

Analysis of the $pd \rightarrow pp_{(STT)} + X$ reaction at 353 MeV using ANKE STT's*

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In this note preliminary results of the analysis of experimental data of the April 2009 beamtime are presented. In the experiment 2 STT's (left and right) have been used with layer thicknesses of: 70 μm (I) and 300 μm (II).

For the analysis the root files containing a list of 2-dimensional hits in layers were chosen. The tracks were reconstructed using the hit list and the following information about each track was reorded: the energy deposit in the first and second layer, the polar(θ) and azimuthal(ϕ) angles, Y and Z coordinates at $X = 0$. The data for 11 runs (from 17434 to 17445) was analysed. The total number of the events was equal to 9 908 692. Among them the number of one-track events was 9 529 546 (96.2 %), of two-track event - 358 258 (3.6%) and more then two - 20 888 (0.2 %) (Fig. 1).

For the selection of the deuteron breakup reaction $pd \rightarrow ppn$, the particle identification parameter ($pid = (dE_1 + dE_2)^{1.62} - dE_2^{1.62}$) was used and the distance between two straight line in space, which was calculated by the formula:

$$distance = \frac{|det|}{\sqrt{(det_1^2 + det_2^2 + det_3^2)}} \quad (1)$$

where:

$$det = \begin{vmatrix} X_2 - X_1 & Y_2 - Y_1 & Z_2 - Z_1 \\ \sin(\theta_1)\cos(\phi_1) & \sin(\theta_1)\sin(\phi_1) & \cos(\theta_1) \\ \sin(\theta_2)\cos(\phi_2) & \sin(\theta_2)\sin(\phi_2) & \cos(\theta_1) \end{vmatrix} \quad (2)$$

$$det_1 = \begin{vmatrix} \sin(\theta_1)\sin(\phi_1) & \cos(\theta_1) \\ \sin(\theta_2)\sin(\phi_2) & \cos(\theta_2) \end{vmatrix} \quad (3)$$

$$det_2 = \begin{vmatrix} \cos(\theta_1) & \sin(\theta_1)\cos(\phi_1) \\ \cos(\theta_2) & \sin(\theta_2)\cos(\phi_2) \end{vmatrix} \quad (4)$$

$$det_3 = \begin{vmatrix} \sin(\theta_1)\cos(\phi_1) & \sin(\theta_1)\sin(\phi_1) \\ \sin(\theta_2)\cos(\phi_2) & \sin(\theta_2)\sin(\phi_2) \end{vmatrix} \quad (5)$$

In Fig. 2 the distribution of the pid parameter for events in which 2 tracks were detected in the STT-s are presented (upper left panel). For the further analysis we chose the tracks which had $4.0 < pid < 5.5$. The distribution of the missing mass for such events is presented in Fig. 2 (upper right panel). In the area of the mass of the neutron is a concentration of events. This suggests that we can see breakup reactions.

The distribution of the distance between the two tracks in space is presented in Fig. 2 (lower left panel). For the further analysis we chose the tracks which had $distance < 5 \text{ mm}$. The distribution of the missing mass for remaining events is presented in Fig.2 (lower right panel). In Fig. 3 (upper panel) the distribution of the missing mass for the events in which both tracks were detected in same STT (blue histogram) and for events in which both tracks were detected in different STT (red histogram), are presented. They differ greatly from each other. The reason for this difference is not clear and requires further study.

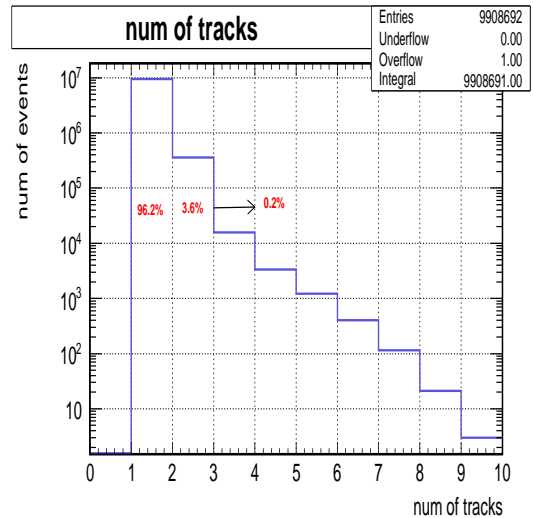


Fig. 1: The distribution of number of tracks in event

To isolate the $pd \rightarrow pd$ elastic scattering reaction, events with one track were chosen. This track was detected in one of the STT's. For this track $pid > 6.0$ (deuteron) was used. The distribution of the missing mass for such events is presented in Fig. 3 (lower panel). In the area of the mass of the proton is a concentration of events. This suggests that we can see the elastic scattering reaction.

Next step is: to prepare analysis code using the Neural Network (NN) method, developed by G. Macharashvili.

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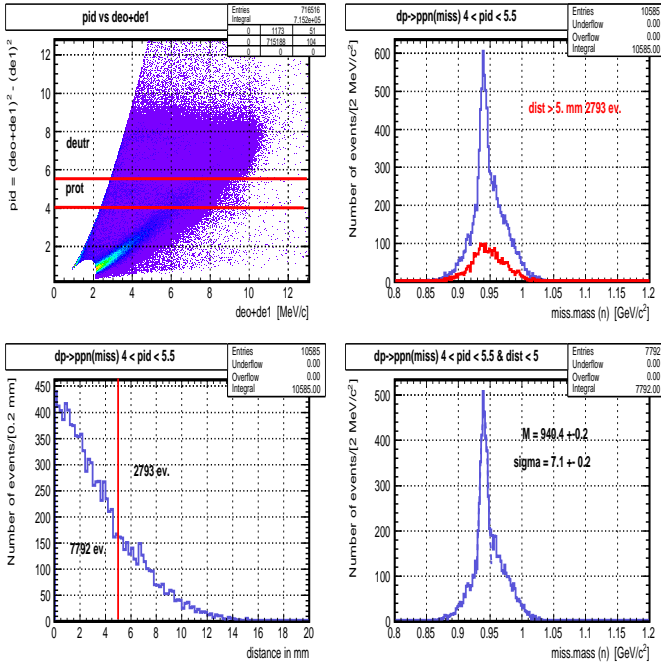


Fig. 2: Upper left panel: the two dimensional distribution pid vs $dE_1 + dE_2$, upper right panel: the distribution by the missing mass for events with $4.0 < pid < 5.5$ (blue) and for the events with the additional cut - $distance > 5.0$ mm, lower left panel: the distribution of the distance, lower right panel: the distribution of the missing mass after $4.0 < pid < 5.5$ and $distance < 5.0$ mm cuts

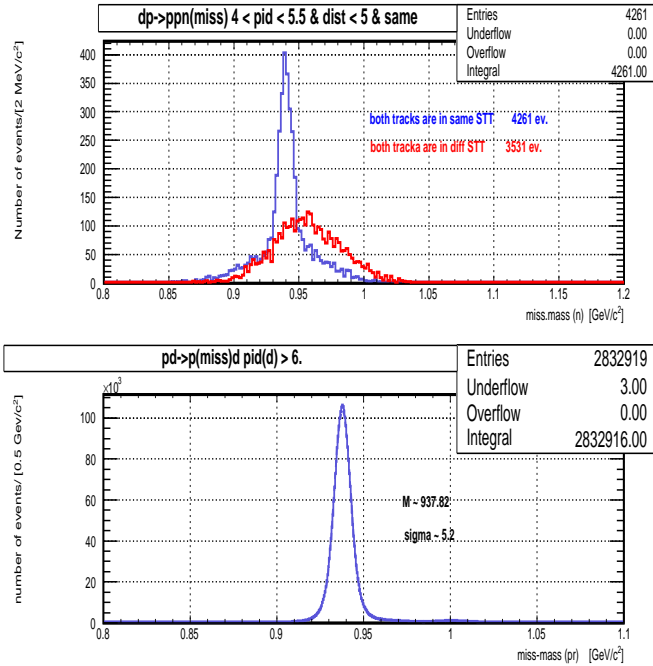


Fig. 3: Upper panel: the two-track events distribution of the missing mass in case when both track are in the same STT (blue) and in case when they are in the different STT (red), lower panel: the one-track events distribution of the missing (proton) mass in case when $pid > 6.0$ (deuterons stopped)