Investigation of the ^{3}He η Final State in dp-Reactions at ANKE*

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The existence of η-mesic nuclei is still an open issue of research. To investigate the possibility of the formation of such bound systems, production measurements with one η meson and one light nucleus in the final state are of great interest. By studying the final state interaction at low excess energies, information about the poles in the scattering amplitude of the η-nucleus system can be gained.

In this context the reaction d+p→ ^{3}He+η is of high interest. However, available data sets at higher excess energies expose clear discrepancies [1]. A single data sample with minimized systematic uncertainties over the whole energy range is needed to solve this problem.

Therefore, the reaction d+p→ ^{3}He+η has been investigated using the ANKE spectrometer from threshold up to an excess energy of Q = 60 MeV [2]. The performed measurement can be seperated into two parts. For the near threshold part a continuously ramped accelerator beam at excess energies ranging from below threshold (Q = -5.1 MeV) up to Q = +11.3 MeV was used [3]. The part at higher excess energies was done with fixed values of Q = 19.5, 39.4 and 59.4 MeV [4].

In the latter case the extraction of the η signal from the missing mass spectrum is done by fitting simulations of the background reactions to the real data and to substract them from the data. In order to determine the differential cross section for each excess energy, the whole range of the ^{3}He c.m. production angles was divided into 20 bins and a missing mass distribution constructed for each of them.

The d+p→^{3}He+η angular distributions obtained at the three high excess energies Q are displayed in figure 1. Also shown are the points measured by the WASA/PROMICE collaboration and polynominal fits to the ANKE data. The ANKE and WASA data are generally in agreement with each other, though our data have smaller statistical error bars and cover the complete cos(θ) range. One important difference is that there is no sign of a forward dip at 19.5 MeV and that any at 39.4 MeV is much weaker than the one found by WASA. The result from the polynominal fits prove that *s* and *p* waves are sufficient to describe the 19.5 MeV data and that *d* and higher partial waves are required to describe the 39.4 and 59.4 MeV data.

The obtained total cross sections are displayed in figure 2. The comparison with other results shows that ANKE and WASA/PROMICE are within their statistical error bars in agreement with each other. The rise between 20 and 40 MeV in both data sets possibly reflects the increased influence of higher partial waves.

Together with the results from the continous ramp data [3] the new data form a complete differential and total cross section sample from treshold up to 60 MeV excess energy for the d+p→ ^{3}He+η reaction.

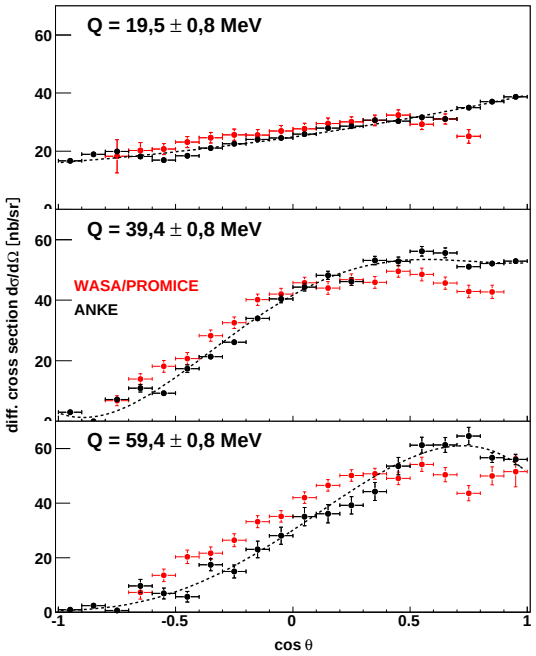

Fig. 1: Differential cross sections for the three excess energies studied at ANKE (black circles) [4]. The WASA/PROMICE data (red circles) shown in the 60 MeV plot were measured at 80 MeV [5]. The black dotted lines represent polynomial fits to the ANKE data.

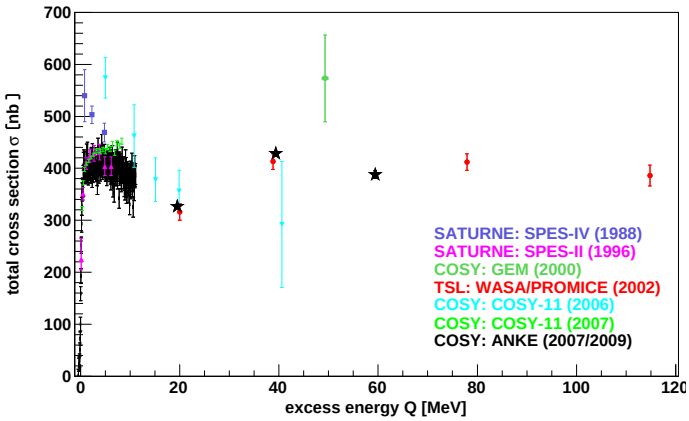

Fig. 2: Comparison of the extracted total cross sections (black stars) [4] with previous data: Ref. [3] (small black circles), Ref. [5] (large red circles), Ref. [6] (large blue squares), Ref. [7] (magenta triangles), Ref. [8] (large green circle), Ref. [9] (inverted cyan triangles), Ref. [10] (small green circles).

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