First results of analysis of the deuteron break-up reaction $dp \to ppn$ with detection of low relative energy proton pairs in the Side Detector of ANKE

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Study of the deuteron break-up reaction $pd \to ppn$ at ANKE with a high momentum transfer to a proton pair has been reported in [1]. In this experiment proton pairs of small relative energies were detected in the Forward Detector. In the c.m. system this corresponds to forward emission of a proton pair.

Another reaction with a high momentum transfer (but involving the same physics process) which could provide similar data for understanding the interaction mechanism is $dp \to ppn$ with emission of low relative energy proton pairs in the backward direction in c.m.s. Such protons could be detected in the Side Detector. These measurements have been done in February 2005 using a polarized deuteron beam and a hydrogen jet cluster target.

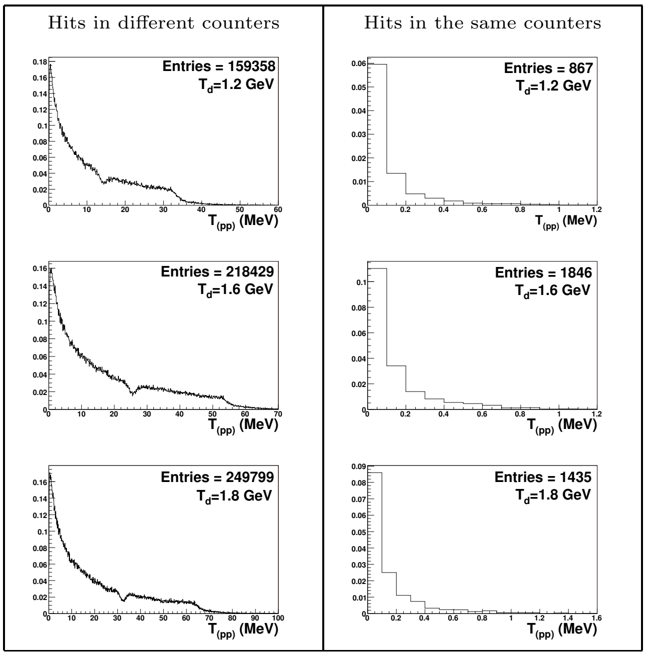

Fig. 1: Acceptance for different deuteron beam energies and for different combinations of hit counters

As a first step of data analysis, simulations have been done with GEANT4 for conditions of the beam-time, i.e. for deuteron energies T_d=1.2, 1.6, and 1.8 GeV, ANKE at an angle of 5.9 degree and using real detector and target coordinates. The acceptance in terms of the proton pair relative energy T_{pp} has been obtained at the condition that two tracks in the Side Detector are found hitting Start counters in combination with the Stop telescopes or Side Wall counters. Ionization losses and multiple scattering were taken into account. In Fig.1 the acceptance for three beam energies is shown for events with particles hitting different Start and Stop counters and those with two hits in the same Start and the same Stop counters. It is seen that the number of events with hits in the same counter (for which the analysis of timing is complicated) is much less than for different counters and T_{pp} for such events is extremely small. The dip in the 15-30 MeV region of T_{pp} is explained by transition from the telescopes to the Side Wall counters. In Fig.2 the calculated resolution of the proton pair relative energy $\sigma_{T_{pp}}$ is shown for T_d=1.6 GeV, this value is very close at all three beam energies. It increases with T_{pp} but for all beam energies is below 1 MeV at T_{pp}<20 MeV.

In Fig.3 the results of a preliminary analysis of experimental data are presented for the beam energy of 1.2 GeV. Only part of statistics is used here. In the left panel a TOF spectrum for one of the Start-Stop combinations is shown. Events from the region of a proton peak in all Start-Stop combinations are selected for further analysis. The right panel is the plot of the measured time difference between two protons versus the calculated one. The right panel is the missing mass distribution which is peaked, as expected, near the neutron mass. Cuts on ionization losses, not yet applied here, will definitely improve the process identification.

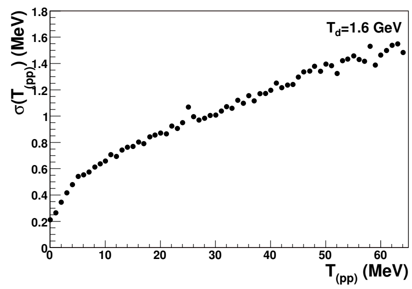

Fig. 2: Resolution on T_{pp} for different beam energies

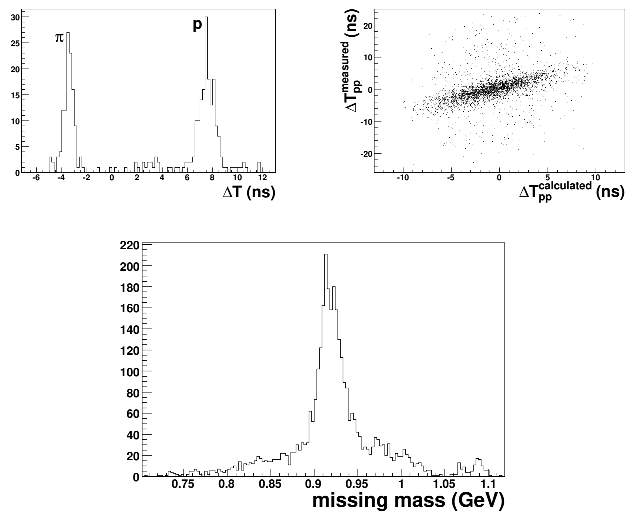

Fig. 3: Experimental distributions: TOF spectrum (left), measured versus calculated time difference between two protons (right), missing mass distribution (central).

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References:

[1] V.Komarov et al. Phys. Lett. B**553**(2003)179-185.