FCAL in Horizon 2020

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On behalf of the FCAL Collaboration

AGH University of Science and Technology Cracow, CERN Geneva, DESY Zeuthen, IFIN-HH Bukharest, INPPAN Cracow, ISS Bukharest, LAL Orsay, JINR Dubna, NCPHEP Minsk, Pontificia Universidad Catholica de Chile, Tel Aviv University, Tohoku Univ. Sendai, Univ. of Colorado Boulder, UC California Santa Cruz, Vinca Belgrade

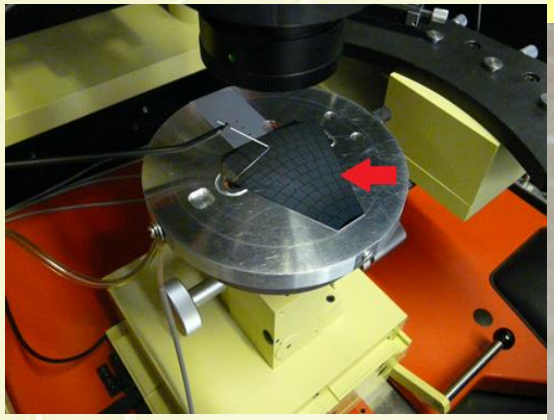
Status Summary

FCAL Deliveries

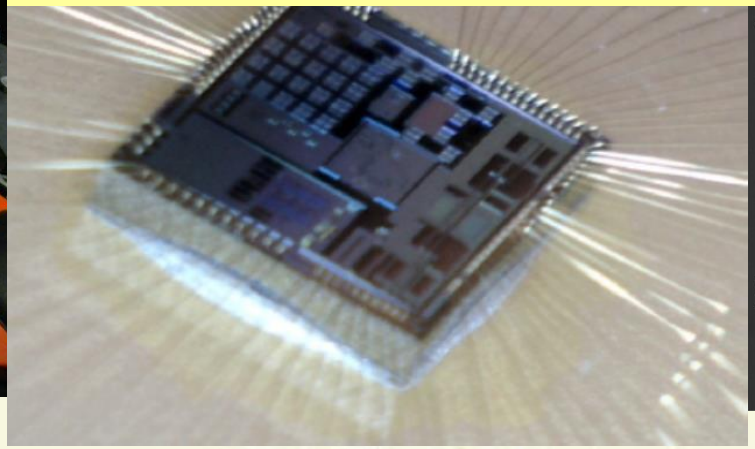
- Designs of the very forward region for ILC and CLIC detectors
- Design of a Luminometer for precise luminosity measurement
- Feasibility of fast luminosity measurement, beam parameter determination and electron tagging with BeamCal and Pair Monitor
- Successful development of sensors and dedicated ASICs (350 nm)
- Successful prototyping and test of major components in the beam
- Preparation of a part of the ILC detector DBD

Dedicated Sensors and ASICs

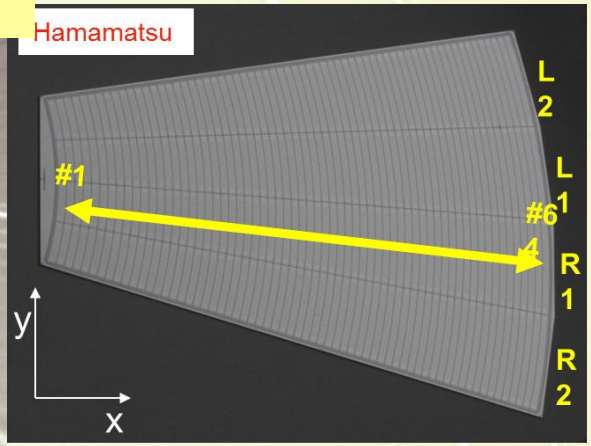
BeamCal: Compensated GaAs

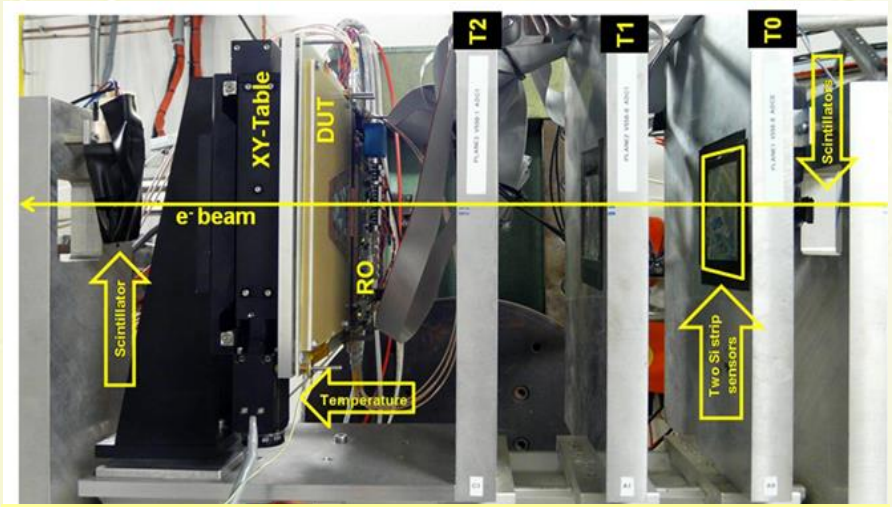


Front-end ASICs and ADCs in 130 nm technology, separate channel for fast feedback



LumiCal: p in n Silic0n



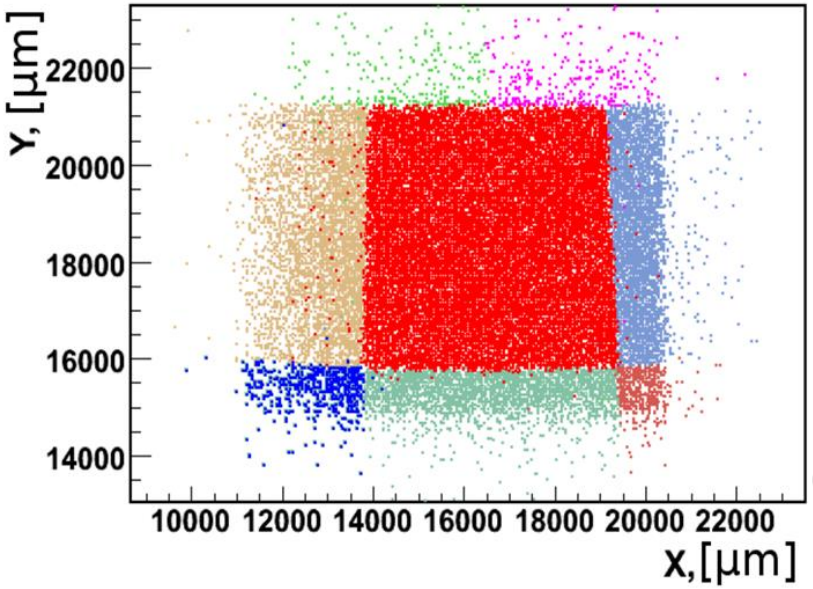


Testbeam setup at DESY II electron beam

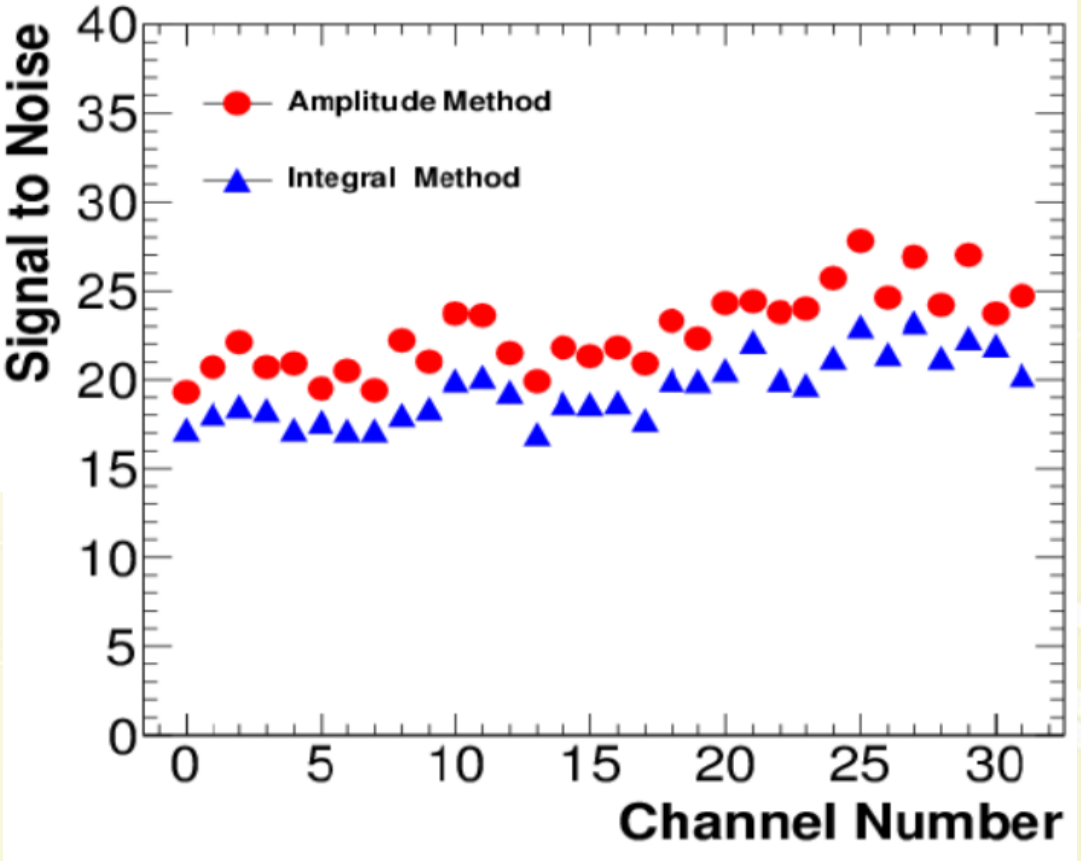
Fully assembled sensor plane, ready for testbeam studies

Example Results

Hit distribution predicted by the telescope and readout from the pads



Measurement of S/N for several pads

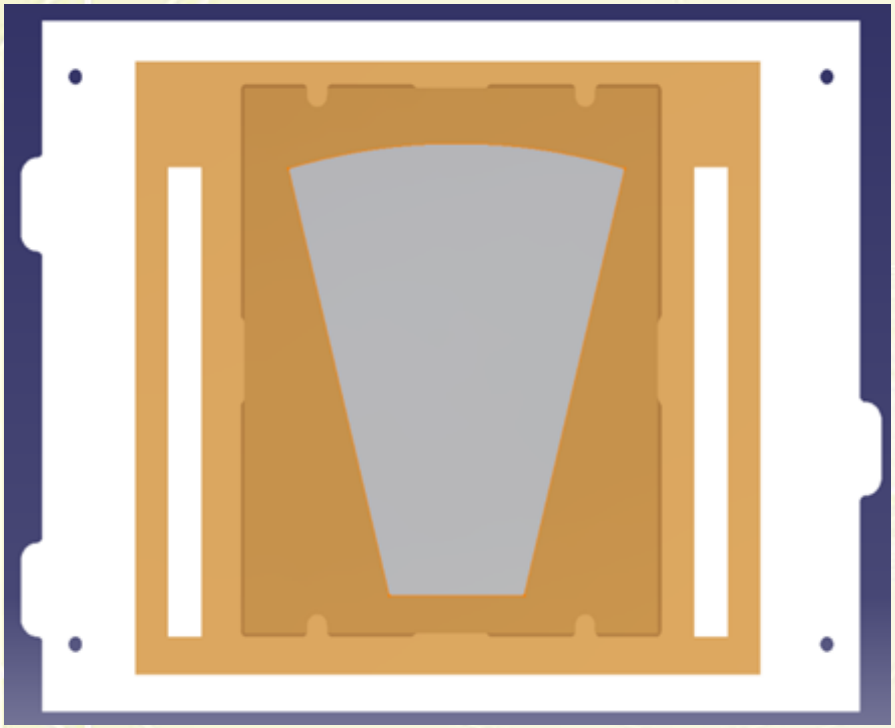


Future Scientific goals

- Construction of a highly compact calorimeter
  - novel connectivity technology (e.g. bump bonding, thin fan-out PCB)
- Construction of a demonstrator calorimeter
  - completion of the mechanical structure (+laser alignment)
  - production of sufficient ASICs in 130 nm technology
  - demonstration of power pulsing
  - readout board with data concentrator and data transfer
- Beam tests
  - Energy resolution (luminosity spectrum)
  - spatial resolution (angular spectrum)
  - bias in the angular measurements (systematic uncertainty)

Sensor Planes & Connectivity Scheme

Thin sensor planes



Available:

- More than 30 silicon sensors
- More than 30 GaAs sensors

Done so far:

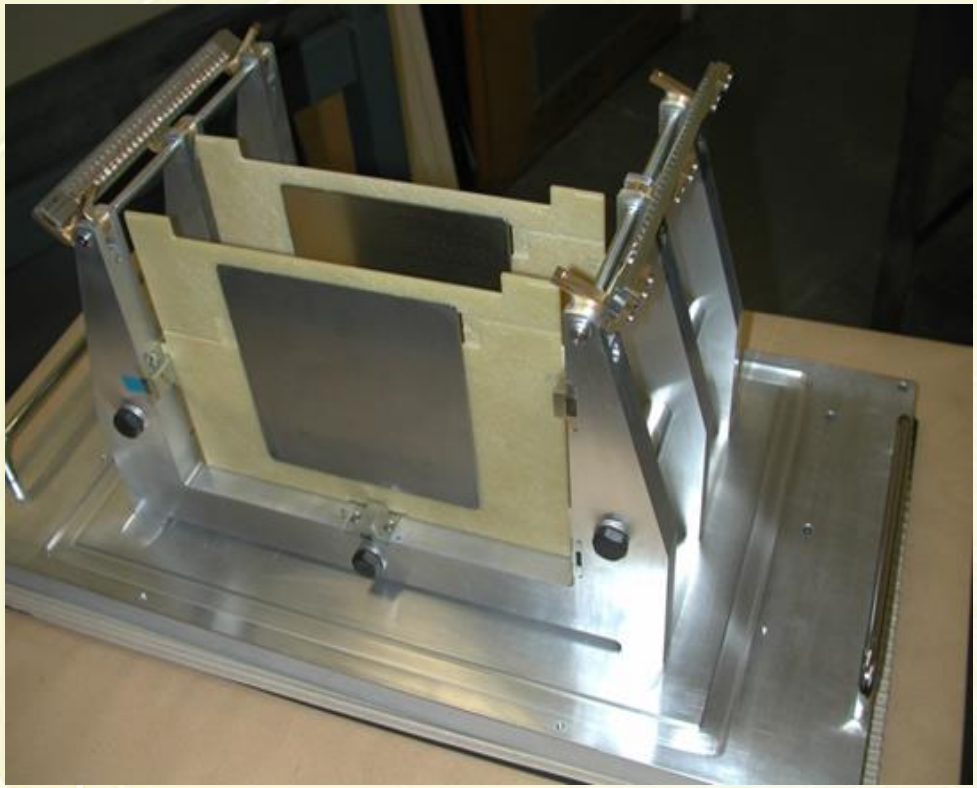
- PCB fanout (1 mm)
- Wire bonding

Needed:

- Thin fan-out (50 – 100 μm)
- Bump bonding

Completion of the Mechanical Structure

Mechanical frame



High Precision Tungsten absorber planes

Status:

- 10 pieces available
- 5 match specification
- 35 needed

For position measurement and position monitoring a laser system is foreseen (semi-transparent Si sensors and FSI)

ASICs

Electronics: New FE and ADC ASICs in

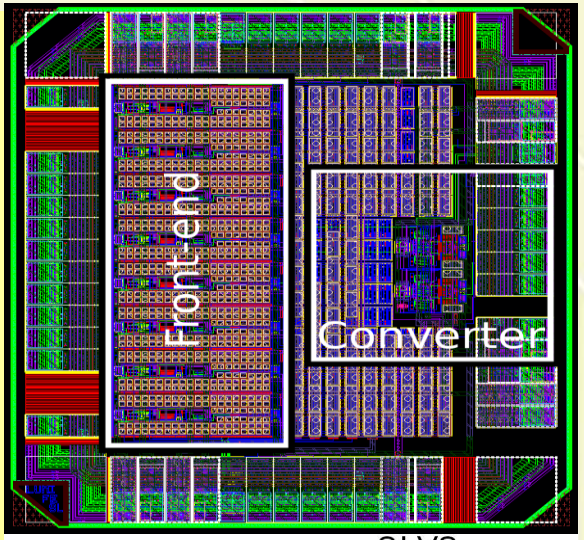
130 nm IBM technology

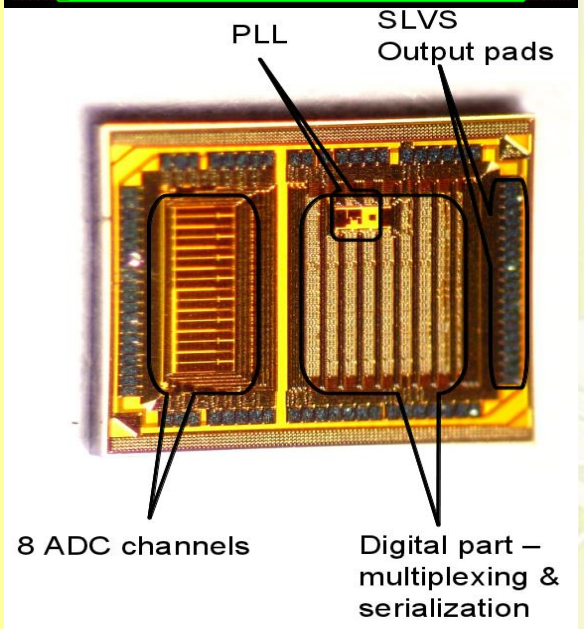
FE ASIC (submitted Feb. 2013)

- 8 channels per chip
- FE t_{peak} = 50 ns, dual gain
- 1.5 mW/channel, power pulsing

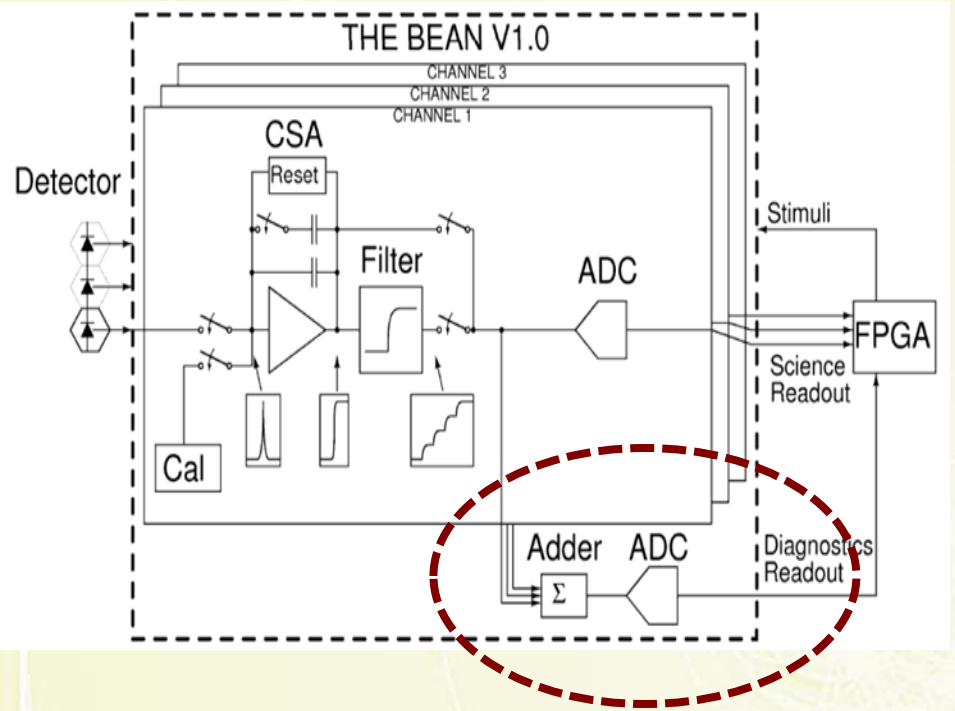
10 bit SAR ADC

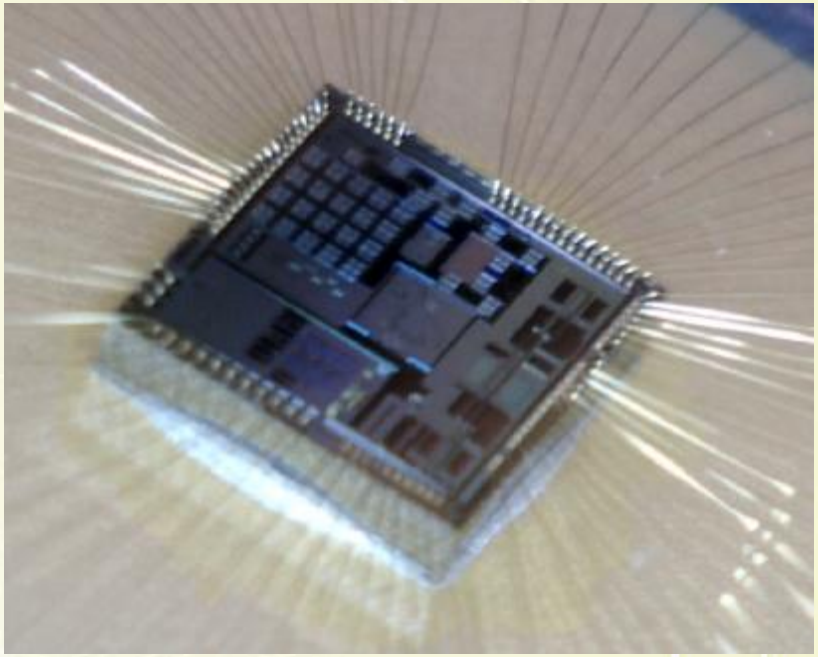
- 8 channels per chip
- scalable frequency (up to 50 Ms/s)
- 1-2 mW at 40 MS/s, power pulsing
- PLL for data serialization
- high speed SLVS interface
- first prototypes 2012
- second submission Feb. 2014





Dedicated BeamCal Readout





- 180 nm TSMC technology
- Currenly noise analysis to optimise the FE part
- 10 bit SAR ADC under test
- Single channel prototype in September 2013
- Assembled sensor planes for beam tests after 2015

Not part of Horizoon 2020, but for a dedicated readout board !!

Demonstrator Calorimeter

- Thin sensor planes
- Miniaturisation of the readout board
  - 32 (64) channel ASIC,
  - combining current FE and ADC ASICs
  - power pulsing
- Data Concentrator and data acquisition
  - zero suppression,
  - high speed data transfer,
  - preprocessing

Beam test results will be imperative to a detector TDR !!!