VFCAL Report

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Infrastructure for sensor diagnostics

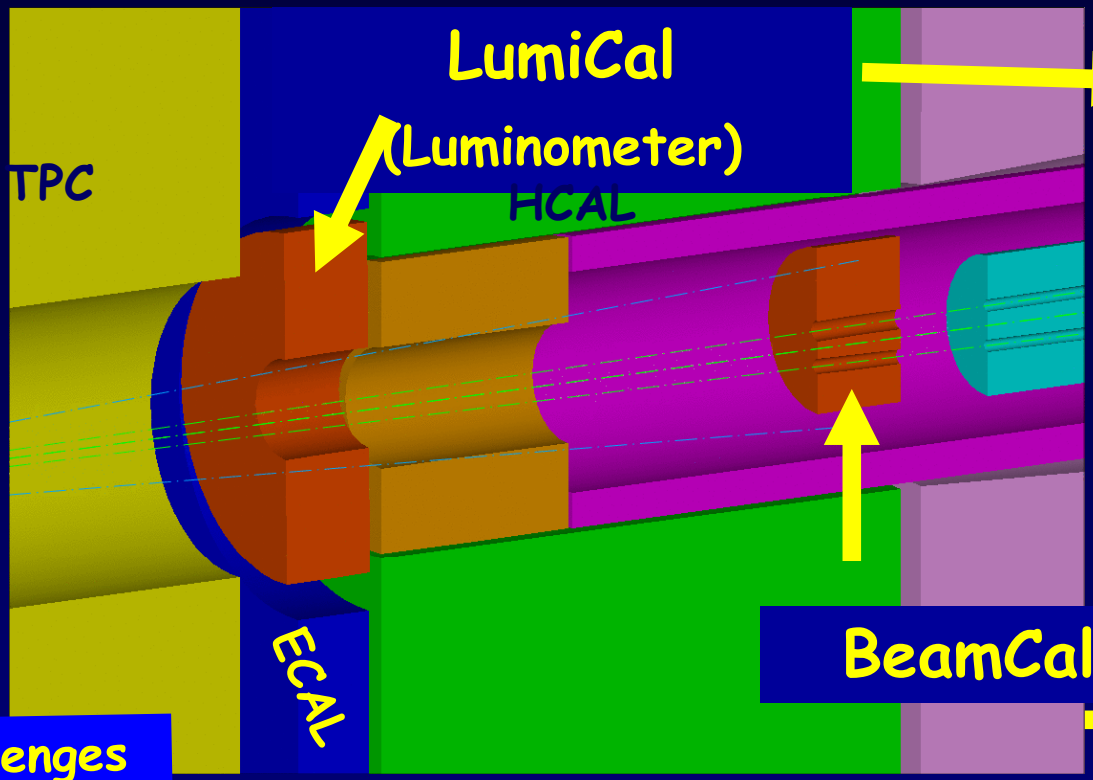
FE Electronics Development

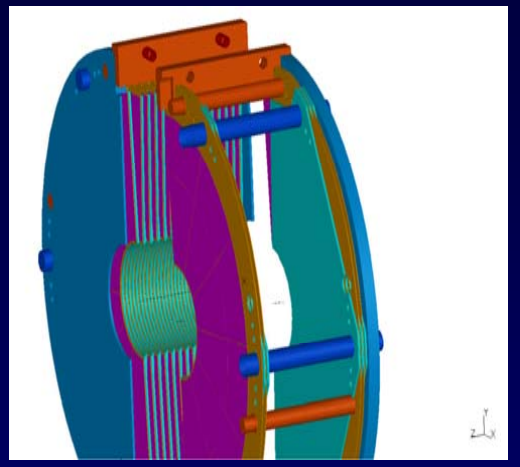
Sensor test facilities

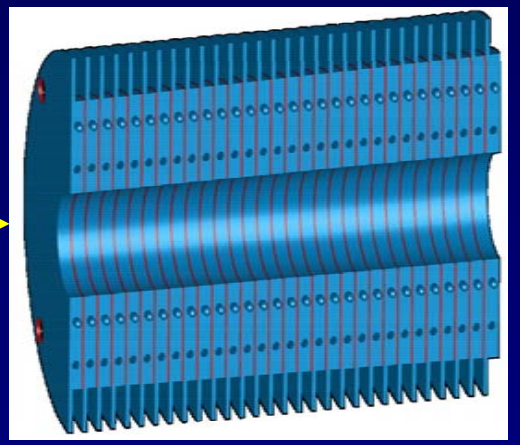
Laser Alignment

Labs involved: Cracow UST, Cracow INP,
Prague (AS), Tel Aviv Univ.
DESY (Z.)

Current design (Example LDC, 14 mrad):







Challenges

LumiCal: -control of position on ~10 μm level
-control of the inner acceptance radius on ~μm level

BeamCal: -radiation hard sensors (~10 MGy/year)

Both: -compact (smallest possible Moliere radius)
-readout after each BX

Infrastructure for Sensor and FE Tests

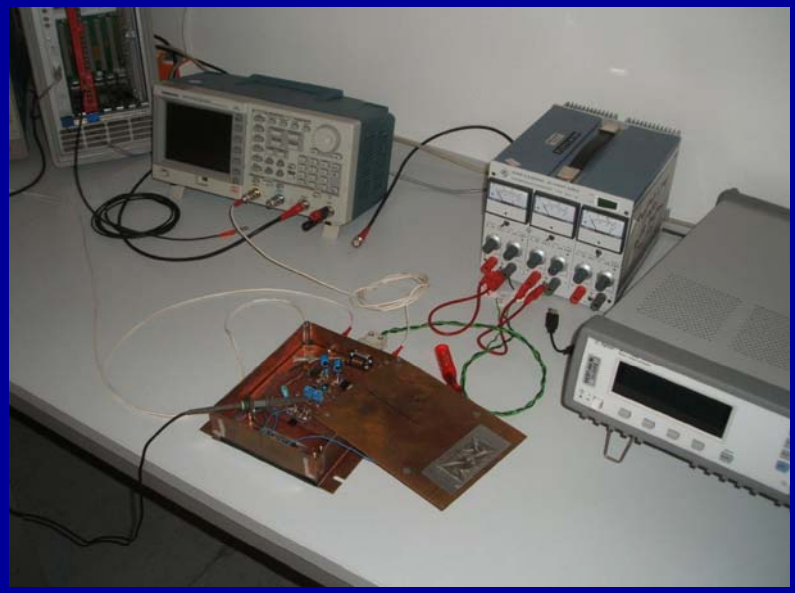
Rooms (Cracow, DESY):

two rooms with filtered air (10k), stabilized temperature

- room 1: bonding and assembly
- room 2: all measurements without radioactive source

Upgrade of the probe station at DESY

- New voltage- current devices (Keithley 6487)
- Control software
- Amplifier test bench



Infrastructure for Sensor and FE Tests

Tel Aviv:
Laboratory room is found and prepared

- Most components of the computer controlled silicon probe station are purchased
- LabView runs with a test circuit just ongoing
- Calibration with real but known Si pads in a few weeks

Prob Station in TA

Infrastructure for Sensor and FE Tests

Design Flow for IC readout chip tests with the custom sequencer V1495

Quartus II
Electronics Design Tool

- edit functional description (VHDL)
- compile to binary

VME Crate Controller
custom LINUX handler
USB to VME bridge

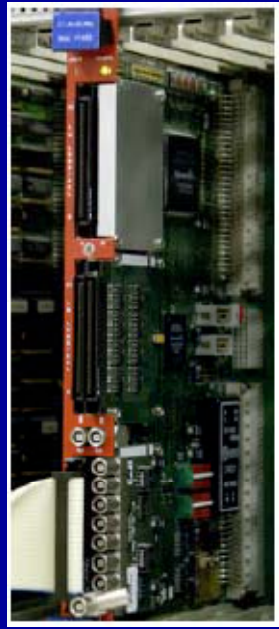
- flash V1495 firmware with user functionality

VME Test Stand
any VME controller

- operate sequencer in stand-alone mode using custom parameter registers

PHY3 Prototype Board
plus Power Supplies, Puls Generators

- operate PHY3 chip with different modes and frequencies



C.A.E.N. V1495 general purpose I/O module

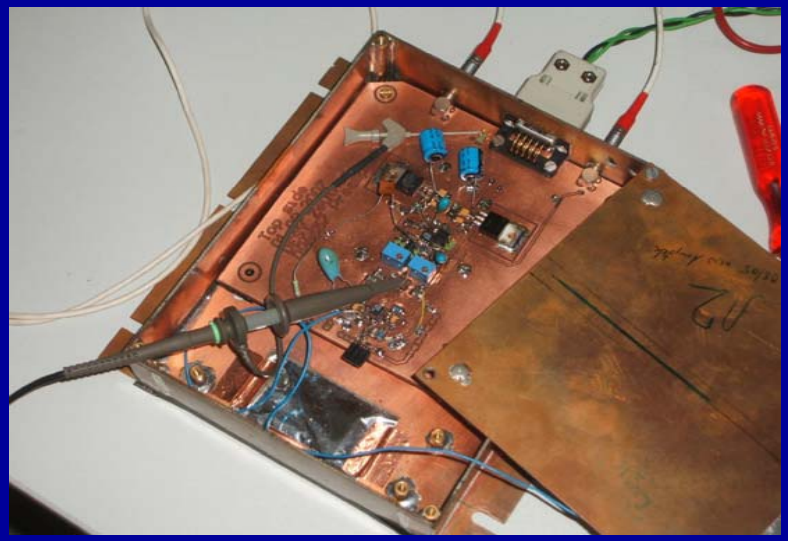
w/ LVDS and NIM In/Out channels

Test Example: PHY3

FE Electronics Development

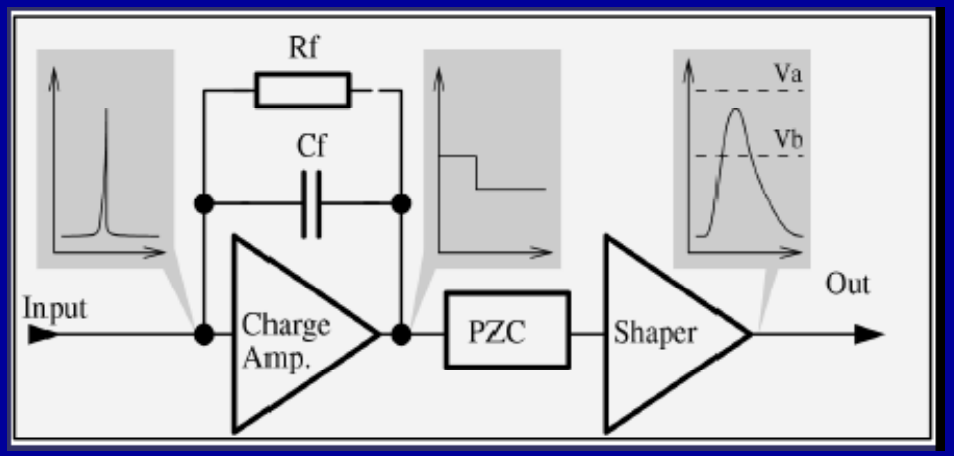
Preamplifier for lab- and test-beam applications
- Low noise (~200 e-)
- 4 channels per board
- Low cost

(summerstudent contribution)



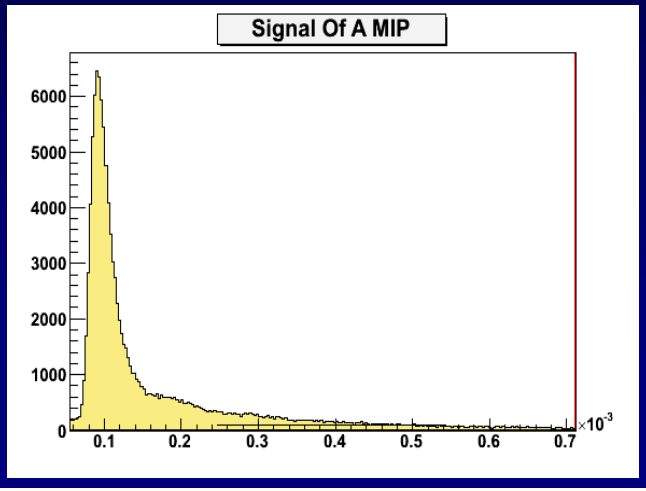
Prototyping of 12 channel Integrated FE (amplifier and ADC)

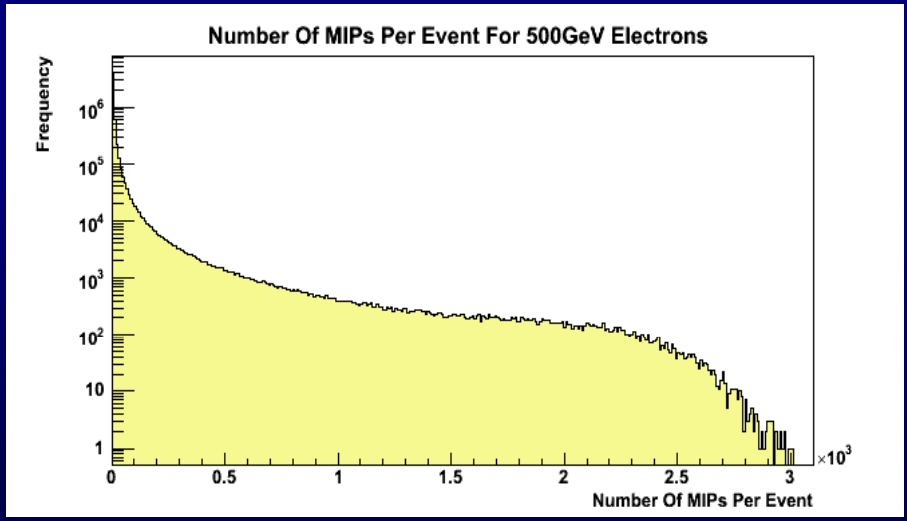
- Charge sensitive variable gain
- test mode: S/N ~ 10
  physics mode: ~ 10 bit
- Tpeak: 50-70 ns

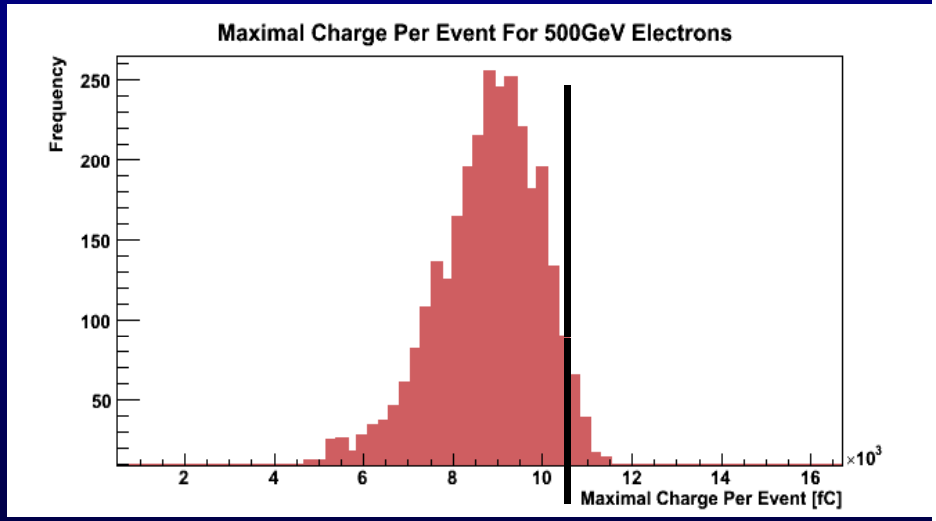


Mokka (Geant 4) simulation of LumiCal Digitisation

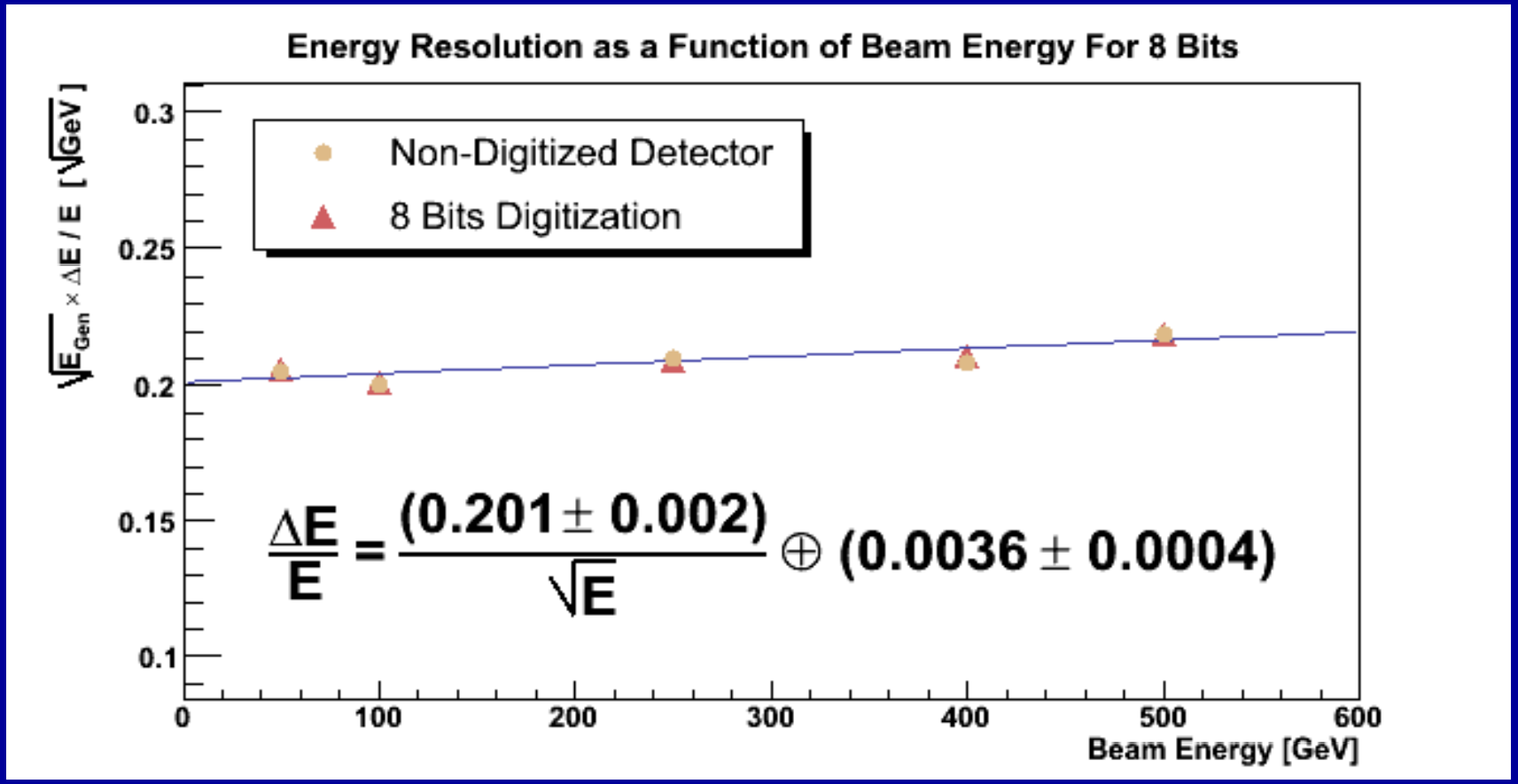
1. 500 GeV electrons for 8-Bit & 10-Bit schemes.
2. Energy MPV of a MIP in 0.3 mm thick silicon is 93.8 KeV.
3. The maximal number of MIPs in a single cell is 3,010.
4. 95% of the signal is below 10,575 pC = 2,586 MIPs.







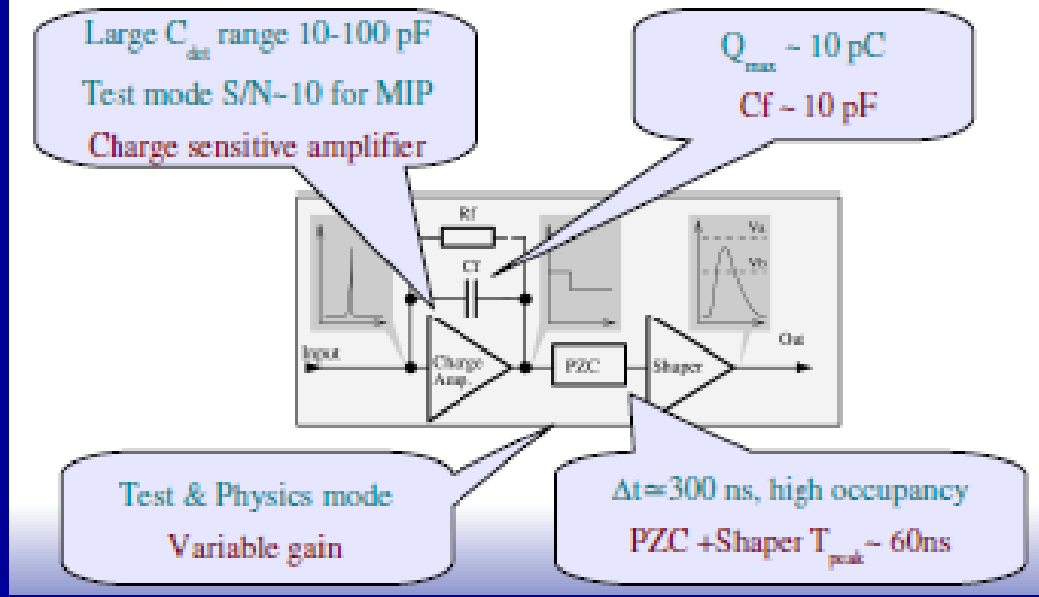
FE Electronics Development



No change with regard to the non-digitized case (The same goes for 10-Bits…).

FE Electronics Development

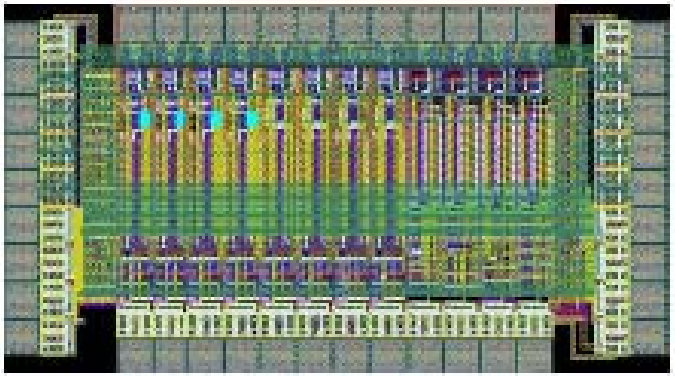
Challanges of LumiCal front-end



Estimates of signal range and occupancy from MC simulations, translated into design requirements

First (few 10) pieces of FE ASICS
Produced and prepared for tests
Tests complete in December 2007
Submission based on a refined design beginning of 2008

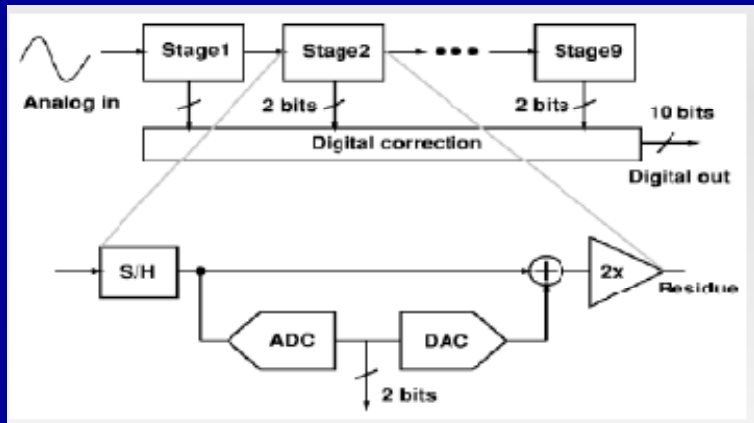
Prototype ASIC contains 8 channels with continuous shaping ard 4 channels with switched-reset



Pad Pitch 100 μm

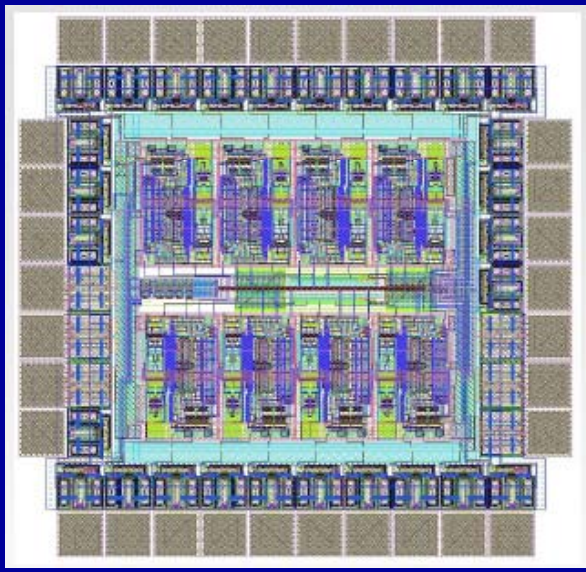
FE Electronics Development

Pipeline ADC concept



Last stage is simplified

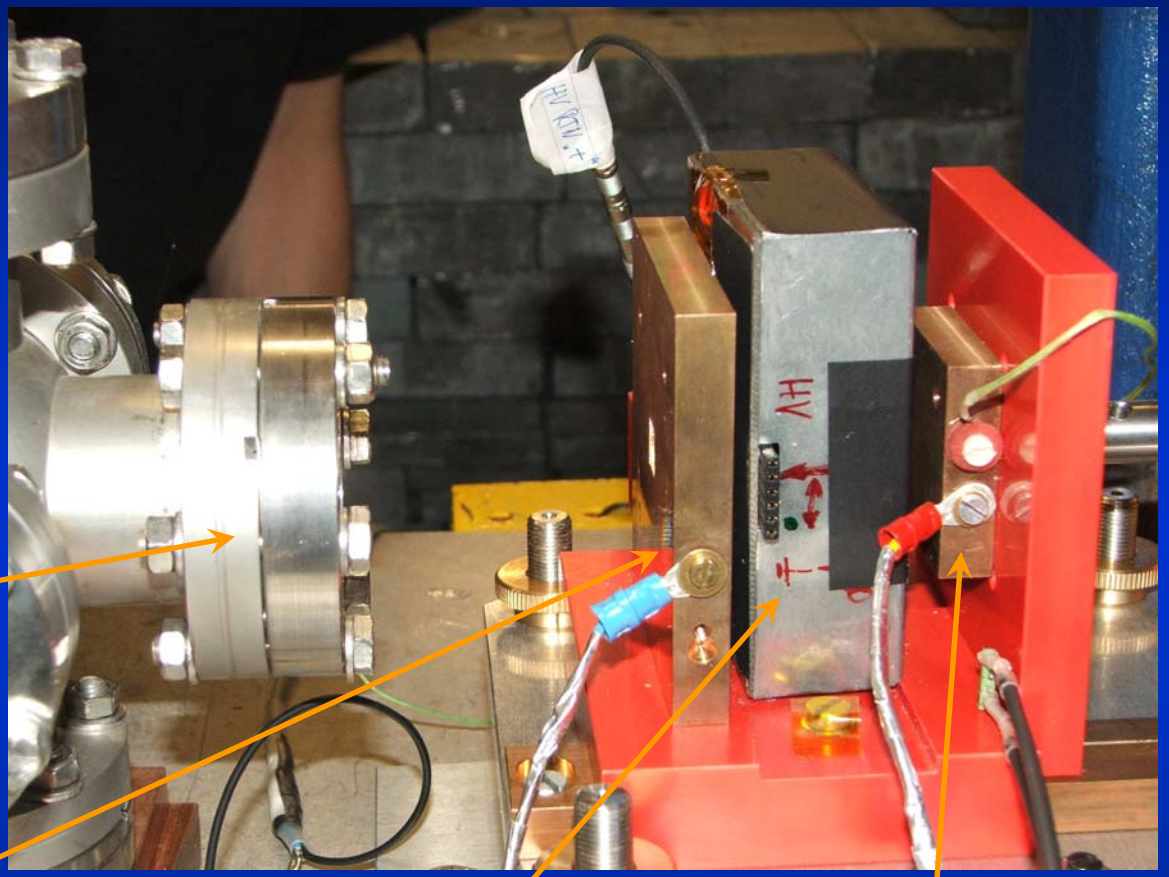
- 9 stages for 10 bit
- A stage produces 2 bits and multiplies signal by 2
- Digital correction relaxes comparator requirements



- 8 stages of 1.5 bit
- Size 1.15x1.11 mm

- First Prototypes of the ADC functional blocks are produced
- Test will start soon and completed in December 2007
- Submission of a 'second generation' prototype beginning of 2008

Test Beam Equipment



exit window of beam line

collimator (I_{Coll})

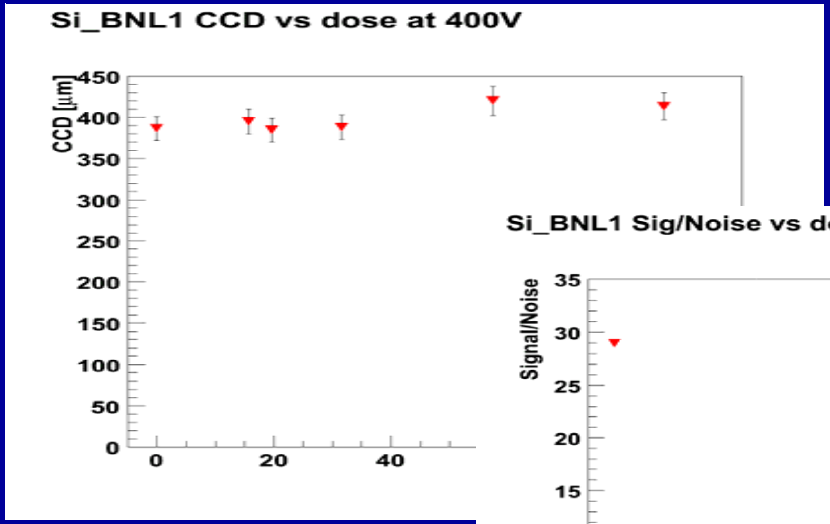
sensor box (I_{Dia}, T_{Dia}, HV)

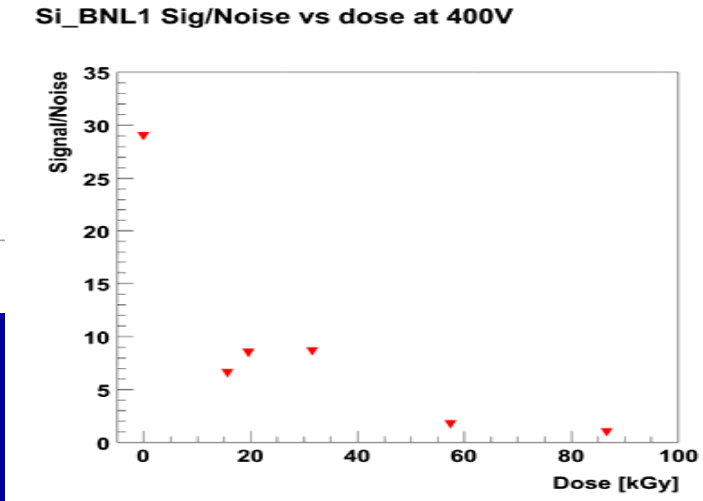
Faraday cup (I_{FC}, T_{FC})

Testbeam

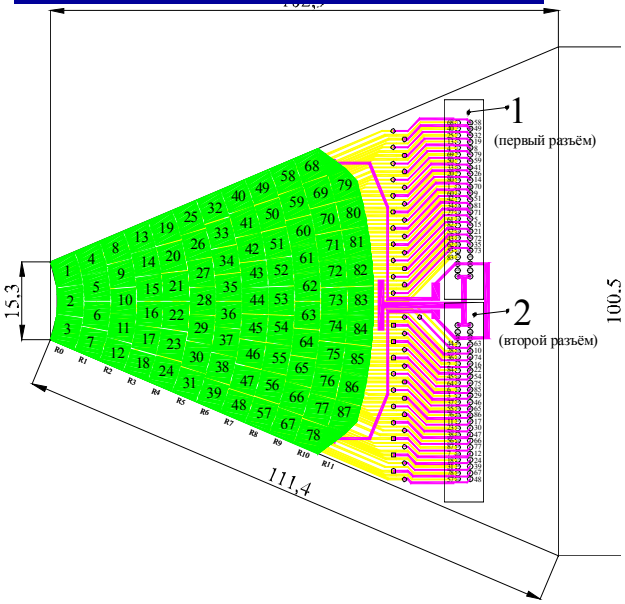
Test Beam 2007

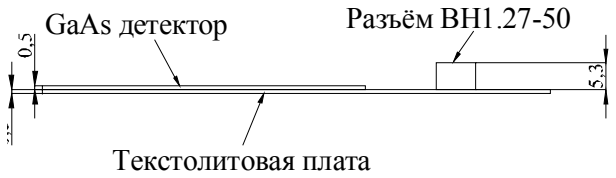
- Completion of Diamond sensor tests
- Test of GaAs sensors
- Test of rad. Hard Si sensors, delivered by BNL and Prague





GaAs sensor prototype





Example: Silicon pad sensors from BNL

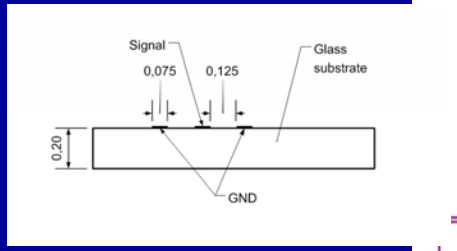
Data analysis is ongoing, preliminary results expected for the EUDET annual meeting in Octobre

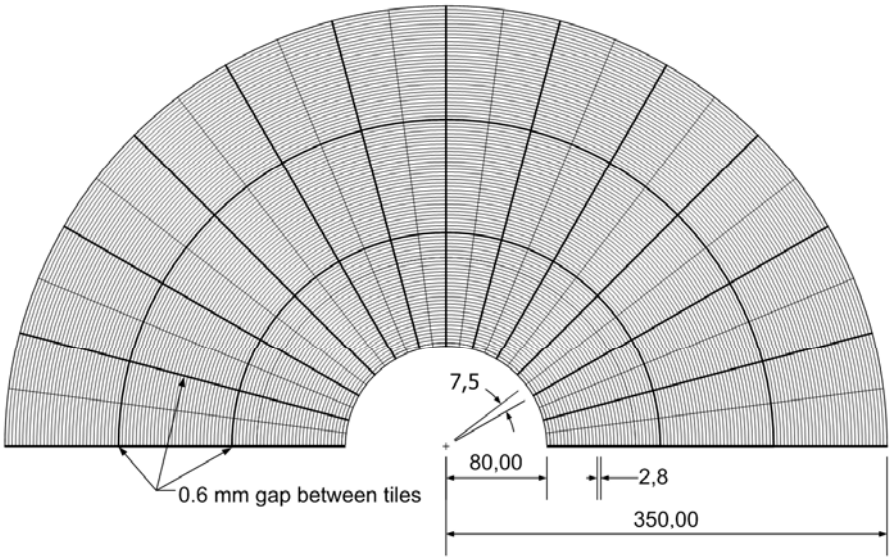
Silicon Sensors for LumiCal

- Sensor prototypes designed
- Contacts to several manufacturers

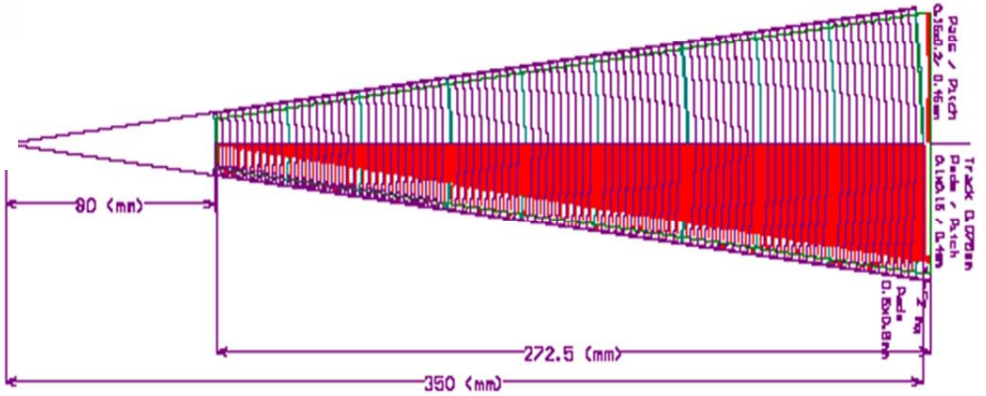
  Tower Semiconductors Israel
  Hamamatsu
  Canbera
  Sintef

- Fan-out design



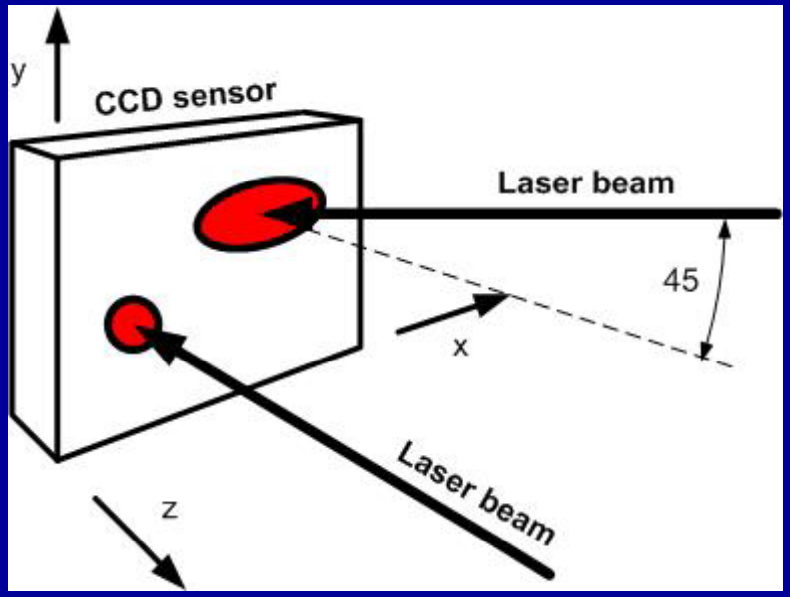


Half plane - 24 sectors, 96 cylinders (36 silicon tiles, 2304 pads)



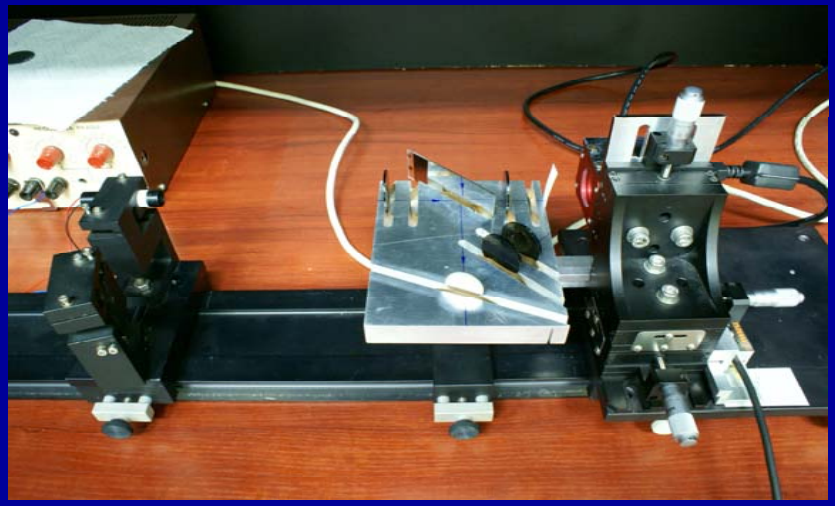
- Sensor Prototypes for tests expected in 2008

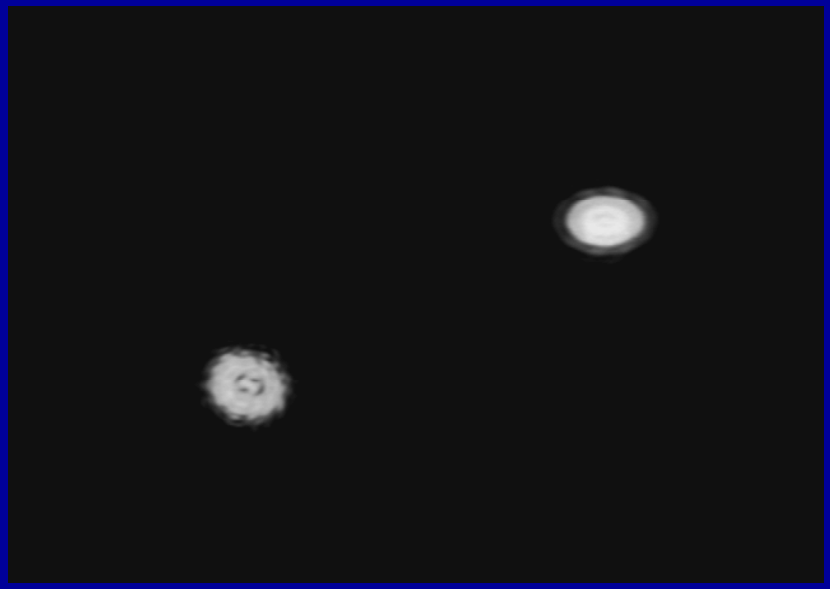
Laser alignment system



Wojciech Wierba et al., INP Cracow

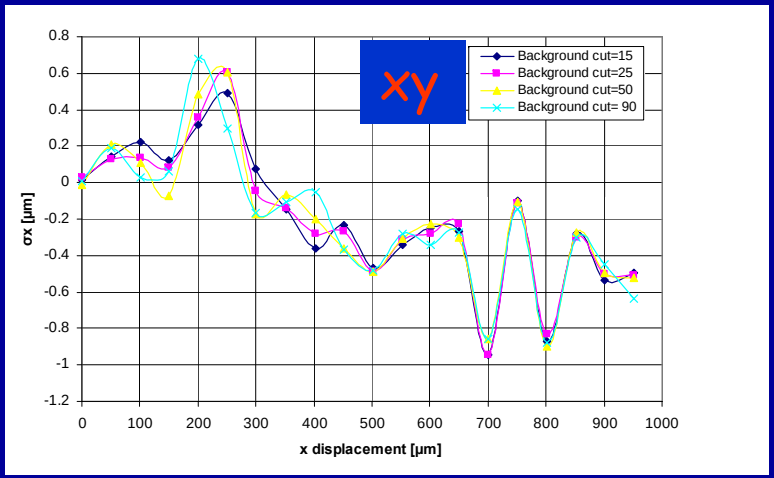
Two laser beams (one perpendicular, second with 45˚ angle to the
sensor plane) allows to measure XYZ translation in one sensor



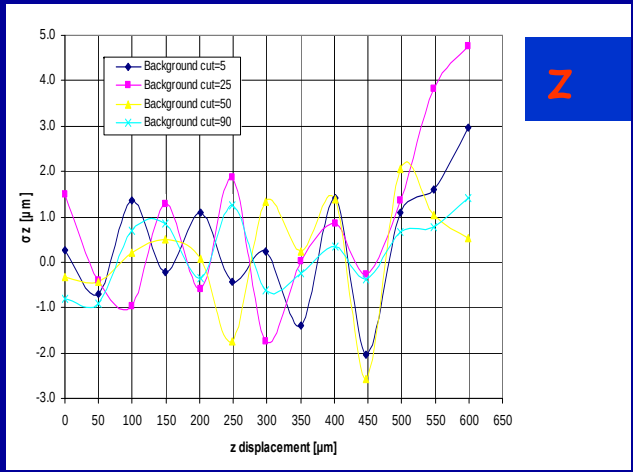


Results and Status

+- 0.5 µm



+- 2 µm



Camera has been moved in steps of 50 µm. The distance have been measured with Renishaw RG-24 optical head with the resolution of ±0.1 µm

- It is necessary to stabilize the temperature of camera (stabilized chamber is under design)
- Main effect is traced to the self heating of the camera.
- Collimator and laser optics should be improved

Plans and Summary

- Laboratory infrastructure is created/improved
- Testbench for FE ASICS prepared
- First design FE ASICS produced
- Testbeam equipment for rad. hard tests completed and used
- Laser positioning system studies are ongoing

Next steps:

- Test of prototype ASICS
- Submission of improved/refined versions beginning 2008
- Analysis of testbeam data (rad. Hardness)
- Preparation of tests for Si sensors (LumiCal)