Design of a test station for silicon strip sensors for PANDA*

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Outline

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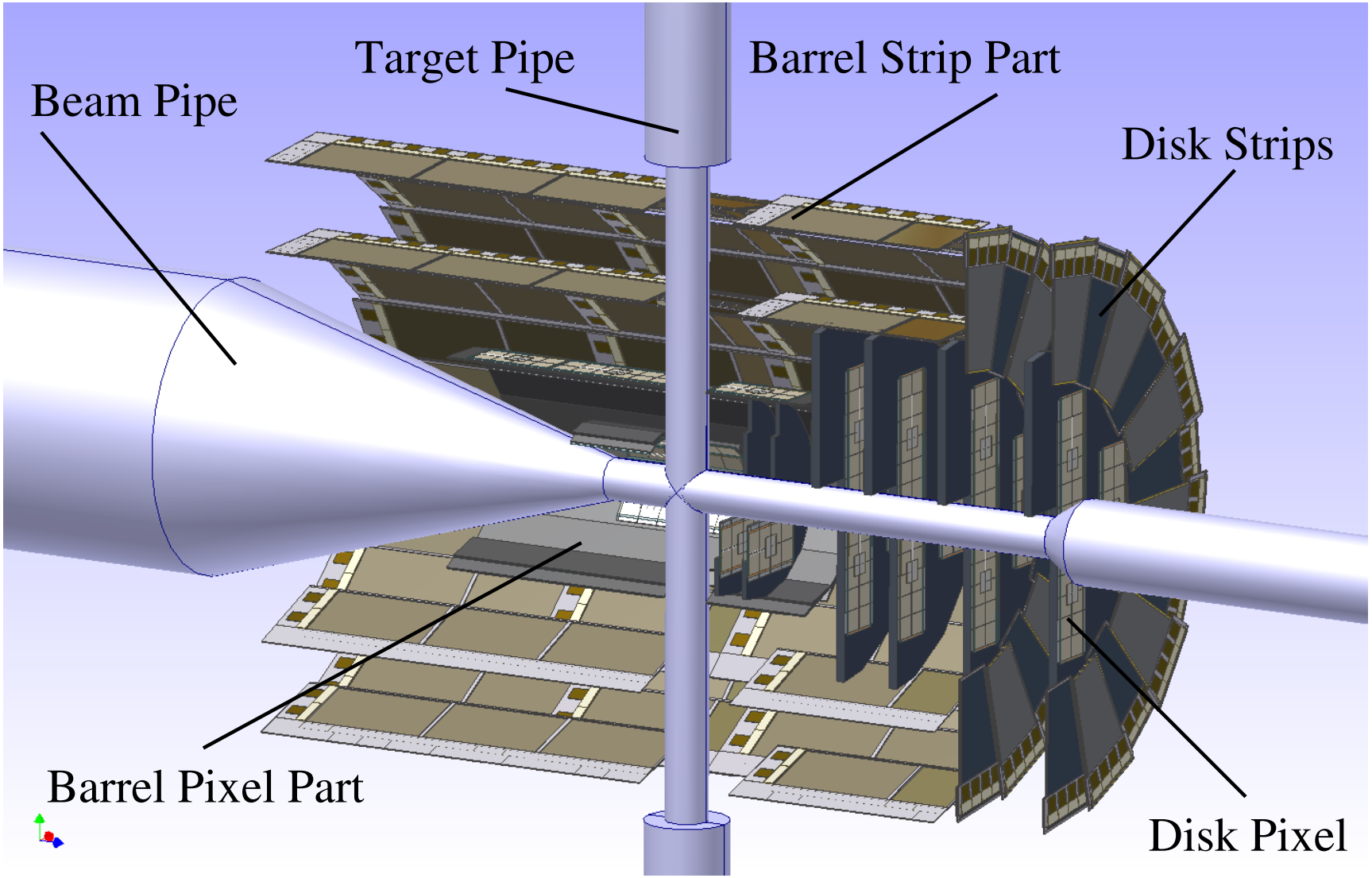
The PANDA Microvertex Detector



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- 12 million pixel channels → about 120 pixel modules
- 160,000 strip channels → about 200 strip modules

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need for solid tests of functionality of sensor modules

- fast characterization of all modules
- determination of bad channels or defunct frontends
- determination of leakage current and depletion voltage
- possibility to decide which modules may be used

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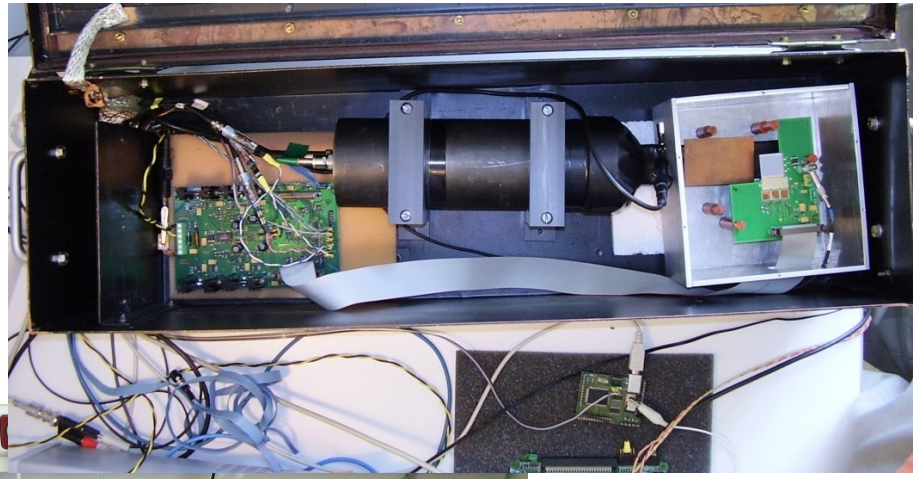
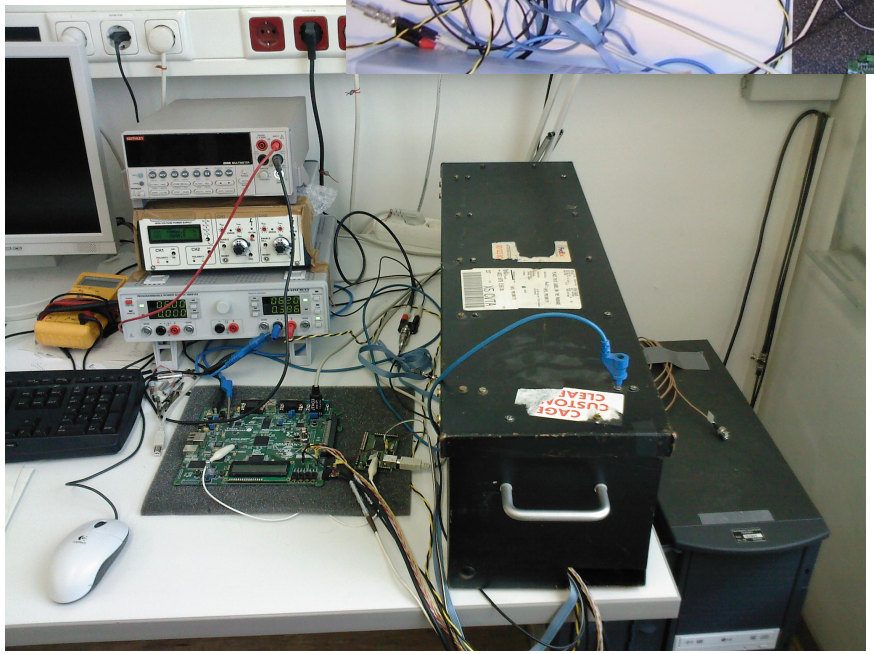
A setup for characterisation of Si-strip sensors and frontends





- handling Si-strip sensors and frontend electronics
- development of readout software
- measurements with ionizing radiation

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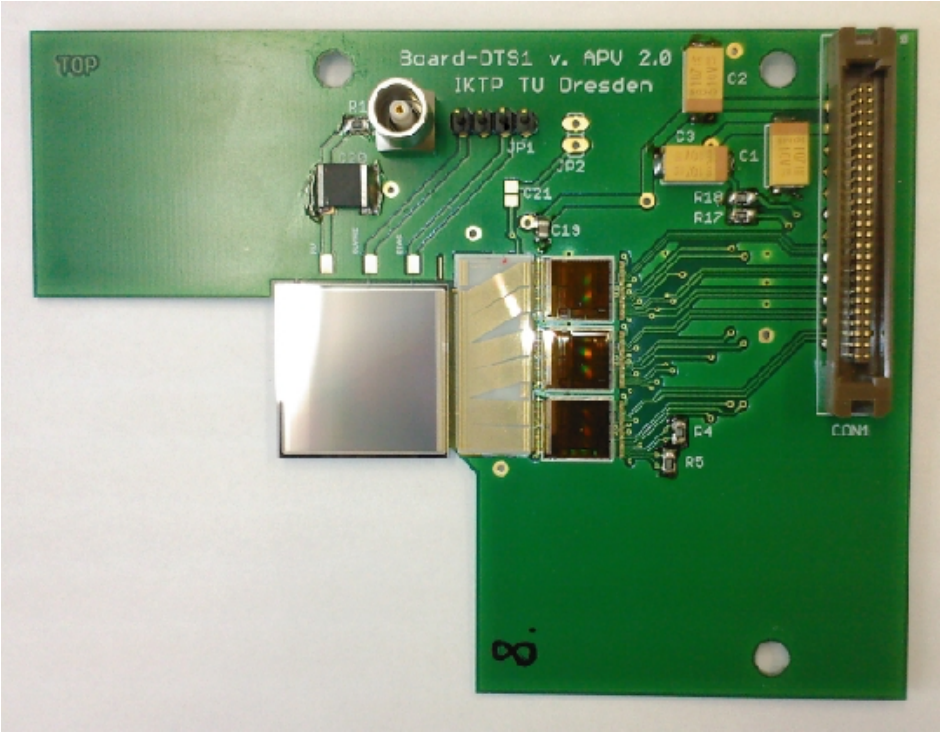
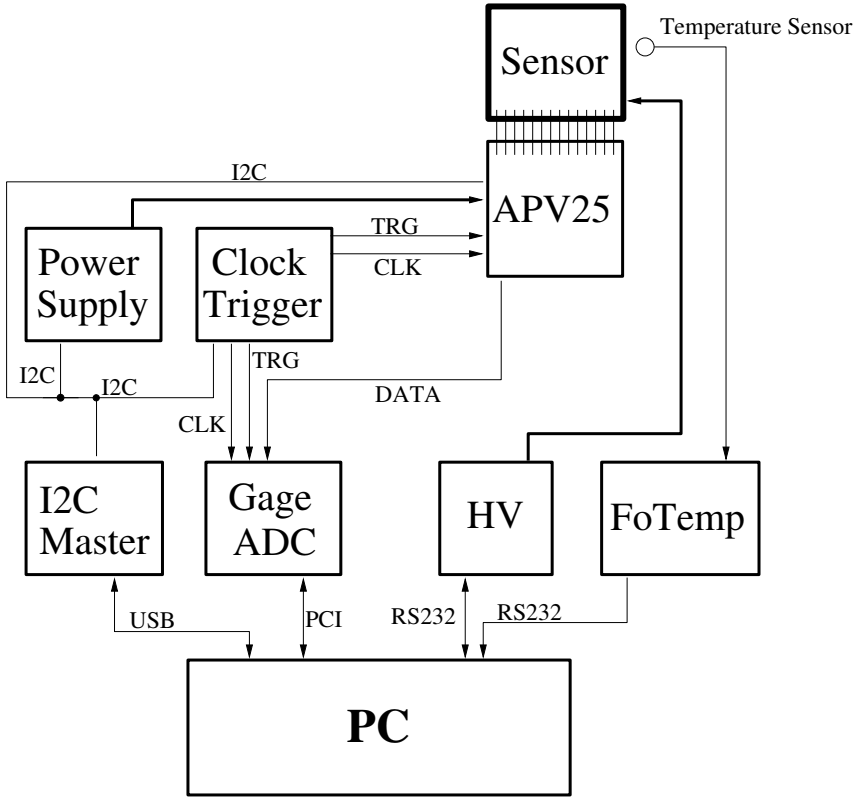
Sensor Module

- L-shaped PCB for double sided mounting
- Sensors with area $2 \times 2\,cm^2$, thickness $320\mu m$, $50\ \mu m$ pitch, 90°stereo angle
- Frontend APV25-S1



Readout and Feature Extraction

- hardware
  - modular setup
  - standard connections to PC
  - easy parameter setting and readout of all components
- software
  - zero suppression
  - identify pedestals and noise
  - find hits and save to file
  - clustering for online monitoring



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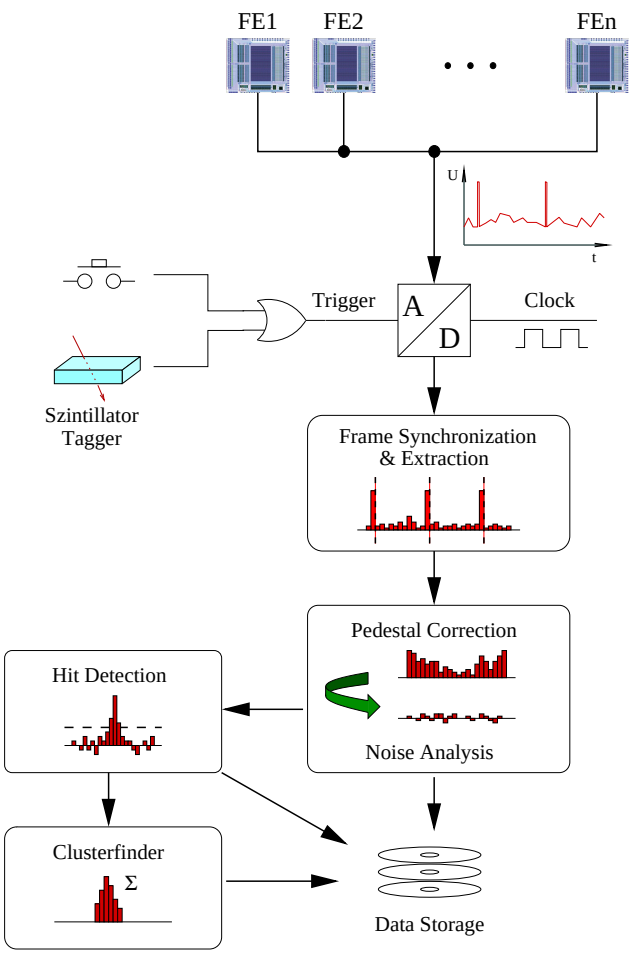

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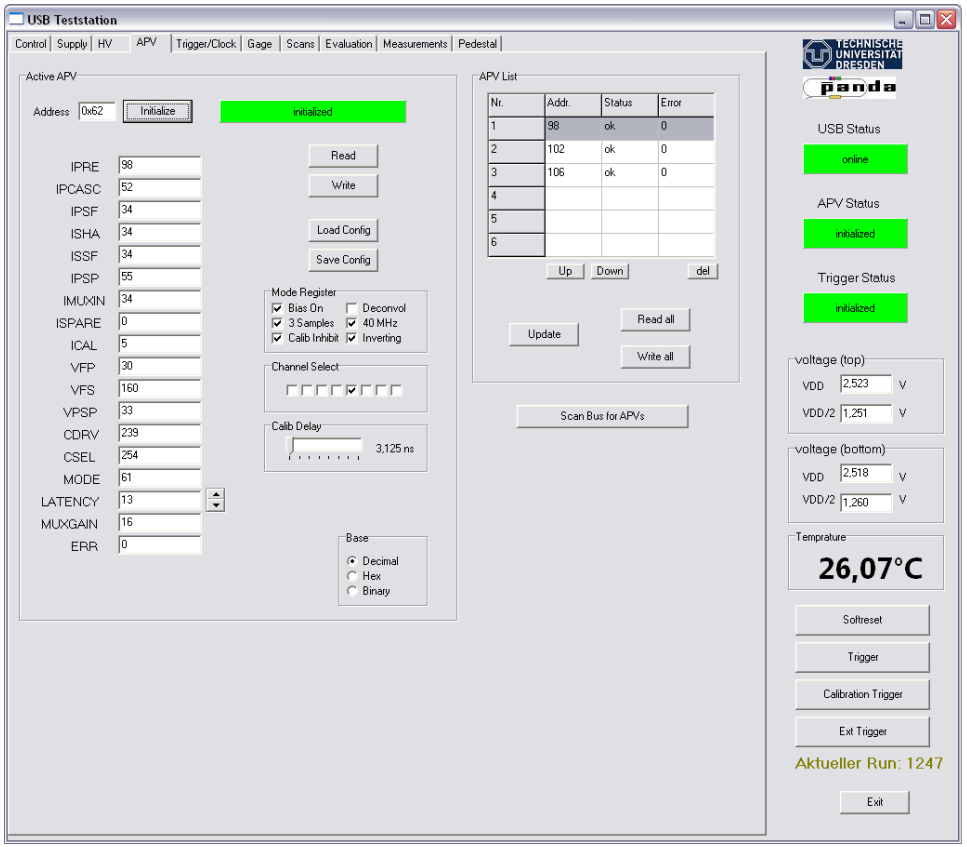
Online Monitoring and Parameter Settings

- APV25 parameter settings
- raw data and pedestals / noise
- online energy deposit monitoring and clustering



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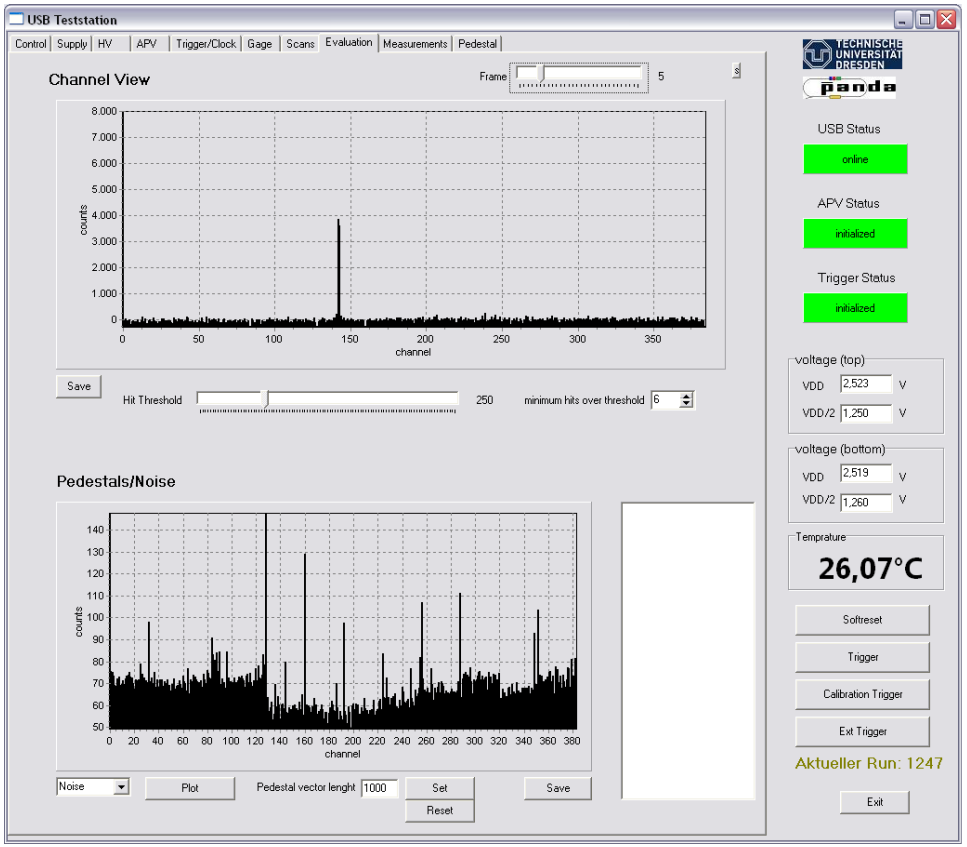

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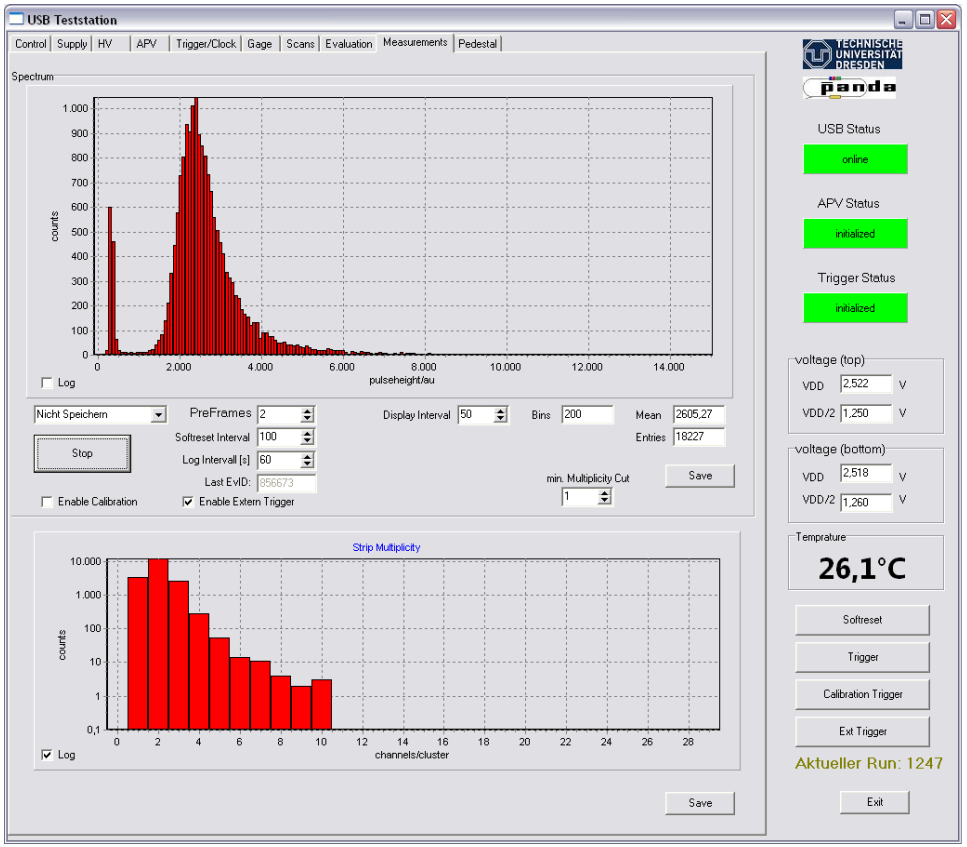

Characterisation of Si-strip sensors modules

- **Tests of functionality of sensor modules**
  1. Analysis of leakage current and noise to determine optimal depletion voltage
  2. Detailed calibration of each channel with APV internal charge generator
  3. Measurements with ^{90}Sr to get response of sensor strips
- **Store results in MySQL-database**

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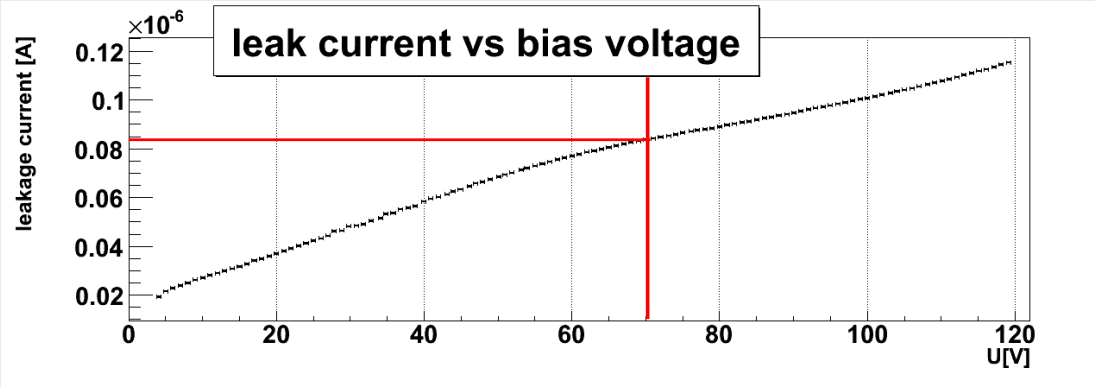
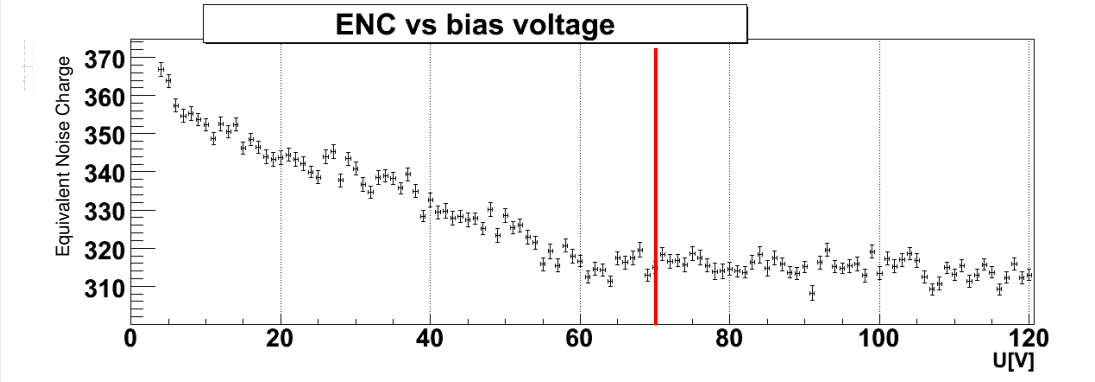
leakage current and noise characteristics

$$ENC = f(d(V_{Dep})),\ I_{Leakage} = f(V_{Dep}, d(V_{Dep}))$$

e.g for Module 09

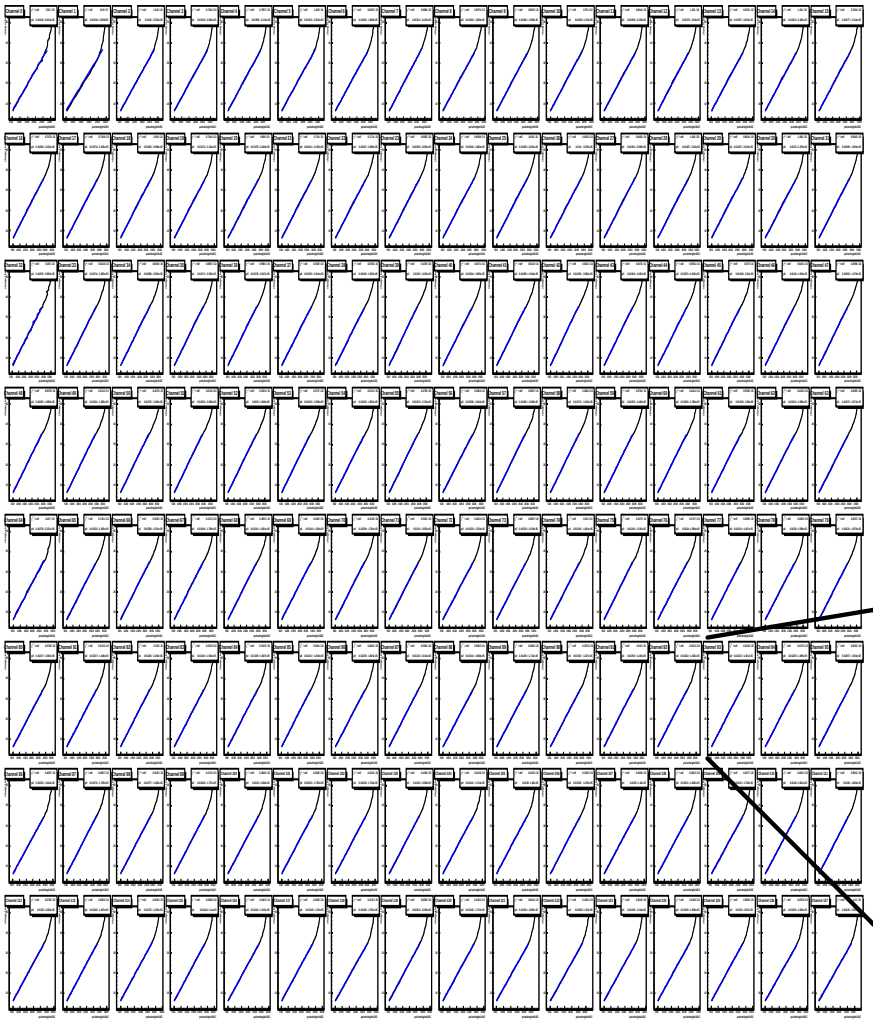




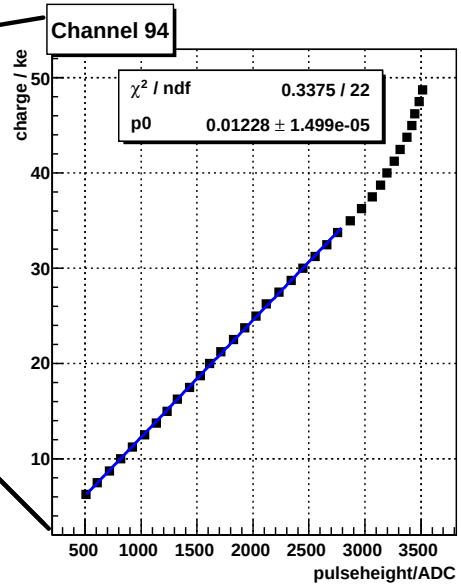
- $V_{Dep} \approx 70\mathrm{V}$
- $I_{Leakage} \approx 85\mathrm{nA}$

Calibration

- injection of defined charge into FE preamps
- store slope parameters for later charge reconstruction



response characteristics of all FE channels



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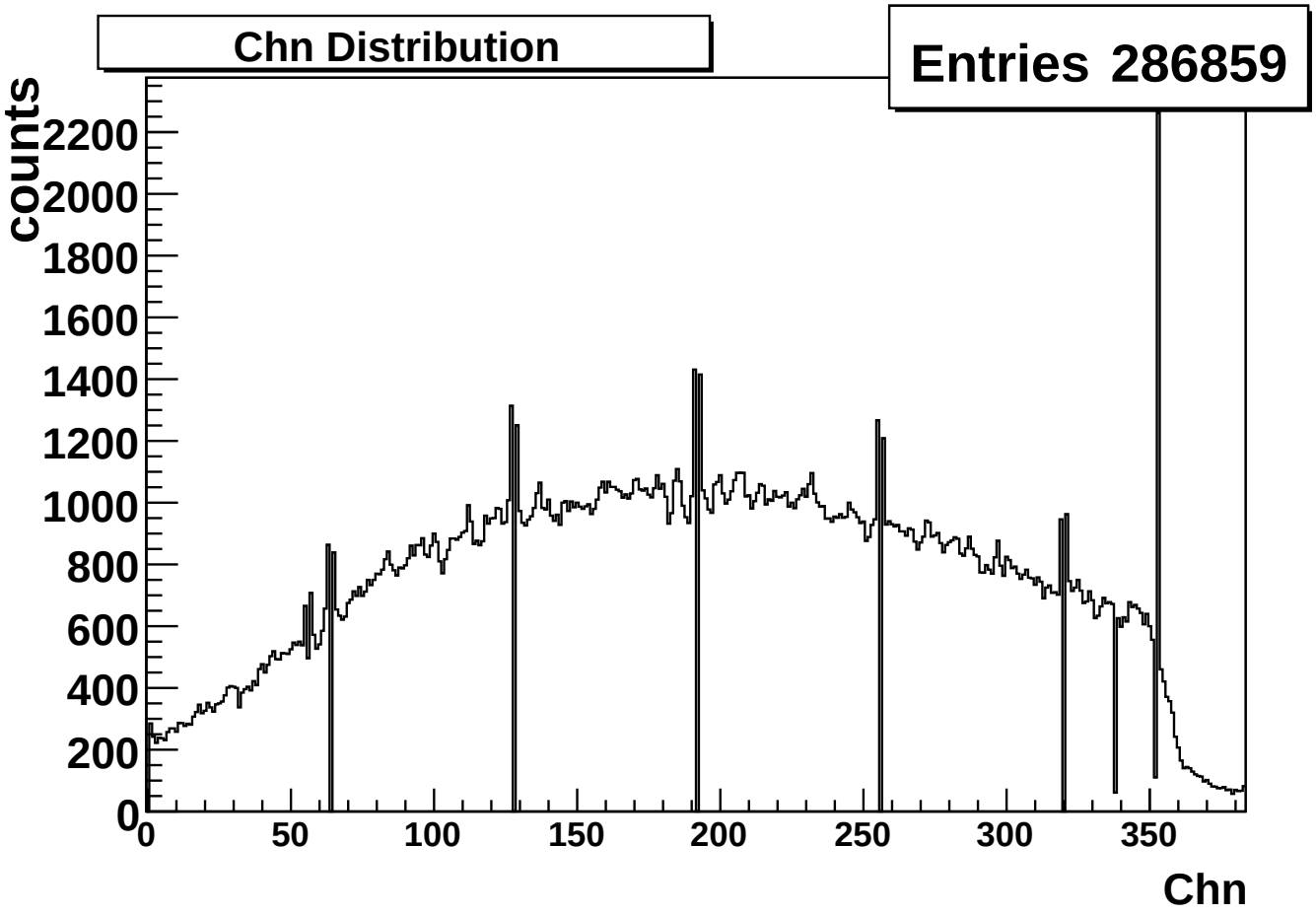
Measurement with ^{90}Sr

- detect noisy / defunct channels or FE
- channels 0, 64,128, 192, 256, 320 not bonded



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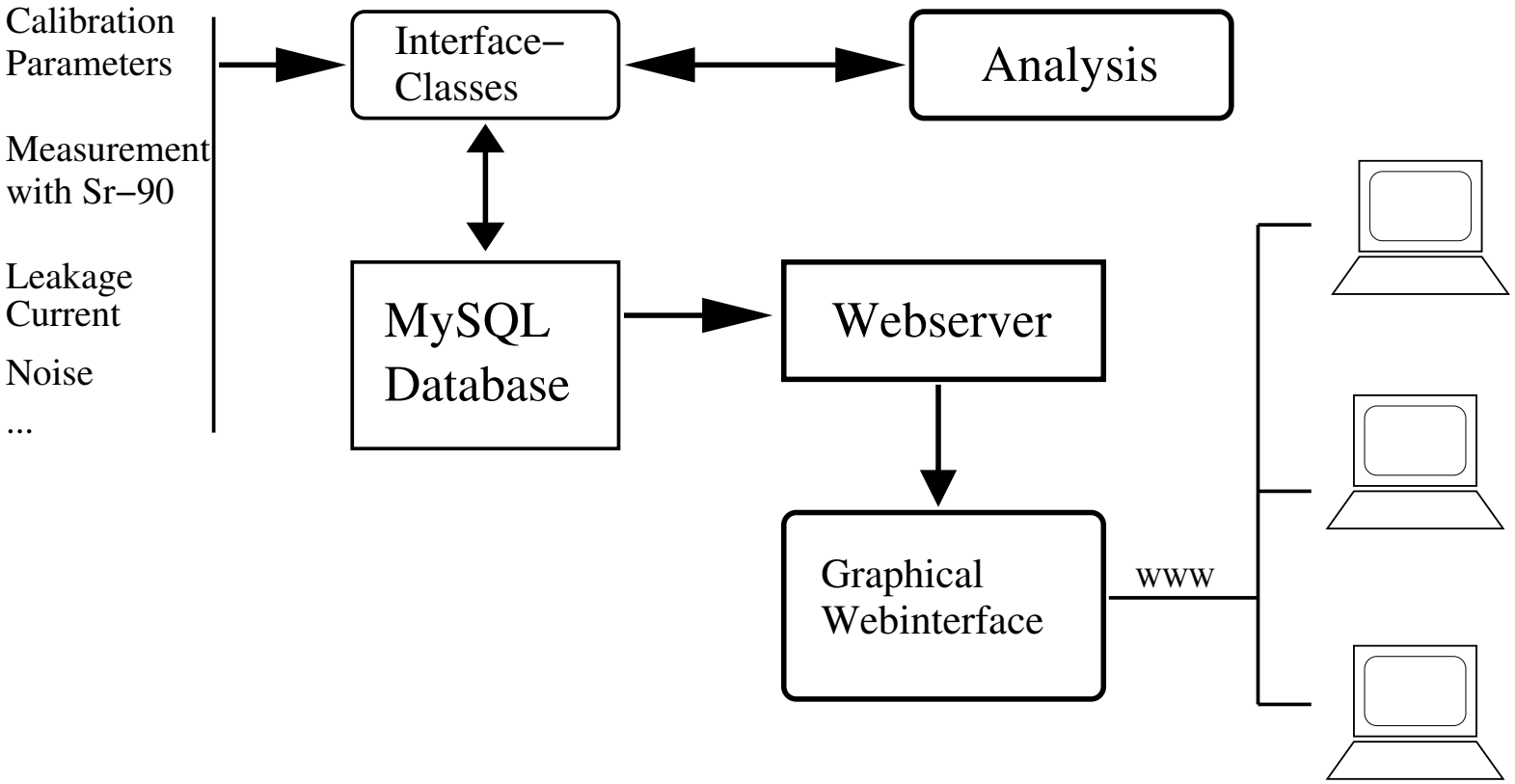
Database Structure



module test results

- until now 15 modules tested
- leakage currents between 85nA - 700nA
- depletion voltage about 35V - 75V
- $<$ 1,5% bad channels per module
- 1 module with defunct frontend

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Summary

- stable test station to characterize silicon strip sensor modules
- measurements with radioactive sources
- simple tests to confirm functionality of sensor modules
- database interface to store results
- base for energy loss, scattering and tracking studies

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Outlook

- tests with different sensor types
- possibility to bond single strips to learn more about depletion, leakage current and radiation damage
- web server planned for better compatibility among different groups within PANDA (connections from Bonn, Mainz and Dresden)

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