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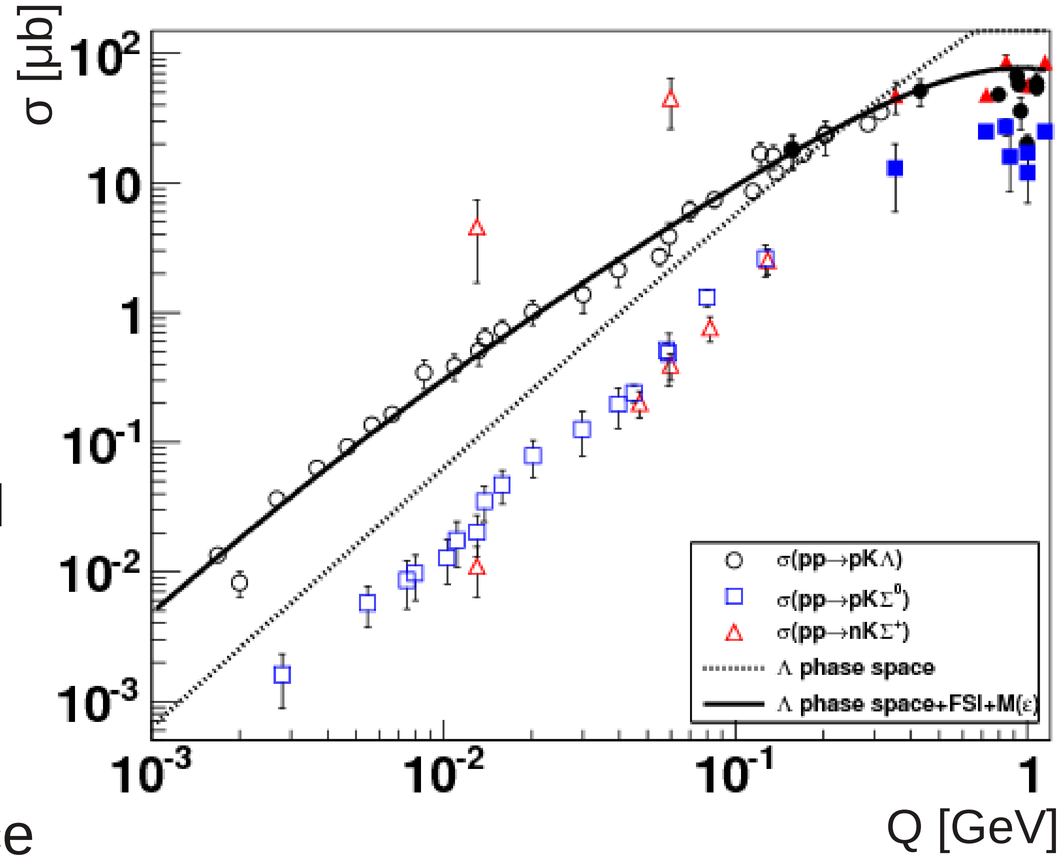
# Studying of the pn → $K^+n\Lambda$ reaction close to threshold at the magnetic spectrometer ANKE-COSY

11th November 2013 | Natalia Savderova

St.Petersburg State Polytechnical University, Russia

# $K^+$ production in pp

$pp \rightarrow K^+p\Lambda$
$pp \rightarrow K^+p\Sigma^0$
$pp \rightarrow K^+n\Sigma^+$

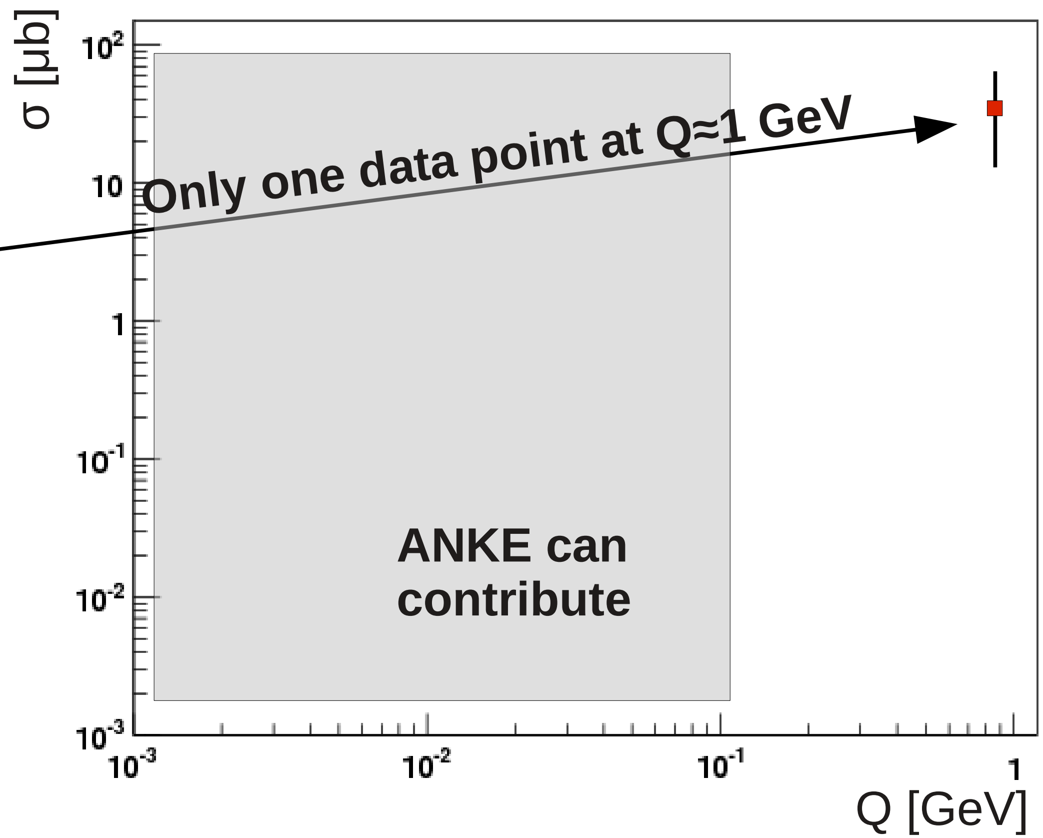



There is **a lot of data** on energy dependence of the total cross sections for $\Lambda$, $\Sigma^0$ and $\Sigma^+$ production in pp reactions

**Strong signal of p$\Lambda$ FSI** is observed in energy dependence of total cross sections and differential observables

# $K^+$ production in pn

$pn \rightarrow K^+ n \Lambda$
$pn \rightarrow K^+ n \Sigma^0$
$pn \rightarrow K^+ p \Sigma^-$

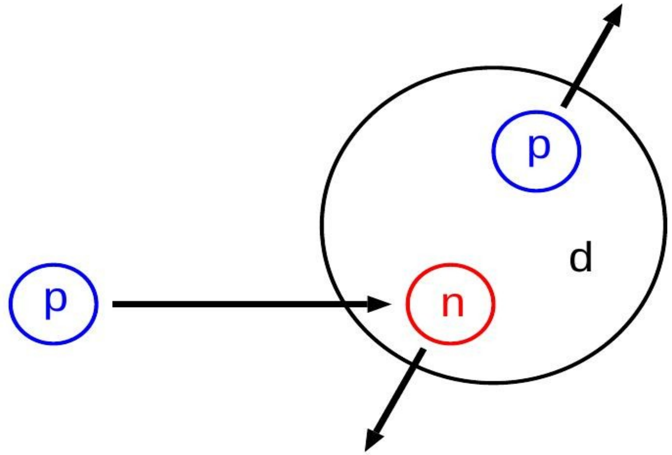



In contrast to pp collisions, there is almost **no data** on $K^+$ production in pn interactions

At ANKE we have access to $\mathbf{pn \rightarrow K^+ n \Lambda}$ and $\mathbf{pn \rightarrow K^+ p \Sigma}$ reaction channels

# Experiment in March 2011

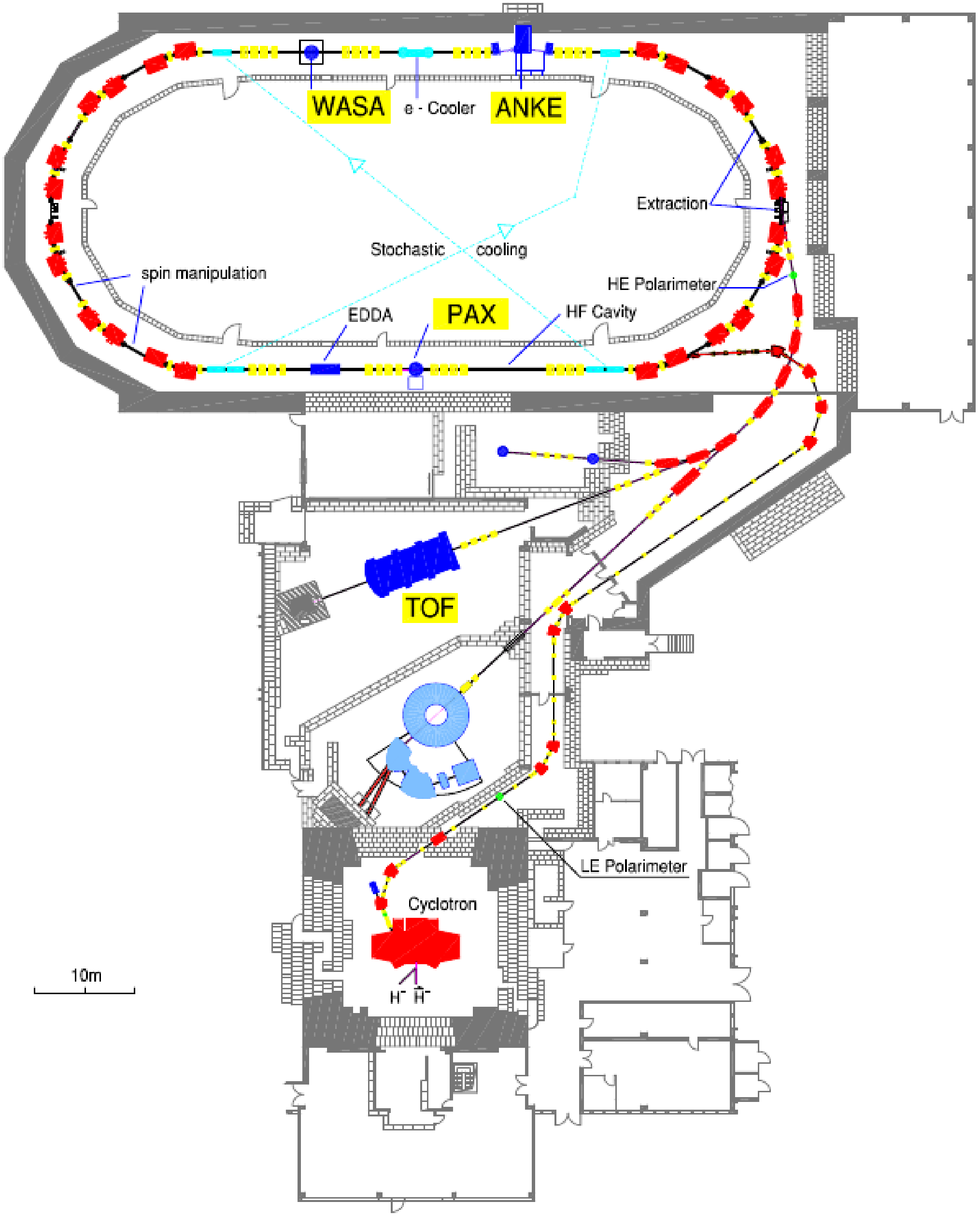
$$pD \rightarrow p_{sp}K^{+}X$$



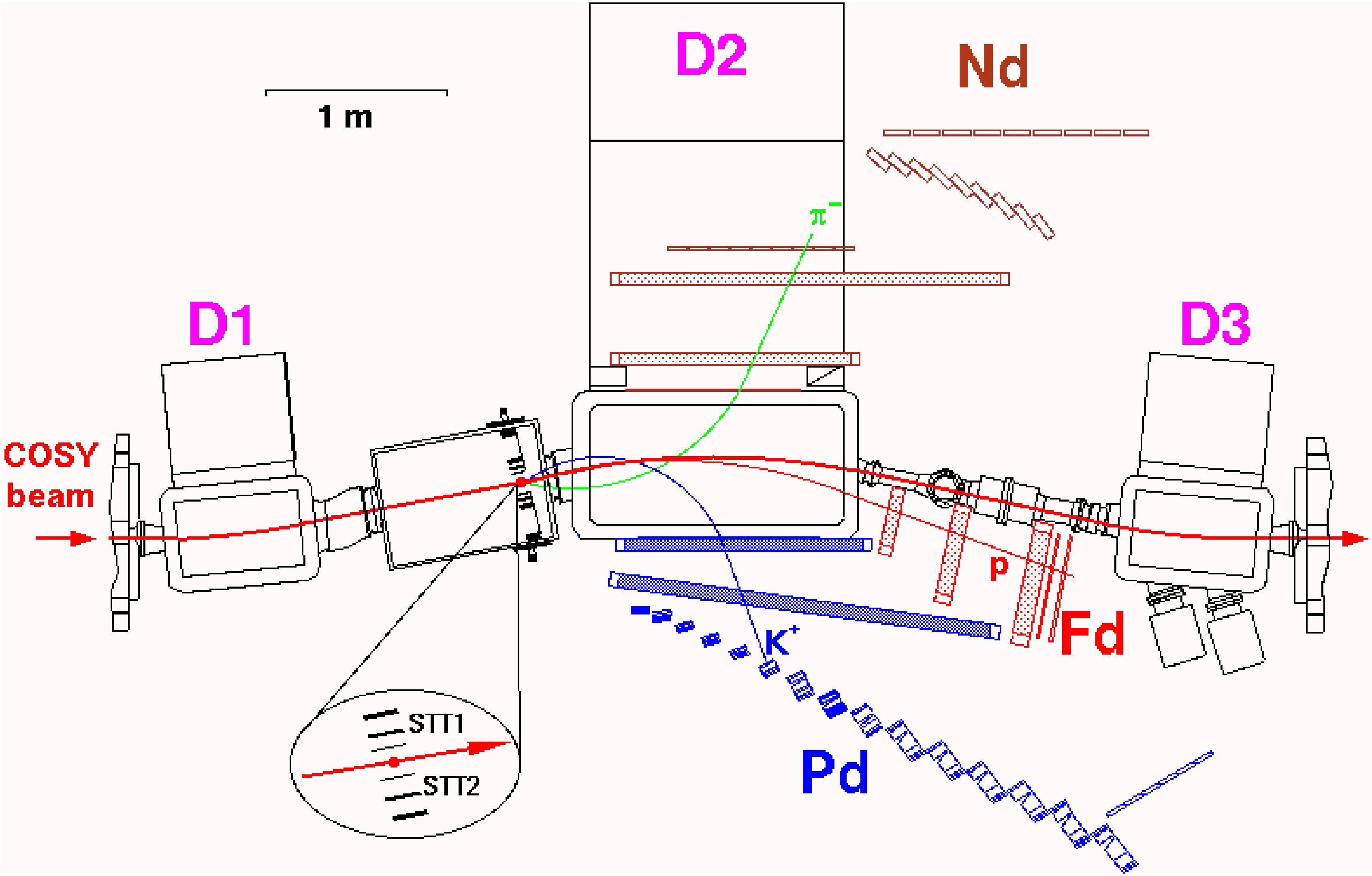

Simple sketch of the spectator model

- Use ANKE deuterium cluster-jet target as an effective neutron target
- Determine excess energy in CM system using ANKE STT
- Identify $K^{+}$ using ANKE range telescopes
- At the energy of the experiment (1.826 GeV) detection of $K^{+}$ and spectator proton is sufficient to identify $pn \rightarrow K^{+}n\Lambda$ reaction

# Cooler - SYnchrotron

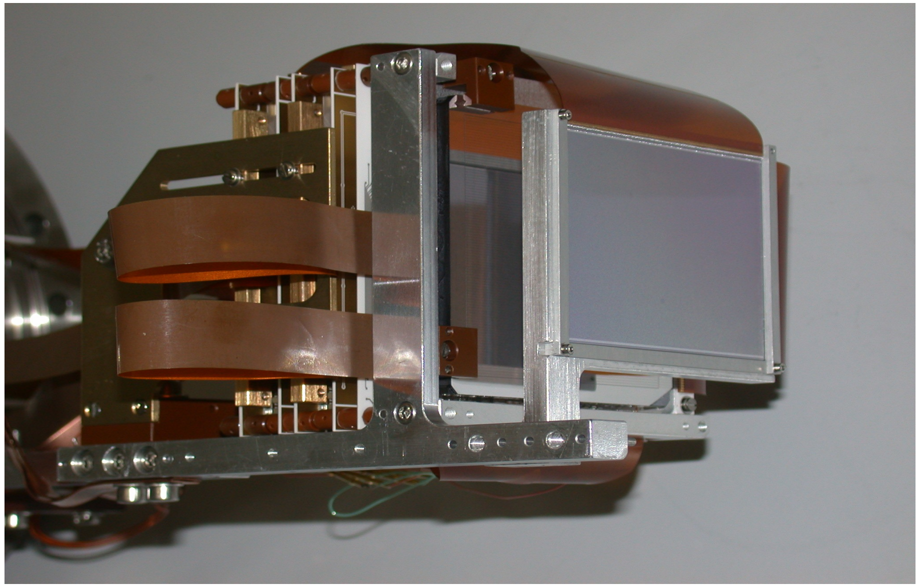


# ANKE



# Silicon Tracking Telescope (STT)

- Proton energy range 2.5MeV-40MeV
- Precision of en. measur. dE/E ~ 1%
- Geometrical acceptance ~10%

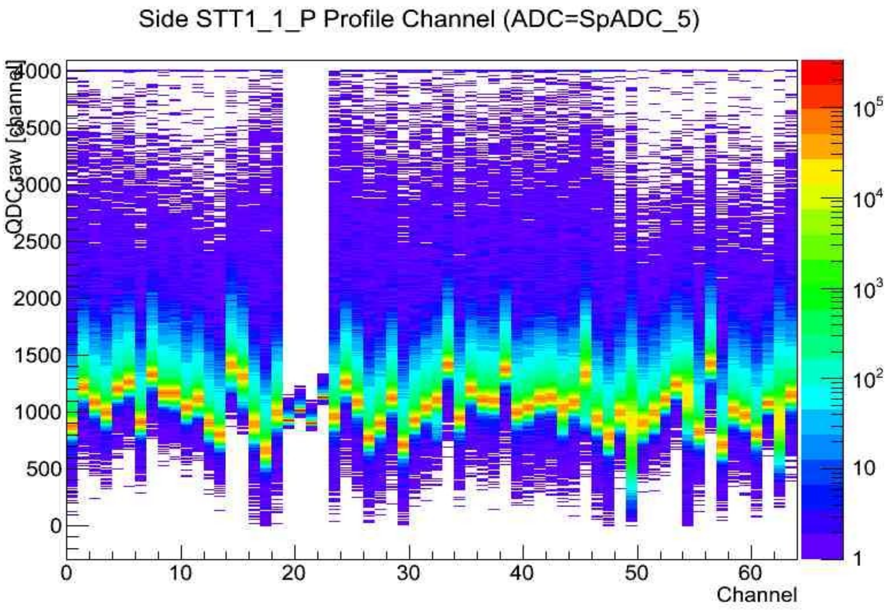


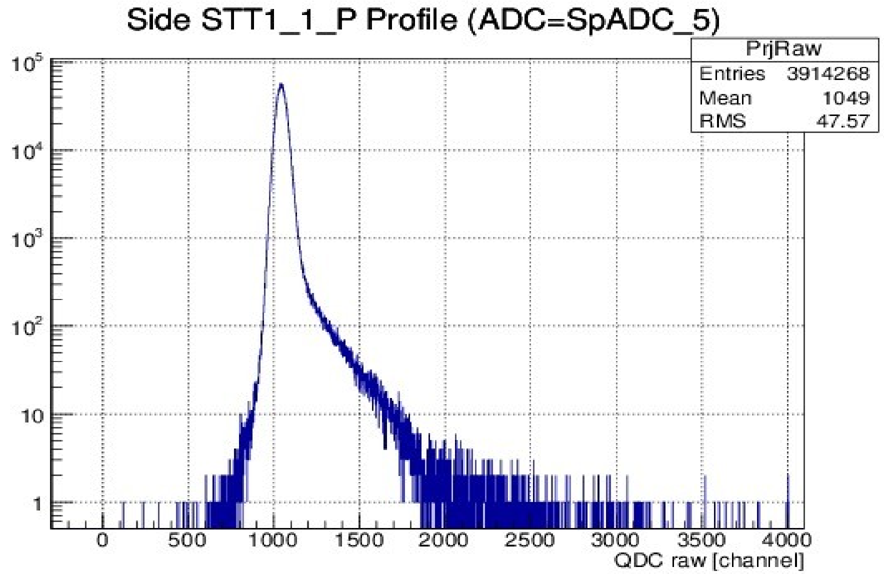
| Thicknesses | Energy | Dimensions | Strips pitch | Strips Number |
|---|---|---|---|---|
| 69 µm | dE<2.5 MeV | 66 × 52 $mm^2$ | ~0,42 mm | 150 × 128 |
| 300 µm | dE<6,2 MeV | 66 × 52 $mm^2$ | ~0,42 mm | 150 × 128 |
| 5100 µm | dE<40 MeV | 64 × 64 $mm^2$ | ~0,7 mm | 96 × 96 |

# My responsibilities included the STT data analysis:

- Definition of pedestal value and its correction for data with 0-suppression and data with no 0-suppression
- Selection of „bad“ segments
- Control of the energy calibration
- Selection of useful events using Time vs Energy dependence

# Data no  0-suppression




- Pedestal  is a value of  output of ADC if  on the input there is no useful signal
- Readout electronics can supress pedestals
- Pedestal values and its RMS can be changed during the beam time
- For pedestal correction following procedure is used:

$$A_i^{Cor} = A_i - CM - P_i$$

# CM – common mode

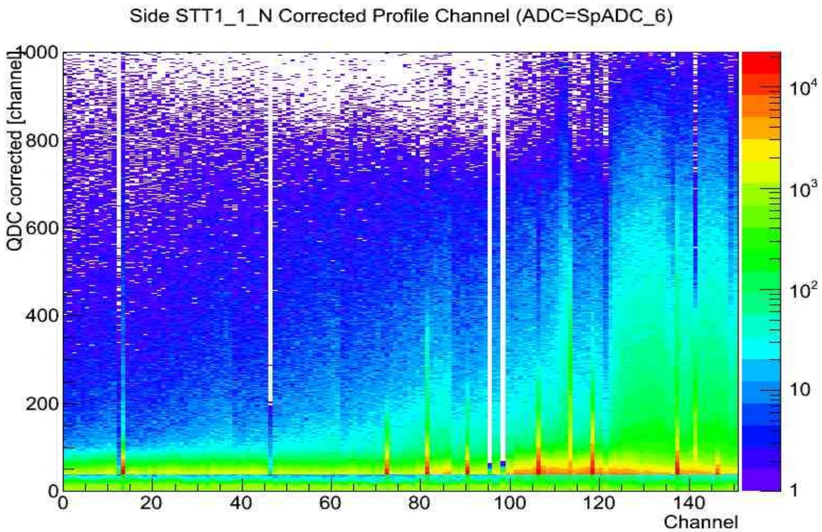
- Common mode is common shift of base line for group of segments in one event.
- Common mode is calculated for each event using the following equation:

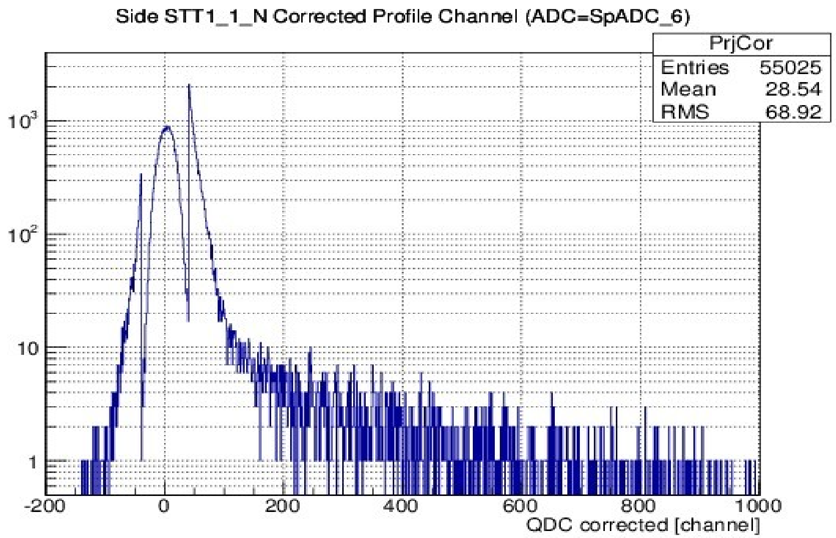
$$CM = \frac{\sum (A_i - P_i)}{\sum n} \qquad A_i < thr_i$$

- CM is used for the calculation of corrected amplitudes in every event for each ADC channel:

$$A_i^{Cor} = A_i - CM - P_i$$

# Data with 0-suppression



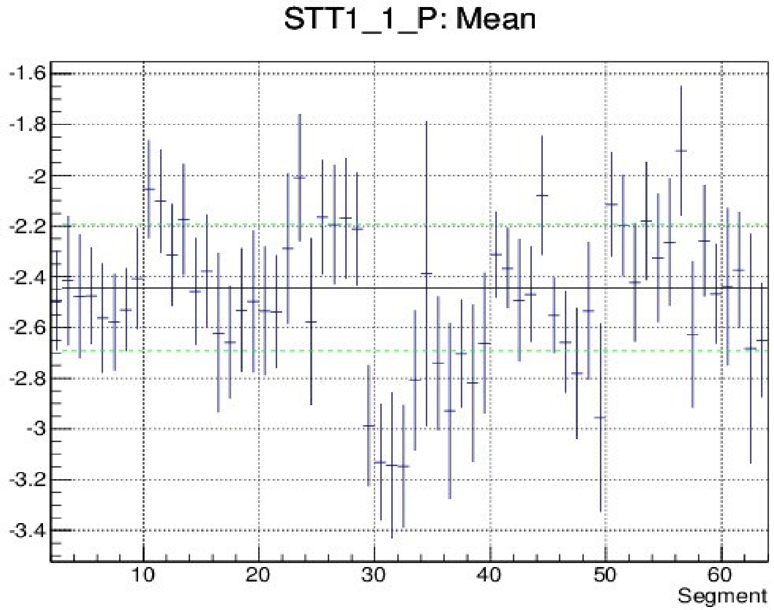

- Online calculation of CM
- Used information about pedestal position in readout electronic
- 1 out of 128 events contains the pedestal information
- Data are recorded on the disk if

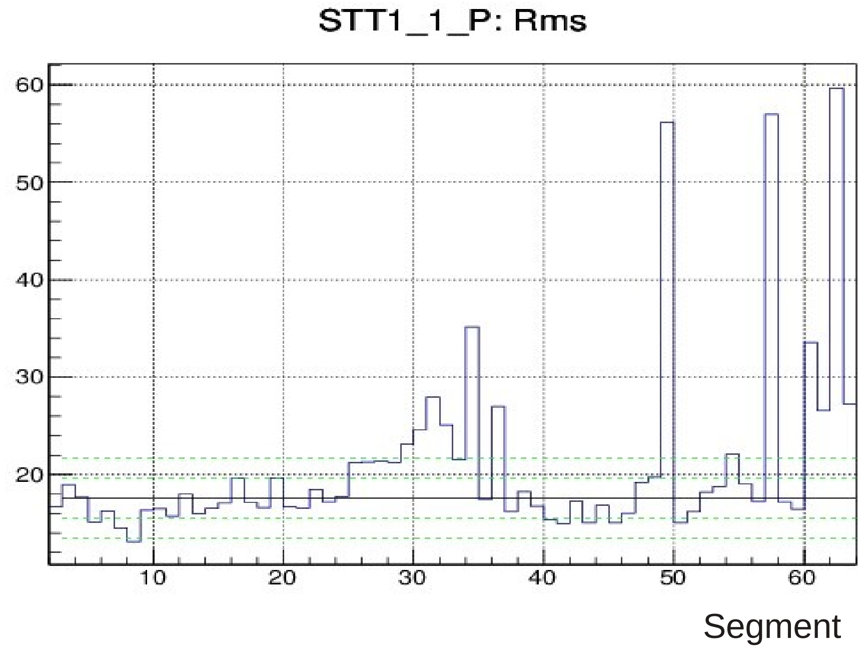
$$A_i^{Cor} = |A_i - CM - P_i| > thr_i$$

## Analysis of pedestal position during experiment

- Using analysis module from S. Trusov pedestal behaviour as function of run number was studied.
- Software to analyse this information was developed
- The goal is to create formal criteria for identification of bad segments and create necessary software

# Analysis of pedestal behavior over the beam time




- Using  algorithm for calculating average mean one can compute pedestal position (left panel) and RMS (right panel) for each segment averaged for all runs
- More information about nonstable segments we can get from RMS distribution
- Criteria to identify of „bad“ segments can be selected using projection of this distribution on Y axis

# Control of energy calibration

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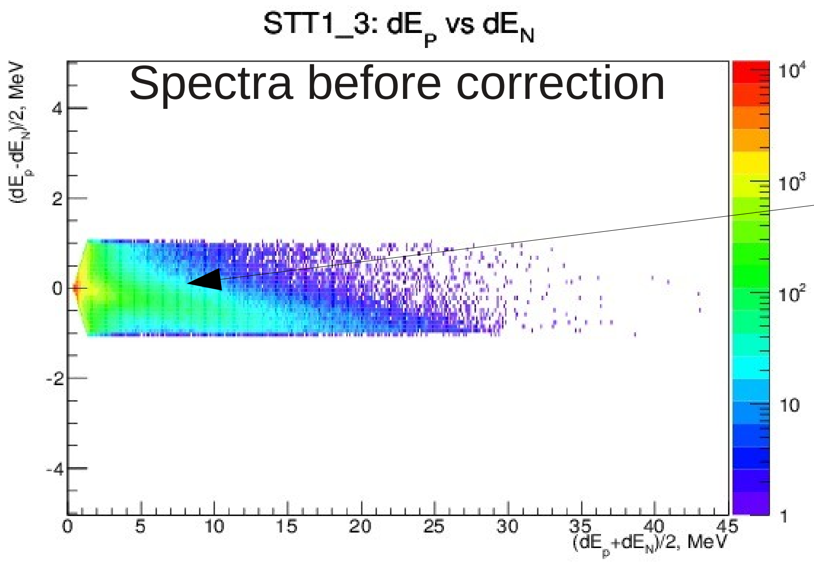
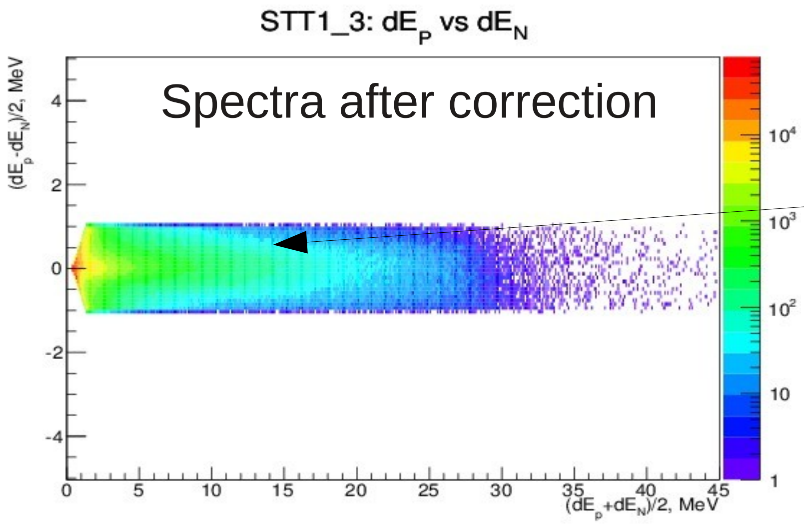


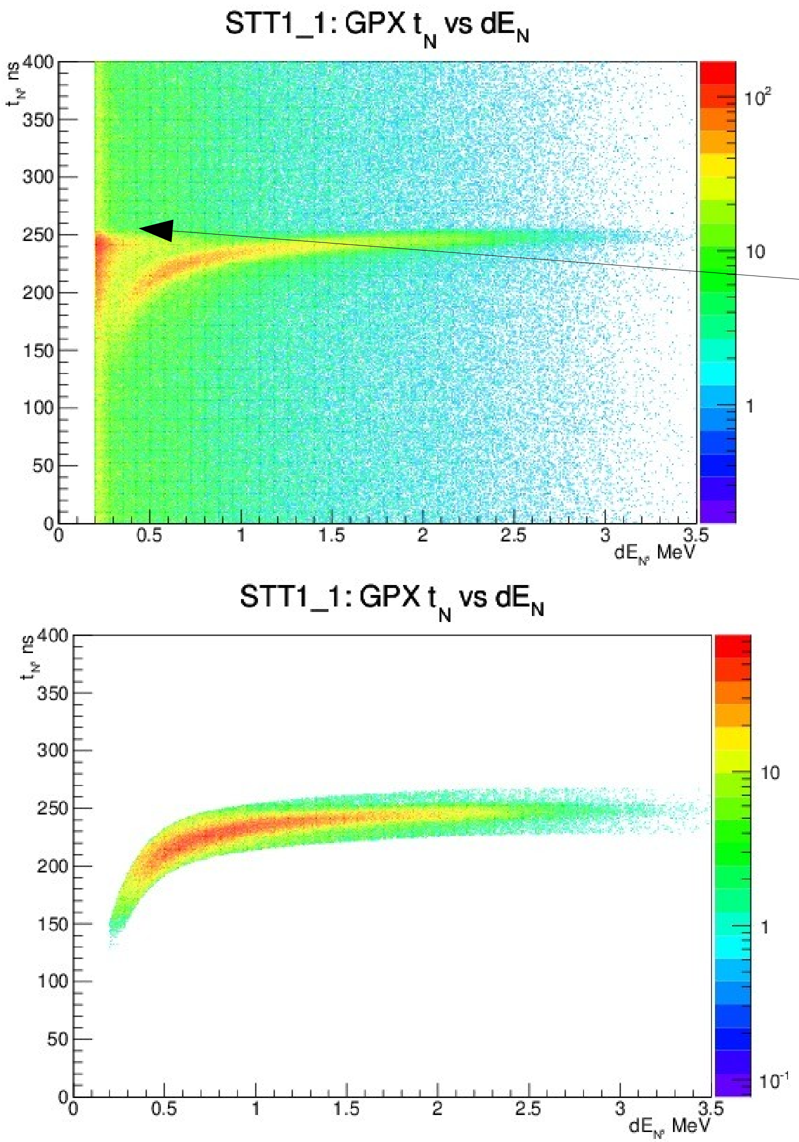

- Energy losses $E_{loss} = (P_0 + P_1 \cdot A^{Cor})$
- Energy losses for N and P sides are different because amplifier cofficient could be different and changed during the beam time.
- Need correction cofficients for every run & detector:

$$k_{New} = k + \frac{\Delta E}{E}$$



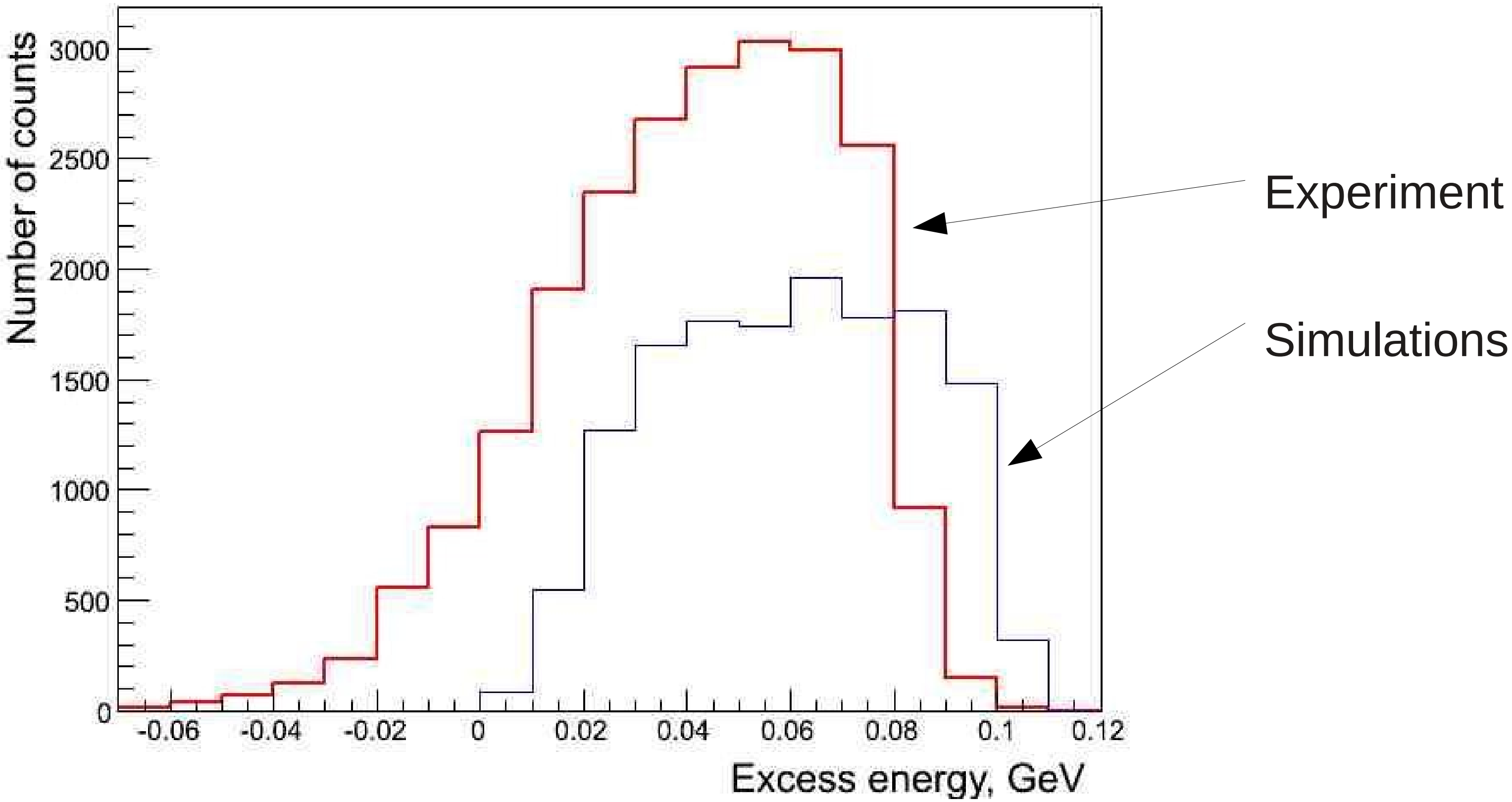

- Spectra after correction

# Selection of useful events




- Detector works with high load rate
- There are many clusters from particles from background events, especially in the region dE<0.5 MeV
- One can apply cut on Time vs E distribution and select useful events

# N(pn → K⁺nΛ) vs Q




- Distribution for the number of $K^+\Lambda$ events as a function of Q has been build using preselected $K^+$ data
- Due to the high luminosity during the experiment we have obtained relatively good statistics

# Results

- STT analysis was completed
- „Formal“ criteria for „bad“ segments identification were created
- In order to reconstruct total cross section for the $pn \rightarrow K^{+}n\Lambda$ reaction: luminosity, range telescope efficiencies and acceptances should be determined

# Thank you!