The process $pp \to da_0^+ \to dK^+\bar{K}^0$ near threshold and non-resonant $K^+\bar{K}^0$ background*

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Recently we have considered different mechanisms of $a_0(980)$-resonance production in πN and NN collisions [1]. These were also applied to the analysis of the $pp \to da_0^+(980)$ reaction. It turned out that the dominant contribution to this reaction is given by the u-channel mechanism which is depicted in the upper left diagram in Fig. 1. The calculated forward differential cross section of the reaction $pp \to da_0^+(980)$ is in a good agreement with existing experimental data at $p_{\rm lab} = 3.8 \div 6.3$ GeV/c from Berkeley [2]. The predicted a_0-resonance contribution to the total cross section of the reaction $pp \to dK^+\bar{K}^0$ is shown by the solid line in Fig. 2.

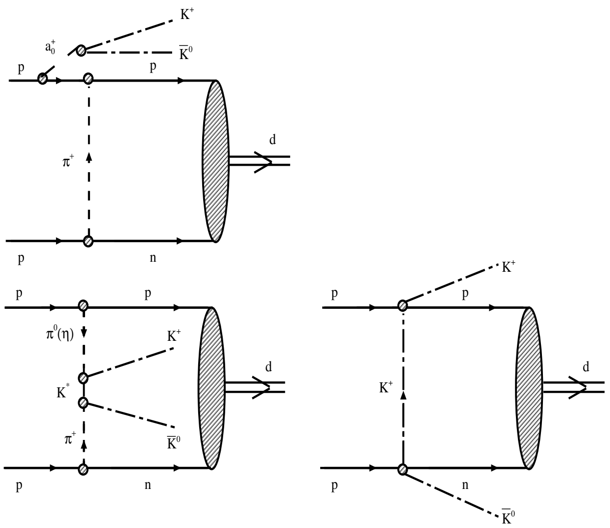

Fig. 1: Diagrams describing resonance (upper left) and non-resonance (lower left and right) mechanisms of the reaction $pp \to dK^+\bar{K}^0$.

It is to understand the nature of the non-resonant contribution to the total $pp \to dK^+\bar{K}^0$ cross section. In Ref. [3] we considered $\pi - K^\star - \pi(\eta)$ and K exchange mechanisms for the non-resonant $K\bar{K}$ production in $NN \to NNK\bar{K}$ reactions (similar diagrams for the reaction $pp \to dK^+\bar{K}^0$ are shown in lower part of Fig. 1). The calculated K-exchange contribution is negligibly small. To constrain the $\pi - K^\star - \pi(\eta)$ exchange contributions we used published data on the reaction $\pi N \to NK\bar{K}$. The results of the calculations for these cross sections in different isospin channels lead us to the conclusion that the a_0-resonance contribution is expected to be more pronounced at $Q \le 250$ MeV while the non-resonance background is essential at $Q \ge 250$ MeV.

Here we use these results to analyze the role of the non-resonant background in the $pp \to dK^+\bar{K}^0$ reaction. The diagrams describing $\pi - K^\star - \pi(\eta)$ and K exchange mechanisms are shown in the lower part of Fig. 1, respectively. The dashed, dash-dotted and dotted lines in Fig. 2 display the background contributions related to $\pi - K^\star - \pi$-, $\pi - K^\star - \eta$ and K exchange, respectively. According to Fig. 2 the resonant part is dominant up to $Q \simeq 60$ MeV. The background can give an important contribution at $Q \ge 100$ MeV. As follows from G-parity constraints, the $\pi - K^\star - \pi$ mechanism contributes to the P-wave in the $K^+\bar{K}^0$-system, while the $\pi - K^\star - \eta$ mechanism contributes to the S-wave. Since the latter contribution is comparatively small, the $K\bar{K}$ pair from the background will predominantly be in P-wave, while in the case of a_0 decay it must be produced in S-wave (see also Ref. [4]).

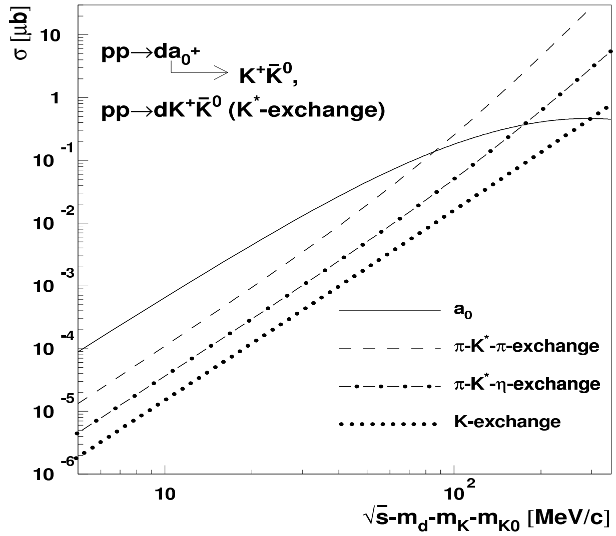

Fig. 2: Total cross section of the $pp \to dK^+\bar{K}^0$ reaction as a function of the c.m.s. excess energy. For all calculations described in this article the same parameters as in Ref. [3] were used.

Recently the cross section of the reaction $pp \to dK^+\bar{K}^0$ has been measured by the ANKE collaboration. A value of $\sigma_{\rm tot} = 38$ nb at $Q = 46$ MeV has been obtained [5] which is in good agreement with our predictions ($\sigma_{a_0^+ \to K^+\bar{K}^0} \sim 40$ nb, $\sigma_{\rm n.r.} \sim 20$ nb).

References:

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