INVESTIGATION OF LIGHT SCALAR RESONANCES $a_0(980)/f_0(980)$ with ANKE

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A program to investigate the light scalar resonances $a_0(980)/f_0(980)$ in hadronic interactions via their decay into the $\pi\eta$ and $K\overline{K}$ channels has started at the ANKE spectrometer of COSY-Jülich. As the first step the reactions $pp \to d\pi^+X$ and $pp \to dK^+X$ have been measured at two energies, $T_p = 2.65$ GeV and 2.83 GeV. The status of the analysis at $T_p = 2.65$ GeV is presented. A total cross section of about 50 nb has been determined for the reaction $pp \to dK^+\overline{K}^0$.

The light scalar resonances $a_0(980)$ and $f_0(980)$ have been studied in many experiments (see e.g. Ref. [1]). Nevertheless, it is not known yet whether they belong to the lightest scalar meson nonet or whether they are of different nature. A major goal of the scientific program of ANKE [2] at COSY Jülich is to supply additional data on the production of the a_0/f_0 in pp, pn, pd and dd collisions which will be sensitive to their internal structure.

Two measurements on $a_0^+(980)$ production in $pp \to da_0^+$ reactions have been performed so far. The first experiment was performed in 2001 at an incident proton energy of $T_p = 2.65$ GeV, the second in the beginning of this year at 2.83 GeV. ANKE allows to detect positively charged particles emitted in forward direction. π^+ and K^+ mesons (possible a_0^+-decay products) are identified via TOF and energy loss; the coincident deuterons are selected by their TOF-momentum correlation. The resulting missing mass analysis is shown in Fig. 1. For π^+d pairs an η peak is observed in the missing mass $m(pp, d\pi^+)$ on a broad background distribution from multiple pion production. In the corresponding missing mass $m(pp, d)$ a shoulder at 980 MeV/c^2 is seen which reveals a peak structure after background subtraction which is based on the assumption of a smooth background behavior around the η-peak region.

The missing mass spectrum $m(pp, dK^+)$ shows a peak at the $\overline{K}^0$ mass containing ∼600 events with a background contribution of less than 10%. This corresponds to a total cross section of $\sigma(pp \to dK^+\overline{K}^0) \sim 50$ nb which is close to the value predicted in Ref. [3] for $\sigma(pp \to da_0^+ \to dK^+\overline{K}^0)$. In the corresponding missing mass distribution $m(pp, d)$ a narrow structure is observed, at low masses limited by the $K\overline{K}$ threshold and at high masses by the beam energy. Once this distribution as well as the missing mass $m(pp, K^+)$ and angular distributions are properly acceptance corrected, the FSI in the $K\overline{K}$ and $d\overline{K}$ systems can be studied. Such (preliminary) mass distributions are shown in Fig. 2.

The solid and dashed lines (taken from Ref. [4]) on the left side of Fig. 2 show the expected mass distribution with S-wave production in the kaon system for nonresonant and resonant (i.e. via the a_0)

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†see http://www.fz-juelich.de/ikp/anke for the collaboration list

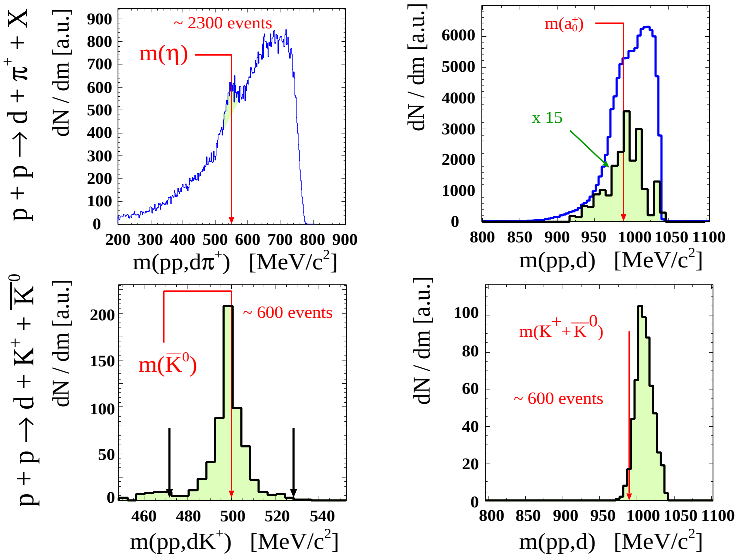

Figure 1: Preliminary missing mass distributions of coincident $d\pi^+$ (upper figures) and dK^+ pairs (lower figures) at $T_p = 2.65$ GeV (without efficiency and acceptance correction).

$K\overline{K}$ production. The dotted line represents nonresonant production assuming a P-wave between the kaons. Our data seem to favor S-wave production in the kaon system which is consistent with the dominance of a_0^+ production. The mass distribution $m(pp, K^+)$ is sensitive to the $d\overline{K}$ FSI, mediated e.g. by the $\Lambda(1405)$ resonance in the $n\overline{K}^0$ system. As an example two calculations (taken from Ref. [5]) are compared to the data with not yet fixed parameters for the $K\overline{K}$ and $d\overline{K}$ FSI (solid line) and without any FSI (dashed line). An improved fit to the data with a refined parameter set is in preparation.

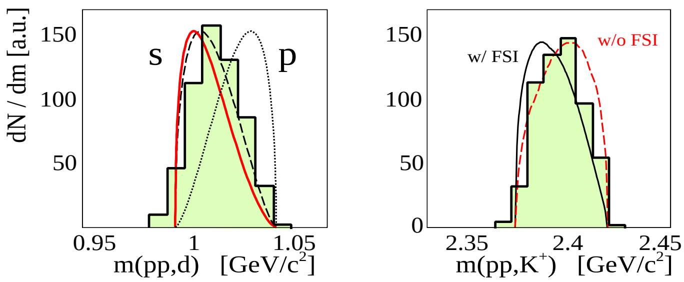

Figure 2: Preliminary acceptance corrected mass distributions of coincident dK^+ pairs.

References

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