Approach towards the Non-associated Strangeness Production in the $pp \longrightarrow pK^+n$ Reaction at COSY-11

J.T. Balewski* and T. Sefzick for the COSY-11 collaboration

December 14, 1997

The W-boson has a mass of 80 GeV [1, 2] and thus, in the range of COSY energies with $\sqrt{s} \leq 3.6$ GeV only virtual W-boson exchange is possible. This leads to a very small reaction probability in the non-associated strangeness production.

One of the following reaction schemes may be considered: • a direct exchange of the virtual W-boson between two scattered nucleons (fig. 1a), • *strong* ISI excites one proton and a W-boson exchanged between two of the protons quarks creates a K^+ meson and a neutron; the *strong* FSI restores energy conservation (fig. 1b).

In the theoretical work of Haidenbauer et al. [3] the cross section for the $pn \longrightarrow p\Lambda$ reaction was estimated to be of 10^{-39} cm^2.

Here, we consider the 3-body reaction

$$pp \longrightarrow pK^+n \tag{1}$$

with its threshold at a beam momentum of p_b=1.832 GeV/c. It is shown by means of Monte-Carlo simulation (see fig. 2), that kinematically, reaction (1) is detectable by the COSY-11 facility. This reaction seems to be a very promising candidate, since (detected) kaon **may not** be produced in any *strong* interaction due, to energy conservation.

In a recent measurement at p_b=2.345 GeV/c the reaction

$$pp \longrightarrow pK^+\Lambda \tag{2}$$

has been successfully measured [4]. In fact, reaction (1) and (2) are kinematically nearly identical and the weak reaction (1) was basically already observable (with very small acceptance) together with reaction (2).

The integrated luminosity of 10^{35}cm^{-2} was certainly too low to observe even a single event of reaction (1) during this run. In addition, the detection efficiency at this high beam energy was only $\sim 5 \cdot 10^{-4}$.

We note however, that the critical missing mass region around the neutron & kaon masses is completely free of any accidental background events, as shown in fig. 3a.

Therefore, we consider the search for the non-associated strangeness production at COSY-11 in the future, or at least the determination of an upper experimental

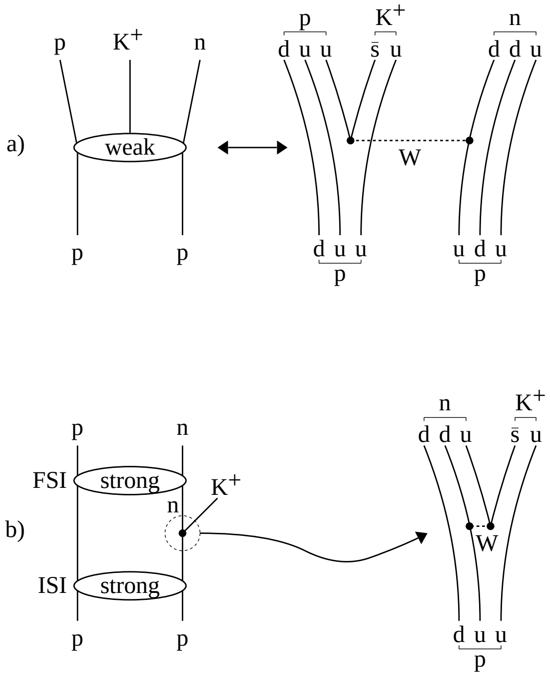

Figure 1: Possible mechanisms of the weak production of K^+ meson in p+p interaction.

limit on the cross section.

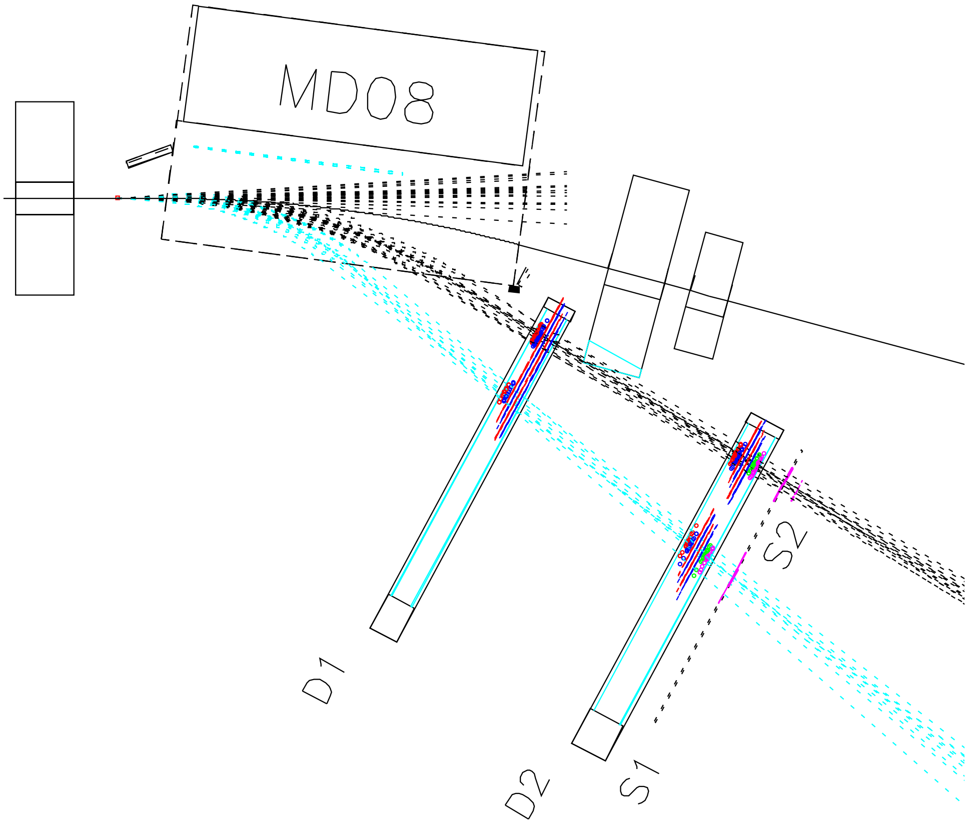

Figure 2: Experimental layout for the $pp \longrightarrow pK^+n$ measurement. Tracks of all outgoing particles, resulting from the Monte-Carlo simulation at a beam momentum of p_b=1.832 GeV/c (Q_{cm} =1.9 MeV) are shown.

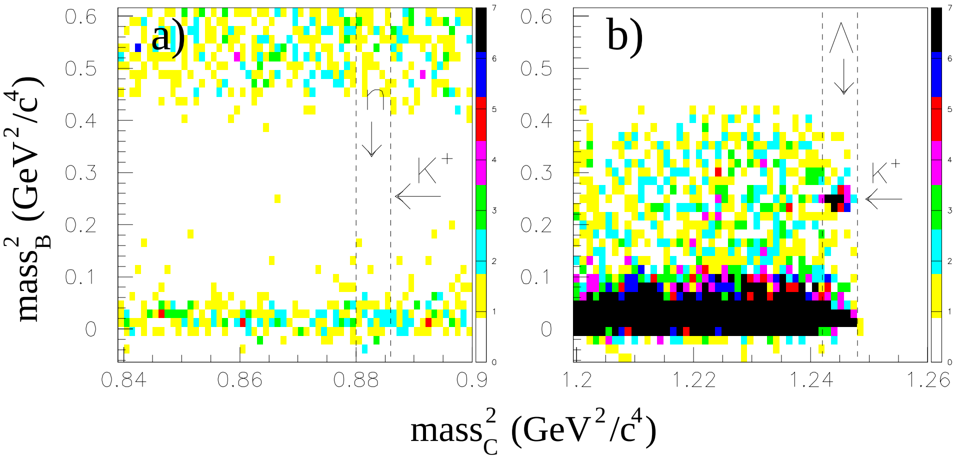

Figure 3: Spectra of the $pp \longrightarrow pBC$ events measured at p_b=2.345 MeV/c and with L·T $\simeq 10^{35}$cm^{-2}. The horizontal arrows indicate the kaon mass, there is no event in this region for the missing mass $C \equiv neutron$ (a), whereas in (b) the Λ peak is well seen. It was assumed in the calculation of the missing mass C, that particle B has a kaon mass.

References

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*) also: Institute of Nuclear Physics, Cracow, Poland