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K - π MASS DISTRIBUTIONS FOR $\pi^- + p \rightarrow Y + K + \pi$ AT INCIDENT MOMENTA OF 1.89 THROUGH 2.24 GeV/c

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In a previous communication dealing with the production of strange-particle resonant states by 2.1 GeV/c π^- mesons, we presented evidence for the existence of a K-π resonance of mass 730 MeV in the reactions $\pi^- + p \rightarrow \Sigma^- K^0 \pi^+$, $\Sigma^- K^+ \pi^0$, and $\Sigma^0 K^+ \pi^-$.[1] No statement was made on the isotopic spin assignment of this possible resonant state, although the lack of an enhancement in the reaction $\pi^- + p \rightarrow \Sigma^+ K^0 \pi^-$ suggested I = 1/2. In this paper we present a continuation of this analysis based on an enlarged sample of events. In addition, interesting and at present unexplained energy-dependent features of this resonance are observed. Y-π and Y-K final state interactions in these data are discussed in another paper.[2]

The experimental details of this analysis, which treats the production of three-body final states by $\pi^- + p$ interaction at incident momenta of 1.89, 1.95, 2.04, 2.16, and 2.24 GeV/c in the Berkeley 72-inch hydorgen bubble chamber, have been discussed elsewhere.[1,2] In Table I are listed the number of observed events considered in this analysis. A detailed examination of the data indicates that most distributions in the interval 1.89 through 2.04 GeV/c are qualitatively similar, but distinct from those in the interval 2.16 through 2.24 GeV/c. For this reason, the data from the five momenta have been combined into these two groups.

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† On leave of absence from the Israel Atomic Energy Commission Laboratories, Rehovoth.

Table I. Distribution of numbers of observed events.

Final state	Incident pion momentum (GeV/c) 1.89 - 2.04	2.16 - 2.24	Total
1. $\Lambda^0 K^+ \pi^-$	117	110	227
2. $\Lambda^0 K^0 \pi^0$	32	13	45
3. $\Sigma^0 K^+ \pi^-$	37	60	97
4. $\Sigma^+ K^0 \pi^-$	32	46	78
5. $\Sigma^- K^0 \pi^+$	206	126	332
6. $\Sigma^- K^+ \pi^0$	116	51	167
			946

The K-π squared distributions for the two momentum groups are given in Figs. 1 and 2, respectively. Figures 1(a) and 2(a) show the $\Sigma^+ K^0 \pi^-$ distributions, in which case the K-π system is always in an I = 3/2 state. Figures 1(b) and 2(b) give the combined Σ^-, Σ^0, and Λ^0 events, and in these cases the K-π system is a mixture of I = 1/2 and I = 3/2. The dashed curves in the $\Sigma^+ K^0 \pi^-$ data are background estimates that include effects of the Y_0^* (1405 MeV) resonance[1, 2, 3] combined with nonresonant phase space as dictated by the Σ-π mass distributions for the same events.[2] The Y_0^* (1525 MeV) resonance[1, 2, 4] makes no appreciable contribution to the $\Sigma^+ K^0 \pi^-$ data. The data of Figs. 1(a) and 2(a) are consistent with these background curves.

The dashed background curves of Figs. 1(b) and 2(b) include effects of the Y_1^* (1385 MeV),[1, 2, 5] Y_0^* (1405 MeV), and Y_0^* (1525 MeV) resonances. The contributions of these resonances have been discussed in detail elsewhere.[2] A striking feature of the data is the pronounced and very sharp peak in the lower momenta data shown in Fig. 1(b) at mass 730 MeV. We estimate the statistical significance of this peak above the background to be approximately four standard deviations, and so it is quite improbable that

this effect is just a statistical accident. The width is estimated at $\Gamma \lesssim 20$ MeV with the experimental uncertainty in measurement being $\lesssim 10$ MeV. There is no evidence for such an enhancement data for the higher momenta shown in Fig. 2(b). The $K^*_{\frac{1}{2}}$ (885 MeV) resonance[1,6] is produced strongly at all energies studied; its width is $\Gamma \approx 60 \pm 5$ MeV.

The lack of enhancement in the 730-MeV region in the $\Sigma^+ K^0 \pi^-$ events still suggests that K^* (730 MeV) has isotopic spin I = 1/2, although we do not rule out completely the possibility that accidental interference effects in the initial state of $\pi^- + p$ could simulate our data. In addition, the branching ratio $\Sigma^- K^0 \pi^+ / \Sigma^- K^+ \pi^0$ should permit an unambiguous determination of its isotopic spin. Our data do not permit a statistically significant determination of the isotopic spin from this branching ratio.

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FIGURE LEGENDS

Fig. 1. K-π mass-squared distributions for (a) $\Sigma^+ K^0 \pi^-$, and (b) $\Sigma^-, \Sigma^0, \Lambda^0$ events at incident-pion momenta of 1.89 through 2.04 GeV/c. The dashed curves are background estimates which take the Y^* resonances into account.

Fig. 2. K-π mass-squared distributions for (a) $\Sigma^+ K^0 \pi^-$, and (b) $\Sigma^-, \Sigma^0, \Lambda^0$ events at incident-pion momenta of 2.16 through 2.24 GeV/c. The dashed curves are background estimates which take the Y^* resonances into account.

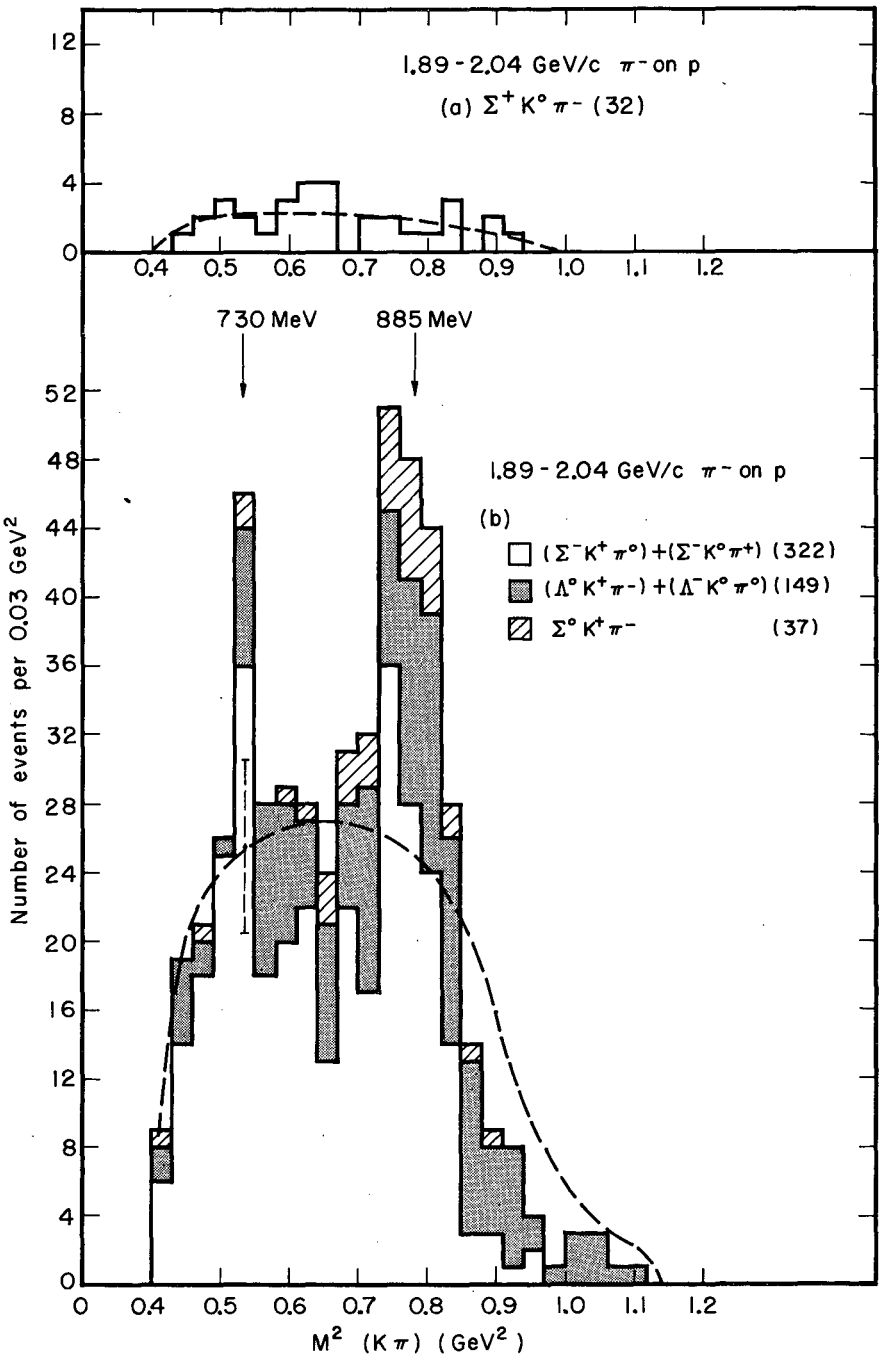
1.89 - 2.04 GeV/c π⁻ on p
(a) Σ⁺ K° π⁻ (32)
730 MeV
885 MeV
1.89 - 2.04 GeV/c π⁻ on p
(b)
(Σ⁻ K⁺ π°) + (Σ⁻ K° π⁺) (322)
(Λ° K⁺ π⁻) + (Λ⁻ K° π°) (149)
Σ° K⁺ π⁻ (37)
Number of events per 0.03 GeV²
M² (K π) (GeV²)
MUB-1154

Fig. 1

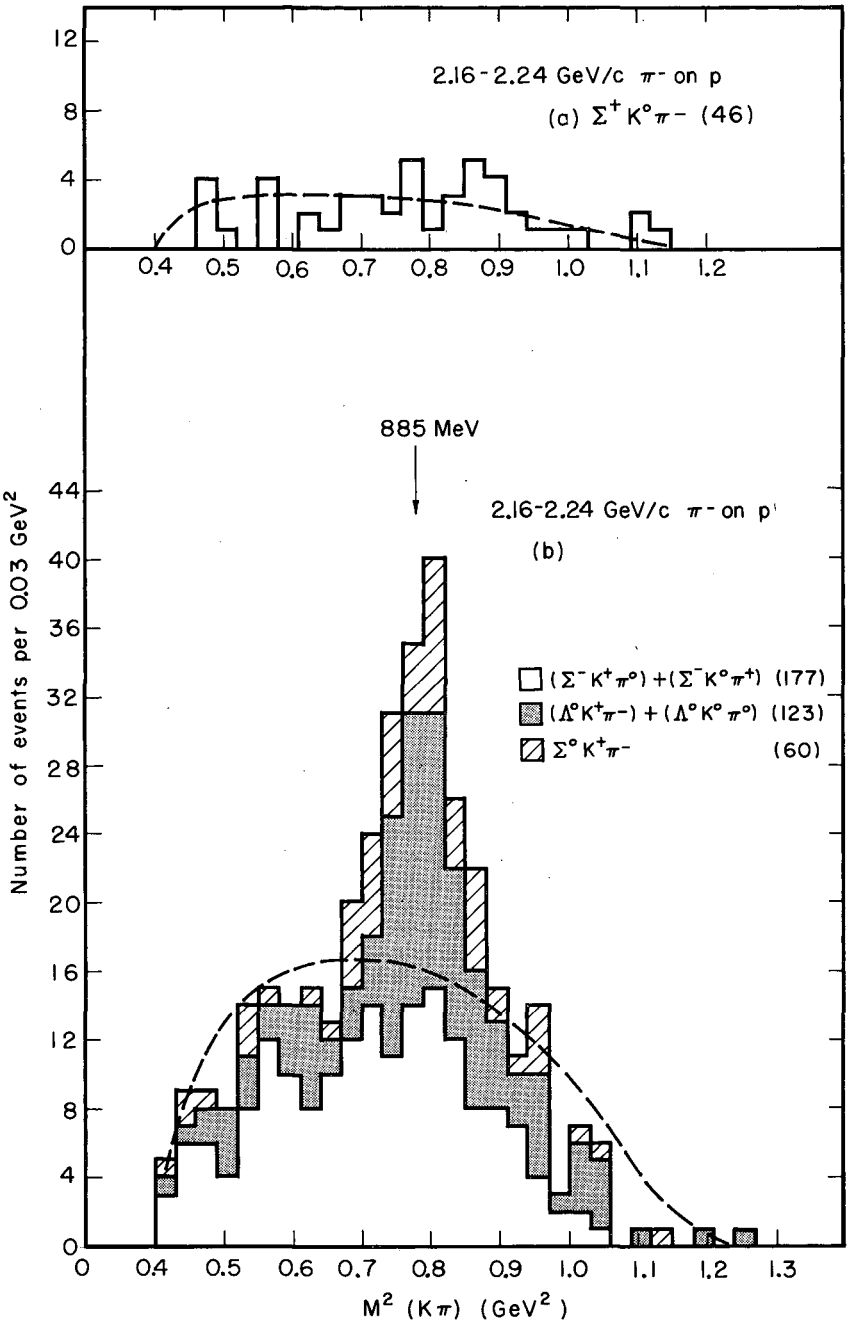
2.16-2.24 GeV/c π⁻ on p
(a) Σ⁺K°π⁻ (46)
885 MeV
2.16-2.24 GeV/c π⁻ on p
(b)
(Σ⁻K⁺π°)+(Σ⁻K°π⁺) (177)
(Λ°K⁺π⁻)+(Λ°K°π°) (123)
Σ°K⁺π⁻ (60)
Number of events per 0.03 GeV²
M² (Kπ) (GeV²)
MUB-1155

Fig. 2

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