2nd KIT-SJTU Workshop
Particle and Astroparticle Physics

Status of Semi-digital Hadron Calorimeter based on RPC

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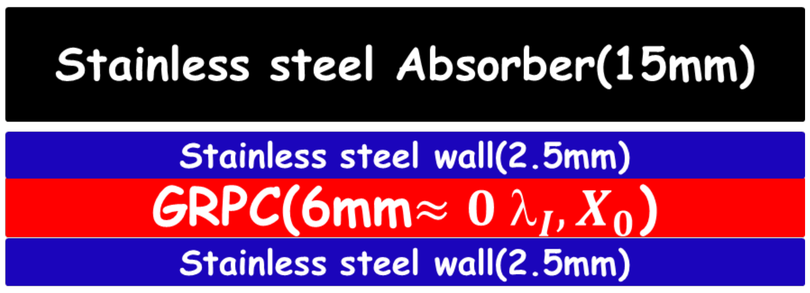
● Introduction

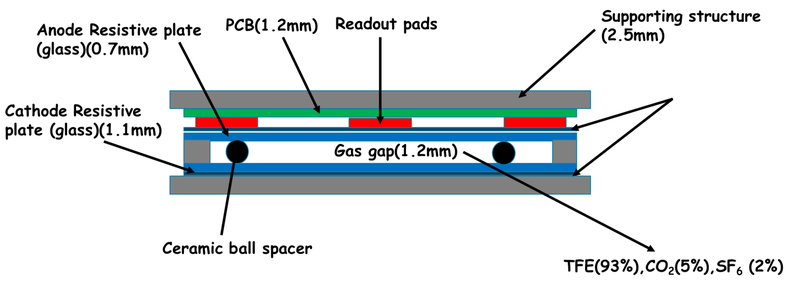
The Semi-digital Hadron Calorimeter (SDHCAL) is the first technological prototype among a family of prototypes of high-granularity calorimeters developed by the CALICE collaboration. The SDHCAL was designed for two targets. The first is to confirm that highly-granular gaseous hadronic calorimeter are capable of measuring hadronic energy with good resolution while providing an excellent tracking tool for Particle Flow Algorithms(PFA). The second target is to indicate that such calorimeter are compatible with the requirements of the future International Linear Collider (ILC) and future Circular Electron Positron Collider(CEPC) detectors including efficiency, compactness and power consumption.

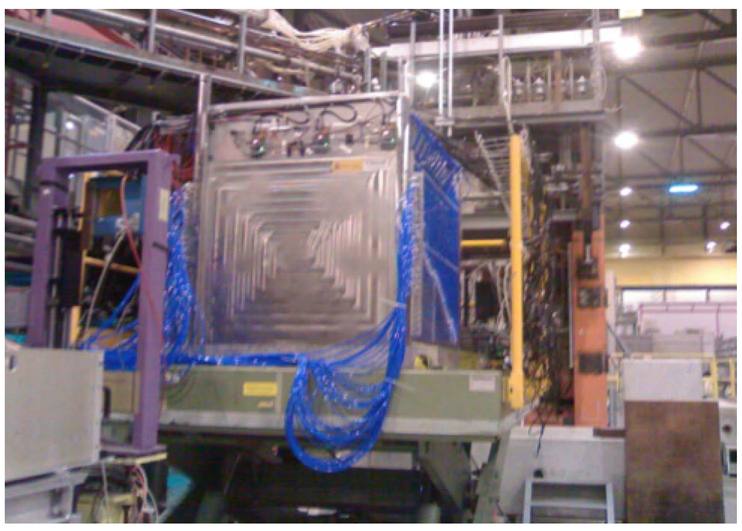
● Prototype description

The SDHCAL is a sampling hadronic calorimeter including 48 layers. Per layer comprises active layer and stainless steel absorber. Each of active layers is manufactured by 1m x 1m GRPC. The GRPC has segmented 9216 readout pads, with 1cm x 1cm size. The pads are located on one face of an electronics board which hosts 144 HARDROC ASICs providing a three-threshold readout on the other side. The active layer is put inside a cassette inserted into a so-called self-supporting mechanical structure.

$(0.12\lambda_I, 1.14X_0)$

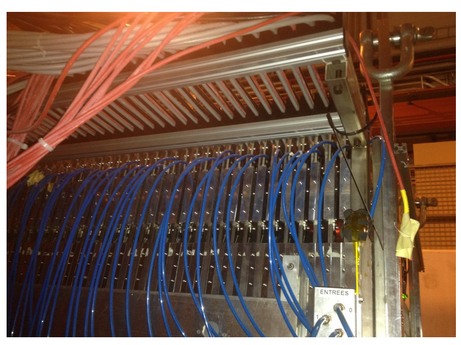






● CERN SPS beam test

The SDHCAL was exposed to pions, muons and electrons in the SPS of CERN in2012, 2015,2016.



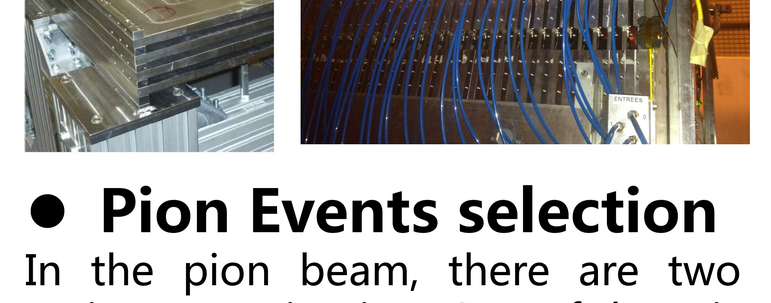
● Pion Events selection

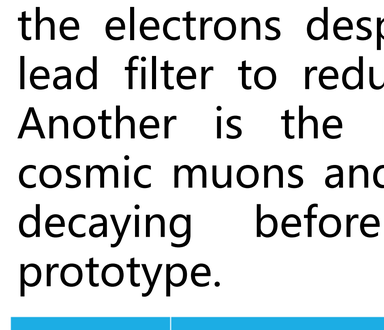
In the pion beam, there are two main contamination. One of them is the electrons despite the use of a lead filter to reduce their number. Another is the muons including cosmic muons and muons of pions decaying before reaching the prototype.

Selections	Detail
Electron rejection	Shower start >=5 or Nlayer > 30
Muon rejection	Nhit/Nlayer > 3.2
Radiative muon rejection	Nlayer(RMS > 5cm)/Nlayer>20%
Neutral rejection	Nhit(belong to first 5 layers)> =4

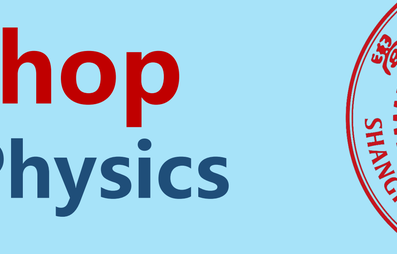
Nhit is the total number of hits

Nlayer is the number of fired layers





When looking at each event you can see if in this event at last 4 layers are fired If no this means that the shower is fully contained in the prototype and tag the event Y



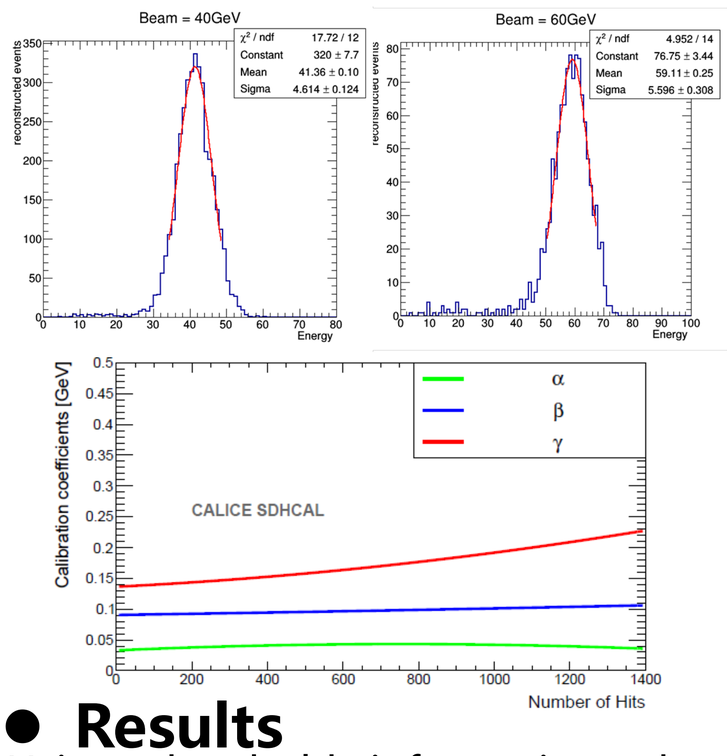
If yes that means that the shower is not fully contained and you can tag this kind of events as N

● Energy reconstruction

$$E_{reco} = \alpha Nhit_1 + \beta Nit_2 + \gamma Nhit_3$$

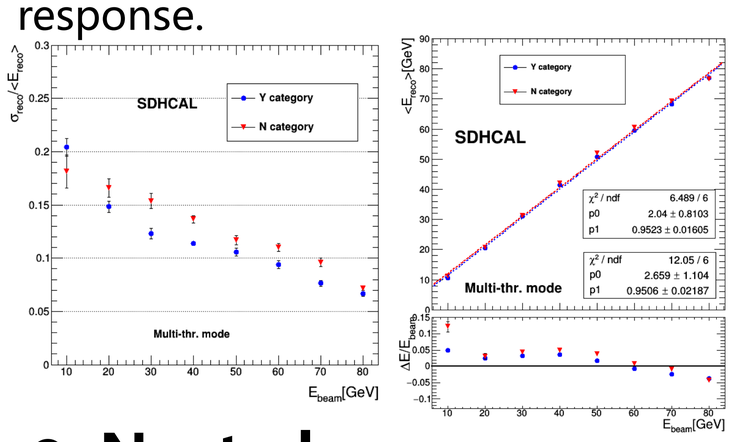
$$\alpha = \alpha_1 + \alpha_2 N_{total} + \alpha_3 N_{total}^2$$
$$\beta = \beta_1 + \beta_2 N_{total} + \beta_3 N_{total}^2$$
$$\gamma = \gamma_1 + \gamma_2 N_{total} + \gamma_3 N_{total}^2$$

$$\chi^2 = \sum_{i=1}^{N} \frac{(E_{beam}^i - E_{reco}^i)^2}{\sigma_i^2}$$



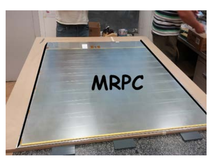
● Results

Using threshold information, the energy resolution reaches a encouraging value 7.2% at 80GeV without using any electronics gain correction to improve the homogeneity of the detector response.



● Next plan

- Studying MVA method in particle identification
- Studying MRPC option
- SiECAL+SDHCAL at CERN



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