Identification of the $pn \to d\omega$ reaction at ANKE

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As it was reported in [1], the experiment aimed at the determination of total and differential cross sections of the $pn \to d\omega$ reaction in the excess energy range $Q < 100$ MeV has been carried out at ANKE. The pn initial state was defined event-by-event due to the detection of a "spectator" proton (p_{sp}) emitted from the windowless deuterium cluster target. Two Silicon Tracking Telescopes (STT) were installed close to the deuterium jet to provide the momentum reconstruction for protons with kinetic energy from 2.7 MeV to 30 MeV. Since the ANKE acceptance for ω-decay products is very small, the reaction under investigation has to be identified among other $pd \to p_{sp}dX$ reactions.

Deuterons arisen from the $pn \to d\omega$ reaction within the (1.2 - 2.7) GeV/c momentum range, as well as other fast charged particles, were detected in the Forward detector consisted of 3 multiwire chambers, 17 scintillator detectors arranged in 2 layers and one layer of 16 Cherenkov counters. Having determined momenta of particles, one can separate fast deuterons from a large proton background by means energy losses in scintillators in combination with Cherenkov counter responses as presented in Fig. 1.

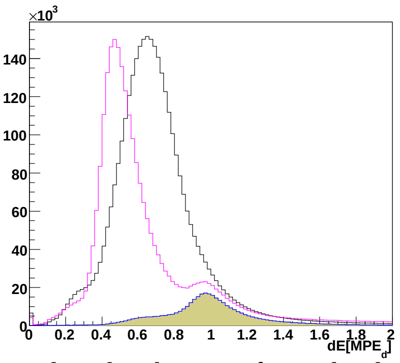

Fig. 1: Energy loss distributions of particles detected in one layer of 9 Fd scintillator detectors. The energy is presented in units of the most probable deuteron energy loss (MPE$_d$) which is momentum dependent. Shown in black is the initial distribution divided by the factor 5. It is dominated of the proton component. A cut on Cherenkov signal amplitudes effectively suppresses a high-momentum proton contribution and produces the distribution shown in magenta. The shadowed distribution is obtained for particles those energy losses in another scintillator layer are, in addition, restricted to the (0.8 - 1.5) MPE$_d$ range.

Finally, particles populating the shadowed histogram in Fig. 1 within the (0.8 - 1.5) MPE$_d$ range were accepted as deuterons. Using the method described in [2], the efficiency of deuteron separation was determined to be about 85%.

The histogram in Fig. 2 represents general features of a missing mass distribution from the $pd \to p_{sp}dX$ reaction. The large physical background from a multi-particle production is strongly peaked near the kinematical limit due to a specifics of the Fd acceptance. A clear evidence for the ω-peak can be still achieved at $Q > 60$MeV. However, at lower Q values the maximum of background continuum is shifted towards the ω mass. To determine the background shape under the ω-peak in a model-independent way, measurements were done at two proton beam energies.

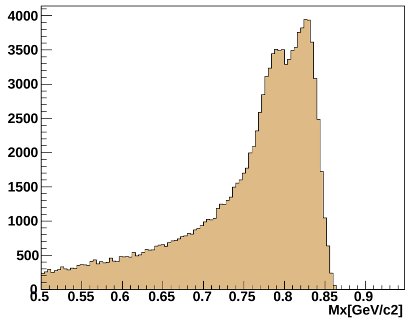

Fig. 2: The missing mass distribution of $pd \to p_{sp}dX$ reaction within the 60-80 MeV Q-range. The ω-meson is visible as the peak in vicinity of 0.783 GeV/c^2

Then, a kinematical transformation of the experimental missing mass distribution from one beam momentum to the other [3, 4] can be used as shown in Fig. 3. The same procedure was tested to be applicable for any selected Q-range. However, the extraction of ω-events was found to be affected by an overlap of the resulting peaks. A further analysis is in progress to take this into account.

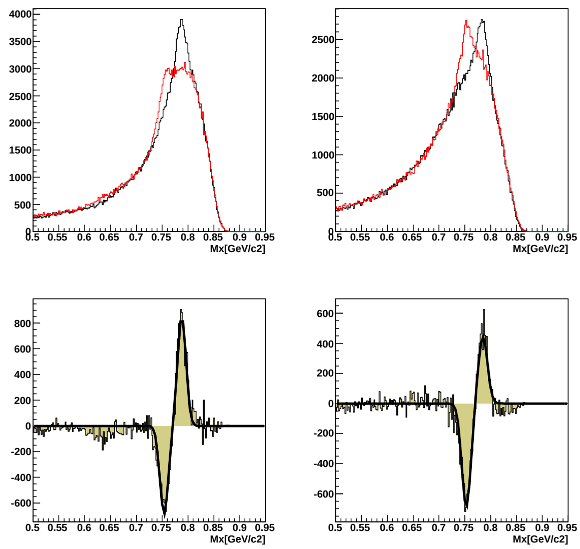

Fig. 3: Upper panels represent overall missing mass plots of the $pd \to p_{sp}dX$ reaction with p_{sp} detected either in the STT1(left side) or in the STT2(right side). Black histograms are obtained at the 2.124 GeV beam energy. The red ones are actually measured at the other beam energy of 2.219 GeV but kinematically transformed to the 2.124 GeV. The lower frames present the corresponding bin-by-bin differences of these two sets of distributions.

References:

[1] IKP Annual Report 2008, p.19
[2] I.Lehmann et al., NIM A 530, 275 (2004)
[3] F.Hibou et al., PRL 83, 492 (1999)
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