Results of test beam analysis for GaAs prototype

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Plan:

> Introduction

> Beam Calorimeter

> Sector Prototype for BeamCal

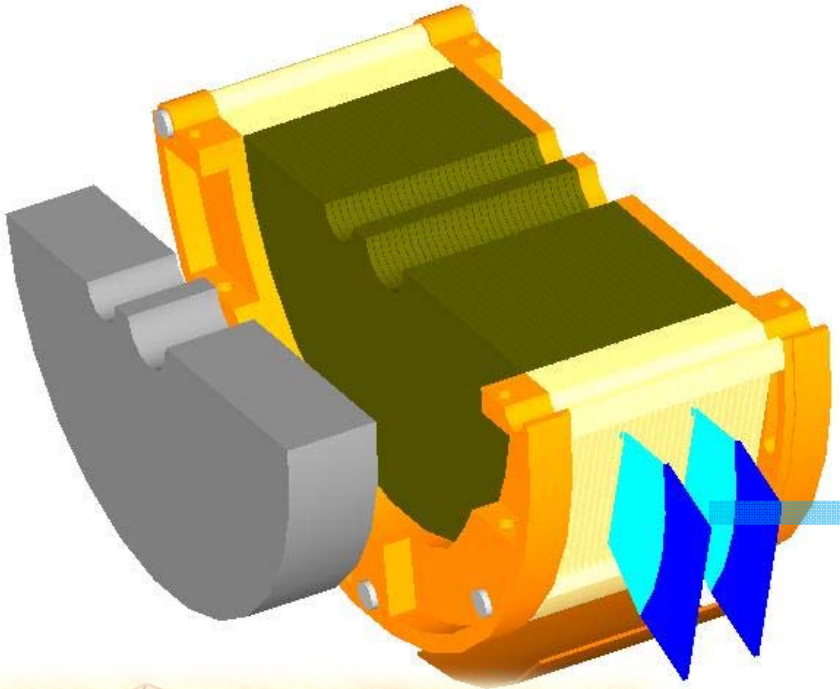
> Test Beam DESYII (Summer 2010)

> Measurements

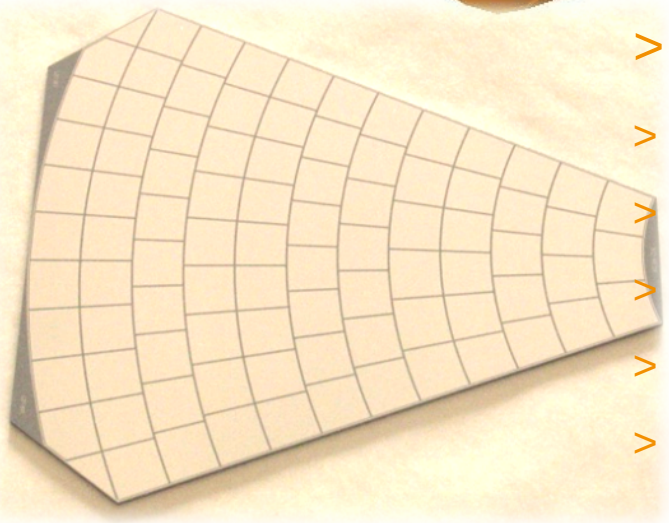
> Analysis

> Conclusions

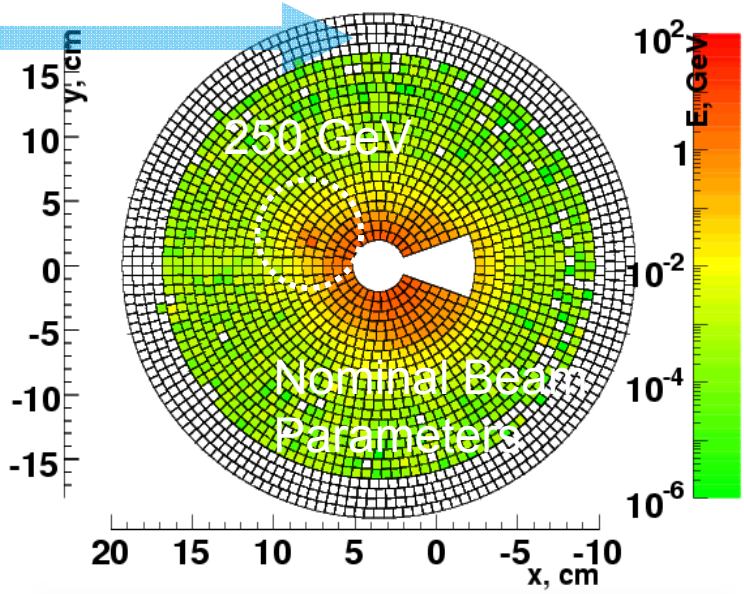
Beam Calorimeter



- Around Beam-pipe
- 30 Layers
  - Tungsten absorber:
  - Sensor layer GaAs or Di
- Radii 2…15 cm, depth ~12 cm
- Sensor segmentation 8x8 mm^2



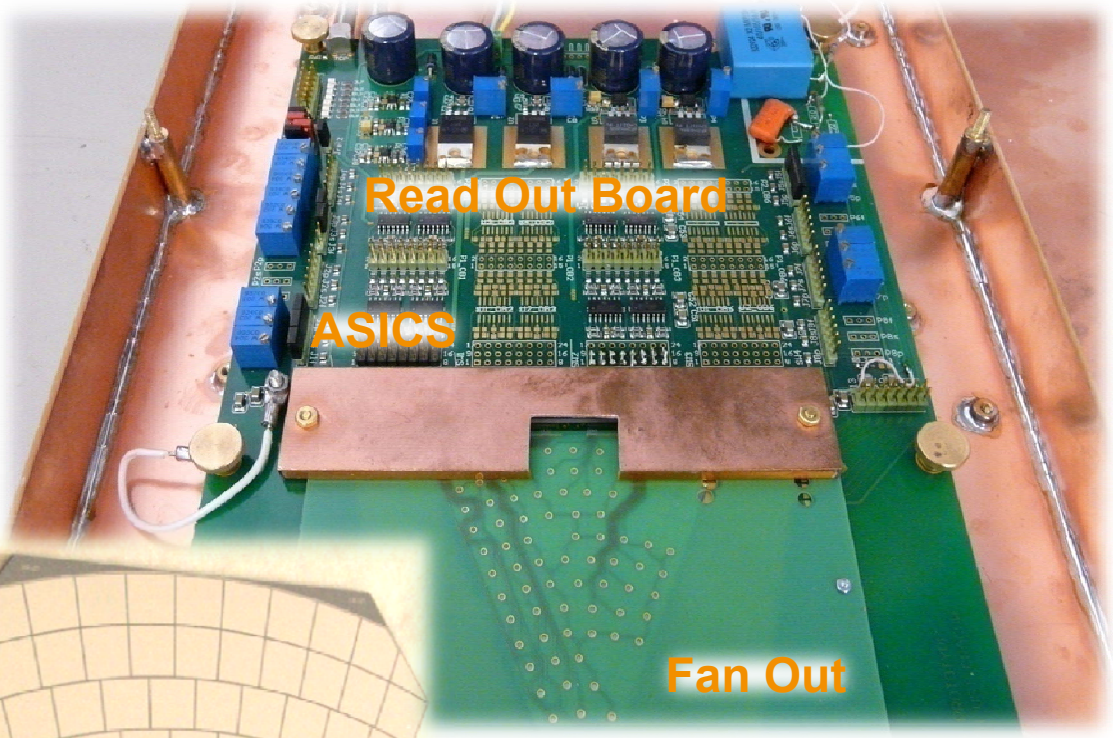
- Prototype
- GaAs plate
- Al metallization
- Thickness 500 μm
- Segmentation ~5x5 mm^2
- Radii 2…8.5 cm

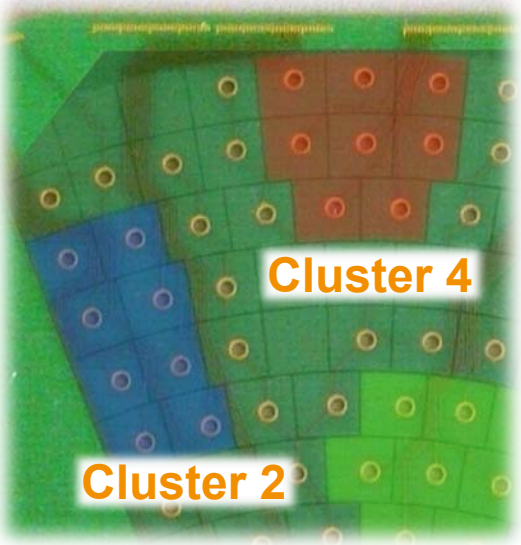


Segmentation of sensor layer

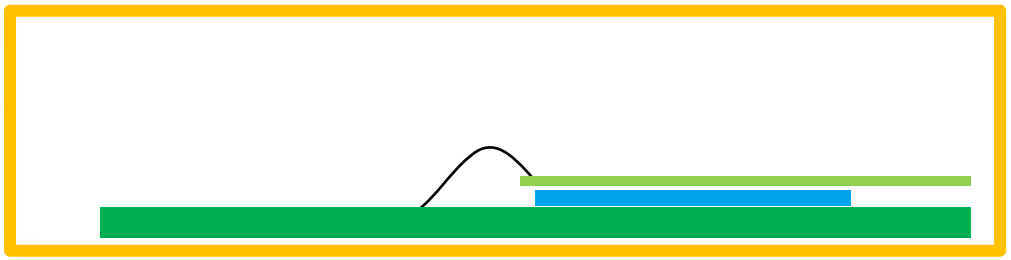
DESY

First Prototype for GaAs



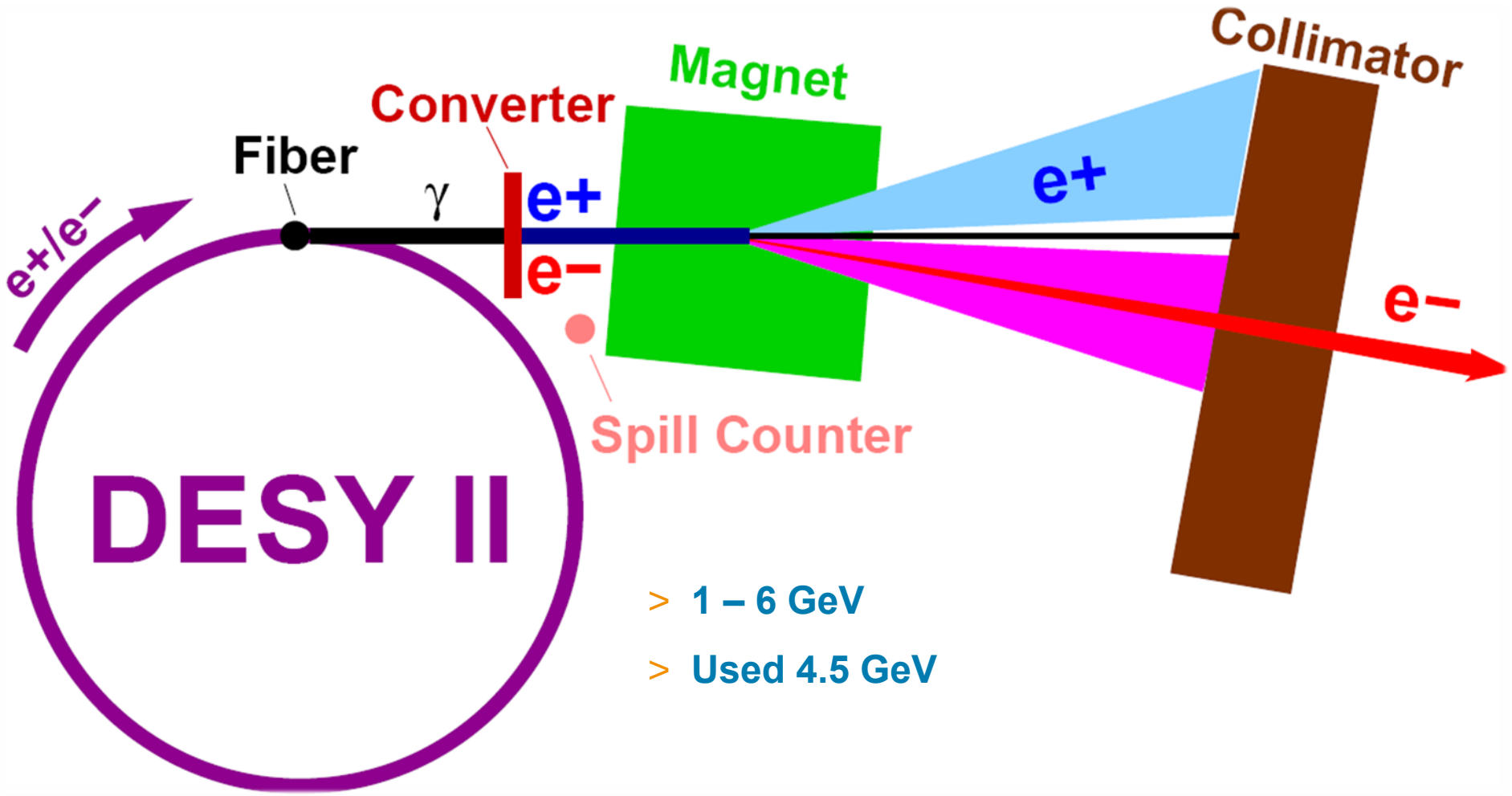


5 GaAs Sensor Plates were tested in the Lab



Al window
Fan Out
Sensor
R/O Board
Al window

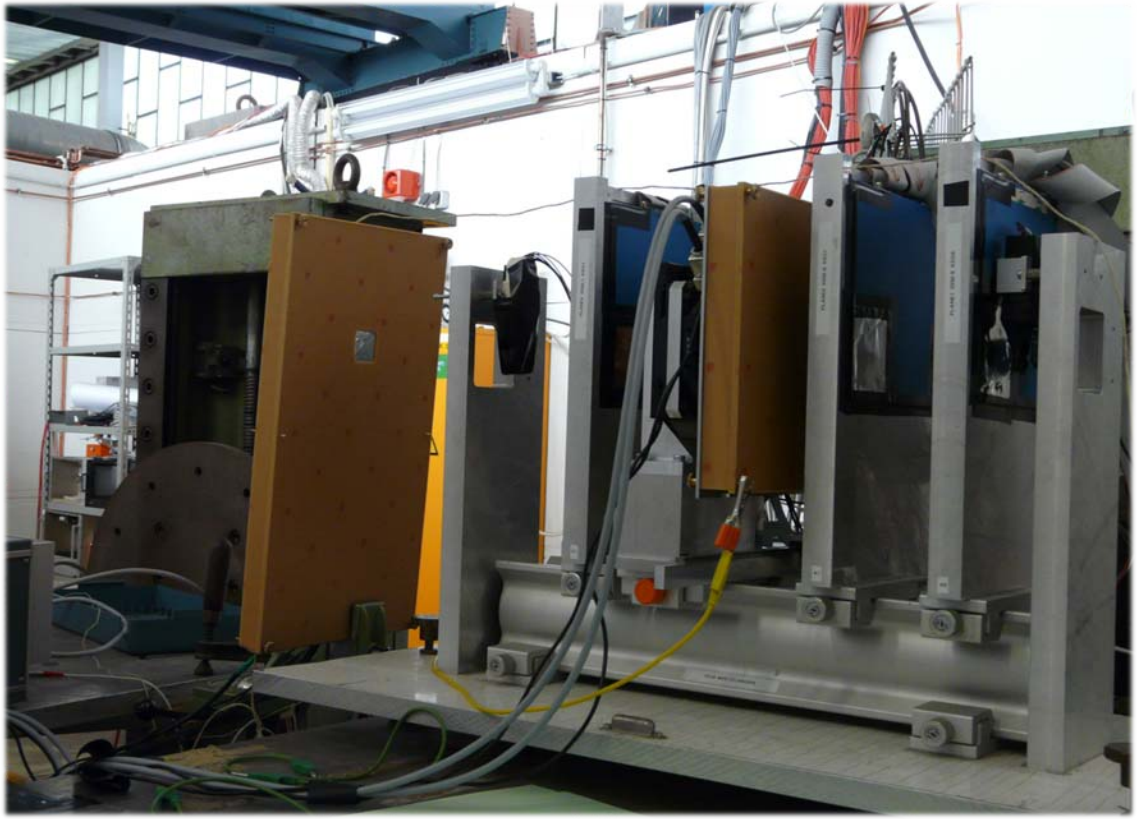
TestBeam DESY II

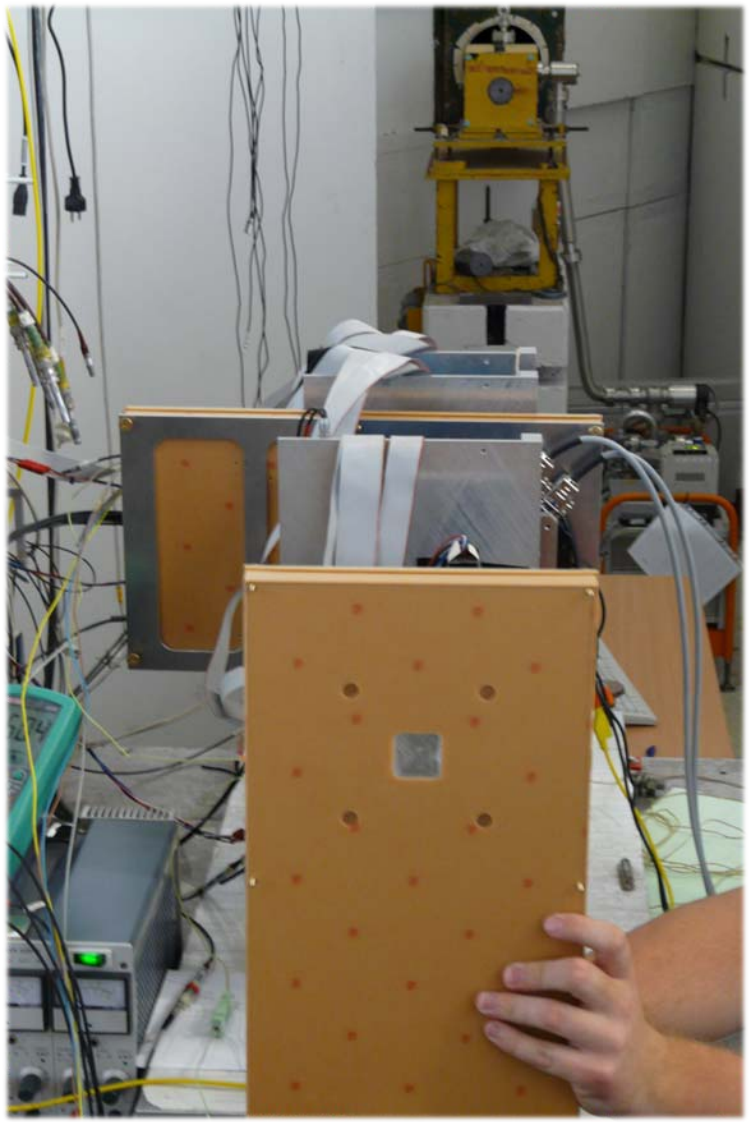


- 1 – 6 GeV
- Used 4.5 GeV

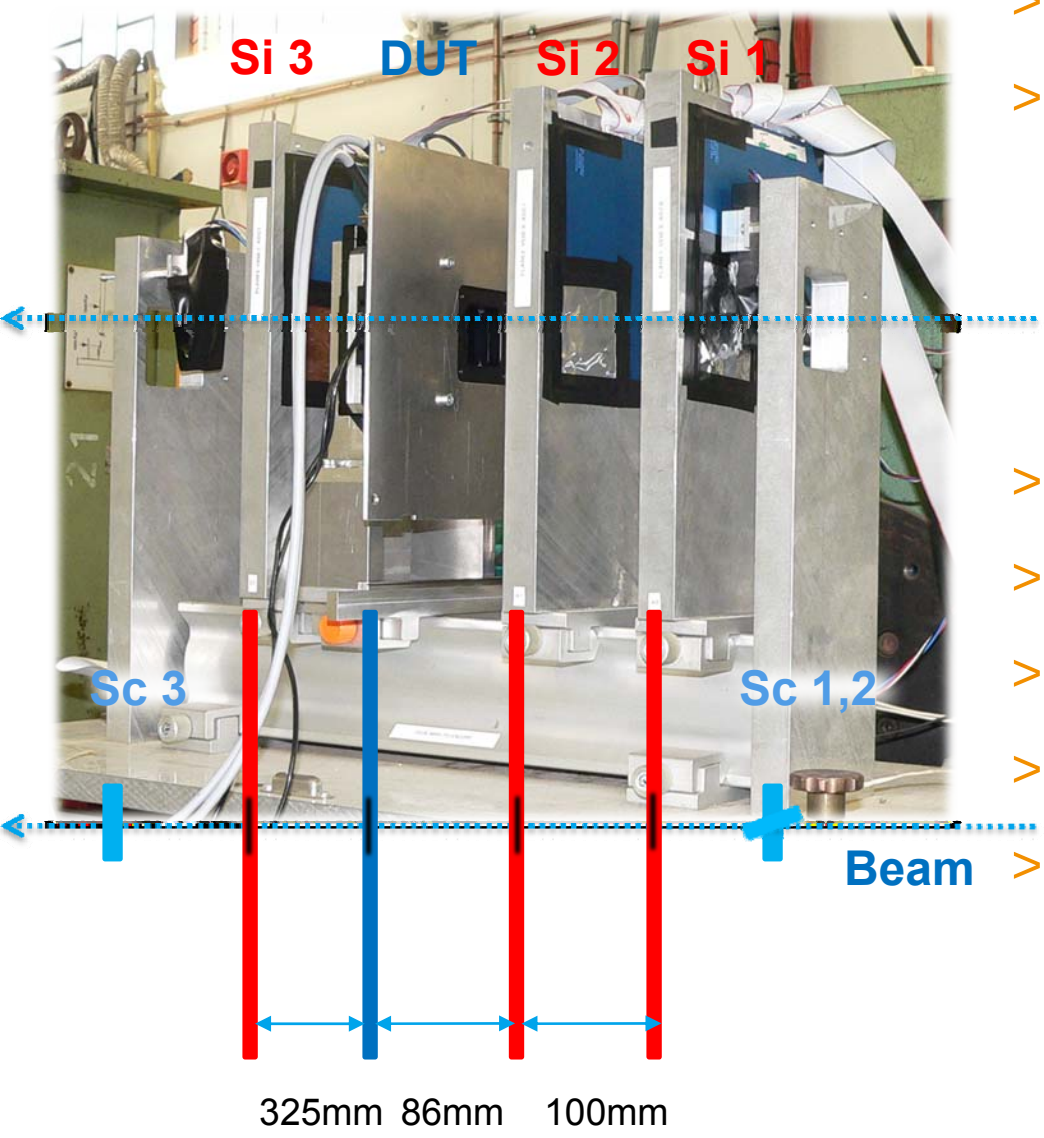
Test Beam Area 22

> Set Up with two boxes





Test Beam Set Up



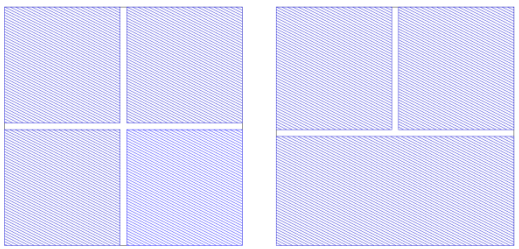
- 7mm scintillator fingers
- Zeus Telescope
  - 3 Si planes
  - Double perpendicular layers
  - 640 strip channels (50μm)
- Precise XY Table
- Sensor Box
- ADC v1721 as for BCM1F
- Veto scheme
- DAQ systems
  - Telescope
  - BCM1F

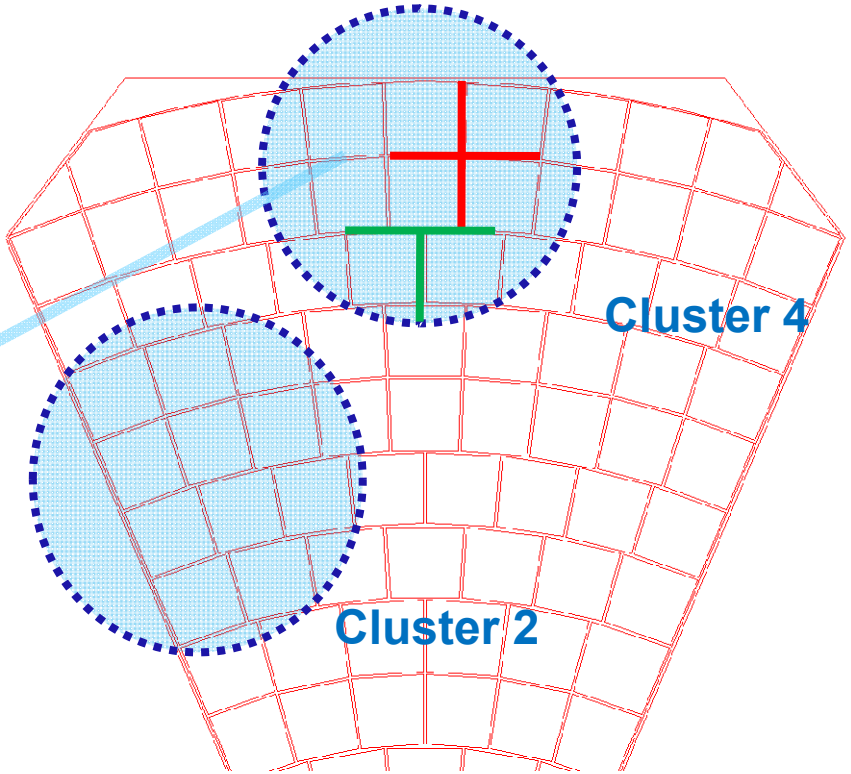
Test Beam Measurements

- To prove front end electronics operation together with sensor and automated readout
- Measure every pad (~200.000 events)
- Edges between pads irradiation

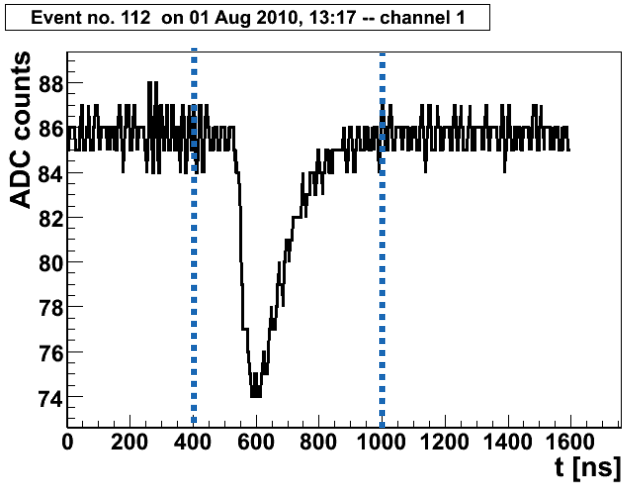
  Green and red regions

  ~2.000.000 events
- Cross talk measurements





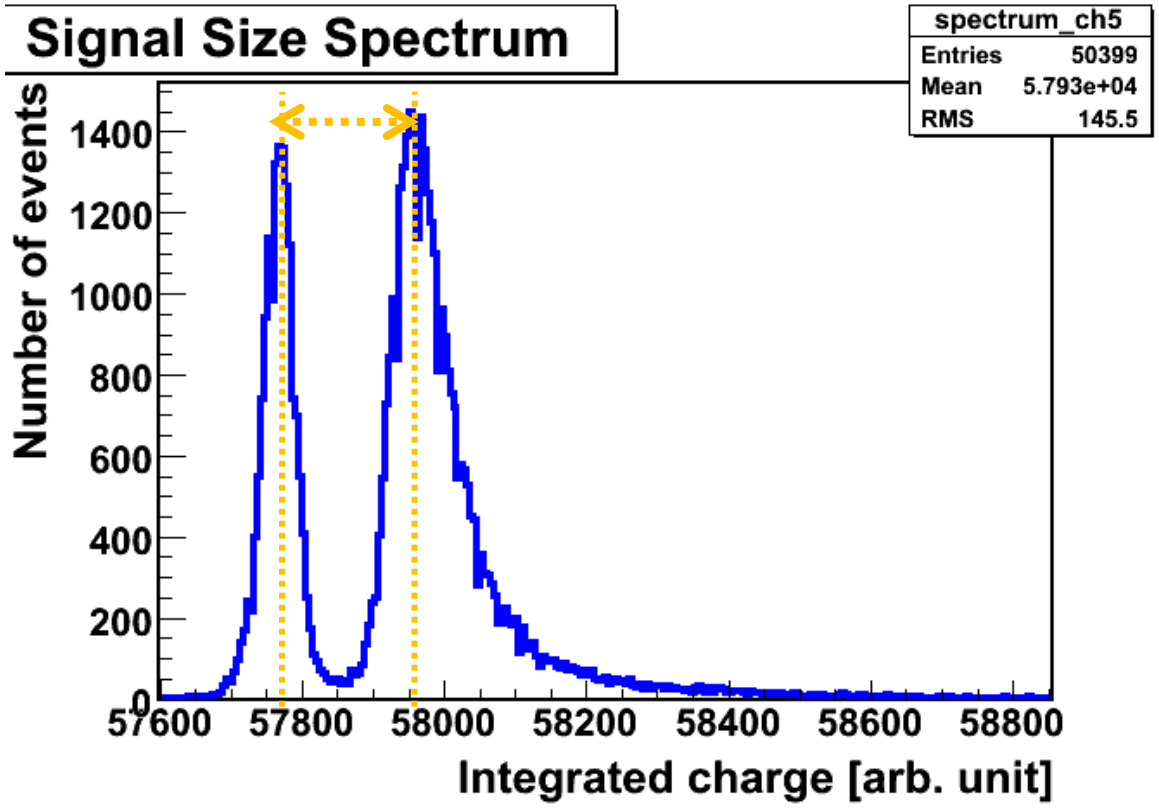
Charge Collection Efficiency (CCE)



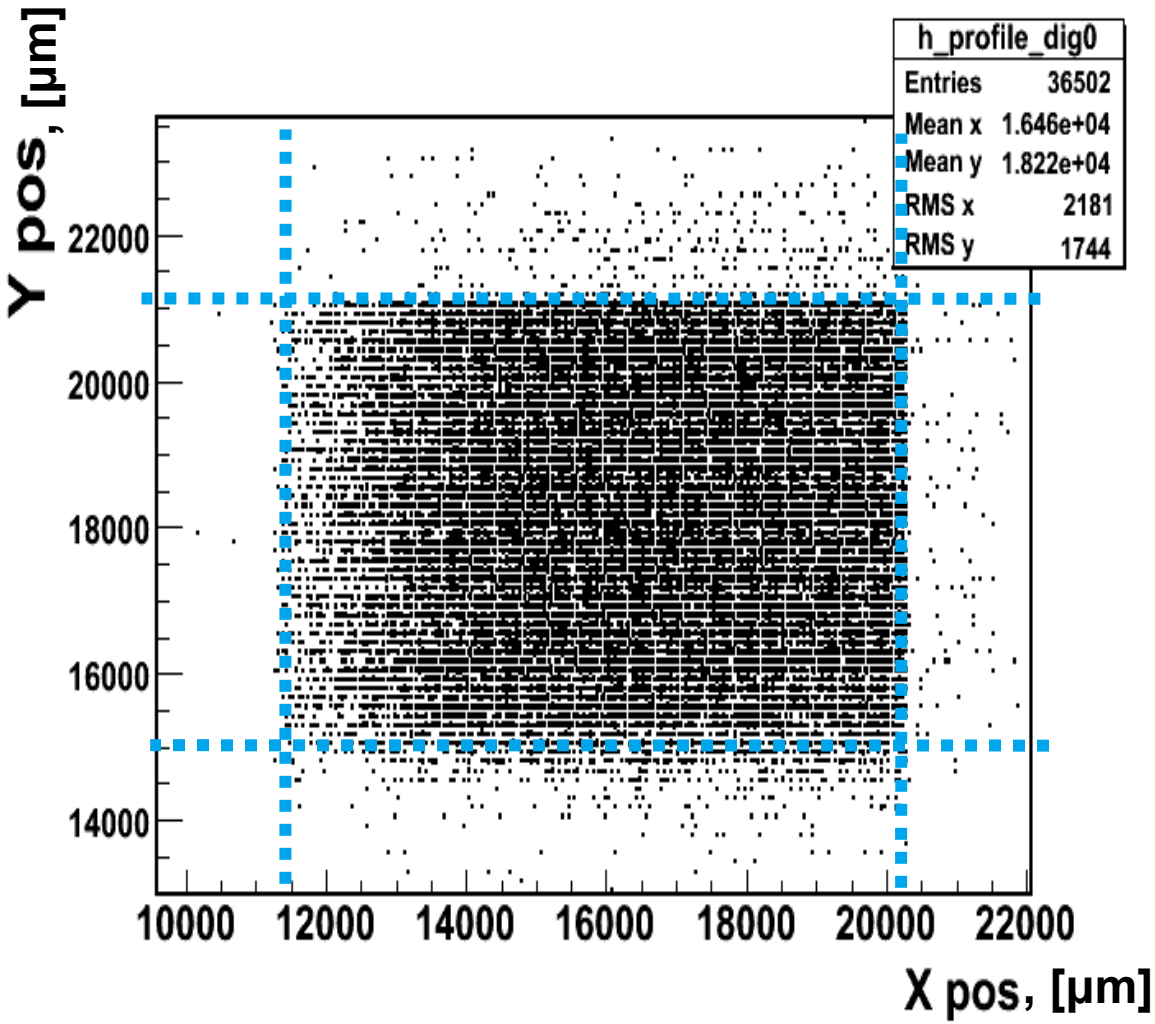
$$CCE = \frac{Q_{collected}}{Q_{induced}}$$

$$CCD = CCE\ d_{thikness}$$

CCE ~ 30%, HV 60V



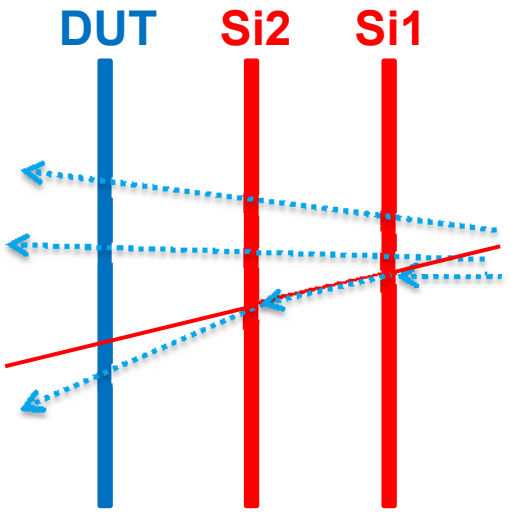
Beam Profile



- Beam Profile
- No tracking
- 90 degree rotation
- 3 Scint in coincidence

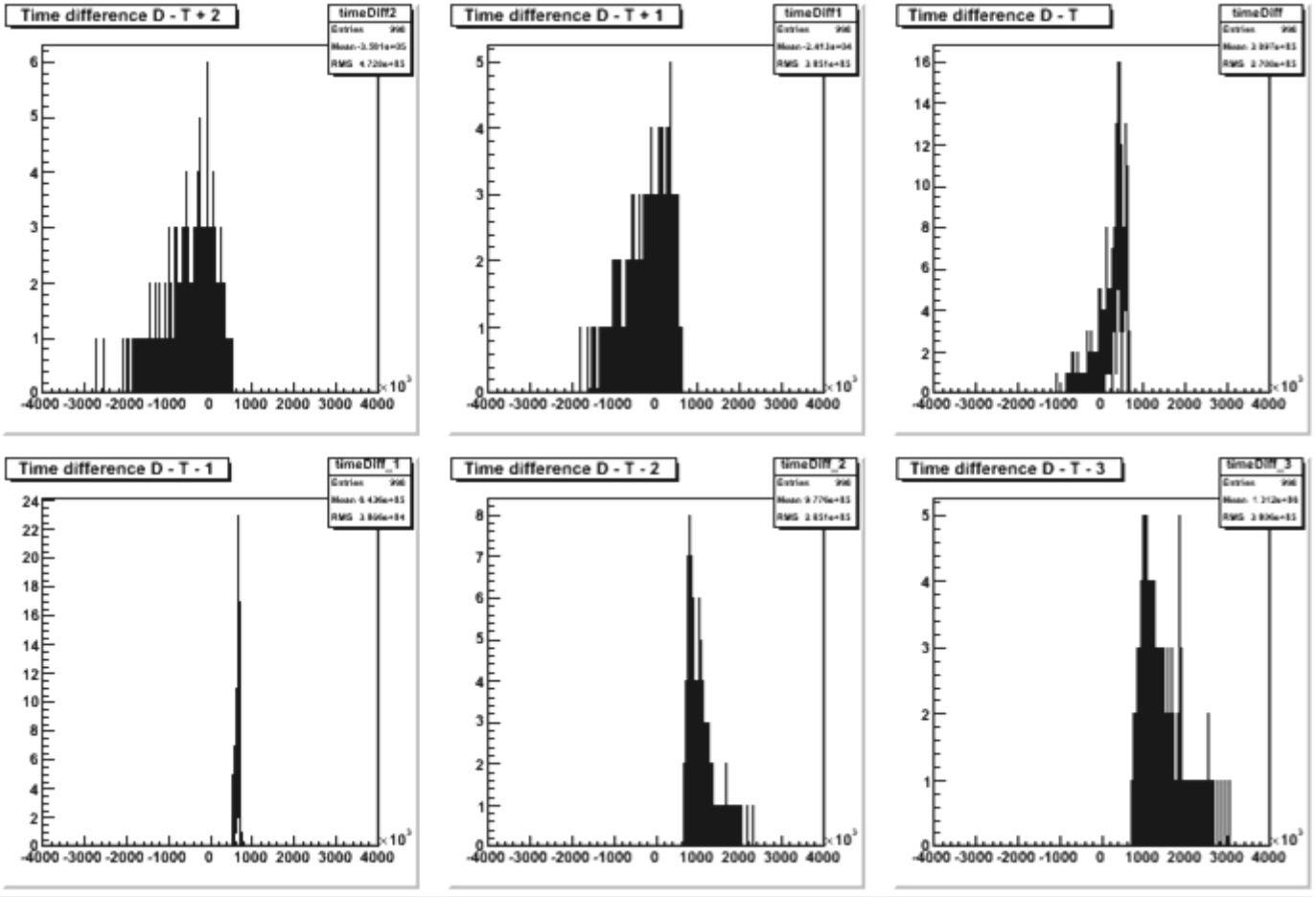
Telescope Analysis

- TelAna provides information about hits (two algorithms of hit calculations + alignment between Si planes)
  - DIG – digital → seed signal
  - COG – center of gravity
- Tracks are reconstructed:
  - 3 hits per telescope
  - 1 hit in every plane
  - 62% of tracks
- 2 telescope planes are used for linear fit for prediction of the position in the sensor



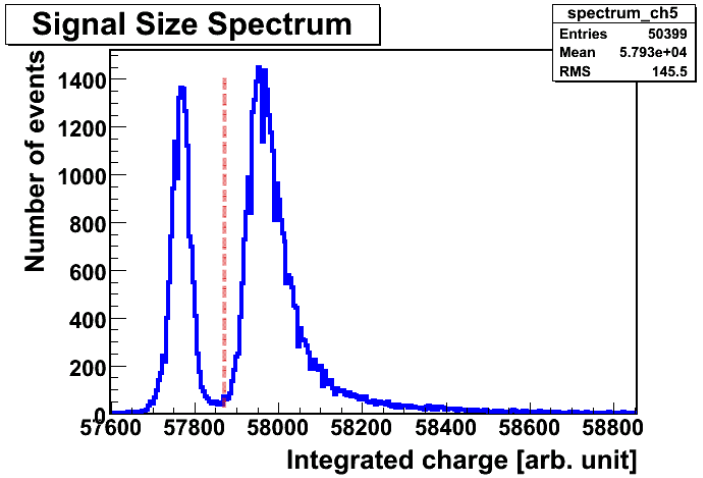
Time Stamping

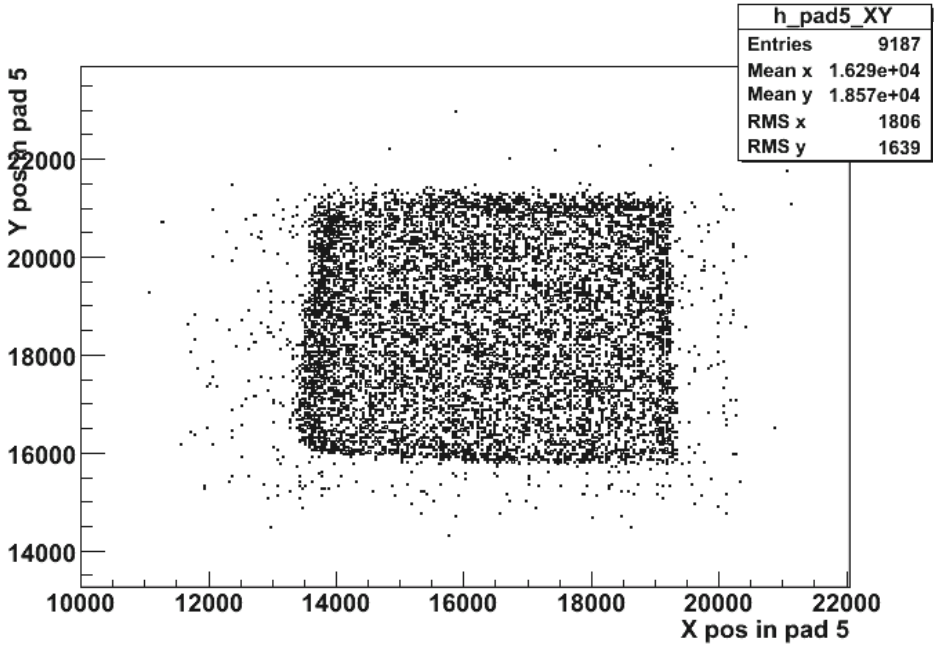
- Telescope DAQ has ~msec; Sensor Box DAQ ~ µsec
- shift between samples in DUT and Telescope ±2 events

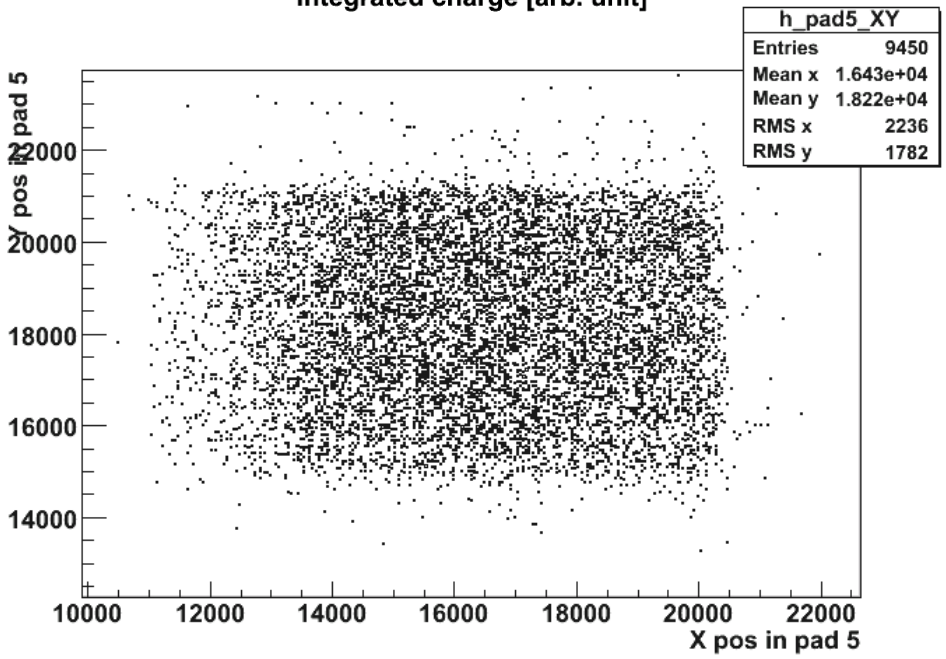


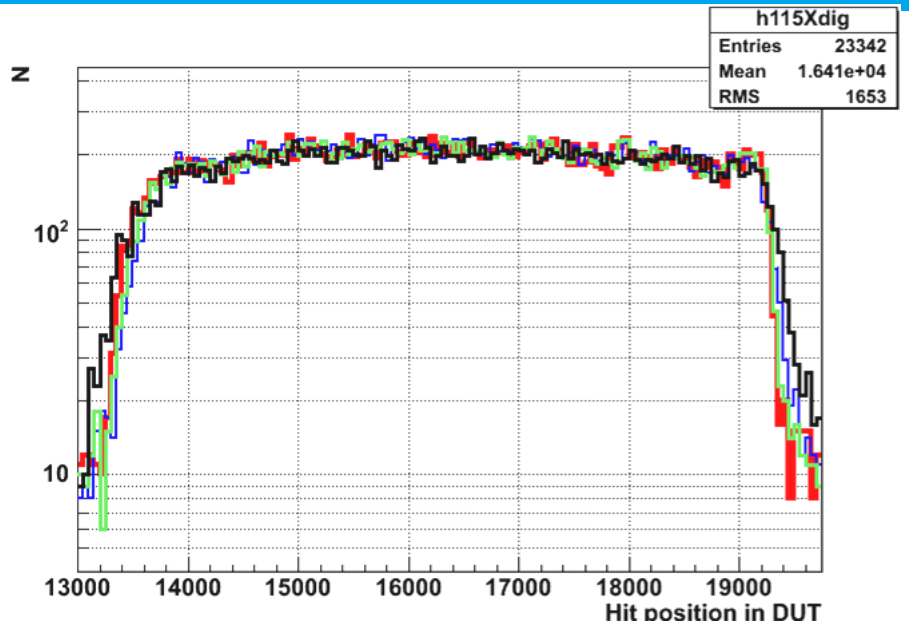
Time Stamping Example

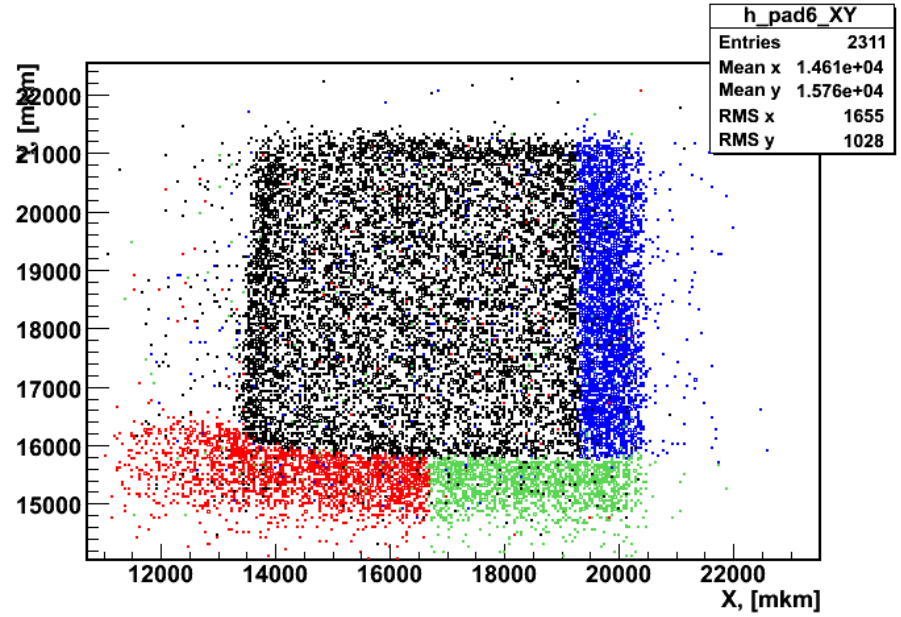
- Same threshold
- Diff shifts in time stampings







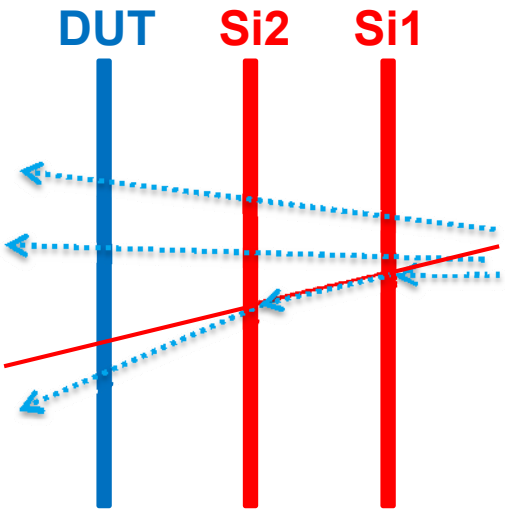


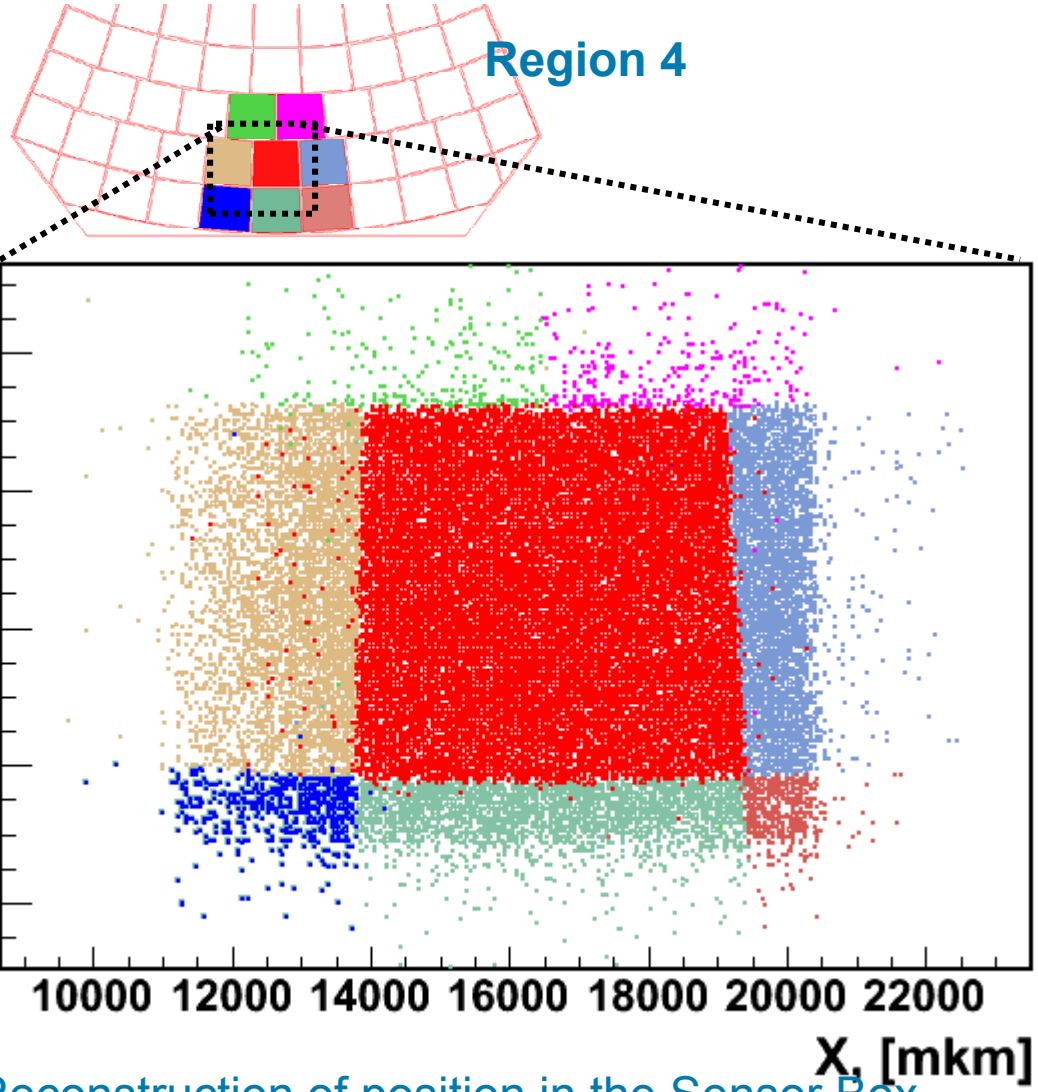


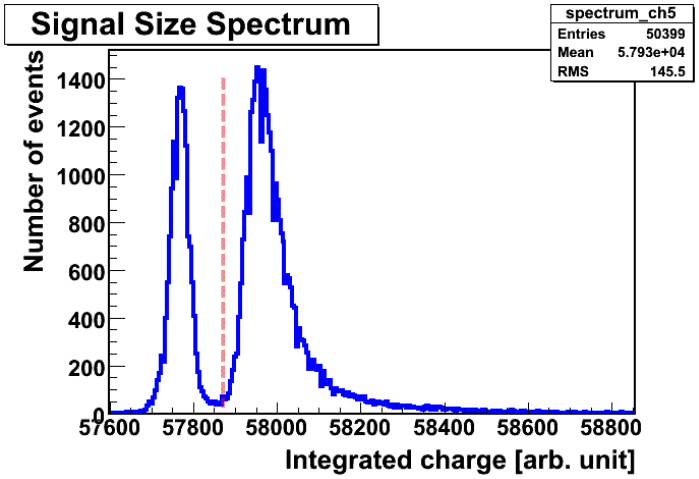
- 3 Si Planes X positions
- Blue - 1 plane
- Green - 2 plane
- Black - 3 plane
- Red - DUT

- Reconstruction position for outer pad

Tracking



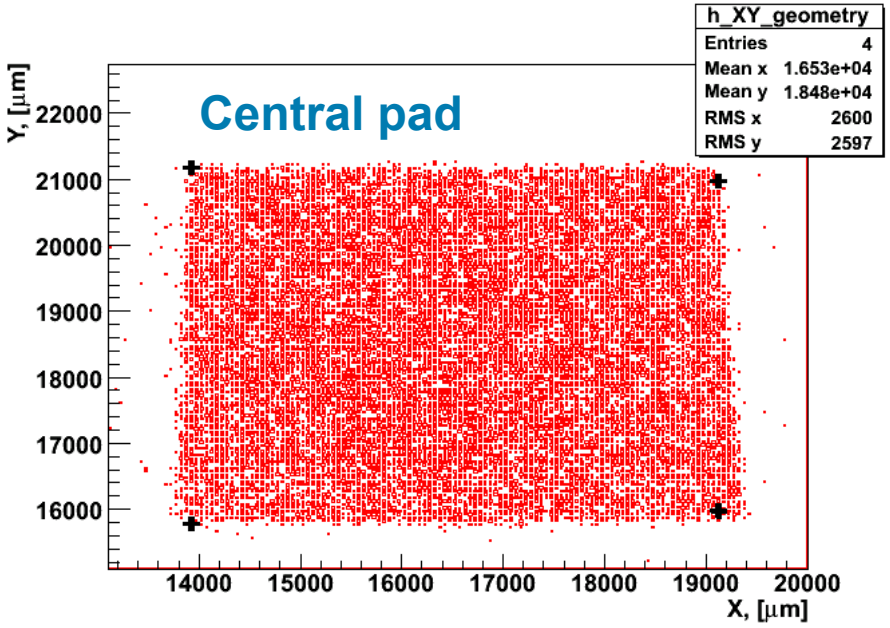


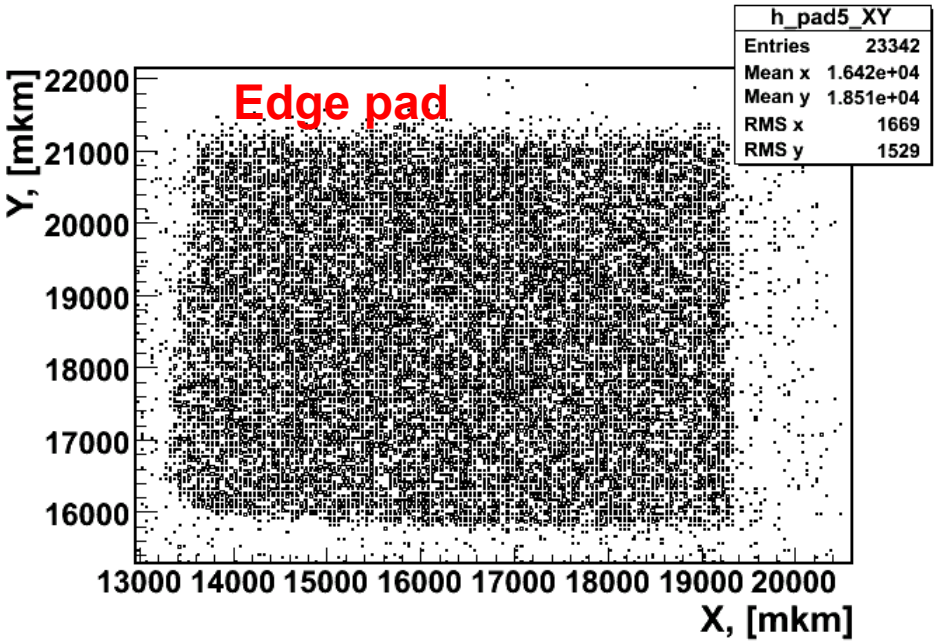


Reconstruction of position in the Sensor Box

Alignment

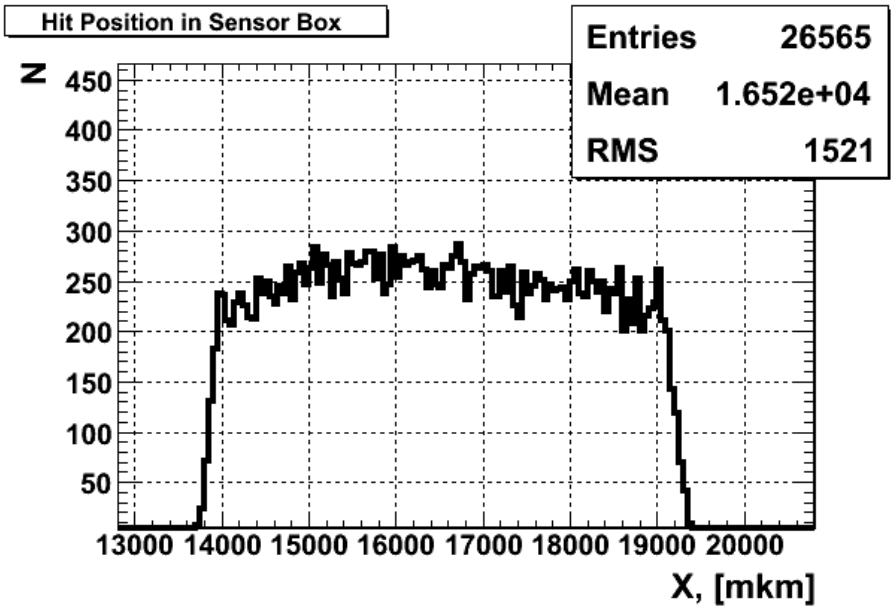
- No connection between Telescope and Sensor Box
- Alignment is made for Telescope itself

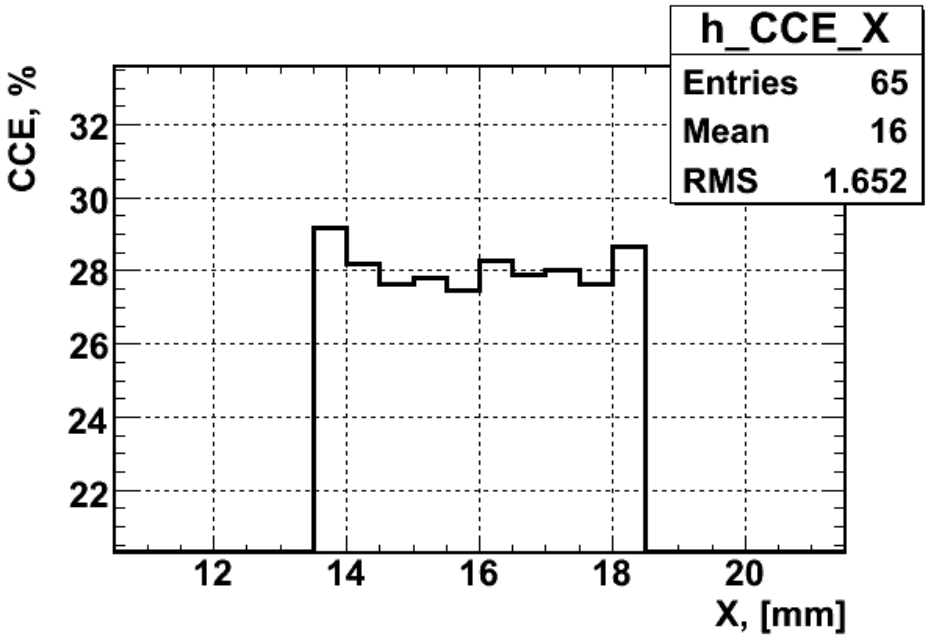




- Surrounding pads were not grounded.

CCE vs Position



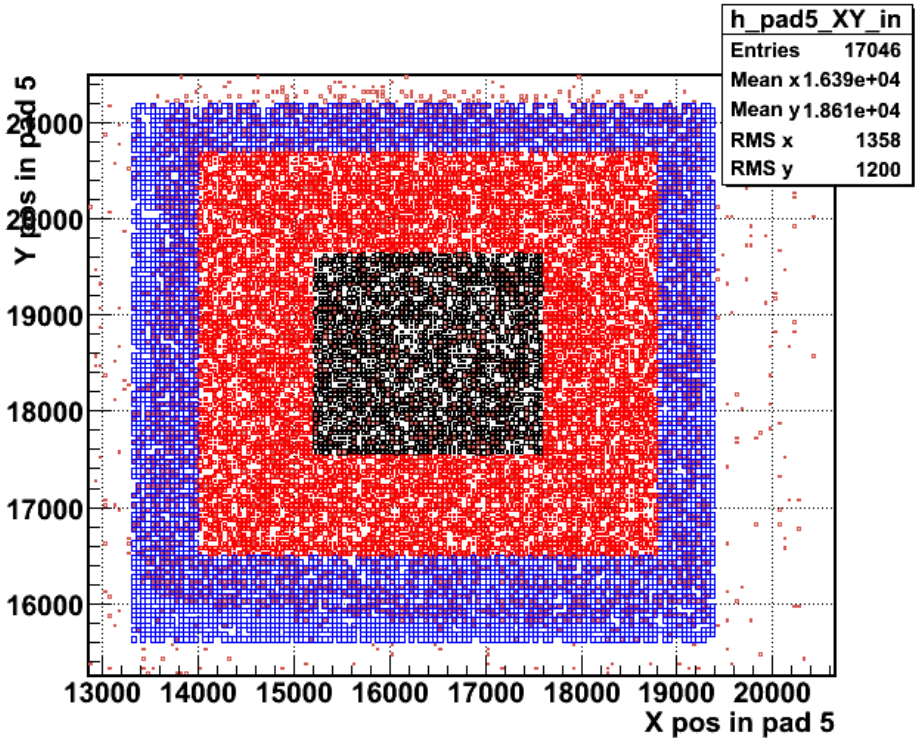


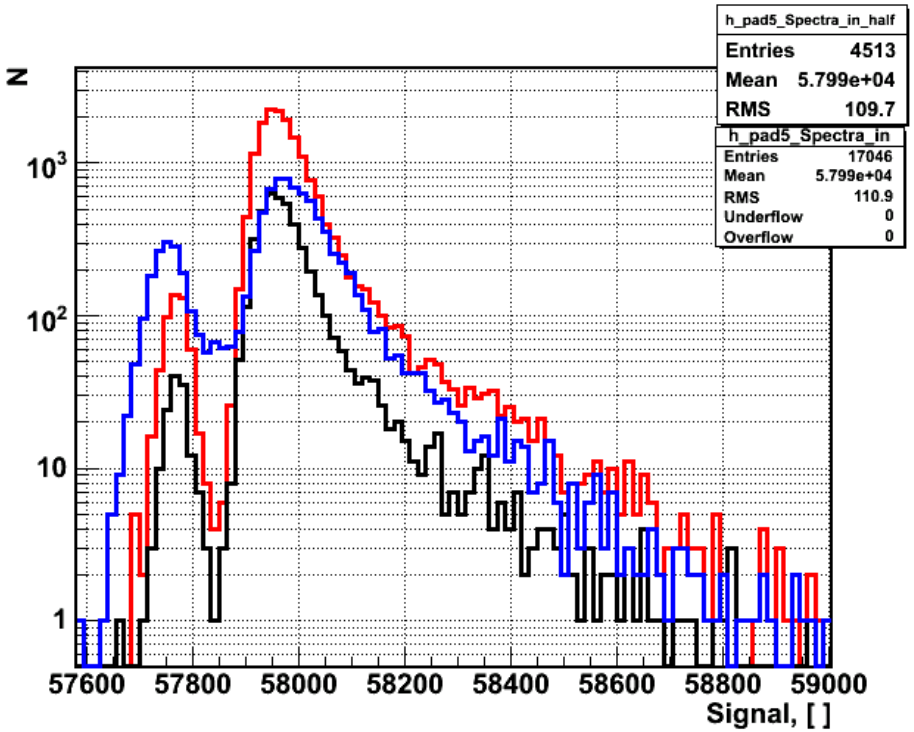
> Number of hits as a function of reconstructed x position in sensor box.

> CCE as a function of reconstructed x position in sensor box.

Spectra

> Different behavior in different areas of pad





Conclusions

- In the summer 2010 a first measurement combining a sensor with a front-end ASIC was made on the TestBeam DESYII (Hamburg).
- The next step will be to add the ADC ASIC.

- BUT:
- Analysis is continuing for edge investigations
- Tracking and alignment have to be understood fully
- CCE vs Voltage measures in the Lab to compare results with previous measurements and with test beam results
- ……..

Back Up Slides

>Thank You for Your Attention!

Lab Measurements

- I-V and C-V measurements of GaAs sectors
- CCE for every pad
- Signal to Noise ratio
- Cross Talk
- CCE vs Voltage

- Tracking reconstruction
- Tracking analysis and uniformity studies