Data analysis of the Silicon Tracking Telescope for the $pn \to nK^+\Lambda$ reaction

N. Savderova[1,2], S. Barsov[1,2], S. Trusov[2,3] and Yu. Valdau[1,2,4] for the ANKE collaboration

The energy dependence of the total cross section for the Λ, Σ^0 and Σ^+ production in proton-proton collisions has been studied using various installations at COSY [1, 2, 3]. In contrast to that, there is almost no data on K^+ production in proton-neutron collisions available in literature. There were several attempts to explore difference between K^+ production on the proton and neutron using different nuclear targets and beams [4], but direct information can be obtained from the analysis of the experimental data collected using ANKE magnetic spectrometer in March 2011 [5].

In this experiment the $pd \to nK^+\Lambda p_{sp}$ reaction has been investigated using proton beam and deuteron as an effective neutron target. Two particles in the final state has been identified in the ANKE detector systems, the K^+ in the range telescopes and spectator proton p_{sp} in Silicon Tracking Telescope (STT). The energy of the proton beam is chosen such that kaons and protons, associated only with Λ production, can be detected in ANKE. Hence, detailed analysis of the ANKE STT is crucial for determination of the energy dependence of the total cross section for the $pn \to nK^+\Lambda$ reaction. For the spectator protons detection two (left and right) STT's have been used [6]. Two types of data, with and without zero suppression, has been collected from the STT during this experiment. To reduce amount of data written from the STT a special mode (zero suppression mode) of readout electronics has been used. In this mode, position of zero of the scale for each individual channel of the QDC has been determined during experiment and, together with threshold, has been loaded in to the readout electronics. In the data stream only data from channels with amplitude, which is higher then the sum of pedestal and threshold values, has been accumulated. For calibration purposes, in a zero suppression mode, one event out of thousand is written in to the data stream without pedestal suppression.

The STT data analysis includes [6]: definition of pedestal position and its correction, selection of nonstable segments, control of the energy calibration, reduction of the coincidence background. At the first stage of the STT data analysis, definition of pedestal positions and its correction has been performed for the data with and without zero suppression separately.

In addition to the traditional methods of pedestal position determination, a new technique for the identification and selection of the nonstable segments was used in the analysis. Using a dedicated software, all the runs were analyzed and information about pedestal position and its width (RMS) has been stored in the text files. This information has been studied as a function of time, taking one run as a time interval, and conclusion about instability of individual channels of the detector has been made run by run. List of nonstable segments, obtained within this analysis, is in agreement with the results of traditional analysis. This method can be used in future for the identification of nonstable channels using a simple, based on a formal criteria, method.

Besides pedestal position analysis, all the steps of the analysis necessary for the spectator proton identification has been done. Due to the possible instabilities in gain for individual detector sides charge accumulated on positive and negative side of individual detector can be different. Special correction procedure has been used to correct for this effect and reconstruct the energy losses.

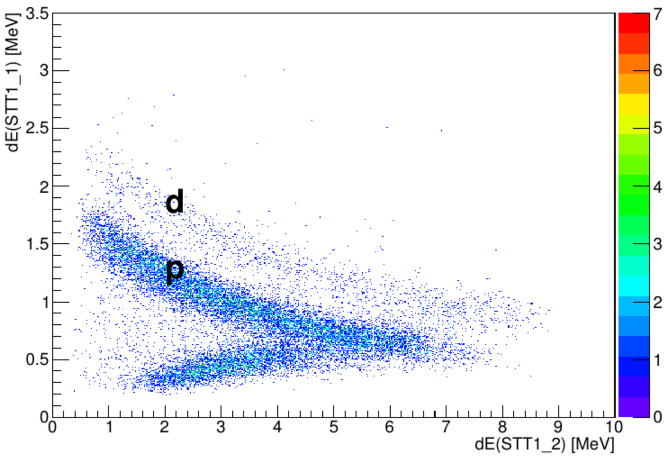

Fig. 1: Energy loss spectra in a first layer as a function of energy loss in a second layer in STT1 reconstructed for one run. Protons and deuteron's are well separated.

Because of the relatively high luminosity during beam time, it is necessary to use time information from the individual detector sides to reduce the coincidence background. Time calibration curve, obtained from the experimental data, has been used to select a genuine tracks in STTs. As a result, a clean identification of the protons and deuteron in the telescopes has been obtained (see Fig. 1).

On a last stage, using preselected K^+ data and reconstructed spectator proton four-momentum, the number of counts as a function of excess energy in $pn \to nK^+\Lambda$ reaction has been reconstructed. Obtained statistic is sufficient for the determination of the total cross section for the $pn \to nK^+\Lambda$ reaction with planned accuracy.

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[1] High Energy Physics Department, Petersburg Nuclear Physics Institute, 188350 Gatchina, Russia

[2] Institut für Kernphysik, Forschungszentrum Jülich, 52425 Jülich, Germany

[3] Lomonosov Moscow State University Skobeltsyn Institute of Nuclear Physics (MSU SINP), 1(2), Leninskie gory, GSP-1, 119991 Moscow, Russia

[4] Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, D-53115 Bonn, Germany