Study of the multi pion production d+p→^{3}He+N·π close to the η-production threshold at ANKE*

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In January 05 the reaction d+p → ^{3}He+η was studied at ANKE [1]. Due to the fact that the reaction of interest was measured by detection of the ^{3}He nuclei and reconstruction of the η meson via the missing mass technique, data on the multi pion production near the η threshold was additionally obtained with the same trigger.

The multi pion production causes background in the missing mass spectrum. For the separation of the η signal from this background a systematic study of the multi pion production near the η threshold is required. This can be done by investigating ^{3}He events with a coincidental detected π^- meson.

Additionally to the forward detector used for the ^{3}He detection, the negative system of the ANKE experimental setup was used to detect π^- mesons. The data presented here was obtained at an excess energy of Q = 20 MeV relative to the η threshold and a fixed beam momentum of 3.223 GeV/c.

In the following analysis only events with a coincidental hit of a ^{3}He nucleus in the forward detector and a π^- meson in the negative system are used. The ^{3}He nuclei were identified as described in [2]. T At the used beam energy, particles detected by the negative system in coincidence with a ^{3}He nucleus hit in the forward system can only be pions or leptonic background.

η mesons which decay into pions can be reconstructed via the missing mass of ^{3}He nuclei (figure 1a). The analysed data (filled histogram) is compared to ANKE Root simulations of the specified reactions distributed according to phase space. The expected peak resulting from d+p →^{3}He + η [π^+ π^- π^0] can not yet be explicitly separated here from the multi pion background. However it is expected that a better description of the background as explained in [2] will make this possible.

Multi pion production can be identified in the missing mass distribution of the ^{3}He π^- system (figure 1b). The two charged pion production leads to the left peak at the mass of the π^+ meson which agrees well to the expected distributon. Furthermore, the simulations indicate that the structure on the right hand side of the spectrum results mainly from the reactions d+p → ^{3}He + η [π^+ π^- π^0] and d+p → ^{3}He + π^+ π^- π^0.

The relative contribution of the reaction ^{3}He + η [π^+ π^- π^0] can be quantified as described in [2]. By this the contribution of the direct production of three pions can be determined.

Although there is only a limited angular acceptance for π^- mesons in the negative detector system as visible in figure 1c, the data can help to understand the behaviour of the background in the η analysis. A comparison with the results of other experimental setups with a better angular acceptance for these reactions [3] can be done.

Furthermore, events with two π^- mesons detected in the negative system can be selected to study the four pion production which can cause a background below the η missing mass peak. Due to the fact that the threshold of this reaction is above the η threshold, a study using η subthreshold data is not possible. Even in case that the four pion production is suppressed as expected, an extracted upper limit for the cross section of the four pion production is of high value for the background determination of the η data.

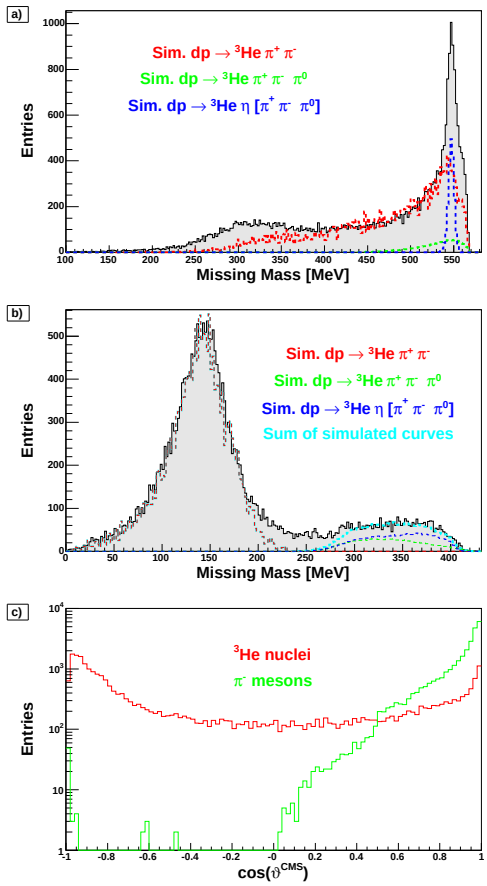

Fig. 1: Spectra for events with a coincident detection of a ^{3}He nucleus and a π^-

a) Missing Mass distribution of detected ^{3}He nuclei compared with ANKE Root simulatons of the given reactions.

b) Missing Mass distribution of the ^{3}He π^- system compared with ANKE Root simulations of the given reactions.

c) Reconstructed scattering angle in the center of mass system for the measured ^{3}He nuclei and π^- mesons.

References:

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* Supported by FZ-Jülich FFE