MESON PRODUCTION IN THE $\vec{p} + d \to {}^3\mathrm{He} + X$ REACTION AT SPES 3 AT $\mathrm{E_{inc}}$= 1450 MeV

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(Received October 9, 1996)

Selected results of the meson production study in the $\vec{p} + d \to {}^3\mathrm{He} + X$ reaction realized with the SPES 3 spectrometer at SATURNE will be presented and related to a semiphenomenological three nucleon model.

PACS numbers: 13.60. Le

The aim of the experiment was to study the angular distribution of the analyzing power and the cross section for meson production in the $\vec{p} + d \to {}^3\mathrm{He} + X$ reaction at $\mathrm{E_{inc}}$= 1450 MeV. The results provide new infromation on the role played by higher partial waves in the meson production mechanism and present an important testing ground for the three nucleon model by Fäldt and Wilkin [1], describing this reaction with a two step process. The $pp \to d\pi^+$ reaction as a first step producing an intermediate π^+ is followed by the $\pi^+ n \to pX$ interaction of the π^+ with the remaining neutron of the target-deuteron.

In the following, first some results on the obtained analyzing power A_y for the π^0 and η-production will be summarized, followed by a short discussion of the angular distribution of the meson production cross-section. A more detailed presentation of the results and the experiment itself can be found in [2] and will be given in another publication.

Under the reasonable assumption, that the polarization observable is isospin independent the obtained $\pi^0 - A_y$ distribution can be compared to the results of the $\vec{p}d \to {}^3\mathrm{H}\pi^+$ reaction obtained by Kerboul *et al.*[3]. The good agreement shows the reliability of the data reduction and analyzing procedure. The $\pi^0 - A_y$ distribution can be compared to the η analyzing power because the two particles have the same spin structure. At present the relative sign of the A_y between the π^0 and η distribution is not yet fixed definitively by the analysis (investigations are going on). If the presently

assumed sign will be confirmed, the comparison of both distributions shows an interesting phenomena. Plotted as a function of the reaction momentum transfer in the center of mass system ($Q^* = p_f^* - p_i^*$, with p_f^* and p_i^* being the final and initial momentum), the experimental points seem to follow the same curve (see Fig. 1). Although the points vary strongly and the error bars are still relatively large this could be an indication for the presence of a common reaction mechanism. This hypothesis of a common process could fit to the two step mechanism of the three nucleon model indicated above, for which the polarization observables of the $\vec{p}d$ reaction would be determined by the $\vec{p}p \to d\pi^+$ reaction step. It would be interesting to describe these A_y distribution data by introducing a parametrization of experimental $\vec{p}p \to d\pi^+$ results in the three nucleon model. The distribution

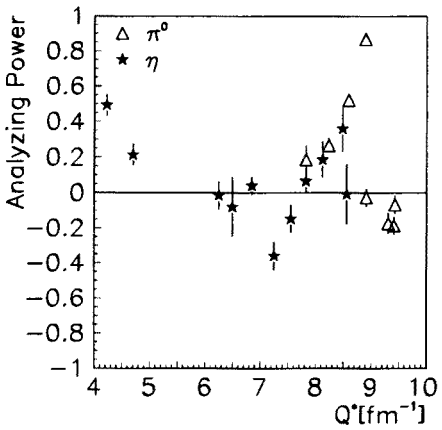

Fig.1

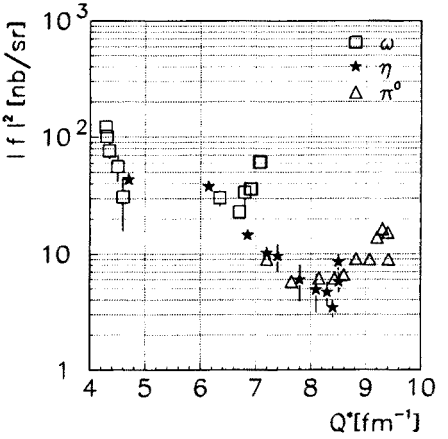

Fig.2

Fig.1. The analyzing power for the π^0 and η meson production are plotted versus the momentum transfer Q^* of the $\vec{p} + d \to {}^3\mathrm{He} + X$ reaction.
Fig.2. The averaged squared amplitude $|f|^2$ for the π^0, η and ω production is plotted versus the momentum transfer Q^* of the $\vec{p} + d \to {}^3\mathrm{He} + X$ reaction.

of the π^0 differential cross-section plotted as function of the meson scattering angle in the center of mass system shows a minimum of about 4 nb/sr around 120° and an increase towards 90°. At 180°, the extrapolated cross-section is 9.7 ± 1 nb/sr which fits perfectly in the π^0 excitation function measured by Berthet *et al.*[4]. A good agreement is also found for the backward scattering of the η with 4.3 ± 0.7 nb/sr at 172°, compared to the Berthet value at 180° of 4.4 nb/sr. Interesting to see is the strong increase of the cross section for angles $\leq 90°$. An extrapolation towards small angles reveals a strong forward-backward asymmetry, which would mean that at 1450 MeV the η production is no longer dominated by the excitation of the $S_{11}(1535)$

resonance. For the ω production the whole phase space was covered by the experiment. Forward and backward scattering can be compared directly without extrapolation. The cross-section at 0° with 29.6 ± 2.8 nb/sr is about a factor of two higher than at 180°. This strong anisotropic behaviour gives some clear indications for the presence of higher partial waves for the above threshold production of the ω meson. In order to compare the production of the three mesons we can determine the averaged squared amplitude $|f|^2$ by factoring out the phase space :

$$|f|^2 = \frac{p_i^*}{p_f^*} \frac{d\sigma}{d\Omega^*} .$$

In Fig. 2 this amplitude is plotted versus the momentum transfer Q^*. Most of the data points seem to be aligned on the same curve. It seems as if the reaction amplitude would only depend on the transferred momentum and not on the meson type produced in the exit channel. Again this supports the possibility of a common production process for all three mesons. In the three nucleon model this could be the $\pi^+ n \rightarrow pX$ second step process, with a momentum transfer via the intermediate π^+, created in the first step. It would be interesting to test whether this three nucleon model with its promising results for particle production at lower energies would also give a valid description at higher energies.

As conclusion we can say, that the data represent strong constraints for the extension of theoretical models to energies further above threshold. The data support the three nucleon model and stress the necessity of the further investigation of the reactions $\pi^+ n \rightarrow pX$ and $pp \rightarrow d\pi^+$ for a better understanding of the meson production mechanism.

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