Status Report and Beam-time Request

ANKE: Forward K^+-production in Subthreshold pA Collisions

Abstract

K^+-meson production in pA (A = C, Cu, Au) collisions has been studied using the ANKE spectrometer at an internal target position of the accelerator COSY-Jülich. The measurements were performed at T_p = 1.0, 1.2, 2.0, 2.3 GeV. In order to complete the program of the experiment we plan to measure the A-dependence at T_p = 2.3 GeV (A = C, Ag, Au) and to use a modified setup which allows to access higher K^+ momenta at T_p = 1.2 and 1.5 GeV. We apply for the beam-time of 2 weeks.

1 Results of the previous ANKE measurements

The complete momentum spectrum of kaons emitted at forward angles $\vartheta \leq 12°$ has been measured for a beam energy of $T_p = 1.0$ GeV far below the free NN threshold at 1.58 GeV. These results are described in the draft paper to be submitted to Physical Review Letters (see Appendix).

Besides the measurements far below the threshold K^+-meson production has also been studied at T_p = 1.2, 2.0, 2.3 GeV with carbon, copper and gold strip targets. The double differential cross sections obtained during the measurements at several energies are presented in fig.1. Here we cover only part of the momentum distribution.

The cross-section ratios for kaon production on different targets (fig.2) are in a reasonable agreement with the predictions of the cascade model [2]. At the highest energy of 2.3 GeV the Au/C-ratio falls down steeper than it follows from the CBUU (Coupled-Channels-Boltzmann-Uhling-Uhlenbeck) model. The most unexpected result is a strong falloff of the Au/C-ratio in a region of low kaon momenta ($P_\mathrm{K} < 250$ MeV/c) which is in a disagreement with the theoretical predictions.

In order to allow a comparison of our measured cross sections with existing data [6, 7] obtained under different kinematical conditions, the latter have to be extrapolated to the ANKE conditions, i.e., kaon-emission angles $\vartheta = 0°$ and a carbon target. This extrapolation is shown in fig.3 a)-c). For the comparison shown in fig.3 d) we use the average slope of the fitted lines and approximate the target-mass dependence by $\sigma \sim A^{2/3}$. There seems to be a reasonable agreement with all data except those from [6] which are a factor of ∼2 larger.

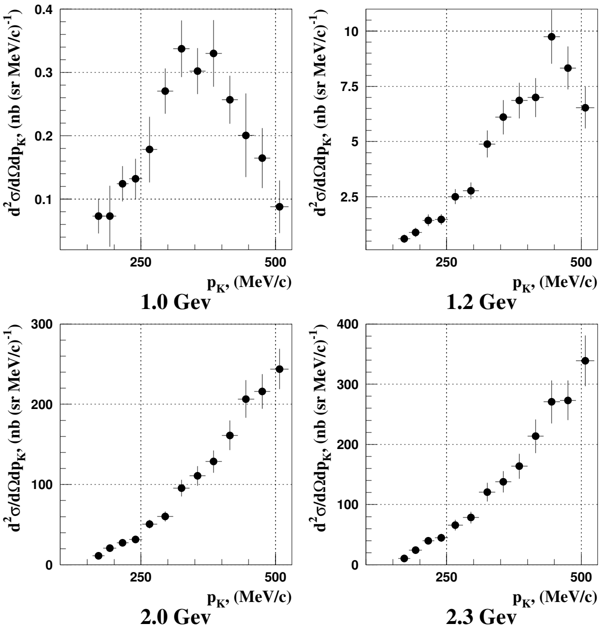

Figure 1: Double differential K^+-production cross section for the reaction $p(1.0\ GeV)^{12}C \rightarrow K^+(\vartheta \leq 12°)X$ as a function of the K^+-momentum. During the measurements D2 was operated at a field strength of $B = 1.3\,\mathrm{T}$.

The analysis of the results and a comparison with various models has been started. But already now there are several open questions to which answers can be given only after additional measurements are done.

2 Motivation for additional measurements

2.1 Measurements of the target-mass dependence at $T_\mathrm{p} = 2.3\,\mathrm{GeV}$

Inspite of a rather poor statistical accuracy at the lowest kaon momentum the falloff of the Au/C-ratio at $T_\mathrm{p} = 2.3\,\mathrm{GeV}$ with decreasing p_K is systematic and is clearly observed. An increase of the Au/C-ratio was found several years ago by the KaoS collaboration (data are not published) at incident proton energies of 2.5 GeV and 3.5 GeV, but they only measured kaon momenta above 350 MeV/c. At the moment ANKE is the only spectrometer being able to measure the low energetic part of the kaon-momentum spectrum. Therefore, to confirm the observed effect below 300 MeV/c we propose to repeat the measurements at 2.3 GeV with higher statistics.

During the previous experiments the statistics at low kaon momenta was

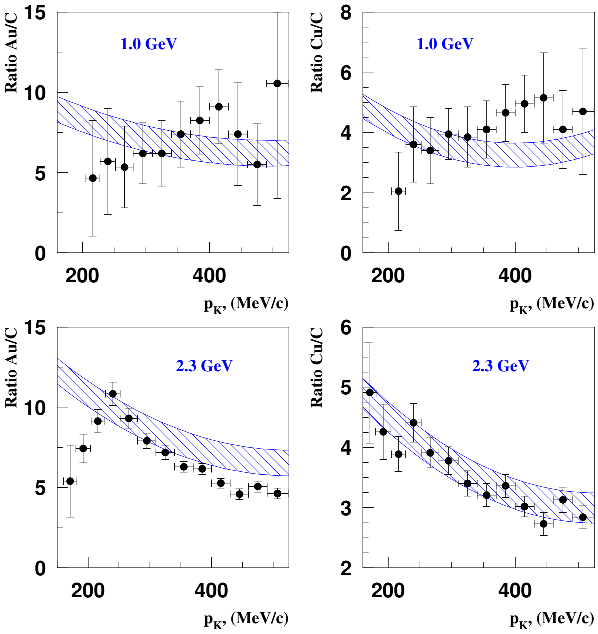

Figure 2: Ratios of the K^+ production cross sections for Cu/C and Au/C as a function of the kaon momentum. The hatched area shows the results of calculations using the CBUU model.

rather poor for a couple of reasons. First, this part of the kaon spectrum is the region of the lowest cross section for kaon production in forward direction at 2.3 GeV. Second, during these measurements a calibration of the telescopes was also performed. For the telescope calibration an open online trigger, accepting also π^+-mesons, had to be used. Thus, the trigger rate was rather high $\sim 10^5$ ev/s, while the data acquisition system accepts ~ 5000 ev/s. Therefore, during the telescope-calibration runs only 5% of the total amount of kaons was written to tape.

A more effective way to measure cross sections, which will be employed during the proposed measurements, is to deploy delayed veto-counter signals directly into the hardware trigger. This suppresses background by a factor of 200-300, reducing trigger rate to $300 - 500$ ev/s, and with reduced telescope efficiencies of (20-25)% for low momentum kaons we totally gain a factor of 4-5 in the kaon count rate. Therefore, one day of beam-time with a single target results in $\sim 400 - 100$ kaons per telescope in the momentum range of $150 - 300$ MeV/c. So, the proposal is to do these measurements for C, Au and one intermediate nucleus – Ag (3 days).

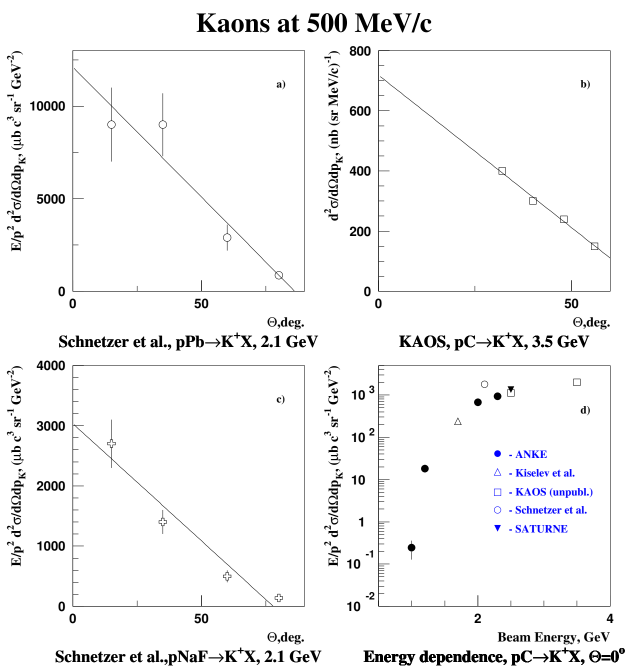

Figure 3: a)-c) Angular dependence from [6] and KAOS collaboration (unpublished). The solid line shows out fit to the data which is used to extrapolate to $\Theta = 0°$. d) Energy dependence of the double differential K^+-production cross section.

2.2 Experimental improvements and measurements at $T_p = 1.5$ GeV

As it is seen from fig.1, using existing telescopes along the focal surface of D2 at $B = 1.3$ T, we are able to measure kaon spectra up to 500 MeV/c. Operating D2 at 1.6 T will allow to extend the region to 620 MeV/c. In addition, we now have the possibility to use two layers of the sidewall counters in coincidence with the start counters. This will provide an additional extension of the experimentally accessible momentum range. At proton beam energies of $1.5 - 2.3$ GeV kaon-production cross sections are large enough (especially in the region of $500 - 900$ MeV/c), and the background of rescattered protons is by 50% lower than the kaon rates. So, with two targets (C, Au) we can perform the measurement of almost complete kaon spectra for 2.3 GeV (1 day) and 1.5 GeV (3 days). The measurements at 1.5 GeV are important since they allow further comparison with existing data of other groups at the same energy. Furthermore, theoretical models predict that at this energy the one- and two-step K^+ production are of comparable strength.

In addition, the measurements at 2.3 GeV can be used to commission the

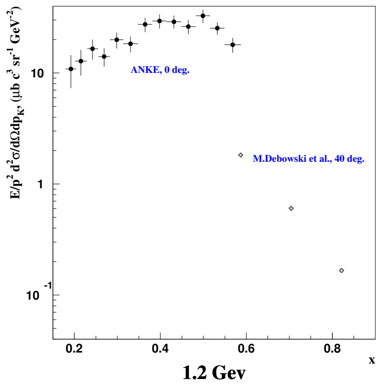

Figure 4: An invariant cross section as a function of K^+ momentum. $x = P/P_{\max}(\Theta)$.

K^- detection system and to start first measurements of K^+K^- correlations with an attempt to detect subthreshold ϕ production in nuclei. It is planned to use the K^- detection system for the measurements of neutral scalar mesons in the beginning of 2002.

2.3 Measurements at 1.2 GeV

Comparing results obtained by the different groups (fig.3, 4) it is clearly seen that the cross sections fall down rather slow with increasing scattering angle by factor of 2 between 0° and 40° close to the maximum of the kaon spectrum (500 MeV/c). Below threshold kaon production is more forward as it follows from the data at 1.2 GeV (fig.4). The incident proton energy of 1.2 GeV is the only energy below threshold at which a comparison with existing data is possible. But it is necessary then to perform the measurements at this energy in wider momentum range. It is possible at ANKE using telescopes but in 1.6 T mode of D2. It is proposed to perform measurements at 1.2 GeV with two different targets (C, Au) in 4 days. After these measurements we consider that the program of inclusive spectra investigation to be finished.

2.4 Test measurements of correlations

The following program in a frame of K^+ investigation as we see it now, comprises measurements of K^+p and K^+d correlations [1]. A first attempt to measure such correlations was made during the last ANKE beam-time (a_0^+ production in pp collisions using a cluster-jet target) at 2.65 GeV, detecting kaon in telescopes and deuterons in the forward detector of the ANKE detection system. One of the criteria of analysis is presented in fig.5. Proton and

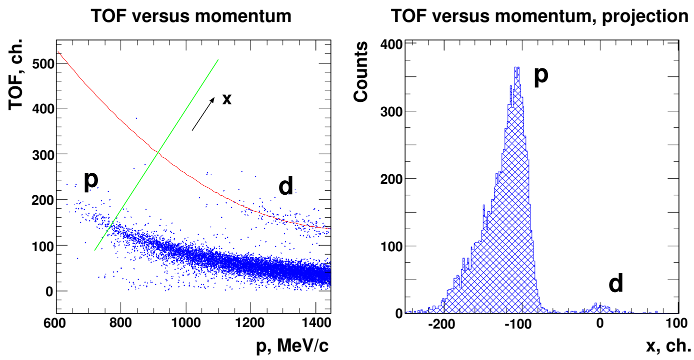

Figure 5: A sample of the time difference of detection of K^+ in telescope and fast forward particle versus momentum of the particle in the forward detector.

deuteron correlation events are clearly separated in the momentum-Δt plot. For the quantitative analysis all events are projected on the line perpendicular to that chosen by the particle we are interested in (e.g. deuterons in the upper band in fig.5). The result is that one sees a 2% of the events in the plot are from K^+d coincidences. At a lower energies the expected amount of K^+d correlations is about 10% in a region of interest being around 800 MeV/c. The open question is the accidental background since for the subthreshold K^+ studies solid state targets of much higher density will be used, but estimations made from previous data at 1 GeV show that this does not exceed 30% after all the criteria are applied. Therefore, having deployed the coincidence of the forward detector, side detector and the sidewall we plan to perform a test measurements at 1.2 GeV for 2 days. An additional day is required to optimize the degraders in telescopes.

3 Beam-time Request

Beam-time request is as follows:

energy	D2 mode	target	time
2.3 GeV	1.3 T	C, Ag, Au	A-dependence = 3 days
2.3 GeV	1.6 T	C	degrader optimization
2.3 GeV	1.6 T	C, Au	wide momentum range = 1 day
1.5 GeV	1.6 T	C, Au	3 days
1.2 GeV	1.6 T	C, Au	4 days
1.2 GeV	1.6 T	C target	correlation = 2 days
totally			14 days

4 Outlook

We ask for two weeks for completion of inclusive measurements in a frame of the presented beam-time request. Future plans are to investigate K^+p and K^+d correlations, which can give a clarification of the production mechanism (4 weeks). Only in case of exotic theoretical interpretations (e.g. strong sensitivity of the data to the high-momentum component) of the data at 1.0 GeV we would ask for additional 4 weeks of measurements at 0.9 GeV. After these measurements the experimental program on K^+ production in nuclei will be finished.

5 Appendix

Forward K^+-production in subthreshold pA collisions at 1.0 GeV (draft to be submitted to Physical Review Letters)

Abstract

K^+-meson production in pA (A = C, Cu, Au) collisions has been studied using the ANKE spectrometer at an internal target position of the accelerator COSY-Jülich. The complete momentum spectrum of kaons emitted at forward angles $\vartheta \leq 12°$ has been measured for a beam energy of T_p = 1.0 GeV far below the free NN threshold at 1.58 GeV. For low kaon momenta the spectrum does not follow a thermal distribution and the larger momenta reflect a high degree of collectivity in the target nucleus.

A central topic of hadron physics is the influence of the nuclear medium on elementary processes. A way to study this question is to measure the production of mesons in nuclei using projectiles with energies below the threshold for free NN collisions (so-called subthreshold production). These processes necessarily involve cooperative effects of the nucleons inside the target nuclei. The investigation of K^+-meson production is particularly well suited since this meson is relatively heavy so that its production requires strong medium effects. Furthermore, kaons have only little interaction with nuclear matter such that final-state interactions after their creation are supposed to be small.

Proton-induced K^+-production at subthreshold energies has been studied at several accelerators: At the synchro-cyclotron of the PNPI total cross sections have been measured [1] for targets between Be and Pb and projectile energies T_p from 0.8 to 1.0 GeV. The results were discussed in terms of different models [1, 2, 3, 4, 5], in particular, of one- or two-step reactions (with the creation of an intermediate pion). It was concluded that additional experimental data are needed for the unambiguous determination of the reaction mechanism and for the extraction of the information on nuclear-medium effects. Therefore, studies of the differential cross sections in pA-interactions $d^2\sigma/d\Omega\, dp$ have been undertaken at BEVALAC [6], SATURNE [7] and CELSIUS [8]. Partial momentum spectra have been obtained at laboratory emission angles of 10°, 15°, 35°, 40°, 60°, 80° and 90°, at projectile energies down to 1.2 GeV. In the above mentioned experiments, evidence for the dominance of the two-step processes has been observed at the lowest value of T_p. Subthreshold production has also been studied at the ITEP-synchrotron [10] where kaons with high momenta were identified at projectile proton energies of 1.75 to 2.6 GeV and in heavy-ion reactions at GANIL [11] and GSI [12].

The COoler SYnchrotron COSY-Jülich [13], which provides proton beams in the energy range $T_p = 0.04 \ldots 2.65$ GeV, is well suited for the study of K^+-production. It allows measurements with very thin windowless internal targets where secondary processes of the produced mesons can essentially be excluded. Subthreshold K^+-production was one of the main motivations to build the spectrometer ANKE [14, 15] within one straight section of the COSY ring. It consists of three dipole magnets D1–D3, see Fig. 6, which separate forward emitted reaction products from the circulating proton beam and allow a determination of their emission angles and momenta. The layout of the device including detectors and the data-acquisition (DAQ) system was optimized for the study of K^+-spectra down to $T_p = 1.0$ GeV. This is a very demanding task because of the small K^+-production cross sections, e.g. 39 nb for pC collisions at 1.0 GeV [1]. Thus the kaons have to be identified in an up to 10^6 times more intense background of secondary protons and pions. The K^+-identification is described in detail in [16, 17]. Therefore, in the following only the basic features of the procedures are summarized.

For the measurements, the COSY ring was filled with $2 - 4 \cdot 10^{10}$ protons per cycle. Typical cycle times were 30 s. The protons were accelerated to 1.0 GeV on an orbit below the target and then lifted up by steerers such that the rate in the ANKE detectors was kept constant and on a level which could be handled by the DAQ system. Thin strip targets of C (polycrystalline diamond), Cu and Au with thicknesses of $40 - 1500$ μg/cm^2 were used. The reaction products were detected with an array of 15 range telescopes positioned along the focal surface. The time-of-flight (TOF) was measured with 0.5 to 2 mm thick start scintillators (23 detectors with 5 cm width each) and 1 cm thick (10 cm wide) stop scintillators which are the foremost components of the telescopes, see Fig. 6. Due to the momentum focussing of the dipole D2, the telescopes can be used to identify the different ejectiles

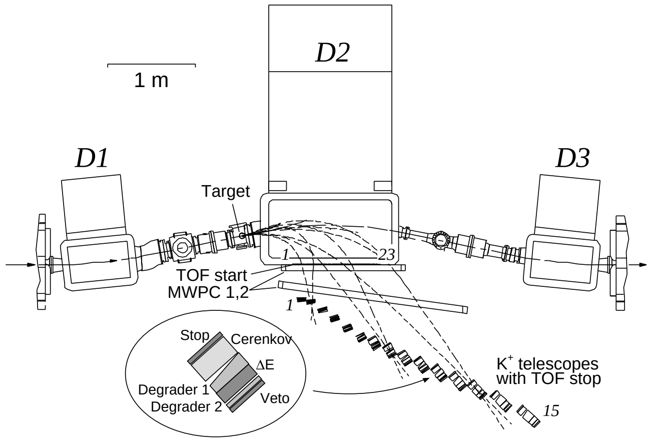

Figure 6: Top view of the ANKE spectrometer in the COSY ring and detectors used for K^+ identification. The inset shows the components of one of the range telescopes. Typical kaon trajectories are indicated. Details can be found in [15, 16, 17].

via their ranges: Protons are stopped before reaching the ΔE counters, the K^+-mesons come to rest before the veto counters while pions give signals in all detectors. Copper degraders are used to slow down the kaons in front of the ΔE counters (degrader 1) and to prevent them from reaching the veto counters (degrader 2). The decay products, pions and muons, of the stopped kaons are emitted isotropically, and partially detected in the veto counter, with a characteristic delay corresponding to the kaon lifetime $\tau = 12.4$ ns. The multiwire proportional chambers MWPC 1 and 2 allow to determine the ejectile tracks and consequently to discriminate particles originating from the target against scattered background, e.g., from the pole shoes of D2. Applying the criteria *i)* TOF, *ii)* energy losses in the scintillation counters, *iii)* delayed signals in the veto counters and *iv)* track origin in the target, it is possible to unambigously identify the K^+-mesons [16]. It should be mentioned that the criteria *i)* and *iii)* were already applied on-line in order to strongly decrease the amount of data written to tape. The other criteria are applied in the off-line analyses. A typical number of K^+-mesons, $N^K_{tel(i)}$, identified in one telescope i during a four days run on C is 100.

From the numbers of identified kaons $N^K_{tel(i)}$, momentum distributions can be obtained since each telescope covers a certain momentum range. The accepted momentum bites range from 13% at the low momentum side of the telescope array ($\sim$ 150 MeV/c) to 7% for high momenta ($\sim$ 510 MeV/c). The vertical angular acceptance of ANKE varies between $\vartheta_{\rm V} = \pm 7°$ and $\pm 3.5°$ for the low- and high-momentum telescopes, respectively. In the horizontal direction, ejectiles with emission angles $|\vartheta_{\rm H}| \leq 12^\circ$ were accepted by the on-line TOF-trigger system [16].

The double differential cross sections for K^+-production were obtained from $N^K_{\mathrm{tel}(i)}$ by comparison with the number of pions $N^\pi_{stop(i)}$ detected in the stop counters of the same telescope which were measured in dedicated calibration runs. The ratio of K^+ and π^+ counts was corrected by the different detection efficiencies ϵ and normalized to the corresponding proton-beam fluxes M^π and M^K (i.e. luminosities) and to the cross sections of π^+-meson production in pC interactions in forward direction at 1.0 GeV known from literature [18, 19, 20]. Due to the much larger π^+-production cross section, they can be identified applying only criteria *i)* and *iv)*. Thus, the cross section is given by:

$$\frac{d^2\sigma^K}{d\Omega dp} = \frac{d^2\sigma^\pi}{d\Omega dp} \cdot \frac{N^K_{\mathrm{tel}(i)}}{N^\pi_{\mathrm{stop}(i)}} \cdot \frac{M^\pi}{M^K} \cdot \frac{1}{\epsilon} \tag{1}$$

$$\epsilon = \frac{\epsilon^K_{tel(i)} \cdot \epsilon^K_{\mathrm{MW}PC(i)} \cdot \epsilon^K_{\mathrm{de}cay}}{\epsilon^\pi_{stop(i)} \cdot \epsilon^\pi_{\mathrm{MW}PC(i)} \cdot \epsilon^\pi_{\mathrm{de}cay}} \ ,$$

where $\epsilon^K_{\mathrm{tel}(i)}$ is the K^+-identification efficiency of the $i^{\,th}$ telescope including the detection probability for the decay muons and pions. Only those events were taken into consideration were signals of the veto counters were delayed by at least 2.5 ns with respect to the signals from the stopped kaons. The efficiency values $\epsilon^K_{tel(i)}$ were obtained from a calibration run at $T_p = 2.3$ GeV where the K^+-production cross section is significantly larger [16]. They turned out to be in the range of $\sim 0.1 - 0.3$.

The pion detection efficiencies $\epsilon^\pi_{\mathrm{stop}(i)}$ on the average are equal to 0.98. The MWPC efficiencies $\epsilon_{\mathrm{MW}PC}$ are in the range 0.97–0.99 both for pions and kaons. $\epsilon^K_{\mathrm{de}cay}$ and $\epsilon^\pi_{\mathrm{de}cay}$ take into account the losses in flight between target and stop counters. These loss factors were determined by simulations as 0.30–0.36 for kaons and 0.85–0.88 for pions, respectively. Relative monitoring of the proton beam interacting with the target nuclei A (M^K_A and M^π_A) was done with an accuracy of 2% using 4-fold coincidences of telescopes 2, 3, 4 and 5 (selection of ejectiles by-passing the spectrometer dipole D2).

The double differential cross section of K^+ production in proton-carbon interactions at $T = 1.0$ GeV deduced from our measurements is presented in Fig.7a). ANKE allows, for the first time, to obtain the complete momentum spectrum at deep subthreshold energies, in contrast to previous measurements at higher energies [6, 7, 8, 9, 10] where only partial momentum distributions were accessible.

From Fig.7b) it is seen that the *low-momentum* part of the K^+-spectrum cannot be described by a thermal distribution which would result in an ex-

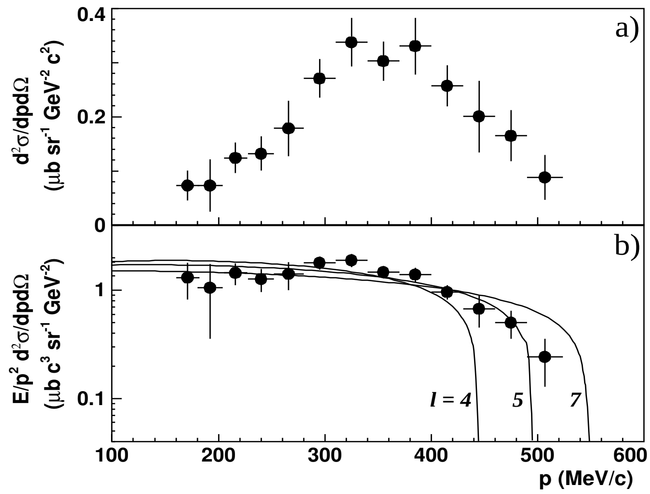

Figure 7: a) Double differential K^+-production cross section for the reaction $p(1.0\ \mathrm{GeV})^{12}C \rightarrow K^+(\vartheta \leq 12^\circ)X$ as a function of the K^+-momentum. b) Same data plotted as invariant cross section. The error bars reflect the statistical uncertainties only. The overall uncertainty of the cross sections from the normalization according to Eq.(1) is estimated to be 10%. The solid lines describe the behaviour of the invariant cross section within a phase-space approximation (Eq.(2)).

ponential fall-off of the invariant cross section with increasing p_{K^+}. Such a thermal distribution has been assumed for a description of kaon spectra and in order to deduce total cross sections from previous measurements within limited angular-momentum intervals [6, 7, 8, 9].

It is known [1, 2, 3, 4, 5] that, in order to allow for K^+-production far below the free NN-threshold, a high degree of collectivity in the target nucleus is needed, i.e. the number of involved target nucleons must be significantly larger than one. Alternatively, high intrinsic momenta of the participating target nucleon(s) are required to supply the missing energy for subthreshold kaon production. This is particularly the case for the *high-momentum* part of the kaon spectrum: in case of K^+-production in a collision with a single target nucleon, internal nucleon momenta of at least $p_N \sim 350(550)$ MeV/c are needed in order to produce kaons in forward direction with momenta of $p_K \sim 260(500)$ MeV/c. We recall that high momentum components above ~ 500 MeV/c are essentially due to many-body correlations in the nucleus.

In order to get a rough estimate about the number of participating nucleons in our case, we describe the invariant cross section within a phase-space approximation. This method has previously been applied [9] to K^+-production data in order to allow a comparison of spectra obtained under different kinematical conditions [6, 7, 9]. For the reaction $p+(lN)\rightarrow(lN)+\Lambda+K^+$ the invariant cross section is given as

$$E\frac{d^3\sigma}{dp^3} \quad \propto \quad \frac{(s_l - m_\Lambda - l^2 m_N^2)^2 - 4 m_\Lambda l^2 m_N^2}{s_l} \tag{2}$$

where m_Λ and m_N are the Λ-hyperon and nucleon masses, respectively. l is the number of nucleons involved in the interaction and

$$s_l{=}s{+}m_K^2{-}2E_K(T_p{+}[l{+}1]m_N){+}2p_K p_p cos\theta_K \ . \tag{3}$$

m_K, E_K, p_K and θ_K are the kaon mass, total energy, momentum and emission angle, respectively, while T_p and p_p denote the beam energy and momentum. s is the squared invariant energy of the incident proton and the l target nucleons. The solid lines in Fig.7b) show the momentum dependence of the invariant cross section from Eq.(2) for $l = 4, 5, 7$. Although Eq.(2) neglects the intrinsic motion of the l target nucleons it nevertheless shows that subthreshold kaon production at $T = 1.0$ GeV can only be understood in terms of cooperative effects with the effective number of nucleons involved in the interaction being $\sim 5 \div 6$. It has been suggested [1, 2, 3, 4, 5] that such cooperative effects can be described in terms of multi-step mechanisms or of high-momentum components in the nuclear wave function.

It has also been pointed out previously [1, 2, 3, 4, 5] that the mechanism of subthreshold K^+ production can be deduced from the A-dependence of the production cross section. The total cross sections measured at PNPI in the energy range $T = 0.8 \ldots 1.0$ GeV scale like $\sigma_{tot} \propto A^1$ [1]. This behaviour has been interpreted in terms of a two-step mechanism with the formation of an intermediate π-meson.

In order to determine the A-dependence for the differential cross sections, different targets in a wide mass range were used at ANKE. All measurements have been carried out with the same geometry of ANKE and its detection system and the same settings of the proton beam. Therefore, ratios of the kaon-production cross sections for various nuclei as a function of kaon momentum $\sigma_A^{K^+}/\sigma_C^{K^+}(p_{K^+})$ are equal to the corresponding ratios of kaon count rates in the individual telescopes normalized to the pion cross-section ratio at a momentum of 507 ± 17 MeV/c detected in telescope #15:

$$\left(\frac{\sigma_A^K}{\sigma_C^K}\right)_{(i)} = \left(\frac{N_A^K}{N_C^K}\right)_{(i)} \frac{M_C^K}{M_A^K} \left(\frac{N_C^\pi}{N_A^\pi}\right)_{(15)} \frac{M_A^\pi}{M_C^\pi} \left(\frac{\sigma_A^\pi}{\sigma_C^\pi}\right)_{(15)} . \tag{4}$$

The pion cross-section ratios in pA collisions with a momentum of 500 MeV/c in forward direction were measured by several groups in the proton-energy

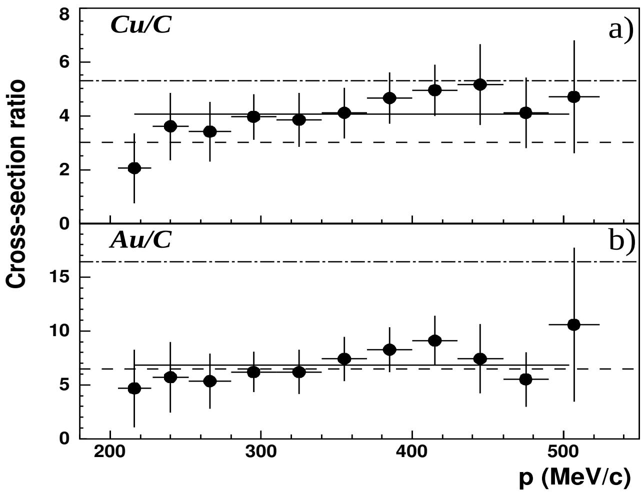

Figure 8: Ratios of the K^+ production cross sections for Cu/C and Au/C as a function of the kaon momentum. The solid horizontal lines indicate a fit by a constant value. The dashed lines illustrate the ratios if the cross sections scale like $A^{2/3}$ (dashed) and A^1 (dashed-dotted).

range $0.73 \div 4.2$ GeV [18, 19, 20] and are known with an accuracy of better than 10% [17]. All uncertainties from the efficiency correction ϵ in Eq.(1) cancel out for the case of cross-section ratios. The results for Cu/C and Au/c are shown in Fig. 8.

The ratios are almost independent of the K^+-momentum. The solid lines in Fig.8 indicate a fit with a constant value resulting in $R(Cu/C) = 4.0 \pm 0.3$ and $R(Au/C) = 6.8 \pm 0.8$. These values should be compared to the expected ratios if the cross sections scale like A^1: $R(Cu/C) \sim 5$ and $R(Au/C) \sim 16$. Our data, however, show a significantly weaker A-dependence with an exponent close to 2/3, see Fig.8. This is in contrast to the behaviour of the total cross sections at the same beam energy found in [1] where kaon production has been described in terms of the two-step mechanism. It is possible that, due to rescatttering of the produced kaons in the target nucleus out of the angular acceptance of ANKE, there is a kaon deficiency at high momenta and angles $\vartheta \sim 0°$. Since this effect should be stronger for heavier targets it could account for a weaker A-dependence of the differential cross section as compared to total cross sections.

Summarizing, we have measured K^+-production far below the free NN threshold at $T = 1.0$ GeV for kaons emitted under forward angles. The low-momentum part of the K^+-spectrum does not follow a thermal distribution whereas the high-momentum part reveals a high collectivity of the target nucleus. Within a simple kinematical model $\sim 5 \div 6$ nucleons are needed in order to allow for the production of kaons with momenta of $p_K \sim 500$ MeV/c. Alternatively, intrinsic momenta of at least $p_N \sim 550$ MeV/c are required if such kaons are produced in a collision with a single target nucleon. Unexpectedly, the target-mass dependence of the differential cross sections shows a scaling significantly weaker than those of the total cross sections [1]. The latter have been interpreted in terms of two-step K^+-production. It remains to be shown by detailed microscopical calculations whether this finding is due to rescattering effects of the produced kaons in the target nucleus or whether this is a reflection of single-step kaon production with high-momentum components in the nuclear wave function, which are due to many-body correlations in the nucleus.

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