Close to threshold measurement of the reaction $pp \to ppK^+K^-$

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The associated strangeness production has been studied via the $pp \to ppK^+K^-$ reaction near the production threshold at an excess energy $Q = 17\,\mathrm{MeV}$ [1] and at $Q = 115\,\mathrm{MeV}$ [2]. Such measurements are not only motivated in order to investigate the not well established structure of the scalar resonances $f_0(980)$ and $a_0(980)$ but also to gain insight into the proton-kaon interaction.

The COSY-11 collaboration has extended the close to threshold measurements with two new data points below the ϕ-threshold at $Q = 10$ and $28\,\mathrm{MeV}$. For a detailed motivation on the continuation of these investigations, we refer to [3, 4].

The analysis of the data at the lower Q-value has been started with detailed time calibrations for the scintillator detectors and drift chambers. The calibration has to be performed within an iterative procedure and is still in progress. For about 20% of the data, the calibration is at a sufficient high accuracy level, so that a clear identification of the positively charged final state particles by their invariant mass is possible. Figure 1 shows the reconstructed squared invariant mass for any particle which was registered in a set of drift chambers and two scintillator detectors for the time of flight measurement. Detailed description of the underlying analysis are reported elsewhere [5, 6].

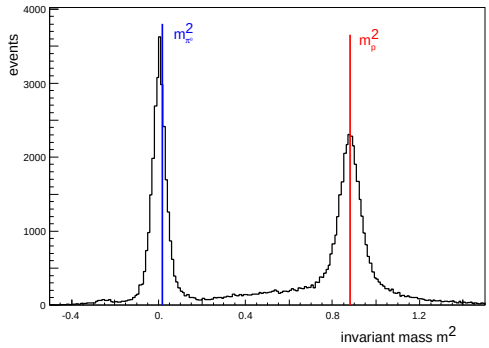
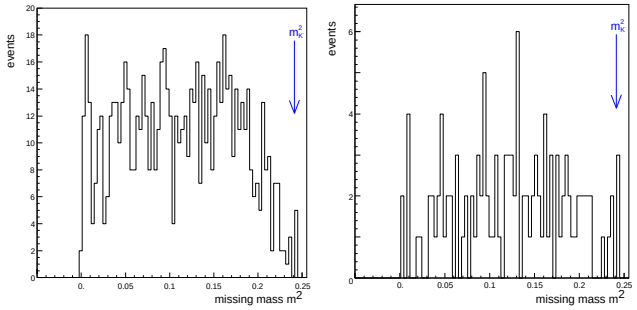


Fig. 1: Squared invariant mass spectrum for any reconstructed particle.

With the event selection condition to register at least three particle tracks in the drift chambers a kaon peak is not expected in the spectrum due to the small cross section of the $pp \to ppK^+K^-$ reaction. The invariant mass resolution for the protons is about $\sigma_p = 27\,\mathrm{MeV/c^2}$ and for the pions $\sigma_\pi \approx 95\,\mathrm{MeV/c^2}$ which is inline with expectations from former measurements. Before a final presort of events with the required final state particles, the further analysis needs a check of the target offset and the drift chamber positioning [7].

Even though the last issues were not investigated yet, some percent of the data at $Q = 10\,\mathrm{MeV}$ were analysed with the present calibrations. In a first cycle, events with two identified protons and a positive kaon were selected. For those events figure 2(a) shows the resulting squared missing mass. The negative kaons will be additionally detected by a scintillator and Si-pad detector arrangement mounted inside the dipole of the COSY-11 experiment [8]. Therefore, the additional requirement of any hit in this detector reduces significantly the background in the missing mass spectrum (figure 2(b)) as expected from the former analysis. A background free spectrum is expected by rejecting events where the measured hit position is not consitent with the expected position from the known four momentum of the missing K^- [1] meson.



(a) (b)

Fig. 2: Missing mass spectrum for events with (a) two identified protons and one K^+ and (b) the further requirement of an additional hit in the dipole scintillator.

In addition to the $pp \to ppK^+K^-$ reaction, the $pp \to pK^+\Lambda(1405)$ reaction will be investigated which has been recorded in parallel by the trigger. Here, first presorts have been performed and first missing mass spectra will be available soon.
Concerning the data set at $Q = 28\,\mathrm{MeV}$, the analysis for the determination of the lumiosity will be started in parallel to the $Q = 10\,\mathrm{MeV}$ data which is the next step to obtain the cross section value.

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