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ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

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A b s t r a c t

In this paper the processes of $\Lambda(\Sigma^0)$ hyperon and K^0-meson generation in $\pi^- p$ - collisions have been studied at the π^- meson energy of 6.8 BeV. There were obtained the cross sections for the production of $\Lambda(\Sigma^0)$ and K^0, the relationships between the cross sections for the generation of $Y^0 K$ and $K\bar{K}$-pairs, the average multiplicity of charged particles, the angular and momentum distributions of Λ and K^0 in the center-of-mass system and the distributions of the transverse momenta of Λ and K^0.

At the present time the papers are published where processes of $\Lambda(\Sigma^0)$ hyperon and K^0- meson generation in $\pi^- p$ collisions were studied only near the threshold (0.9 - 1.4) BeV/c[1].

To clear up the structure of the nucleon and the character of the interaction between elementary particles it is necessary to obtain the experimental data at higher energies. The processes of generation of $\Lambda(\Sigma^0)$ hyperons and K^0-mesons in the collisions of negative π mesons of the momentum 6.8 ± 0.6 BeV/c with hydrogen have been studied by means of a 24-litre propane bubble chamber in the steady magnetic field of 13.700 oersted. The experiment arrangement is described in the paper by Wang Kan -chang et al[2].

Methods of Analysis and Selection of $\pi^- p$ Interactions

A stereocamera with the objectives " Руссар-плазмат " with the focal distance of 67 mm was used to take photos of the working volume of the chamber. The photographic film was pressed to the flat-parallel glasses on which the crosses are indicated (the straight lines are intersected at an angle of 90°). The base for stereophotographing is determined by the distance between the crosses and is equal to 300mm. The objectives are adjusted so that their optical axes are parallel and pass through the points at which the straight lines are intersected on the glasses. The scale of photographing for the mean plane of the working volume of the chamber is 1 : 10. During the operation the camera is kept in a fixed position on the upper plate of the chamber. The pictures obtained were scanned twice or thrice by different scanners with the help of stereomagnifiers or reprojectors. For the observation of V^0 the efficiency of such scanning was found to be 91% and 96% respectively. There were scanned 14000 pictures. Λ and K^0 were considered to be generated in $\pi^- p$ interaction if they satisfied the following criteria:

1. In the star to which Λ and K^0 belong we failed to observe short black tracks characterising for the disintegration products of carbon nuclei.

2. The number of rays in the star is even (0,2,4,6).

3. The total charge of all secondary particles is equal to zero.

4. Not more than one baryon (Λ , Σ , p) is observed in the star.

5. The momenta of Λ and K^0-particles in the c.m.s. do not exceed the maximum values available in the generation of Λ and K^0 in the collision of π^- mesons with free protons.

The events selected during the scanning were analysed, and 233 of them satisfied a: the criteria mentioned above. The measurements of the events were made with the micros - copes УИМ -21 by measuring the coordinates of the corresponding points on both picture of a stereopair.

The spatial coordinates, angles and momenta were calculated with an electronic computer "Ural". The calculation for the geometrical construction of the track in space was made by the method of least squares. The curvature of the track was approximated by the parabola. The inhomogenity of the magnetic field over the whole working volume of the chamber did not exceed $\pm$ 3%. Due to multiple scattering the error in the determination of the momenta is, on the average, 13% for relativistic particles when the track is 10cm long.

To identify Λ and K^o - particles the kinematic relations were used between the emission angles and the corresponding momenta of the decay products. This allowed to determine the momenta of Λ and K^o-particles with an accuracy of 10%.

Correction for the Geometry

The effective region of the chamber for the generation and the observation of Λ and K^o-particle decay is smaller than the geometrical dimensions of the chamber 55 x 28 x 14 cm^3 and depends upon the lifetime of the particle and its velocity .

The effective region was determined experimentally. For this purpose the distribution was constructed of points of Λ and K^o generation in the camera. It turned out that the distribution of these events simulates the distribution of the tracks of a primary beam in the following intervals: along the x-axis - from 4 up to 22cm, along the z-axis - from 3 up to 9cm*. If the direction of the primary particle beam is taken as a positive direction, and the middle of the chamber - as an origin along the y-axis, then 90% of all the events of Λ and K^o production are situated within the interval from -24 up to +14cm. 209 out of 233 events belong to this region. It turned out that the effective regions for Λ and K^o-particles practically coincide. The difference in the lifetimes is compensated because of large velocities what leads to a great relativistic increase of the lifetime of K^o, and it becomes comparable with the lifetime of Λ . To take into account Λ and K^o -particles, which decay outside the chamber, as well

* x is the width of the chamber, y is the length of the chamber along the direction of the beam, z is the deep coordinate.

as the difference in the probabilities of recording Λ and K^0 emitting in the vertical and horisontal planes, the corrections were introduced:

W_1 is the correction for the probability of Λ and K^0 decay outside the chamber

W_2 is the correction for the losses of Λ and K^0 because of large deep angles.

1. The probability of Λ and K^0 decay within the chamber is determined by the well-known exponential relation ($1 - e^{-L/l_0}$), where $l_0 = \beta c \gamma \tau_0$ is the mean range and L is the potential range. The distance from the point at which the particle is generated up to the boundary of the effective region for observing the decay is meant by a potential range. The dimensions of this region depend upon the minimum length necessary for measuring the momenta of the decay products. In our experiment this length was 4 cm. Using the values of Λ and K^0 lifetimes from[3], we calculated f_i - the probability of observing the decay in our chamber for each event. The mean value f_i for the observation of Λ and K^0 is equal to 84% and 78%,respectively,whereas for the observation of the ΛK^0, $K\bar{K}^0$ pairs - 65% and 63%, respectively. The magnitude inverse to the probability of observing the decay in the chamber gives the correction W_1.

2. The depth of the chamber is smaller than its width and, therefore, the probability of observing Λ and K^0 particles generated in the chamber and emitted at large azimuthal angles is less than for observing Λ and K^0 emitted at small azimuthal angles ($\phi = 0^\circ \div 90^\circ$). This is the so-called efficiency over ϕ. There was constructed the distribution in ϕ for Λ and K^0. It was found that the correction in ϕ for Λ decays is W_2 =1.48 ± 0.1 and for K^0-decays W_2 = 1.13 ± 0.03.

Cross Section for the Production of $\Lambda(\Sigma^0)$ and K^0

In this paper we did not intend to estimate the fraction of Λ from Σ^0 decay. The decay of Σ into Λ and γ quantum practically just at the point of generation does not permit to distinguish Λ obtained in the Σ^0 decay by γ quanta, since in our chamber only 11% of γ quanta convert into an electron-positron pair. It is seen from Table 1 that together with neutral strange particles a few more charged particles are produced at our energy. These are mainly π^-mesons. The average number of charged particles accompanying the generation of Λ and K^0 is equal to 2.5 ± 0.1. Among charged particles there are also $K^{\pm}$ mesons.

We recorded the neutral strange particles which are produced in the following reactions

$$(1)\ \pi^- + p \to \Lambda + K^0 + n\pi$$
$$(2)\ \pi^- + p \to \Sigma^0 + K^0 + n\pi$$
$$(3)\ \pi^- + p \to \Lambda + K^+ + n\pi$$
$$(4)\ \pi^- + p \to \Sigma^0 + K^+ + n\pi$$
$$(5)\ \pi^- + p \to K^0 + \tilde{K}^0 + N + n\pi$$
$$(6)\ \pi^- + p \to K^0 + K^- + N + n\pi$$
$$(7)\ \pi^- + p \to \tilde{K}^0 + K^+ + N + n\pi$$

At our energy K^0 can also be produced in the following reactions

$$(8,9)\ \pi^- + p \to \Sigma^{\pm} + K^0 + n\pi$$
$$(10)\ \pi^- + p \to \Xi^- + K^0 + K + n\pi$$
$$(11)\ \pi^- + p \to \Xi^0 + K^0 + K + n\pi \qquad \text{etc.}$$

but the contribution of K^0 from these reactions to the total statistics is negligible: $\Sigma^{\pm}$ have a characteristic mode of decay, short lifetime and, therefore, may be reliably recorded and well identified from the reactions (1)-(7) under study; Ξ^0 have very small production cross section in $\pi^- p$ interaction*. For sufficiently large momenta (1.25BeV/c) we cannot distinguish $\pi^{\pm}$ mesons from $K^{\pm}$ mesons and protons. The measurements of the ionization in this interval of momenta do not give a reliable separation of π^+ mesons from protons, not to mention the separation of π^+ from K^+ mesons. Therefore, we evaluated the events with the decay schemes (3),(4), (6), (7) in the following way: we know the branching ratios of Λ and K^0 decay into neutral particles , as well as the fraction of longlived K^0 mesons. We denote this fraction for Λ by $f_\Lambda = 0.33$ and for K^0 by $f_{K^0} = 0.63$/4/. Then the correct numbers may be determined by the number of pairs $K^0(n_{\Lambda K^0})$ and $K^0\tilde{K}^0(n_{K^0\tilde{K}^0})$ which were found experimentally

$$N_{\Lambda K^0} = \frac{n_{\Lambda K^0}}{(1-f_\Lambda)(1-f_{K^0})}$$

$$N_{K^0\tilde{K}^0} = \frac{n_{K^0\tilde{K}^0}}{(1-f_{K^0})(1-f_{K^0})}$$

Due to the neutral decay of K^0 and to the existence of K_2^0, a part of $N_{\Lambda K^0}$ will be recorded as a single Λ .

The number of such events is $n_1' = N_{\Lambda K^0} f_{K^0}(1-f_\Lambda)$. n_1' is subtracted from the total

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* The cross section for Ξ^- production is estimated to be $3.6^{+2.5}_{-3.1}\ \mu b$/nucleus at this energy. The paper will be published.

number of the single Λ with the corrections W_1 and W_2 the remainder may be considered as Λ generated according to reactions (3) and (4).

An analogous calculation was made for K^0-mesons.

Thus, we estimated the probabilities of reactions (1),(2) and (3),(4), as well as (5) (6) and (7). For the sake of simplicity we denote:

$$\sigma(Y^\circ K^\circ) = \sigma(1) + \sigma(2)$$

$$\sigma(Y^\circ K^+) = \sigma(3) + \sigma(4)$$

$$\sigma(K^\circ \tilde{K}^\circ) = \sigma(5)$$

$$\sigma(K^\circ K^\pm) = \sigma(6) + \sigma(7)$$

and

$$\sigma(Y^\circ K) = \sigma(Y^\circ K^\circ) + \sigma(Y^\circ K^+)$$

$$\sigma(K^\circ \tilde{K}) = \sigma(K^\circ \tilde{K}^\circ) + \sigma(K^\circ K^\pm)$$

We have scanned our material specially with the aim of observing the γ -quantum conversion from π° meson decay. During the scanning of 228 events in which neutral strange particles are produced it was found that in 32 events a conversion electron-positron pair belonged to the primary star. This constitutes 14%. 20 conversions of γ -quanta are observed together with Λ and 12 conversions of γ -quanta - together with K^0. The difference between 20 and 12 is not great within the error. On the other hand, since the threshold for the production of a $K\tilde{K}$ pair is higher than for $Y^\circ K$, then the multiplicity for $K\tilde{K}$ pairs must be less. Therefore, one can suppose that all the conversions of γ quanta are the decay products of π° mesons, and among them the fraction of γ quanta from Σ° decay is comparatively small.

To determine the total cross section for the production of $\Lambda(\Sigma^\circ)$ and K^0-particles 7000 photographs were taken, on which the number of primary π^- mesons on each picture did not exceed 15-20. The number of mesons was counted twice independently on each tenth picture.

The difference in the number of tracks according to the results of two observers was 0.6% when the number of mesons was about 100.000. As was mentioned above, the efficiency of observing V° -events was equal to 91% for the twofold scanning and 96% for the threefold scanning. Besides the corrections W_1 and W_2 due to the geometry of the chamber, a correction was made for the neutral mode of decay and long-lived K_2^0-mesons in the determination of the total number of the events of $\Lambda(\Sigma^\circ)$ and K^0-generation. The result for different reactions is given in Table II with account of all corrections.

Our experiment is performed with propane (C_3H_8). Therefore, it is necessary to correct the cross section for the admixture of interactions with quasi-free protons from carbon. For this purpose one counted the number of $\pi^- n$ interactions associated with Λ or K^0 decay*. The number of such events was 30% of the selected $\pi^- p$ interactions.

In the course of analysing 10% of the interactions originally selected as $\pi^- p$ did not satisfay the fifth condition and were excluded from the consideration.

Assuming that the cross sections for the generation of Λ and K^0-particles on quasi-free protons and neutrons of carbon are identical, we obtain that 20% of $\pi^- p$ interactions are due to the interaction of π^- with quasi-free carbon protons.

Considering the above-mentioned corrections as well as the admixtures of mesons and the efficiency of observing, the total cross section for the creation of $\Lambda(\Sigma^-)$ and K^0 particles is found to be (2.0 ± 0.35)mb.

$$\sigma(Y^\circ K) = 0.8 \pm 0.25 \text{ mb}$$

$$\sigma(K^\circ \bar{K}) = 1.2 \pm 0.3 \text{ mb}$$

$$R = \frac{\sigma(Y^\circ K)}{\sigma(K^\circ \bar{K})} = 0.7 \pm 0.2$$

Momentum and Angular Distributions of Λ and K^0 Particles in the Center-of-Mass System

In constructing the angular and momentum distributions we took into account only the correction W_1 .

In Fig.1 is given the momentum distribution of hyperons. In Fig.1a) are compared the momentum spectra of Λ emitting in the c.m.s. in the forward and backward directions . It is seen that the momentum spectrum of particles emitted in the backward direction in the c.m.s. is spread from zero up to 1.6BeV/c while those emitted in the in the forward direction, cuts off near 1BeV/c.

In Fig.2 is shown the angular distribution of Λ hyperons. The character of this distribution does not depend upon the multiplicity of particles produced together with Λ . Λ hyperons are flying mainly in the backward direction.

In Fig. 3 is presented the momentum distribution of K^0-mesons.

*The selection criteria for $\pi^- n$ interactions will be described in /5/.

It is seen from Fig.3a) that the momentum spectrum of K^0 mesons emitting in the forward direction is almost the same as for K^0-mesons emitting in the backward direction.

If for Λ hyperons the angular distribution is independent of the multiplicity of other particles generated together with Λ , then for K^0 the situation changes essentially. In Fig.4a) is presented the angular distribution of K^0-mesons for the multiplicity $n_s \leqslant 2$ and in Fig.4b) for the multiplicity $n_s \geqslant 4$. (n_s is the number of charged particles). For the cases with small multiplicity (n_s = 0,2) a greater number of K^0-mesons fly in the forward direction.

$$\frac{\overrightarrow{n}}{\overleftarrow{n}} = 2.0 \pm 0.4$$

For the cases with large multiplicity (n_s = 4,6) the angular distribution, within insufficient statistics, is practically isotropic. In Fig.5 and 6 are shown the angular and momentum distributions:

a) for π^- mesons in the usual multiple production/5/

b) for π^- mesons generated together with $\Lambda(\Sigma^0)$.

We compared only negative particles produced together with a hyperon. This allows to identify them uniquely as mesons. In usual multiple production the negative particles are also very likely to be π^- mesons.

It is seen from the comparison of these distributions that they have quite a similar character.

The mean values of the transverse momenta for Λ and K^0—388 $\pm$ 35 MeV/c and 393 $\pm$ 35 MeV/c respectively, i.e. within the error they are equal.

The distribution of the transverse momenta of Λ hyperons and K^0-mesons is shown in Fig.7. The mean value of the transverse momenta does not depend upon the multiplicity, what is seen from Table III.

DISCUSSION OF EXPERIMENTAL RESULTS

1. The Cross Section for Generation of Y^0K and $K^0\tilde{K}$ Pairs

The experimental result we obtained points out that at an energy of π^- mesons of about 7 BeV the cross section for the generation of the $K\tilde{K}$ pair becomes greater than the cross section for the creation of Y^0K . The ratio of the cross sections gives the value $R = \frac{\sigma(Y^0K)}{\sigma(K^0\tilde{K})}$ = 0.7 $\pm$ 0.2. We have studied only the $K^0\tilde{K}$ pairs. If we suppose that at our energy the cross section for the production of the charged pair K^+K^- is the same as for $K^0 \tilde{K}^0$, then the ratio may be reduced to 0.5.

Near the threshold the cross section for the production of ΛK^0 and $\Sigma^0 K^0$ pairs is studied rather in detail. The total cross section for $Y^0 K^0$ has the maximum of 1.1.mb at about 0.96BeV and falls to 0.4mb at 1BeV, and then it increases again at 1.3BeV up to 0.6 mb/1/. But we do not know how the cross section behaves further. For comparison we make use of paper/6/, in which the multiple production of π^- mesons has been studied at 5BeV. Among 106 ($\pi^- p$) interactions in a hydrogen-filled diffusion chamber 4 events of strange particle production was observed. One of these events was identified as $\pi^- + p \rightarrow \Lambda + K^+ + \pi^-$. This constitutes 4% of the total cross section for inelastic $\pi^- p$ interaction. If we take the total cross section for inelastic interaction to be 18 mb, as the authors of this paper have obtained, then the cross section for strange particle production will be 0.7 mb. It seems this estimation cannot be considered quite correct,but one may think that by accounting all the corrections the cross section for the produotion of YK pair will be of the order of one millibarn. The comparison of paper/6/ with our result $\sigma(Y^0 K)$ =0.8 ± 0.25 mb shows that with the inorease of π^- energy the cross section for pair production, probably, does not change.

The comparison of our result with the calculations aocording to the statistical theory/7/ does not give even a qualitative agreement.

In the caloulations by the statistical theory, for the probability of production of different pairs of strange particles the following values have been obtained relative to the total cross section for $\pi^- p$ interaction:

$W(\Lambda K)$ = 3.8% $W(\Sigma K)$ = 6.8% and $W(K\tilde{K})$ = 1.1%

If we assume

$\sigma(\Sigma^0 K) = 1/3\ \sigma(\Sigma K)$ and

$\sigma(K^0 \tilde{K}) = 3/4\ \sigma(K\tilde{K})$ then

we get

$\sigma(Y^0 K) = 0.06\ \sigma_t$ or 1.5mb

$\sigma(K^0 \tilde{K}) = 0.008\ \sigma_t$ or 0.2mb

The theoretical and experimantal values of the cross section for the creation of $K^0 \tilde{K}$ pairs are different by an order. If Y^0 is treated as a bound state KN (Goldhaber scheme) then, as was pointed out by M.A.Markov/8/,the cross section for $K\tilde{K}$ pairs will inorease with the energy increase of the primary π^- meson. In view of this, it would be very interesting to clear up the variation of the oross scetion for $K\tilde{K}$pairs at π^- meson energy above and below ours.

From our preliminary results the cross section for $K \tilde{K}$ pair generation is increasing at 8 BeV energy.

2. Mean Multiplicity

At our energy, together with the production of strange particles some more other particles, both charged and neutral, are generated. Let us compare the mean multiplicities in the production of strange particles and in the usual multiple production of π mesons[5] for the same energy.

For the usual multiplicity the mean number of charged particles is $n_s = 3.2 \pm 0.2$.

When strange particles are generated the observed mean number of the charged particles is equal to $n_s = 2.5 \pm 0.1$. There is no doubt that π mesons comprise the major part of all charged particles. As a part of energy is spent for the creation of a pair of strange particles then for the production of π mesons there remains a smaller part of energy. Then one can expeot that the number of π mesons produced together with strange particles will be less than in usual multiple production of π mesons. This is in agreement with our result. We have already mentioned above that in 14% of the events there is a pair from γ quanta conversion, while for the usual multiplicity the stars with γ quanta conversion are 21%. If we assume that the number of electron-positron pairs from γ quanta conversion is proportional to that of π^0 mesons then the ratio of the number of π^0 mesons in the strange particle production to that of π^0 mesons in the usual multiple production will be 2 : 3, whereas for the charged ones this ratio is not conserved. If we take the ratio 2:3 for mesons as well, then the average multiplicity of oharged mesons must be $n_s = 2.0$. Thus, the differenoe between the experimental multiplicity and that calculated above is 0.5 when strange particles are produced. This differenoe may be accounted for the presence of $K^{\pm}$ mesons among the charged particles accompanying the production of neutral strange particles. Indeed, if we estimate a fraction of charged K-mesons in other way, we obtain the same result, and namely: $n_{K^{\pm}} = 0.5$.

This estimate was made on the basis of the reactions observed with account of :
a) neutral decays of Λ and K^0, b) deoays outside the working volume of the chamber. We consider the event in which the decay is not observed to be a multiple production of mesons. Therefore, it may be omitted. But since we already know the probability of and K^0 decays into charged particles

$$\eta_\Lambda = (1 - f_\Lambda) \qquad \text{and} \qquad \eta_K = (1 - f_K) \qquad \text{and}$$

the probability of recording the charged decays

$$\eta'_\Lambda = \left(\frac{1}{W_1 W_2}\right)_\Lambda \quad \text{and} \quad \eta'_{K^0} = \left(\frac{1}{W_1 W_2}\right)_{K^0}$$ we can determine

$$\bar{n}_{K^\pm} = \frac{\eta_\Lambda \eta'_\Lambda N_{\Lambda K^\pm} + \eta_{K^0} \eta'_{K^0} N_{K^0 K^\pm}}{\eta_\Lambda \eta'_\Lambda N_{\Lambda K^\pm} + \eta_{K^0} \eta'_{K^0} N_{K^0 K^\pm} + [\eta_\Lambda \eta'_\Lambda + \eta_K \eta_{K^0}] N_{\Lambda K^0} - n_{\Lambda K^0} + 2 [\eta_K \eta'_{K^0} N_{K^0 \bar{K}^0} - 1/2\, n_{K^0 \bar{K}^0}]} = 0.5 \pm 0.12$$

where

$$N_{\Lambda K^\pm}, \quad N_{K^0 K^\pm}, \quad N_{\Lambda K^0}, \quad N_{K^0 \bar{K}^0}$$

are from Table II and $n_{K^0 \bar{K}^0}$; $n_{\Lambda K^0}$ are the observed number of $K^0 \bar{K}^0$ and ΛK^0 pairs. Both these estimates coincide well.

3. Angular and Momentum Distributions

The angular distributions of Λ hyperons produced in $\pi^- p$ interactions near the threshold are studied well. An analysis of the amplitude was made by the S and P-waves/9/.

At our energy, of course, such an analysis cannot be made. To clear up the angular distributions of secondary particles it is possible to use only general ideas.

As is shown from angular distribution (Fig.2) the single Λ hyperons have an evident tendency to be emitted in the backward direction in the c.m.s. Such an asymmetry cannot be a consequence of the admixture of carbon events because even under the most unfavourable assumptions that all Λ from $\pi^- C$ interactions (about 20%) are emitted backward, the remaining asymmetry is equal to $\overrightarrow{\pi}/\overleftarrow{\pi}$ =1/5. This asymmetry is also observed in pair events. An analogous result holds for the protons in the usual multiple production of π mesons /5/,/8/ In Table IV are given the angular distributions of ΛK^0 and $K^0 \bar{K}^0$ pairs, where only the correction W_1 was taken into account. Although the number of pairs is not great, the main tendency is evident: Λ are emitted in the backward direction, while K^0 - in the forward direction. However, this latter tendency is less expressed. Because of insufficient statistics we cannot consider the angular distribution of $K^0 \bar{K}^0$ pairs in more detail. It is seen from Fig.4 that the angular distribution of K^0 is extended forward. This depends upon the multiplicity of secondary charged particles. When n_s = 0 or 2, it is not symmetrical, and when n_s =4 or 6, the distribution is practically isotropic. In Fig.5 c) is given the angular distribution of π^- mesons produced together with a $\Lambda(\Sigma^0)$ hyperon. The dotted line shows the distribution for n_s = 2, the solid one - for n_s=2 + 4 + 6. It is seen that at small multiplicity (n_s = 2) mesons are flying predominantly in the forward direction in the c.m.s. The ratio $\overrightarrow{\pi}/\overleftarrow{\pi}$ = 1.7±0.5.

When $n_s = 4$, such an anisotropy in the distribution is less explicit although the statistics is poor and does not allow to make a quantitative estimate. A qualitative comparison of π^- meson distribution in the usual multiple production (Fig.5a) with that of π^- mesons generated jointly with Λ shows that they have the same character. The behaviour of π^- mesons produced in both types of interaction is similar to that of K^0mesons.

Analogous results for π mesons have been obtained in/5/,/6/and /8/where the multiple production in ($\pi^- p$)-collisions was studied. It was established that a proton keeps its original direction which it had before the interaction, i.e., it is flying backward in the c.m.s. while π mesons are flying forward when the multiplicity is small, and the distribution becomes almost isotropic with increasing the multiplicity.

The momentum distributions of π^- mesons in the usual multiple production /5/ and in the production together with a $\Lambda(\Sigma^0)$hyperon have the same form. This is seen from Fig.6. Because of the similarity in the momentum and angular distributions,in the first approximation one can treat Y^0 and N as baryons belonging to one group, K^0 and π^- mesons to another one.

Of course, it is very important to clear up the character of the angular distribution in the generation of $\Sigma^\pm$ hyperons, as near the threshold they have an angular distribution different from that ofΛ/1/. If the assertion that a group of baryons, in spite of different kinds of particles behaves in the same manner in the interaction, is correct then one can expect the $\Sigma^\pm$ hyperon angular distribution to be similar to that of Λ .

The character of the angular distribution of Λ affects also the momentum distribution. A very small number ofΛ is flying forward. This means that the probability of large momentum transfer in a collision is not great. Then one can expect a softer spectrum of Λ emitting forward. It is seen from Fig. 1a) that this is in agreement with our experimental results.

4. Transverse Momenta

It is interesting that Λ hyperons and nucleons from inelastic $\pi^- p$ interactions which are not accompanied by a generation of strange particles have the same distributions and equal mean values of the transverse momenta independent of multiplicity . In/5/ and /8/ the transverse momenta for protons were determined for different values of multiplicity. Within the experimental error the values of the transverse momenta agree well with our result. The magnitude of the root-mean-square transverse momentum for Λ and K^0 is equal approximately to 400MeV/c. Using the uncertainty principle $\Delta p \cdot \Delta r \gtrsim \hbar$, one can estimate the radius of the interaction region responsible for the production of strange particles $\Delta r \geqslant \frac{\hbar}{\Delta p} = \frac{\hbar}{3m_\pi c} = 4\cdot 10^{-14}\,cm$. is of interest to note that the dimensions of the interaction region in strange particle production and in the usual multiple production almost coincide.

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Table I

Identified particles n_s	0	2	4	6	Total
$\Lambda + K^o$	2	8	3	0	13
Λ	6	47	17	3	73
$K^o + \tilde{K}^o$	0	5	1	0	6
K^o	16	62	26	3	107
Λ or K^o	2	6	2	0	10
total	26	128	49	6	209
	/12,5%/	/61,6%/	/23,%/	/2,9%/	/100%/

Table II

Reactions	/1/+/2/	/3/+/4/	/5/	/6/+/7/
Observed number (with account of all corrections)	136 ± 38	107 ± 33	89 ± 36	264 ± 54

Table III

n_s	$p^{\perp}_{\Lambda}$	$p^{\perp}_{K^o}$
$n_s \leq 2$	395 ± 47 BeV/c	394 ± 42 MeV/c
$n_s \geq 4$	367 ± 60 MeV/c	386 ± 66 MeV/c
$\bar{n}_s$	388 ± 35 MeV/c	393 ± 35 MeV/c

Table IV

$\cos\theta^*$	ΛK^0		$K^0\tilde{K}^0$
	Λ	K^0	
/1,0/ - /0,6 /	0,0	7,0	7,5
/0,6 - /0,2/	5,3	0,0	4,0
/0,2 - /-0,2/	0,0	2,2	0,0
/-0,2/ - /-0,6/	1,2	1,1	1,0
/-0,6/ - /-1,0/	10,3	3,3	2,4

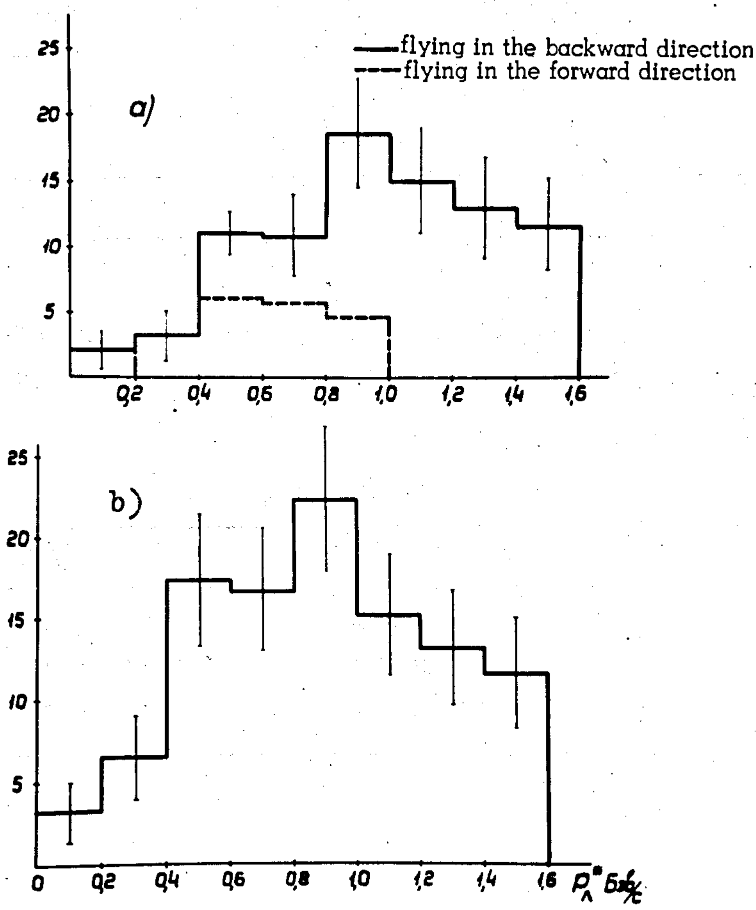

Fig.1. Momentum distribution of Λ in the c.m.s.

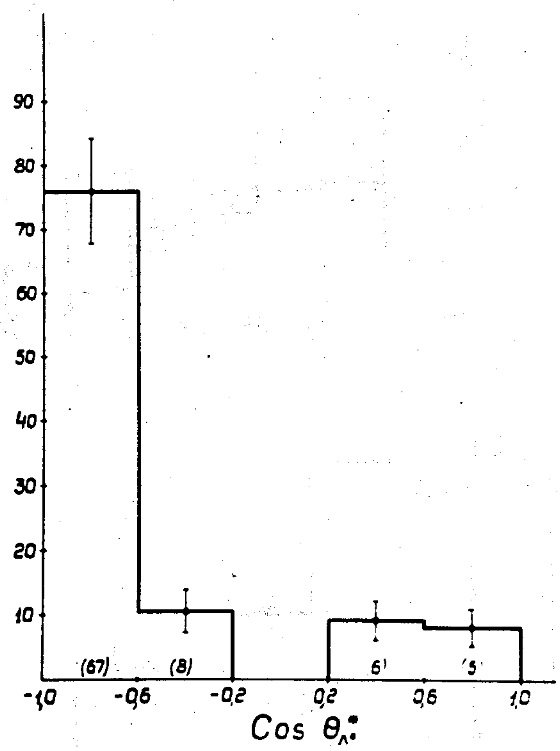

Fig.2. Angular distribution of Λ in the c.m.s.

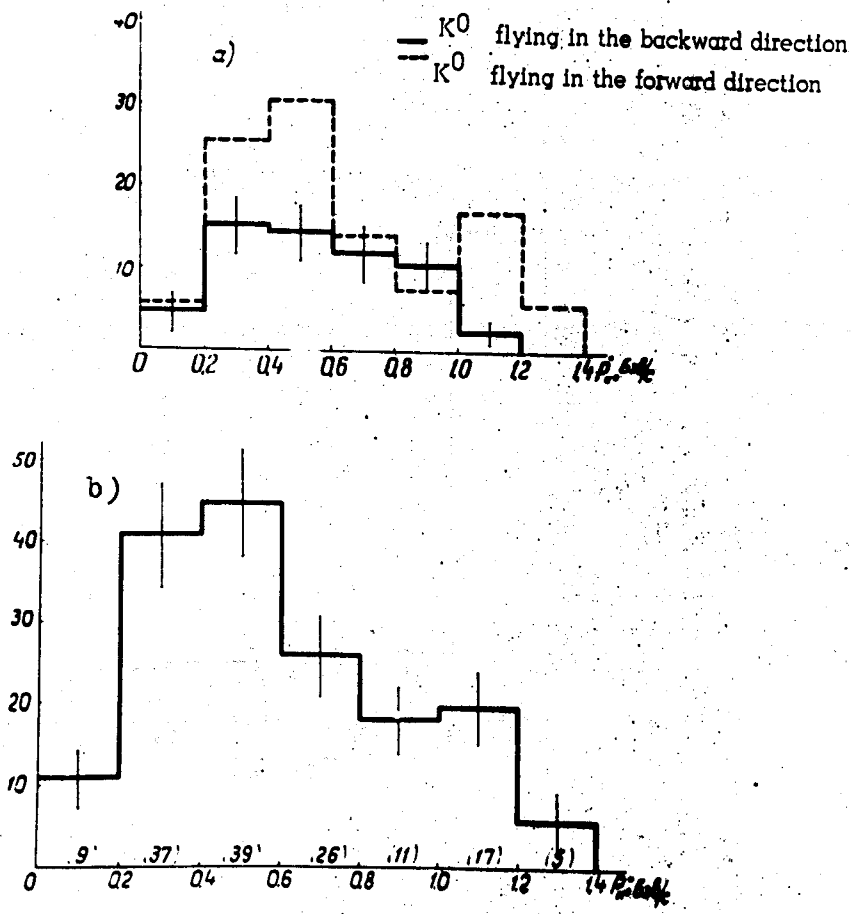

Fig.3. Momentum distribution of K^0 in the c.m.s.

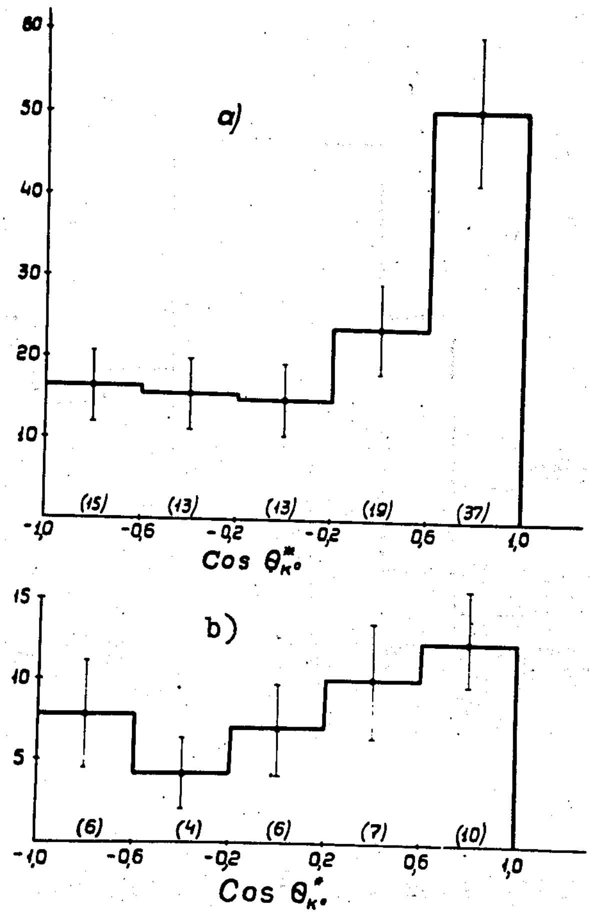

Fig.4. Angular distribution of K^0 in the c.m.s.

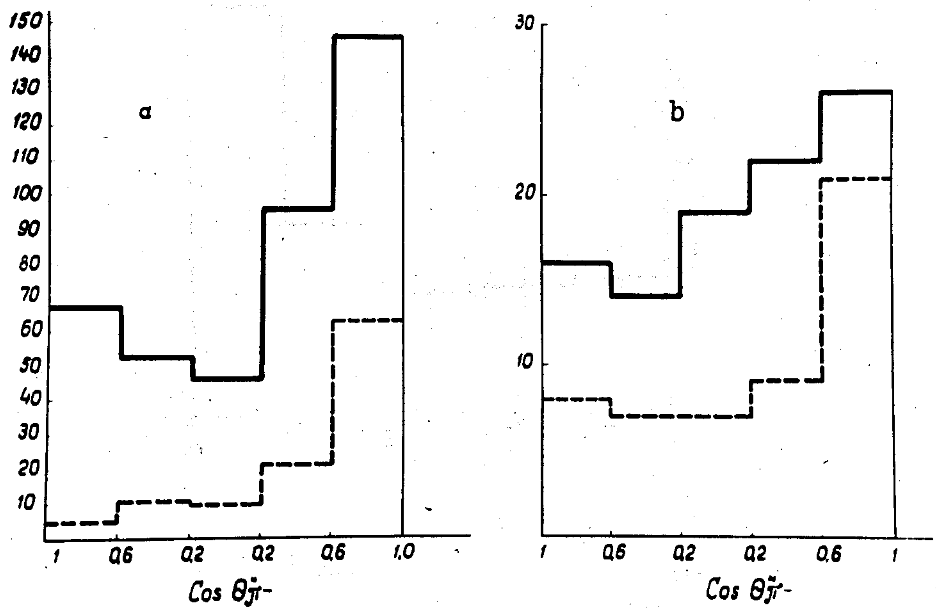

Fig.5.Angular distributions of π^- in the c.m.s.

a) for usual multiple production of mesons by π^- mesons.

b) for generated together with $\Lambda(\Sigma)$ hyperon.

— $n_s = 2+4+6$

--- $n_s = 2$

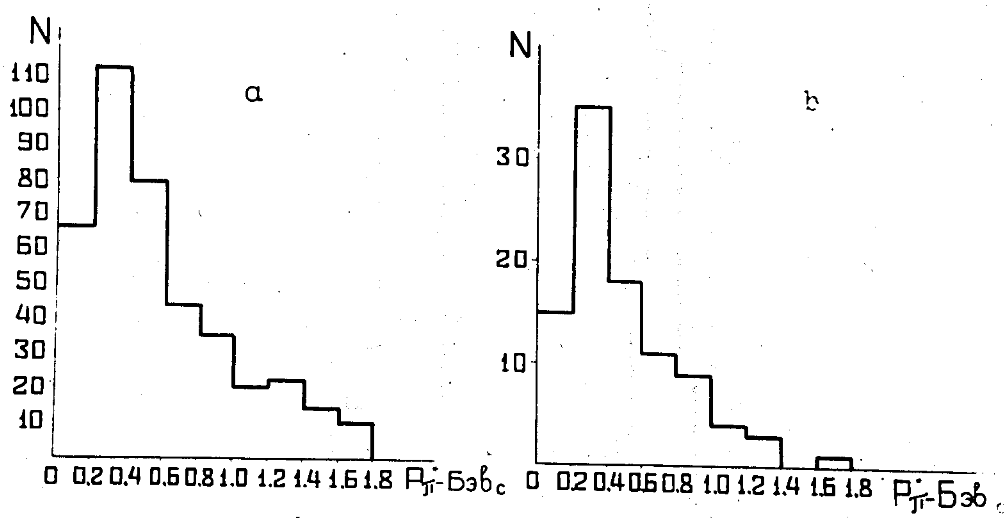

Fig.6. Momentum distribution of π^- in the c.m.s.

a) for usual multiple production of π^- mesons by π^- mesons

b) for π^- mesons generated together with a $\Lambda(\Sigma)$ hyperon.

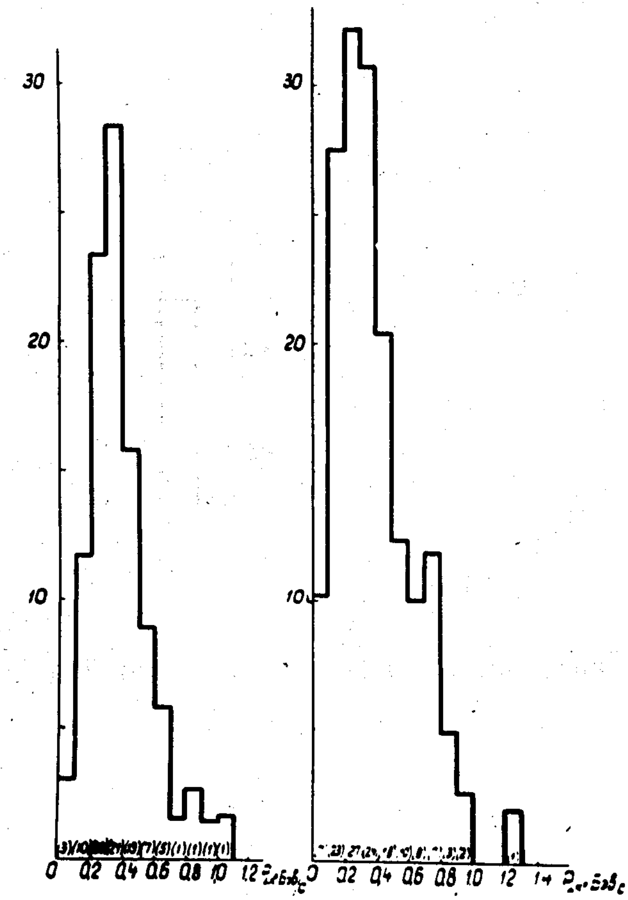

Fig.7. Distribution of tranverse momenta

a) for Λ

b) for K^{o}