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THE A-DEPENDENCE OF K^0 AND Λ NEUTRINOPRODUCTION ON NUCLEI

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Abstract

Agababyan N.M., Ammosov V.V., Atayan M. et al. The A-dependence of K^0 and Λ Neutrinoproduction on Nuclei: IHEP Preprint 2006-14. – Protvino, 2006. – p. 10, figs. 8, tables 4, refs.: 25.

For the first time, the A-dependence of the production of K^0 , and Λ is investigated in neutrinonuclear reactions, using the data obtained with SKAT bubble chamber. An exponential parametrization ($\sim A^\beta$) of the particle yields results in $\beta_{V^0} = 0.20 \pm 0.06$ for V^0 particles (K^0 and Λ), while for π^- mesons the A-dependence is much weaker ($\beta_{\pi^-} = 0.067 \pm 0.008$). A nuclear enhancement of the ratio K^0/π^- is found; this ratio increases from 0.055 ± 0.013 for νN -interactions up to 0.070 ± 0.011 at $A \approx 21$ and 0.099 ± 0.011 at $A \approx 45$. It is observed, that the multiplicity rise of V^0 's occurs predominantly in the backward hemisphere of the hadronic system. It is shown, that the A-dependence of the Λ^0 and π^- yields can be reproduced in the framework of a model, incorporating the secondary intranuclear interactions of pions originating from the primary νN -interactions.

Аннотация

Агабабян Н.М., Аммосов В.В., Атаян М. и др. А-зависимость нейтринообразования K^0 и Λ на ядрах: Препринт ИФВЭ 2006-14. – Протвино, 2006. – 10 с., 8 рис., 4 табл., библиогр.: 25.

Впервые изучена А-зависимость образования K^0 и Λ в нейтрино-ядерных реакциях на основе данных, полученных на пузырьковой камере СКАТ. Для экспоненциальной параметризации ($\sim A^\beta$) выхода частиц получена $\beta_{V^0} = 0.20 \pm 0.06$ для V^0 -частиц (K^0 и Λ), в то время как для π^- -мезонов наблюдается намного более слабая А-зависимость ($\beta_{\pi^-} = 0.067 \pm 0.008$). Найдено возрастание отношения K^0/π^- , которое увеличивается от 0.055 ± 0.013 для νN -взаимодействий до 0.070 ± 0.011 при $A \approx 21$ и до 0.099 ± 0.011 при $A \approx 45$. Определено, что возрастание множественности в основном происходит в задней полусфере адронной системы. Показано, что А-зависимость выходов Λ^0 and π^- может быть описана в рамках модели, включающей в себя вторичные внутриядерные взаимодействия пионов, образованных в первичном νN -взаимодействии.

1. Introduction

The leptonproduction processes on nuclei provide a valuable information on the space-time structure of the quark string fragmentation and the hadron formation. Hitherto the detailed experimental data are available for the pion leptonproduction processes. The data for strange particles are comparatively scarce. In particular, no data are available on the A- dependence of their leptonproduction. Meanwhile, this process can carry an additional information concerning the nuclear medium influence on the dynamics of the quark string fragmentation, because the yield of strange particles is rather sensitive (unlike pions) to the string tension which can, in principle, be affected by the nuclear medium.

This work is aimed to infer the first experimental data on the A- dependence of yields of neutral strange particles (K^0 mesons and Λ hyperons) in neutrino-nuclear interactions. In Section 2, the experimental procedure is briefly described. The experimental data on the A- dependences of the mean multiplicities and inclusive spectra of K^0 and Λ are presented in Section 3 and discussed in Section 4, where a comparison of the data with the model predictions is presented. The results are summarized in Section 5.

2. Experimental procedure

The experiment was performed with SKAT bubble chamber [1], exposed to a wideband neutrino beam obtained with a 70 GeV primary protons from the Serpukhov accelerator. The chamber was filled with a propan-freon mixture containing 87 vol% propane (C_3H_8) and 13 vol% freon (CF_3Br) with the percentage of nuclei H:C:F:Br = 67.9:26.8:4.0:1.3 %. A 20 kG uniform magnetic field was provided within the operating chamber volume. The selection criteria of the properly reconstructed charged current interactions and the procedure of the reconstruction of the neutrino energy E_ν can be found in our previous publications ([2,3] and references therein). Each event was given a weight (depending on the charged particle multiplicity) which corrects for the fraction of events excluded due to improperly reconstruction. The events with $3 < E_\nu < 30$ GeV were accepted, provided that the invariant mass W of the hadronic system exceeds 1.5 GeV. No restriction was imposed on the transfer momentum squared Q^2 . The number of accepted events was 5987 (6953 weighted events). The mean values of the kinematical variables

are: $\langle E_\nu \rangle = 9.8$ GeV, $\langle W \rangle = 2.7$ GeV, $\langle W^2 \rangle = 7.9$ GeV², $\langle Q^2 \rangle = 2.5$ (GeV/c)², and the mean energy transferred to the hadronic system $\langle \nu \rangle = 5.1$ GeV.

The selection criteria for the decay of neutral strange particles and the procedure of their identification were similar to those applied in [2]. The number of the accepted neutral strange particles (V^0 's) was 110 out of which 46(64) had the biggest probability to be identified as $K^0(\Lambda^0)$. The corresponding average multiplicities, corrected for the decay losses, are $\langle n_{V^0} \rangle = (7.11 \pm 0.68) \cdot 10^{-2}$, $\langle n_{K^0} \rangle = (4.29 \pm 0.63) \cdot 10^{-2}$, $\langle n_{\Lambda^0} \rangle = (2.82 \pm 0.35) \cdot 10^{-2}$.

For the further analysis the whole event sample was subdivided, using several topological and kinematical criteria [4], into three subsamples: the 'cascade' subsample B_S with a sign of intranuclear secondary interactions, the 'quasiproton' (B_p) and 'quasineutron' (B_n) subsamples for which no sign of secondary interactions was observed. The corresponding weighted event numbers for B_S , B_p and B_n subsamples are 3654, 1653 and 1646, respectively. About 40% of subsample B_p is contributed by interactions with free hydrogen. Weighting the 'quasiproton' events with a factor of 0.6, one can compose a 'quasinucleon' subsample $B_N = B_n + 0.6B_p$ and a 'pure' nuclear subsample $B_A = B_S + B_N$ having an effective atomic weight $A_{eff} \approx 21$ (the definition of A_{eff} for the composite target will be done below in Section 4). In the next sections, we use the data obtained for subsamples B_N and B_A , as well as the published data [2] on neutrino-freon interactions (with $A_{eff} \approx 45$), in order to extract the A-dependence of the yields of the neutral strange particles and to infer an information about the nuclear medium influence on their production. We have verified, that the mean values of the kinematical variables (quoted above) are consistent in the all three data sets (at $A_{eff} = 1, 22$ and 45).

3. The A-dependence of the mean multiplicities and inclusive spectra

The mean multiplicities $\langle n_{K^0} \rangle$, $\langle n_\Lambda \rangle$ and, for comparison, $\langle n_{\pi^-} \rangle$ for π^- mesons, as well as the ratio $R(K^0/\pi^-) = \langle n_{K^0} \rangle / \langle n_{\pi^-} \rangle$ are presented in Table 1 for the 'quasinucleon' and nuclear subsamples and for neutrino-freon interactions ($A_{eff} \approx 45$) [2].

It should be noted, that the quoted values of $\langle n_{K^0} \rangle_N = 0.030 \pm 0.007$ and $\langle n_\Lambda \rangle_N = 0.018 \pm 0.004$ for the 'quasinucleon' do not contradict the available data around $E_\nu \sim 10$ GeV obtained for νp interactions [5,6]. The A-dependence of the data presented in Table 1 is approximated as $\sim A_{eff}^\beta$ (see fig. 1). The fitted values of the slope parameter β are: $\beta_{K^0} = 0.232 \pm 0.109$, $\beta_\Lambda = 0.147 \pm 0.070$ and $\beta_{\pi^-} = 0.067 \pm 0.008$. Similarly, for the combined data on the neutral strange particles ($V^0 \equiv K^0 + \Lambda$) one gets $\beta_{V^0} = 0.196 \pm 0.060$ (Fig. 2) which significantly exceeds that for π^- mesons. The ratio $R(V^0/\pi^-) = \langle n_{V^0} \rangle / \langle n_{\pi^-} \rangle$, being equal to 0.087 ± 0.015 for the 'quasinucleon' interactions, increases up to 0.116 ± 0.012 (i.e. by a factor of about 1.3) at $A_{eff} \approx 21$, and up to 0.143 ± 0.012 (i.e. by a factor of about 1.6) at $A_{eff} \approx 45$. Hence, the production of the neutral strange particles is influenced by the nuclear medium stronger than that for pions. A similar pattern was observed recently [7] in deep-inelastic neutrino-nucleus scattering (at $W > 2$ GeV and $Q^2 > 1$ (GeV/c)²). As it was shown in [7], the V^0 's multiplicity gain $\delta_{V^0} = \langle n_{V^0} \rangle_A - \langle n_{V^0} \rangle_N$ could be qualitatively explained in the framework of a model incorporating the secondary intranuclear interactions of produced pions, $\pi N \rightarrow V^0 X$, the role of which turns out to be relatively more prominent, than that for secondary interactions $\pi N \rightarrow \pi^- N$ which results in a π^- multiplicity gain $\delta_{\pi^-} = \langle n_{\pi^-} \rangle_A - \langle n_{\pi^-} \rangle_N$ (see also [8]). In the next Section, a similar model predictions will be compared with the multiplicity gains δ_{K^0} , δ_Λ and δ_{π^-} extracted from the data of Table 1.

Table 1. The mean multiplicities $\langle n_{K^0} \rangle$, $\langle n_{\Lambda} \rangle$, $\langle n_{\pi^-} \rangle$ and the ratio $R(K^0/\pi^-)$ at different A_{eff} .

A_{eff}	$\langle n_{K^0} \rangle$	$\langle n_{\Lambda} \rangle$	$\langle n_{\pi^-} \rangle$	$R(K^0/\pi^-)$
1	0.030 ± 0.007	0.018 ± 0.004	0.55 ± 0.01	0.055 ± 0.013
22	0.044 ± 0.006	0.030 ± 0.004	0.63 ± 0.01	0.070 ± 0.011
45	0.071 ± 0.008	0.031 ± 0.004	0.72 ± 0.01	0.099 ± 0.011

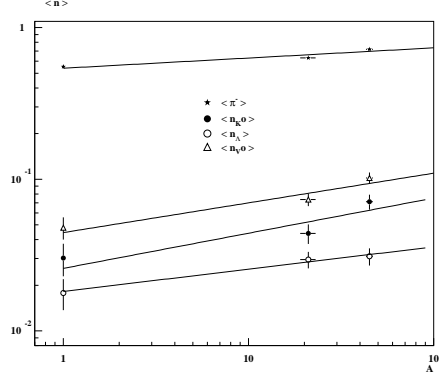


Figure 1. The A-dependence of the total yields of K^0 , Λ and π^- . The curves are the result of the exponential fit.

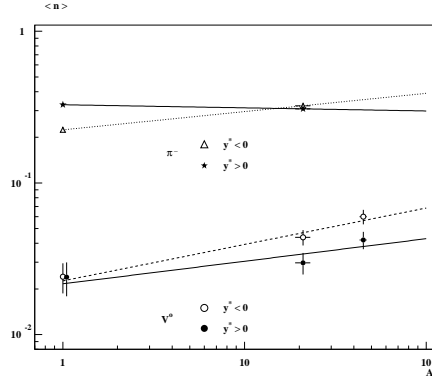


Figure 2. The A-dependence of the yields of V^0 , and π^- in the forward ($y^* > 0$) and backward ($y^* < 0$) hemispheres and of the total yield of V^0 . The curves are the result of the exponential fit.

It is expected, that the particles produced in secondary interactions occupy predominantly the backward hemisphere in the hadronic c.m.s. (i.e. the region of $y^* < 0$, y^* being the particle rapidity in that system). This expectation is verified by the data on $\langle n_{V^0} \rangle$ and $\langle n_{\pi^-} \rangle$ for the both hemispheres (Table 2).

In Fig. 2, the data of Table 2 are approximated by an exponential dependence, resulting in $\beta_{V^0}(y^* > 0) = 0.149 \pm 0.098$, $\beta_{V^0}(y^* < 0) = 0.240 \pm 0.078$ and $\beta_{\pi^-}(y^* > 0) = -0.021 \pm 0.013$ and $\beta_{\pi^-}(y^* < 0) = 0.120 \pm 0.016$. As it is seen from Table 2 and Fig. 2, the nuclear effects induce a significant rise of the V^0 multiplicity in the backward hemisphere and, to a less extent, in the forward hemisphere. On the contrary, the nuclear medium acts as an attenuator for the π^- yield in the forward hemisphere, while the A-dependence of $\langle n_{\pi^-}(y^* < 0) \rangle$ is significantly weaker as compared to $\langle n_{V^0}(y^* < 0) \rangle$.

Table 2. The mean multiplicities $\langle n_{V^0} \rangle$ and $\langle n_{\pi^-} \rangle$ at $y^* > 0$ and $y^* < 0$.

A_{eff}	$\langle n_{V^0} \rangle$	$\langle n_{\pi^-} \rangle$
$y^* > 0$		
1	0.024 ± 0.006	0.328 ± 0.011
21	0.030 ± 0.005	0.308 ± 0.007
45	0.042 ± 0.005	—
$y^* < 0$		
1	0.024 ± 0.005	0.224 ± 0.009
21	0.044 ± 0.005	0.323 ± 0.008
45	0.060 ± 0.006	—

A more relevant (conventional) measure of the nuclear strangeness enhancement can be inferred from a comparison of the relative yield $R(K^0/\pi^-) = \langle n_{K^0} \rangle / \langle n_{\pi^-} \rangle$ in the 'quasinucleon' and nuclear interactions. The data on $R(K^0/\pi^-)$, presented in Table 1 and Fig. 3, exhibit a noticeable A-dependence, which can be described by a slope parameter $\beta_{K^0/\pi^-} = 0.158 \pm 0.091$.

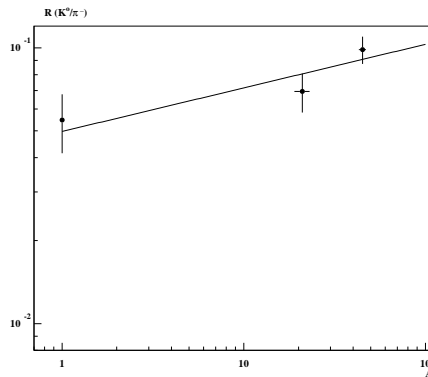


Figure 3. The A-dependence of the ratio $R(K^0/\pi^-)$. The curve is the result of the exponential fit.

More detailed information concerning nuclear effects in the particle yield in different domains of the phase space can be inferred from following figures. Fig. 4 shows the rapidity distributions. The distributions for the subsample B_A are shifted towards lower values of y^* as compared to those for the subsample B_N (Figs. 4a - c). The nuclear enhancement effect is more expressed at $y^* < -0.3$, being less significant at the midrapidity ($|y^*| < 0.3$). For the both ('quasinucleon' and nuclear) subsamples, the ratio $R(K^0/\pi^-)$ tends to increase with increasing y^* , being systematically higher for the nuclear subsample. A faint indication is seen, that the nuclear strangeness enhancement factor $R_A(K^0/\pi^-)/R_N(K^0/\pi^-)$ is higher in the domain $y^* < -0.3$, overlapping with the target fragmentation region. The distributions on the kinematical variable $z = E_h/\nu$ (E_h being the energy of K^0 or Λ) are plotted in Fig. 5. It is seen from Fig. 5a, that the nuclear enhancement effects for the K^0 yield are significant at the low z region ($z < 0.2 \div 0.3$), while for the leading K^0 's ($z > 0.4$) there is a faint indication on a nuclear attenuation. These effects can be also seen from Fig. 6a, which shows the slope parameter β_{K^0} for K^0 mesons

acquiring $z > z_{min}$. With increasing z_{min} , the nuclear enhancement regime ($\beta_{K^0} > 0$) tends to be transformed to the attenuation one ($\beta_{K^0} < 0$). Note, that the nuclear attenuation effects for charged kaons with $z > 0.2$ were observed recently at higher energies ($7 < \nu < 23$ GeV), in the deep-inelastic scattering of positrons on nuclei [9]. The data on Λ are less conclusive (Figs. 5b and 6b). They, however, indicate, that the Λ yield at $z < 0.2$ is definitely higher for the heaviest target ($A_{eff} \approx 45$).

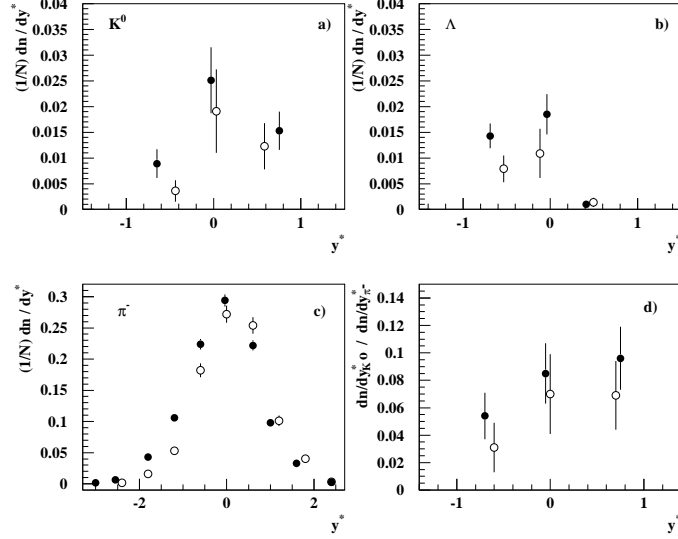


Figure 4. The rapidity distributions of K^0 (a), Λ (b), π^- (c) and the ratio K^0/π^- (d) in the 'quasinucleon' (open circles) and nuclear (black circles) subsamples.

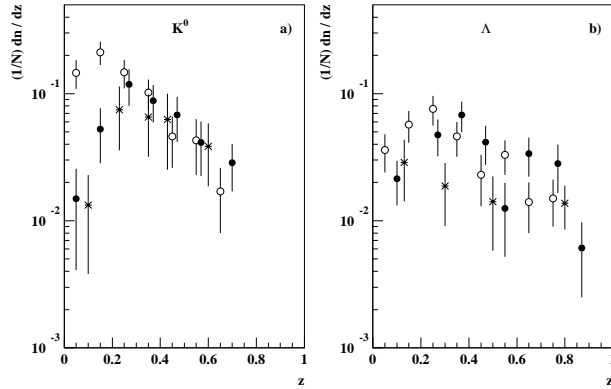


Figure 5. The z distributions of K^0 (a) and Λ (b) in the 'quasinucleon' subsample (asterisks), at $A_{eff} \approx 21$ (black circles) and $A_{eff} \approx 45$ (open circles).

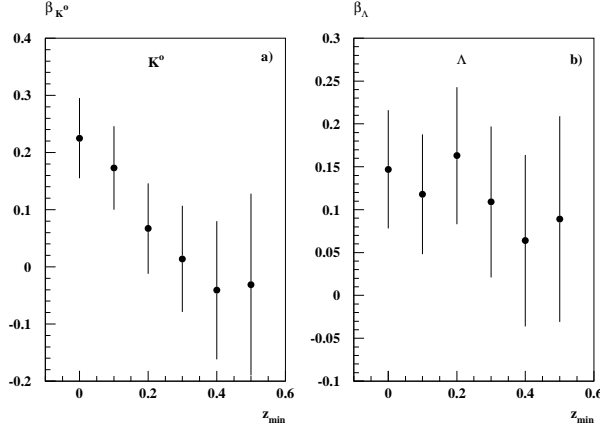


Figure 6. The z_{min} -dependence of the slope parameters β_{K^0} (a) and β_{Λ} (b).

Fig. 7 shows the squared transverse momentum distributions for K^0 and Λ (p_T^2 being measured transverse to the current direction). Their approximation by an exponential form, $\sim \exp(-bp_T^2)$, results in $b_N(K^0) = 4.0 \pm 1.4$ and $b_N(\Lambda) = 4.1 \pm 1.2$ (GeV/c) $^{-2}$ for the 'quasinucleon' subsample and $b_A(K^0) = 4.0 \pm 0.8$ and $b_A(\Lambda) = 3.3 \pm 0.6$ (GeV/c) $^{-2}$ for the nuclear subsample. These values are consistent with those obtained for neutrino-freon interactions [2], $b_{Freon}(K^0) = 4.7 \pm 0.6$ and $b_{Freon}(\Lambda) = 3.9 \pm 0.9$ (GeV/c) $^{-2}$, as well as for (anti)neutrino interactions with protons [5,6,10] and light nuclei ($A \leq 20$) [11,12,13,14,15]. Due to the large uncertainties in our measurements, no conclusion can be drawn concerning the A-dependence of $b(K^0)$ and $b(\Lambda)$. However, the data of Fig. 7 indicate, that the nuclear enhancement of the K^0 and Λ yields occurs at comparatively low p_T^2 , at $p_T^2 < 0.4$ (GeV/c) 2 for K^0 and $p_T^2 < 0.2$ (GeV/c) 2 for Λ . One can, therefore, conclude, that K^0 's and Λ 's produced in secondary intranuclear interactions acquire on an average smaller p_T 's as compared to those for the 'directly' produced ones.

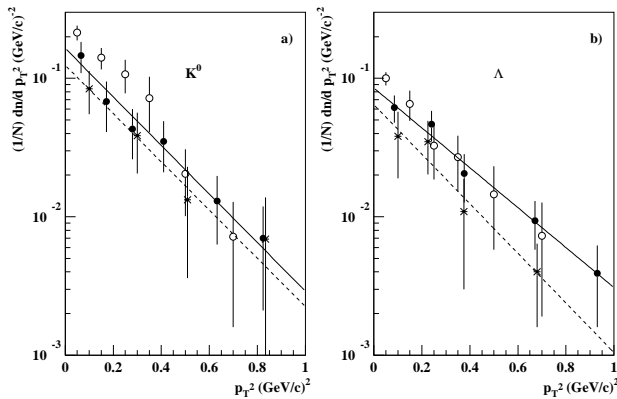


Figure 7. The p_T^2 -distributions of K^0 (a) and Λ (b) in the 'quasinucleon' subsample (asterisks), at $A_{eff} \approx 21$ (black circles) and $A_{eff} \approx 45$ (open circles). The curves are the result of the exponential fit for the 'quasinucleon' subsample (dashed) and for $A_{eff} \approx 21$ (solid).

4. Discussion

As it is shown in the previous Section, the multiplicity rise for hadrons in nuclear interactions occurs mainly in the backward hemisphere of the hadronic c.m.s. or, alternatively, in the low- z region. This behaviour can be conditioned by secondary intranuclear collisions of 'primary' hadrons (mainly pions) originated from the neutrino-nucleon interaction.

Table 3 shows the experimental values of the total multiplicity gains $\delta_{K^0}^{exp}$, δ_{Λ}^{exp} and $\delta_{\pi^-}^{exp}$ (integrated over the whole phase volume) for two composite nuclear targets with $A_{eff} \approx 21$ and 45.

Table 3. The A-dependence of the experimental and calculated multiplicity gains for K^0 , Λ and π^- .

A_{eff}	$\delta_{K^0}^{exp}$	$\delta_{K^0}^{th}$	δ_{Λ}^{exp}	δ_{Λ}^{th}	$\delta_{\pi^-}^{exp}$	$\delta_{\pi^-}^{th}$
21	0.014±0.007	0.009±0.002	0.012±0.004	0.008±0.002	0.087±0.010	0.108±0.023
45	0.041±0.011	0.012±0.002	0.013±0.004	0.010±0.002	0.168±0.016	0.146±0.031

Bellow an attempt is undertaken to obtain predictions for these gains in the framework of a model [8,9] incorporating secondary interactions of 'primary' pions, $\pi N \rightarrow K^0 X$, $\pi N \rightarrow \Lambda X$, $\pi N \rightarrow \pi^- X$. The mean multiplicity $\bar{n}_h(p_h)$ of the hadron h ($h \equiv K^0, \Lambda$ or π^-) in inelastic πN interactions is estimated (with an uncertainty of about 10-15 %) from the available experimental data [16], in the pion momentum range from $p_{\pi} \sim 0.9$ -1 GeV/c up to $p_{\pi} \sim 11$ -12 GeV/c (above which the pion yield is negligible in this experiment). The corresponding mean multiplicity in the π^0 - induced reactions is assumed to be the average of those in π^+ and π^- - induced reactions, with an uncertainty related to the difference between the latters.

The probability $w_A(p_{\pi})$ of the secondary inelastic interactions of pions within nuclei ($A \equiv C, F, Br$) is calculated taking into account their formation length [17]. The obtained A-dependence of $w_A(p_{\pi})$ and the mean probability $\langle w_A(p_{\pi}) \rangle$, averaged over the nuclei of the propane-freon mixture or the freon, are used to estimate the effective atomic weight A_{eff} of the composite target from the requirement that the probability of the inelastic interaction of pions within the nucleus with $A = A_{eff}$ is equal to $w_{A_{eff}}(p_{\pi}) = \langle w_A(p_{\pi}) \rangle$. As a result, one obtains $A_{eff} = 21 \pm 2$ and 45 ± 2 , respectively, for the propane-freon mixture and the freon, the quoted errors reflecting the fact that the extracted value of A_{eff} turns out to be slightly dependent on the pion momentum.

In order to obtain the contribution from the secondary interactions of π^{\pm} mesons to the multiplicity gain, $\delta_h(\pi^{\pm} N)$, the product $w_A(p_{\pi}) \cdot \bar{n}_h(p_{\pi})$ was integrated over the momentum spectra of 'primary' π^+ and π^- mesons measured in the 'quasinucleon' interactions. The expected contribution of non-identified protons (estimated with the help of the LEPTO 6.5 event generator) was subtracted from the π^+ spectrum. Besides, the absorption of low energy π^- mesons on the quasinucleon pairs within the nucleus was taken into account (see for details [19,20] and references therein). The contribution from the secondary interactions of the 'primary' π^0 mesons was estimated under assumption that their momentum spectrum is the average of those for π^+ and π^- mesons (see [21] and references therein).

Table 3 shows the summary contribution from the secondary interactions of π^+ , π^- and π^0 mesons to the multiplicity gains $\delta_{K^0}^{th}$, δ_{Λ}^{th} and $\delta_{\pi^-}^{th}$, the latter being reduced due to the negative contribution from the π^- absorption (note, that about 8% and 11% of 'primary' π^- mesons are being absorbed in nuclei of the propane-freon mixture and the freon, respectively).

It is seen from Table 3, that the predicted multiplicity gains are compatible with the experimental values, except for $\delta_{K^0}^{th} = 0.012 \pm 0.002$ at $A_{eff} \approx 45$ which composes only $29 \pm 9\%$ of the measured value $\delta_{K^0}^{exp} = 0.041 \pm 0.011$. In Fig. 8, the predicted A-dependence of the total mean multiplicity $\langle n_h \rangle_A^{th} = \langle n_h \rangle_N + \delta_h^{th}$ is compared with the experimental data, which also include those for $\nu N e$ -interactions, extracted from [11] (where the same cut $W > 1.5$ GeV was applied) via an approximation of the measurement results around $E_\nu = 9.8$ GeV (the mean neutrino energy in our experiment). It is seen, that the model qualitatively describes the A-dependence of the yields of Λ and π^- , but predicts lower values for the K^0 yield as compared to the data. Unlike the experimentally observed nuclear enhancement of the ratio $R(K^0/\pi^-)$ (the last column of Table 1), no A-dependence for this ratio results from the model; the predicted values of $R^{th}(K^0/\pi^-) = 0.059 \pm 0.011$ and 0.059 ± 0.010 at $A_{eff} \approx 21$ and 45, respectively, are consistent with $R_N(K^0/\pi^-) = 0.055 \pm 0.013$ (cf. Table 1).

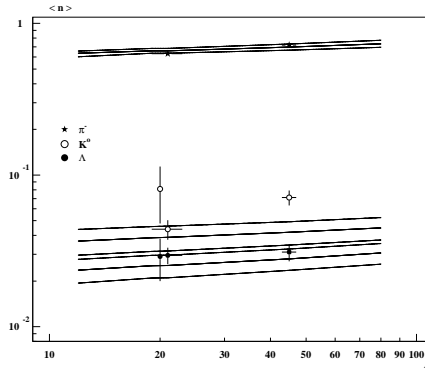


Figure 8. The A-dependence of the total yields of K^0 (open circles), Λ (black circles) and π^- (asterisks). The solid and dashed curves are the model predictions and the uncertainty in the latter (see text)

One can, therefore, conclude, that the secondary intranuclear interaction processes, incorporated in the applied model, are far from to be sufficient to explain the observed enhancement of the K^0 yield. It seems, that the others (not considered in the model) processes cannot improve radically the data description. For example, in the secondary processes like $K^+n \leftrightarrow K^0p$, $K^-p \leftrightarrow \bar{K}^0n$, $YN \leftrightarrow \bar{K}^0N'$ (where Y stands for a hyperon), the contributions of the direct and inverse reactions should largely cancel each other. The model does not also incorporate the production of hadronic resonances with a proper space-time structure of their formation, intranuclear interactions and decay. However, even if a resonance, e.g. ρ meson (which yield composes about 10% of that for charged pions [22,23]) produces more K^0 's in a reaction $\rho N \rightarrow K^0X$ as compared to $\pi N \rightarrow K^0X$, the contribution from the latter turns out to be reduced due to the reduced multiplicity of the 'primary' pions, hence resulting in a partly compensation of the contribution from the former. As for the intranuclear interactions of 'primary' recoil nucleons, $NN \rightarrow K^0X$, their contribution to $\delta_{K^0}^{th}$ has been estimated to be less than a few percents as compared to that for 'primary' pions.

A better description of the data on $\delta_{K^0}^{exp}$ can be achieved under assumption that the quark string fragmentation is influenced by the surrounding nuclear medium, the quark string tension κ being dependent on the local nuclear density $\rho_A(r)$ near the string breaking point. A simplest assumption is a linear dependence $\kappa_A(r) = \kappa_N[1 + a\rho(r)]$, where $\kappa_N \approx 1$ GeV/fm is the

string tension in the vacuum, while a is a proportionality coefficient. Below we will present the model predictions at $a = 1/(0.6fm^3)$. At this value, the string tension κ_A for the case of C, F and Br nuclei turn out to be $\kappa_C = 1.158$, $\kappa_F = 1.180$ and $\kappa_{Br} = 1.198$. In their turn, the latters correspond to a nuclear enhancement of the $(s\bar{s})$ - pair yield characterized by the ratio $r_\lambda(A) = \lambda_A^{eff}/\lambda_N$, where λ_A^{eff} is related to the Wroblewsky parameter λ_N (relevant for the string fragmentation in the vacuum) [24] as $\lambda_A^{eff} = \lambda_N^{\kappa_N/\kappa_A}$ [25]. Taking into account a possible uncertainty in λ_N , $0.15 < \lambda_N < 0.20$, the ratio $r_\lambda(A)$ for the case of C, F and Br nuclei turn out to be $1.25 < r_\lambda(C) < 1.30$, $1.28 < r_\lambda(F) < 1.34$ and $1.31 < r_\lambda(Br) < 1.37$. The corresponding multiplicity rise for V^0 's as compared to the mean multiplicity $\langle n_{V^0} \rangle_N$ in neutrino interactions with (quasi)free nucleons is, therefore, $\delta_{V^0}(A) = (r_\lambda(A) - 1) \cdot \langle n_{V^0} \rangle_N$. Further, we assume, that the nuclear medium influences the yield of strange particles in the secondary intranuclear interactions too, leading to its enhancement as compared to that in the pion interactions with free nucleons. This enhancement is characterized by the ratio $r_\lambda^{sec}(A)$ (depending on the mean nuclear density at the secondary interaction point), being equal to $1.20 < r_\lambda^{sec}(C) < 1.24$, $1.22 < r_\lambda^{sec}(F) < 1.27$ and $1.28 < r_\lambda^{sec}(Br) < 1.34$.

The model predictions at an increased string tension are compared with the data on δ_h^{exp} in Table 4. It is seen, that, within experimental errors and theoretical uncertainties, there is a reasonable consistency between the data and the model predictions.

Table 4. The A-dependence of the experimental and calculated (at an increased string tension, see text) multiplicity gains for K^0 , Λ and π^- .

A_{eff}	$\delta_{K^0}^{exp}$	$\delta_{K^0}^{th}$	δ_Λ^{exp}	δ_Λ^{th}	$\delta_{\pi^-}^{exp}$	$\delta_{\pi^-}^{th}$
21	0.014±0.007	0.020±0.004	0.012±0.004	0.015±0.003	0.087±0.010	0.112±0.024
45	0.041±0.011	0.025±0.005	0.013±0.004	0.019±0.003	0.168±0.016	0.151±0.032

It should be also noted, that a small difference between the values of $\delta_{\pi^-}^{th}$ given in Tables 3 and 4 is caused by a slightly different probabilities of the secondary intranuclear interactions due to the difference in the formation length of pions (being inversely proportional to the string tension κ [17]).

5. Summary

For the first time, the A-dependence of the neutral strange particle and, for comparison, π^- meson production in the neutrionuclear interactions is investigated. This dependence for K^0 mesons and Λ hyperons is found to be significantly stronger than for π^- mesons. An exponential approximation ($\sim A^\beta$) of the particle yields results in a slop parameter $\beta_{V^0} = 0.196 \pm 0.060$ for the summary yield of K^0 and Λ in the whole phase volume, while for π^- mesons this parameter is noticeable smaller, $\beta_{\pi^-} = 0.067 \pm 0.008$. A nuclear enhancement of the K^0/π^- ratio is observed; this ratio, being equal to $R_N(K^0/\pi^-) = 0.055 \pm 0.013$ in νN - interactions, increases with the target atomic weight, reaching $R_A(K^0/\pi^-) = 0.070 \pm 0.011$ at $A \approx 21$ and 0.099 ± 0.011 at $A \approx 45$.

It is observed, that the multiplicity rise of the neutral strange particles occurs predominantly in the backward hemisphere (in the hadronic c.m.s.) or alternatively, in the low z region ($z < 0.2$), hence indicating on a prominent role of the secondary intranuclear processes. An at-

tempt is undertaken to estimate the nuclear enhancement of the particle yields caused by the secondary intranuclear collisions of 'primary' pions originated from neutrino-nucleon interactions. The model calculations reproduce the measured multiplicity rise for π^- mesons and Λ hyperons, but badly underestimate that for K^0 mesons. Somewhat better description of the data can be achieved under assumption that the process of the quark string fragmentation is influenced by the surrounding nuclear medium, which induces an increasing of the string tension and, hence, an enhancement of the $(s\bar{s})$ - pair yield.

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