Measurement of the reactions pp $\to$ p $K^+\Lambda$ (Σ^0) around the Σ^0 Threshold

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Measurements of the reaction pp $\to$ p K^+ Y^0 in the vicinity of the Σ^0 threshold were performed at the COSY-11 facility [1] in order to determine the total cross section of the Σ^0 production in the pp collision and compare it to the correspondig Λ production [2]. On the other hand, the momentum spectra of kaons produced in the pp $\to$ p $K^+\Lambda$ reaction possibly provide cusp effects caused by coupling between the Λp and Σp channel [3]. The reaction pp $\to$ p K^+ Y^0 was measured at beam momenta of 2.563, 2.575, 2.581, 2.587 and 2.596 GeV/c which corresponds to excess energies $\epsilon = 75$ (-1), 79(3), 81(5), 83(7) and 86(10) MeV for the Λ (Σ^0) production, respectively. A measurement with three different beam energies was performed using the supercycle of COSY. For both channels the same detectors and trigger conditions were used as in the Λ threshold measurement.

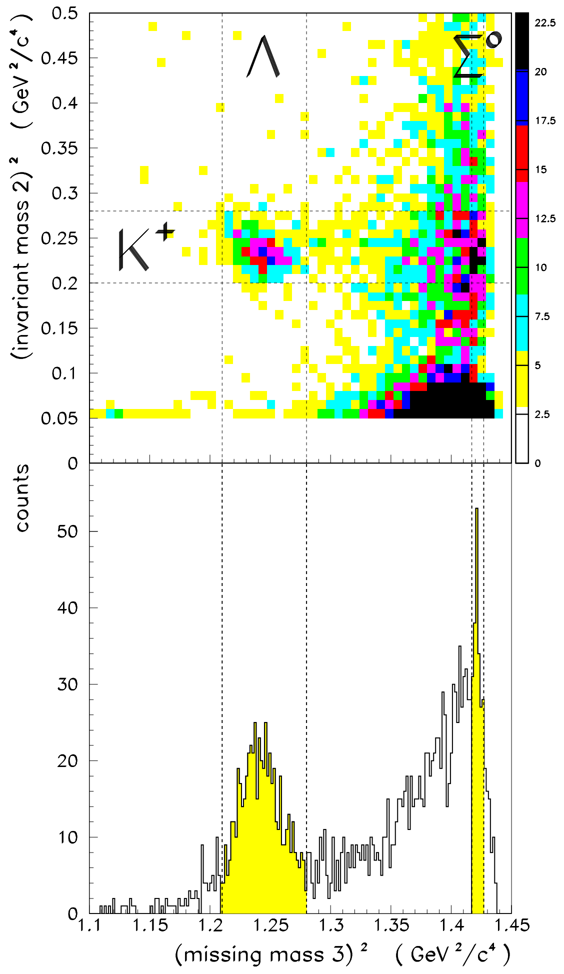

Figure 1: Squared invariant mass of the particle 2 versus the missing mass of the particle 3 (top) for $\epsilon = 7$ MeV. The projection of events in the marked kaon region results in the missing mass distribution (bottom).

The four momenta of both positively charged particles are determined permitting the identification of the uncharged hyperon via the missing mass method.
Figure 1 (top) shows the good separation of the reaction channels. Projecting the marked kaon region results in the distribution of the hyperon missing masses (bottom) with the marked mass regions corresponding to the Λ and the Σ^0, respectively.

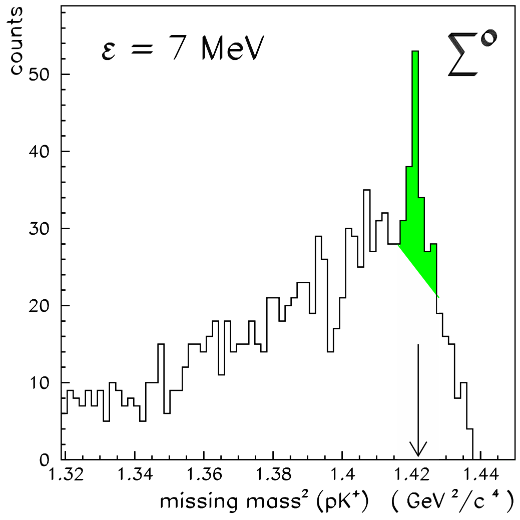

Figure 2: Squared missing mass of pK^+. A clear enhancement above the extrapolated background is seen corresponding to the Σ^0 mass sqared (arrow).

In figure 2 a clear signal corresponding to the Σ^0 is seen. A first preliminary evaluation of the cross section value is in the order of 5 nb for $\epsilon = 7$ MeV giving a ratio of the cross sections of the Λ/Σ^0 production in pp interaction of 164/5 which is much larger than expected. Extensive background studies are in progress.
A strong coupling of the Λ and Σ^0 channels is expected because they differ only in isospin and slightly in mass. For the investigations of a cusp in the kaon CMS-momentum distribution only the events in the lambda mass region (shadowed aerea in figure 1 bottom) have been taken into account. Due to the limited detection acceptance the data analysis has to be guided by careful Monte Carlo simulations. In first obtained distributions an enhancement at the predicted kaon momentum is seen but due to low statistics not significant. The comparison with data sets of higher statistics presently beeing analyzed will shed more light on this subject.

References:

[1] S. Brauksiepe et al., NIM A 376 (1996) 397

[2] J. Balewski et al., accepted by Phys. Lett. B, and in this Annual Report

[3] B. Holzenkamp et al., Nucl. Phys. A 500 (1989) 485