Investigation of the $a_0^+(980)$ Resonance in the Reaction $pp \to d\pi^+\eta$ (*

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In January 2001 a first measurement on $a_0^+(980)$-resonance production with ANKE has been performed at a beam energy of T=2.65 GeV. Goal of the experiment is to detect a_0^+-resonance production in the reactions $pp \to dK^+\overline{K^0}$ and $\to d\pi^+\eta$. The analysis of the $K^+\overline{K^0}$ channel has been finalized and the results are published in Ref. [1] The status of the analysis for the reaction $pp \to d\pi^+\eta$ is presented here.

Deuterons and pions were detected simultaneously in the ANKE side and forward detection systems, respectively. Figure 1 (a) presents the missing mass $mm(pp, d\pi^+)$ spectrum for the selected $d\pi^+$ pairs, which exhibits a peak around the η mass, containing ~6200 events. This peak sits on a huge background from multi-pion production $pp \to d\pi^+\ (n\pi)\ (n{\geq}2)$ [2]. For events in the mass range $530 \div 560$ MeV/c^2 around the η peak, a shoulder at ~980 MeV/c^2 is visible in $mm(pp, d)$ (Fig. 1 (b)), where the peak from a Flatte distribution describing the $a_0^+(980)$ signal is expected.

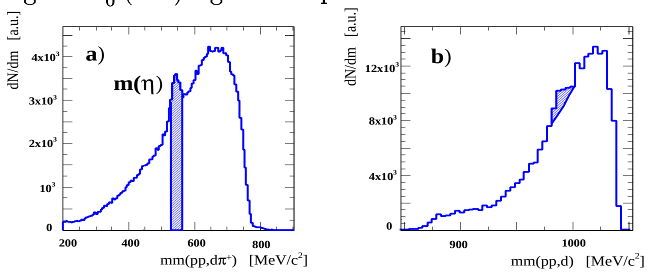

Fig. 1: Missing-mass distribution $mm(pp, d\pi^+)$(a) for the selected $d\pi^+$ pairs at T=2.65 GeV and $mm(pp, d)$(b), for the the selected events in the range $530 \div 560$ MeV/c^2 in $mm(pp, d\pi^+)$.

According to theoretical predictions [3, 4] the cross section of a_0^+ production is expected to be $\sim 1\mu$b, while for the nonresonant $\pi^+\eta$ production there are different estimations: from $0.6 \div 1.4\mu$b (our estimate) and $1.6 \div 3.3\mu$b [3] up to one order of magnitude higher [4]. The separation of the resonant and the nonresonant contributions is possible due to different acceptances for these reactions. For the GEANT simulation model distributions for the resonant [3] and the nonresonant [5] $\pi^+\eta$ production are used. Figure 2 shows the result of simulations for the deuteron momentum spectrum.

In the range $p_d = 1.4 \div 1.6$ GeV/c the contribution from the nonresonant process dominates and the resonant part can be neglected. Thus the cross section of the nonresonant contribution can be obtained in this momentum range from the number of events below the η peak in $mm(pp, d\pi^+)$ (Fig. 3(a)). After that, for the range $p_d = 1.6 \div 2.8$ GeV/c, where both the resonant and the nonresonant components are present, it is possible to calculate the number of events for nonresonant production taking into account the different acceptances. Finally, the number of a_0^+ events is given by the difference between the total number of events under the η peak (Fig. 3(b)) and the calculated amount of the nonresonant events.

The following values of the total cross sections (relying

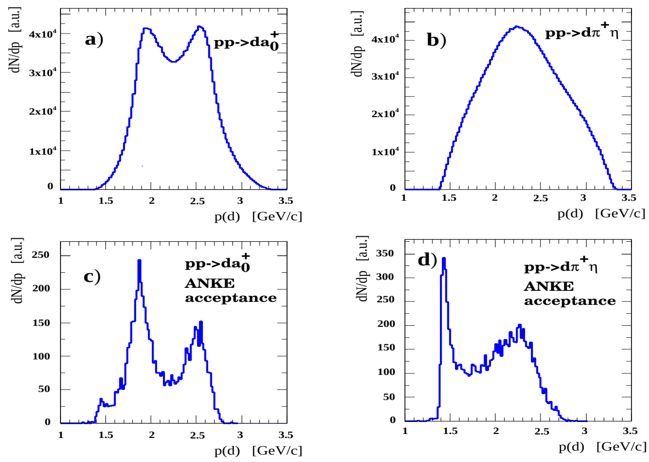

Fig. 2: Simulated deuteron-momentum spectra for resonant (a, c) and nonresonant (b, d) $\pi^+\eta$ production. The upper (lower) spectra show the distributions at the target and of the events detected at ANKE, respectively.

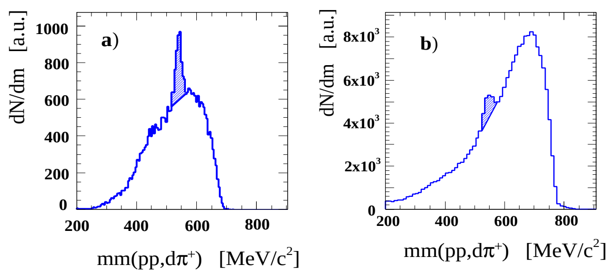

Fig. 3: Missing-mass distribution $mm(pp, d\pi^+)$ for the momentum ranges $p_d = 1.4 \div 1.6$ GeV/c(a) and $p_d = 1.6 \div 2.8$ GeV/c(b).

on the models from Refs. [3, 5]) have been obtained: $\sigma_{a_0} = (1.1 \pm 0.2 \pm 0.7)\mu$b for a_0^+ production and $\sigma_{\mathrm{n.r.}} = (3.5 \pm 0.2 \pm 1.0)\mu$b for nonresonant $\pi^+\eta$ production. Taking into account the value of the total cross section $\sigma(pp \to da_0^+ \to dK^+\overline{K^0}) = 0.83 \times (38{\pm}2{\pm}14)$ nb [1], the branching ratio is $BR(KK/\pi\eta) = 0.029 \pm 0.005 \pm 0.02$. This is in agreement with model calculations [3, 6], $BR(KK/\pi\eta) \approx 0.04$, for this beam energy.

References:

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