Investigation of the $a_0(980)/f_0(980)$ resonances in pp and pn interactions with ANKE*

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The production of the light scalar resonances $a_0/f_0(980)$ in hadronic interactions is being investigated with the ANKE spectrometer, where their decays into $K\bar{K}$ can be observed. Final goal of these studies, which will be later supplemented by measurements of the non-strange decays with WASA, is to learn about the nature of these states and about isospin violating processes in the a_0/f_0 system [1].

The first ANKE experiments have been performed for pp collisions at beam energies $T_p = 2.65$ GeV (2001) [2] and $T_p = 2.83$ GeV (2002), and for pn collisions, using a deuterium cluster-jet target, at $T_p = 2.65$ GeV (2004) [3].

For the $pp \to dK^+\bar{K}^0$ data at $T_p = 2.83$ GeV the analysis is almost completed. The reaction has been identified by detecting dK^+ pairs using TOF and energy loss information, and cutting on the $\bar{K}^0$ peak in the dK^+ missing mass spectra. Moreover, the momentum resolution could be improved by a factor of two by using Runge-Kutta tracking instead of a polynomial method (Fig. 1).

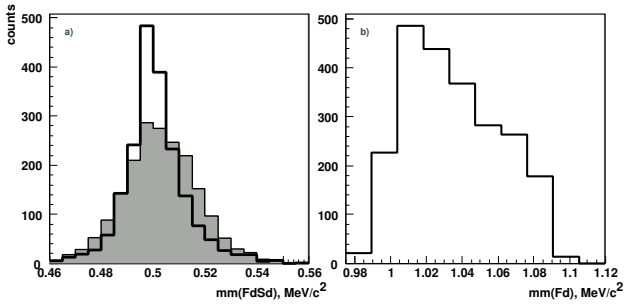

Fig. 1: a) dK^+ missing mass using two momentum reconstruction methods, polynomial (shaded histogram) and Runge-Kutta (solid line). b) Deuteron missing mass obtained with the Runge-Kutta algorithm.

Due to the increased phase-space volume as compared to the 2.65 GeV data, zero elements in the acceptance matrices have appeared (lower part of Fig. 2). This makes a model independent acceptance correction, as used for $T_p = 2.65$ GeV, impossible.

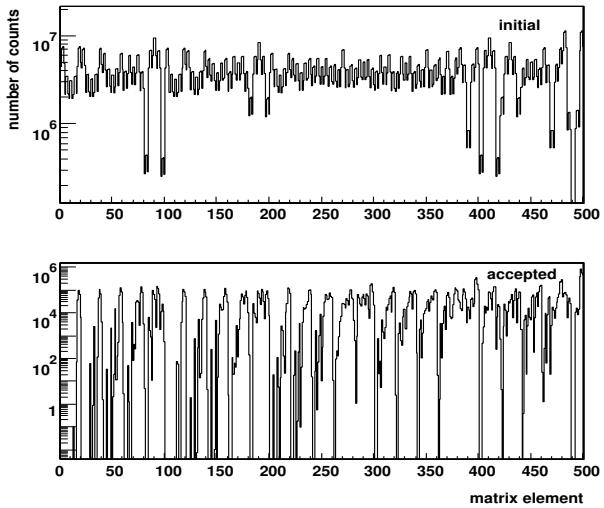

Fig. 2: Acceptance matrix of ANKE. For a description of the method see Ref. [2].

In order to calculate the total cross section for the higher energy a model described in Ref. [4] has been used as input for simulations. The integrated luminosity has been determined from pp elastic scattering. The preliminary value of the total cross section of the reaction $pp \to dK^+\bar{K}^0$ is around 210 nb, the statistical and systematic unsertainties amount to 20–30% of this value.

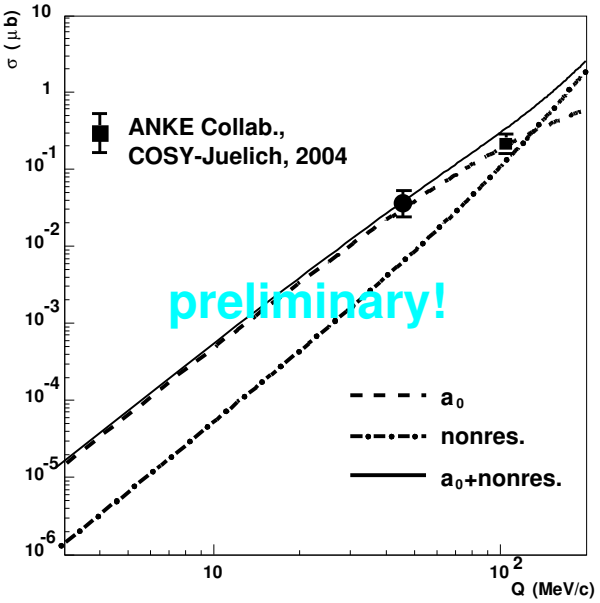

Fig. 3: Total cross-section for the reaction $pp \to dK^+\bar{K}^0$. The error bars represent the statistical and systematic uncertainties. The data point at the lower energy is taken from Ref. [2], the lines correspond to the model from Ref. [4].

A preliminary analysis of the pn-experiment for a_0/f_0 production in the reaction $pn \to da_0/f_0 \to dK^+K^-$ is available. Since all final particles — besides spectator protons which do not take part in the reaction — have been detected by ANKE, the K^+K^- invariant-mass spectrum should reveal an enhancement at low masses corresponding to the a_0/f_0. However, only a ϕ-meson (which also decays to K^+K^-) peak is clearly seen in this spectrum [5]. The events in the low mass region may either be produced via the a_0/f_0 resonances or they are background from misidentified particles.

References:

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