Resistive Micromegas Multigen 2D for Muon tomography

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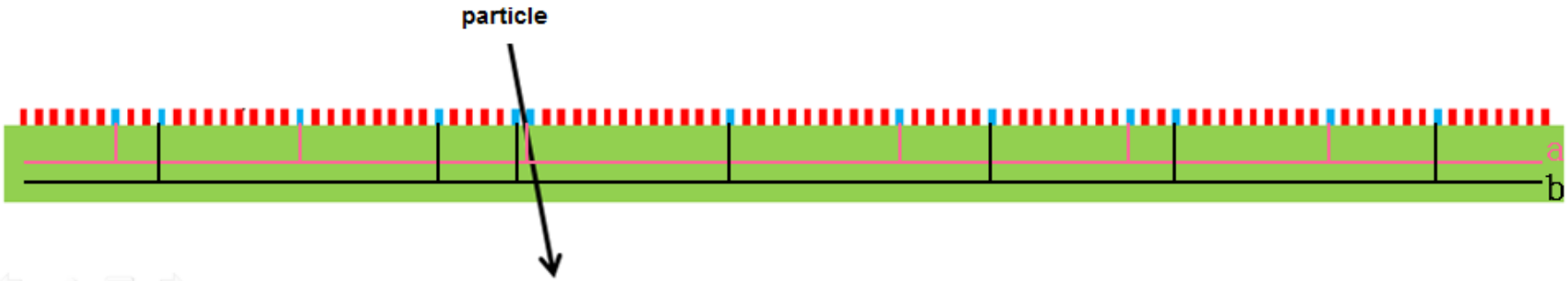
Outline

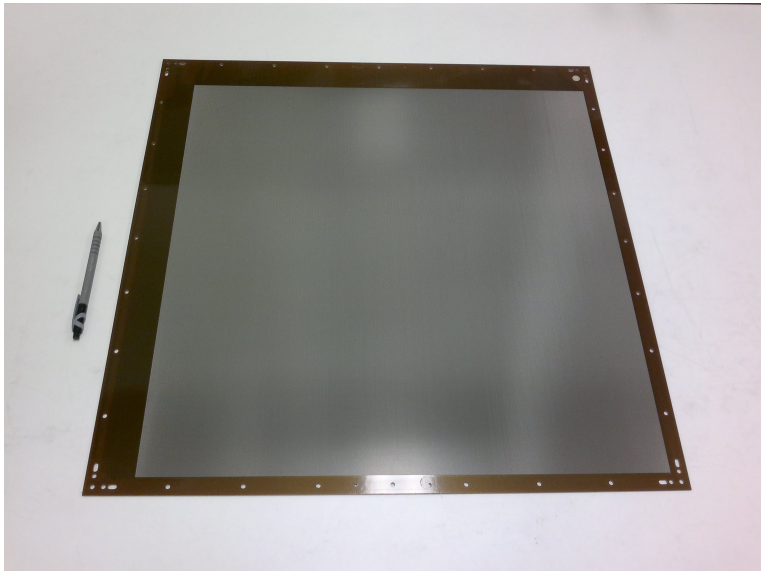
Genetic multiplexing

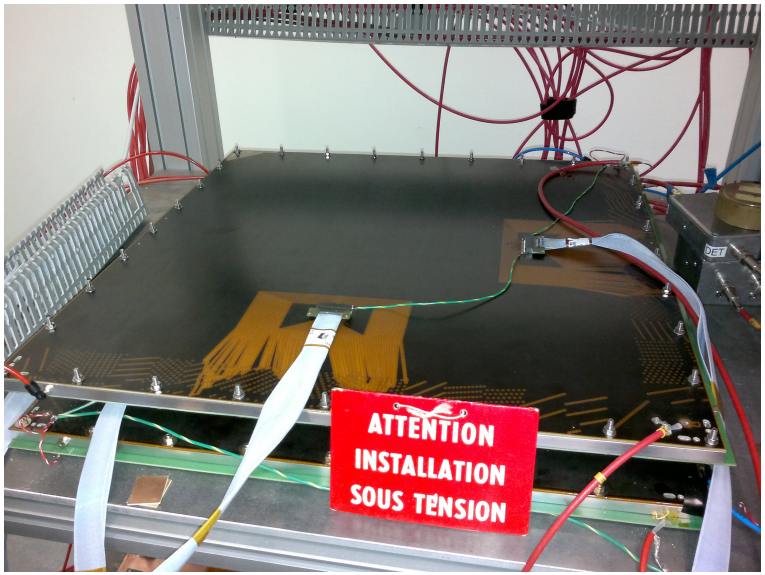
- One particle : signal in multiple adjacent strips
- Identify n-uplet position is enough
- 1024 strips $\rightarrow$ 61 electronic channels



Detector overview

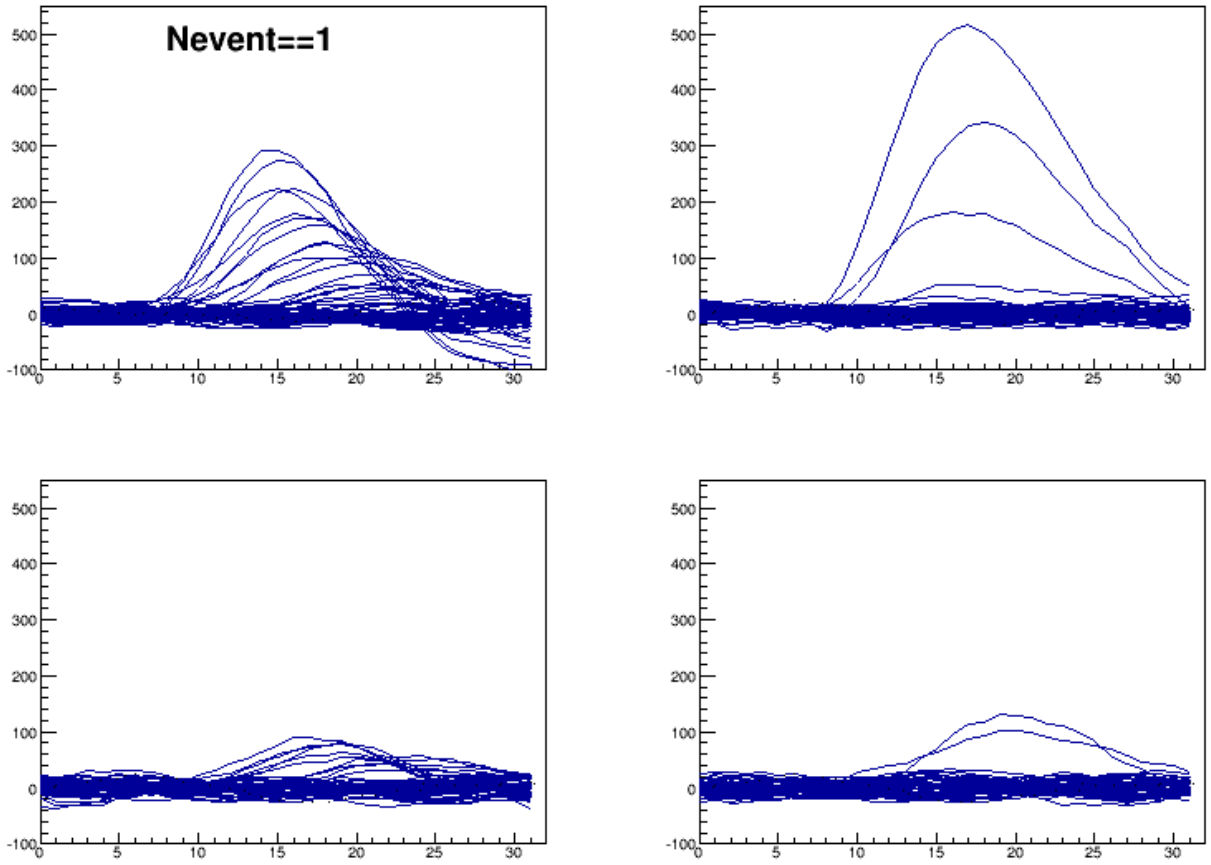
- Dimensions : $50 \times 50\mathrm{cm}^2$
- Resistive
- 2D : 2 perpendicular layer of readout strips
- Multiplexed





Detector overview

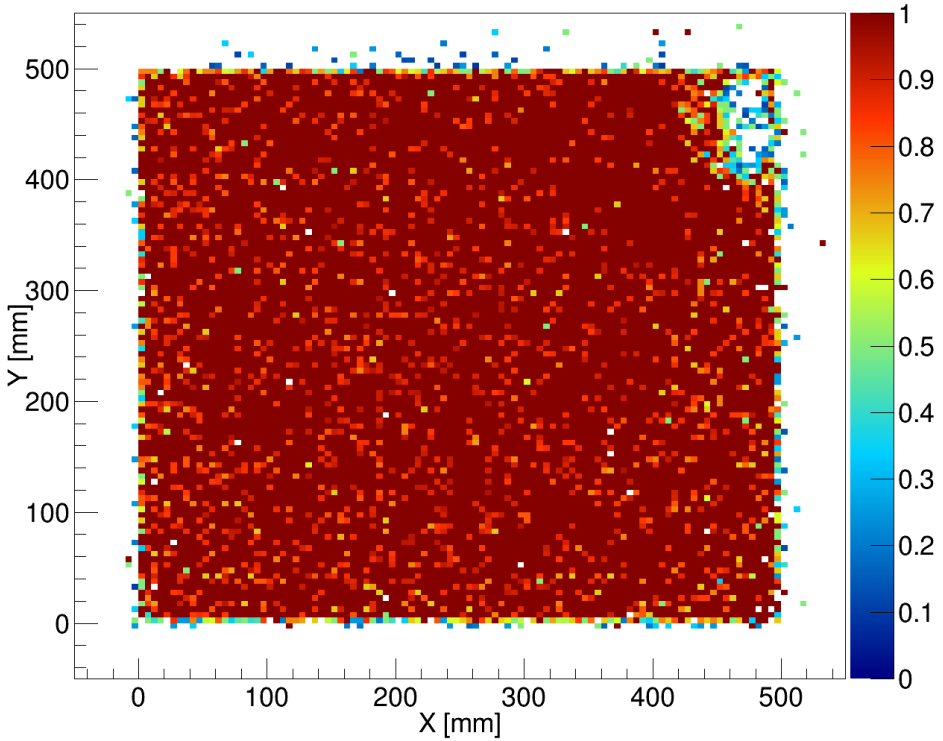
- Asymetry :
  - Strips parrallel with resistive strips
  - Strips perpendicular with resistive strips



Efficiency

- At maximum gain (amplification field : $\sim 4 \cdot 10^6\ \mathrm{Vm}^{-1}$)
- Cosmic bench configuration :
  - 3 2D tracking detectors
  - 1 2D tested detector
- Clustering consideration
  - Noise in strips perpendicular wrt. resistive strips
  - 1 strip without signal allowed in clustering

- Efficiency of the perpendicular coordinate :
  - Before correction : 96%
  - After correction : 97%



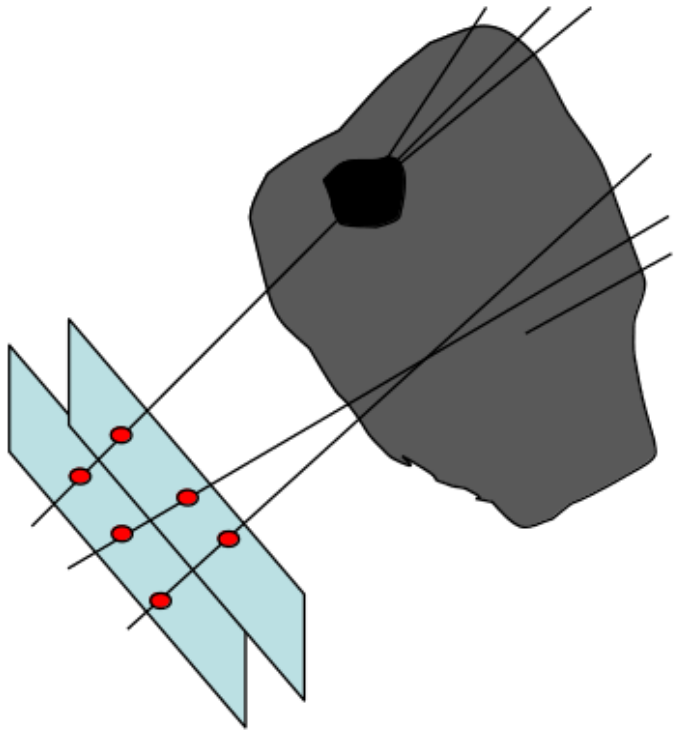
Capacitance studies

- Observations :
  - Multiplexing increase detector capacitance
  - Dream electronics (CLAS12)
  - Average S/B with protected chips ($220\ \mathrm{pF}$ decoupling capacitor)
  - Poor S/B with unprotected chips
- Decoupling capacitor can be optimized to miximise S/B
  - AGET/Feminos electronics (MINOS)
  - Different capacitor for each chip (from $220\ \mathrm{pF}$ to $2\ \mathrm{nF}$)
  - Data taking : finished
  - Analysis : in progress

Outline

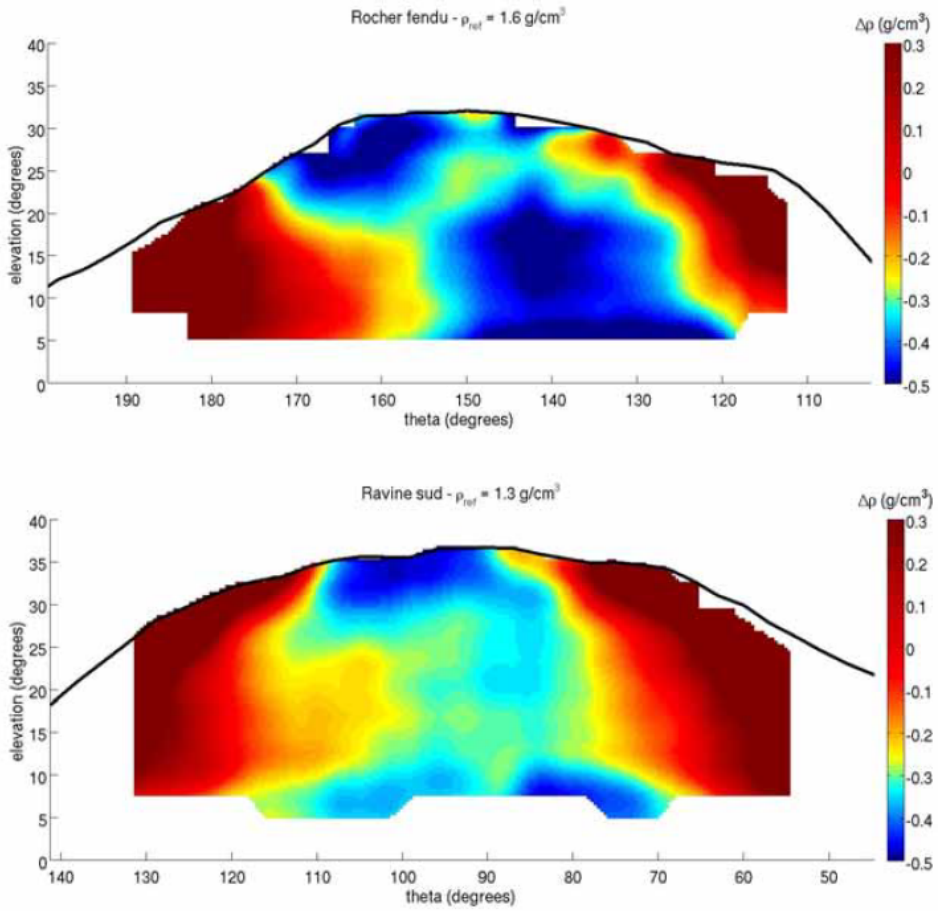
Principle

- Flux measurement
- Reconstruction :
  - Flux difference between 2 runs
  - Substraction of acceptance effects
  - Comparison with simulations
- Easy to setup
- Poor resulution : $\sim$1 muon out of 100 are stopped by $10\ \mathrm{cm}$ of lead
- High acquisition time



Principle

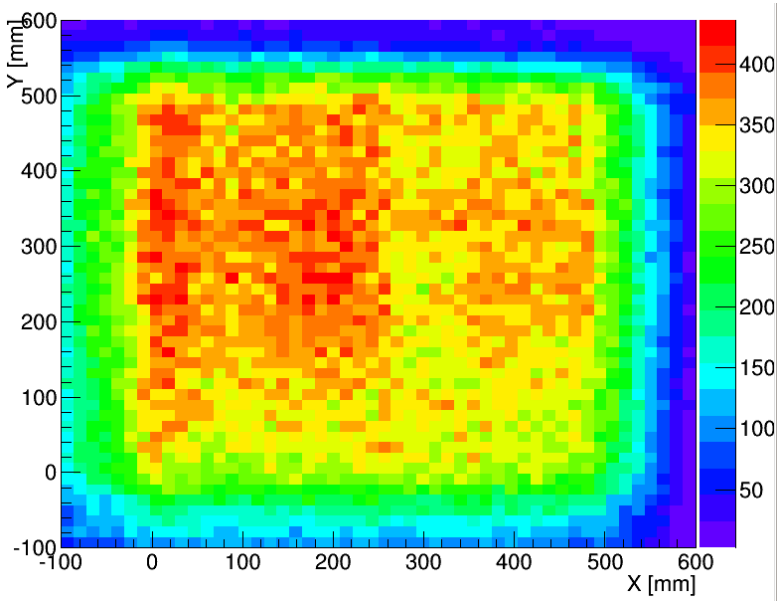
- Suited to study large objects
- Applications :
  - Volcanology
  - Mining exploration

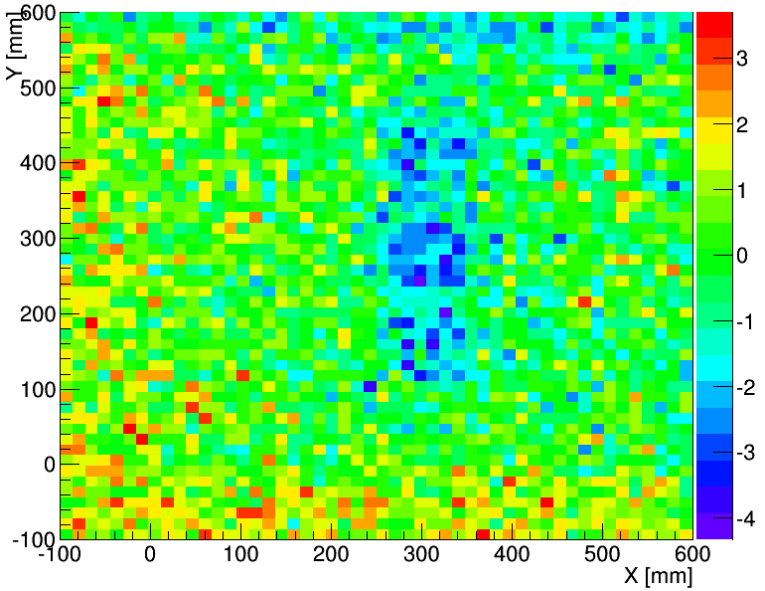


DIAPHANE project (IPGP, IPNL)

First results

- Cosmicbench :
  - $50 \times 50 \mathrm{cm}^2$ detectors
  - 6 1D layers
- $10\ \mathrm{cm}$ thick lead bricks
- 2 days of data (trigger rate : $\sim 6\ \mathrm{Hz}$)





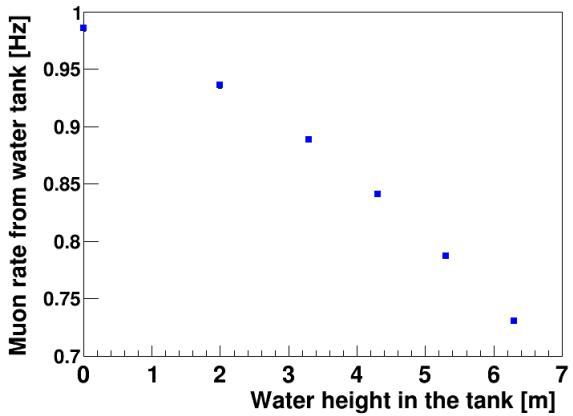
WatTo experiment

- Start date : march-april 2015
- Saclay's watter tower tomography
- 3-4 Multigen 2D telescope
- 45° inclination
- Why ?
  - Test the detector outside
  - Test the electronic outside
  - Test low consumption HV modules
  - Test on battery power
  - Test image quality versus time of acquisition

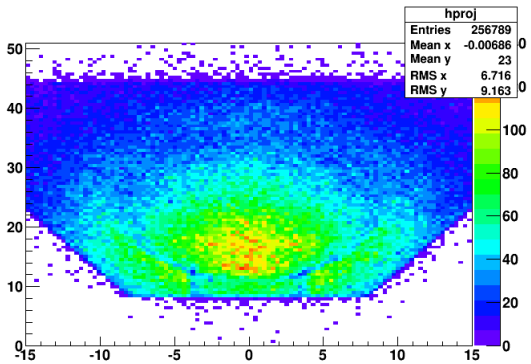
WatTo experiment

Simulations :

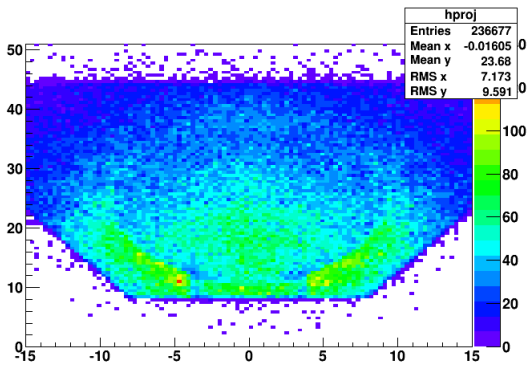
- Monitoring of the water height



- Tank without water



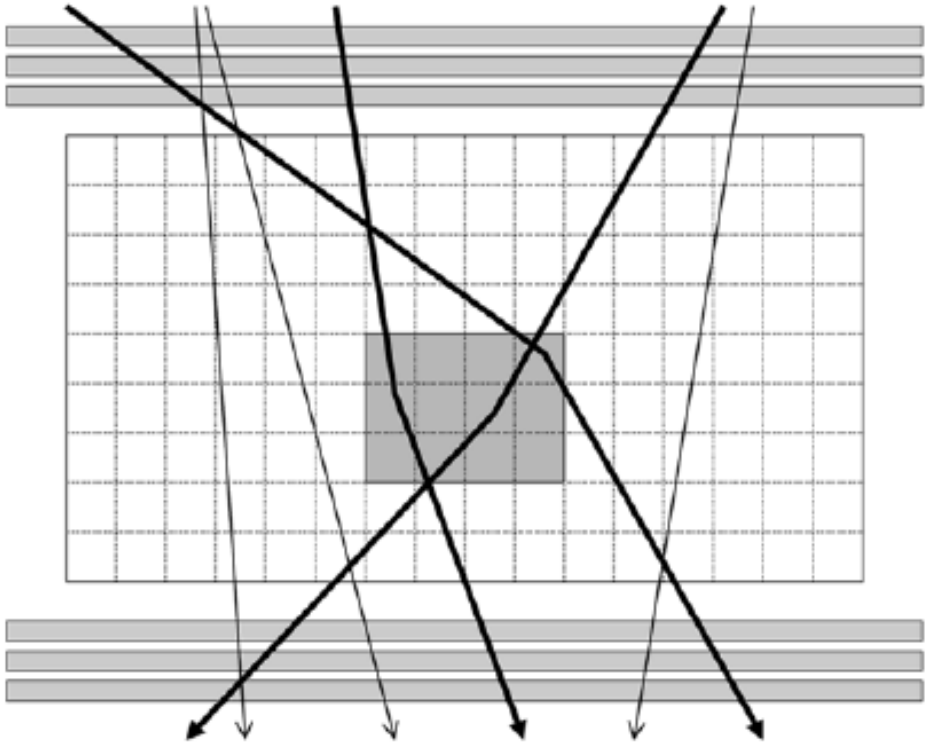
- Tank full of water



Outline

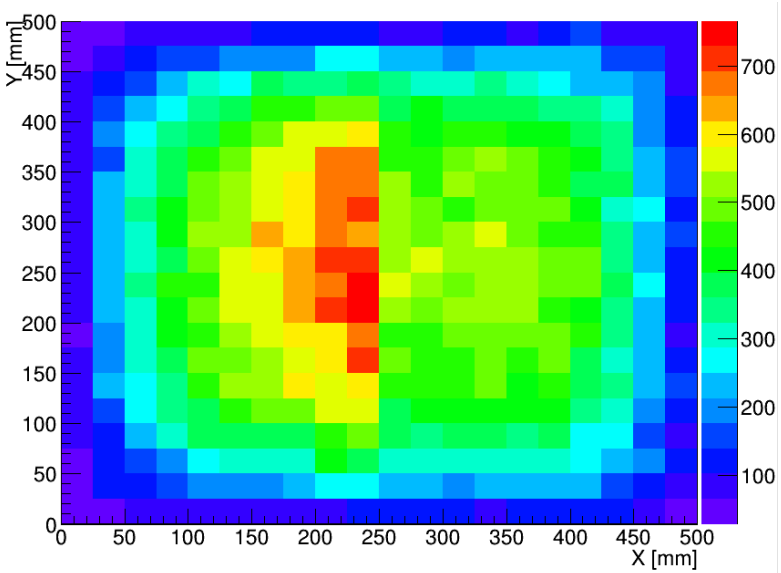
Principle

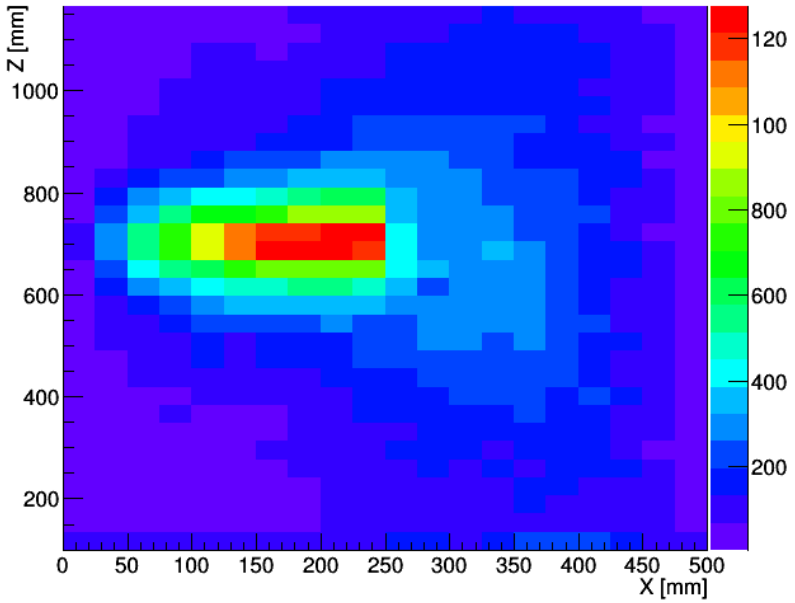
- Multiple scattering
- $\begin{pmatrix} x \\ \theta \end{pmatrix}$ measurement at both end
- 3D image
- More information used wrt. absorption tomography
- Reduce acquisition time
- Need a model for reconstruction
- No real data results at the moment



PoCA reconstruction

- Simplest reconstruction
- Point Of Closest Approch
  - middle of shortest segment between incoming trajectory and outgoing trajectory
- Acceptance effect sensitive
- Lot of non-used information
- Density map is the PoCA distribution





Likelihood reconstruction

- Based on maximum likelihood method
- Deviation angle distributed on a gaussian
  - $\sigma_\theta \propto 1/\rho$
- Each muon contribute to the density of every voxel he passes through
  - Proportionnal to the deviation Δx inside the voxel
  - Inversely proportionnal to the path length inside the voxel