K^+-PRODUCTION IN PROTON-NUCLEUS INTERACTION*

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The K^+ differential cross sections are evaluated in the simple and extended folding model. Angular dependence of the cross sections is compared with existing experimental data.

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Intensive studies of K^+ production in nucleus-nucleus collisions, performed in the recent years with the aim to study nuclear equation of state, lead to the conclusion that the knowledge of the mechanism of K^+ production in proton-nucleus collisions is indispensable for understanding of more complicated processes occuring in the nucleus-nucleus interaction. It turned out, however, that the existing experimental data on the K^+ production in proton-nucleus reactions are extremely scarce especially for proton energies corresponding to subthreshold (in the nucleon-nucleon center of mass system) production. They consist only of the data of Koptev *et al.*[1] on the total production cross sections for several nuclei and of results on measurements of differential cross sections $\frac{d\sigma}{dpd\Omega}$ obtained at one scattering angle by GSI-IPN-Cracow University-LNS-TH Darmstadt collaboration, presented during this meeting by M. Dębowski. The analysis of these data in the frame of simple [2] and extended folding model [3] shows that at subthreshold energies the elementary process $P + N \rightarrow K^+ + N + \Lambda$ is not able to reproduce alone the data and some other processes must be taken into consideration e.g. two-step reaction in which first pions are created $P + N \rightarrow \pi + N + N$ while in the second stage of the reaction the pions interact with nucleons creating K^+ mesons: $\pi + N \rightarrow K^+ + \Lambda$. It seems, however, that the data taken by Dębowski *et al.*at energies exceeding the NN threshold energy indicate dominating role of the one-step process. As it was

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mentioned above, these data were obtained at single scattering angle (40° in the laboratory system) only, thus it is not obvious whether the angular dependence of the cross sections at higher proton energies is in agreement with the assumption of a dominance of one-step production mechanism. A possible disagreement should be most pronounced at large scattering angles.

In the present contribution we discuss model calculations of the angular dependence of K^+ production cross sections in the frame of simple [2] and extended [3] folding model for p+NaF system at $E_{lab}(P)=2.1$ GeV and compare these calculations with the data of Schnetzer *et al.*[4]. It is very fortunate for our purpose that these data cover large scattering angles (up to 80° in the laboratory system).

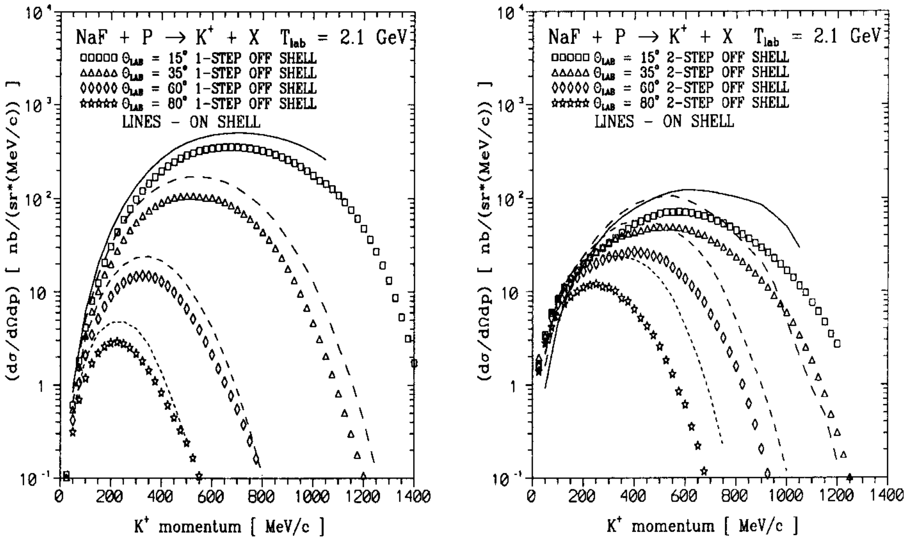

Fig. 1. Description in the text.

In the Fig. 1 experimental data of Schnetzer *et al.*[4] for K^+ production in p+NaF collisions at $E_{lab}(P)=2.1$ GeV are shown together with results of calculations which take into consideration both, one-step and two-step processes. In the r. h. s. part of the figure calculations are presented which were performed in the frame of simple folding model [2] while in the l. h. s. part of the figure those calculations are shown which were done according to the extended folding model formalism [3]. All the presented calculations were done without free parameters. If the overall normalization is allowed the theoretical curves in r. h. s. of the Fig. 1 can exactly reproduce the experimental data *i.e.*the shape of momentum spectra as well as angular dependence is very well reproduced. This is not the case for theoretical

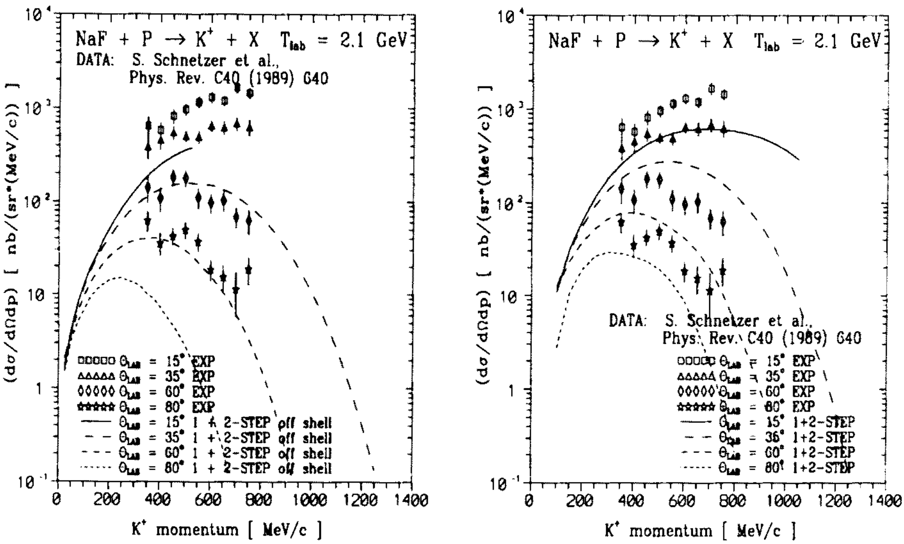

Fig. 2. Descritpion in the text.

results of the extended folding model (l. h. s. of the Fig. 1). Theoretical curves fall down too quickly with increasing of the scattering angle. Thus, the simple folding model better describes the data than the extended folding model. The origin of such unexpected result may be found from inspection of the Fig. 2 in which model predictions are compared for one-step mechanism of K^+ production (l. h. s. part of the figure) and two-step reactions (r. h. s. part of the figure) evaluated in the simple folding model (lines) and extended folding model (squares, triangles, diamonds and stars for 15°, 35°, 60° and 80° respectively). It is evident that the shape of theoretical one-step spectra is very similar for both models — the results differ basically only in the magnitude. Simple folding model predicts slightly larger values of the differential cross sections. However, this common shape predicted by both models does not agree with the experimental data measured at large scattering angles (60° and 80°) shown in Fig. 1. Thus, it seems that inclusion of the two-step mechanism is indispensable. Moreover, as can be seen in the r.h.s. part of the Fig. 2, the spectra evaluated assuming two-step mechanism decrease with the angle slower than those from one-step mechanism and therefore their angular dependence agrees much better with that of the experimental data.

It is interesting to note, that the spectra of two-step production mechanism predicted by simple folding model fit better to the data than those of the extended folding model. It seems, that the on shell relation between

Fermi motion momentum and energy of nucleons taking part in the two-step production process approximates better the real situation than the off shell behaviour with constraints imposed by using the single particle spectral fuction twicely as it is done in the extended folding model [3].

The rescattering of pions in the intermediate stage of the reaction as well as rescattering of the produced kaons was not taken into account in the presented calculations. It is, however, expected that the qualitative features of the spectra discussed here will be not destroyed by inclusion of these processes.

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