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High Granularity Semi-Digital Hadronic Calorimeter Using GRPCs

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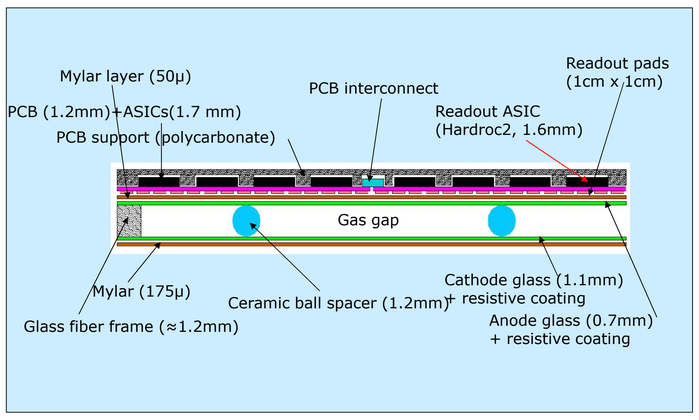
High granularity HCAL at ILC

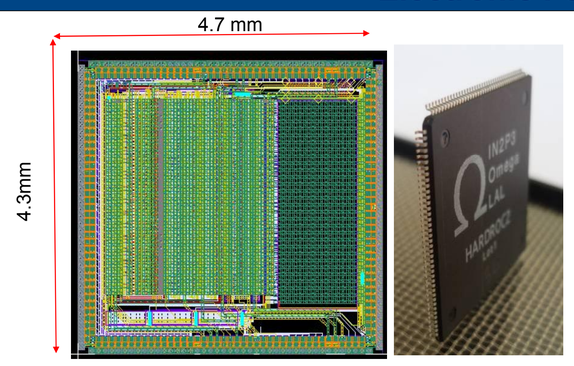
A Semi-Digital Hadronic Calorimeter using Glass Resistive Plate Chambers (GRPCs) is one of the calorimeters candidates proposed for particle physics experiments at the future electrons collider. It is a high granular calorimeter which is required for application of the particle flow algorithm in order to improve the jet energy resolution as one of the main goals.

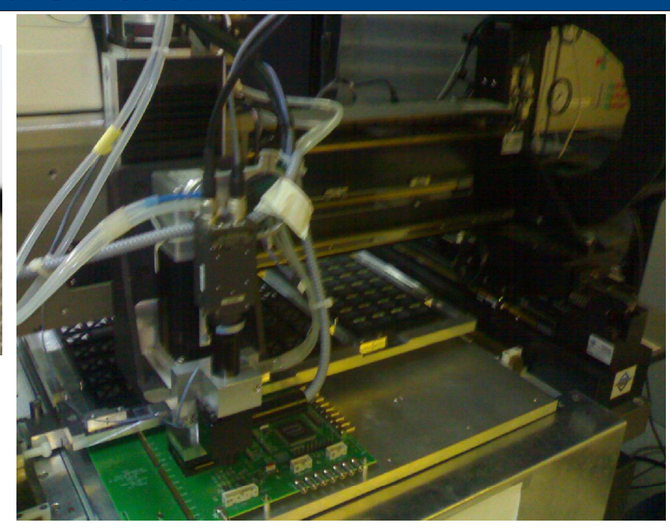
The Glass Resistive Plate Chamber



- Resistive material coatings:Graphite / Licron / Statguard
- Glass plate: Borosilicate. (Cathode 1.1 mm / Anode 0.7 mm)
- Gas mixture :TFE :93.5 % CO2 : 5 % SF6 : 2 %
- Gas distribution: Capillary tubes drives channeled inlets.
- Spacers: 1.2 mm ceramic balls + a few 8mm diam. disk.

Electronic For GRPCs SDHCAL

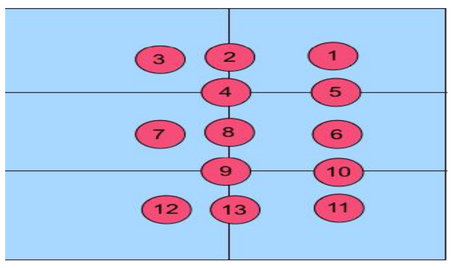


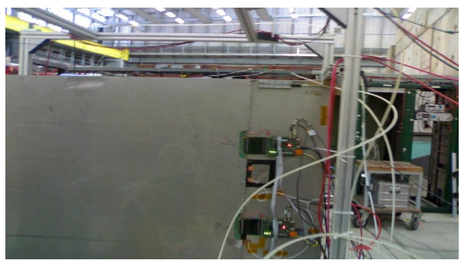


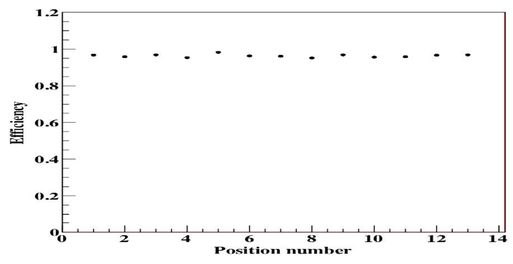
ASICs : HARDROC2
One ASIC manage 8x8 (64channels)
1cm² sensitive PADs.
Triggerless mode
Memory depth : 127 events
Semi-digital ASICs: 3 thresholds
Range: 10 fC-30pC
Power-pulsed→consumption< 10µW/ch

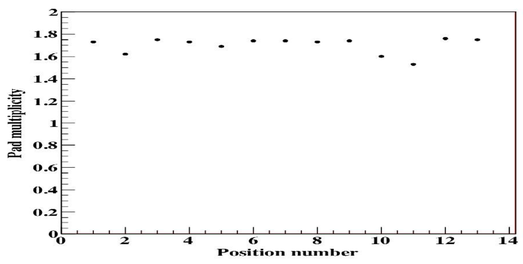
Electonics: ASICs stand test:
A robot was used to test the 10500 ASICs
The procedure allows to select the good ASICs and calibrate them Yield 93%

The Homogeneity Study of The GRPC



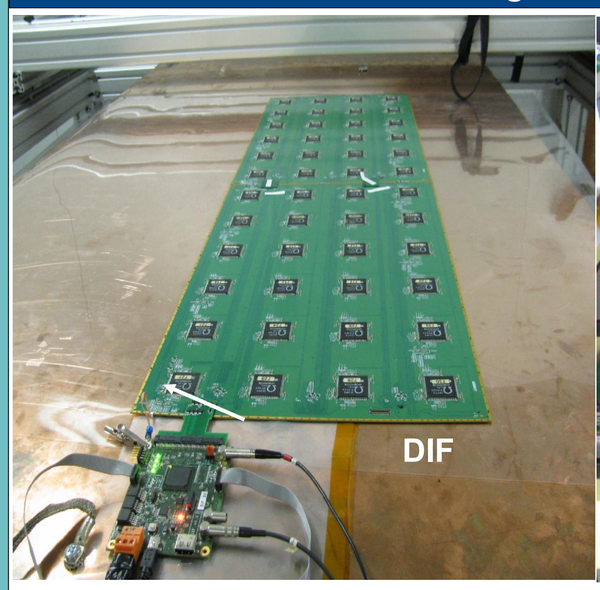


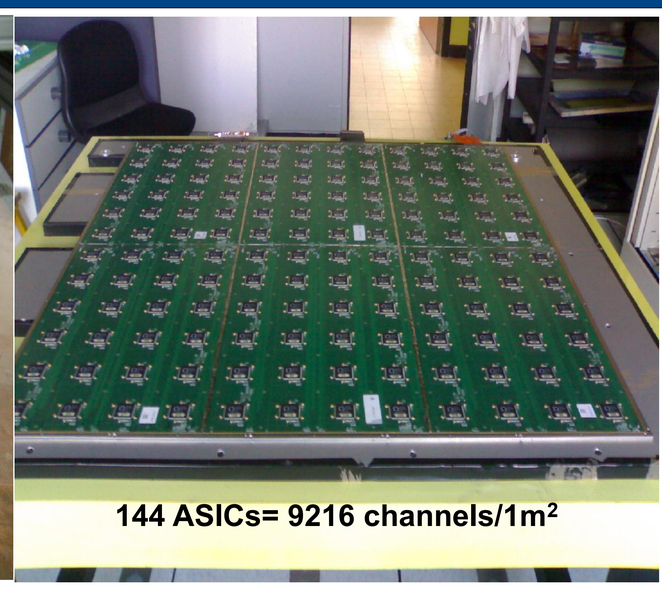




The homogeneity of the detector and its readout electronics were studied.

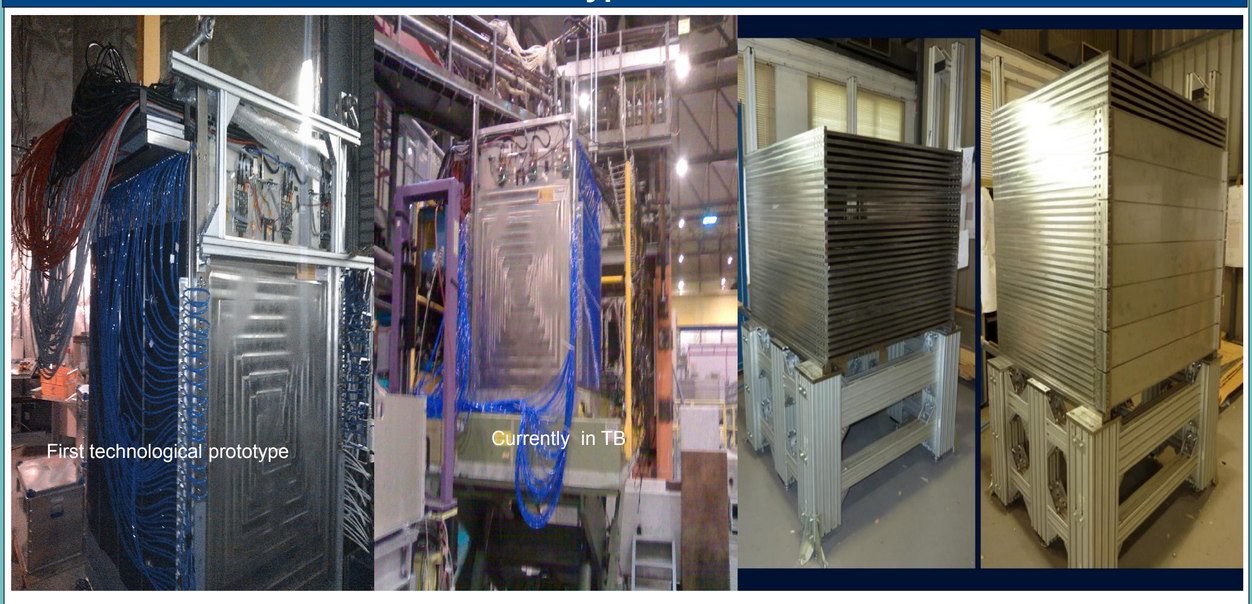
Large Electronics





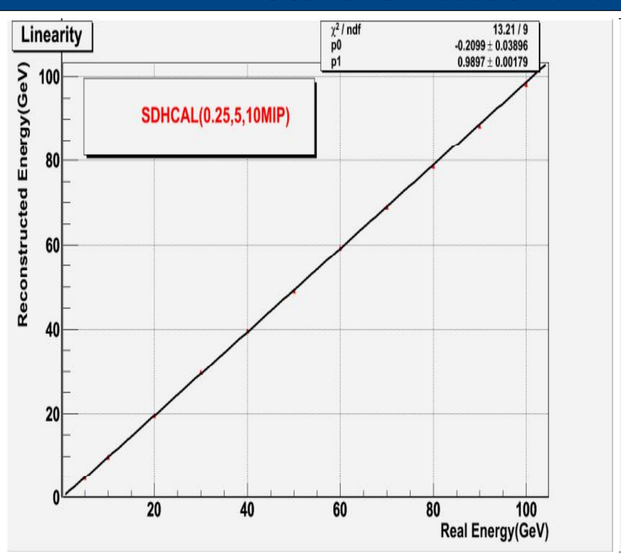
DIF: FPGA-based DAQ talking through USB with Xdaq

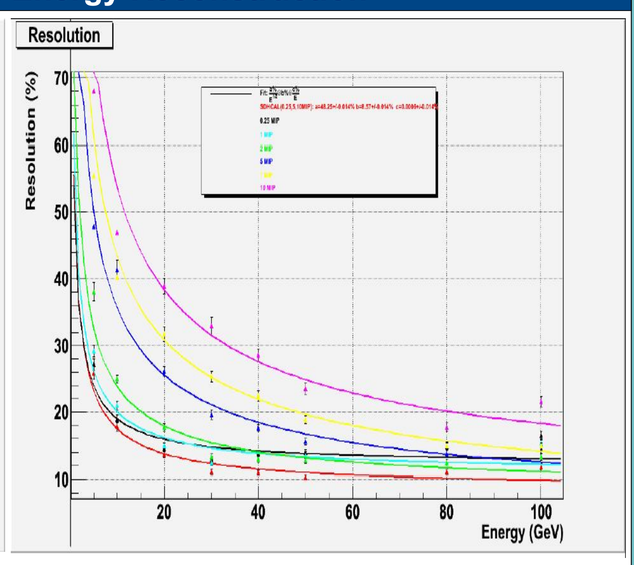
The SDHCAL Prototype- Mecanical Structure



Construction of the SDHCAL prototype 460800 electronics channels And self-supporting mechanical structure 50 units (>6 λ_I) working with power-pulsing

Geant4 Simulation and Energy Reconstruction





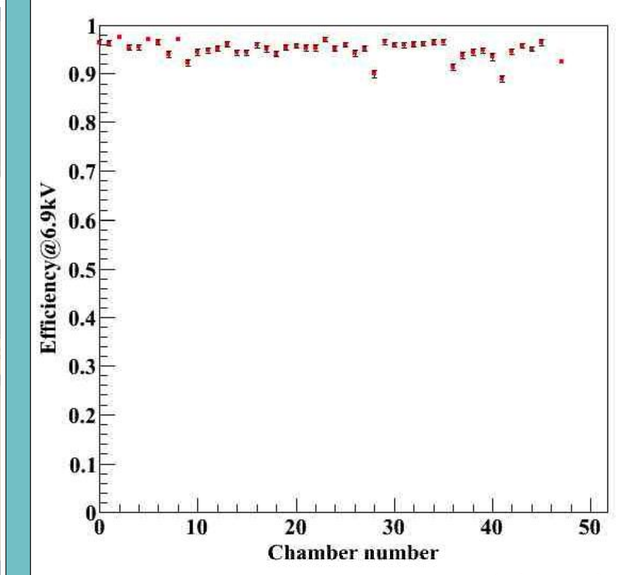
Reconstructed Energy:

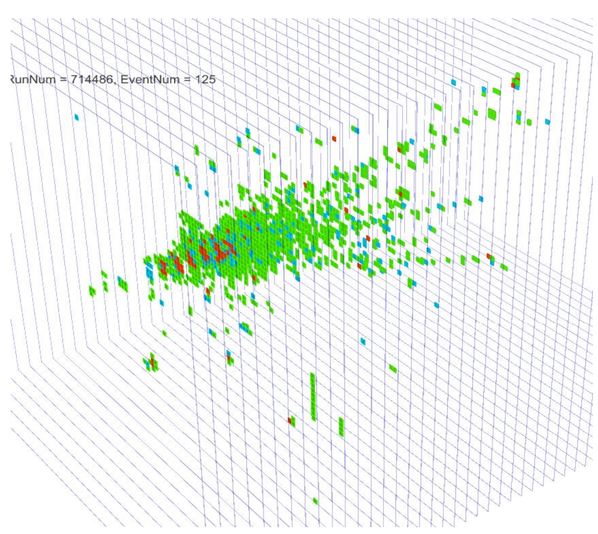
$$E_{rec} = (a \times N_{S1} + b \times N_{S2} + c \times N_{S3})$$

a, b, c depend of the energy

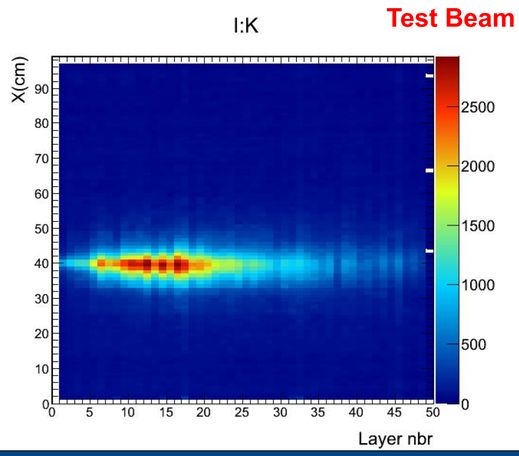
$$\chi^2 = \frac{1}{N} \times \sum_{i=1}^{N} \frac{(E_{beam} - (a \times N_{S1} + b \times N_{S2} + c \times N_{S3}))^2}{\sigma^2}$$

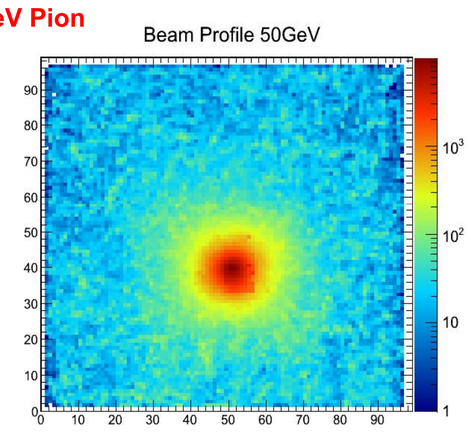
TestBeam Cern SPS May 2012





Test Beam Data 50 GeV Pion





Shower Profile Comparison with Monte Carlo simulation 50 GeV Pion