HEPHY

Institut für Hochenergiephysik

Silicon Tracker Activities in Vienna - Status

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Overview

1. We will have a first combined test beam with the Large Prototype TPC @ DESY (Nov 09)

1. Vienna did a complete cycle: “from sensor design to test beam data” in the last year

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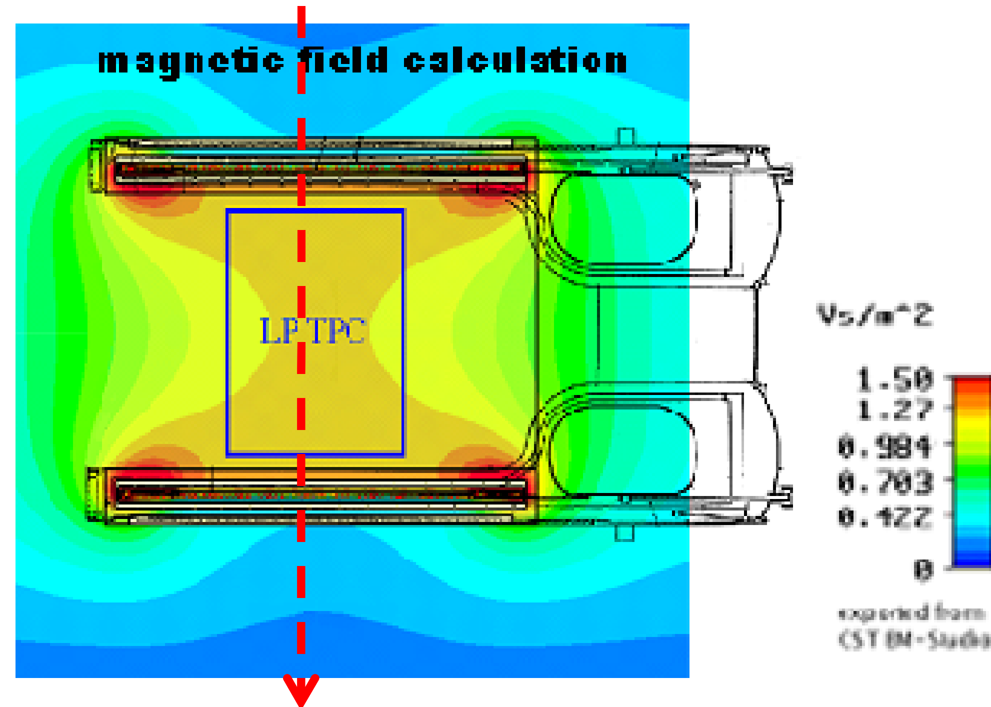
The Large Prototype TPC Setup @ DESY

- electron beam @ DESY: 1 GeV/c < p < 6 GeV/c
- *PCMAG:* superconducting magnet, up to 1.25 T

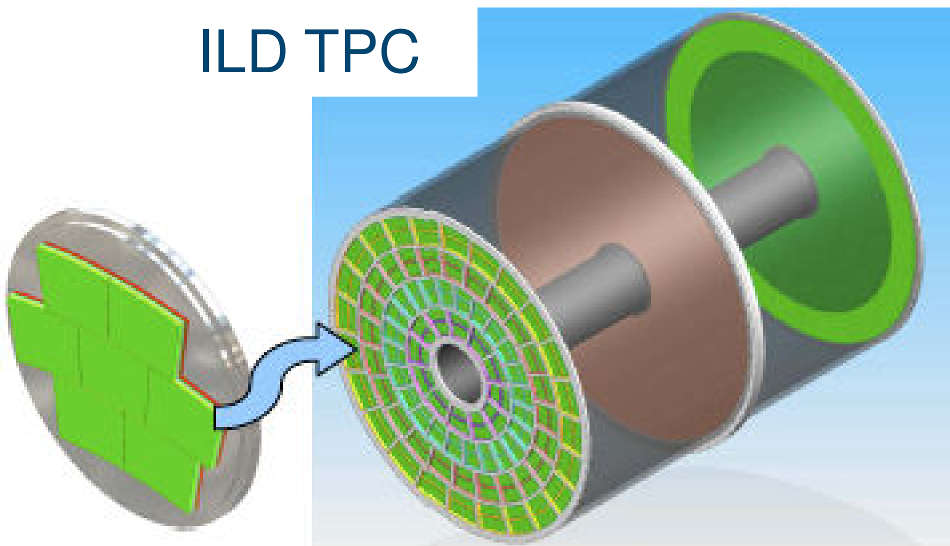


Present setup: concrete block replaced by a table movable in x, y, z, α.

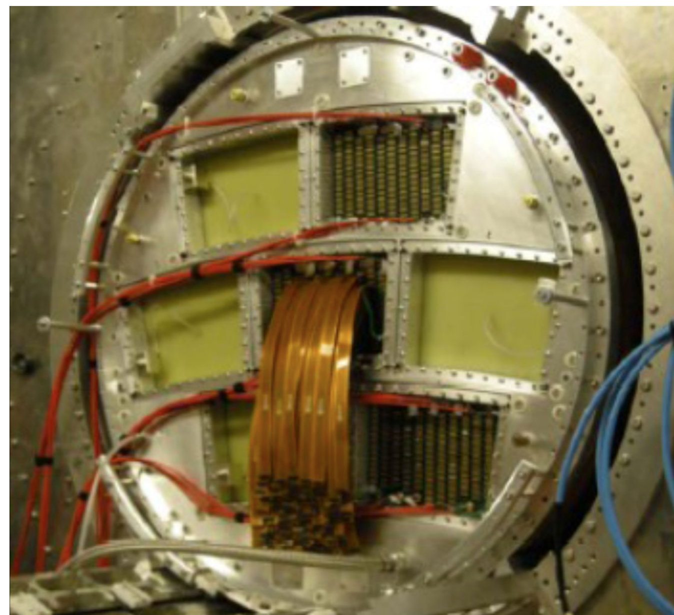
The Large Prototype TPC

- The LPTPC represents one half part of the planned ILD TPC
- With the possibility to test different TPC readout systems (GEMs and MicroMeGaS)

ILD TPC



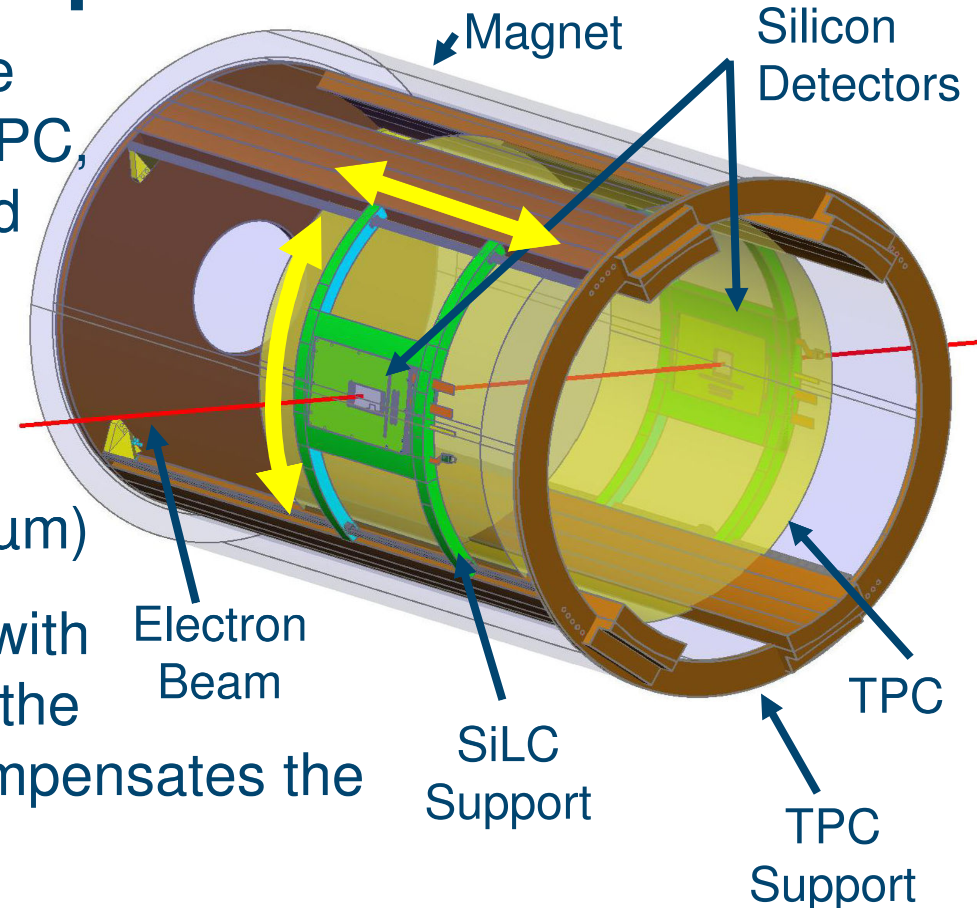
Field Cage:
diameter ~ 800mm
length ~ 600mm



LPTPC Endplate equipped with 3 double GEM modules

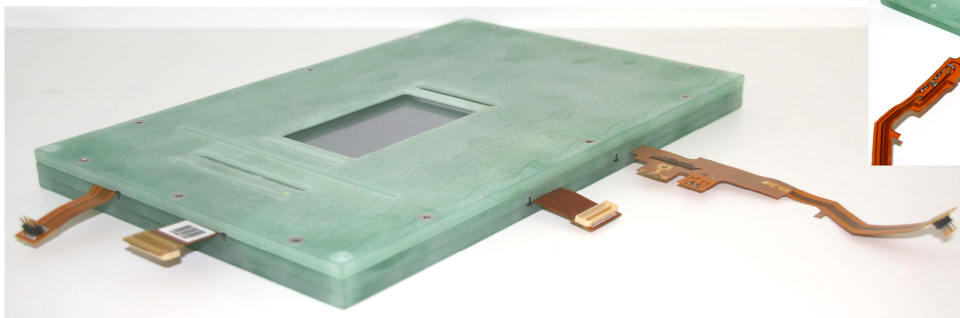
The Silicon Envelope for the LPTPC

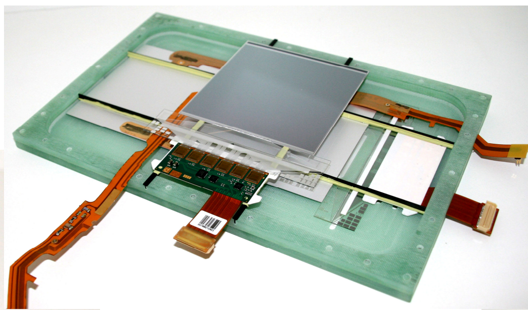
- On each side of the TPC, in the small gap between magnet and TPC, one silicon module will be installed
- Both modules contain 2 perpendicular silicon micro strip sensors providing a precise measured point of the track (<10 µm)
- It is foreseen to scan the TPC with the beam making it essential that the support of the silicon modules compensates the movements of the magnet
- This setup will allow to test a first prototype of a silicon envelope layer with the TPC prototype

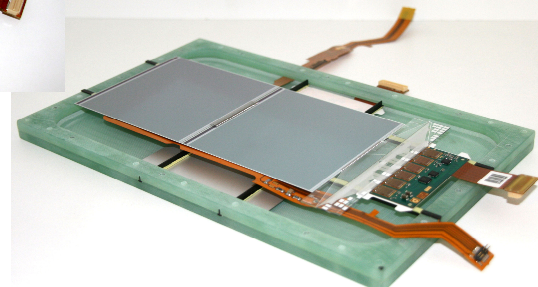


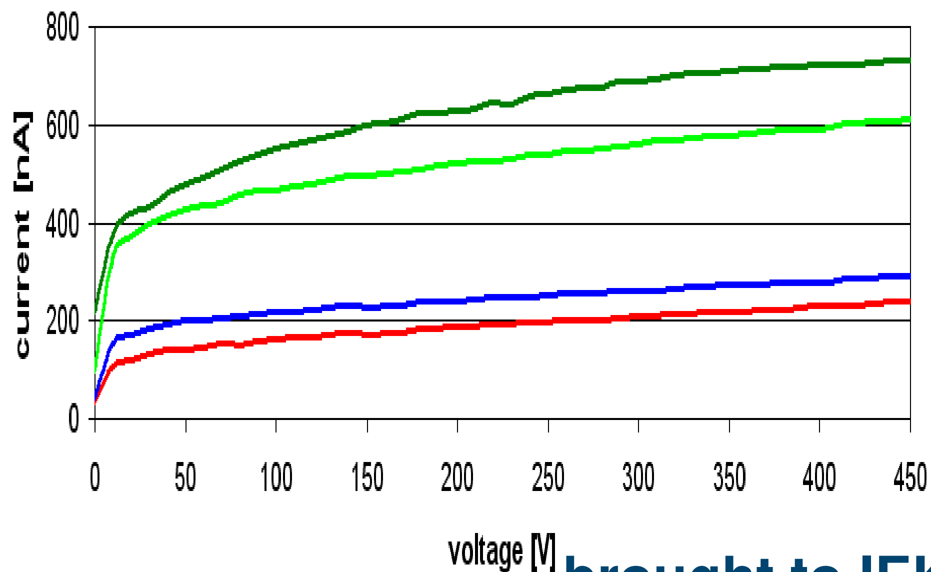
Si-Hardware – Sensor Modules

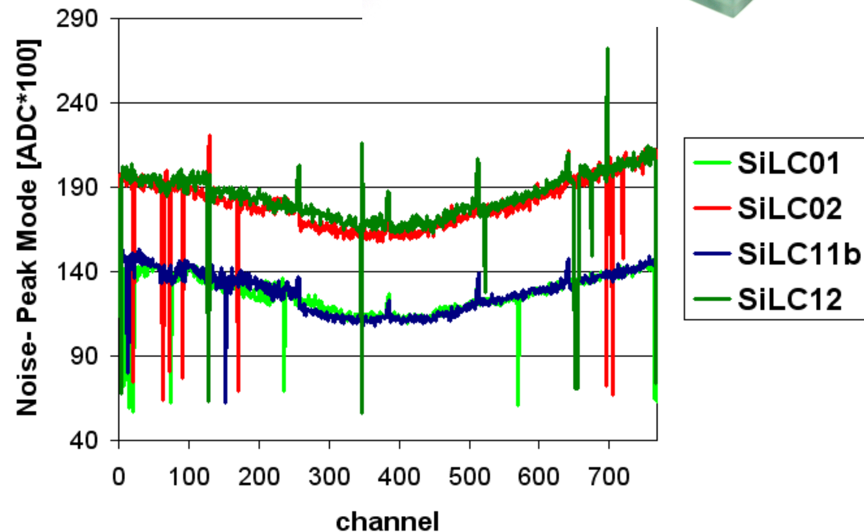
- Built and tested in Vienna







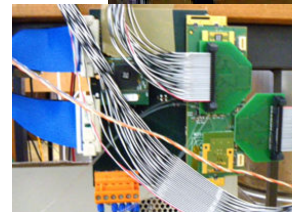


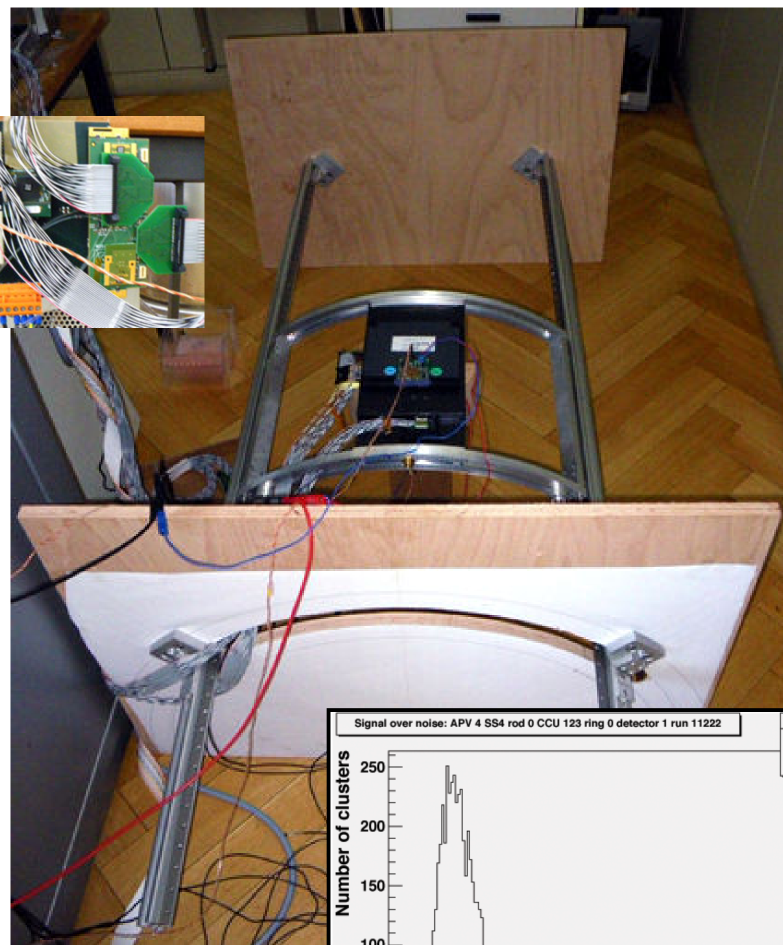


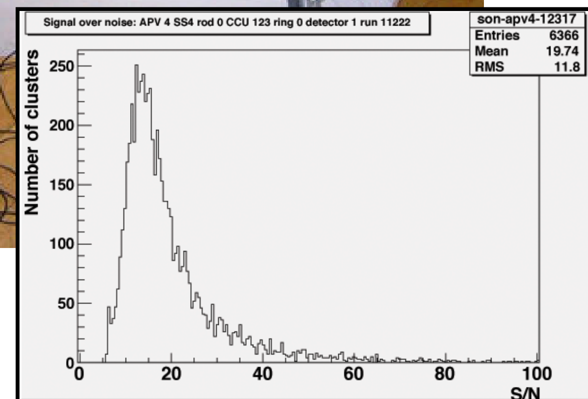
brought to IEKP Karlsruhe for final test in May 09

Si-Hardware – Final Test @ IEKP (May 09)

Adapted CMS readout







- Full Si-Support (Bars and Sledge) with mounted Silicon Sensor Module
- wooden plates as dummy for the TPC-support and the gap between magnet and TPC
- Scintillators to trigger on cosmics

-> everything worked fine

-> signal over noise measured

Installation @ DESY (June 2009)

- optical and ribbon cables from test beam area to hut installed
- DAQ software installed in hut

- Silicon support installed into TPC support
- Combined support installed into magnet
- sledges containing the Si-Modules can move freely inside the magnet

-> first combined data taking in November

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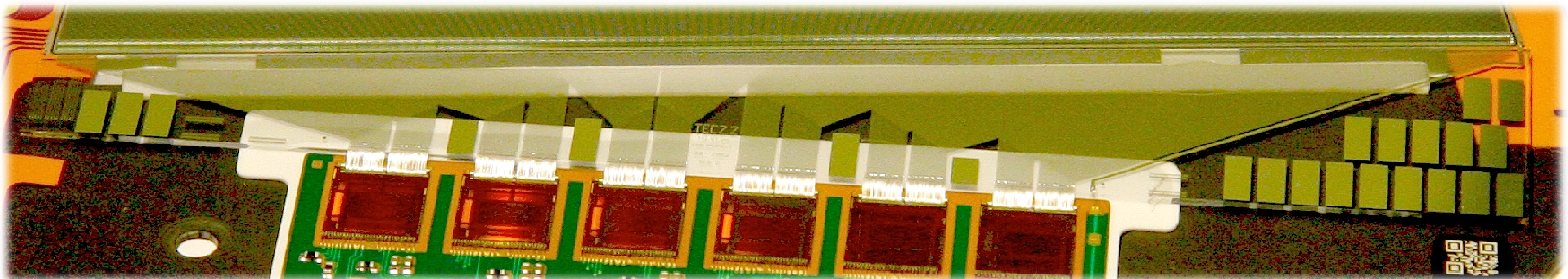
From Sensor Design to Test Beam Data

Different things of interest:

- Test the production facility in ITE Warsaw
- Gain experience with the design and the production of silicon strip sensors, in particular with a second metal layer
- First sensors with pitch adapter (PA) directly on the sensor

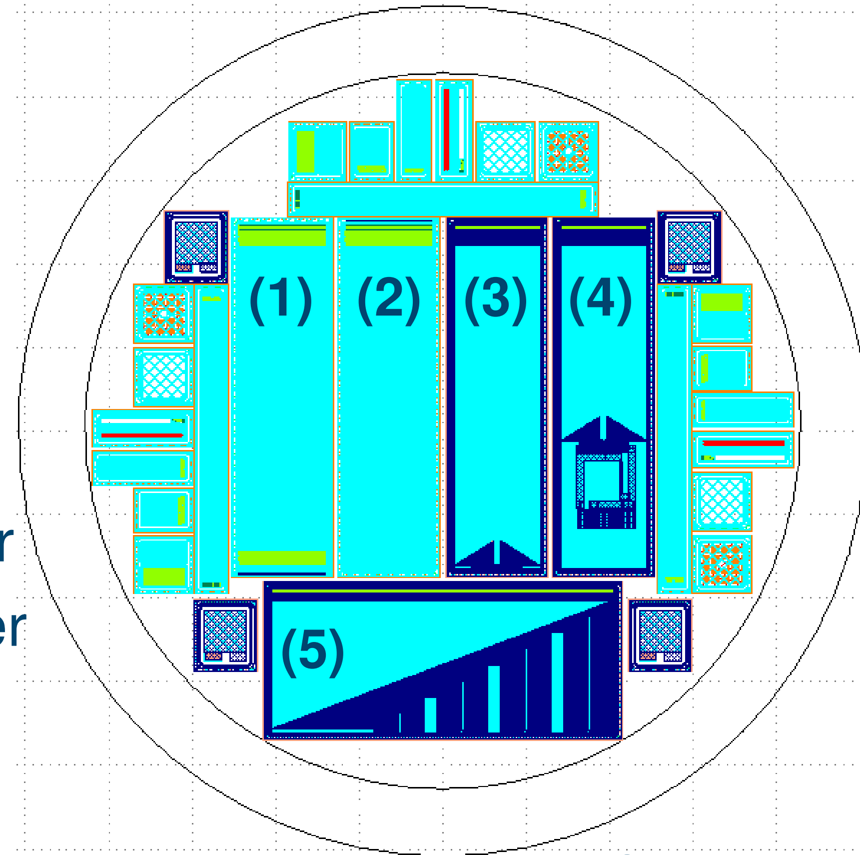
-> In contrast to the old "standard designs": sensor strips go straight to the edge, and get connected to the readout electronics with the help of an external pitch adapter, which matches the strip pitch of the sensor with that of the readout electronics; the use of such PA increases the amount of material and reduces the sensitive area



Sensor Design

Silicon Wafer Design in Vienna:

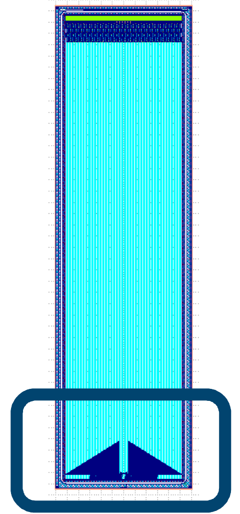
- 3 “standard halfmoons” (test struct.)
- 4 Test sensors:
  - 128 strips, 80 µm pitch
  - (1) standard strip
  - (2) included PA on 1st metal layer
  - (3) included PA on 2nd metal layer
  - (4) 2nd metal routing for chip on sensor bump-bonding
- 1 Test sensor
  - 512 strips, 80 µm pitch
  - (5) Included PA on 2nd metal layer



Color code:
First Metal Layer
Second Metal Layer

Produced in ITE Warsaw (by Jacek Marczewski)

Sensor Design (close up)



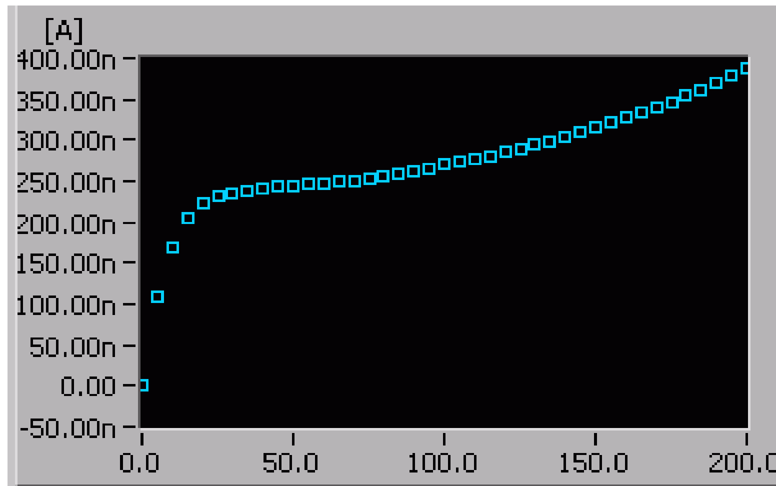
test sensor (2) with 128 strips and pitch adapter on 1st metal layer

Electrical Characterization

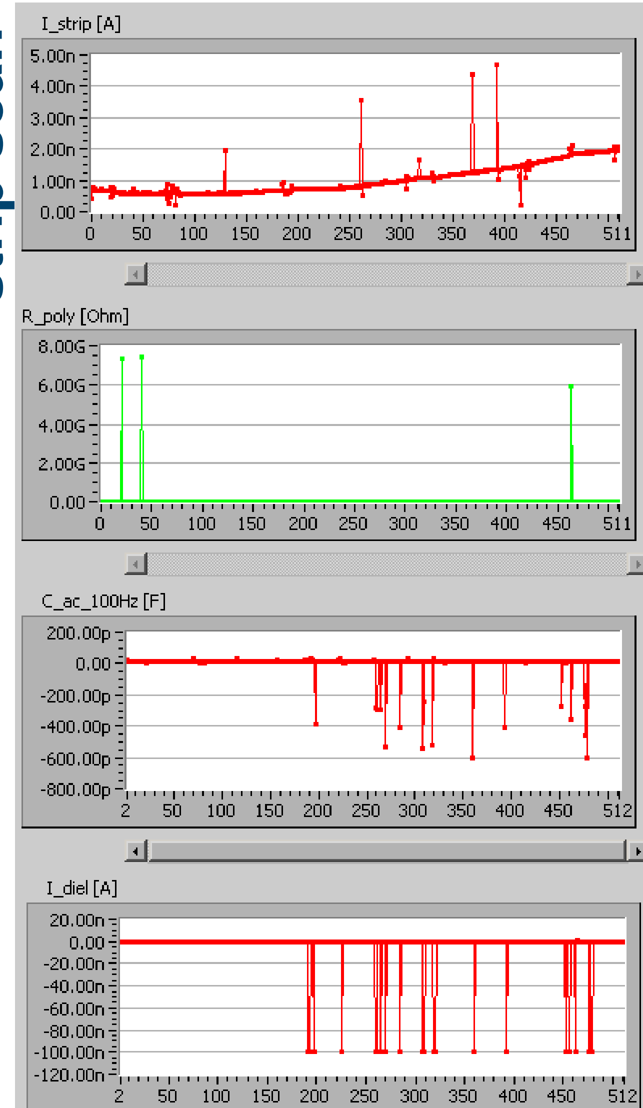
Done in Vienna

(results verified by Karlsruhe)

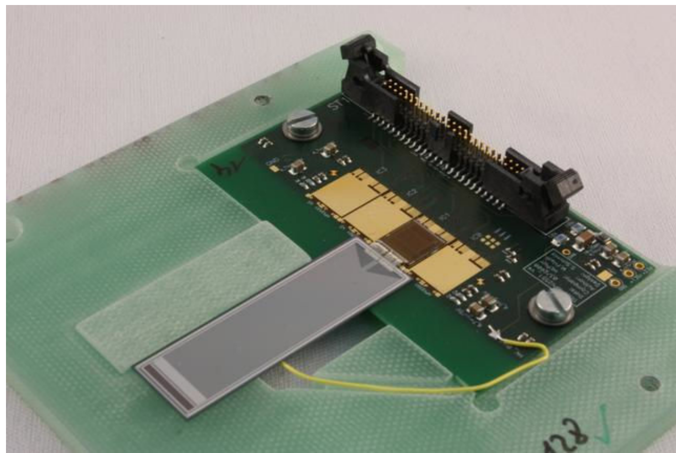
- $V_{FD} \approx 25$ V
- Bulk Resistivity ≈ 12.5 kΩcm
- Polysilicon resistor is much too low
  - $R_{poly} \approx 200$ kΩ
- Many pinholes (≈ 10 – 20 per sensor)

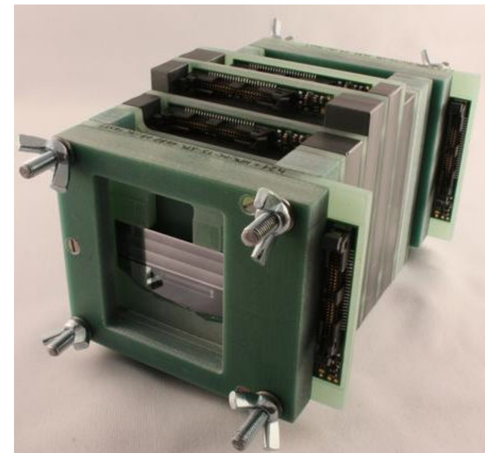


strip scan



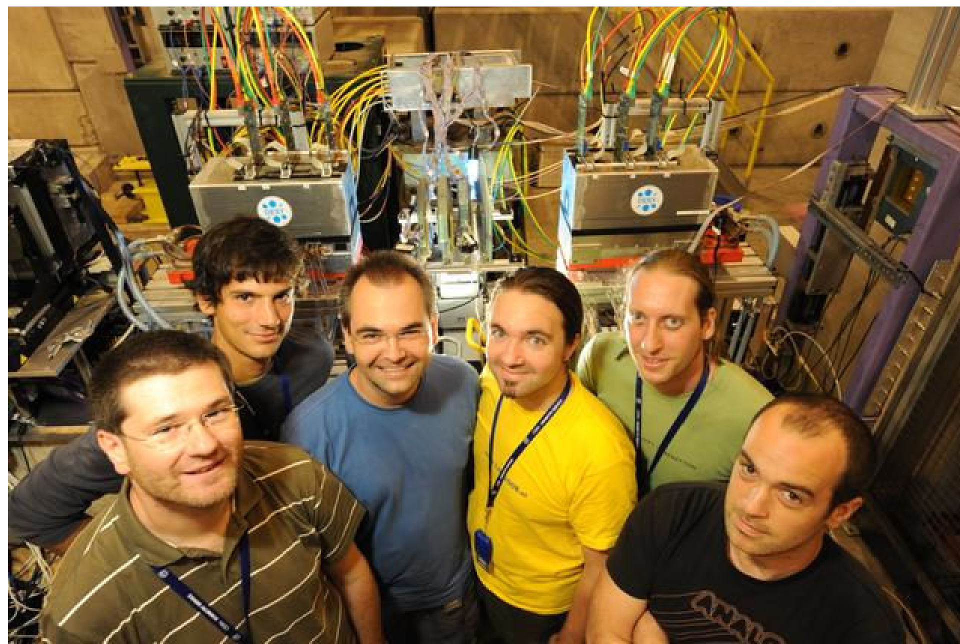
Modules built and tested in Test Beam





- Test beam at CERN's SPS (August 19-26, 2009)
- Low intensity 120 GeV Pions
- We used the EUDET Beam Telescope to get triggers and tracks

-> 3.2 M events (1 TB of data)

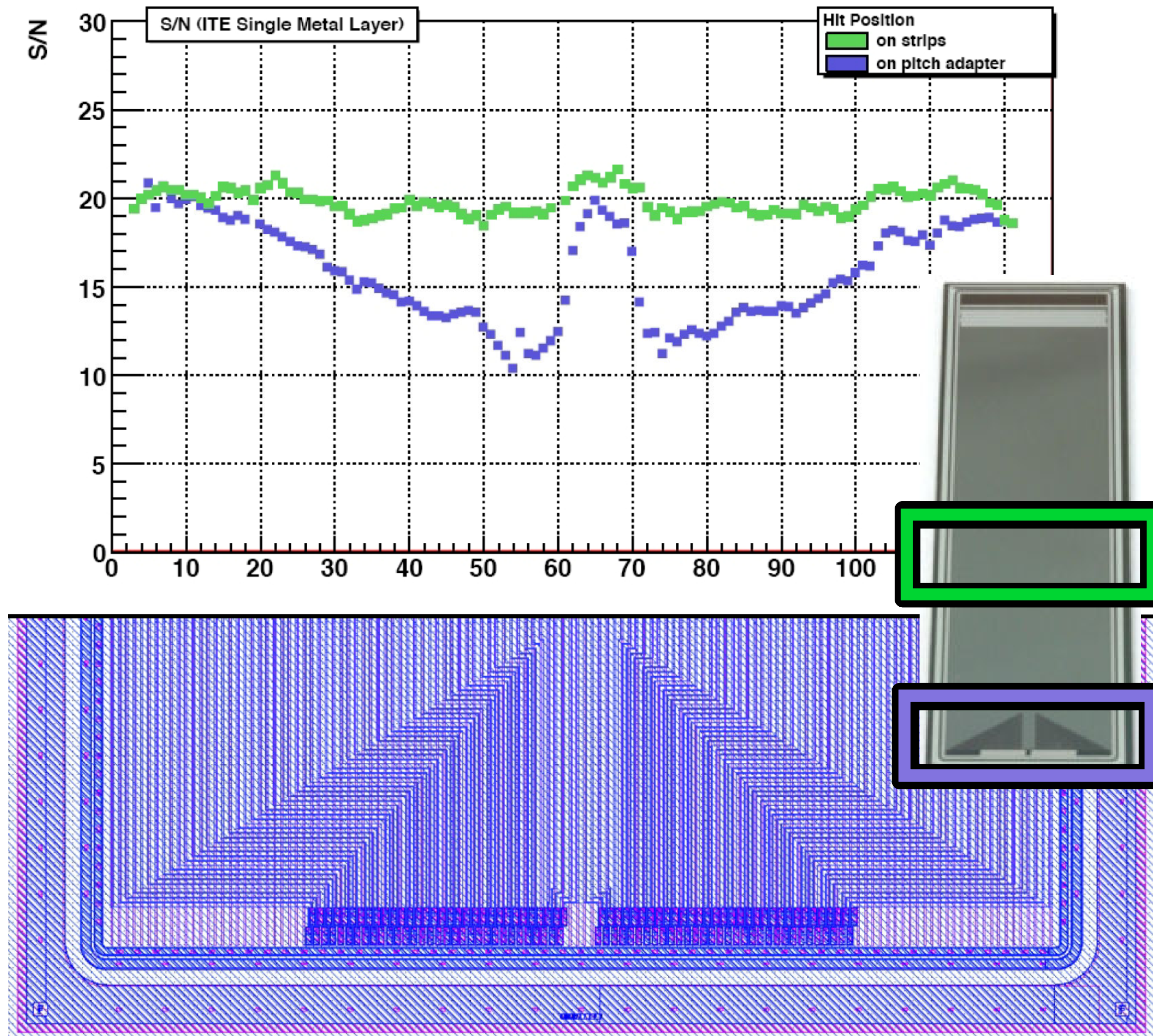


Preliminary Results – one Example

Sensor (2) with pitch adapter integrated on 1st metal layer:

- We compared hits in the region of the PA (blue) with hits in the region away from the PA (green)
- No alu metallisation over strip in PA region, and higher resistivity of p^+ w.r.t. alu = smaller signal
- Cross talk -> more noise

-> Reduction of signal over noise as expected



Final Remarks

- First combined test beam of the silicon envelope with the Large Prototype TPC in November 2009 at DESY

- In the SPS Test beam we took a lot of data, not only with the new produced sensors from ITE, which needs to be analyzed

-> a lot of work is waiting