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THE REACTION $K^+N \rightarrow K^*N$ IN THE ISOSPIN-0 CHANNEL NEAR THRESHOLD

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In an earlier Letter,[1] partial cross sections for K^+d and isospin-0 KN reactions at K^+ momenta of 865, 970, 1210 and 1365 MeV/c were presented. In this paper we present a discussion of the isospin-0 $K^+N \rightarrow K\pi N$ channel based on further analysis of K^+d data at 1210 and 1365 MeV/c plus recently analyzed data at 1585 MeV/c from the same exposure of the 25-inch bubble chamber at the Bevatron. Our results show that above the K^*N threshold at 1080 MeV/c most of the $I = 0$ $K\pi N$ production proceeds via the K^*N channel. The K^* production and decay angular distributions indicate the presence of several partial waves even near threshold and suggest that the main production mechanism is t-channel pion exchange. Thus there is no apparent support for an s-channel resonance interpretation of the peak in the $I = 0$ KN total cross section around 1200 MeV/c.[2]

(1) Methods.--(a) As shown earlier the isospin-0 $KN \rightarrow K\pi N$ cross section is given by

$$\sigma_0(KN \rightarrow K\pi N) = 3[\sigma(K^+n \rightarrow K^0\pi^+n) + \sigma(K^+n \rightarrow K^+\pi^-p) - \sigma(K^+p \rightarrow K^+\pi^0p)] . \qquad (1)$$

Since the same relation applies to angular distributions and invariant-mass spectra, the K^*N cross section could be obtained by making the appropriate fit to the $K\pi N$ Dalitz plot obtained from Eq. (1).

(b) Alternatively, the K^*N cross section can also be determined from

$$\sigma_o(KN \to K^*N) = 3[\sigma(K^+n \to K^{*+}n \to K^o\pi^+n) + \sigma(K^+n \to K^{*o}p \to K^+\pi^-p) - \frac{1}{2}\sigma(K^+p \to K^{*+}p \to K^o\pi^+p)] \quad , \qquad (2)$$

in which each appropriate deuterium channel is individually separated into K^*N and the $K^o\pi^+p$ hydrogen channel rather than the $K^+\pi^op$ state is used to subtract out the $I = 1$ $K^{*+}N$ part of the cross section.

(2) Results.--In Fig. 1 we give the energy dependence of the isospin-0 and isospin-1 $KN \to K^*N$ cross sections from threshold to 3.0 BeV/c. The isospin-1 cross sections at 1210, 1365 and 1585 MeV/c are taken from the work of Bland et al.[3] Higher momentum data are taken from the compilation of Price et al.[4] The isospin-0 cross sections have been calculated using Eq. (2). At 1210, 1365, and 1585 MeV/c we have used the $K^+p \to K^{*+}p \to K^o\pi^+p$ data of Bland et al.[3] and at 3.0 BeV/c we have used the published K^+d data of Bassompierre et al.[5] to calculate the isospin-0 cross section. A smooth curve has been drawn through the isospin-1 $KN \to K^*N$ cross sections and has been scaled upward by a factor 2.5 to give the smooth curve passing through the isospin-0 $KN \to K^*N$ cross sections. The data indicate that the energy dependency of the isospin-0 and isospin-1 $KN \to K^*N$ cross sections are quite similar in this energy region.

In Fig. 2 we give the production and decay angular distributions for the isospin-0 $KN \to K^*N$ reaction at 1210, 1365, and 1585 MeV/c. For the 1210 and 1365 MeV/c data procedure (a) was used, whereas at 1585 MeV/c, the availability of only the $K^o\pi^+p$ final state in hydrogen permitted only procedure (b). Cosine θ is the K^* production angle cosine $\hat{K}^+\cdot\hat{K}^*$ in the K^*N center of mass, cos α is the polar-decay-angle cosine $\hat{K}^+\cdot\hat{K}$ in the K^* c.m., and angle φ is the Treiman-Yang azimuthal decay angle.

The K^* angular distributions in Fig. 2 are strikingly different from those produced in the isospin-1 state.[6] In the isospin-0 channel, the production angular distributions peak sharply in the forward direction, the polar decay angular distributions vary mainly as $\cos^2 \alpha$, and the azimuthal decay angular distributions are flat. In the isospin-1 channel (Ref. 6), the production distributions peak much less sharply, the polar decay distributions vary mainly as $\sin^2 \alpha$, and the azimuthal decay distributions vary mainly as $\sin^2 \varphi$. In the first case, the distributions are characteristic of exchange in the t-channel of a light pseudoscalar meson, whereas in the second case they are characteristic of exchange of a heavier vector meson. All the main features point to π exchange being the dominant K^* production mechanism in the isospin-0 channel, and ω,ρ exchange being dominant in the isospin-1 channel.

As is the case with $K\Delta$ and K^*N production in the $I = 1$ channel, the major inelastic process in the $I = 0$ channel in the region of the total cross-section bump, namely K^*N production, exhibits behavior which can be interpreted in terms of t-channel exchanges. Furthermore as is evident from Fig. 2 this process is highly peripheral even very close to the bump and therefore does not suggest dominance of one partial wave. There is therefore no evidence of resonant behavior near 1200 MeV/c at least insofar as the inelastic channels are concerned.

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FIGURE CAPTIONS

Fig. 1. Energy dependence of the isospin-0 and isospin-1 $KN \rightarrow K^*N$ cross sections.

Fig. 2. Production and decay angular distributions of the isospin-0 $KN \rightarrow K^*N$ reaction at 1210, 1365, and 1585 MeV/c. Angles are defined in text.

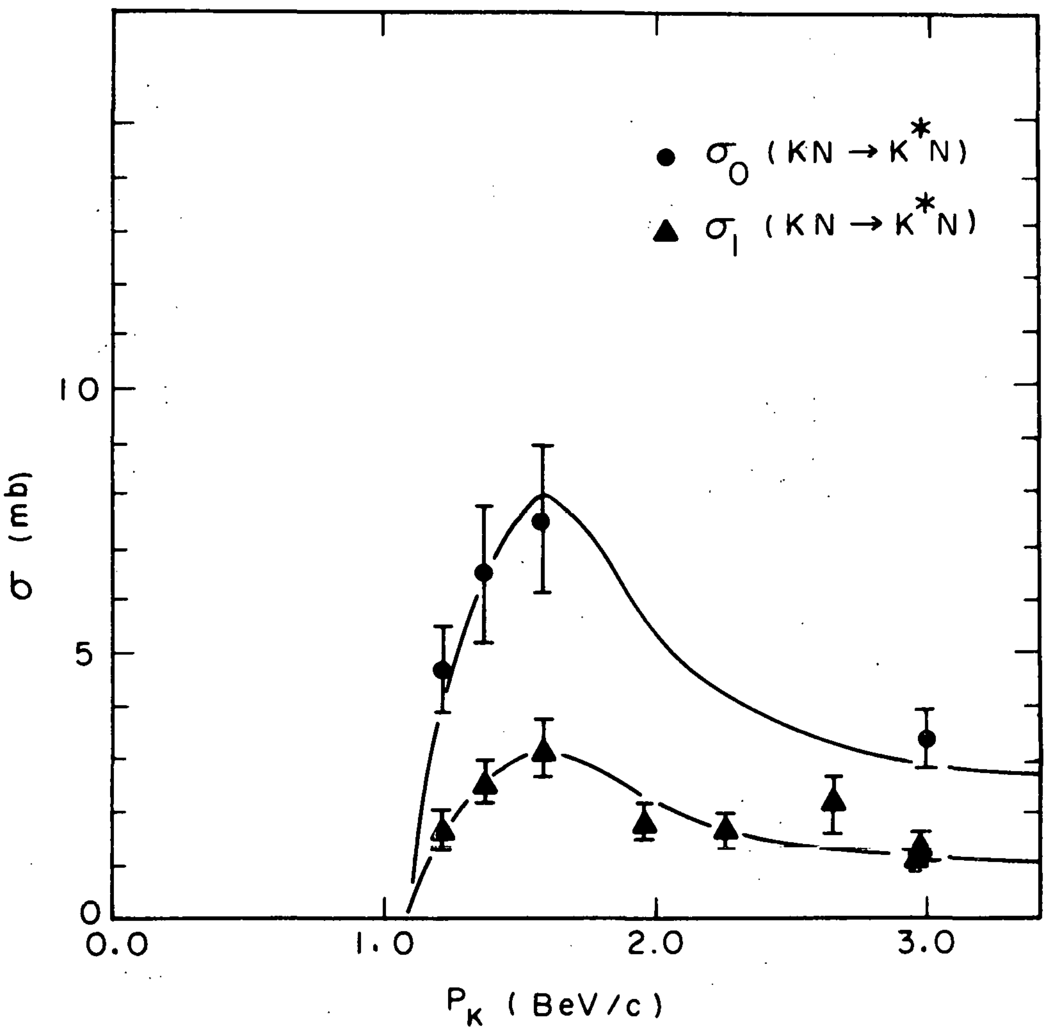

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Fig. 1

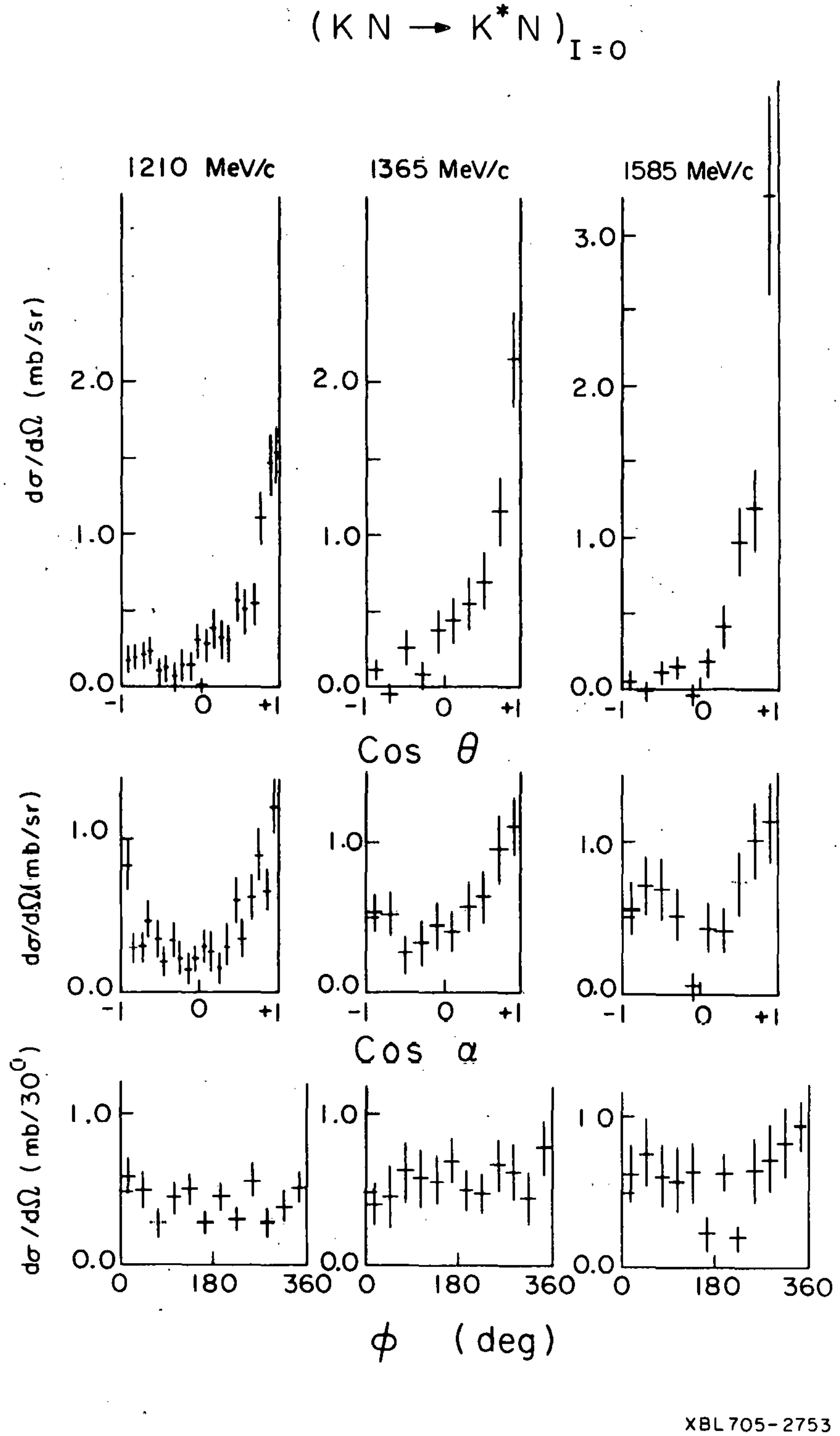
(K N → K*N)I=0
1210 MeV/c
1365 MeV/c
1585 MeV/c
dσ/dΩ (mb/sr)
3.0
2.0
1.0
0.0
-1
0
+1
Cos θ
dσ/dΩ(mb/sr)
Cos α
dσ/dΩ (mb/30°)
180
360
φ (deg)
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Fig. 2

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