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

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Outline

1. Introduction

2. Test Station for Silicon Strip Sensors

3. Characterisation of Si-Strip Sensor Modules
The PANDA Microvertex Detector

- Target Pipe
- Barrel Strip Part
- Disk Strips
- Disk Pixel
- Beam Pipe
- Barrel Pixel Part
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
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
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, $90^\circ$ 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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Online Monitoring and Parameter Settings

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

\[ ENC = f(d(V_{Dep})), \quad I_{\text{Leakage}} = f(V_{Dep}, d(V_{Dep})) \]

e.g. for Module 09

- \( V_{Dep} \approx 70\text{V} \)
- \( I_{\text{Leakage}} \approx 85\text{nA} \)
Calibration

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

response characteristics of all FE channels
Measurement with $^{90}\text{Sr}$

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

- Calibration Parameters
- Measurement with Sr–90
- Leakage Current
- Noise

- Interface–Classes
- MySQL Database
- Webserver
- Graphical Webinterface

Analysis

WWW
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
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)