First investigation of the $pd \to p_{sp}pK^+\Sigma^-$ reaction at ANKE*

S. Barsov[a], A. Dzyuba[a], V. Koptev[a], E. Shikov[a], Yu. Valdau[a], for the ANKE collaboration

The ANKE spectrometer is a suitable tool for the study of light strange hyperon (Λ, Σ) production in the close-to-threshold region. Recently an investigation of Σ^+ production in $pp \to nK^+\Sigma^+$ reaction has been carried out [1, 2]. The next step in this scientific programme is a measurement of the $pn \to pK^+\Sigma^-$ reaction.

The $pd \to p_{sp}pK^+\Sigma^-$ reaction has been studied using data from the July 2008 beam time. Two data samples with beam momenta of 2915 MeV/c and 3015 MeV/c were taken over ten days. The main goal of the experiment was the measurement of ω-meson production in *pn* collisions [3], but the detector setup and trigger conditions allowed the use of these data to study Σ^- production. In these condition the deuterium target was used as an effective neutron target by measuring the momentum of the *spectator* proton. In this approach, events of quasi-free $pn \to pK^+\Sigma^-$ reaction could be reconstructed at well-defined centre-of-mass energies.

The main trigger was organized as the coincidence of forward-going high momentum particles registered in the forward detector (Fd) and low momentum ejectiles detected by the silicon tracking telescopes (STT). The ANKE side detector (Sd) was not demanded in the trigger but it was switched on and it allowed one to identify K^+ mesons. The principle of the Σ^- experiment was the search for K^+ in the Sd in coincidence with protons in the Fd and spectator protons in the STT.

The particles detected in the Fd were dominantly protons with a very small fraction of deuterons, so only the kinematic cut, which rejects protons with momenta higher than that allowed by conservation laws for the $pd \to p_{sp}pK^+\Sigma^-$ reaction ($|\vec{p}_{Fd}| < 1.8$ GeV/c) has been made. However, the background in the Sd, consisting dominantly of protons and pions, was several orders higher than the fraction of kaons. Several criteria were used to overcome this: *i)* Kaons were identified using time-of-flight measurement; *ii)* The correlations of signals between kaons in the Sd and protons in the Fd has been used. Protons and deuterons in the STT could be separated on the basis of their energy losses in the silicon planes.

After selection of kaons, protons and spectator protons, an overall missing-mass distribution has been produced (Fig. 1). A peak at about 1.2 GeV/c^2 is clearly seen and could be interpreted as a signal from $pd \to p_{sp}pK^+\Sigma^-$ reaction. The total number of Σ^- events under the peak is about 500 for each of the two momenta.

For each of the selected events an excess energy ε has been calculated The missing-mass spectra for several 20 MeV-wide intervals in ε have been produced and the number of events extracted using a fitting routine. The numbers of $pn \to nK^+\Sigma^-$ events is plotted as a function of excess energy in Fig. 2.

The next step in these studies will be determination of acceptance from simulations, efficiencies of particle detection and luminosity. It is expected that cross section values will be obtained during 2010.

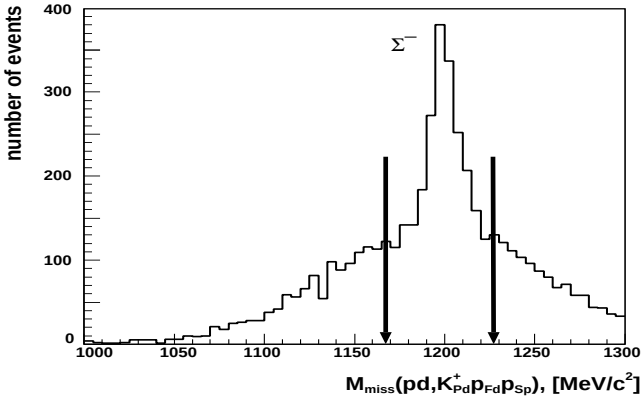

Fig. 1: Total missing-mass distribution. Events between the two vertical arrows were considered as Σ^- candidates.

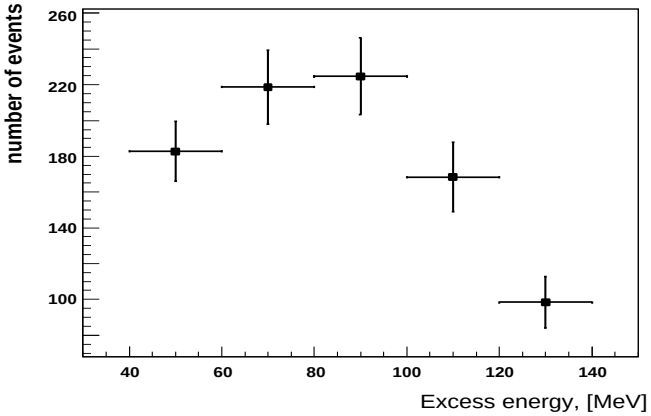

Fig. 2: Number of extracted events for the $pn \to nK^+\Sigma^-$ reaction as a function of excess energy

References:

[1] Yu. Valdau *et al.*, Phys. Lett. B **652**, (2007), 245-249,

[2] Yu. Valdau, COSY Proposal #171.1, submitted for publication.

[3] S. Barsov, COSY Proposal #175.

[a] PNPI, Gatchina, Russia.

* supported by COSY-FFE program