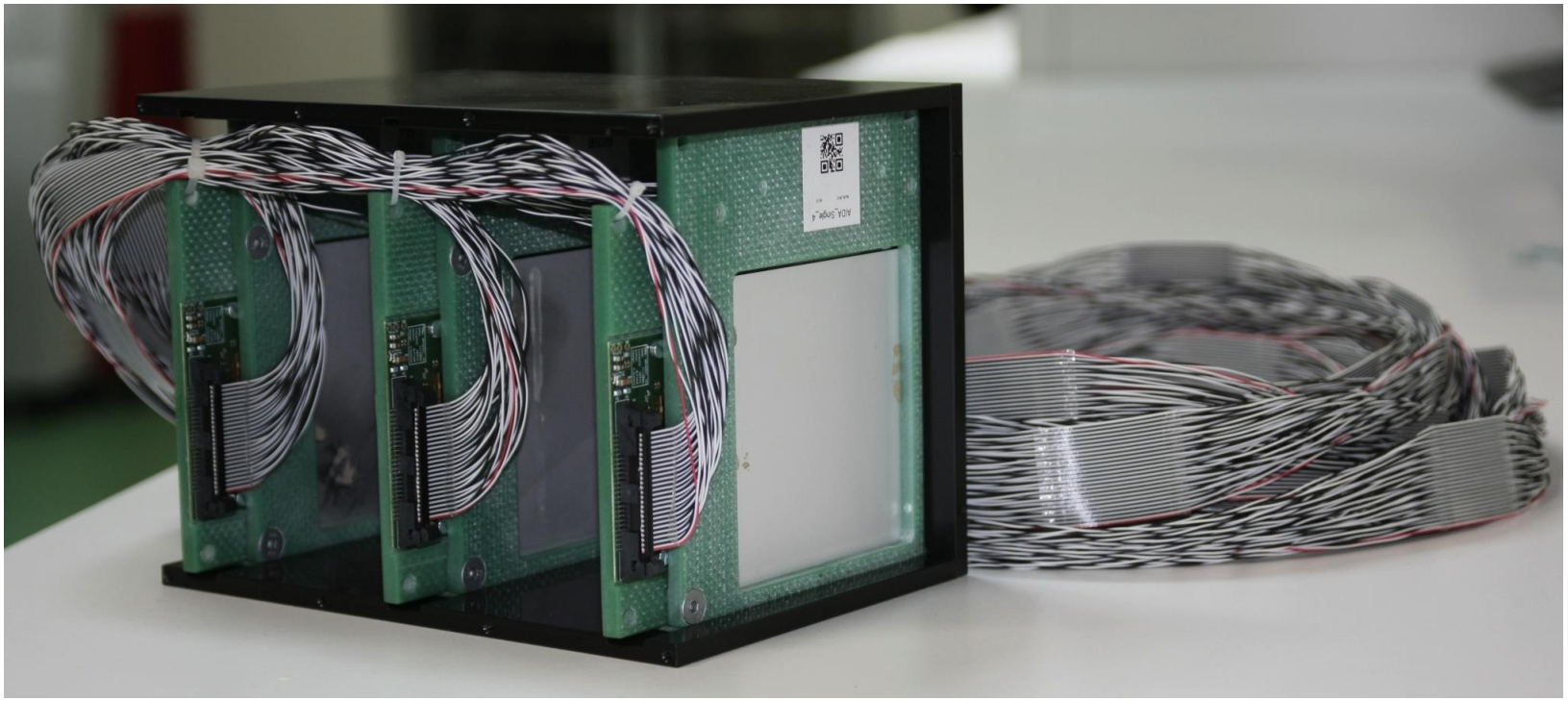
HEPHY
Institute of High Energy Physics

ÖAW
Österreichische Akademie der Wissenschaften



WP9.4 baseline deliverable summary

Thomas Bergauer (HEPHY Vienna)

10 December 2014

WP9.4 Silicon Tracking Goals

- Creation of a **multi-layer micro-strip detector coverage for the calorimeter infrastructure of Task 9.5** to provide a precise entry point of charged particle
  - The calorimeter infrastructure of task 9.5 will be preceded by **several layers** of Silicon micro-strip detectors to provide a precise entry point **over a large area**.

WP9.4 Silicon Tracking Goals

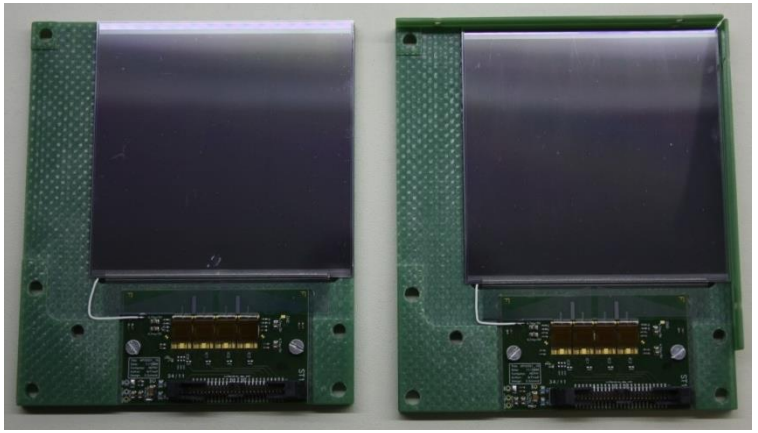
- **Finely segmented** and **thin** Silicon micro-strip detectors will be **designed** and **procured** by the participating institutes [OEAW; IPASCR (CUNI)].
- In the baseline design the system will be read out by **electronics developed for the LHC experiments** with established performance. [CSIC (IFCA, IFIC, UB)]
- For optimal read-out of **long ladders** a **custom IC** with longer shaping time **will be developed** and validated.
- Part of the ladders will be equipped with realistic services, including **cooling**, **powering**, **alignment**, structural and environmental **monitoring**.

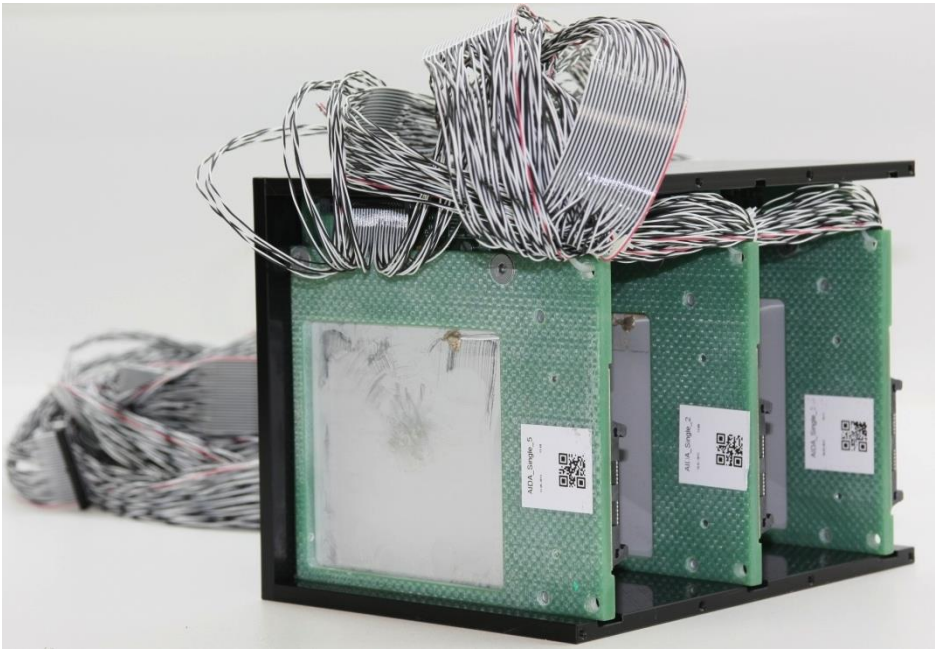
Baseline Deliverable	Advanced Deliverable
Two orthogonal layers of u-strips	Ultra-light strip layer of thin sensors (230 um)
HPK SiLC sensors	Integrated PA or 2D-Poly silicon or short strip sensors.
AVP25 based hybrid	APV25 based hybrid
Conventional mechanics	Light mechanics with embedded Fiber Optic Sensors
Integration with DAQ	Integration with DAQ
Offline software	Offline Software

Ivan Vila

Outline

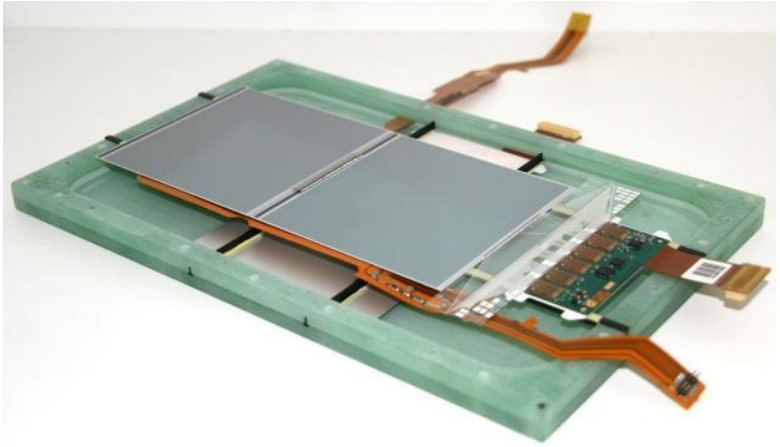
- **Hardware:**
  - The Sensors
  - The Modules
  - The Telescope
- **Test beam:**
  - Setup and read out
  - Results





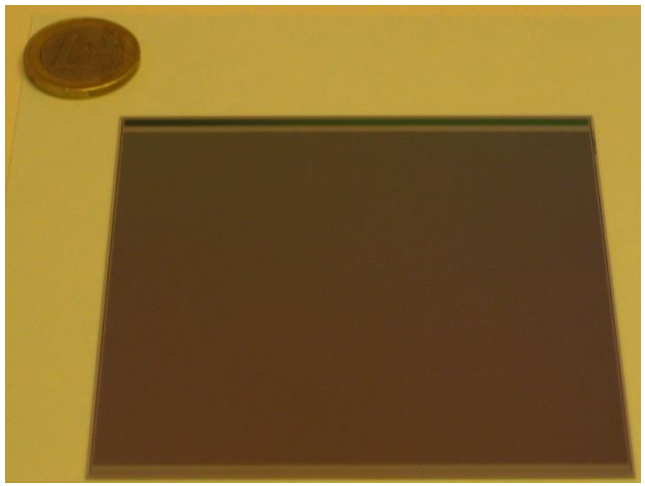
General:

- HPK sensors procured by the SiLC collaboration are used:
  - 6 Sensors available from Vienna Modules (LP-TPC)
  - Another 10 from LPNHE Paris
- Requirements:
  - Resolution: For most drift chambers studies a sub-millimeter accuracy would sufficient, but for detailed uniformity checks 0.1 mm would be desirable (statement of calorimeter group)

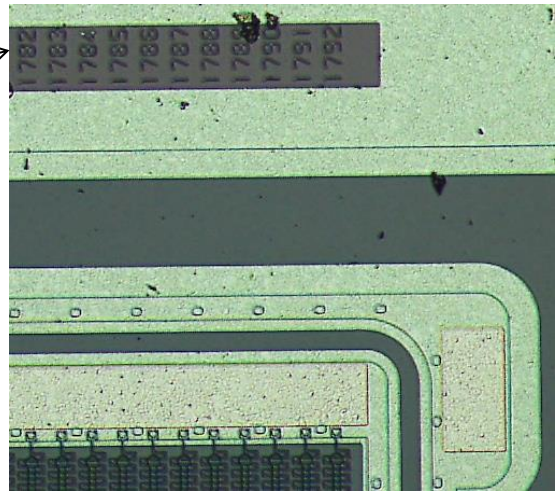


1.1. The Sensors

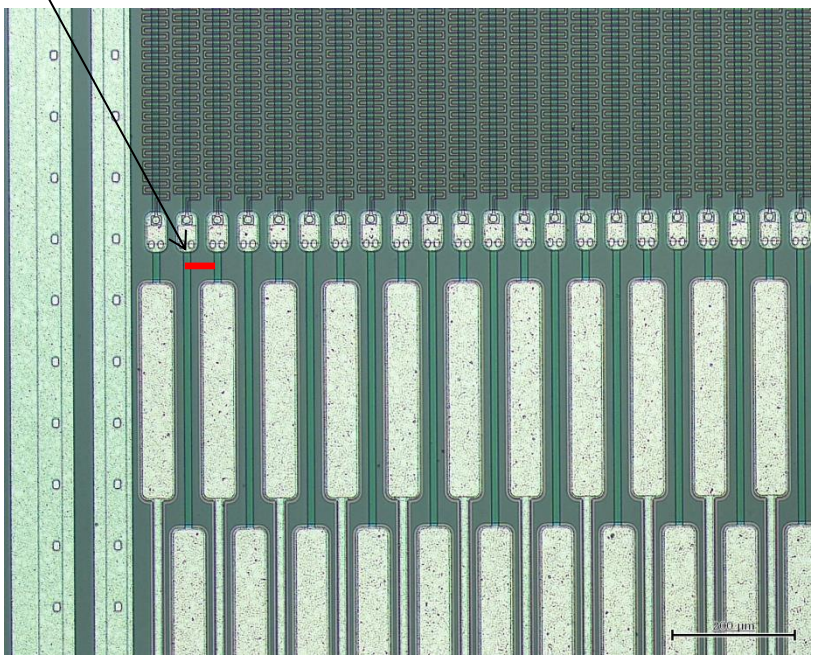
- Design Parameter:
  - Strip width: 12.5 µm
  - Pitch: 50 µm
  - Area: 95 x 95 mm²
  - Strip length: ~95 mm
  - Thickness: 320 µm



1792 Strips on each sensor



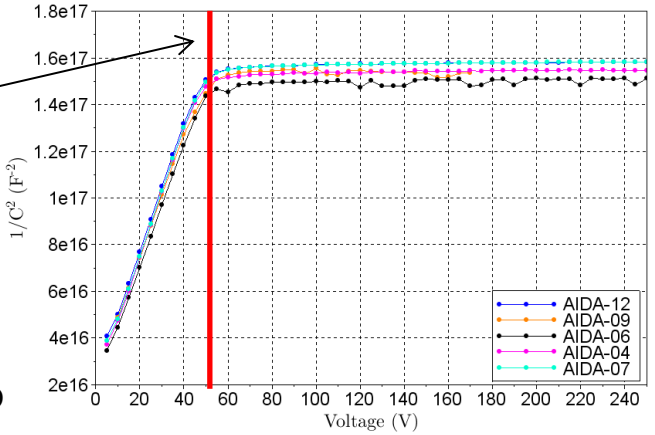
Small pitch of 50 µm



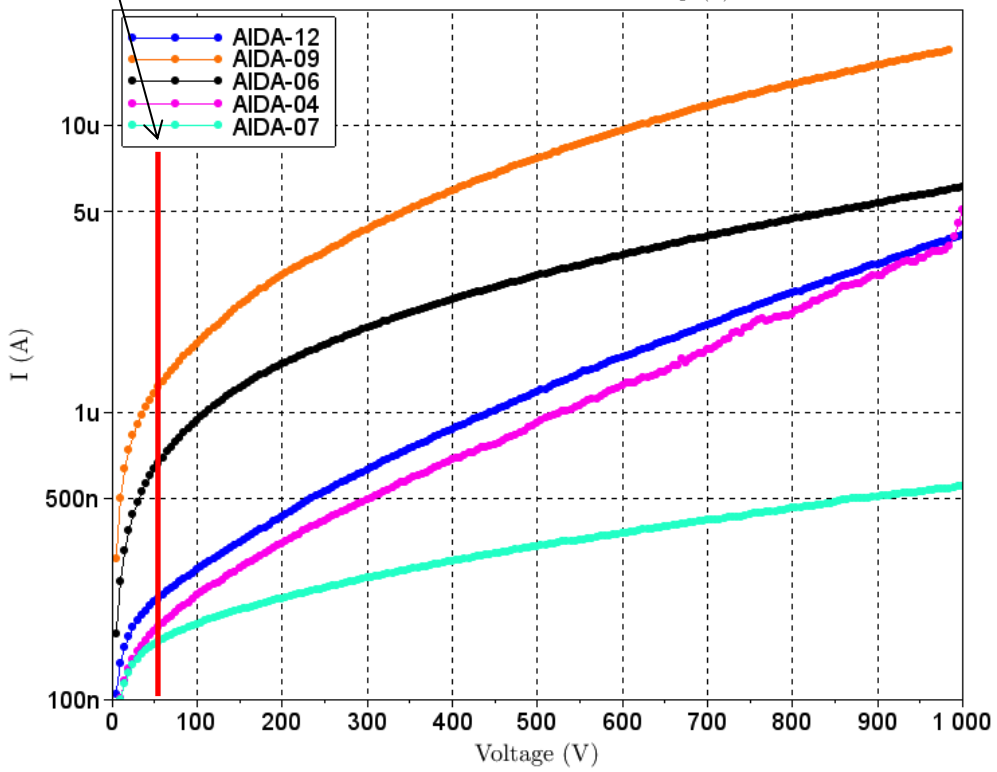
1.1. The Sensors

- Electrical characterization
  - Full depletion Voltage reached between 50 and 60 V
  - Leakage current: No break though until 1 kV although there are differences between the sensors the leakage currents is fine
  - Operation Voltage:100 V

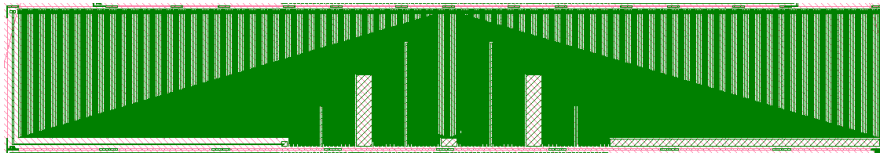
V_{FD} around 50 V



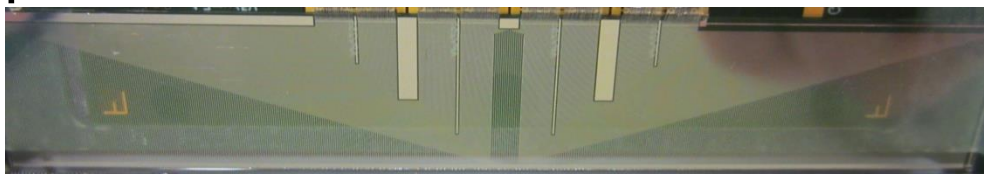
Leakage currents at V_{FD}



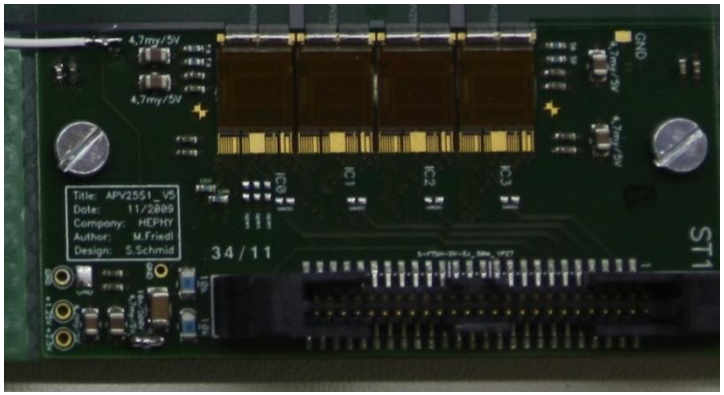
1.2. The Modules



- Pitch Adapter:
  - 512 channels with 150 µm pitch for 4 APVs
  - Designed at HEPHY Vienna, produced by CMN Barcelona



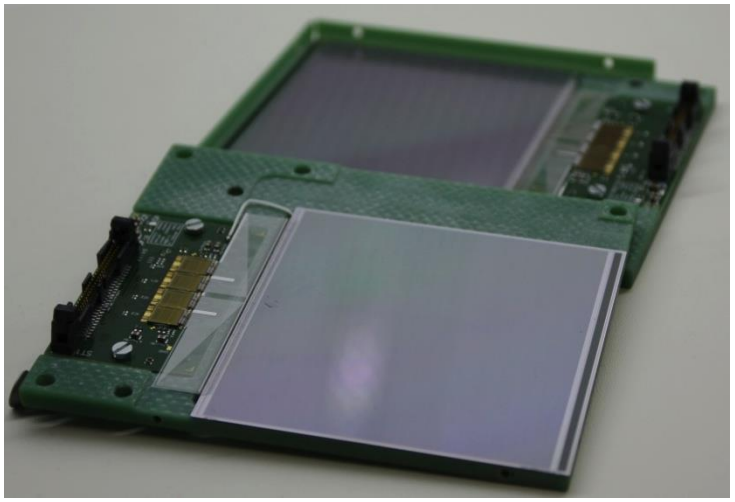
- Hybrid:
  - Prototype hybrids of the Belle II project; are able to read out 4 APV chips

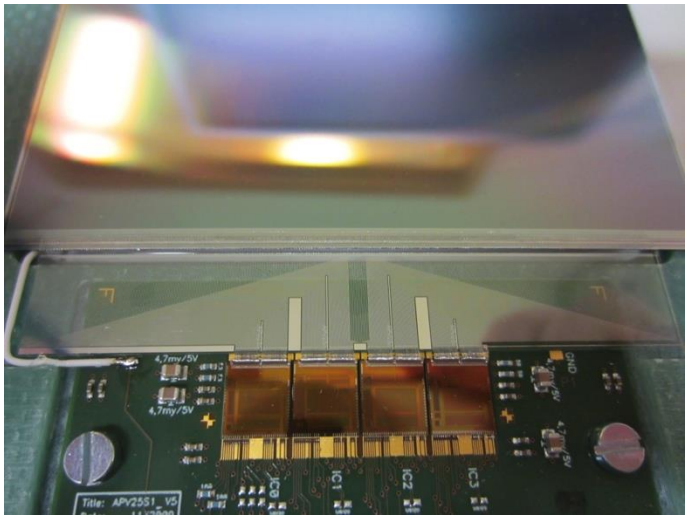


- APV 25 analog read out chip

1.2. The Modules

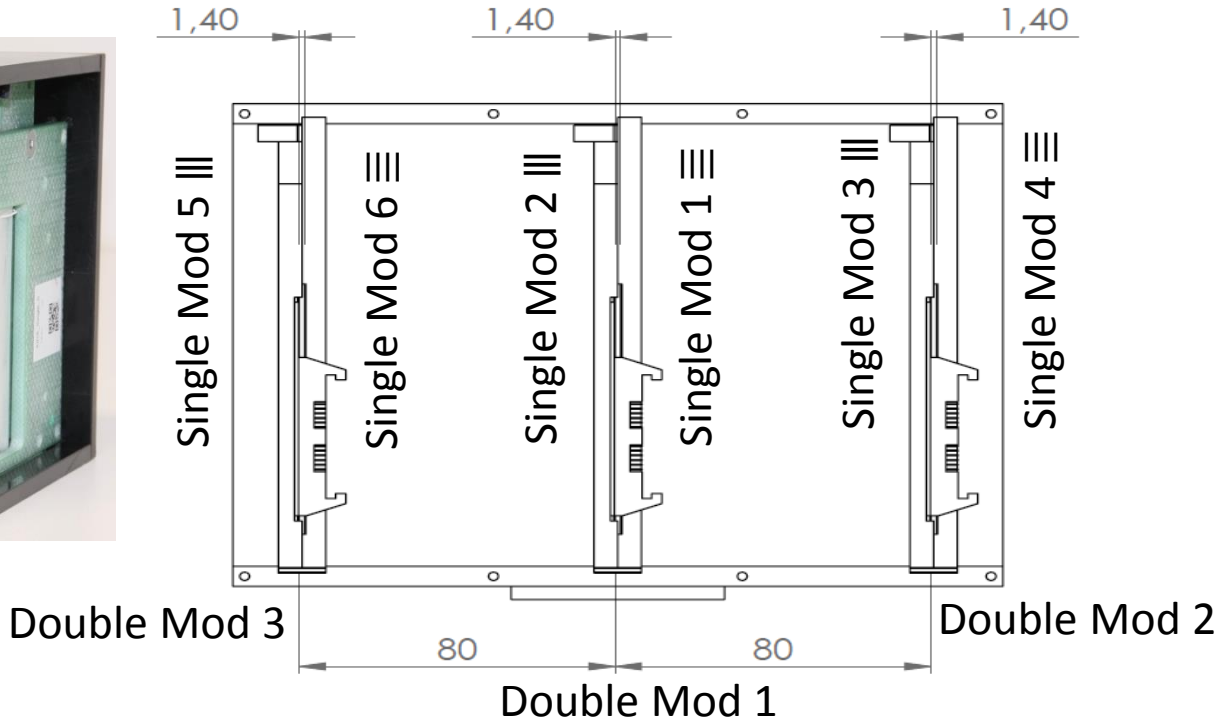
- Readout:
  - 512 strips are read out
  - Two intermediate strips are not read out (150 µm pitch)
- Design:
  - The support frame of all six modules is identical designed
  - Sensors are mounted perpendicular to each other
  - Two single modules are arranged to one double module; fixed by distance holder





1.3. The Telescope

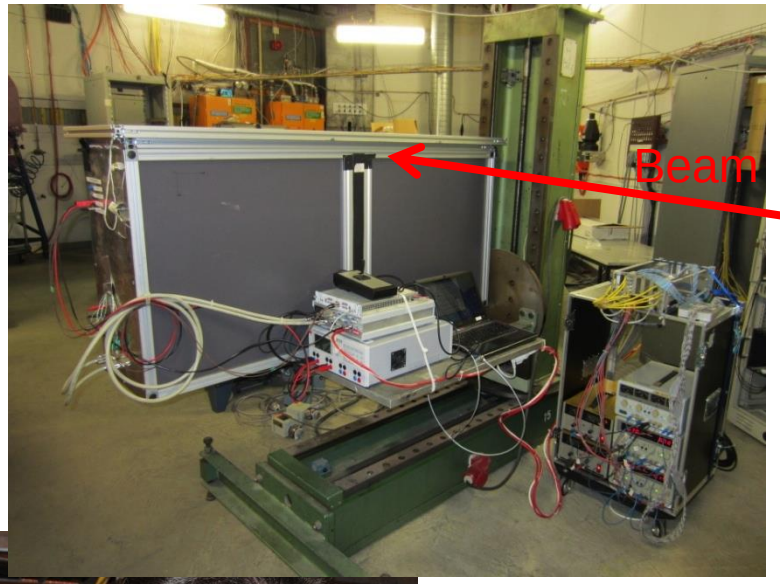
- Design Parameter:
  - Double module: 1.4 mm between two single modules, arranged with strips perpendicular to each other
  - Telescope: 80 mm between the different double modules

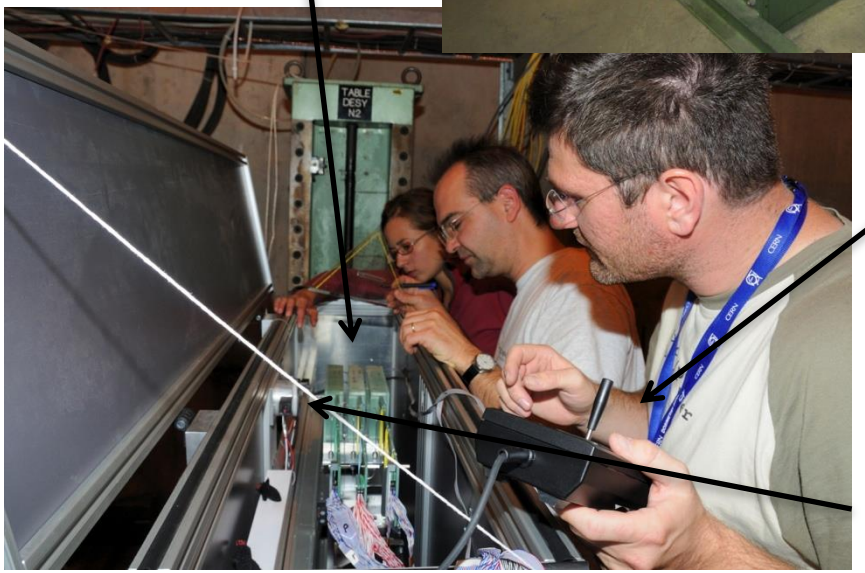


TB at DESY January 2014

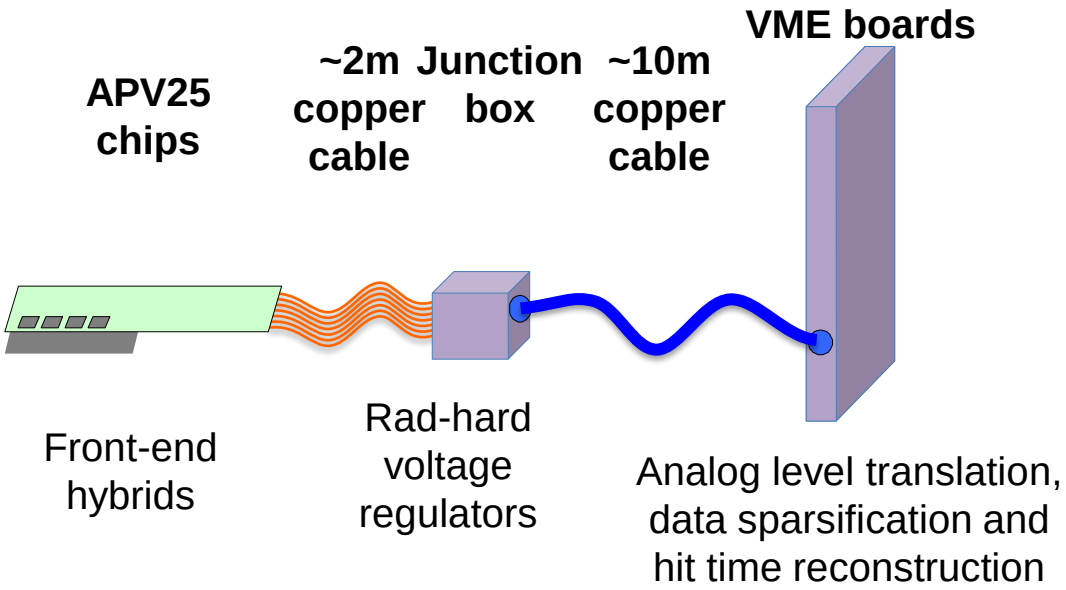
2.1. The Setup

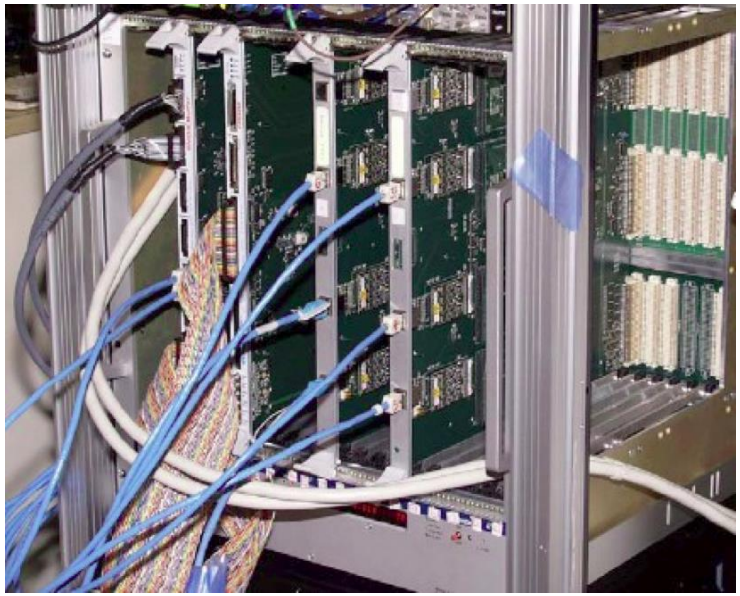
- Hardware
  - Box: The DUT has been mounted on an moveable x-z table
  - Triggering with scintillator and photomultiplier
- Readout
  - Presented data have been taken with an self developed DAQ system using LabWindows/CVI (NI)





2.1. The Setup





Readout APVDAQ:

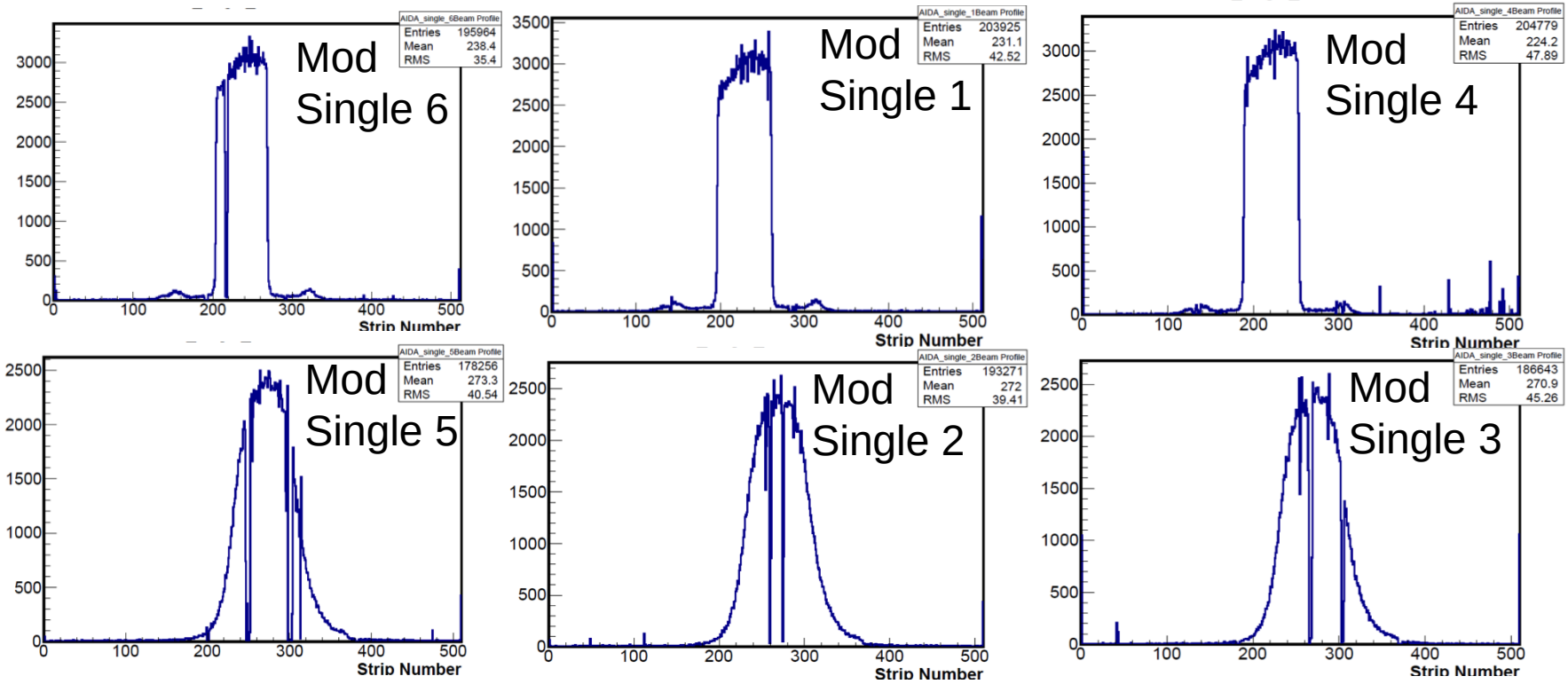
- Self-developed DAQ system, based on APV 25 readout chip (CMS development)
- Mature setup used for various beam tests in the past
- Software running LabWindows/CVI (NI)
- LINUX based DAQ is also available (TuxDAQ)

2.2. Results

Beam Profiles (run 36): Different shape due to different orientation

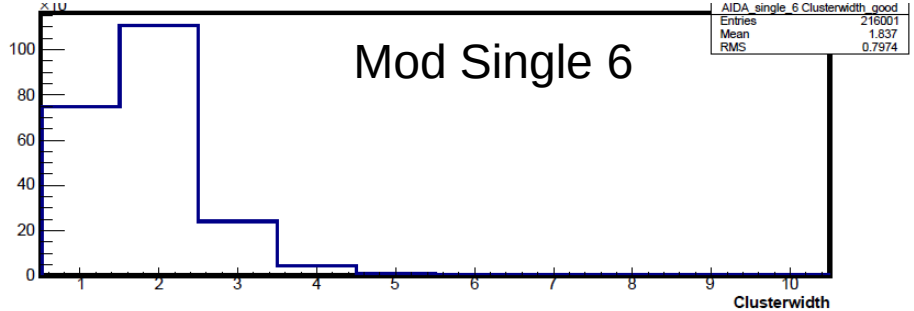
Single Mod 5 |||	Single Mod 6 ≣	Single Mod 2 |||	Single Mod 1 ≣	Single Mod 3 |||	Single Mod 4 ≣
Double Mod 3		Double Mod 1		Double Mod 2	

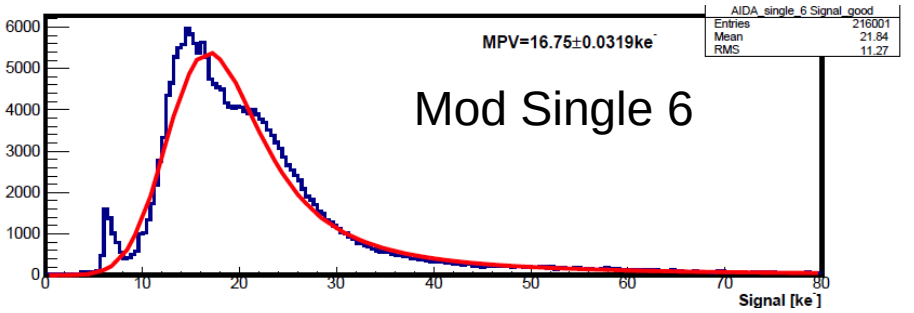
Telescope

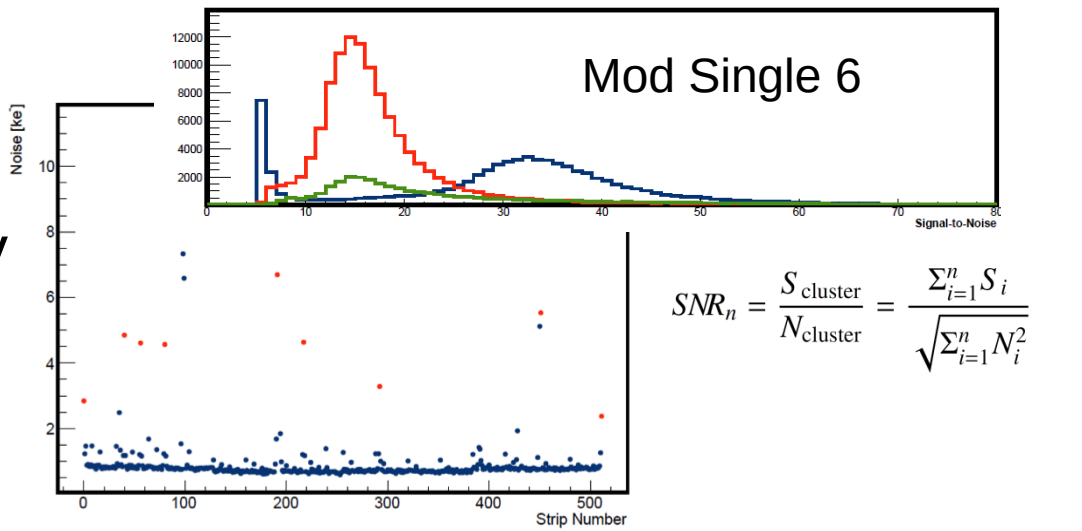


2.2. Results

- General properties (run 36):
  - Cluster width: Due to intermediate strips mainly cluster with width two
  - Signal: around 16 ke; cluster of all widths are considered
  - SNR: for different cluster widths (1, 2, 3)
  - Noise: Very low (mainly smaller than 1 ke)



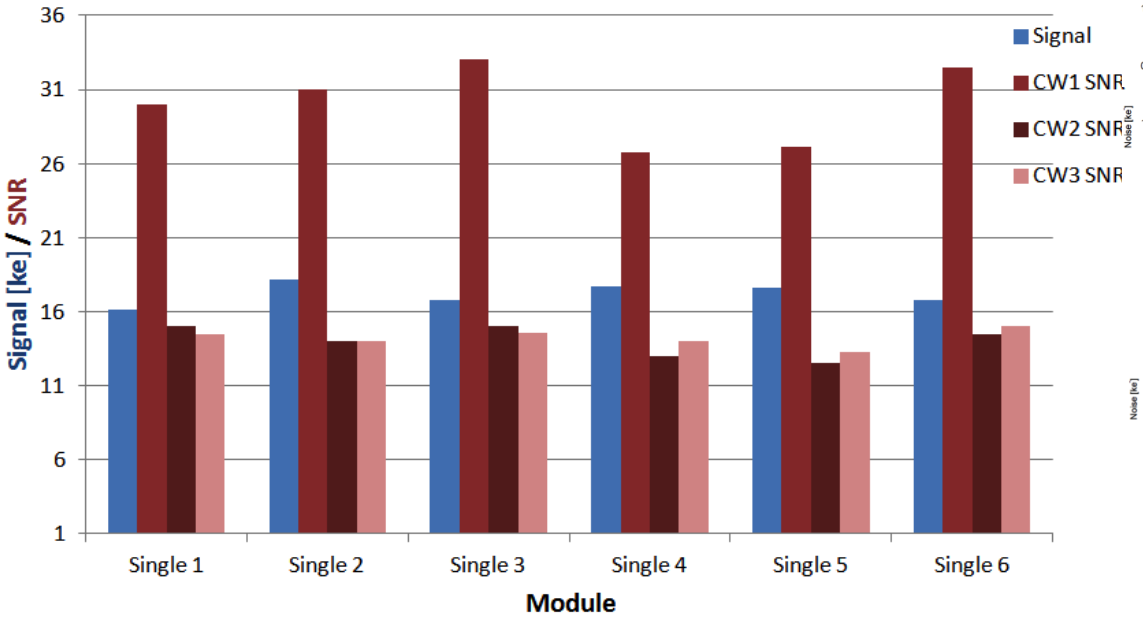


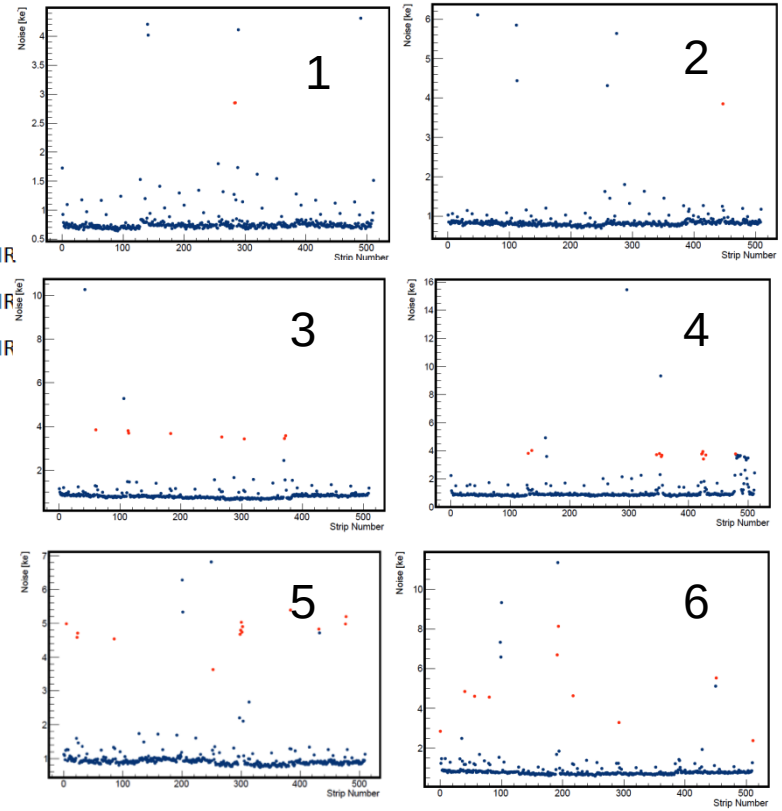


$$SNR_n = \frac{S_{\text{cluster}}}{N_{\text{cluster}}} = \frac{\Sigma_{i=1}^{n} S_i}{\sqrt{\Sigma_{i=1}^{n} N_i^2}}$$

2.2. Results

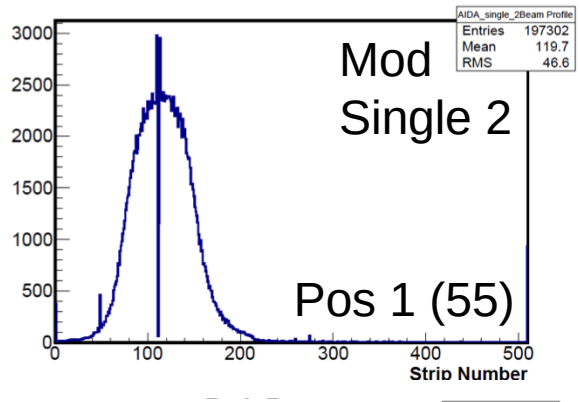
- The different single modules behave very similar (run 36)
- Only single module 4 features a small accumulation of noisy strips at the right edge

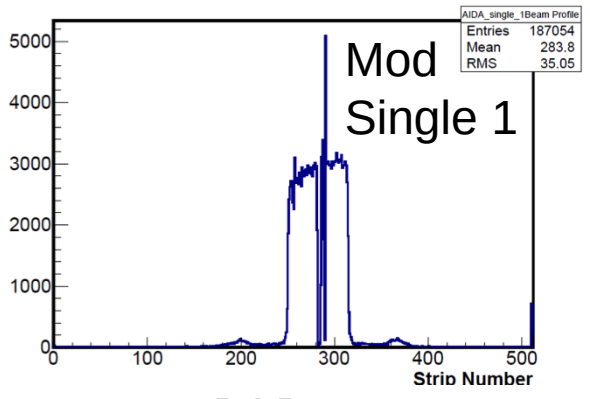


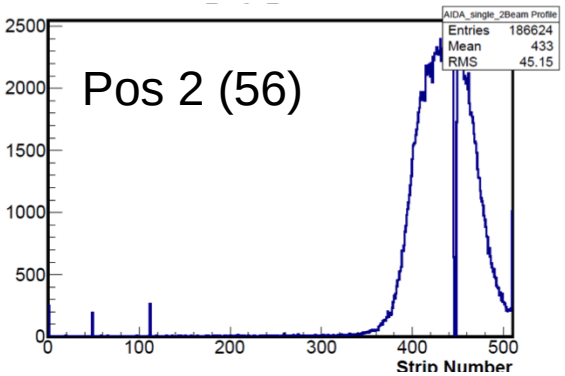


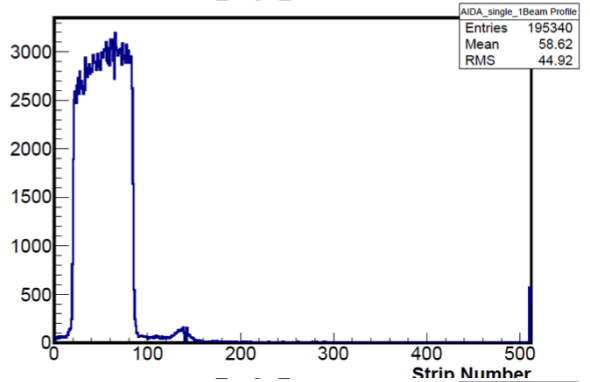
2.2. Results

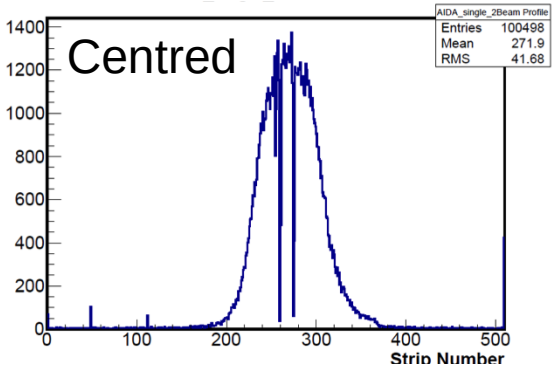
- Position Scan:
  - Different Positions tested before centering the telescope
  - Good quality in all tested areas of the modules

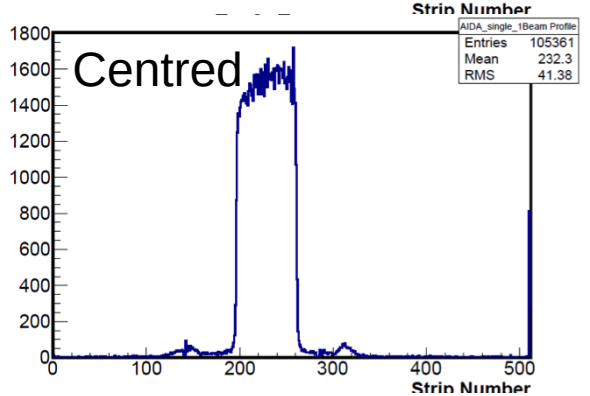






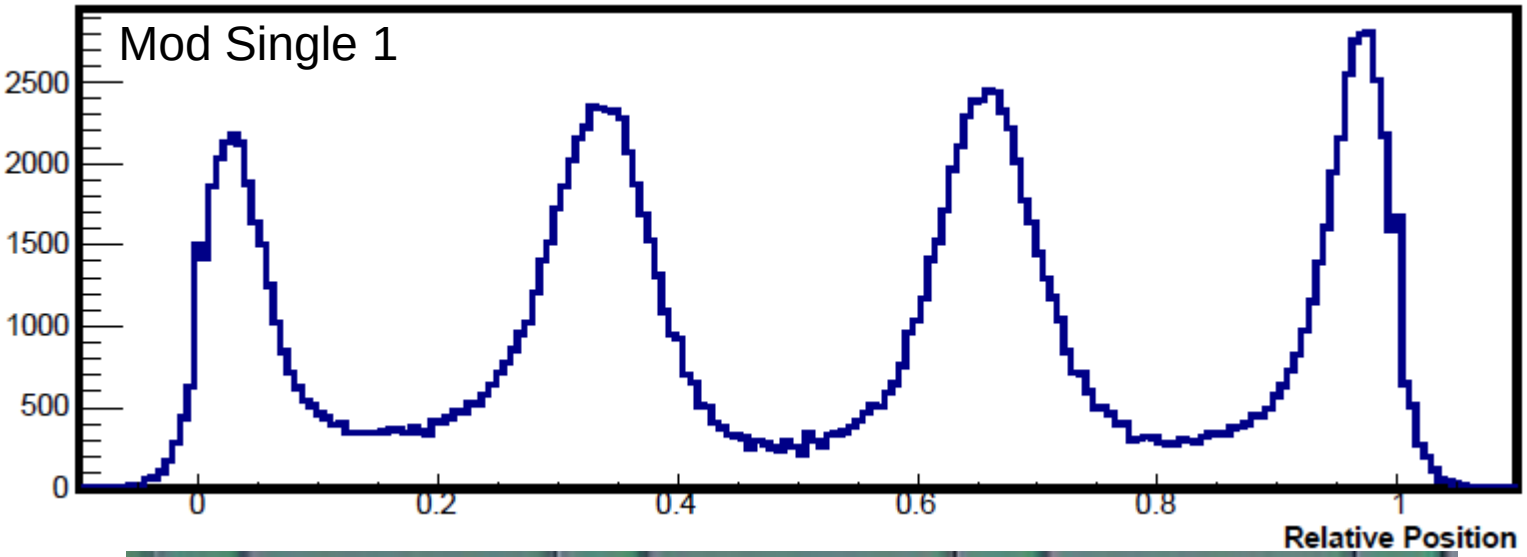






2.2. Results

- Eta Distribution (run 36): The effect of two intermediate strips is clearly seen (hits with cluster size one are also included)



Bonded strip read out (left)

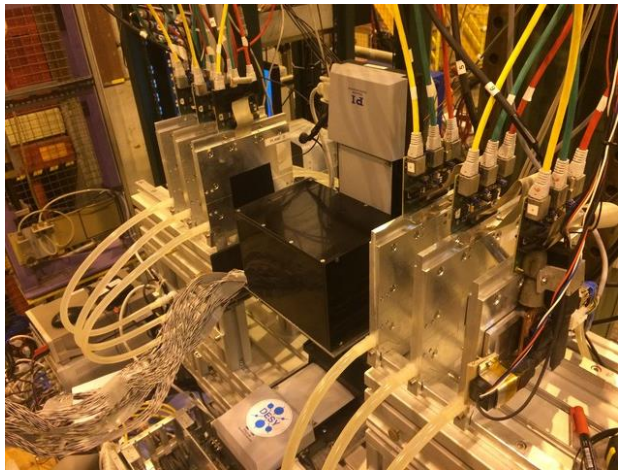
Intermediate strip (left)

Intermediate strip (right)

Bonded strip read out (right)

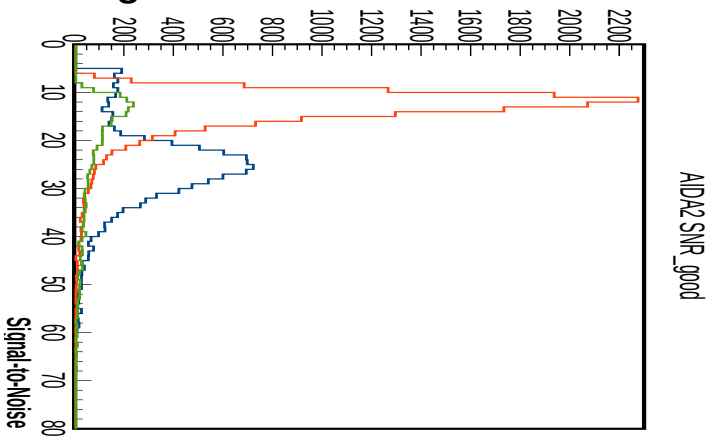
Testbeam at CERN SPS Nov 2014

- 120GeV hadrons
- Parasitically to HEPHY Belle II SVD testbeam in H6a/b
- Exactly the same hardware as at DESY
  - BUT: using EUDET telescope for tracking
  - BUT: still two data streams (EUDAQ, TuxDAQ) with time stamp synconization from TLU)

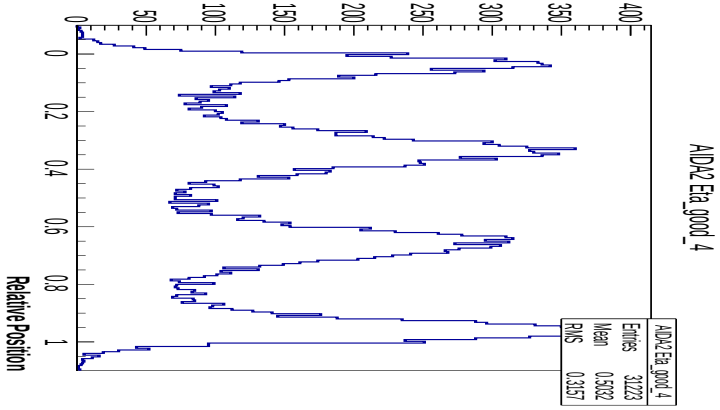


Testbeam SPS preliminary Results

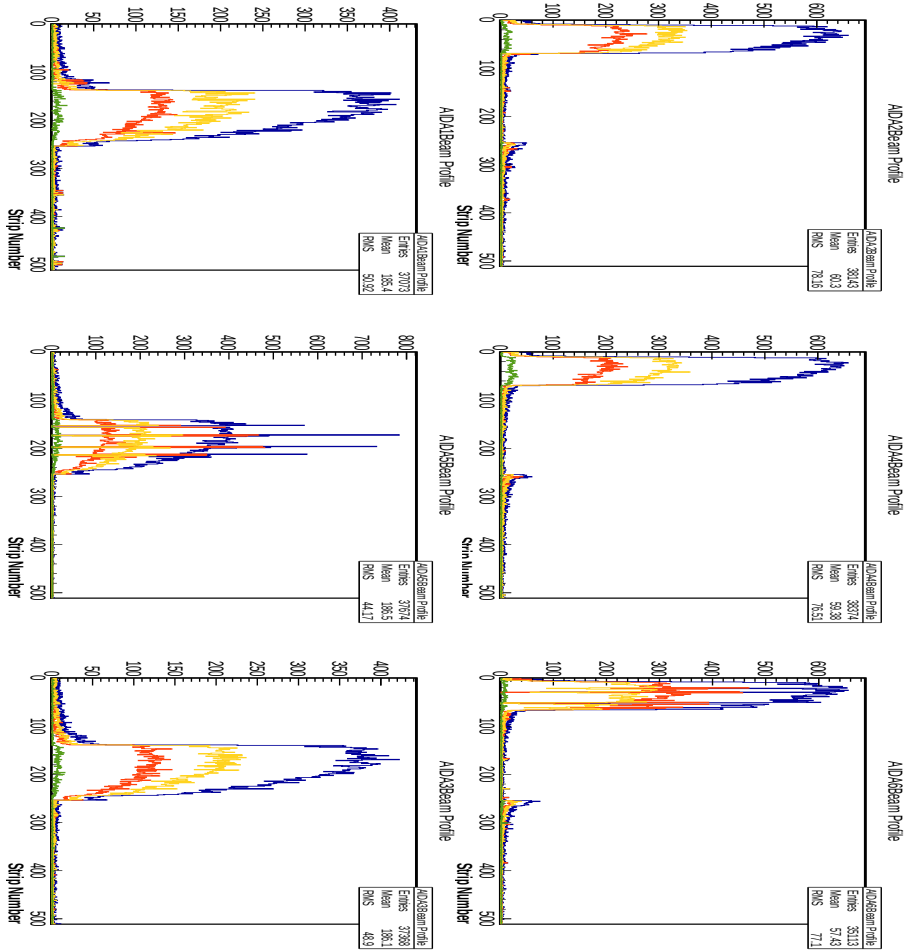
Signal to noise



Eta distribution (charge sharing)



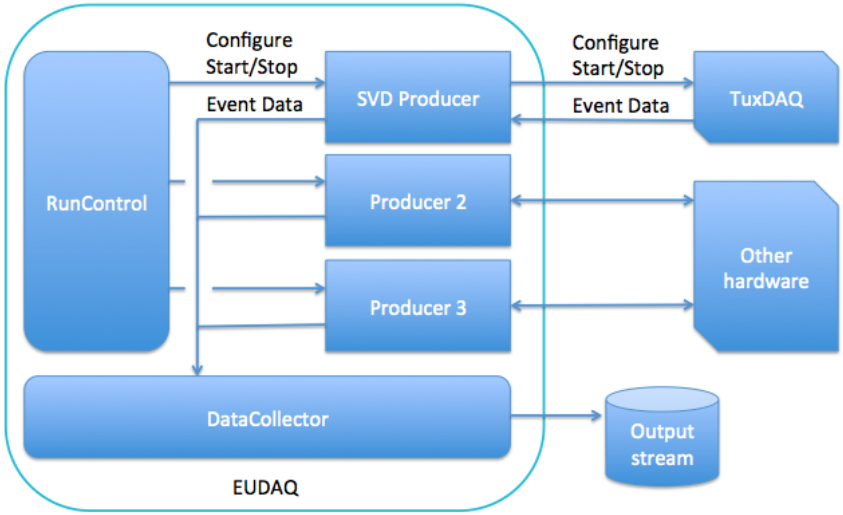
Hitmaps of all 6 planes



Towards full EUDAQ integration

First version of EUDAQ Producer exists:

- Still uses SiTRA "TuxDAQ" software for communication/configuring the hardware,
- Interacts with TCP socket to dedicated "SVD producer" written by CUNI Prague people
  - Commands configure, start run, and stop run from the RunControl are sent to DAQ
  - Raw events received from DAQ system are sent to DataCollector which creates the output stream
- Producer is written for EUDAQ 1



Deliverables and Milestones

After 1st year:

•MS39: Design of Silicon micro-strip ladders (Milestone; Report) [month 13: March 2012]

In 4th year:

D9.5: Silicon micro-strip ladders: Physical device [month 39: May 2014], actually September 2014

- **20 pages report also submitted as AIDA note**


AIDA-Deliverable-D9.5_v2.pdf (Seite 1 von 23)

Suchen

AIDA

Grant Agreement No: 262025

AIDA

Advanced European Infrastructures for Detectors at Accelerators

Seventh Framework Programme, Capacities Specific Programme, Research Infrastructures, Combination of Collaborative Project and Coordination and Support Action

DELIVERABLE REPORT

SILICON MICRO-STRIP LADDERS

DELIVERABLE: D9.5

Document identifier:	AIDA-Deliverable-D9.5_v1
Due date of deliverable:	End of Month 39 (April 2014)
Report release date:	07/04/2014
Work package:	WP9.4
Lead beneficiary:	OEAW
Document status:	Draft

Abstract:

For testing the highly granular calorimeters developed within task 9.5 of AIDA a silicon strip telescope is developed that provides a precise entry point reference. This report describes the concept of this silicon strip telescope covering all aspects. First, the actual silicon detectors are presented. In the next section, the detector modules and their layout are shown to form a beam telescope . This is followed by a detailed description of the DAQ electronics and the software necessary to operate the system. Finally, the performance of the system is demonstrated with data and plots coming from a beam test at DESY, where the system was successfully operated and showed its capabilities. This task was led by HEPHY in Vienna (OEAW), with important contributions from the Spanish Research Council (CSIC).

Summary

- Silicon strip telescope using 2x3 planes built using mostly existing hardware
- Two beam tests show excellent performance
  - DESY March 2014, SPS Nov 2014
  - Full analysis of EUDET telescope runs to be done (residuals, resolution)
- Full EUDAQ1 integration almost completed

- Deliverable report successfully submitted in September 2014