The Reaction $pd \to {}^3He\ \eta(\eta')$ at COSY–11

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Previous investigations in Saclay [1,2] on the $pd \to {}^3He\ \eta$ reaction in the near threshold region lead to theoretical interpretations of the production mechanism like double scattering processes [3,4]. Such calculations of the total cross sections at excess energies $\epsilon < 7$ MeV are in good agreement with the Saclay data, but underestimate the cross sections derived by the GEM collaboration as well as preliminary results of the CELSIUS collaboration at higher energies ($\epsilon > 40$ MeV) [5,6]. Since in the intermediate energy region no data exist, it was proposed to study the η–production in the pd scattering predominantly at excess energies up to $\epsilon = 40$ MeV.
First measurements on the η– and η'–production at $\epsilon = 10$ MeV and 40 MeV were performed using the COSY–11 detection system.
COSY–11 is an internal experiment, utilizing a set of two drift chambers and two scintillation walls for the identification of positively charged particles and the precise reconstruction of their four–momenta. The ${}^3He$–nuclei are separated from background–particles (π^+, p, d and t) by their high energy loss in the scintillators. Undetected particles are identified via the missing mass method and thus there exists a non–negligible background from multi–pion production.

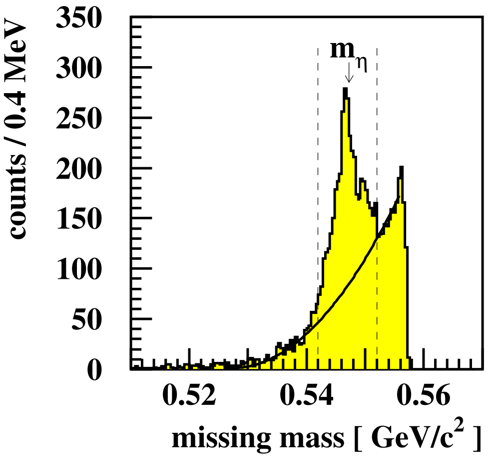

Figure 1: Missing mass distribution for the reaction $pd \to {}^3He\ \eta$ at an excess energy of $\epsilon = 10$ MeV.

The resulting missing mass distribution for the $pd \to {}^3He\ X$ reaction at $\epsilon = 10$ MeV for η–production is shown in figure 1. There is a clear peak in the region of the mass of the η with a FWHM of ≈ 6 MeV and an integrated η–production yield over background contributions of 1:1 within a 3σ width of the η peak. This is in accordance with Monte Carlo simulations, assuming two pion production to be the only background mechanism.
The knowledge of the angular distribution is essential.

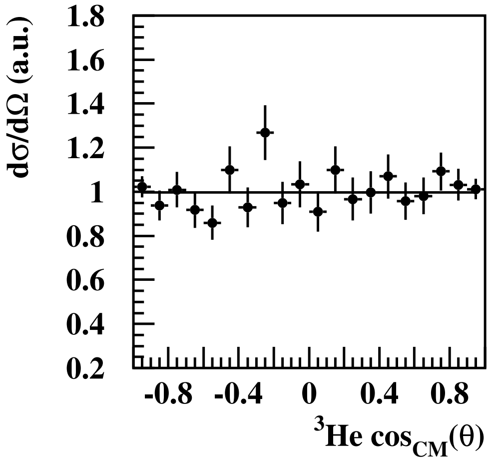

Figure 2: Angular distribution of the ${}^3He$ nuclei in the center of mass system.

Therefore, Monte–Carlo simulations have been used to correct the data for the limited spatial acceptance. Figure 2 shows the ratio of the ${}^3He$ angular distribution of the simulations with the real data. In agreement with results from [1] also at $\epsilon = 10$ MeV the data are consistent with pure S–wave scattering.
These first results show the excellent capability of COSY–11 for the detection of ${}^3He$. Further measurements on $pd \to {}^3He\ \eta$ and η' are in preparation.

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