$dp \to dpX$ process at ANKE at 3.7 GeV/c

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Below the results of a brief analysis of ANKE dp data collected in November 06 are presented. The deuteron beam momentum of 3.7 GeV/c corresponds to the proton beam energy of 1.137 GeV in pd kinematics. The final pd pairs were selected by TOF in the ANKE forward detector and the complete kinematics of the $dp \to dpX$ process was reconstructed. The forward going protons have low momentum in the rest frame of the initial deuteron and can be considered as spectators, thus an $np \to dX$ process can be studied. In Fig.1 one can see that production of one and two pions cover two angular ranges of deuteron in the pn cm system: forward with $\theta < 40^o$ and backward with $\theta > 140^o$. We will consider these regions separately below since the resolution of reconstructed kinematical variables and the momentum range of the final deuteron differ noticeably.

If one looks at the distribution of the mass of the pn system $M(pn)$ vs the undetected X mass M_X (Fig. 2), one can see the signals from single, double pion and eta meson production. The band at the $M(pn) \sim 2.38$ GeV appears due the Fermi distribution of the spectator proton momentum. Position of this band coincides quite well with the maximum of the two π^0 production cross section observed at WASA. Although the event kinematics reconstruction is not perfect at the moment, it's precise enough for this first analysis.

To understand how well we can correct the data for the Fermi distribution, we analysed first the single pion production region where the cross section is known to be fairly smooth. We performed a GEANT simulation of the $dp \to dp\pi^0$ process with the deuteron emitted isotropically in the pn system and with Fermi distribution included. Experimental resolution was also taken into account. In Fig. 3 one can see that the results of this simulation (shifted by 5 MeV) excellently coincide with the experimental spectra. The ratio of experimental and simulated spectra is shown in Fig. 4 and indeed does not contain extrema in the region of ~ 2.38 GeV. This ratio is proportional to the total cross section of the process at given $M(pn)$. From this comparison one can conclude that we understand how to account for Fermi distribution well enough.

Next, the same simulation was performed for the range of $M_X = 2\pi - 3\pi$. The X mass distribution was at first assumed flat in the simulation and the deuteron again emitted isotropically in the pn cm system. The simulation was compared to the experiment in two regions of the reconstructed values of M_x: $0.06 - 0.12$ (GeV/c^2)^2 (Fig. 5) and $0.12 - 0.17$ (GeV/c^2)^2 (Fig. 7). One can see a significant difference between the experimental spectra and the simulated ones. The ratios of experimental and simulated spectra are shown in Figs. 6 and 8, where one can see a peaking structure close to the expected position of ~ 2.37 though somewhat higher than that. These results stay the same if one assumes a p-wave in the dX system in the simulation, and change very little if one takes the experimental M_x spectrum instead of a flat distribution in the event generator. The behavior of the ratio at the tails of the raw peak is very sensitive to the background estimation even though the misidentified background is quite low and makes only few percent of the real dp events.

From the figures shown one can conclude that the cross section behavior is not monotonous. Extraction of the exact parameters of the distributions is a matter of a rather nontrivial procedure of separation of two nearly coinciding peaks. Although these data look similar to the ones anaylised at WASA, there are few important differences: *i*) the final two pion system is measured inclusively, *ii*) one has to limit the range of M_X used for the cross section integration in order to select the two pion region, *iii*) the experiment total energy differs from the WASA case. In view of the latter difference and some shift of the maxima compared to the WASA results, it would be very interesting to see the results from WASA at 1.1 and 1.3 GeV.

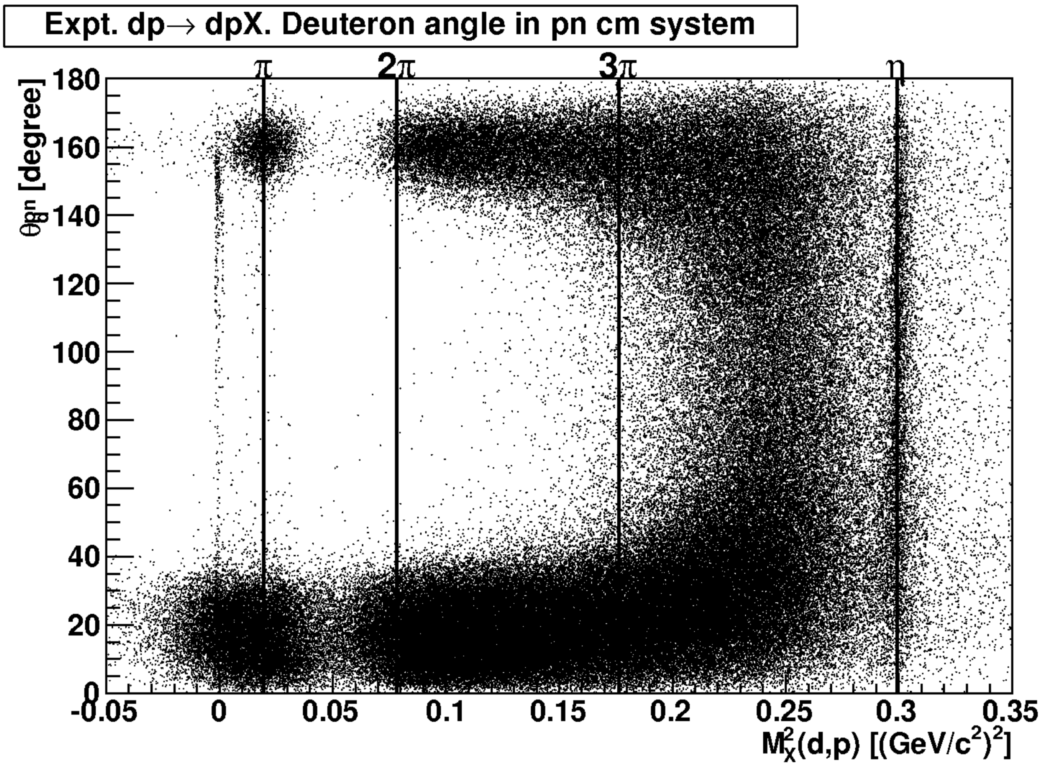
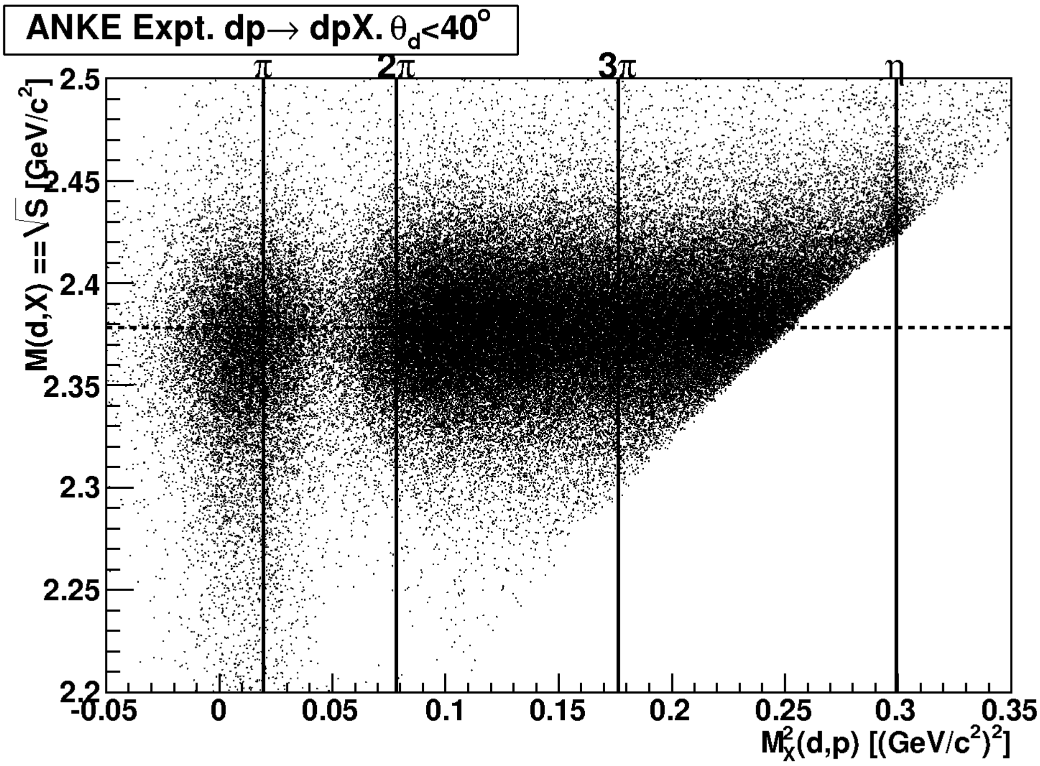
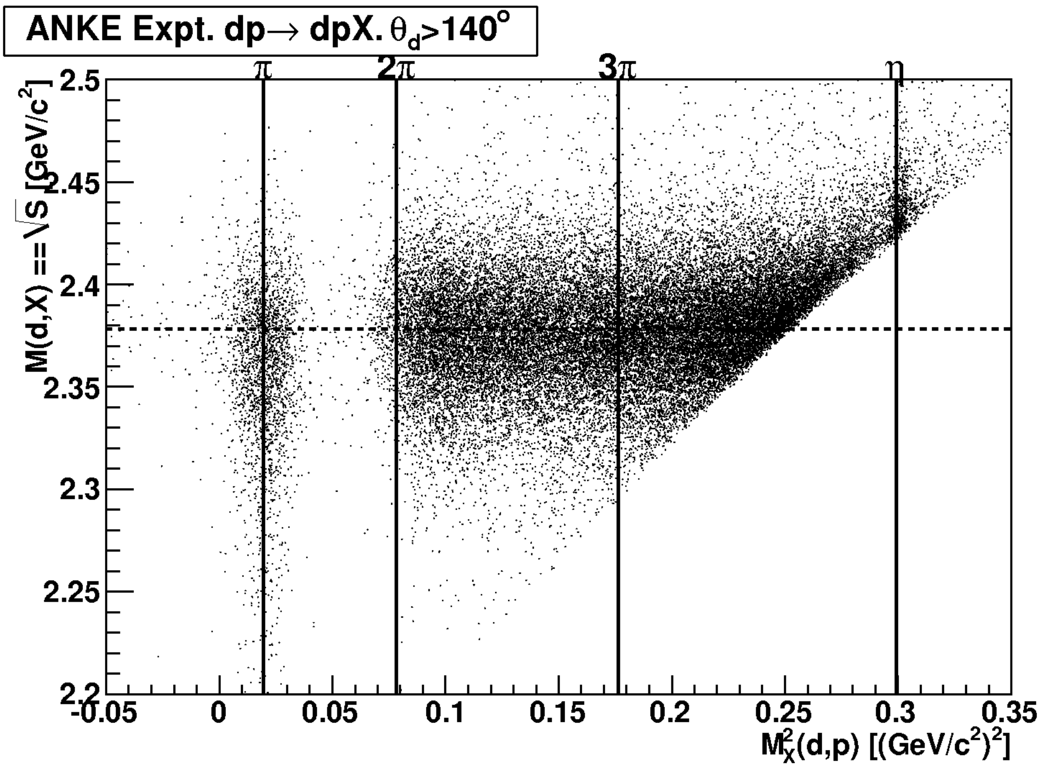


Figure 1: Experimental spectra of the deuteron scattering angle in the pn system vs the mass of the missing meson system.

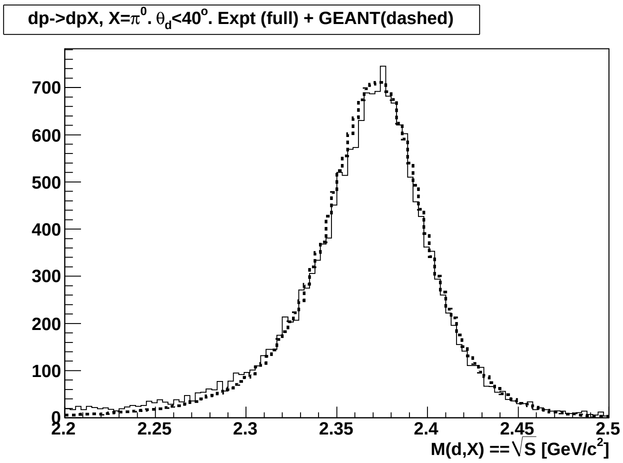


(a) Forward deuterons

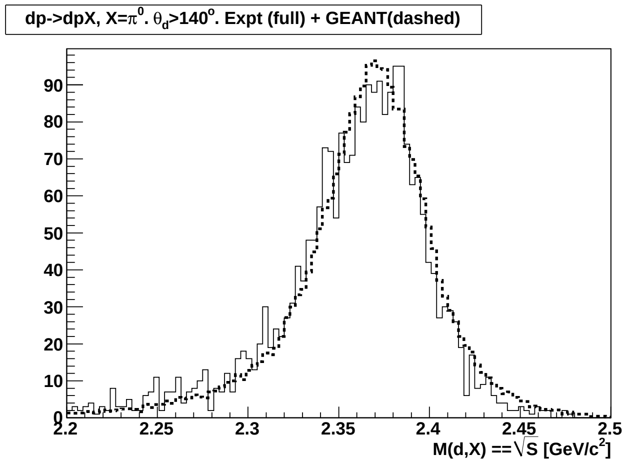


(b) Backward deuterons

Figure 2: Experimental spectra of the mass of the initial pn system vs the mass of the missing meson system. The nominal mass of free pn system is shown by the dashed lines.

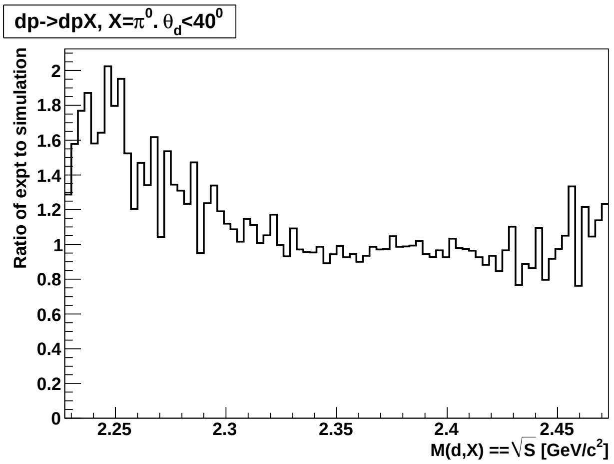


(a) Forward deuterons

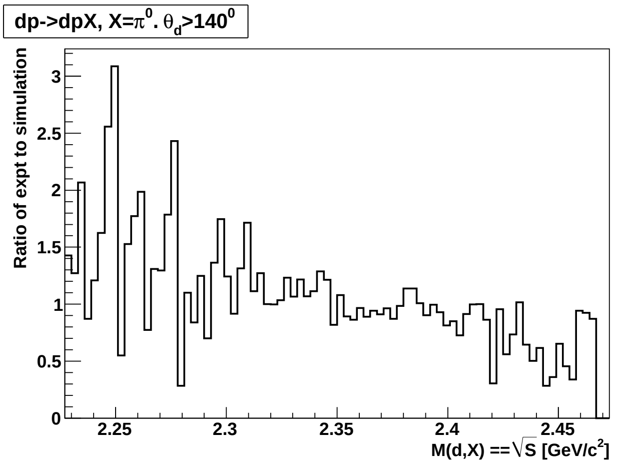


(b) Backward deuterons

Figure 3: Raw experimental spectra of the mass of the initial pn system in the π^0 region compared with a GEANT simulation based on the Fermi distribution.

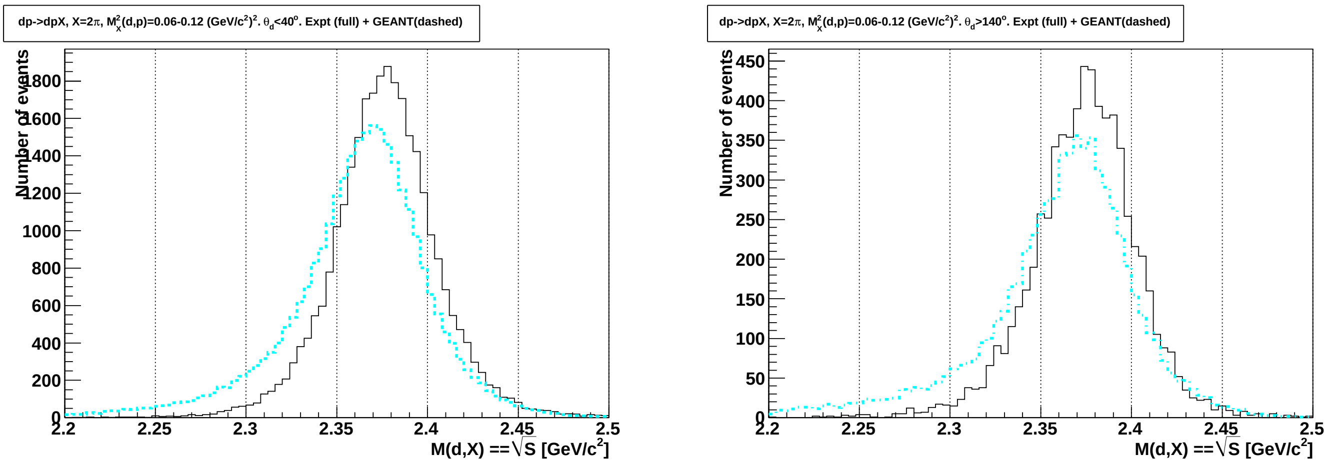


(a) Forward deuterons



(b) Backward deuterons

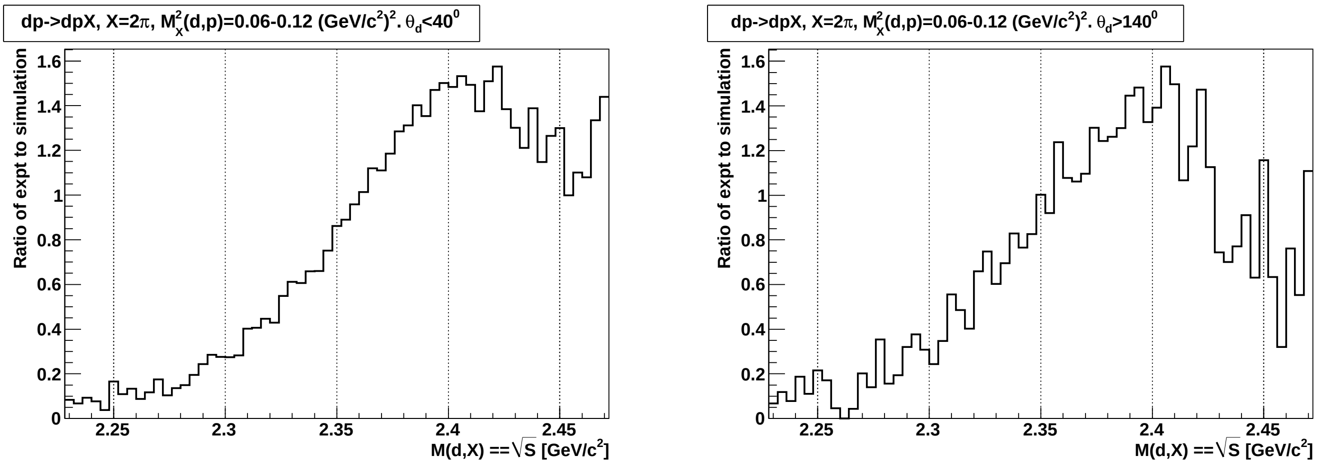
Figure 4: Ratios of the experimental and simulated spectra from Fig. 3



(a) Forward deuterons

(b) Backward deuterons

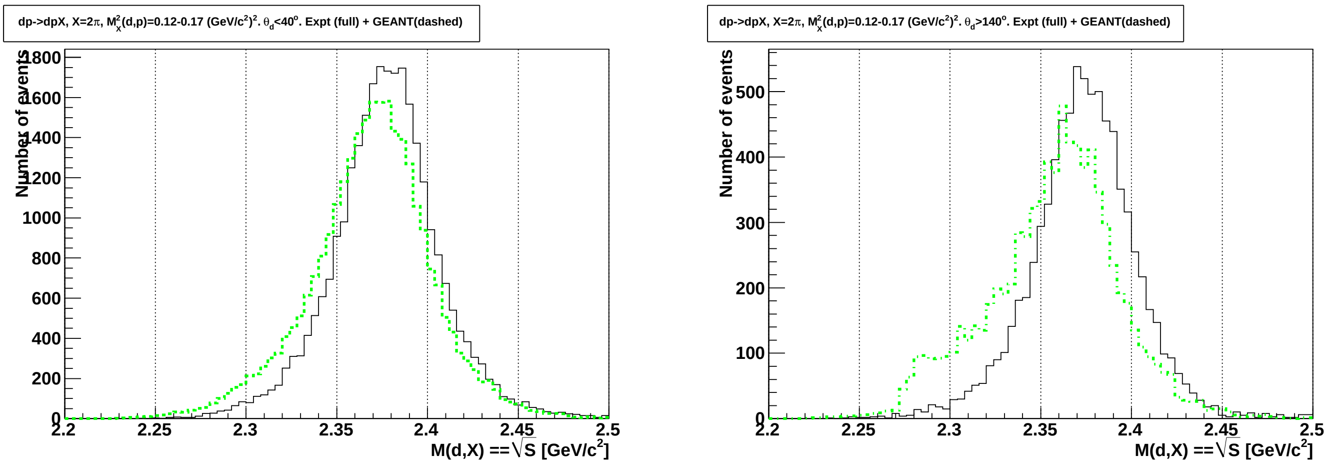
Figure 5: Raw experimental spectra of the mass of the initial pn system in the region $M_x^2 = 0.06 \div 0.12 (\mathrm{GeV/c^2})^2$ compared with a GEANT simulation based on the Fermi distribution.



(a) Forward deuterons

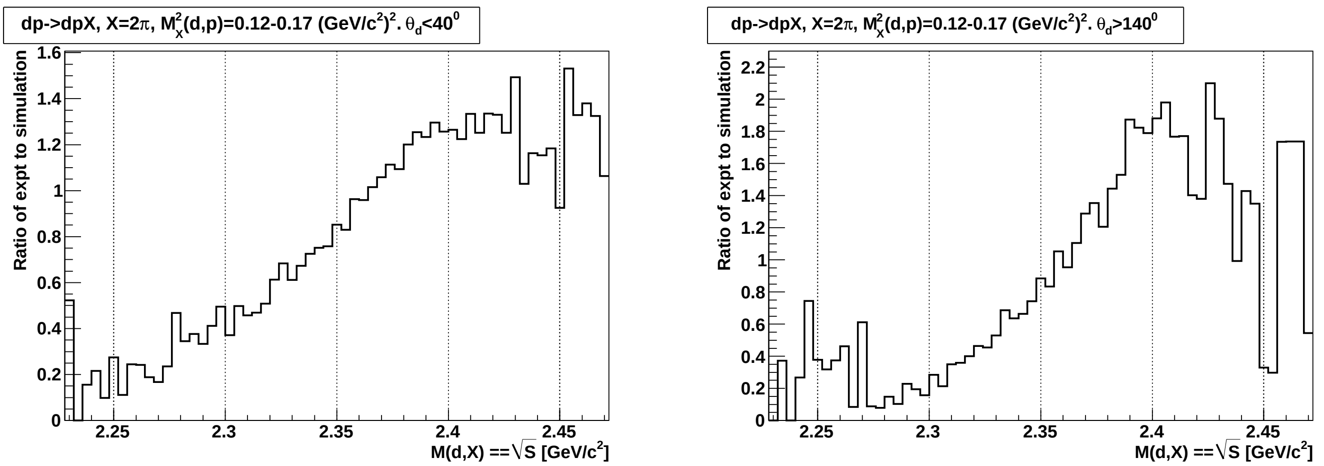
(b) Backward deuterons

Figure 6: Ratios of the experimental and simulated spectra from Fig. 5



(a) Forward deuterons (b) Backward deuterons

Figure 7: Raw experimental spectra of the mass of the initial pn system in the region $M_x^2 = 0.12 \div 0.17 (\mathrm{GeV/c^2})^2$ compared with a GEANT simulation based on the Fermi distribution.



(a) Forward deuterons (b) Backward deuterons

Figure 8: Ratios of the experimental and simulated spectra from Fig. 7