Study of η-Meson Production in the Reaction pd → ^{3}He η at COSY-11*

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At COSY-11 [1], measurements on the η- and η′-meson production in the proton-proton scattering have been extended by production measurements in the proton-deuteron interaction, e.g. studies on the reaction channels pd → ^{3}He η (η′) [2,3].

In addition to the elementary nucleon-nucleon reactions the production of mesons using heavier targets provides the possibility to study reaction processes with more than only one involved target nucleon. These data sets in the near threshold region are valuable for the development of theories on η- and η′-meson production in the elementary nucleon-nucleon scattering and the verification of their predictions [4,5], which may also be important in the context of understanding the production processes for these mesons in heavy ion collisions. Furthermore, close to threshold data on the pd → ^{3}He η reaction are of great interest to study the strong attractive η-nucleus interaction at low energies, which might be a signal for the existence of quasi-bound η-nucleus states.

At COSY-11 data on the reaction channel pd → ^{3}He η have been taken in the range of excess energies ranging from Q = 5 MeV up to Q = 40 MeV. The COSY-11 standard procedure for particle identification is the track-reconstruction of positively charged particles through a well known magnetic field by means of a set of two drift chambers, yielding a precise momentum determination, followed by a time-of-flight measurement by a set of two scintillator hodoscopes. Detected ^{3}He-nuclei can be separated in a ΔE/p plot from pions, protons and deuterons due to the comparatively large energy loss of the ^{3}He-nuclei in the scintillation detectors. The η-meson itself is identified using the missing mass technique.

In Fig. 1 the extracted production amplitude for these data

$$|f|^2 = \frac{p_d}{p_\eta} \cdot \frac{d\sigma}{d\Omega}$$

is presented as function of the center of mass η-meson momentum p_η (filled circles) and compared with results from other experiments. These new COSY-11 data fill the open gap between the very near to threshold data (SPES-II) and data at higher energies (WASA-PROMICE and COSY-GEM) and confirm the strong increase of $|f|^2$ with decreasing excess energies. This behavior is interpreted to be caused by the strong attractive η-nucleus interaction.

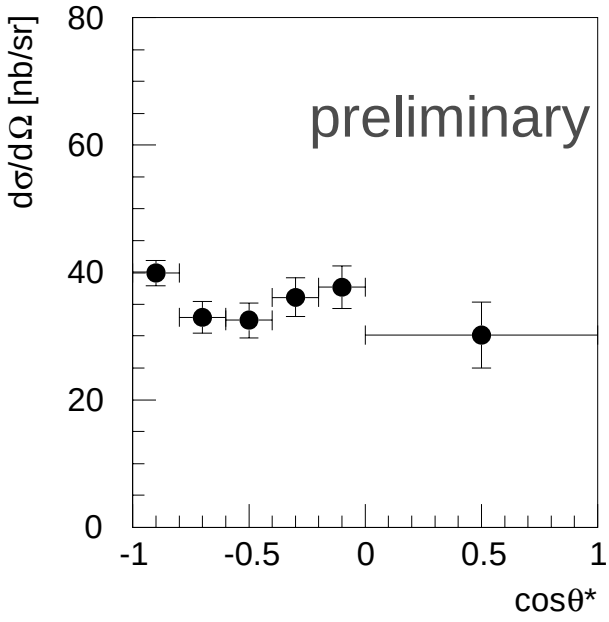

Fig. 2: Angular distribution of the detected ^{3}He nuclei in the center of mass system, obtained at an excess energy of Q = 11 MeV.

In Fig. 2 an angular distribution for the detected ^{3}He nuclei is given exemplarily for Q = 11 MeV. Comparing the COSY-11 results from Q = 5 MeV up to Q = 40 MeV a transition from an almost flat distribution at lower excess energies to a non-isotropic emission at higher energies is observed, which is consistent with available data sets.

References:

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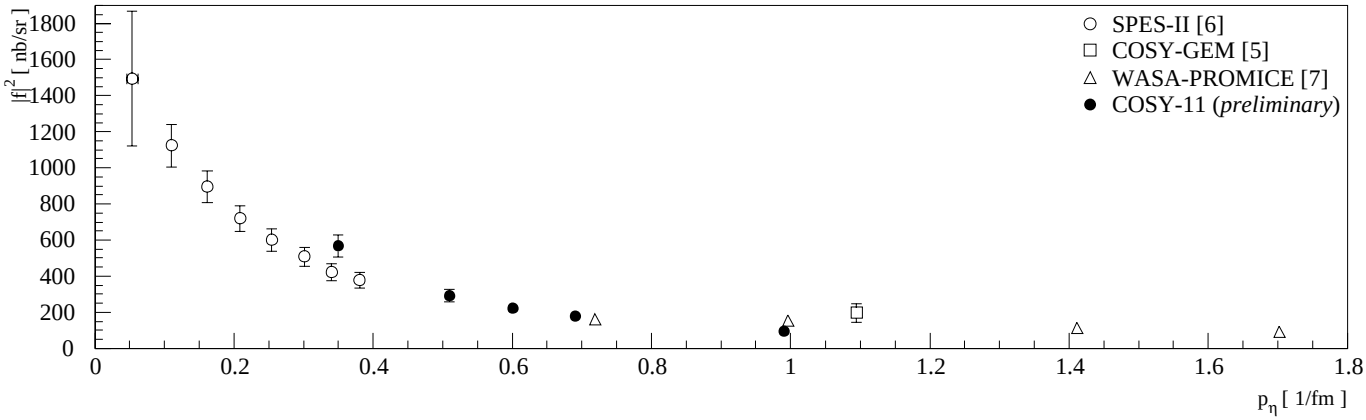

Fig. 1: Production amplitude for the reaction pd → ^{3}Heη.