Measurements on the Reaction p + d $\rightarrow$ d + p_{spec} + η at ANKE

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The production of η mesons in the reaction $p+n \rightarrow d+\eta$ has been measured in summer 2002 using the ANKE spectrometer at beam momenta of 2.055 GeV/c and 2.095 GeV/c. Due to the absence of pure neutron targets, the Münster cluster target has been operated with deuterium gas [1], acting as an effective neutron target and leaving the remaining proton as a spectator particle. This outgoing spectator proton carries a momentum which corresponds to the Fermi-momentum of the nucleons in the deuteron at the moment of the interaction. Since in the initial state of the reaction the target is at rest, the neutron in the deuteron has to carry the opposite momentum to fulfill momentum conservation. With the excess energy changing with the Fermi-momentum distribution it is possible to scan, with only one fixed beam momentum, a broad range of excitation energies, if the total energy is determined on an event by event basis. Therefore, for the studied reaction channel $p+d \rightarrow d+p_{spec}+\eta$ in addition to the detection of the outgoing deuterons the four-momenta of the emitted spectator protons will to be determined, allowing to identify the η production using the missing mass method. For this purpose a dedicated spectator detector, which consists of three layers of vertically segmented silicon detectors [2], has been placed close to the interaction point (Fig. 1).

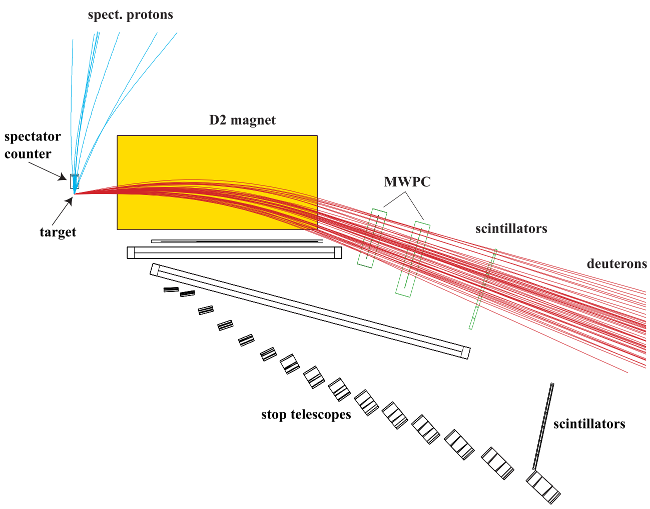

Fig. 1: Detection scheme at the ANKE experiment.

Currently, the data are evaluated using the new software-environment RootSorter [3] which replaces the old xd-based sorter software. The event selection is performed by accepting events with one deuteron detected in the forward detection system and one proton detected in the spectator counter. The particle identification in the spectator detector can be performed with a high accuracy using the ΔE/ΔE method (Fig. 2).

In Fig. 3 the energy losses of the corresponding hits in the forward scintillation hodoscope are presented as a function of the reconstructed particle momenta. As expected at intermediate reconstructed momenta a clear signal from a deuteron band above the proton band is obvious. In the further analysis these deuterons will be cleaned from the proton signals in order to identify the η meson production with a background as low as possible. This background itself is mainly caused by proton hits arising from the elastic proton-deuteron scattering as well as from the quasi-elastic proton-proton scattering which in turn can be used for normalization studies.

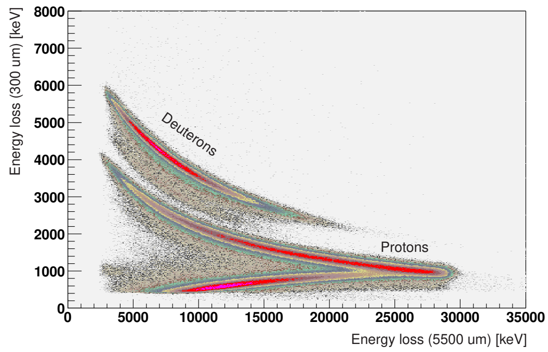

Fig. 2: Energy loss in the second layer of the spectator detector as function of the energy loss in the third layer.

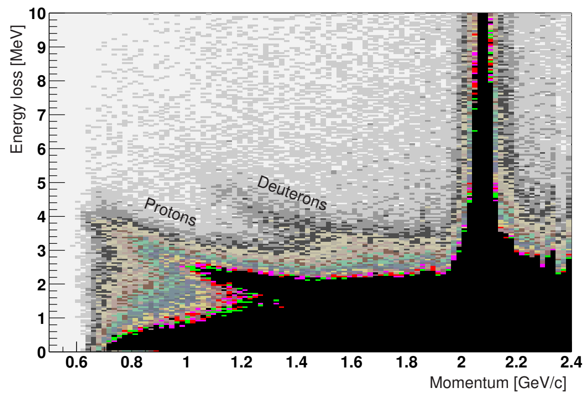

Fig. 3: Energy loss in the first forward hodoscope layer versus the reconstructed momentum of the ejectiles.

References:

[1] H.-H. Adam et al., *Deuterium Recuperation for Cluster Targets at COSY*, Annual Report 1999, Jül-3744, p. 52

[2] I. Lehmann, Studies on a Detection System for Spectator Protons at ANKE, Diploma Thesis 2000

[3] V. Hejny, M. Hartmann and A. Mussgiller, ANKE RootSorter, Users Guide 2002

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