Investigation of the $a_0^+(980)$ Resonance in the Reaction $pp \to dK^+\overline{K^0}$ at ANKE*

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Despite of the various experiments on the light scalar resonances $a_0(980)/f_0(980)$ their internal nature is not yet understood. They are interpreted as genuine mesons, as $K\bar{K}$ molecules or compact qq–$\overline{qq}$ states (for an overview see Ref. [1]). With several measurements at ANKE (and later WASA) in pp, pn, pd and dd interactions close to the $K\bar{K}$ threshold we want to determine yet unknown observables. The final goal will be the extraction of the charge-symmetry breaking a_0/f_0 mixing amplitude which is predicted to be large [2] but no unambigious signal has been observed up to now. The first two experiments on a_0^+ production (where mixing must be absent) have been performed in pp collisions in 2001 and 2002 at $T_p = 2.65$ GeV ($Q = 46$ MeV) and $T_p = 2.83$ GeV ($Q = 103$ MeV). From the measurement at the lower energy the total cross section of the reaction $pp \to dK^+K^0$ ($\sigma = (38 \pm 2 \pm 14)$ nb) as well as differential distributions have been extracted [3]. The corresponding mass and angular distributions are shown in Fig. 1. The experimental data have been fitted with the assumption that only s– and p–waves are present in the subsystems (s–waves everywhere are forbidden, higher partial waves suppressed). The result is shown by the solid curve corresponding to $\sim 85\%$ $K\bar{K}$ s–waves (dashed curve) and $\sim 15\%$ p–waves (short-dashed curve). Since $K\bar{K}$ pairs from an a_0 decay have to be in an s–wave, this is interpreted as a major contribution of a_0 production.

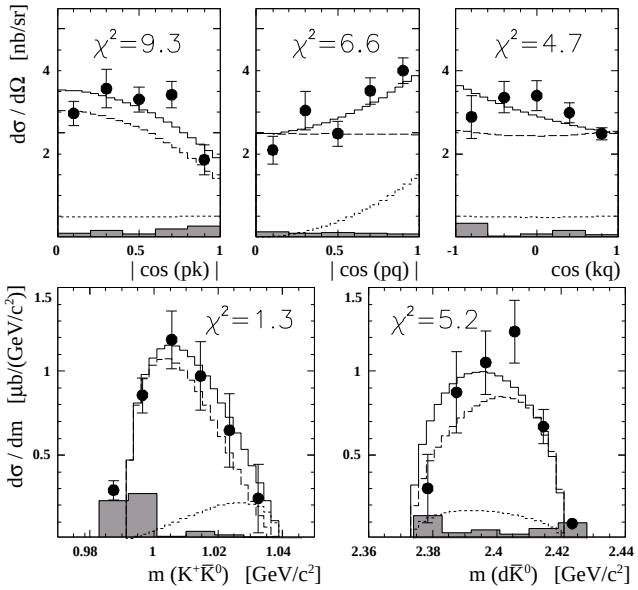

Fig. 1: Angular and mass distributions of $pp \to dK^+\overline{K}^0$ events. The error bars represent the statistical uncertainty whereas the shaded distribution reflects the systematic uncertainty imposed by the procedure of acceptance correction. The curves are described in the text.

The analysis of the reaction $pp \to d\pi^+\eta$ is more complicated due to a large background and is discussed in Ref. [4].

The data measured at the higher beam energy is still being analysed. We succeeded to identify K^+ mesons also in the so-called sidewall counters allowing us to investigate a wider kaon momentum interval. This became feasable due to a second layer of sidewall counters positioned about 1.5 m behind the first one. Setting a gate on the kaon TOF for the first sidewall counters reveals the kaon signals clearly and largely suppresses protons and pions in the second layer. With a second gate on TOF in these counters the kaon candidates are selected. Together with a coincident deuteron detected in the forward system the missing mass $m_X(dK^+)$ can be calculated and is shown in Fig. 2a. A clean $\bar{K}^0$ peak is visible. After selecting these events (indicated by the arrows) the missing mass $m_X(d)$ ($\equiv m_{inv}(K^+\bar{K}^0)$) is calculated (shown in Fig. 2b). Due to the higher beam momentum the accessible mass interval is much wider than for the previous measurement. The number of collected events is 2-3 times larger and corresponds to an estimated increase in the total cross section of also 2-3 times. The goal of the ongoing analysis is to again extract differential cross sections.

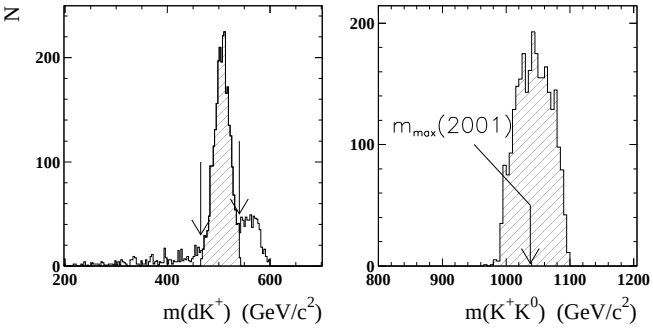

Fig. 2: Mass distributions of $pp \to dK^+\overline{K}^0$ events (see text).

References:

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