SDHCAL software status

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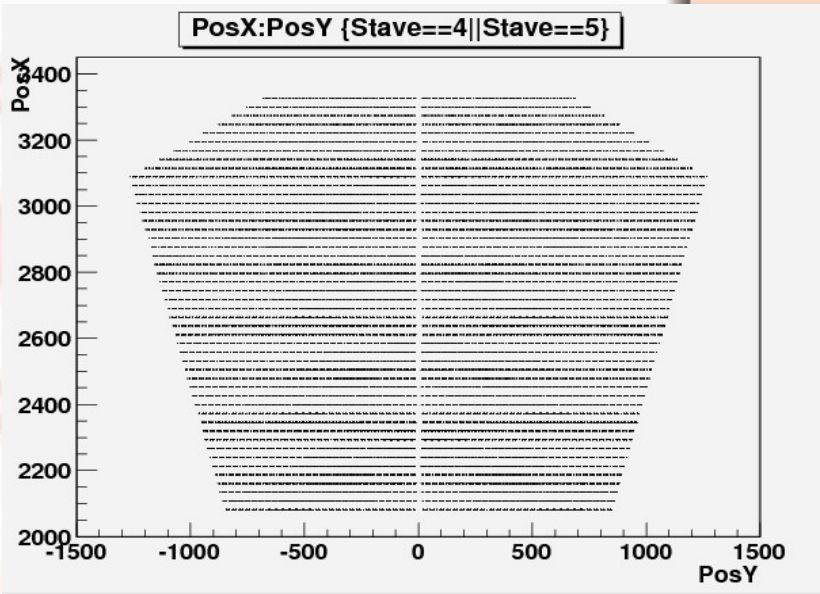
CALICE meeting, Heidelberg, September 15th 2011

Mokka simulation

Available in ilcsoft v01-11 :

- GRPC with detailed implementation
- GRPC sensitive detector with Videau barrel geometry or TESLA barrel geometry
- Easy to choose between geometries and options

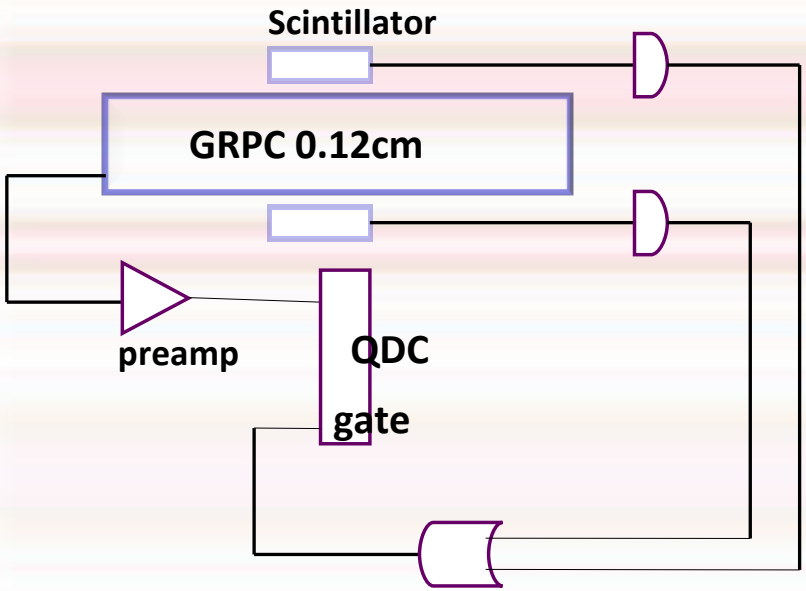


Added in more recent version :

- Detailed GRPC in Endcaps
- Ability to store GEANT4 steps in LCIO. (G. Musat)

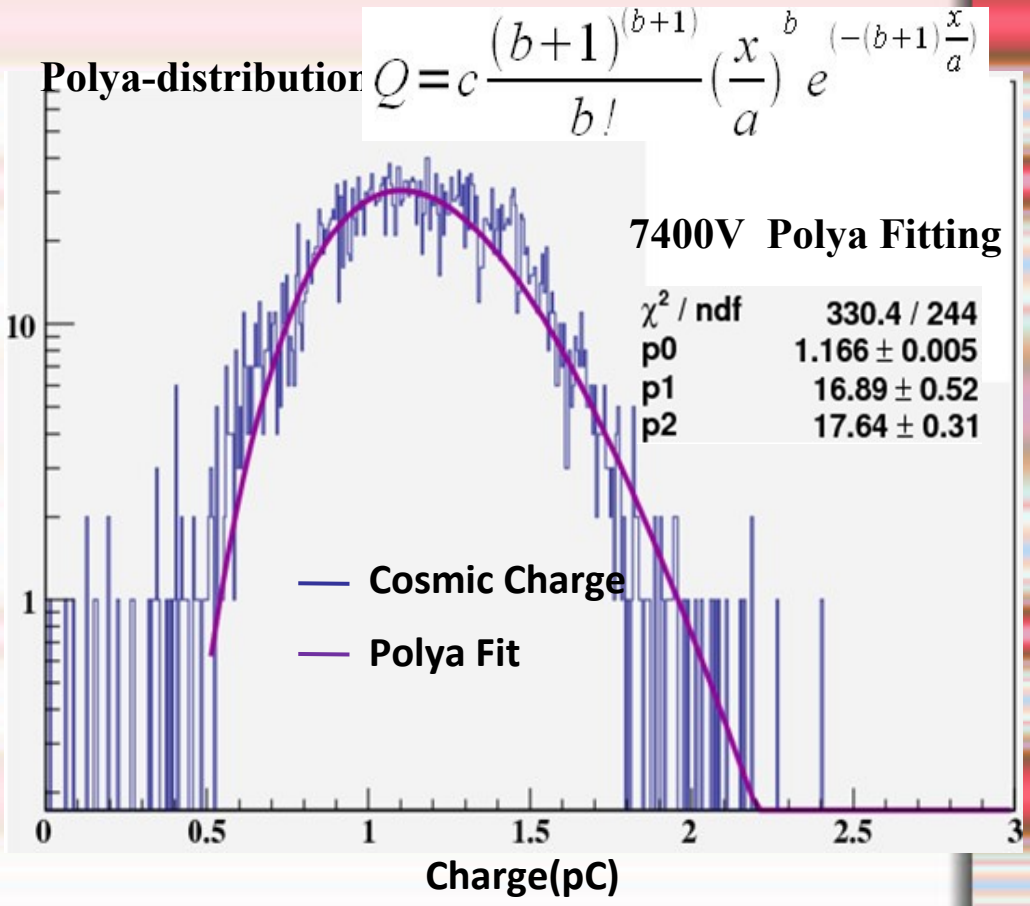
Digitisation

- Transform GEANT4 deposited energy to induced charge.
  - Measure GRPC Analog signal with cosmic muon



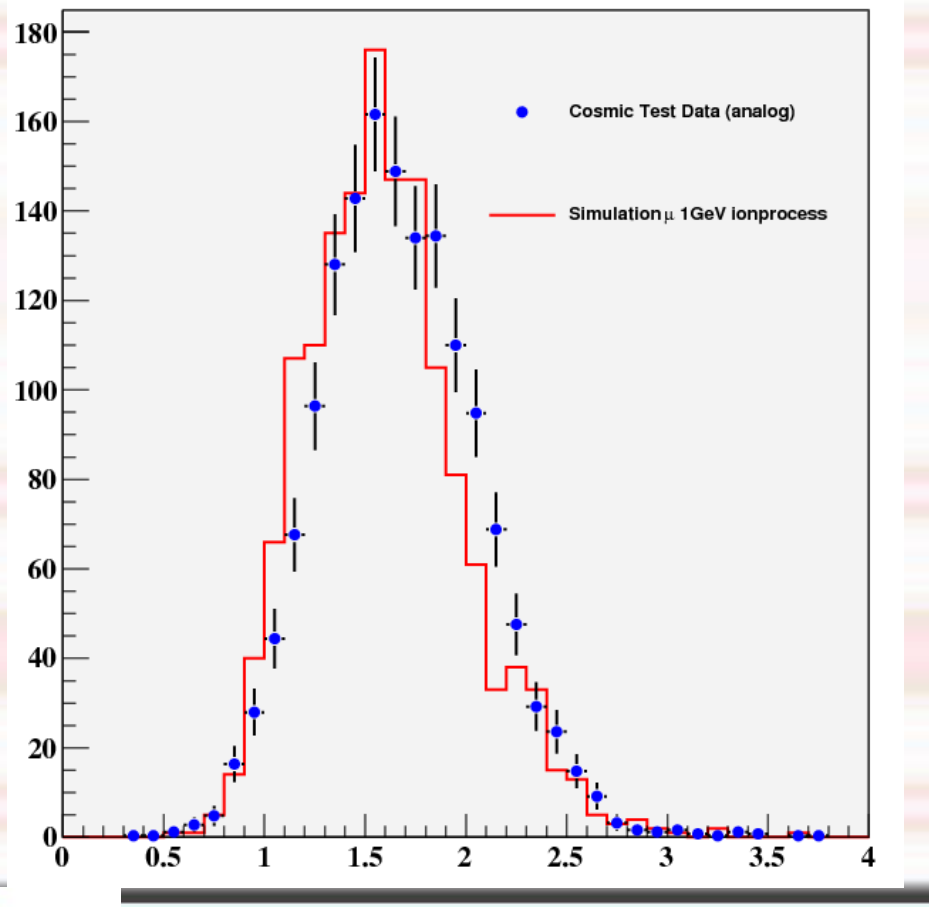
Charge Spectrum Cosmic Test Set Up
64 Channels, trigger area < Channel area
Analog readout

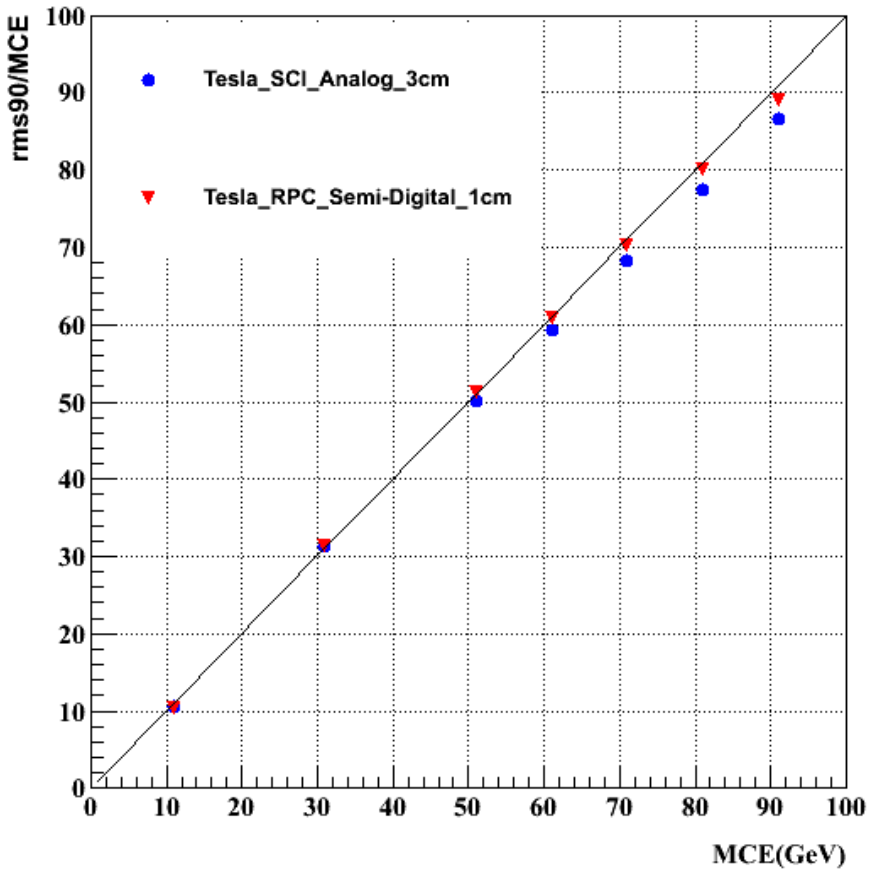
$$Q = c\frac{(b+1)^{(b+1)}}{b!}\left(\frac{x}{a}\right)^{b} e^{(-(b+1)\frac{x}{a})}$$



Digitisation

- Transform GEANT4 deposited energy to induced charge.
  - Measure GRPC Analog signal with cosmic muon
  - **Simulate it in Marlin Processor and compare with data**
  - The Marlin Processor can also simulate the 3 thresholds.
  - Calibrate the 3 Thresholds with single K^0_L and Pandora.
  - Pandora made compatible with Videau geometry.



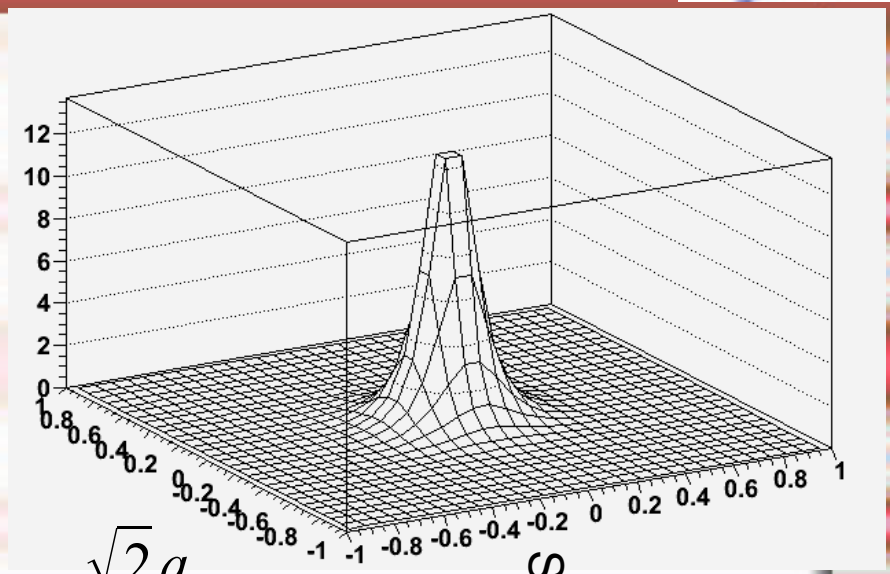


Multiplicity

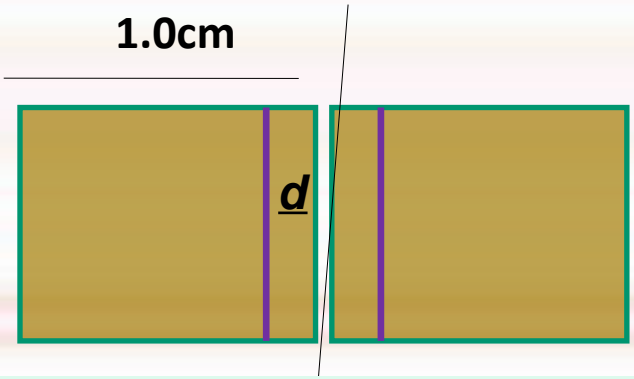
- **Spread of the induced charge**

KIRK T. MCDONALD's lecture

$$\sigma(x,y) = c\frac{-q}{2a}\frac{1}{\cosh\left(\pi\frac{\sqrt{(x-x_0)^2+(y-y_0)^2}}{a}\right)}$$



At low order, equivalent to a 2D gaussian with width $\frac{\sqrt{2}\,a}{\pi}$



Simplification

<--- 1cm --->

1/4	1/2	1/4
1/2	1	1/2
1/4	1/2	1/4

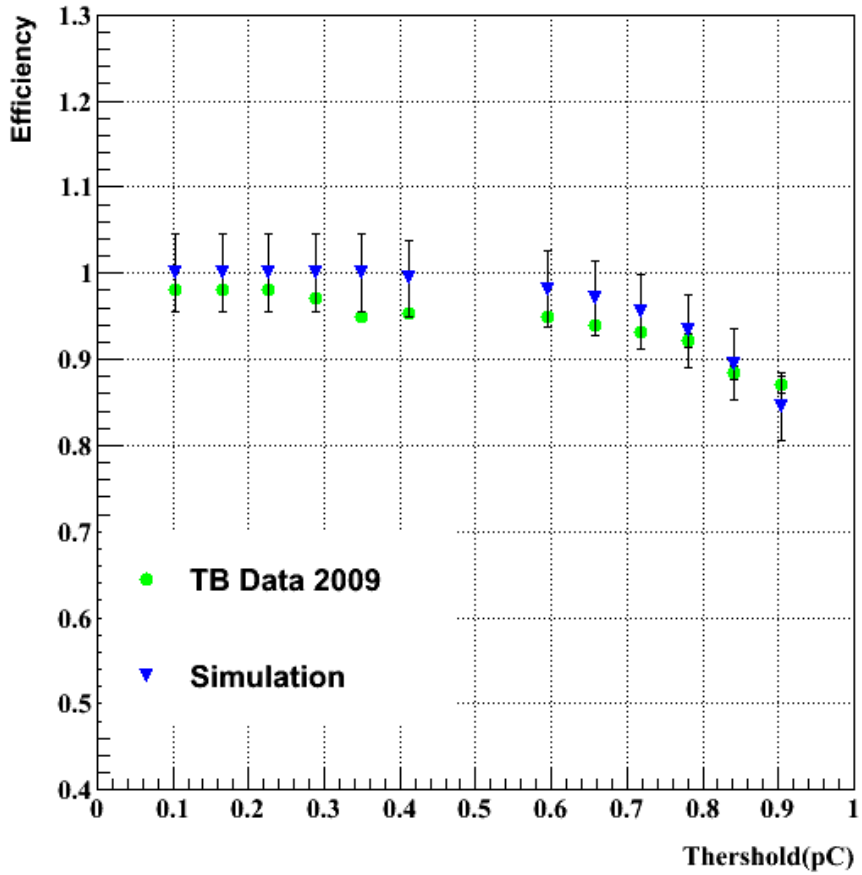
Dispatching induced charge on more than one cell for tracks on the cell border.

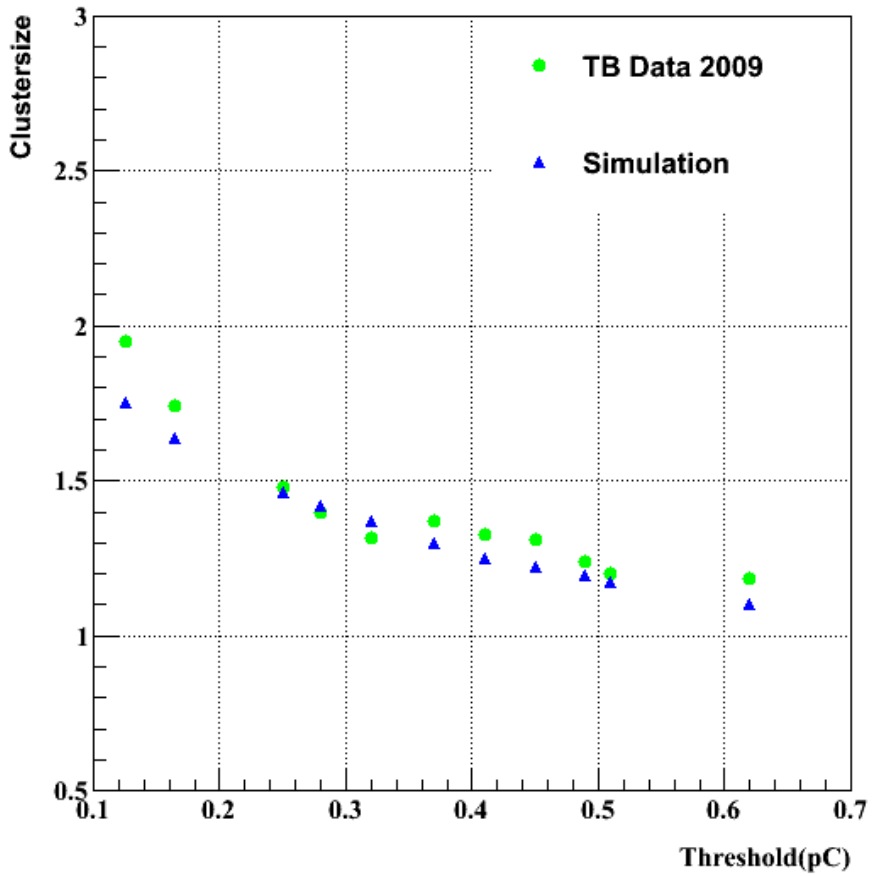
Parameter a tuned to data

Multiplicity

- Spread of the induced charge
  - **Dispatching of induced charge in more than one cell**

Comparison between standalone GEANT4 program (not Mokka) and data : it works





(note : standalone GEANT4 protoype simulation produces LCIO files)

Multiplicity

- Spread of the induced charge
  - Dispatching of induced charge in more than one cell
  - **Implementation in Marlin, need track position inside the cell :**
    - Use of LCIO v1.60 (work started) : implementation in Mokka done
    - Randomly draw track position inside the Cell and do simplified dispatch (Marlin Processor written)
    - Mokka simulation with $1mm^2$ cells and rebuild $1cm^2$ cells in Marlin (Marlin processor written)

Multiplicity

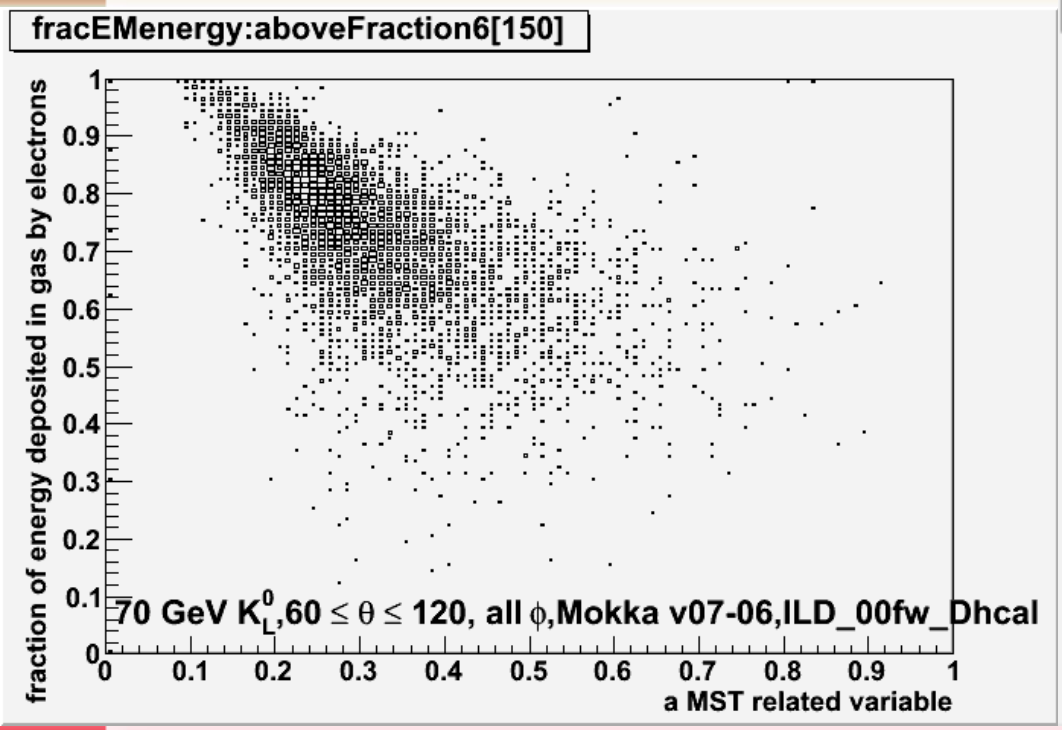
- Dispatching of induced charge in more than one cell for tracks on the cell border

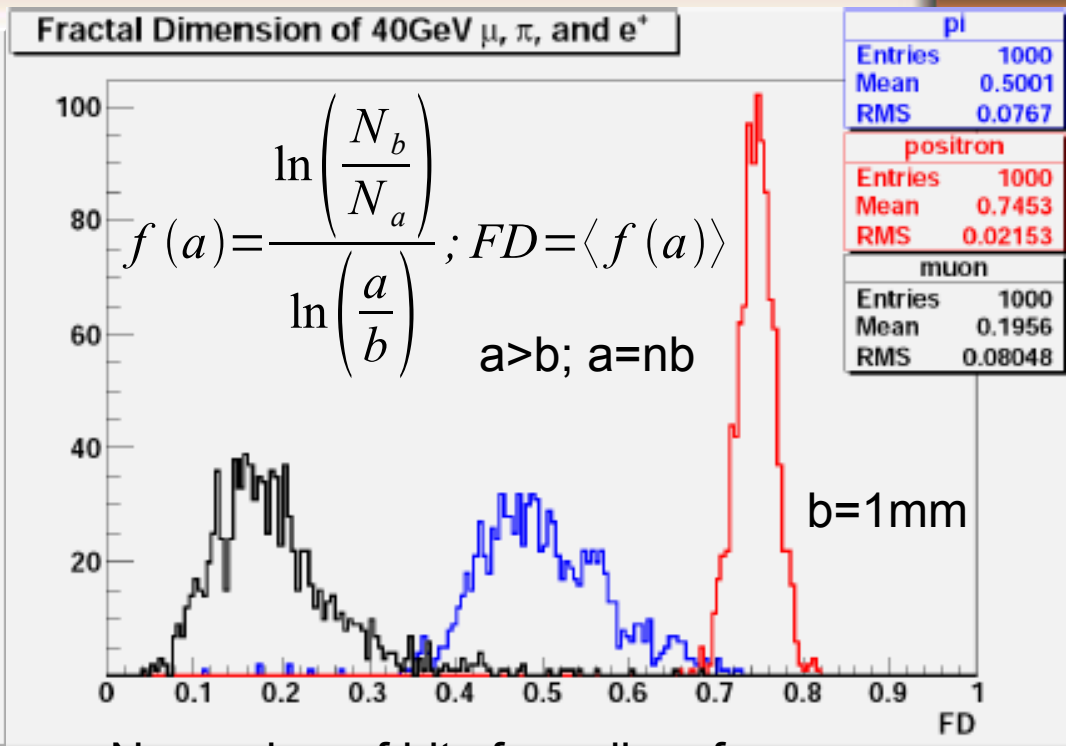
Options		pros	cons
Marlin processor	Add steps in LCIO file	•Flexible, •Realistic, •Tested against data.	•Just starting to implement •Size of Mokka output (detailed shower+position)
	Random draw of track position	•Marlin processor exists	•Not exactly right. •Not yet tested against data •Size of Mokka output (detailed shower)
	$1mm^2$ simulation	•Marlin processor exists •Size of Mokka output kept low •Tuned to reproduce mean data multiplicity and mean hit efficiency. •Can be used for GEM,μMEGAS,...	•Not yet fully tested against data. •Change of geometry while running Marlin (GEAR?)
Mokka	Perform it in simulation	•Tested against data for many thresholds. •Size of Mokka output low •Can simulate with the right cell size	•Energy to induced charge should also be put there. •No flexibility to retune parameters. •Code not yet ported to Mokka.

Analysis tools

- **Marlin processors written :**
  - Use of PandoraPFANew
    - Code have been updated to deal with Videau geometry
    - Some other minor stuff to implement (gap between modules)
  - Minimum Spanning Tree
  - Fractal Dimension

For PID and Energy Estimation





N_a number of hits for cell surface = a

b=1mm

1mm	e+	u	h
e+	998	0	2
u	1	994	5
h	15	14	971

b=10mm

10mm	e+	u	h
e+	1000	0	0
u	0	995	5
h	17	14	969

PID performance :

Conclusion

- Geometry simulation :
  - **Barrel and endcap simulation ready, in Mokka and debugged**
- Simulation of induced charge and threshold effects :
  - **Ready**
  - **Debugged**
  - **Tested against data**
- Multiplicity simulation:
  - **Physics understood**
  - **Tested against data**
  - **Have started implementation of best/most flexible solution (LCIO v1.60).**
- Reconstruction :
  - **Use of Pandora.**
  - **Some advanced tools using SDHCAL fine granularity already developped.**
- DAQ :
  - **Testbeam DAQ produces LCIO files.**