Λ-Hyperon Production in the $pp \longrightarrow pK^+\Lambda$ Reaction at Threshold.

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The associated strangeness production in the $pp \longrightarrow pK^+\Lambda$ reaction was measured by the COSY-11 collaboration at the beam momentum of 2.345 GeV/c (Q_{cm} = 2 MeV).

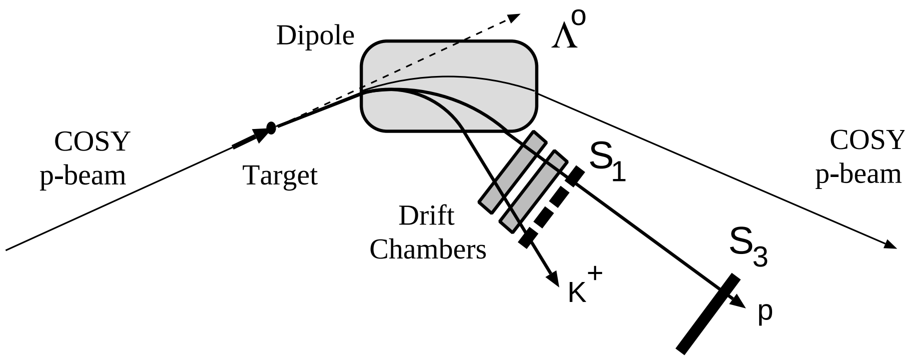

Figure 1: Experimental layout for the $pp \longrightarrow pK^+\Lambda$ measurement.

As shown in fig. 1, the complete kinematical reconstruction of events was obtained employing a system of drift chambers, scintillators and the magnetic field, the details are described in Ref. [1]. The momenta, time of flight and finally the invariant masses of both the final proton and the final kaon were reconstructed. The clear identification of $pp \longrightarrow pK^+\Lambda$ events is shown in fig 2, where 69$\pm$ 7 events were identified, leading to the total cross section of 8.2 $\pm$ 1.8 nb.

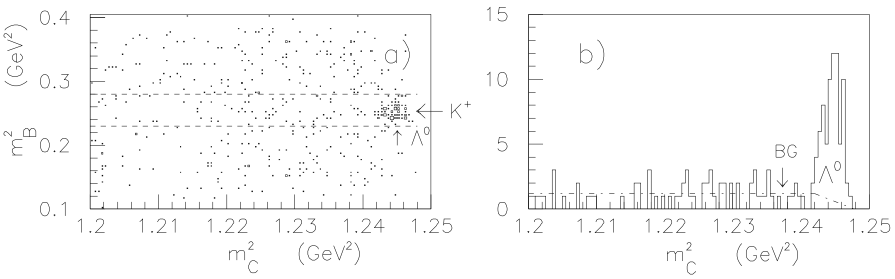

Figure 2: Only events of the type $pp \longrightarrow pBC$ were considered. a) Squared invariant mass of the meson $K^+ \equiv B$ versus the squared missing mass of the (pK^+) system. b) Events from the area between the dashed lines in fig. a) were projected onto the x-axis.

The energy dependence of the K^+ production cross section close to threshold

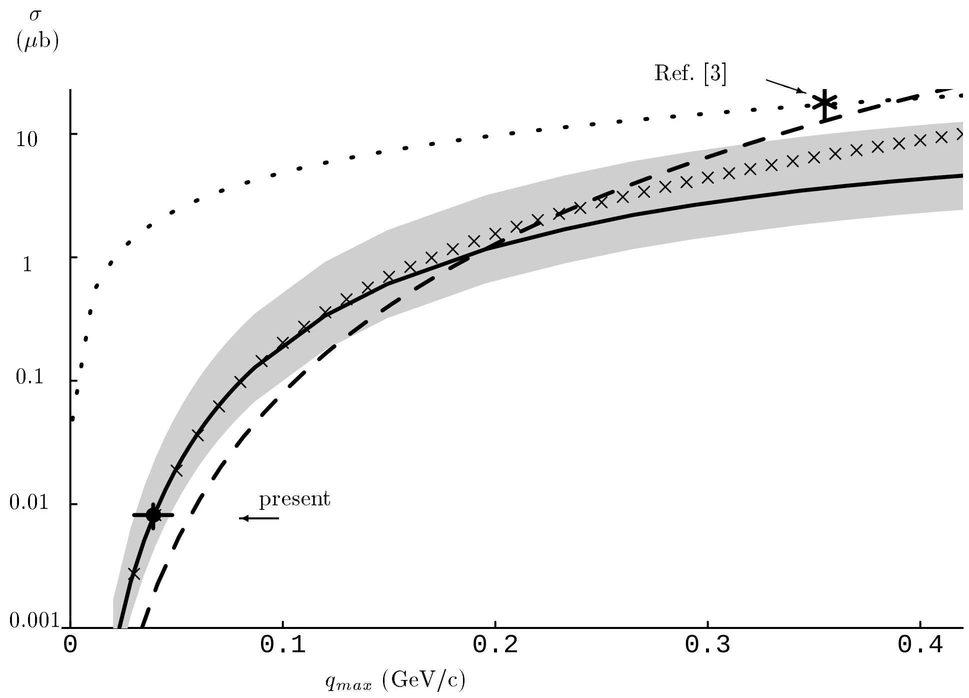

Figure 3: Presently evaluated cross section (solid line) for the reaction $pp \longrightarrow pK^{+}\Lambda$ as function of the maximum momentum of K^{+}. The dashed and the dotted lines represent the phenomenological parametrizations by Schürman and by Randrup, respectively ref. [4] and ref. [5] . The crosses result from impulse approximation calculations by Fäldt and Wilkin from Ref. [6], normalized to the data point measured by COSY-11.

was predicted, applying a 3-body phase space dependance modified by the $p\Lambda$ final state interaction. In the calculation we use the effective range parameters from Ref. [2]. The evaluated excitation function depending on the maximal kaon momentum (q_{max}) is shown by the solid line in fig. 3, where the curve has been normalized to the present data point.

Due to the 0.1 % uncertainty in the determination of the beam momentum, there is a 20% error in q_{max} which results in a relatively large uncertainty of the energy dependence, as is indicated by the shaded area.

The prediction of the simple S-wave model underestimates the experimental cross section for the BNL data point [3] at $q_{max} = 355\ MeV/c$. This is expected since P-waves (and possibly even higher partial waves) should contribute to the cross section in this energy range. Moreover, the Σ^0 production channel, which opens at $q_{max} \approx 300$ MeV/c, may[1] influence the Λ-hyperon production amplitude.

Based on the data point presented here, already two conclusions can be drawn: (i) parametrizations of the $NN \to N\Lambda K$ cross section as given by Schürmann and Zwermann [4] and by Randrup and Ko [5], which are commonly used in investigations of the kaon production in nucleon-nucleus and nucleus-nucleus collisions, are definitely in disagreement with the present experimental data point at only 2 MeV above threshold and (ii) strong final state interaction in the p-Λ channel precludes the conjecture

of the constant matrix element M in the vicinity of the reaction threshold.

Details of this work were published in Phys. Lett. B [7].

References

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