RECONSTRUCTION, ANALYSIS & SIMULATION SOFTWARE FOR MICROMEGAS DHCAL PROTOTYPES

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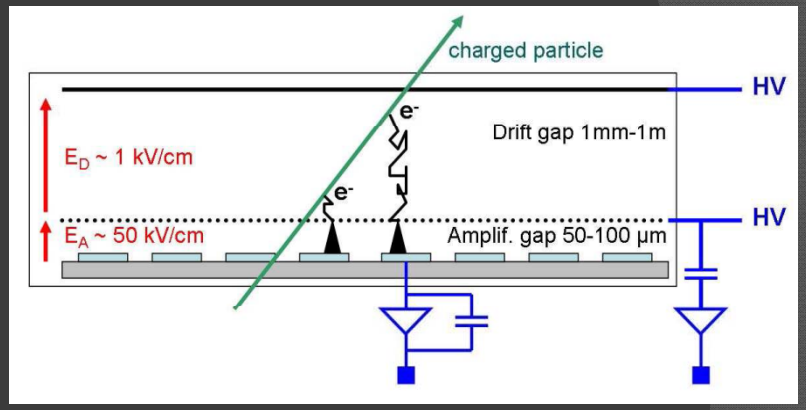
Introduction

- Motivations for a Digital hadronic calorimeter
  - Count hits instead of measuring energy deposits
  - Reduce cost with still good enough energy resolution
    - Scintillator
    - Gas (GEMs, RPC, Micromegas)

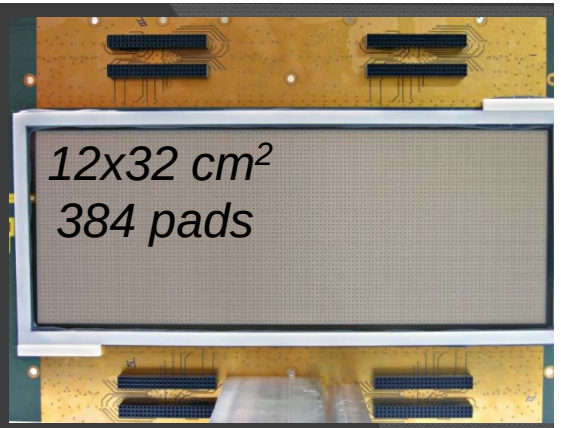


- Micromegas
  - Available in large areas
    called Bulk Micromegas, e.g. 40 x 40 cm^2
  - Very short recovery time (100-200 ns)
  - Narrow charge distribution (σt ~ 10-20 µm)
  - Gas gain of10^4-10^5 depending on gas mixture

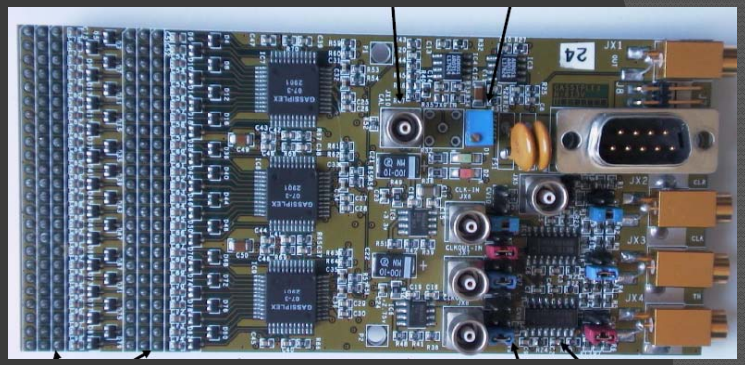
- Micromegas DHCAL with 3 mm drift gap in Ar-based mixture

  Low hit multiplicity and high efficiency
  Crucial for separating showers (PFA) and measuring the energy

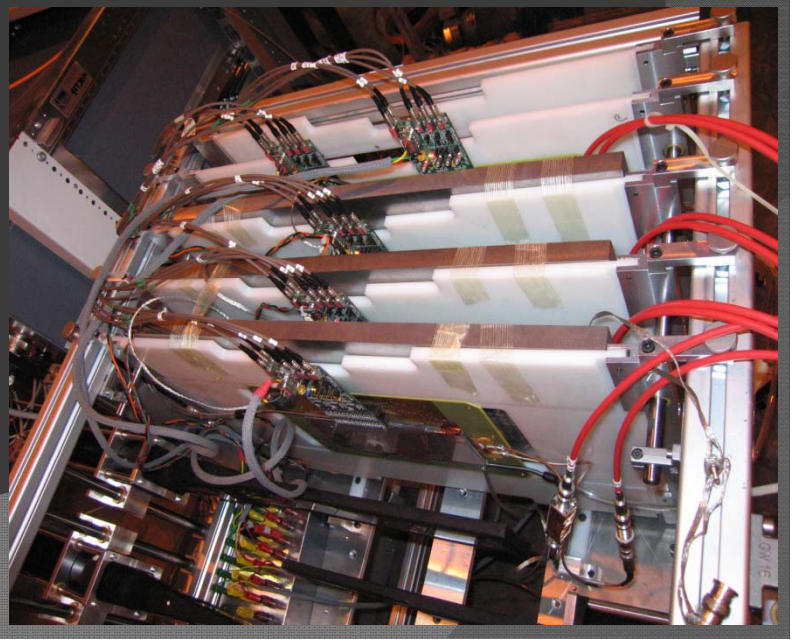
Detectors with analog readout (I)



- Prototypes fabricated at LAPP
  - 3 mm drift gap, 1 cm^2 pads , 6x12 cm^2 to 8x32 cm^2 area
  - With analog or digital readout
  - Short term plan (this year): 1 m^2 prototype
  - Long term plan: 1 m^3 prototype



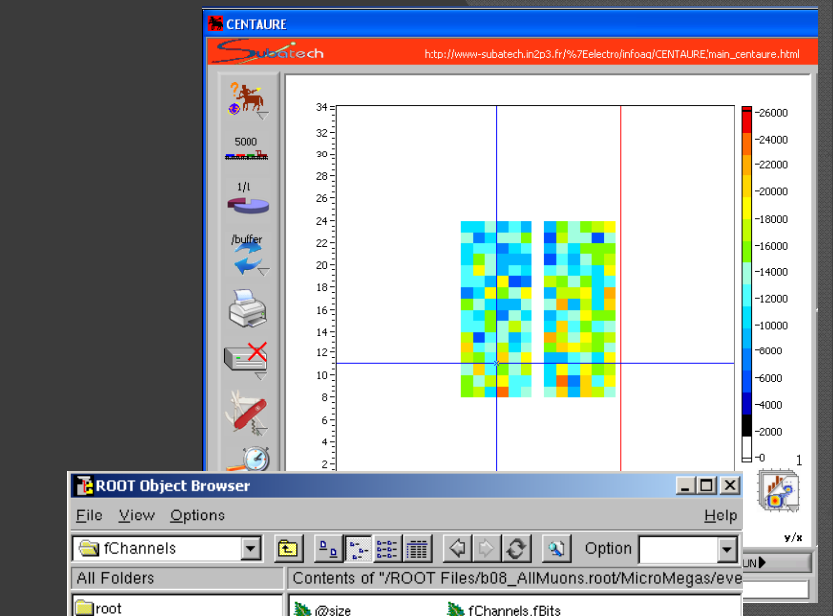
- Analog readout prototypes
  - 6x16 cm^2 and 12x32 cm^2 active areas
  - 96 and 384 readout channels

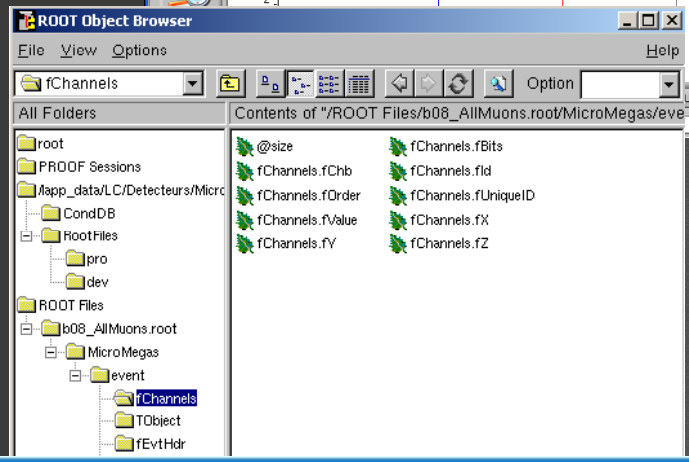


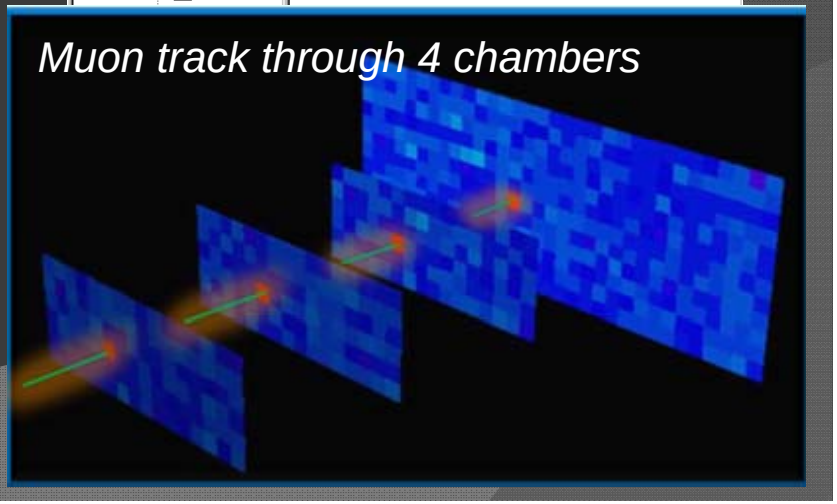
- Gassiplex chips
  - 16 channels with preamplifier and shaper
  - 6 chips per Gassiplex card
  - Multiplexed-signal directed to VME modules for digitization

Detector with analog readout (II)

- Data acquisition
  - CENTAURE program
    - Read VME or CAMAC modules
    - Developed by D. Roy at SUBATECH/Nantes
    - Binary files
  - Home-made C++ programs
    - Data storage
      - TTrees and Root files
    - Analysis
      - Event display
      - Signal distribution
      - Efficiency
      - Multiplicity
- Beam test in Aug. & Nov. 08 at CERN
  - Analysis on-going

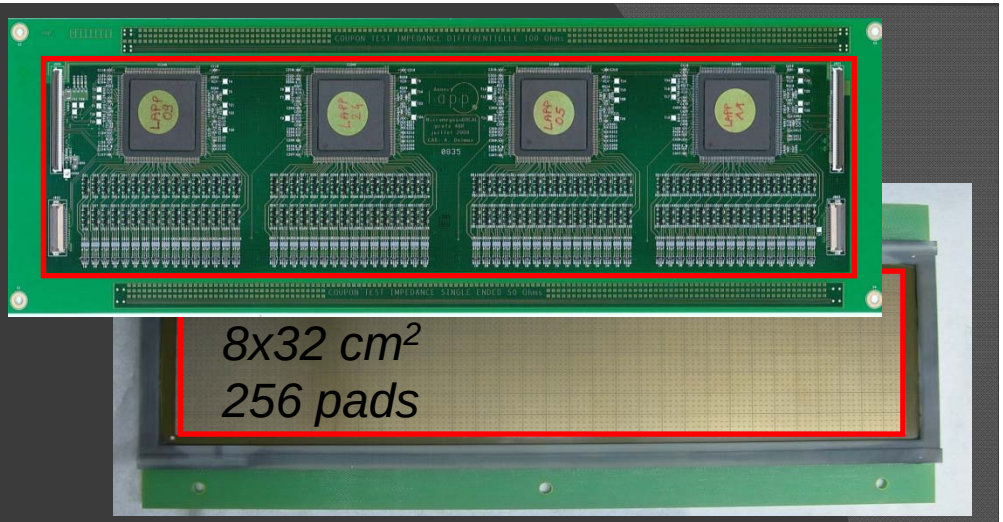


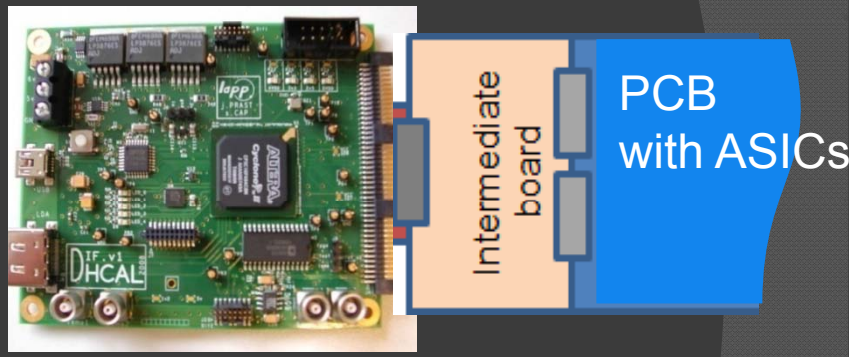


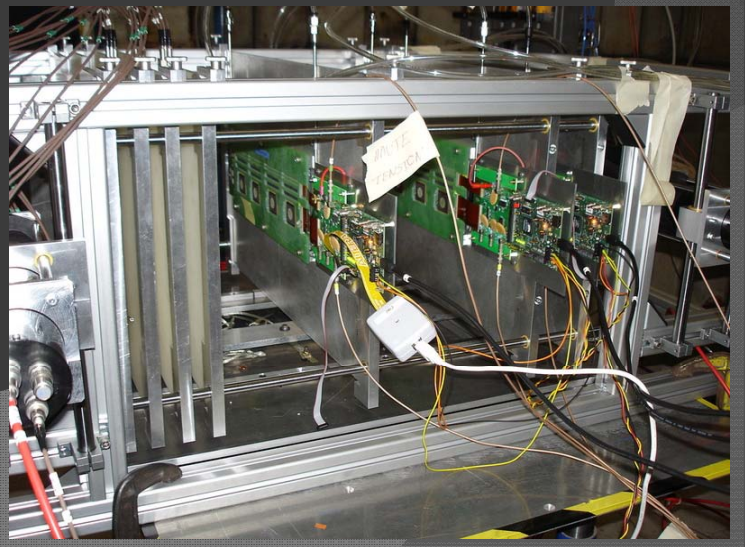


Detector with digital readout

- Detectors
  - HARDROC or DIRAC chips embedded in the PCB
  - 8x32 cm^2 and 8x8 cm^2 realized so far
- Chip/PC interface: DIF board
  - Separated from the SLAB
  - For large number of ASICs HARDROC, DIRAC and also SPIROC and SKYROC
- Software: CrossDaq
- Beam test in Nov. 08 at CERN
  - Not much time for preparation
  - HV stability issues
  - Data analysis not started yet

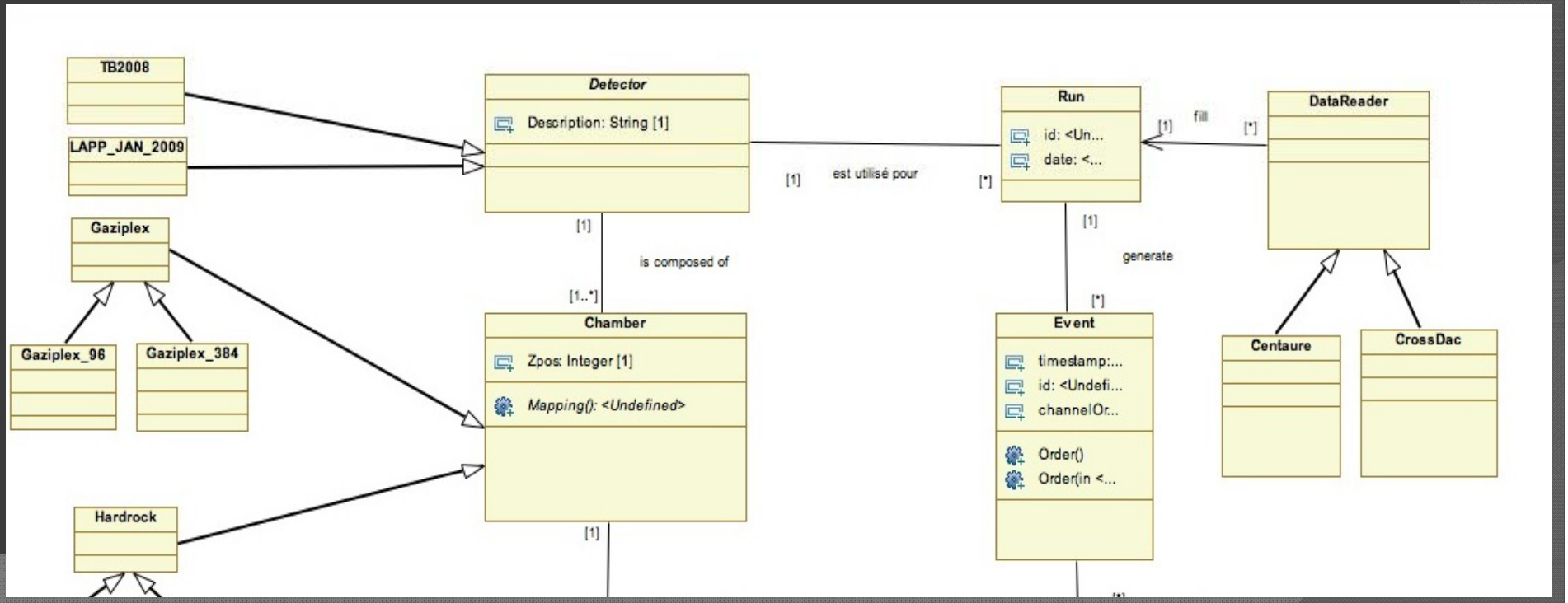






Common software for analog/digital readout

- Different detectors, data format and DAQ: need flexibility
- New Object Oriented program almost ready for use
  - Event reconstruction of any Run
    - Different chambers and initialization files for the DAQ softwares (Centaure, CrossDaq)
    - Allows for any combination of chambers
    - Run description contained in an XML file
  - Will also provide tools for data analysis



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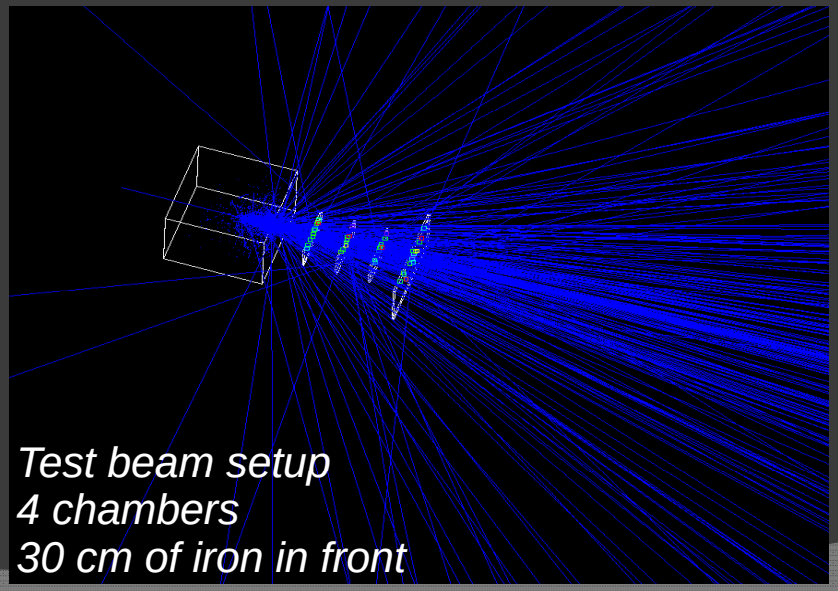
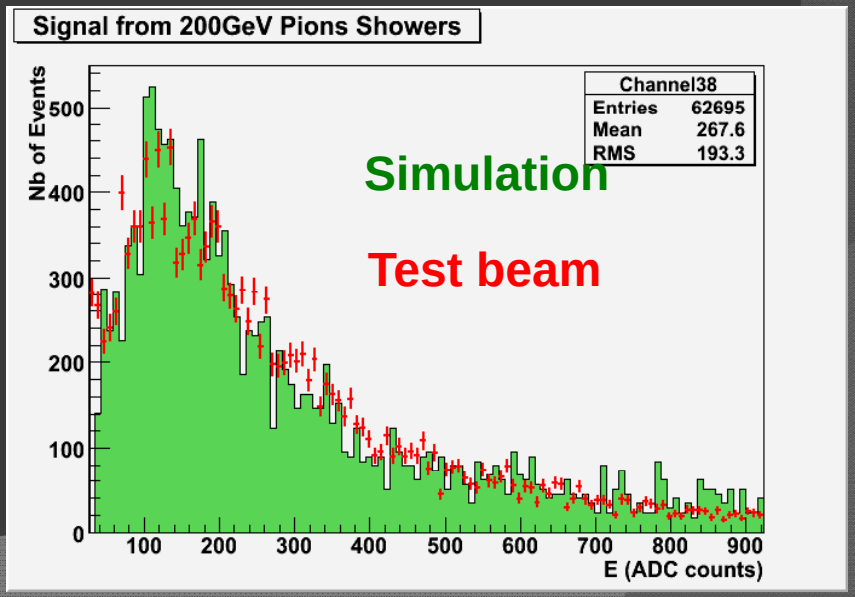
```
<micromegas>

 <run name="run02"/>
 <info date="020109"/>

 <input path="/lapp_data/LC/Detecteurs/MicroMegas/data/testbeam_1.acq" type="centaure"/>
 <input path="/lapp_data/LC/Detecteurs/MicroMegas/data/testbeam_2.acq" type="centaure"/>

 <output root="/lapp_data/LC/Detecteurs/MicroMegas/data/testbeam.root" />

 <detector name="TB2008" description = "Detector stack used for the CERN November 2008 test
     beam">
   <chamber type="GASSIPLEX384" zPos="20"/>
   <chamber type="GASSIPLEX96" zPos="50"/>
   <chamber type="HARDROCK1" zPos="60"/>
</detector>
</micromegas>
```

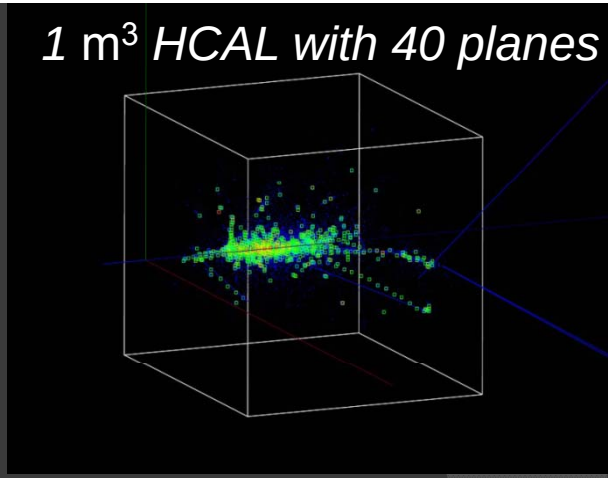
- Simulation tools:
  - SLIC full simulation of SiD concept (Geant 4)
  - Analysis done with Java Analysis Studio 3 (JAS3)

- Simulation of setup of 2008 beam tests
  - Comparison with real data
  - Better understanding of our detector
  - Preparation for next test beam



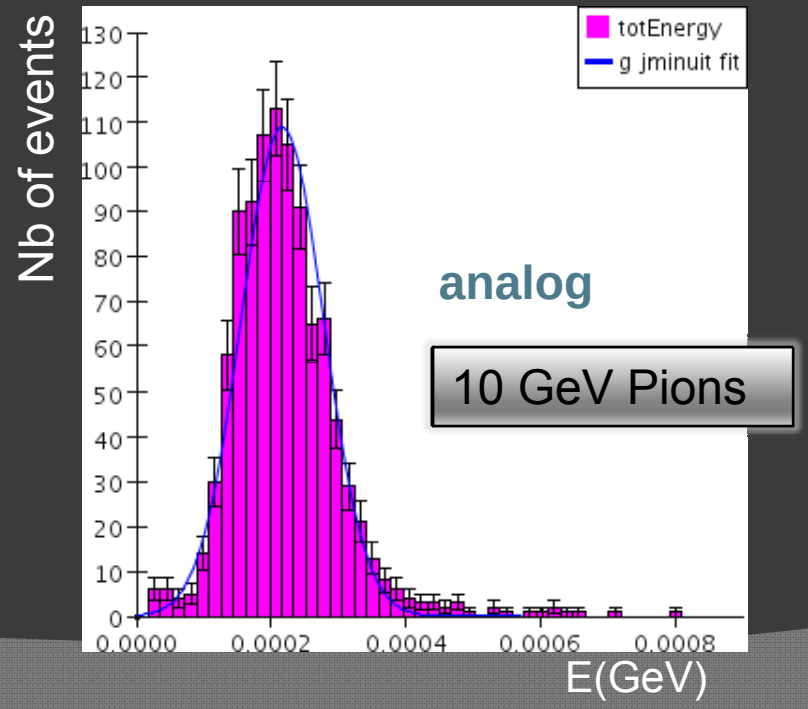
Test beam setup
4 chambers
30 cm of iron in front

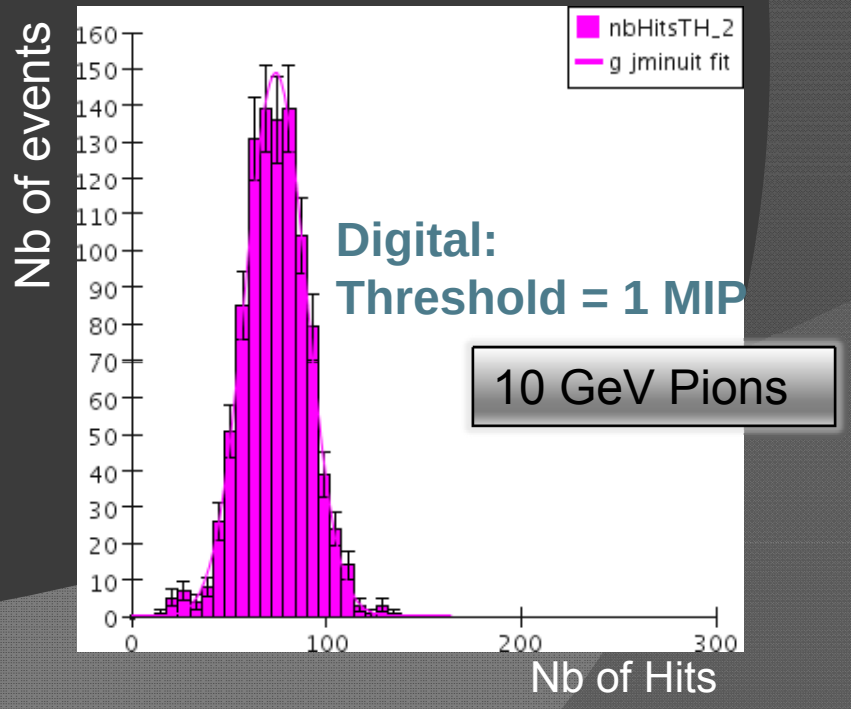




- DHCAL with Micromegas:
  - 1 m² prototype geometry implemented
    - Ideal Micromegas, digitization not yet implemented

- Look at the energy resolution of a 1 m³ calorimeter
  - Number of hits VS deposited energy for different gas thicknesses, N layers, absorbers
  - Digital/semi-digital: how many thresholds, at which values?





Thanks for your attention

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