405 GeV/c [6(c)].
- Fig. 8 Comparison of the x distribution for $K^{*+}(892)$ and ρ^0 in pp interactions at 12 GeV/c (a) and 24 GeV/c (b) and in π^+p interactions at 16 GeV/c (c). The ρ^0 data are scaled down by the cross sections ratios $\lambda = \sigma(K^{*+})/\sigma(\rho^0)$ given in sect. 6.

Fig.1

Fig 2

Fig.3

Fig.4

Fig.5

Fig.6

Fig.7

Fig.8