K^+ production on proton and deuteron targets

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The ratio between strangeness production on proton and neutron targets is very poorly known. However, it is an important input parameter for theoretical models of K^+ production in *pA* and *AA* interactions. Using a deuterium cluster-jet target at the magnetic spectrometer ANKE the first experimental data for strangeness production on the deuterium target have been collected. The analysis of the experimental data using naive phase space approach shows a significant difference between strangeness production on the proton and neutron [1]. Several theoretical investigations of the difference have been initiated Ref. [2, 3], but due to the lack of the experimental data collected on the neutron targets all the conclusions are rather model dependent.

In order to extract information about K^+ production on the neutron from the deuterium target one needs either to fully identify particles in the final state or to use the spectator detection technique. Due to the limited acceptance of the ANKE spectator detector prototype [4] it was impossible to perform such a measurement. Another approach requires a very significant amount of the experimental data. Therefore, a simple experiment measuring the ratio between K^+ production on the proton and deuteron targets at the same beam energy has been done.

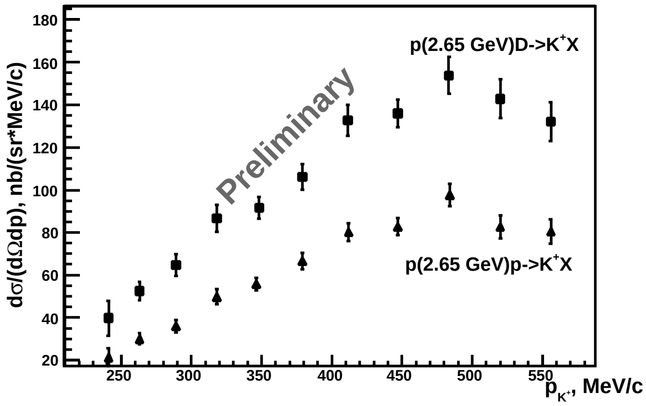

Fig. 1: Double differential cross sections for the K^+ production on the proton and deuteron targets at a proton beam energy of 2.65 GeV

In Fig. 1 two double differential cross sections measured at a proton beam energy of 2.65 GeV on deuterium and proton targets are presented. The deduced ratio between K^+ production on the proton and deuterium targets is of the order of two. Using this value one can conclude that there is no difference between K^+ production on the proton and neutron at 2.65 GeV proton beam energy like it was suggested earlier in Ref. [5].

The error bars of the points in Fig. 1 are mostly due to the systematic uncertainty of the telescope efficiency determination. Since this two experimental data sets have been collected at the same beam energy with the same acceptance and other parameters of the detection system the ratio between K^+ production on the proton and deuteron targets does not depend on the telescope efficiency and can therefore be estimated with relatively small error. The systematic uncertainty of the ratio $\sigma_D^{K^+}/\sigma_p^{K^+}$ mostly depends on the error of the two luminosity determination methods and are in the order of 20%.

In Fig. 2 double differential K^+ production cross sections on the deuterium target at 2.02 GeV [1] and at 2.06 GeV at the proton target are presented. The difference between these

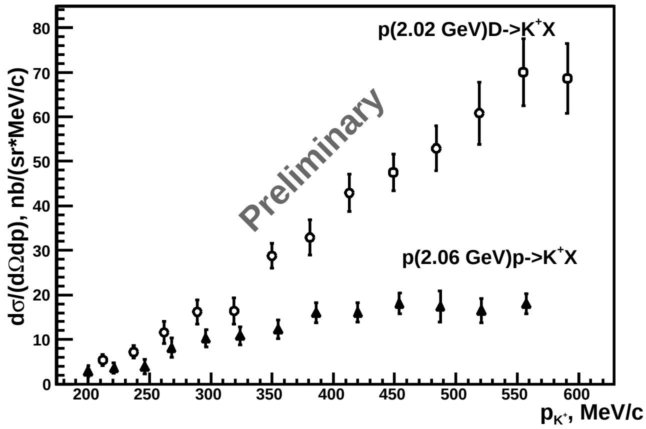

Fig. 2: Double differential cross sections for the K^+ on the proton at 2.06 GeV and on deuterium target at 2.02 GeV

two double differential cross sections is roughly a factor of 2.6. Taking into account that K^+ production double differential cross sections on the proton target at 2.02 and 2.06 GeV should differ by $\sim 15-20\%$ one ends up with a ratio of $\sigma_D^{K^+}/\sigma_p^{K^+} \sim 3$. This value leads to a two times difference between total K^+ production cross section on the neutron and proton, which is in agreement with the number suggested by model in Ref.[6].

The data shown in Fig. 1 suggest a ratio $\sigma_D^{K^+}/\sigma_p^{K^+} \sim 2$ at 2.65 GeV, which leads to the conclusion that there is no difference between K^+ production on the proton and neutron at this energy. On the other hand the analysis of the *pD* inclusive data in Ref. [1] using naive phase space approach gives the $\sigma_n^{K^+}/\sigma_p^{K^+} \sim 3$ at 2.02 GeV. The comparison of the *pD* experimental data at 2.02 GeV with *pp* at 2.06 GeV in Fig. 2 indicates that a $\sigma_D^{K^+}/\sigma_p^{K^+}$ ratio at 2.06 GeV higher than one, but does not allow to make a qualitative conclusion about difference between strangeness production on the proton and deuteron at this energy and possible energy dependence of the $\sigma_n^{K^+}/\sigma_p^{K^+}$ ratio.

Further conclusions about $\sigma_n^{K^+}/\sigma_p^{K^+}$ ratio have to wait for the results of the analysis of the *pp* and *pD* data collected at 2.16 GeV.

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