Results on η-Production in the Reaction $pd \to {}^3He\ \eta$

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The study of near-threshold η-meson production in proton-deuteron scattering is motivated by the discussion of the underlying production processes. The existing data are described by two competing models. In the two-step model [1, 2] in the first step the proton and one deuteron nucleon interact and a pion is emitted, which itself interacts in a second step with the remaining nucleon to create the η. Different to this, the resonance model describes the η-production via the excitation of the S_{11} resonance $N^*(1535)$ [3]. Existing data, covering the nearest threshold region up to excess energies of 7 MeV [4] and one data point at 50 MeV [3] cannot be described as a whole by one of these models. In order to clarify the situation, measurements were carried out at COSY-11 at four different excess energies between 5 and 20 MeV.

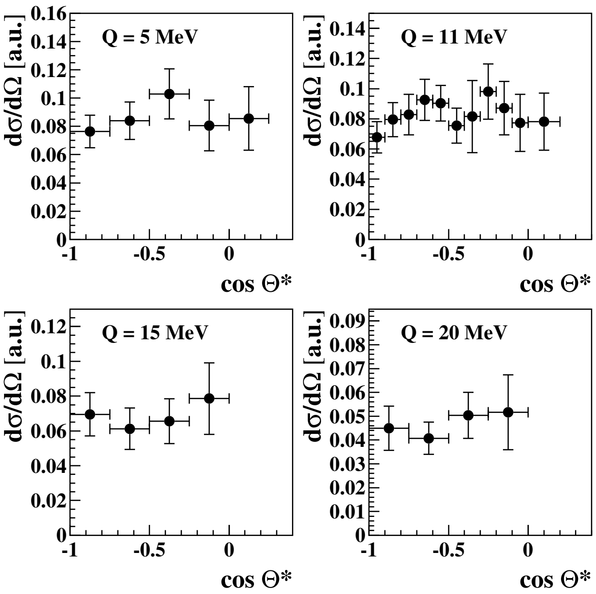

Figure 1: Differential cross sections for the reaction $pd \to {}^3He\,\eta$, referring to the scattering angle of the produced ^{3}He nuclei. The data are taken from [5] and [6].

At COSY-11 the four-momenta of positively charged particles can be completely reconstructed. For the identification of undetected particles or systems of particles the missing mass method is used.
For the determination of differential cross sections missing mass spectra have been produced for different bins of the center of mass scattering angle Θ^* of the ^{3}He nuclei. In each of these spectra the missing mass peak has to be separated from the background and the content of the η peak has to be corrected for acceptance.
Figure 1 shows differential cross sections of the reaction $pd \to^3 He\ \eta$ at four excess energies. As can be seen, even at excess energies of up to 20 MeV the data are in accordance with the assumption of an isotropic scattering.

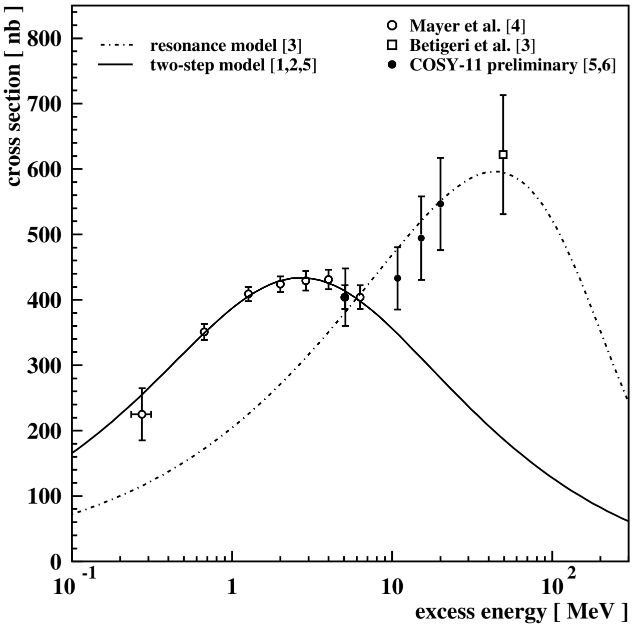

Figure 2: Excitation function of the reaction $pd \to {}^3He\ \eta$ near threshold.

For the determination of total cross sections the data have to be normalized for the luminosities. The monitoring of the luminosity is done by simultaneous measurement of the elastic scattering process $pd \to pd$. The absolute normalization can be achieved by comparing the measured differential data to literature data. As this is not yet done, the COSY-11 data point at an excess energy of 5 MeV was fixed to the one measured in Saclay at the same beam momentum; as the relations of the luminosities at the other energies are known, the excitation function in the intermediate excess energy region can be filled with the COSY-11 cross sections. The result is shown in Figure 2. It has to be pointed out that the data have been taken within approximately 2.5 days of measurement each and that the statistics shown correspond to roughly 2/3 of the complete data sample. The COSY-11 data suggest that there is a transition between the two-step process and the resonant production. Nevertheless, for a better understanding of the shape of the excitation function, more data in the near threshold region are needed.

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