GaAs Test Beam Results

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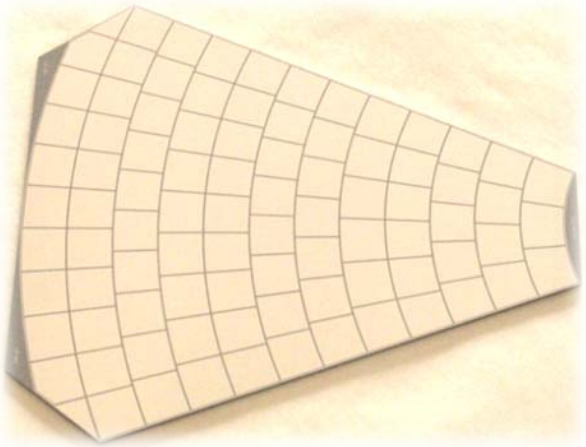
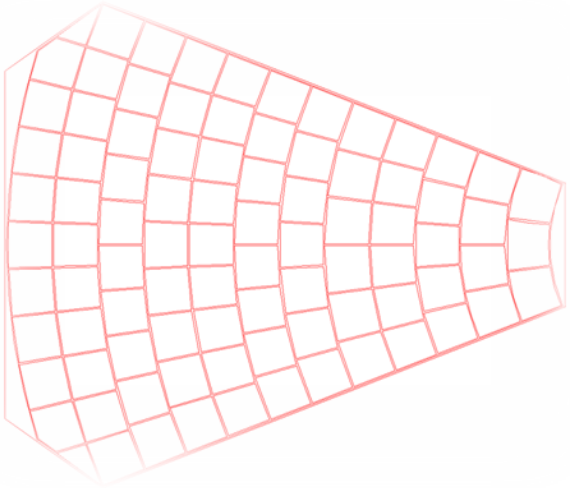
Plan:

- GaAs prototype
- Sensor Box
- DESY II
- Test Beam Set Up
- Charge Collection Efficiency (CCE)
- Tracking
- Conclusions

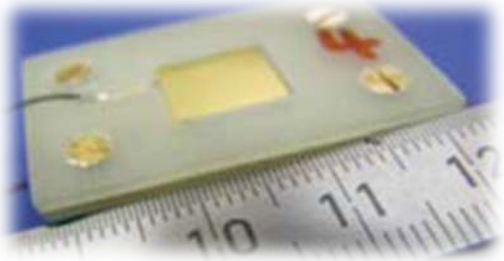
GaAs Sector Sensor



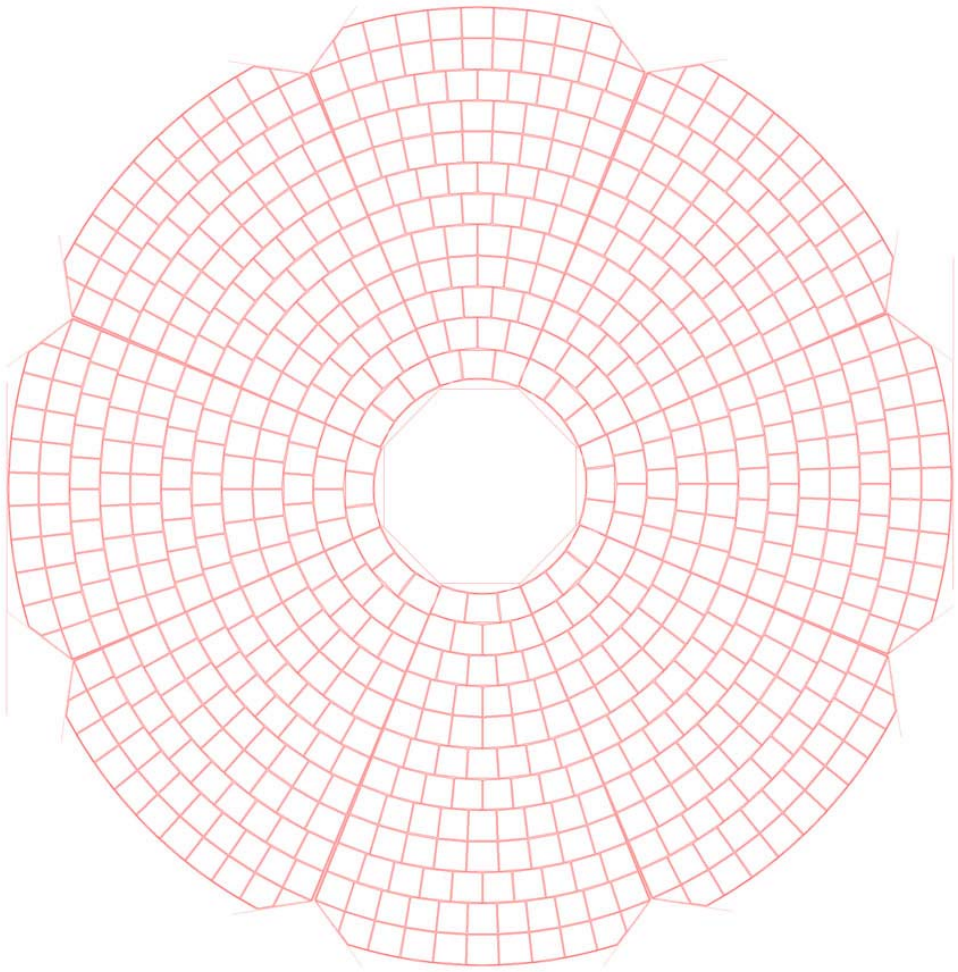


Prototype:

- GaAs plate
- Al metallization
- Thickness 500 μm
- Segmentation ~5x5 mm^2
- Radii 2…8.5 cm
- 12 Rings
- 85 full pads
- Guard ring



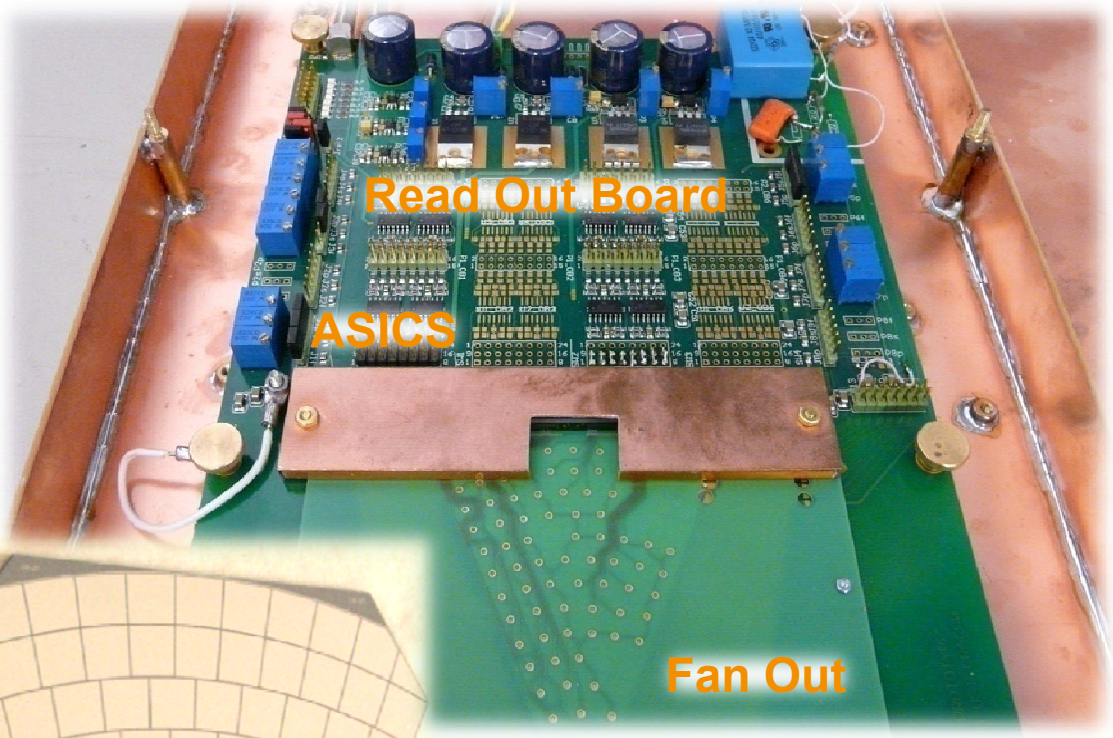
How it could be:

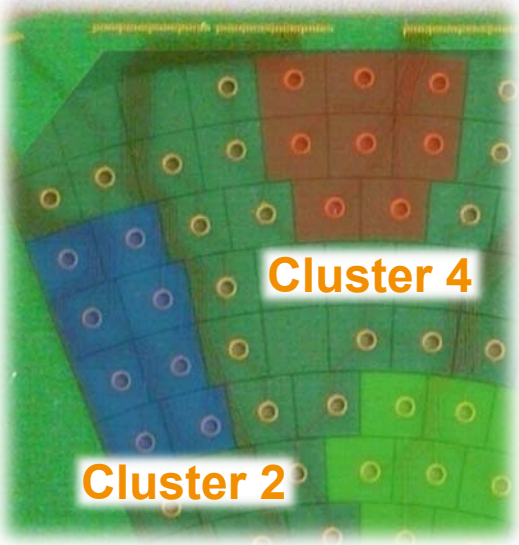


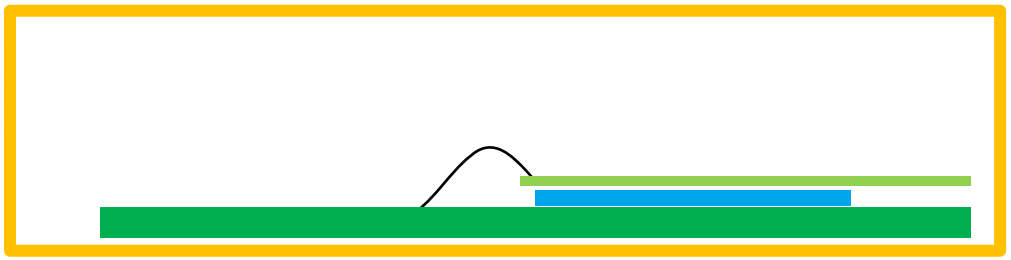
Prototype:

> 8 Sectors

Sensor Box

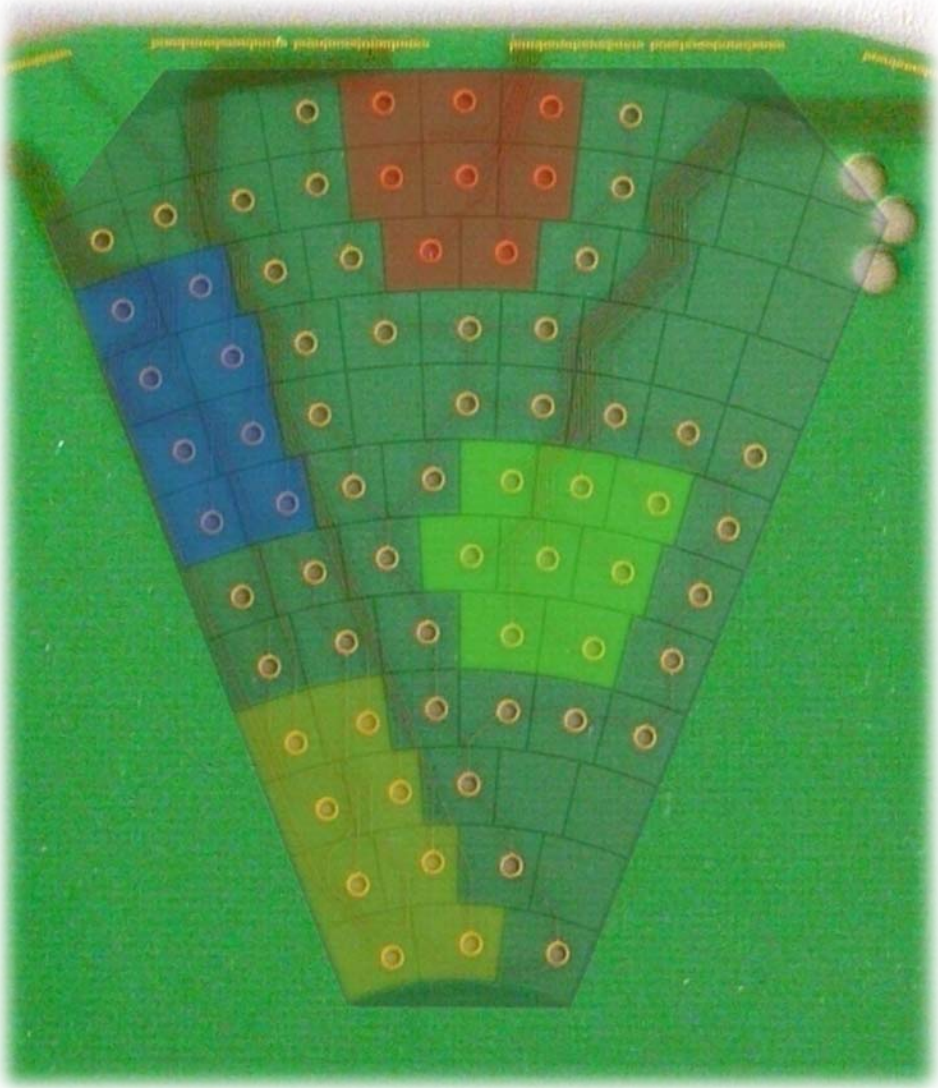






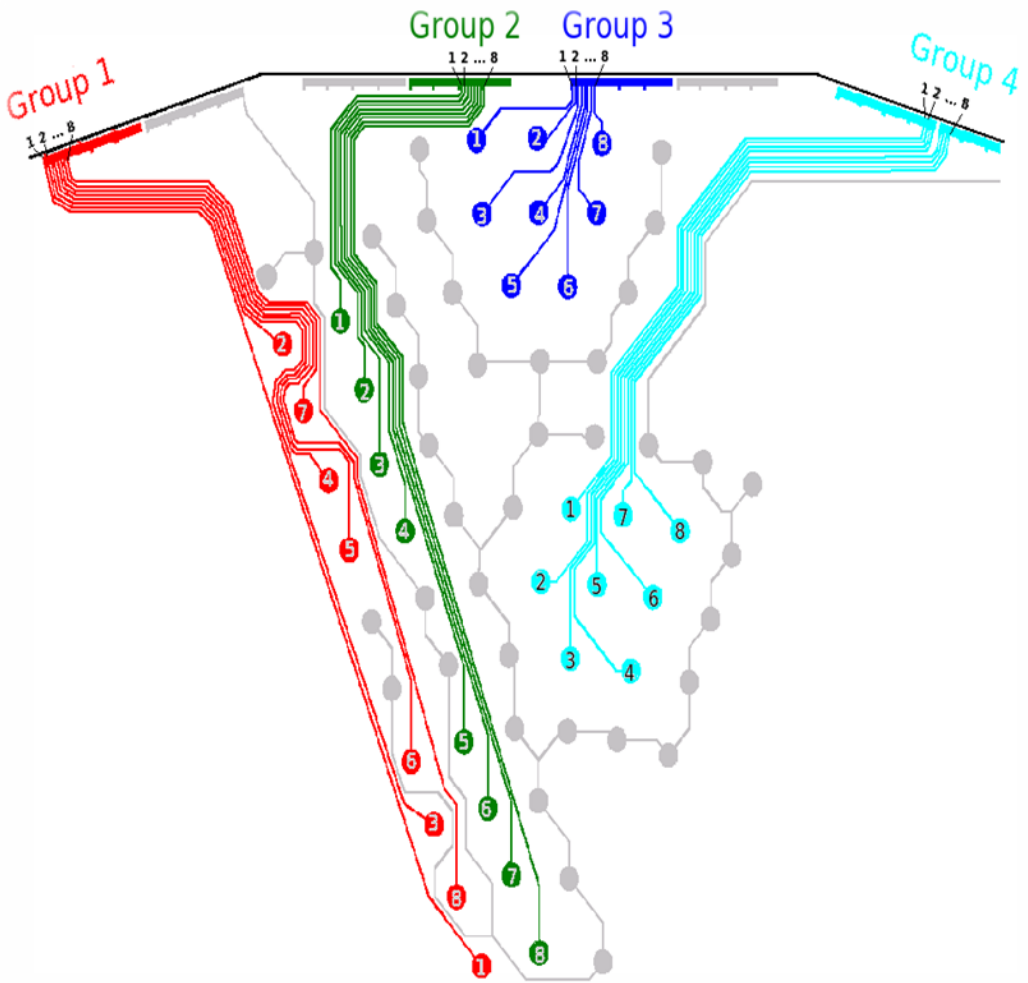
Al window
Fan Out
Sensor
R/O Board
Al window

Chosen Clusters



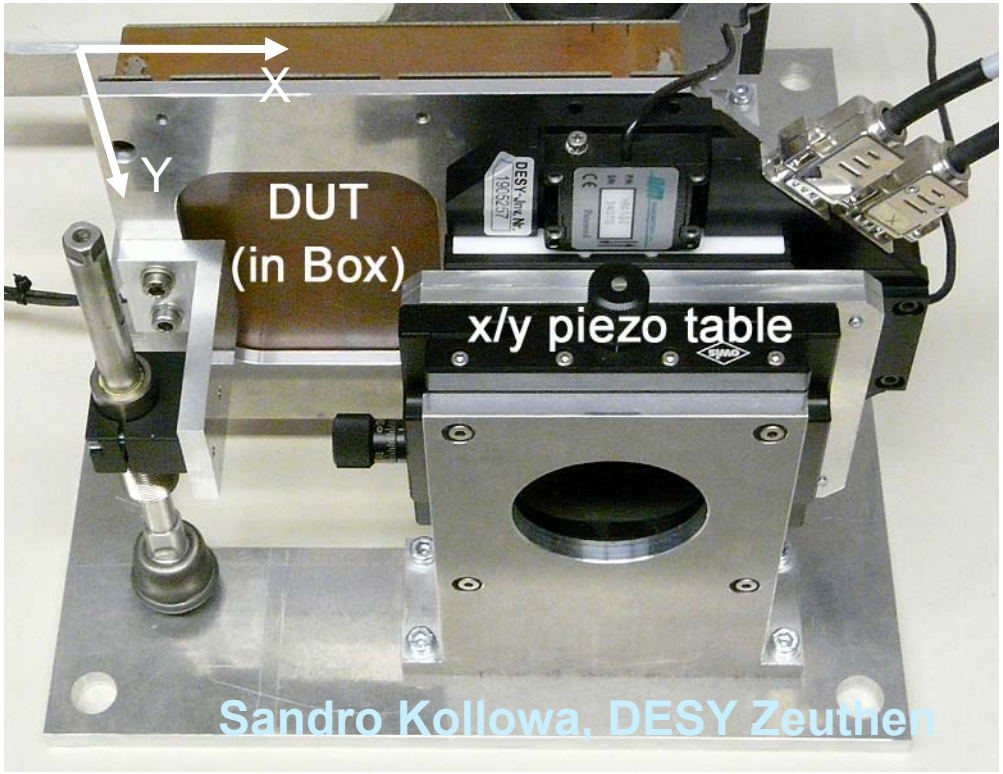
- 4 Clusters chosen
- 8 channels
- Different areas

Fan Out Layout



- 4 different bonding
- To see difference in cross talks
- To connect to different chips

XY table



Range: ~ 5 cm in X and Y

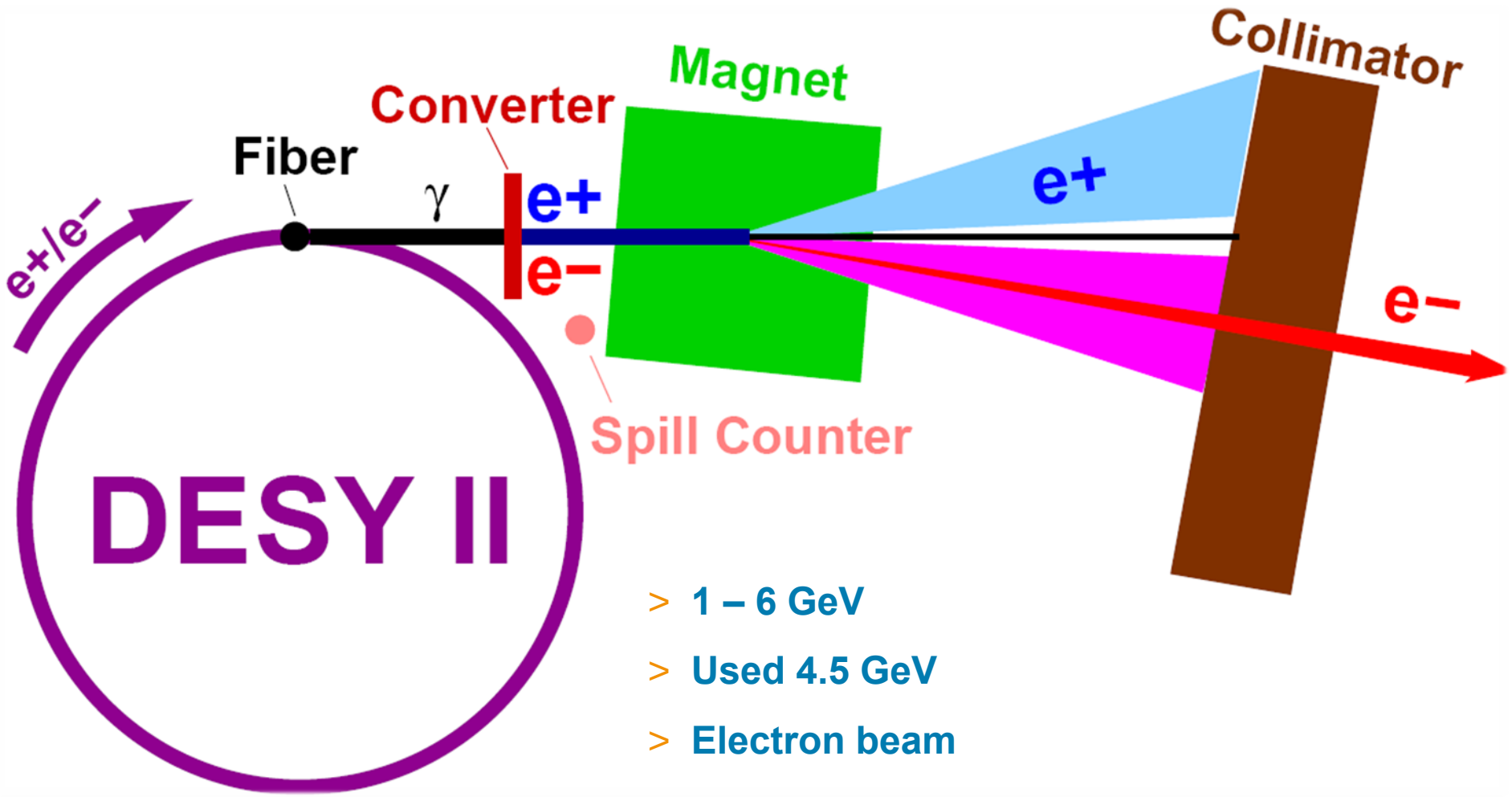
Speed: 5 mm/sec

Step: 100 nm

Weight checked: 350-1110 g

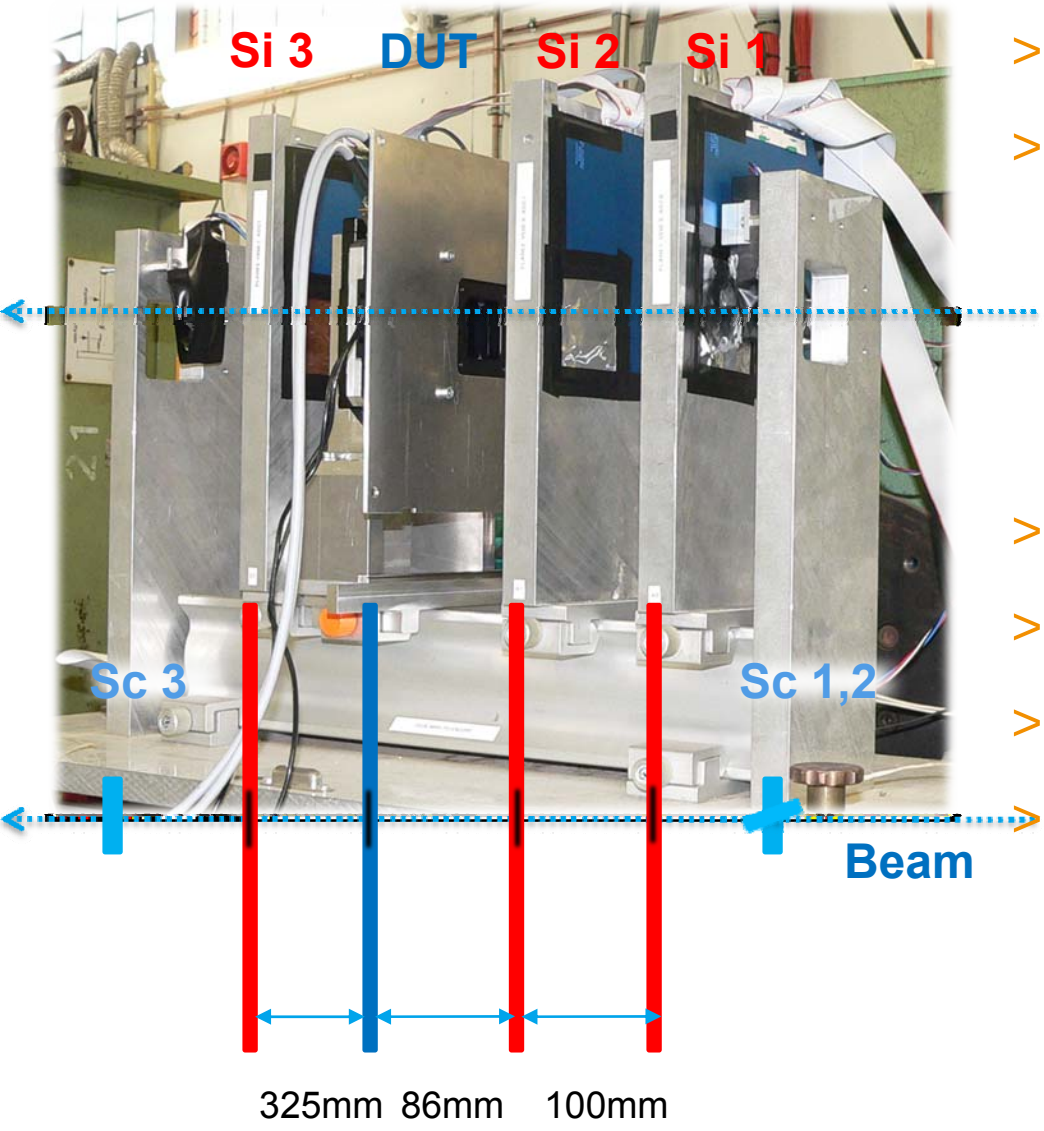
Software: Lab View program

TestBeam DESY II



- 1 – 6 GeV
- Used 4.5 GeV
- Electron beam

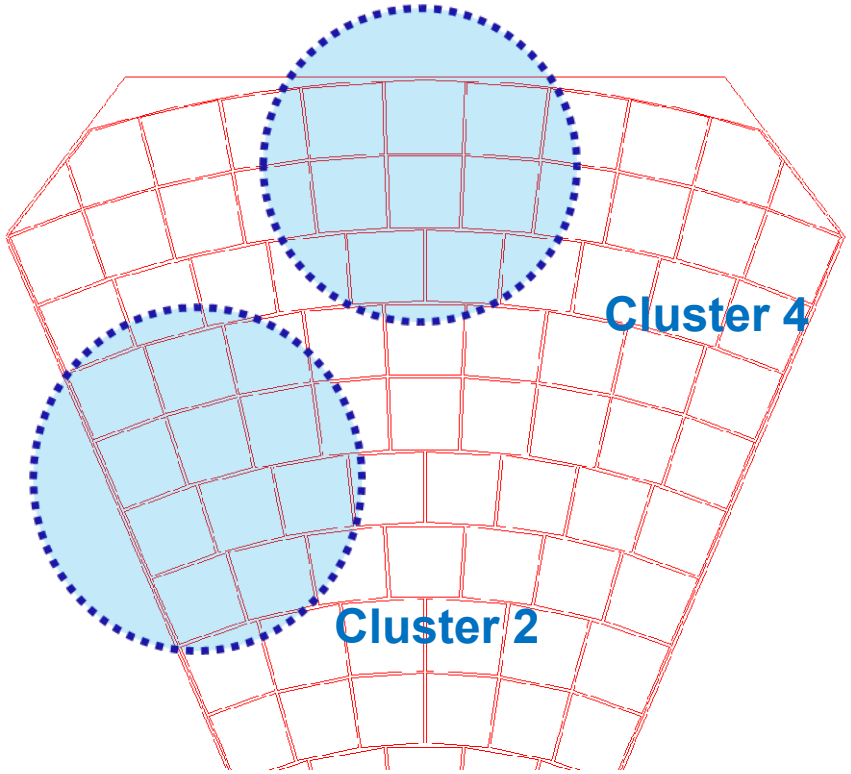
Test Beam Set Up



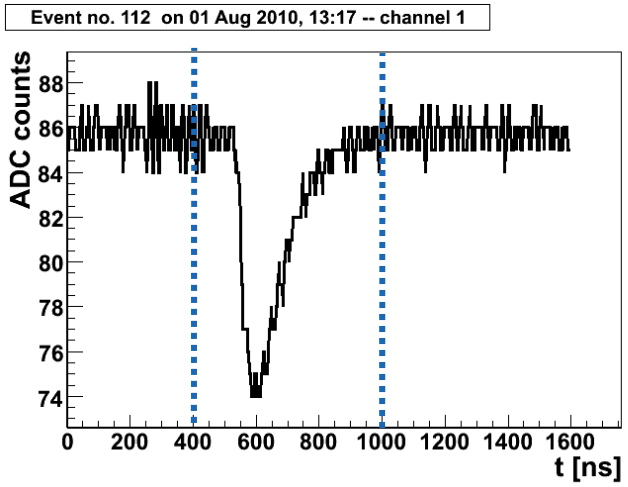
- 3 x 7mm scintillator fingers
- Zeus MVD Telescope
  - 3 Si planes
  - Double perpendicular layers
  - 640 strip channels (50µm)
- Precise XY Table
- Sensor Box
- ADC v1721 as for BCM1F
- DAQ systems
  - Telescope
  - BCM1F

Test Beam Measurements

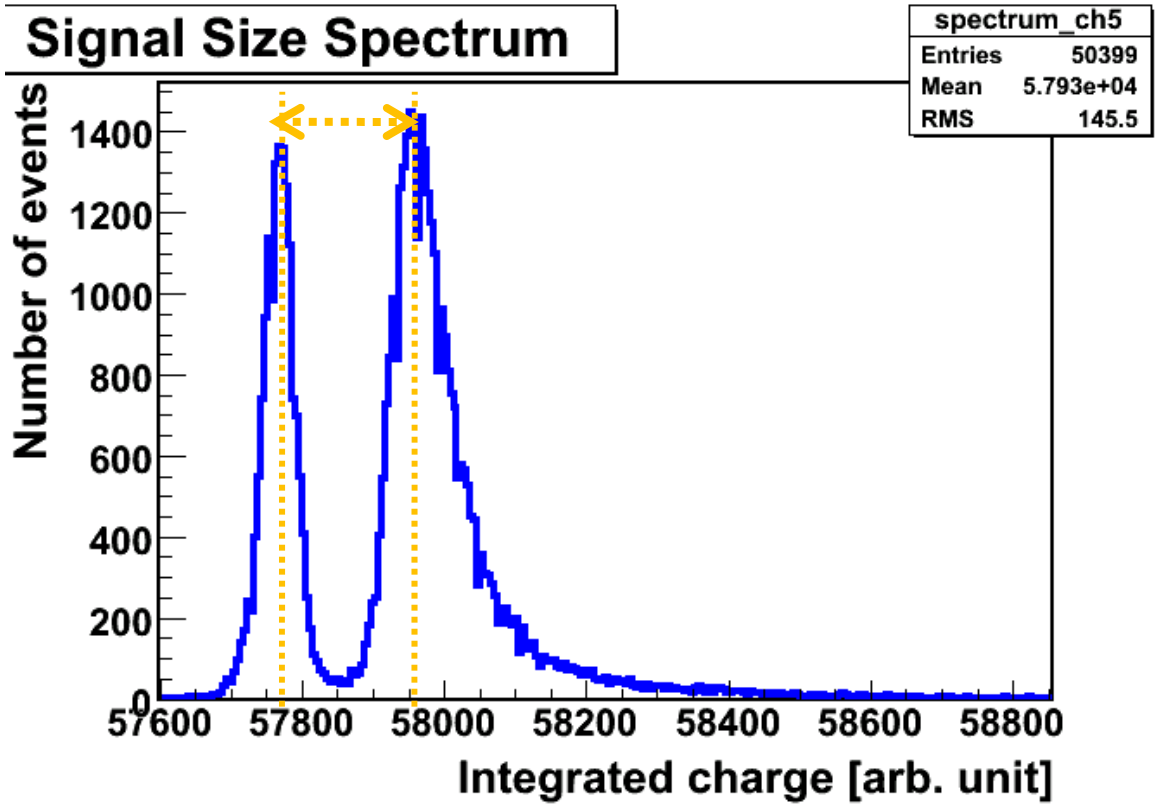
- To prove front end electronics operation together with sensor and automated readout
- Collect experience for preparation BCM1F, BeamCal, LumiCal prototype
- Measured:
  - Pads irradiation
  - Edges between pads irradiation
  - Cross talk measurements



Charge Collection Efficiency (CCE)



CCE ~ 30%, 23-34% all
S/N ~ 8, 6-12 all
HV 60V

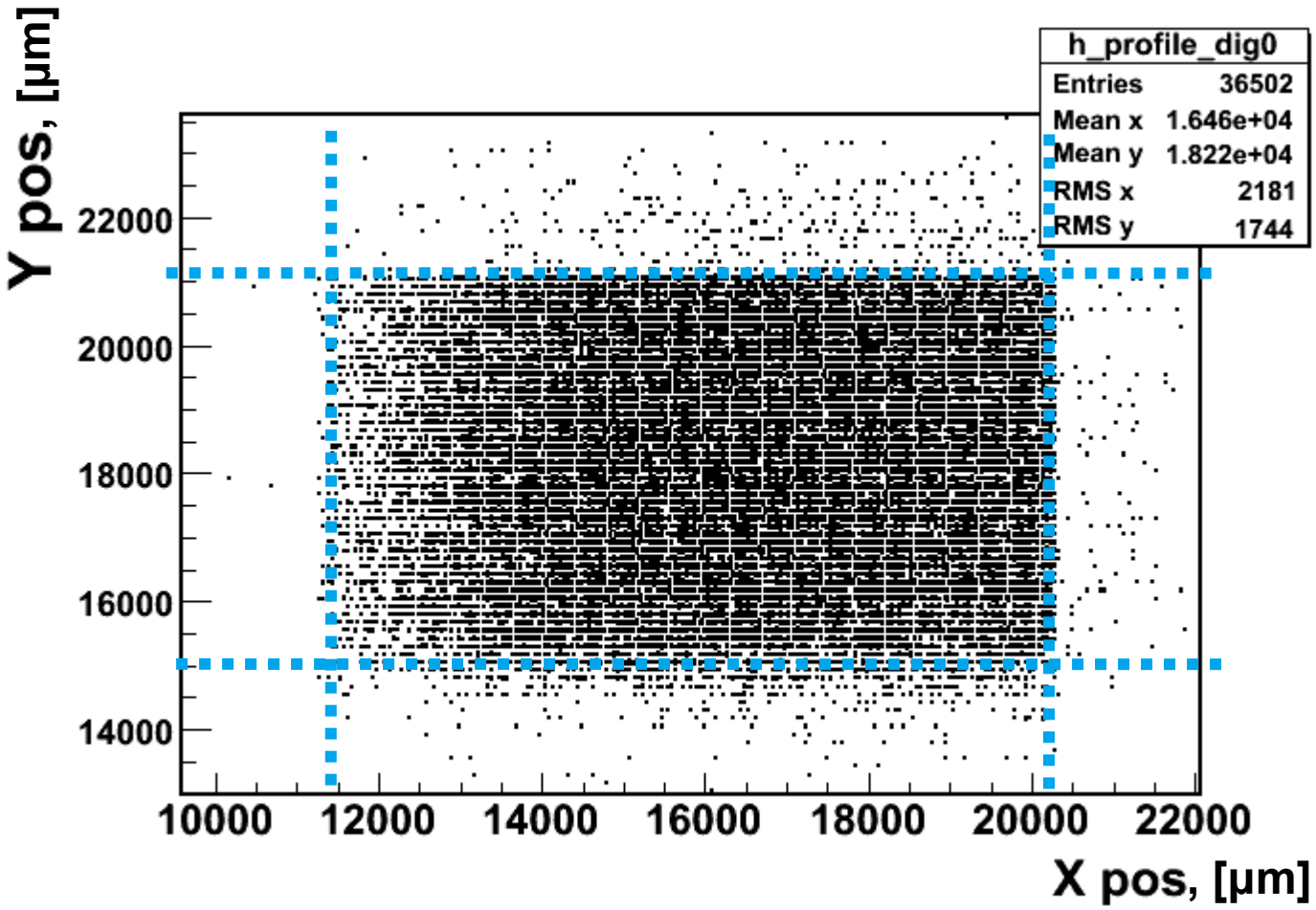


$$CCE = \frac{Q_{collected}}{Q_{induced}}$$

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

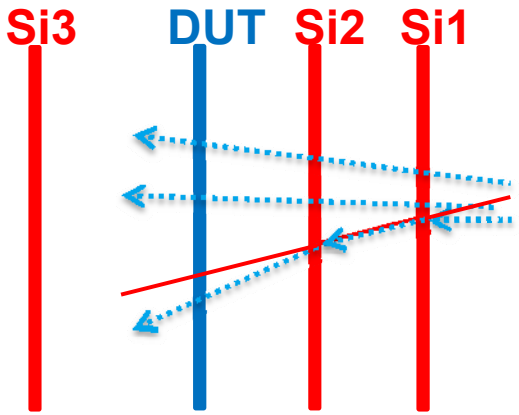
$$S/N = \frac{MPV_{Signal}}{Sigma_{Pedestal}}$$

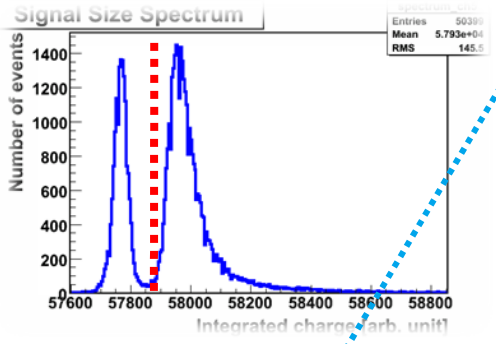
Beam Profile

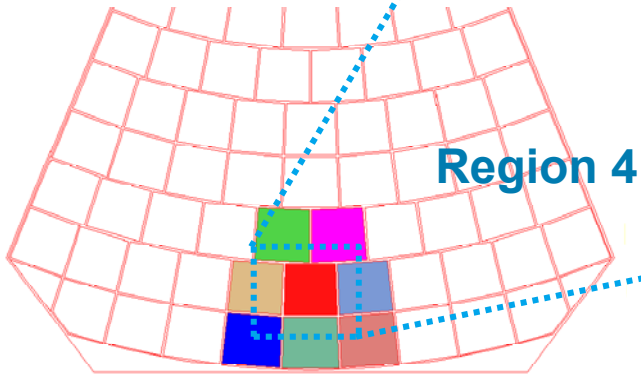


- No tracking
- 90 degree rotation
- 3 Scint in coincidence

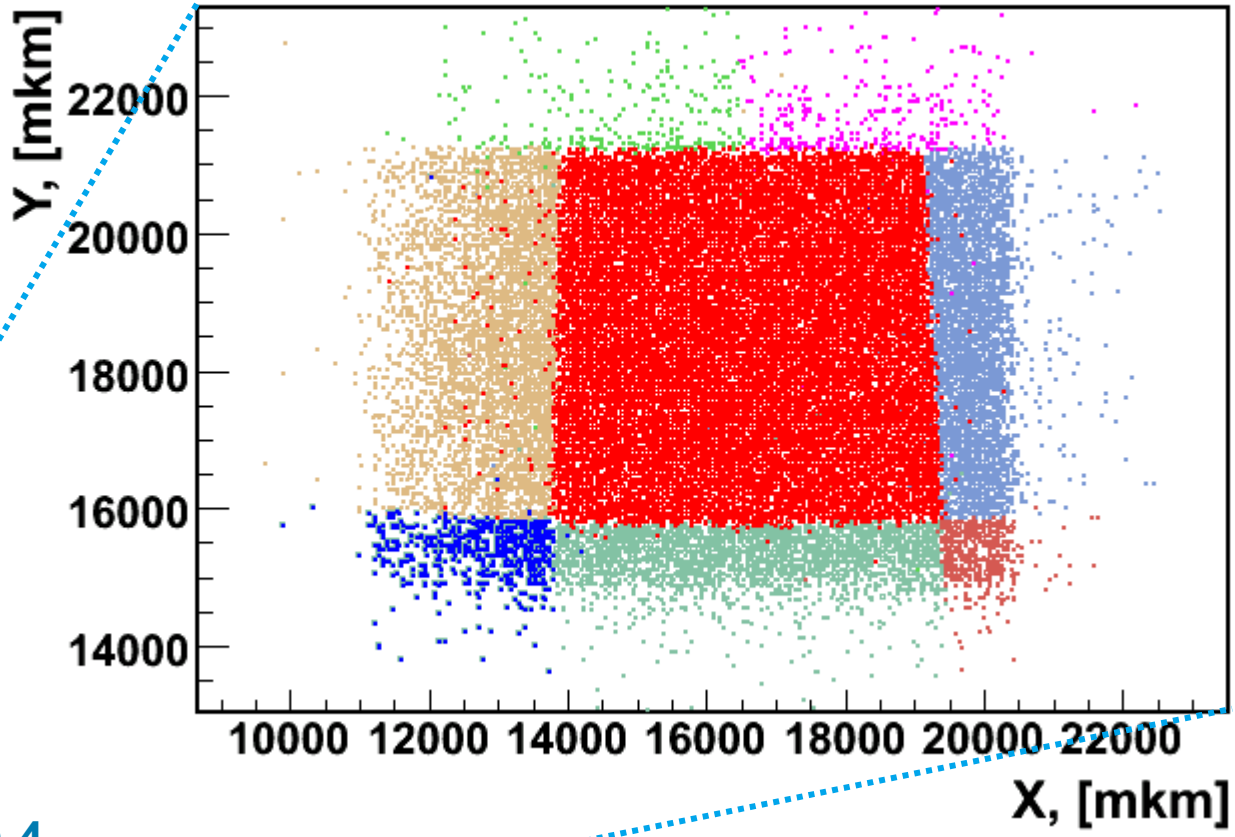
Tracking







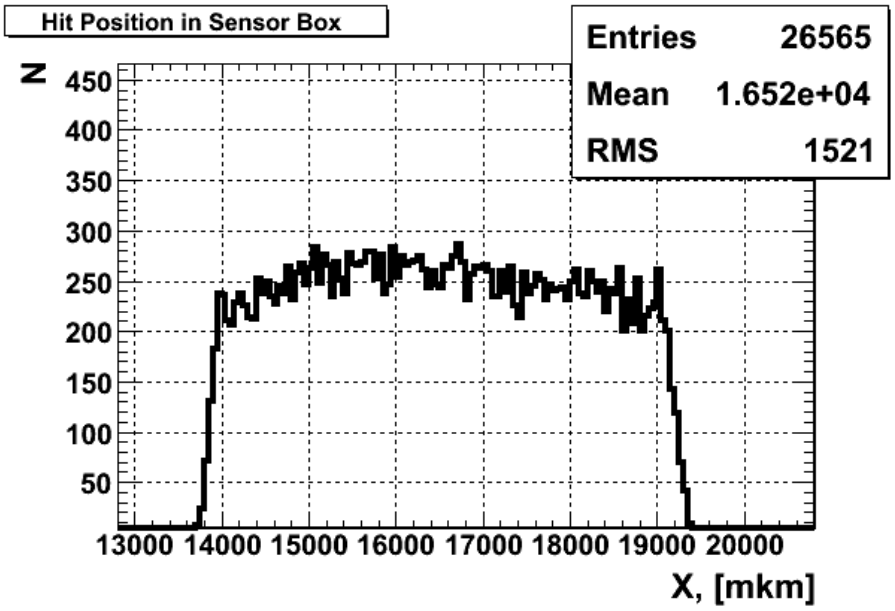
Region 4

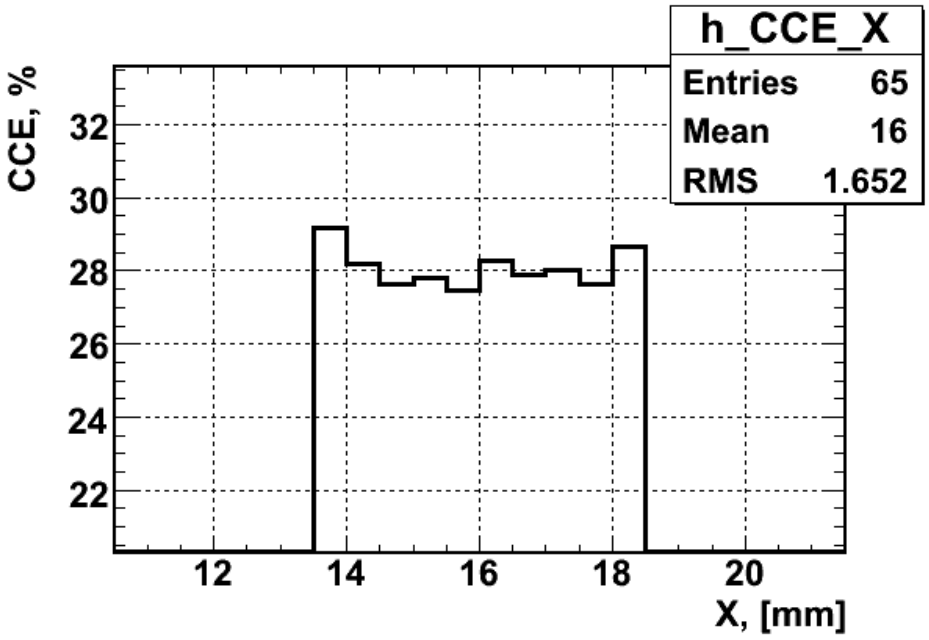


Reconstruction of position in the Sensor Box

DESY

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.

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.
- After this will be successful, a prototype calorimeter will be the next step.
- Lab measurements continue for sensor investigations.

Back Up Slides

>Thank You for Your Attention!

GaAs Samples

	Diamond	GaAs	Sapphire
	Insulator	Semiconductor	Wide band-gap insulator
Leakage Current	few pA at 500V	~300 nA at 50V	~ 1 pA
CCE before irradiation	~100% For single crystals	~ 50 %	~ 2 %
Radiation hardness	tested up to 10 MGy with e-	1 MGy	12 MGy
CCE relative drop after irradiation	Up to 10 %	Up to 10%	Up to 30%