2(b)] is approximately uniform, although there may be a depletion of events at low T_0.

It has been suggested[9] that there may exist a 1^{+-}, $I=1$ meson, called α, which might determine the structure of the axial vector strangeness-nonchanging form factor of the weak decays, $F_A(q^2)$, at low energies. Dennery and Primakoff[9] have estimated that $m_\alpha \simeq m_\rho/1.2 = 4.3 m_\pi$, a value which is not inconsistent with the second mass peak in Fig. 1. The only purely neutral decay mode (into known particles) of such an object would be a decay into three π^0 mesons.[10] For the 000 and +-0 decay modes the branching ratio would be $(000)/(+-0) \leq \frac{3}{2}$, which would be consistent with the observation of very few events above 600 Mev in the missing-mass distribution in Fig. 3.

It should be emphasized that our statistics are limited. If we are observing a true resonance and not, for example, a final-state interaction peculiar to the p-p system, the peaks should be seen in other processes. So far, experiments in which η or ω have been found have not shown striking peaks in this energy region. The cross section for production appears to be small, and the c.m. energies of other experiments may have been less suitable.

We wish to thank the BNL bubble chamber group and our scanners for their invaluable services. We are indebted to Dr. W. J. Fickinger for providing data from his sample of two-pronged p-p events. We thank Dr. J. Bernstein for helpful discussions.

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Λ^0-K^0 PRODUCTION BY PIONS ON PROTONS*

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The associated production of hyperons and heavy mesons in pion-proton collisions was first observed in the Brookhaven National Laboratory diffusion cloud chamber.[1] Since then the production of strange particles in the same and similar reactions has been studied by many groups.[2] This Letter is concerned with the extension of this work to lower energies, specifically incident pion kinetic energies of 775, 791, 829, and 871 Mev. The pion interactions were observed in the BNL 20-in. hydrogen bubble chamber. Since the primary pion energies are above the ΛK threshold but below that for ΣK production, only one strange particle channel is available, namely,

$$\pi^- + p \rightarrow \Lambda^0 + K^0, \quad K^0 \rightarrow \pi^- + \pi^+, \quad \Lambda^0 \rightarrow \pi^- + p \qquad (1)$$

We report here the cross sections, angular distributions, and polarizations of the Λ^0 for the above reaction as a function of energy.

The external proton beam at the Cosmotron was caused to strike a 6-in. Cu target. Negative pions which emerged at an angle of 4° were subsequently focussed and bent through 45° by a quadrupole and two shimmed dipole magnets. With this arrangement it was possible to obtain ~25 pion tracks per picture with a momentum resolution of $\pm\frac{1}{3}\%$. These pictures were scanned for single and double V events, that is, interactions which produced reaction (1) where Λ^0, K^0, or both, decayed via their charged decay modes. The events were measured on a digitized stage with an accuracy of $\pm 2\ \mu$ on the film. The reconstruction and analysis was performed with the standard BNL TRED-KICK programs. All events whose χ^2 probability was greater than 0.1% for the appropriate number of constraints were accepted. There was no difficulty in distinguishing Λ^0's from K^0's since the ionization of the positive decay track served to identify the proton or π^+ in the few difficult cases. In this manner 1099 events were found and identified in a restricted fiducial volume. In addition: (a) 20% of the film was rescanned; a 94% scanning efficiency was calculated at each energy. (b) The same film was scanned for δ rays of momentum >45 Mev/c, thereby determining the μ and e beam contamination to be $(6.2\pm 2.5)\%$ and $(0.3\pm 0.3)\%$, respectively. (c) The total number of pion interactions into both charged and neutral modes was recorded in this same portion of the film.

From the above information it is possible to determine a value for the total $\pi^- + p$ cross section, as well as that for ΛK production at these energies. These results as well as other information pertinent to these exposures are presented in Table I.

The three values for the total πp cross section, as well as those previously determined by various counter groups,[3] are plotted in Fig. 1. It is clear that the results of the present experiment agree very well with the previous data. In Fig. 2 the cross section for ΛK production is plotted as a function of the hyperon center-of-mass momentum. Also included are previously published results. It should be noted that the rise of the cross section from threshold is gradual, and that the sharp rise corresponding to speculations of s-wave production does not occur.

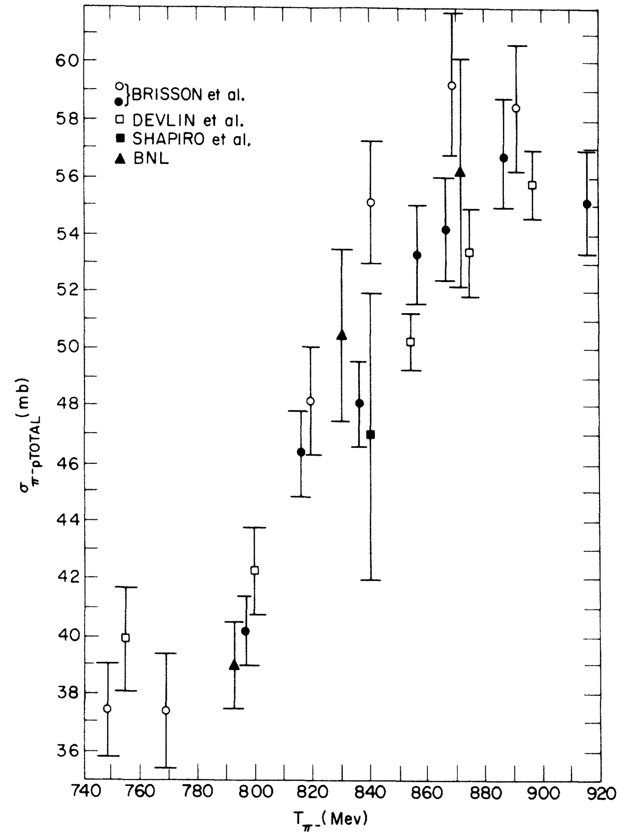

FIG. 1. Plot of total π^--p cross sections.

In Fig. 3 the differential cross sections $d\sigma/d\Omega$ at the various energies are plotted. Figure 4 shows the corresponding distributions in $\alpha P(\omega_\Lambda) \times d\sigma/d\Omega$,[4] where α is the Λ^0 decay asymmetry parameter as defined in reference 4, and $P(\omega_\Lambda)$ is the Λ^0 polarization. In both cases an s-p and an s-p-d wave fit to the data are also shown. At the lowest and highest energies only partial waves up to $l=1$ were necessary, while at $T_\pi = 829$ Mev

Table I. Exposure details and cross sections.

T_π (Mev)	$P_{\text{c.m.}}$ (Mev/c)	No. pictures	No. events	$\sigma_{\Lambda K}$ (mb)	$\alpha\bar{p}$	σ_{total} (mb)
775	50	12000	17	0.056 ±0.015		
793	100	50000	167	0.14 ±0.02	+0.43±0.15	39 ±1.5
829	155	50000	358	0.43 ±0.04	+0.20±0.10	50 ±3.0
871	205	50000	557	0.56 ±0.04	+0.41±0.08	56 ±4.0

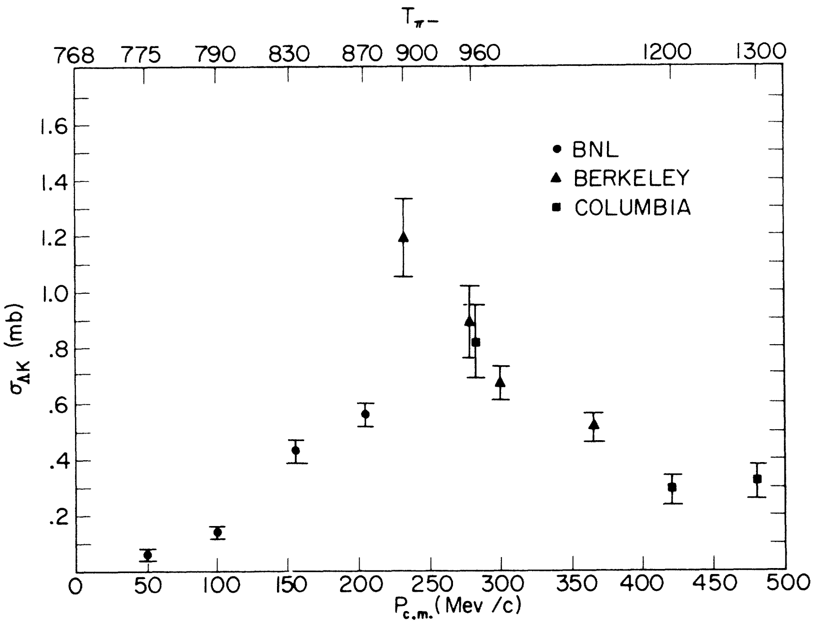

FIG. 2. Plot of cross sections for ΛK production by pions on protons.

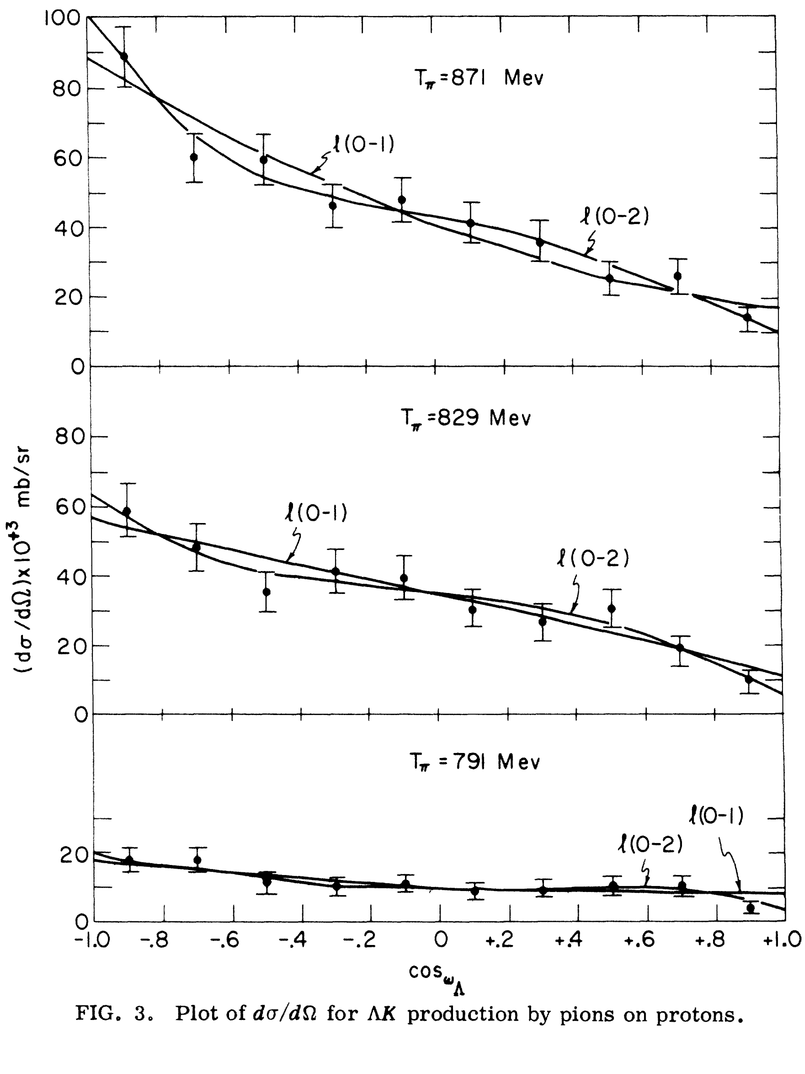

FIG. 3. Plot of $d\sigma/d\Omega$ for ΛK production by pions on protons.

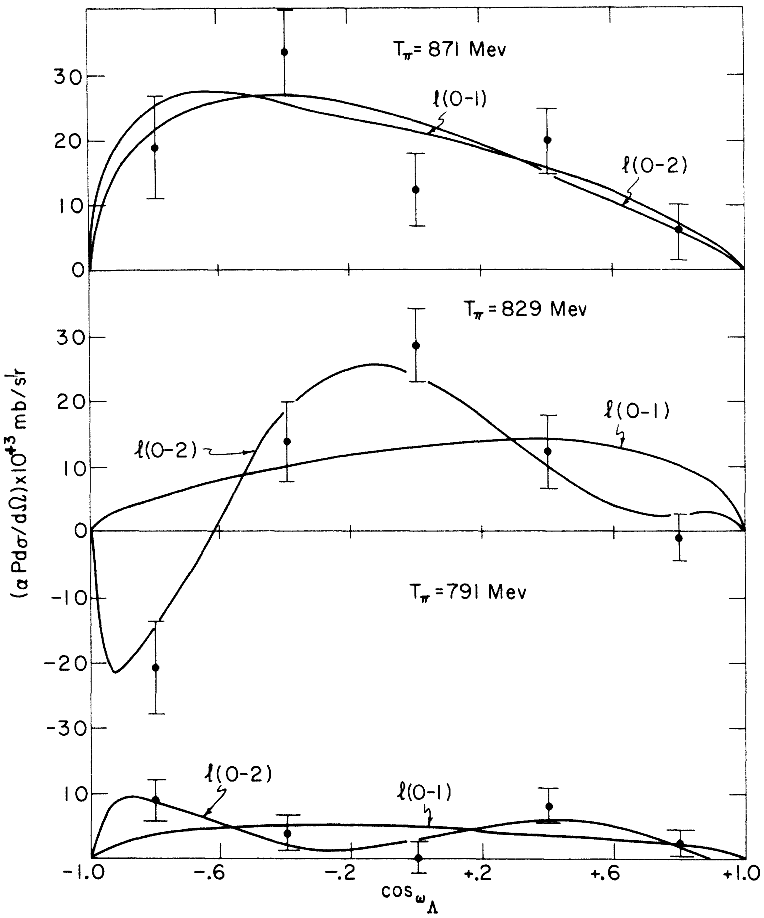

FIG. 4. Plot of $\alpha P d\sigma/d\Omega$ for ΛK production by pions on protons. P is the polarization of the Λ^0.

l values up to 2 were needed. This inclusion of higher partial waves at $T_\pi = 829$ Mev is due to the poor s-p fit to the polarization distribution which misses 3 of the 5 points by 3 standard deviations. If we separate the data into 10 intervals in the angular distribution and 5 intervals in the polarization distribution and calculate the χ^2 for the various fits, one obtains the following probabilities verifying the importance of higher partial waves at 829 Mev.

T_π (Mev)	s-p $l = 0$–1	s-p-d $l = 0$–2
791	10%	40%
829	<0.1%	35%
871	25%	14%

The partial wave amplitudes seem to exhibit a behavior with energy whereby the d-wave amplitude becomes finite and significant at 829 Mev but is consistent with zero at 871 Mev. A possible explanation would be a ΛK resonance with mass ≈ 1650 Mev. A detailed partial wave amplitude analysis is in progress and will be published at a later date.

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