

Measurement of the $dp \rightarrow {}^3\text{He}\eta$ reaction close to threshold

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Study of the $dp \rightarrow {}^3\text{He}\eta$ reaction is of high interest due to a very strong effect of the final state interaction which was observed in the near-threshold data measured at the SPES-4 [1] and the SPES-2 spectrometer [2]. This effect can be interpreted as a possible manifestation of the ${}^3\text{He} - \eta$ bound state [3]. The measured cross sections do not allow, however, for a reliable determination of the ${}^3\text{He} - \eta$ low energy scattering parameters due to inconsistencies between the data sets, and due to possible contributions from higher partial waves [4]. In order to resolve these inconsistencies and to check the possible onset of higher angular momenta, we performed high precision measurements of the total and differential cross sections of the $dp \rightarrow {}^3\text{He}\eta$ reaction.

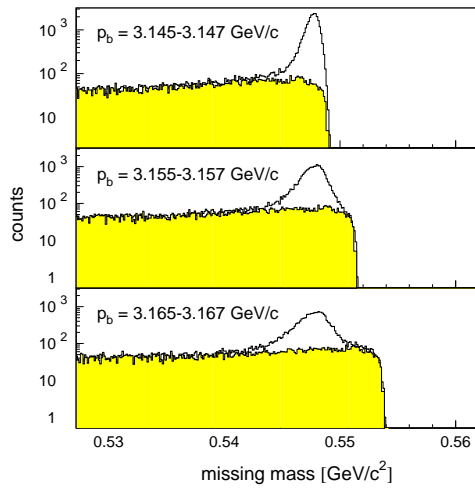


Fig. 1: Missing mass spectra for three different beam momentum intervals above the η production threshold.

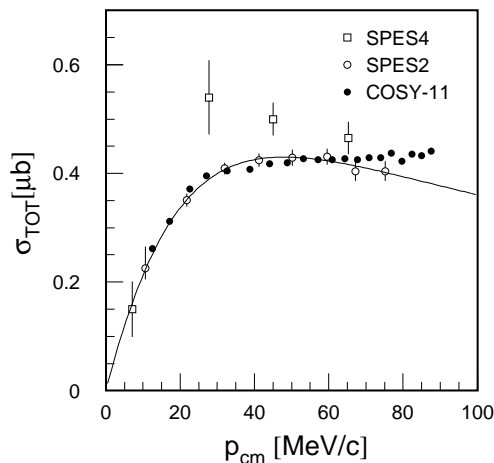


Fig. 2: Total cross section for the $dp \rightarrow {}^3\text{He}\eta$ reaction as a function of the ${}^3\text{He}$ c.m. momentum. The solid line represents the scattering length fit to the SPES-2 data.

The experiment was conducted with the internal deuteron beam of COSY scattered on a proton target of the cluster jet type and with the COSY-11 facility detecting the charged reaction products. For reduction of various possible systematical uncertainties, the measurements were performed during a slow acceleration of the beam with the nominal beam momentum continuously varied from 3.099 GeV/c to 3.179 GeV/c, crossing the threshold for the $dp \rightarrow {}^3\text{He}\eta$ reaction at 3.141 GeV/c. Identification of the ${}^3\text{He}$ ejectiles was based on the energy loss in scintillation counters and, independently, on the time-of-flight measured on a path of 9 m between two scintillation hodoscopes. The η mesons were identified via the missing mass technique (see Fig. 1). The luminosity was monitored using coincident measure-

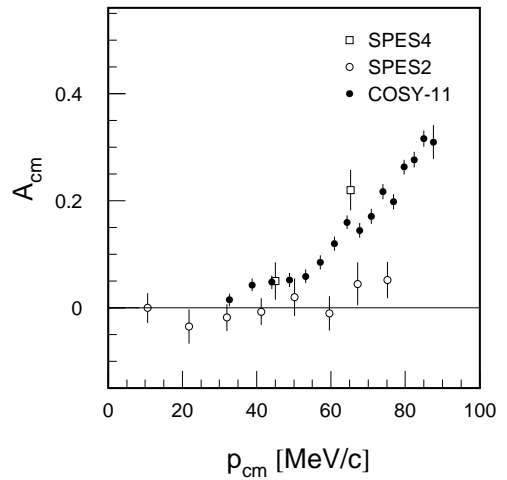


Fig. 3: Forward-backward asymmetries of angular distributions of ${}^3\text{He}$ in c.m. system.

ment of the elastic $d - p$ scattering and, independently, of the $p - p$ quasi-free scattering. The preliminary results on the total cross section dependence from the ${}^3\text{He}$ center-of-mass (c.m.) momentum are shown in Fig. 2. They are consistent with the SPES-2 results, however, at higher momenta, they deviate from the scattering length fit to the SPES-2 data [2]. The forward-backward asymmetries of the differential cross sections in the c.m. system are shown in Fig. 3. They deviate clearly from zero for c.m. momenta above about 40 MeV/c. This effect indicates a presence of higher partial waves in the final state and it can result from the S- and P-wave interference.

References:

- [1] J. Berger et al., Phys. Rev. Lett. **61**, 919 (1988).
- [2] B. Mayer et al., Phys. Rev. **C 53**, 2068 (1996).
- [3] C. Wilkin, Phys. Rev. **C 47**, R938 (1993)
- [4] A. Sibirtsev et al., Eur. Phys. J. **A 22**, 495 (2004).

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