1st SuperB Collaboration Meeting, Queen Mary University

Prototype Data Analysis: First Look and Plans

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Outline

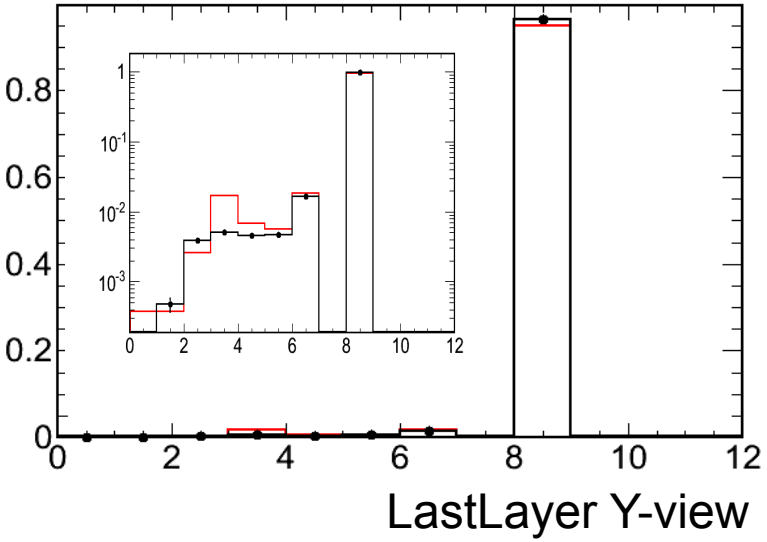
- General Strategy
- December 2010 · July 2011 data comparisons
- Reconstruction of some discriminating variables
  - Track parameters
- Conclusion and To Do List

Prototype Data Analysis: Strategy

- Compare Data and Simulation
  - To check of hadronic shower models (QGSB_BERT, QGSB_HR, ...)
  - Define a model to digitize the Simulation output:
    - Both aspects important for the final SuperB full simulation: go beyond the TDR phase
- Last hit layer is a quantitative clear measurable quantity related to the pion punch-through
  - Affected by muon contamination in the pion sample
- Rough longitudinal segmentation: not enough to study shower shape from data
  - Had shower starting point not reconstructed: rely on simulation
  - Total number of hits/layer and lateral size for pions, strongly related to the hadronic shower shape

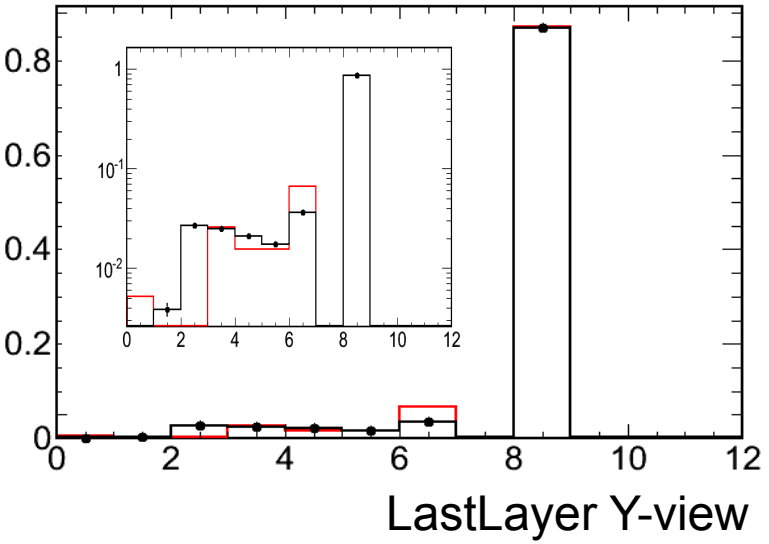
July2011-December2010: comparison

8 GeV · Muon enriched sample



Dec2010
July2011

6 GeV · Muon enriched sample



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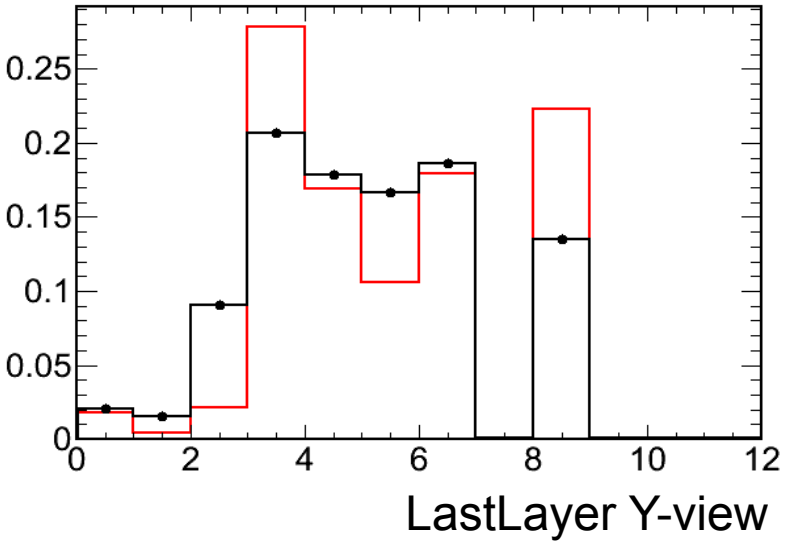

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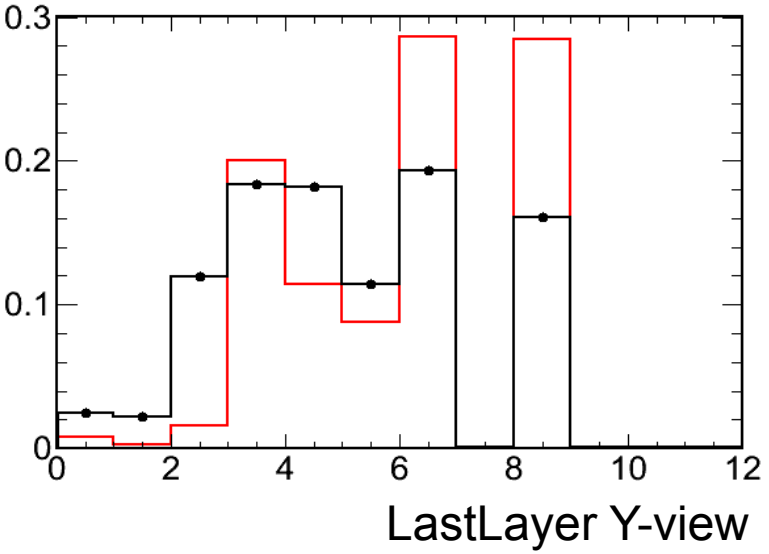
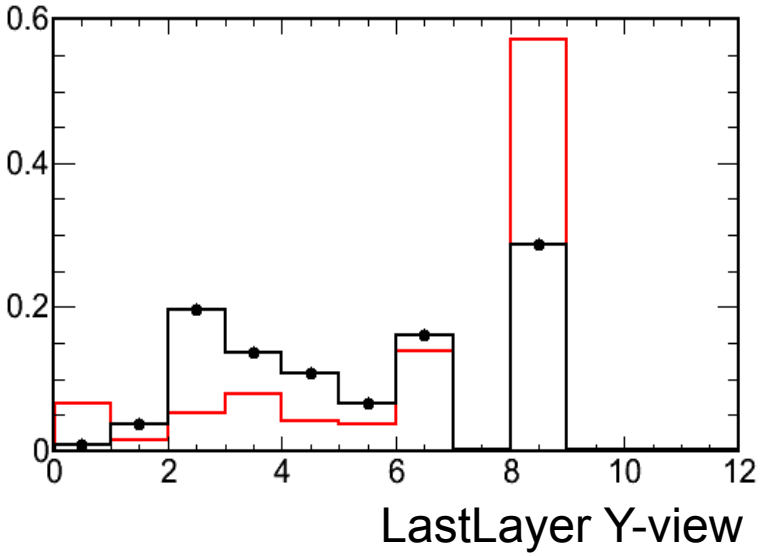


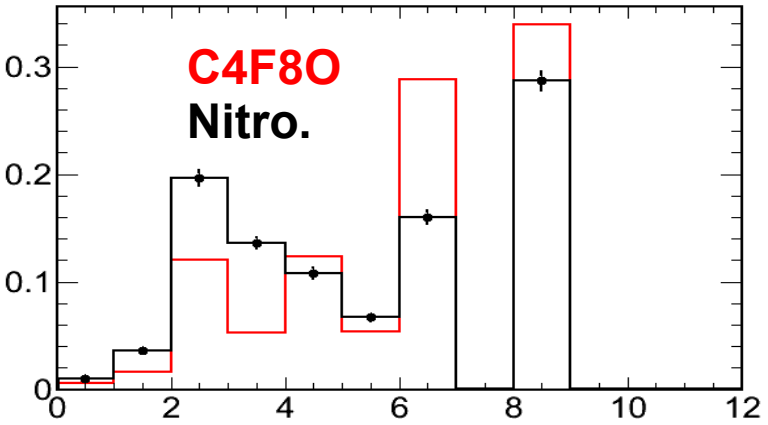
July2011-December2010: comparison

4 GeV · Muon enriched sample



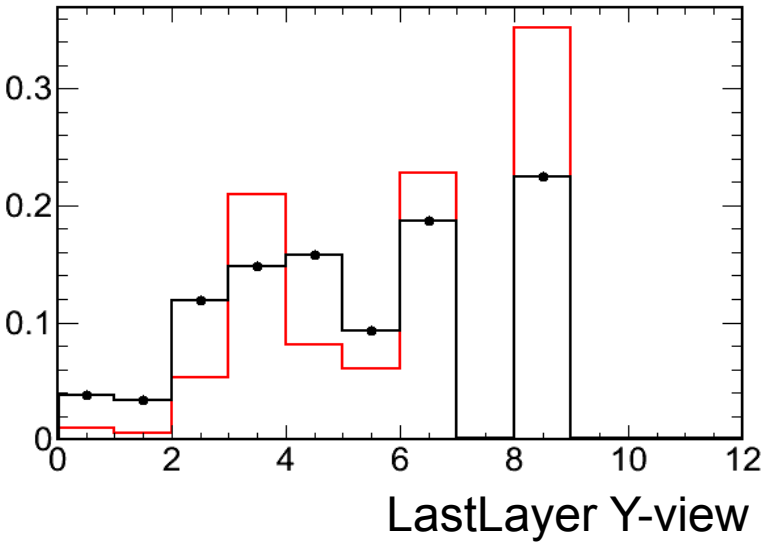
Dec2010
July2011

4 GeV · Muon enriched sample

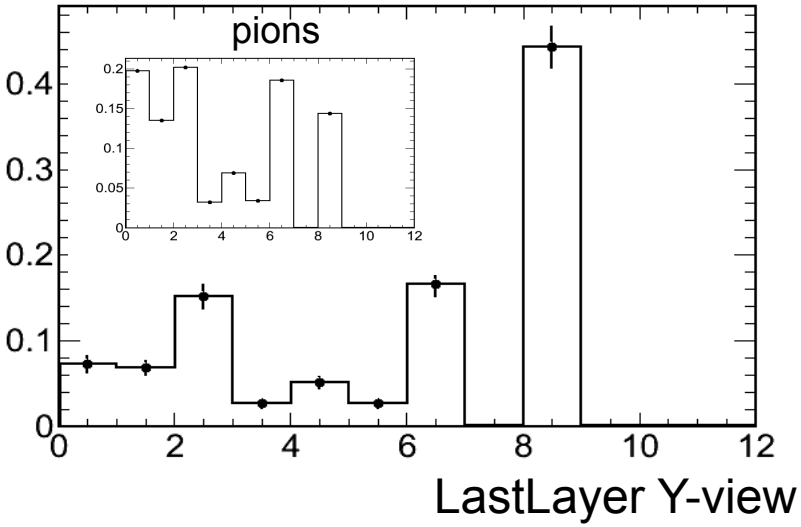


- Problems with Run4? Need further investigation for the next test!
- Run at 2 GeV show a clear 'peak' from muons

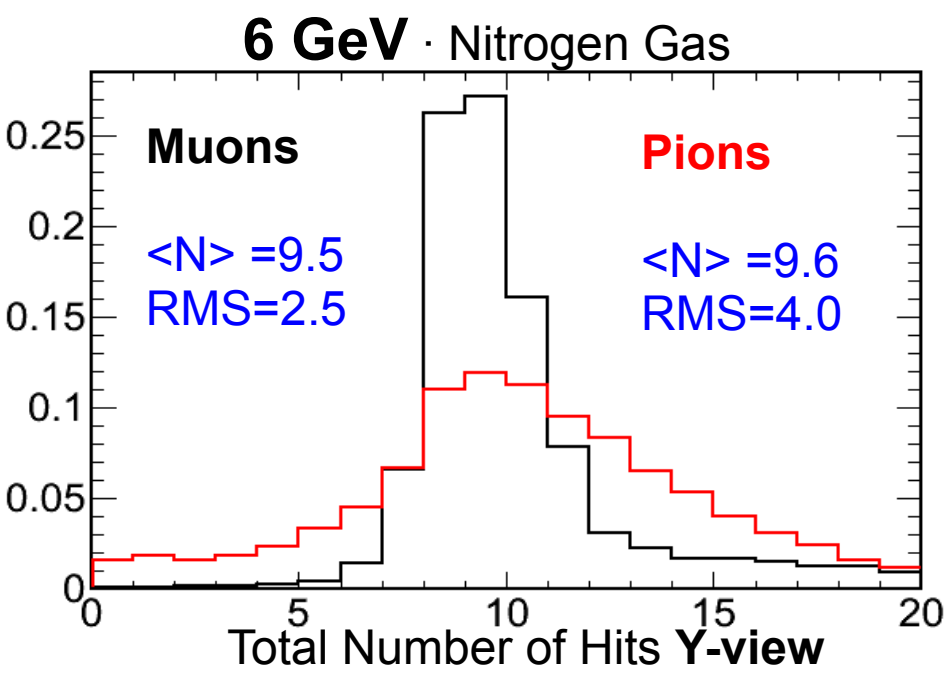
4 GeV · Pion enriched sample

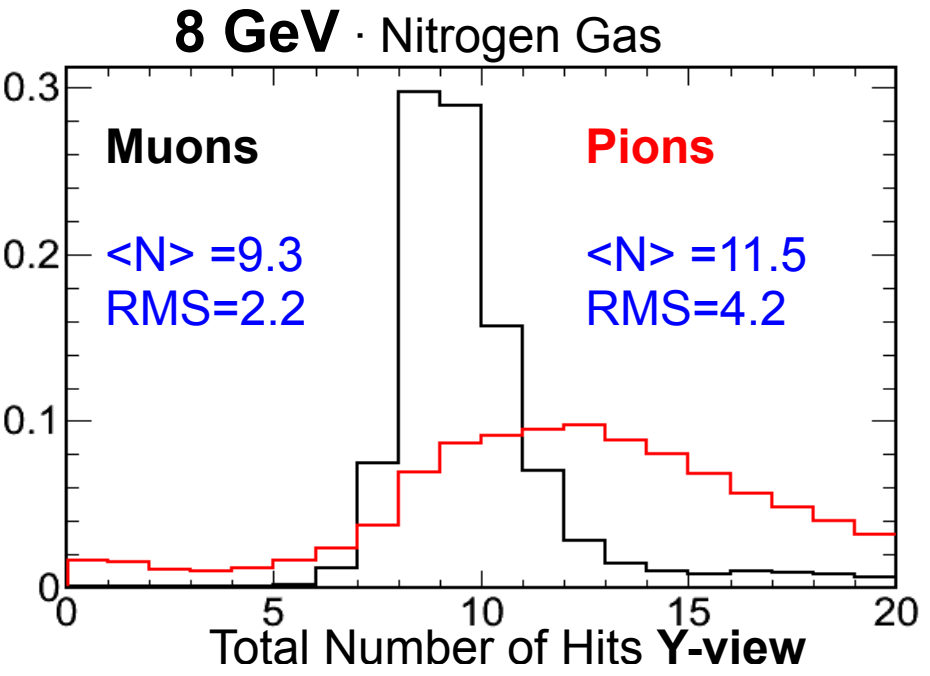


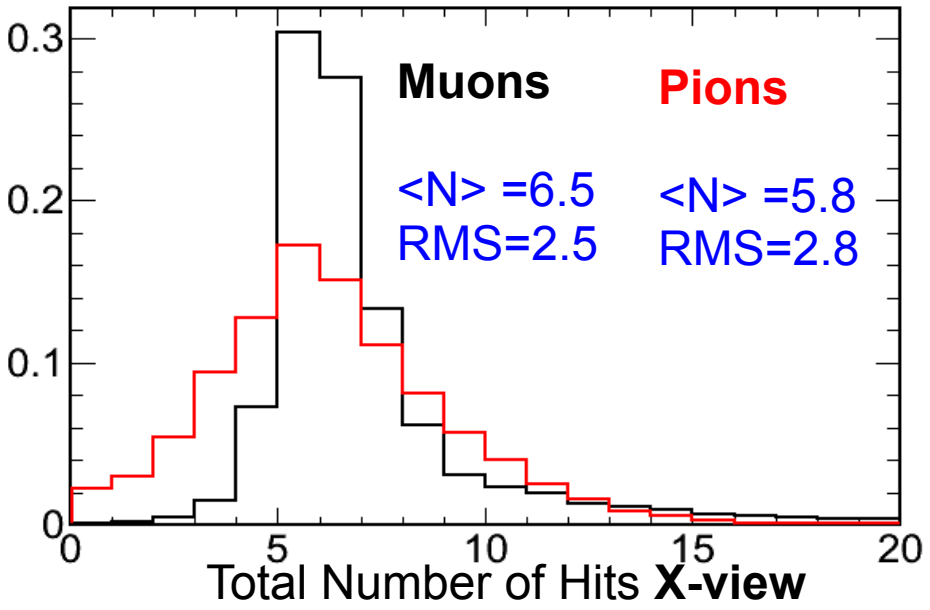
2 GeV · Muon enriched sample

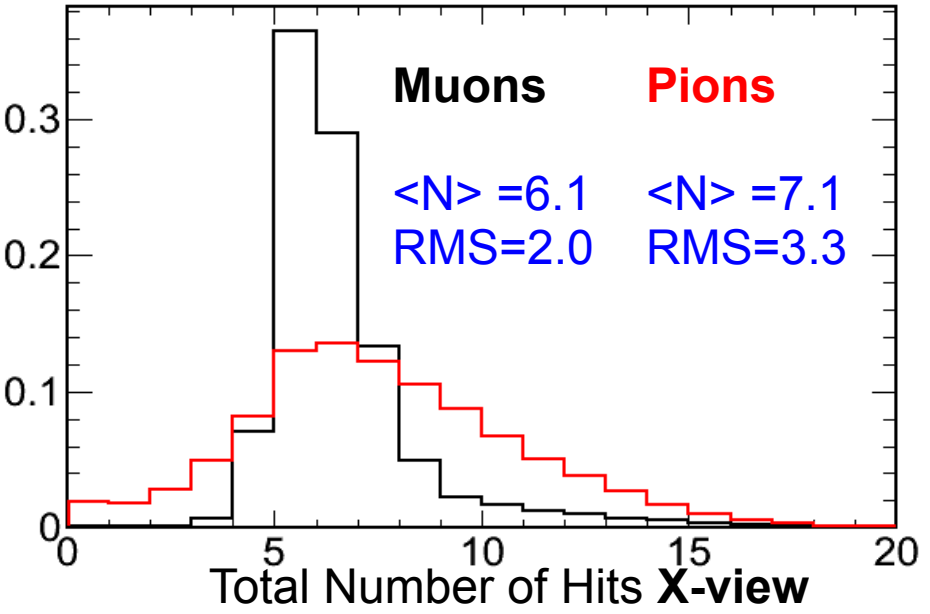


Total Number of Hits: 6 and 8 GeV



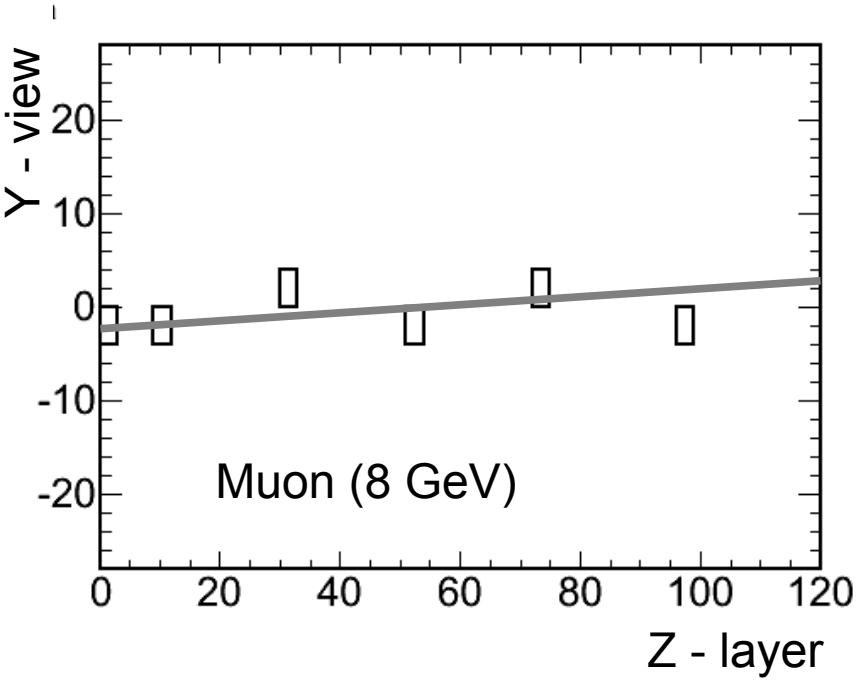


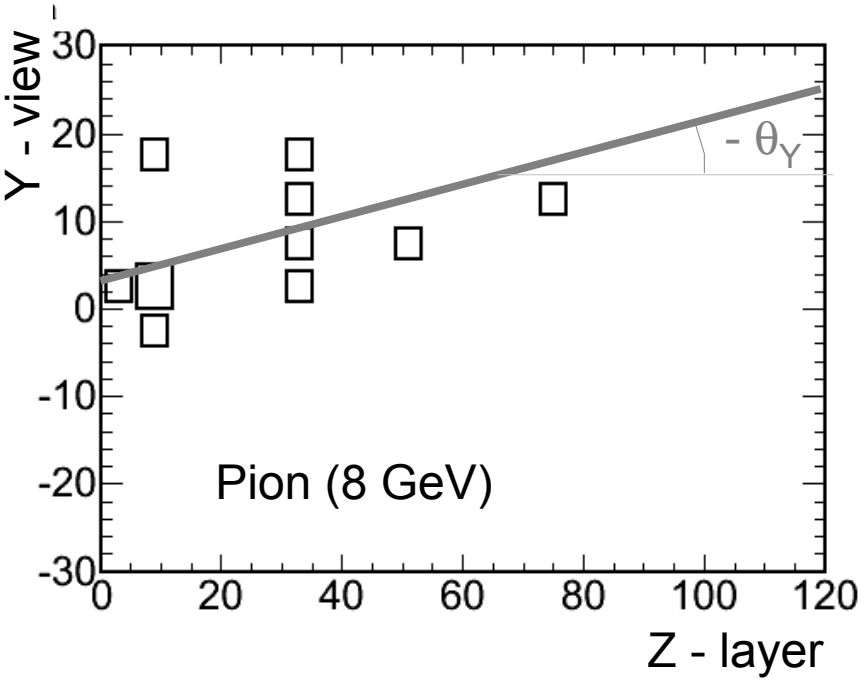


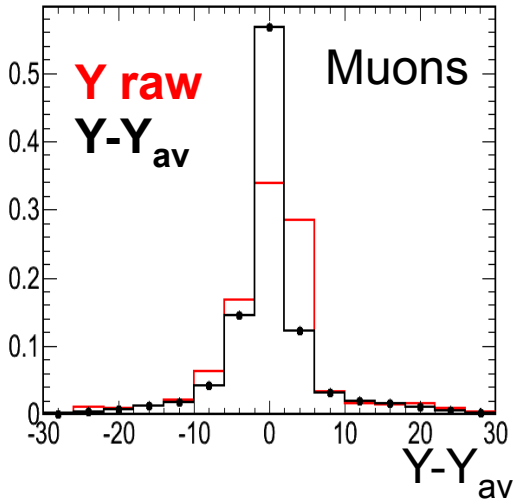


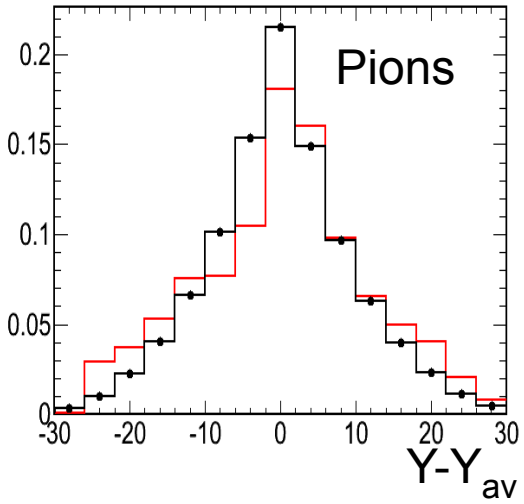
Tracking

- Linear fit of the hit positions
- Fit separated for the X and Y view:
  - X-view: 5 layers
    - $X = X_0 + \tan(\theta_X) \cdot Z$
  - Y-view: 7 layers
    - $Y = Y_0 + \tan(\theta_Y) \cdot Z$
- Later distribution of the signal respect to the fitted $Y\text{-}Y_{average}$





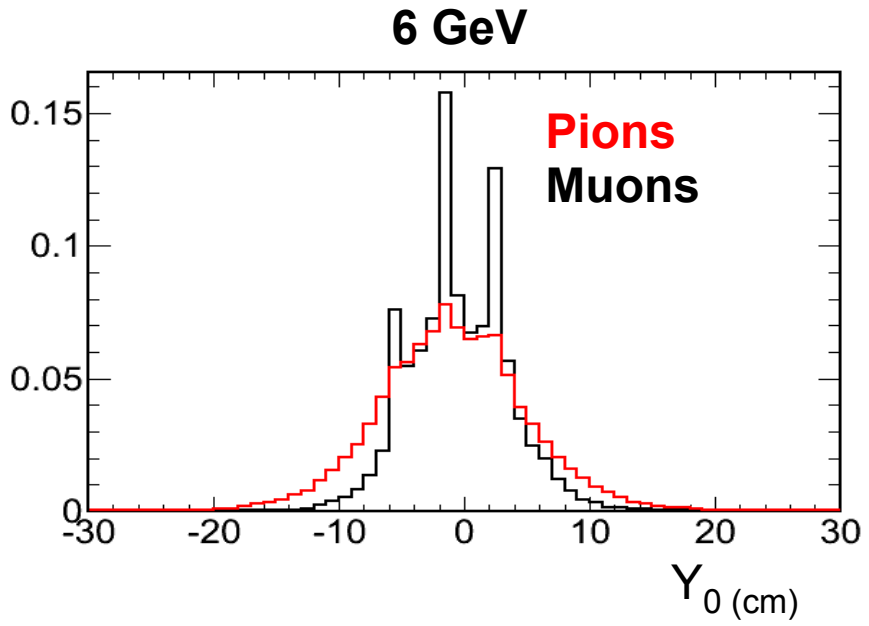


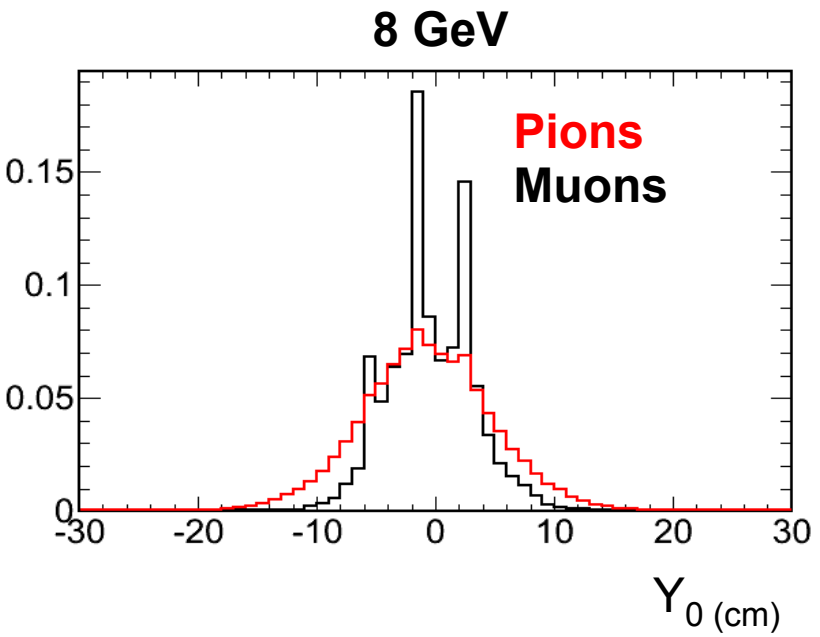


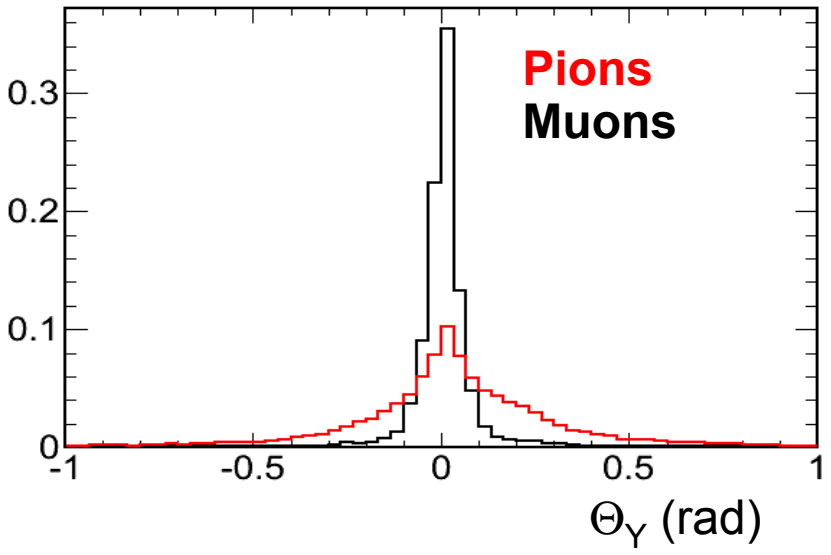
Tracking: fit parameters

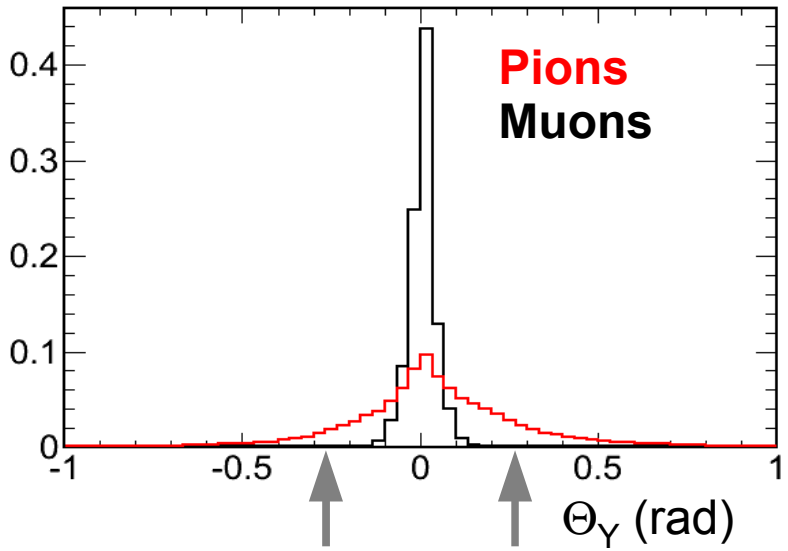
$X = X_0 + \tan(\theta_X) \cdot Z$

$Y = Y_0 + \tan(\theta_Y) \cdot Z$







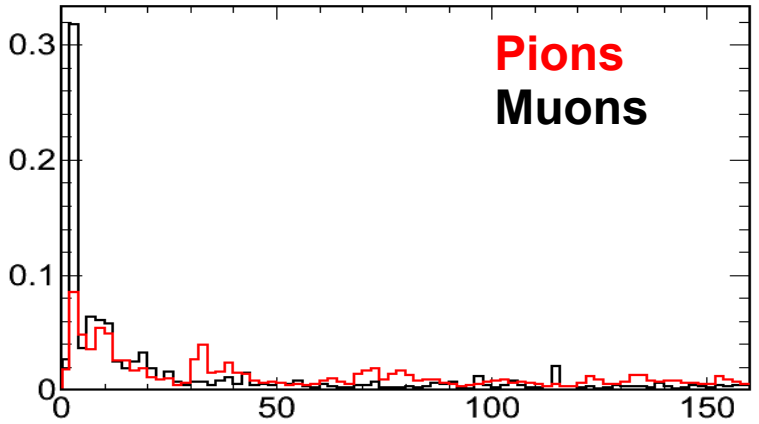


Other discriminating variables

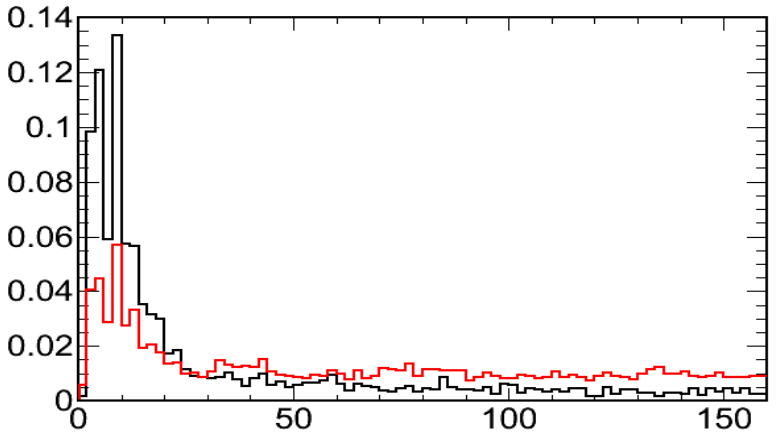
$$\chi^2 = \sum_{i=0}^{N_{Hits}} (Y_i - Y_{track})^2$$

Average Number of Hits per Layer

6 GeV

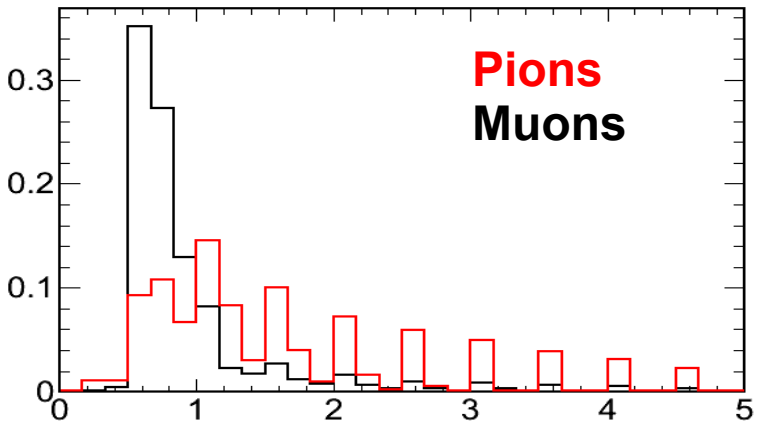


X-Z fit χ^2

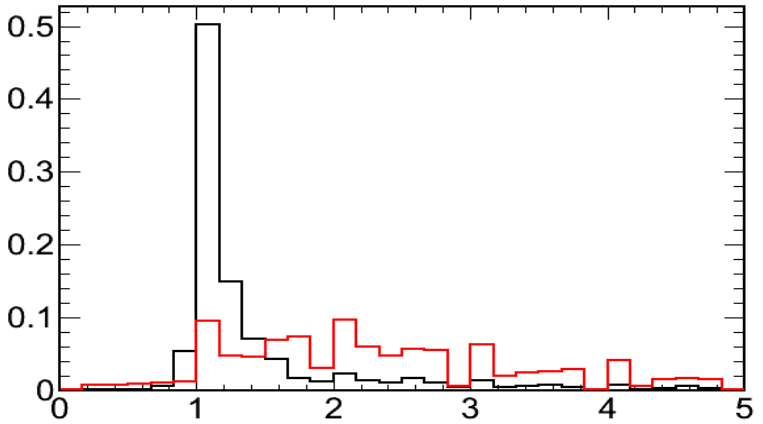


Y-Z fit χ^2

6 GeV



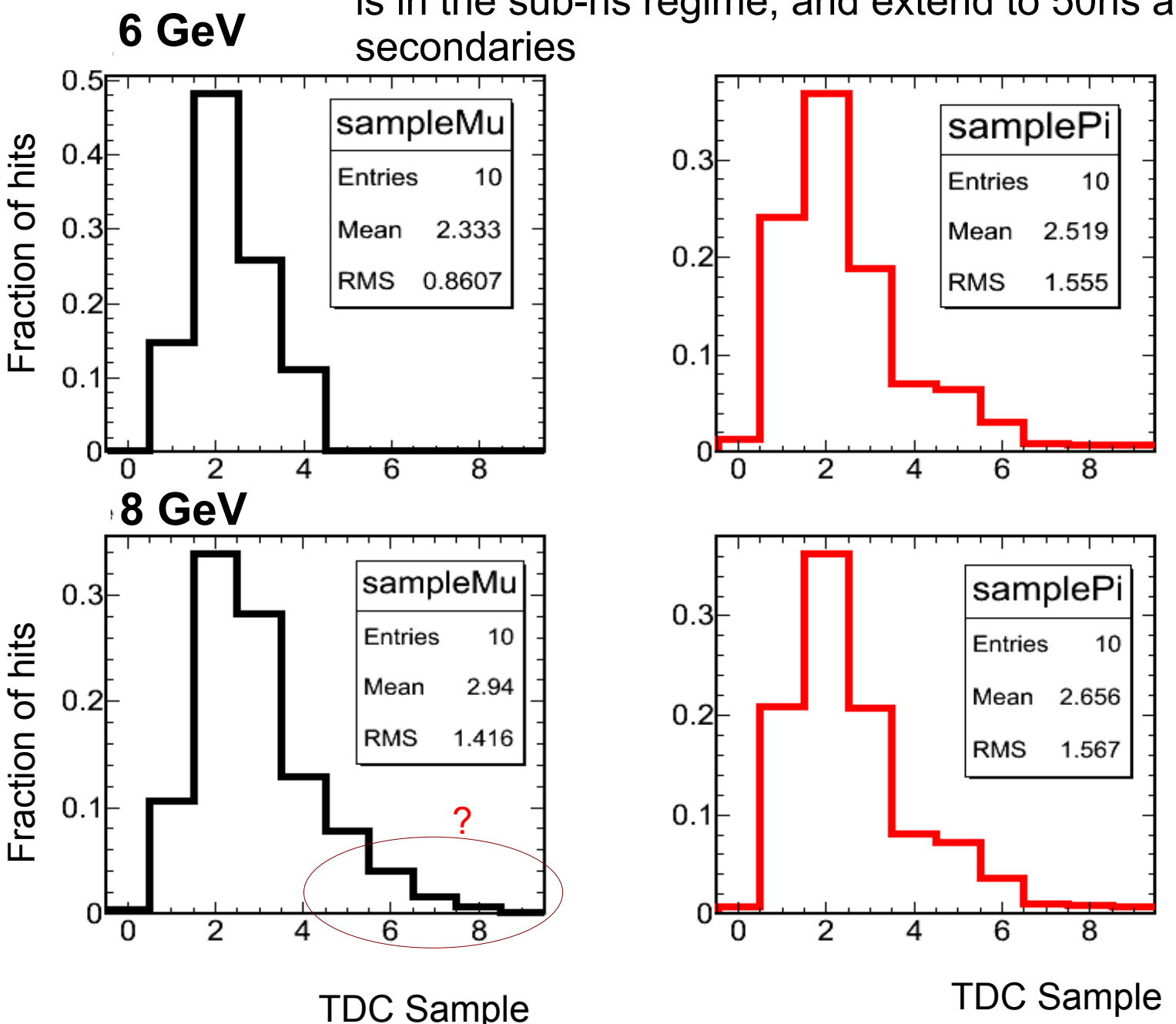
X-view NHits/Layer



Y-view NHits/Layer

Time Samples: μ–π discrimination?

- From simulation: time development of the signal in IFR for muons is in the sub-ns regime, and extend to 50ns and more for pion secondaries

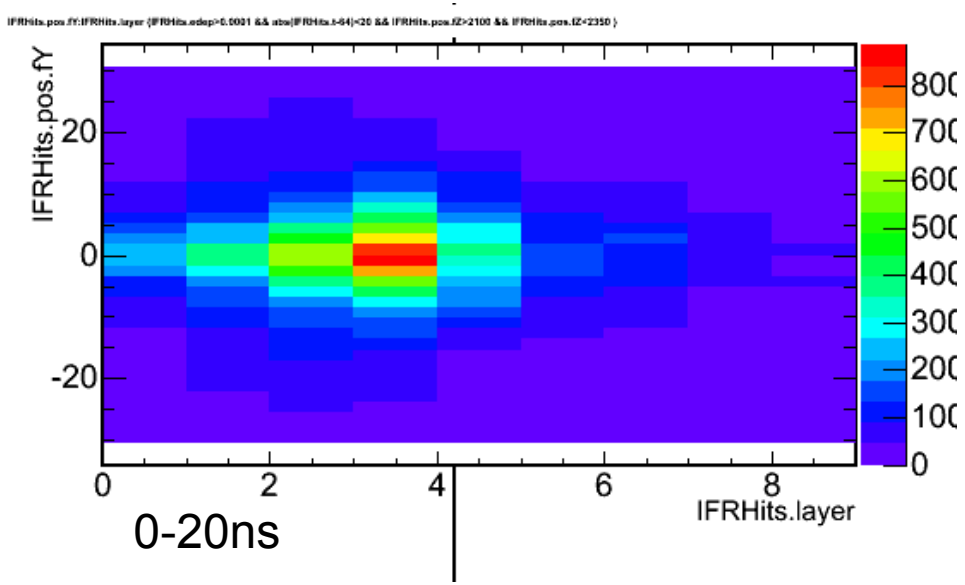


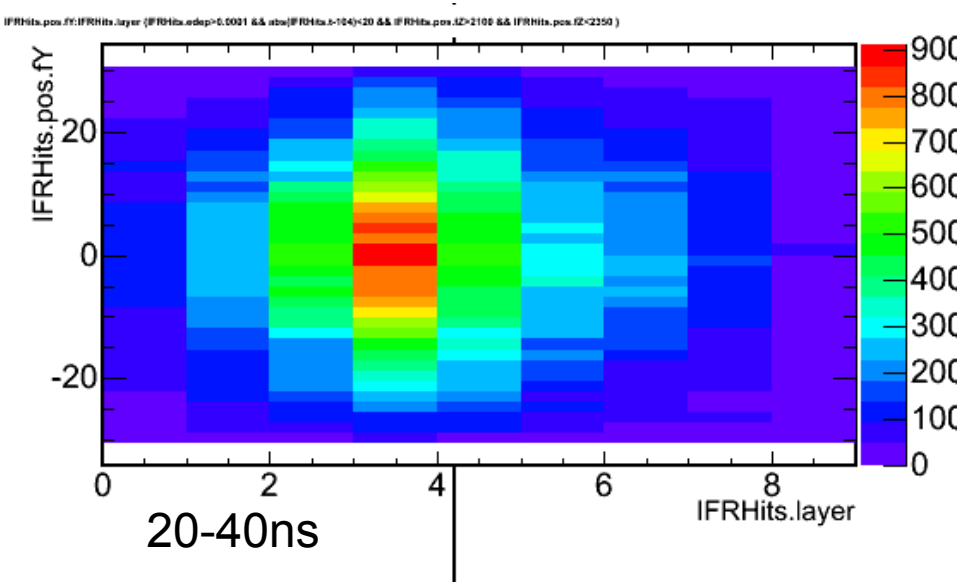
- Data from test beam and cosmics, confirm different signal time development for muon and pions!
- Use this information in a selector?
  - Require specific calibration
  - Digitization? Need a detailed simulation of the electronics and signal formation

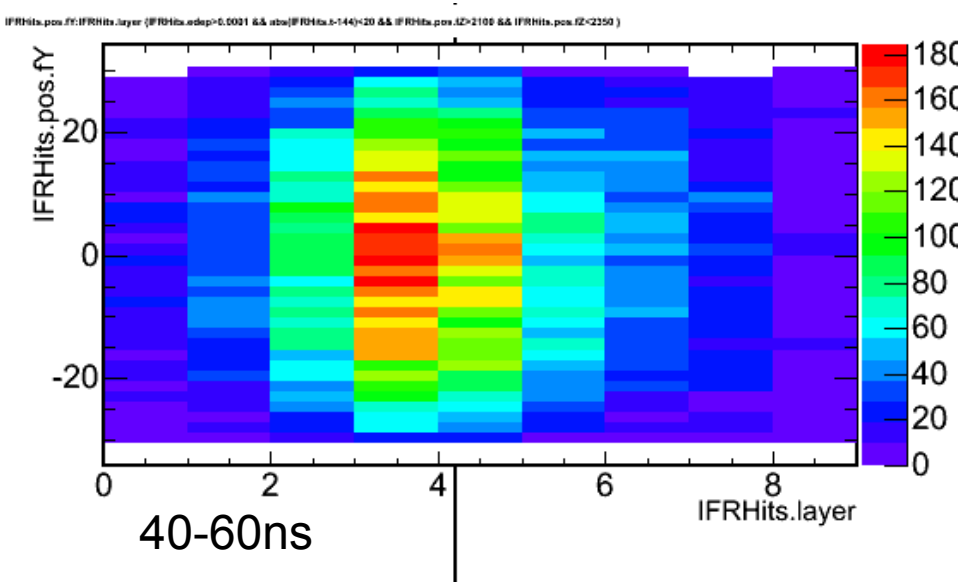
To Do

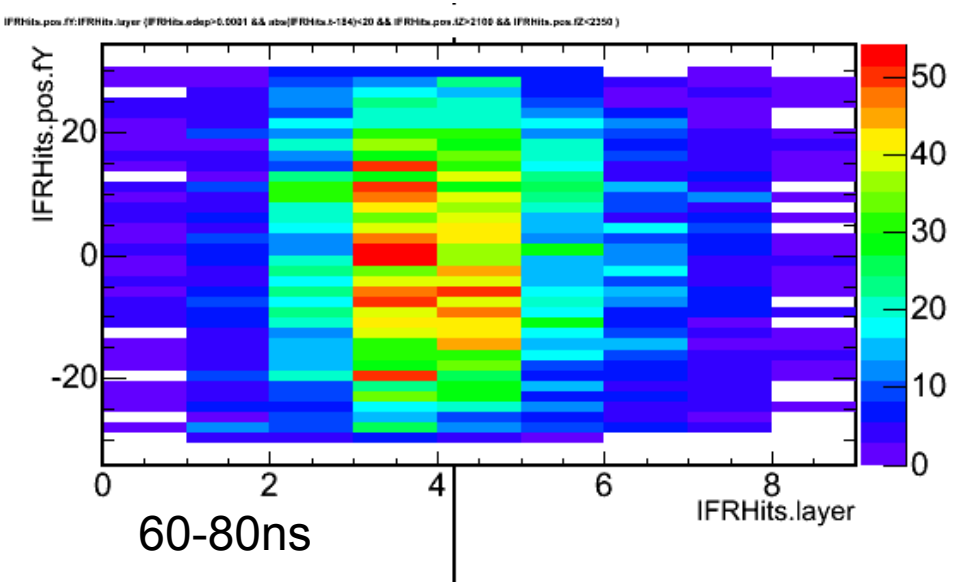
- Before the next test beam (October)
  - Detailed comparison with simulation and simple MC tuning
  - Already available rootples with the July2011 Geometry/Setup
    - Gigi improved the simulation: particle gun at -70m from the Cherenkov: crucial to account for the muon contamination in the pion sample:
      - Mostly decay in flight before the Cherenkov and after the Ch
- For the TDR
  - Tune the simulation: digitization, physics lists,....
  - Implement a muon selector based on data, and compare the performances with the detailed simulation
  - Use the tuned simulation to define the total amount of iron and the detector segmentation

Simulation: time development for 8 GeV π





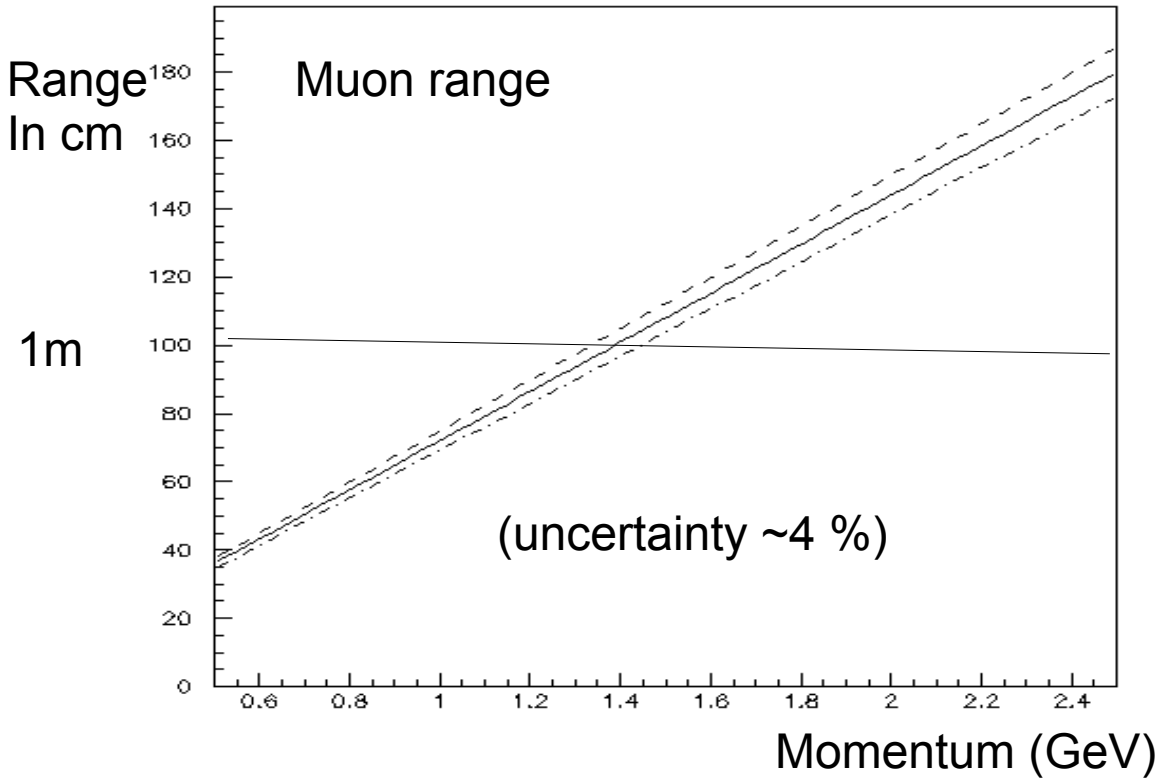




25% of hits have gTime>20ns

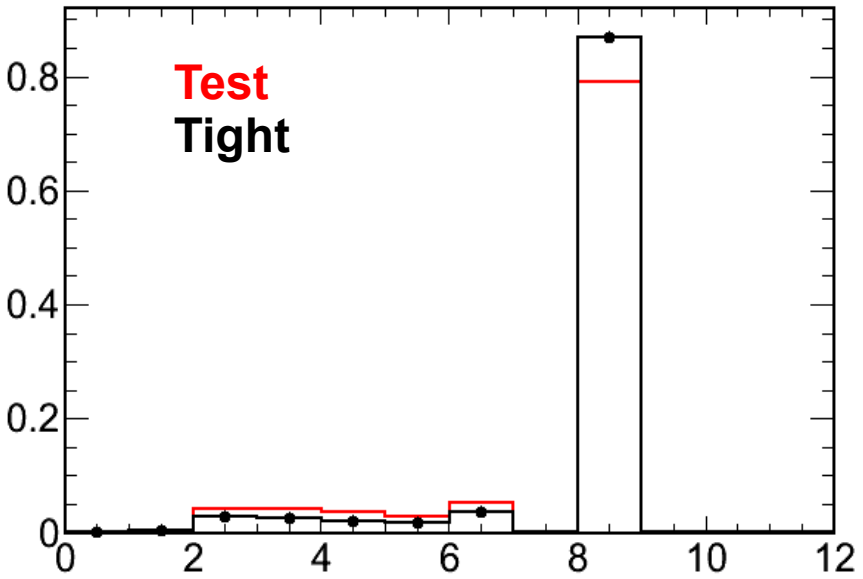
General idea

- Smaller betagamma-> smaller muon momentum, important muon pion separation in the ~GeV and sub-GeV regime
- For high momentum (above 2 GeV) the segmentation should be not crucial, only the total amount of iron is important
- Below 1-1.5 GeV muons stop in the iron: total amount of iron not important but the segmentation could be relevant



Tight-Test trigger comparison

6 GeV · Muon enriched sample



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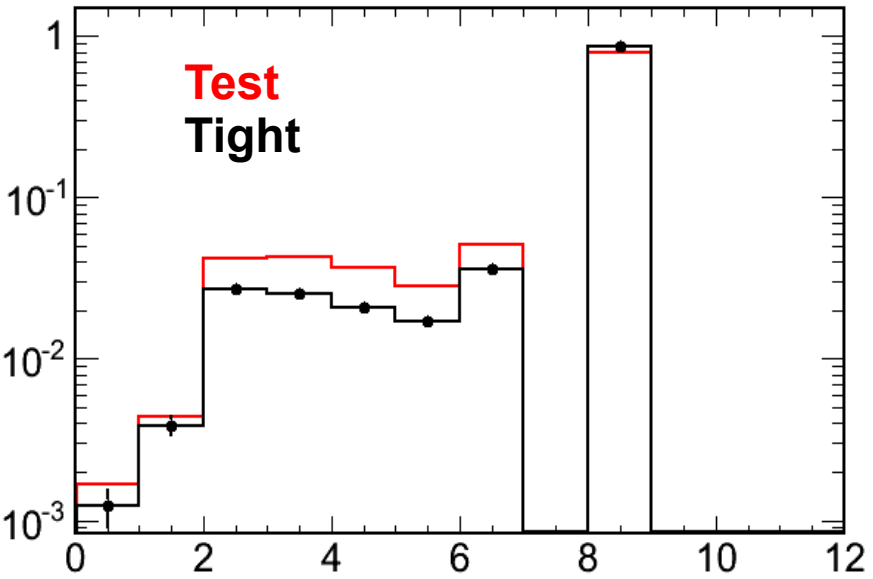

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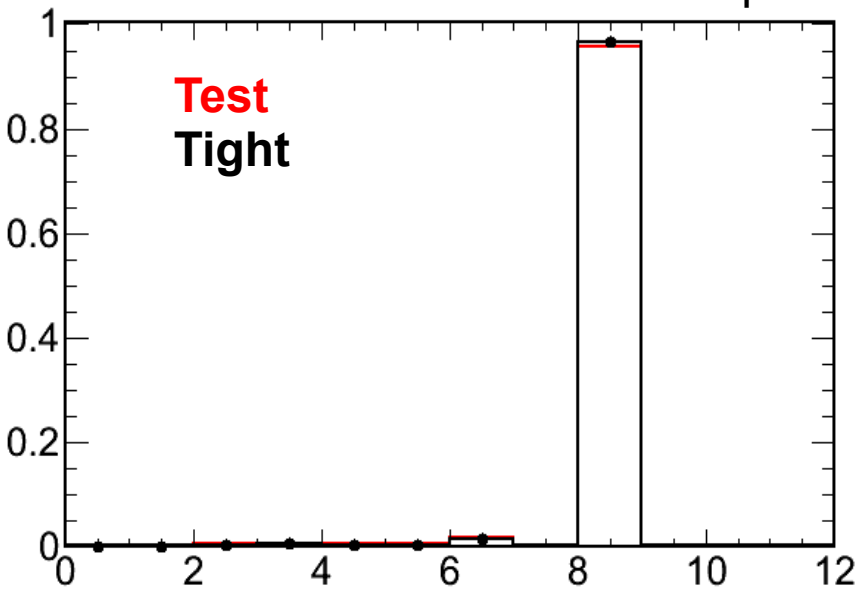

8 GeV · Muon enriched sample