ILD SDHCAL status

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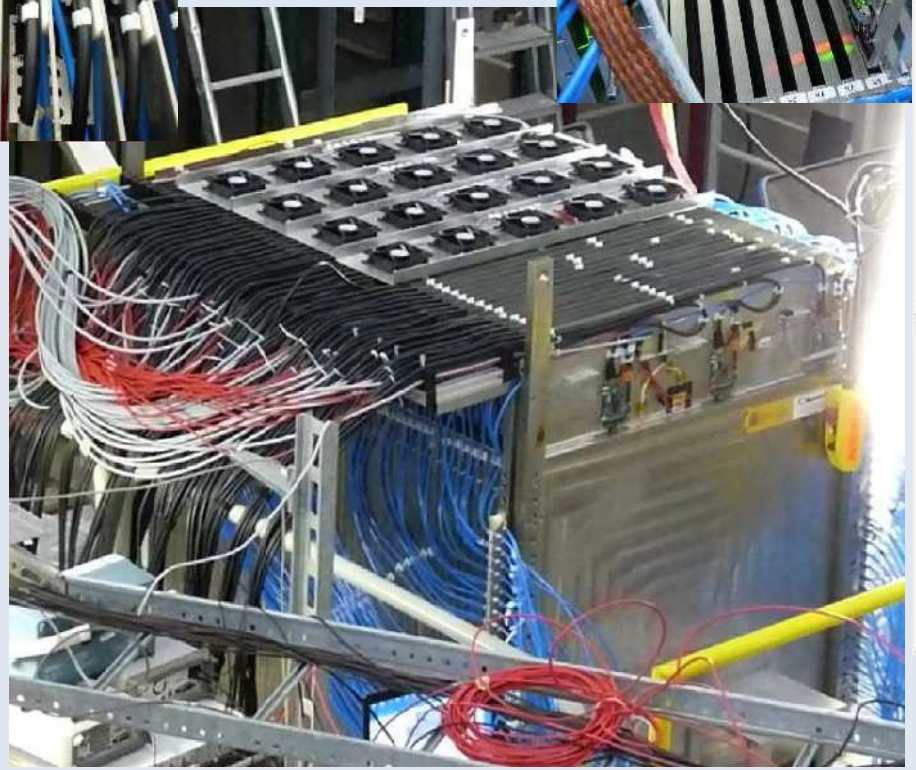
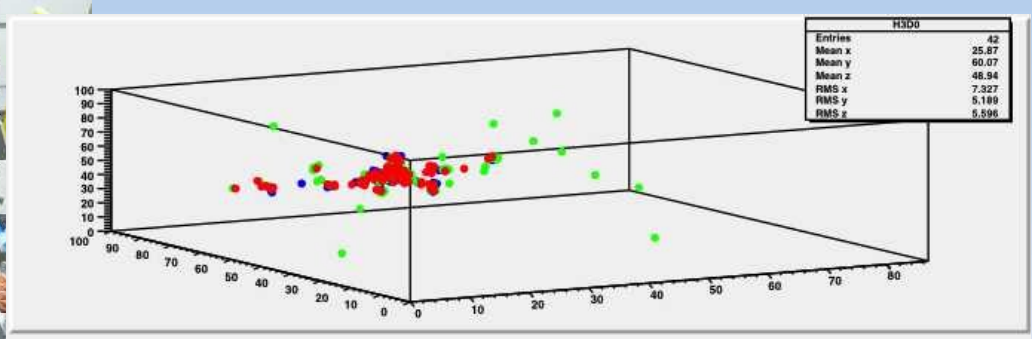
LCWS'11
Grenade
29/09/2011

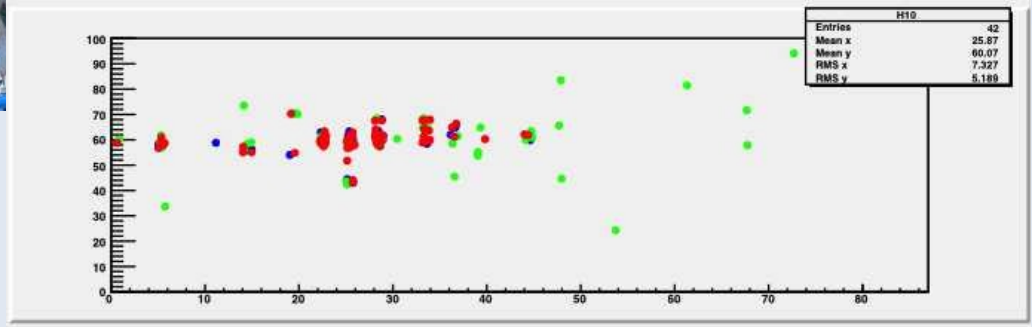
SDHCAL test beams

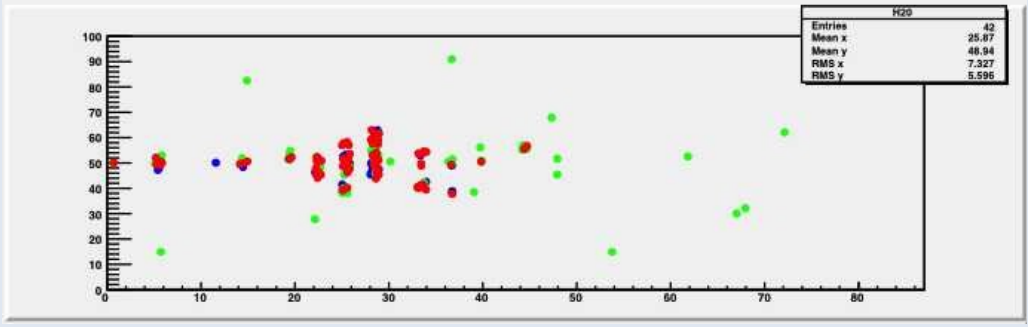
- Test beam at SPS in June
  - Technical difficulties : inconclusive; some events taken but focus was put on preparation of full scale TB
- Technical tests last 2 weeks at PS
  - Fix of grounding, procedures, FW, HW.
  - successful use of 2nd Gen CALICE DAQ on
    - 31 chambers
    - 4400 ASICs (individually configured)
    - 285k channels
  - ~100k trigger taken
    - High noise from heating
    - Importance of Power Pulsing
    - Data being looked at
- Test beam 3–12th october @ SPS
  - with 48 chambers

SDHCAL tests @ PS
Sept. 2011



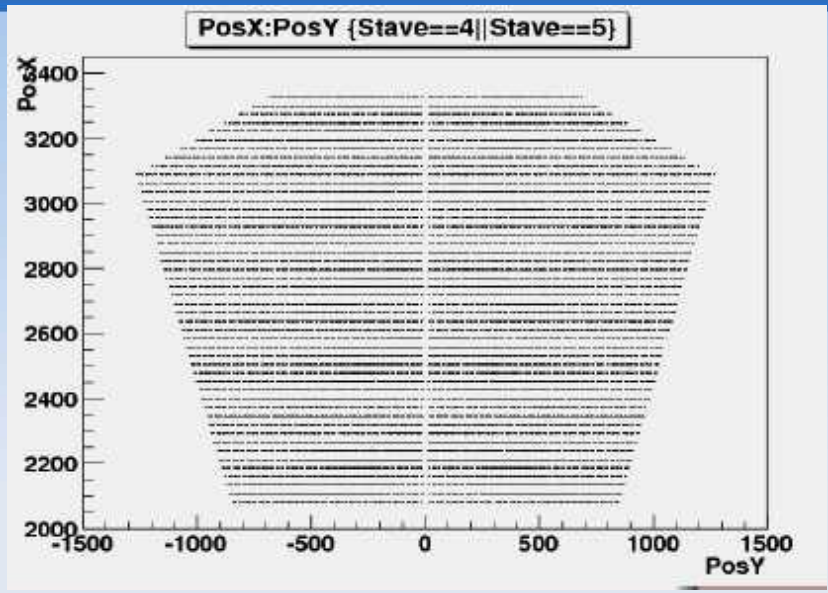


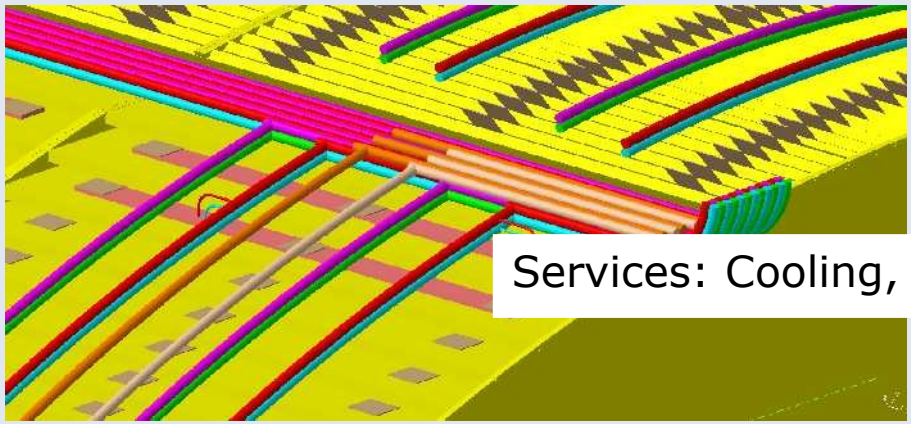




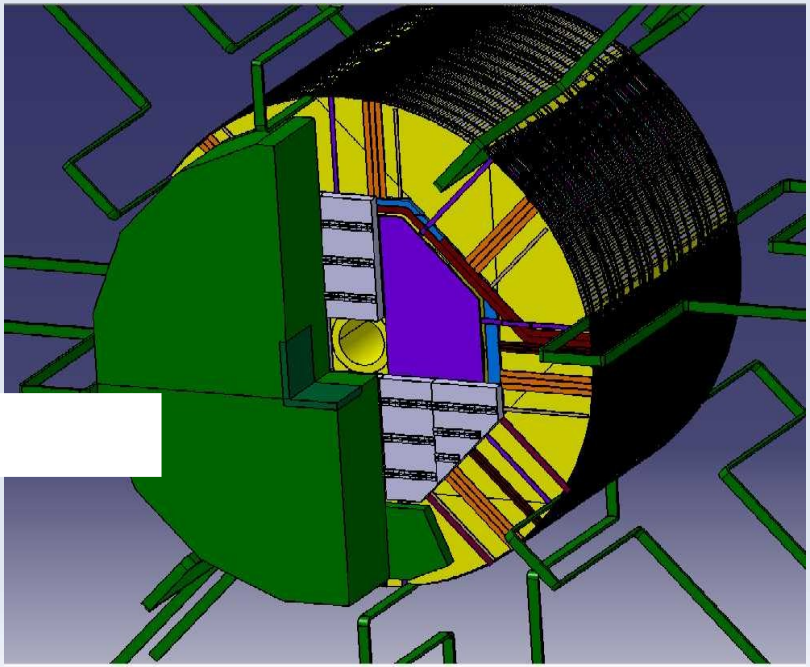
SDHCAL simulation in Mokka

- 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 (by G. Musat)
  - Services have been added (G. Musat & C. Clerc)





Services: Cooling, Gas,HV,LV..



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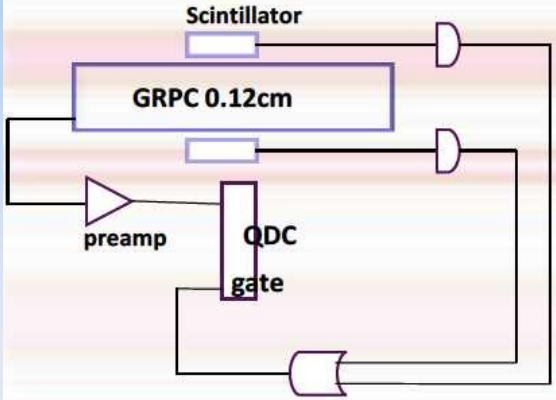
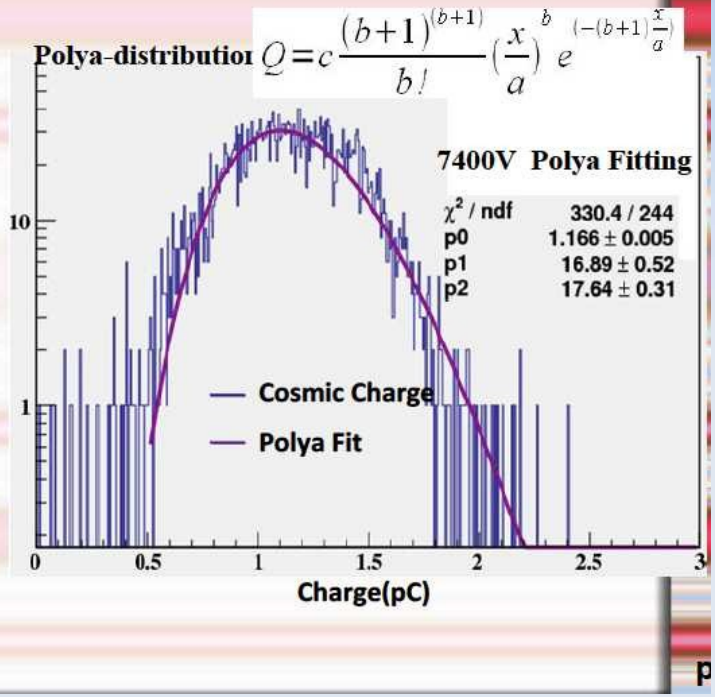
Digitisation

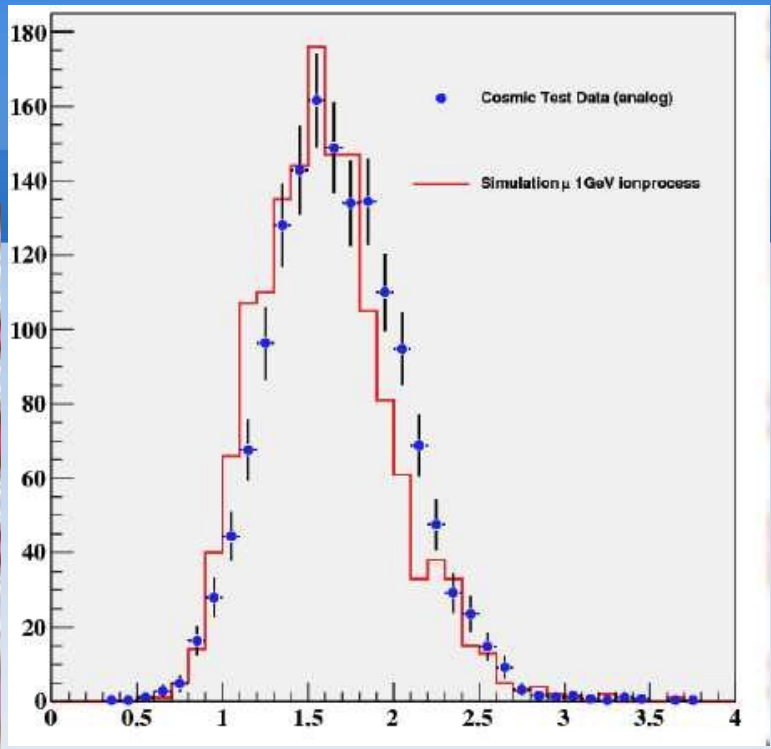
- Transform GEANT4 deposited energy to induced charge.
  - Measure GRPC Analog signal with cosmic muon

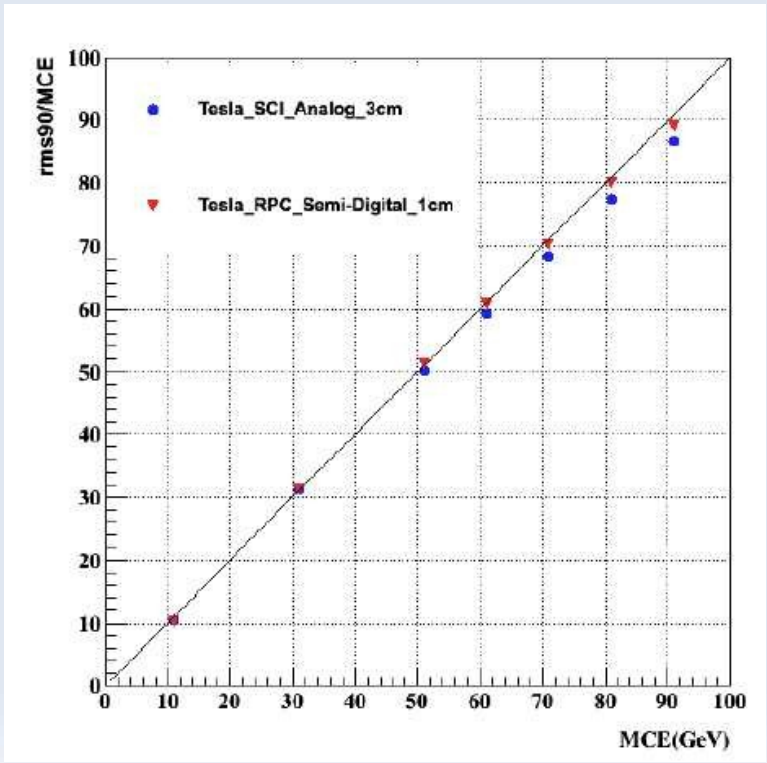


Charge Spectrum Cosmic Test Set Up
64 Channels, trigger area < Channel area
Analog readout

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







- 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.
-

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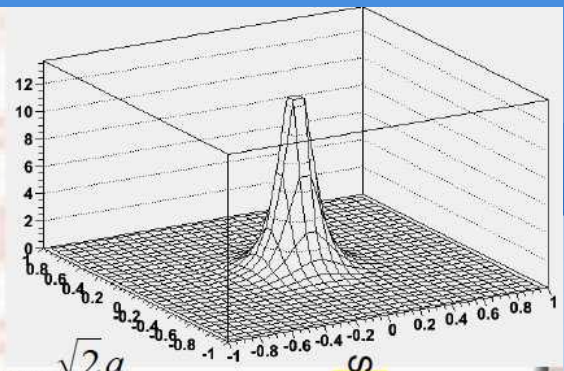
Multiplicity

- Goal: spread the charge between neighbouring cells
- The multiplicity requires the hit position.
  3 paths are possible:
  - Use the GEANT hit position
    - available in latest version of LCIO (v1.60)
  - Randomly draw track position inside the Cell (MarlinProcessor written)
  - Mokka simulation with 1 mm² cells and rebuild 1 cm2 cells in Marlin (Marlin processor written)
- The TB results are well reproduced using random method.

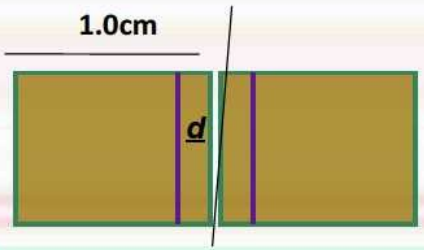
Spread of the induced charge

KIRK T. MCDONALD's lecture

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



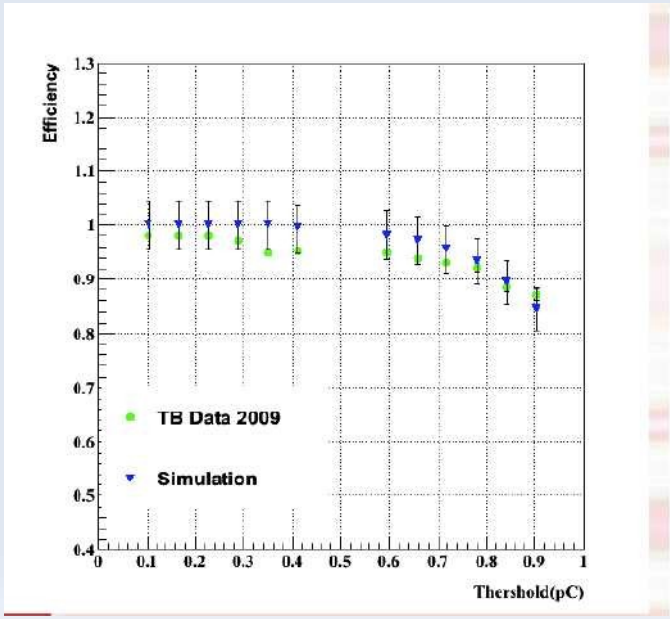
At low order, equivalent to a 2D gaussian with width $\frac{\sqrt{2}a}{\pi}$

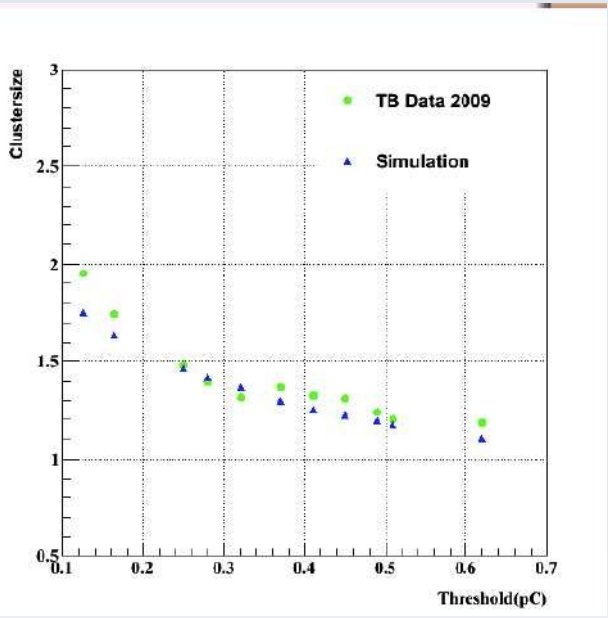


Dispatching induced charge on more than one cell for tracks on the cell border.
Parameter a tuned to data

Simplification

<---	1cm	--->
1/4	1/2	1/4
1/2	1	1/2
1/4	1/2	1/4





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Multiplicity methods; summary

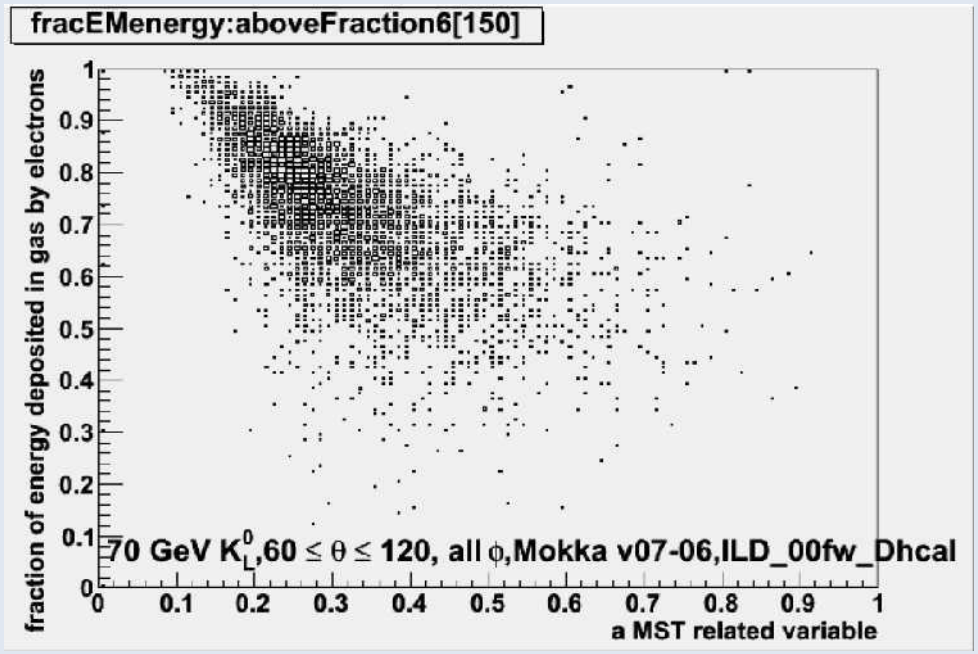
Options		pros	cons
Marlin processor	Add steps in LCIO file	•Flexible, •Realistic, •Tested against data.	•Just starting to implement •Size of Mokka output (detailed shower+position)
	Random draw of track position	•Marlin processor exists	•Not exactly right. •Not yet tested against data •Size of Mokka 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.

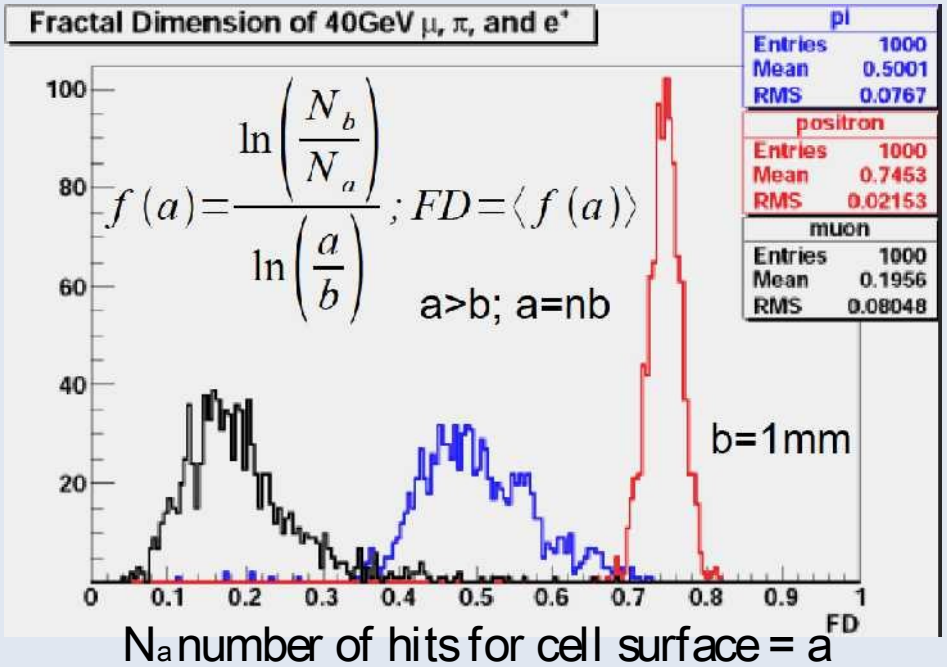
- To be decided very soon...

Analysis tools

- All implemented in Marlin framework
- 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
- Track reconstruction

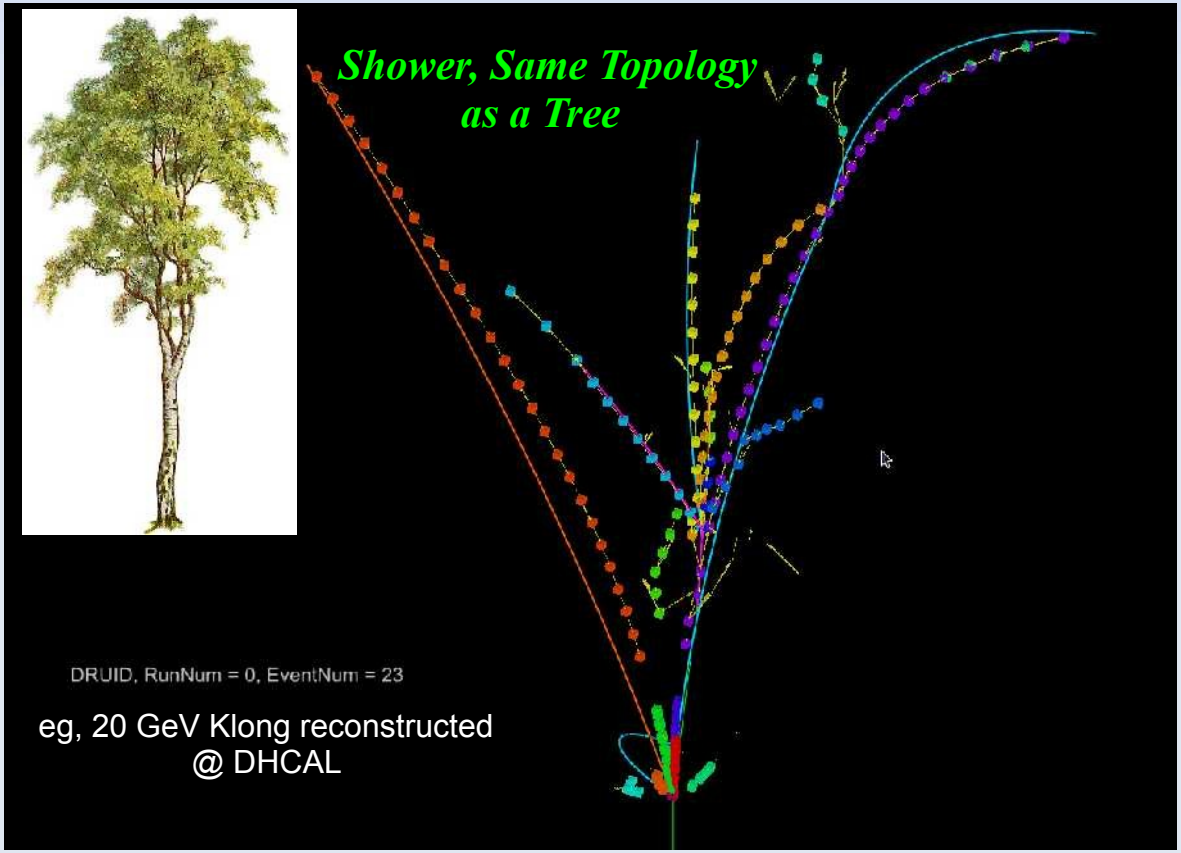
For PID and Energy Estimation

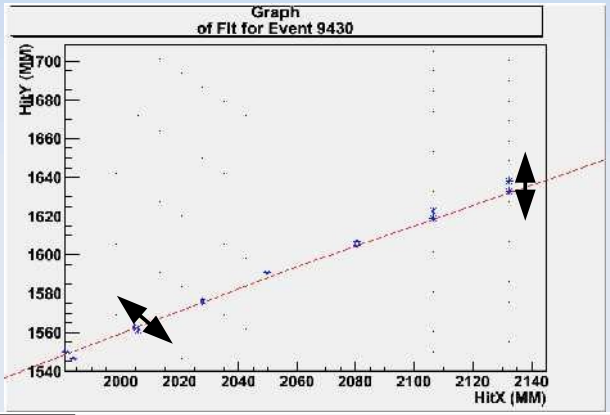


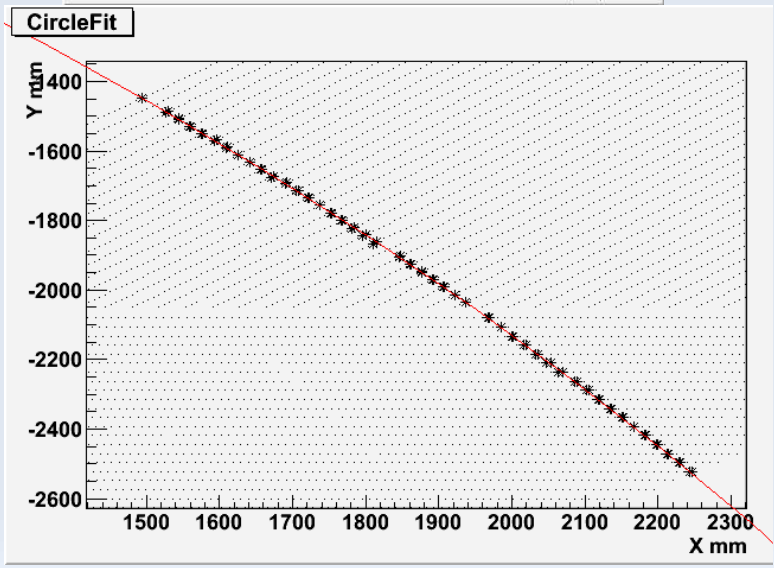


Arbor: to reconstruct shower as a tree

- Potential application: shower separation, calo track tagging & measurement
- Preliminary study with circle fit to calo tracks (J. Sniff, V. Boudry, K. Belkadhi / LLR)
  - using Pratt fit method on Videau barrel geometry, with full error calculation
  - Preliminary results: flat ~10% resolution on MIP track in the barrel & leakage correction (from π's) using 1 cm² single thr. DHCAL cells







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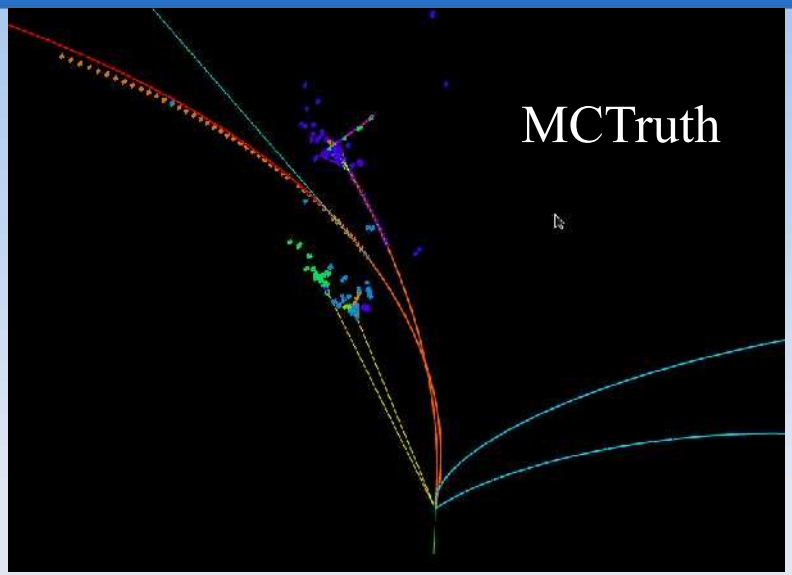
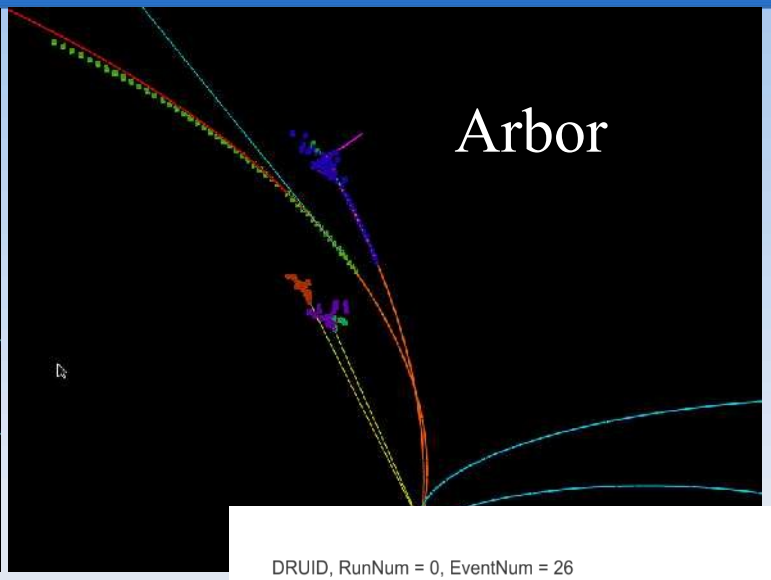
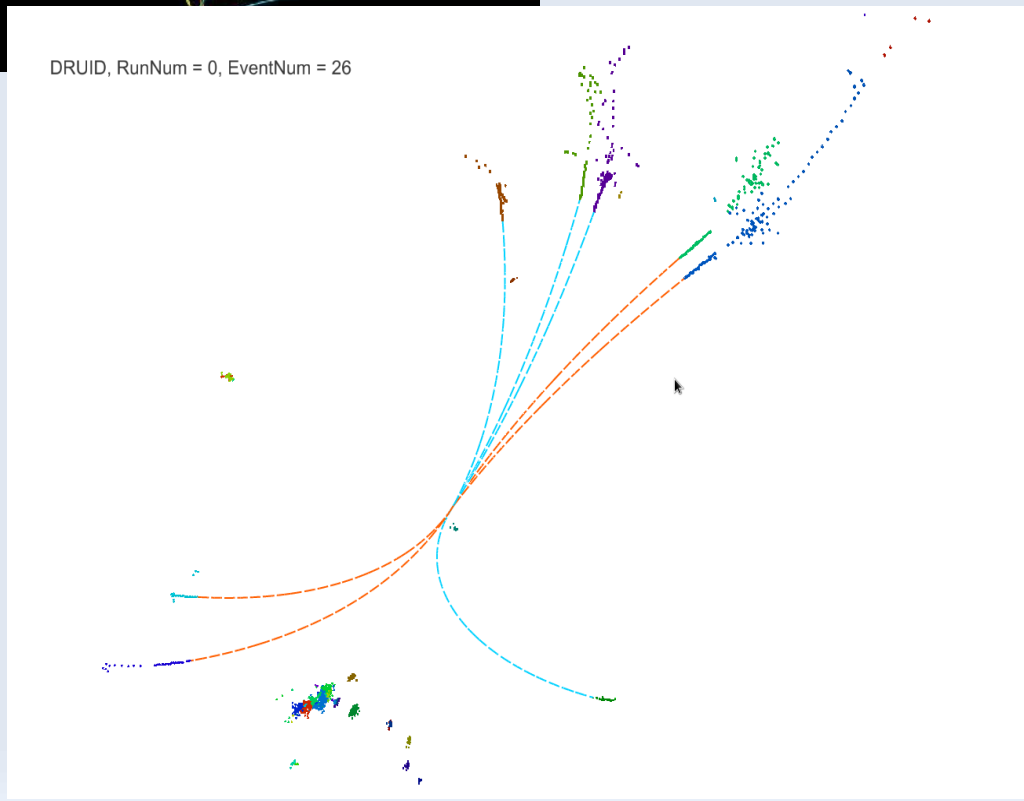
Spares on Arbor Example: Klong 5-prong decay & uds event







- Promising preliminary results to be conformed & tuned.
  - Energy scale
  - various type of events
  - ...

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Summary and outlook

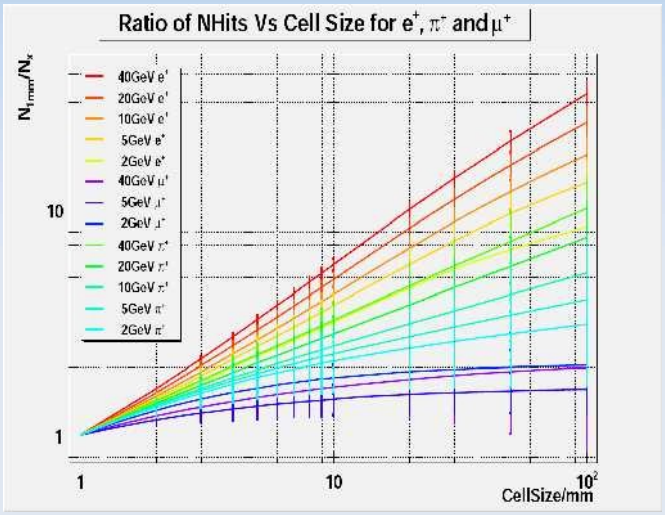
- Large SDHCAL TB data sample should be available very soon to tunes the algorithm
- The simulation bricks are being finalised
  - Geometry completed : services, endcap
  - Digitisation & multiplicity in good agreement with TB data. being implemented with latest version of Marlin / LCIO.
    - Choice of method to be done very soon
- Many news ideas on how to use very fine granularity to improve separation, PID and measurements being tested

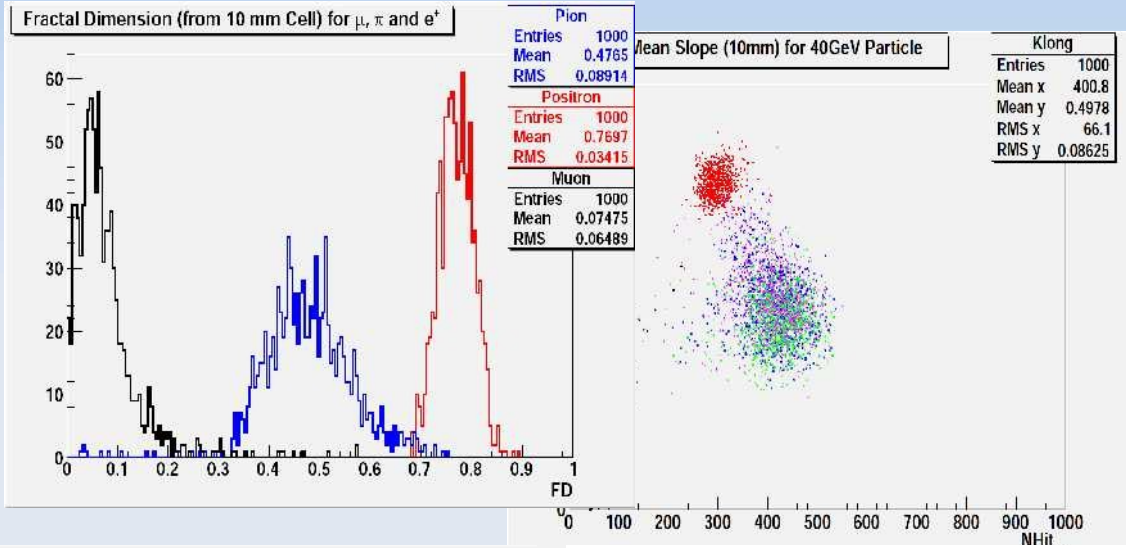
Back up

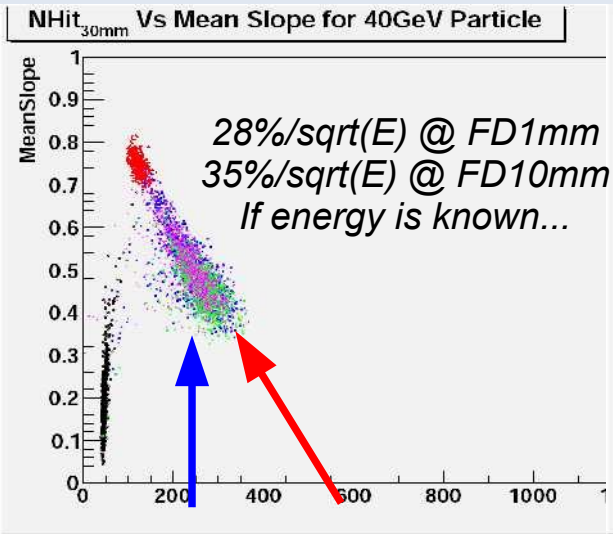
Shower Fractal Dimension

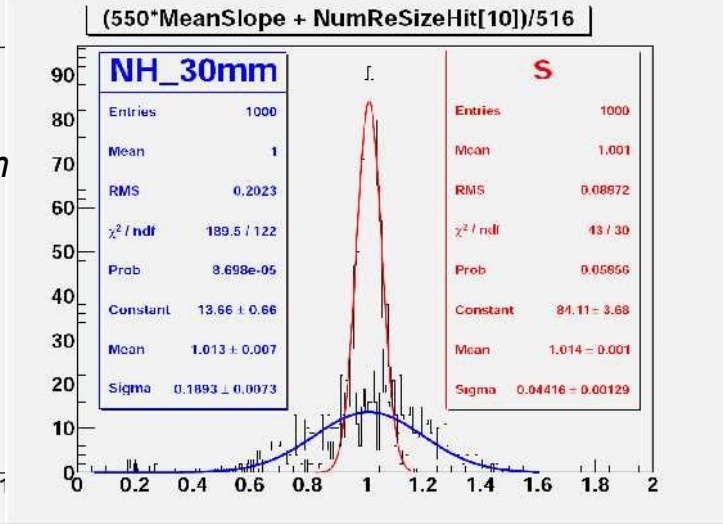
Self Similar pattern of Shower:

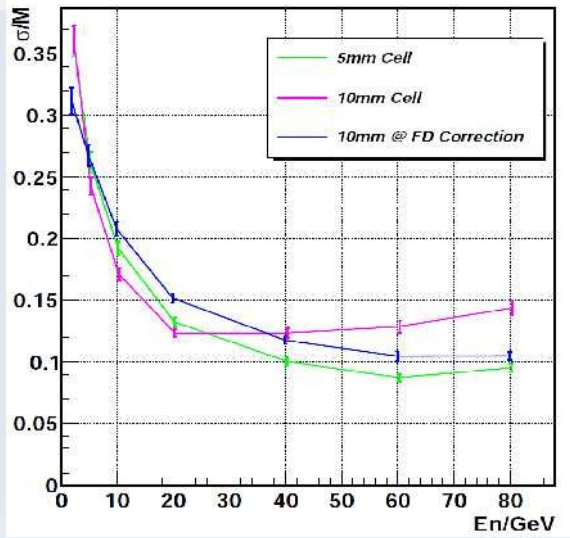
High granular calorimetry allows a direct measurement on shower Fractal Dimension, which has promising particle identification power and impaction on shower energy estimation.











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Digitization

Digitization framework based on MC information at 1mm²:

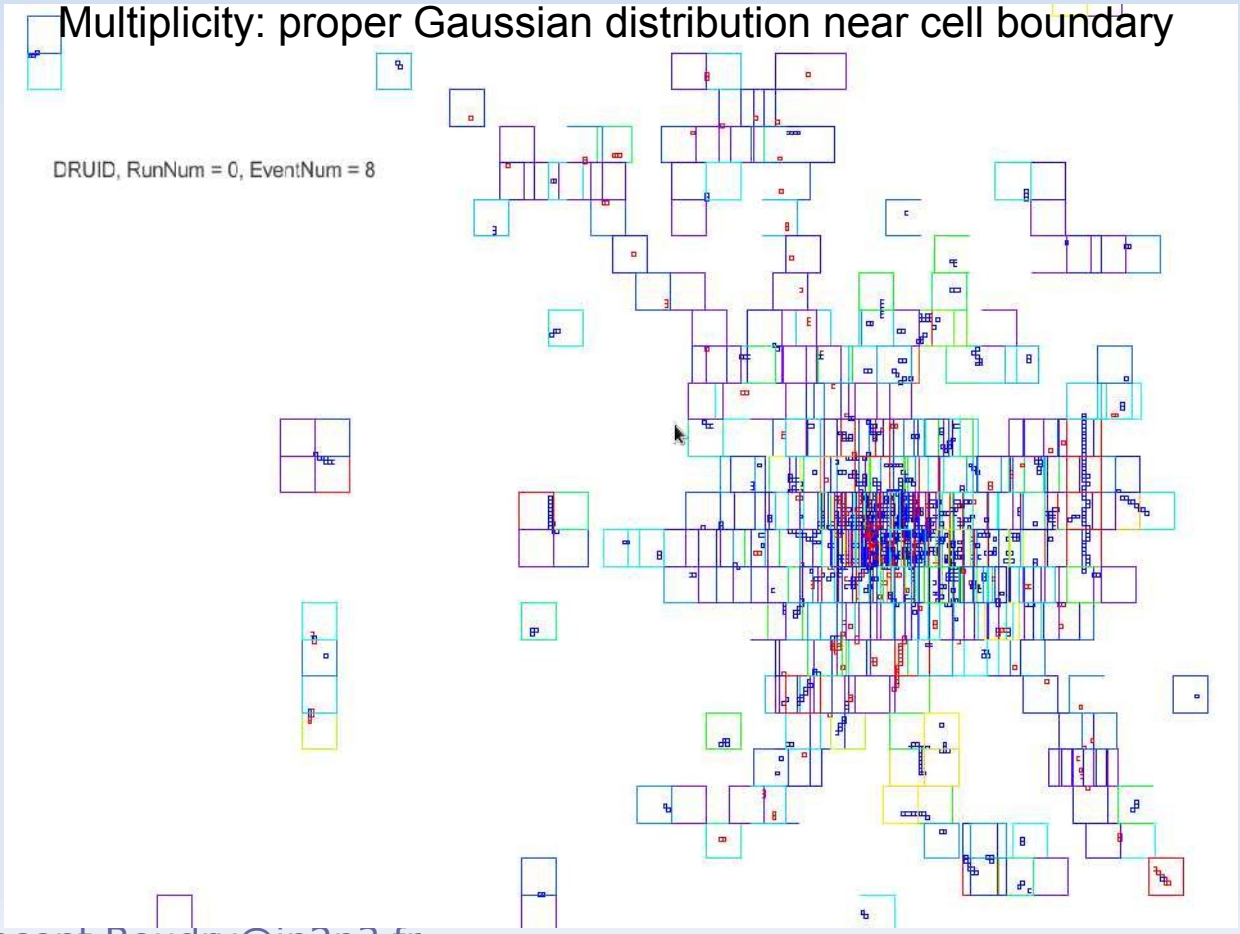
Proper description & extendible for the digitization module of other gaseous detectors

Limited data size (Nhits controlled within 3 times to 1cm²) + data sample available for cell size optimization study

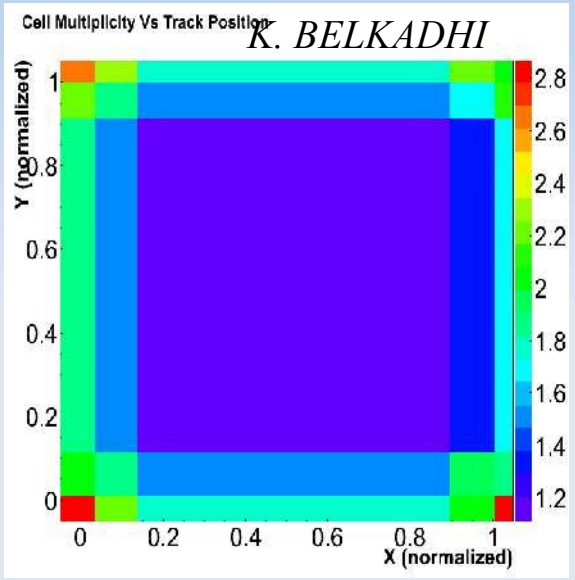
Parameter validating from experimental input:

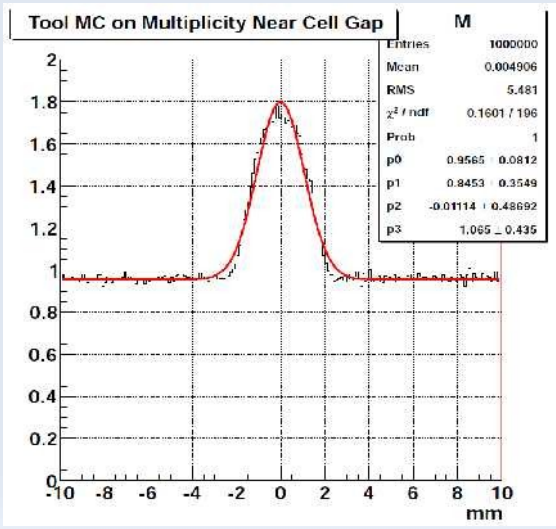
Eff = 95.7%;

Multiplicity: proper Gaussian distribution near cell boundary



K. BELKADHI





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