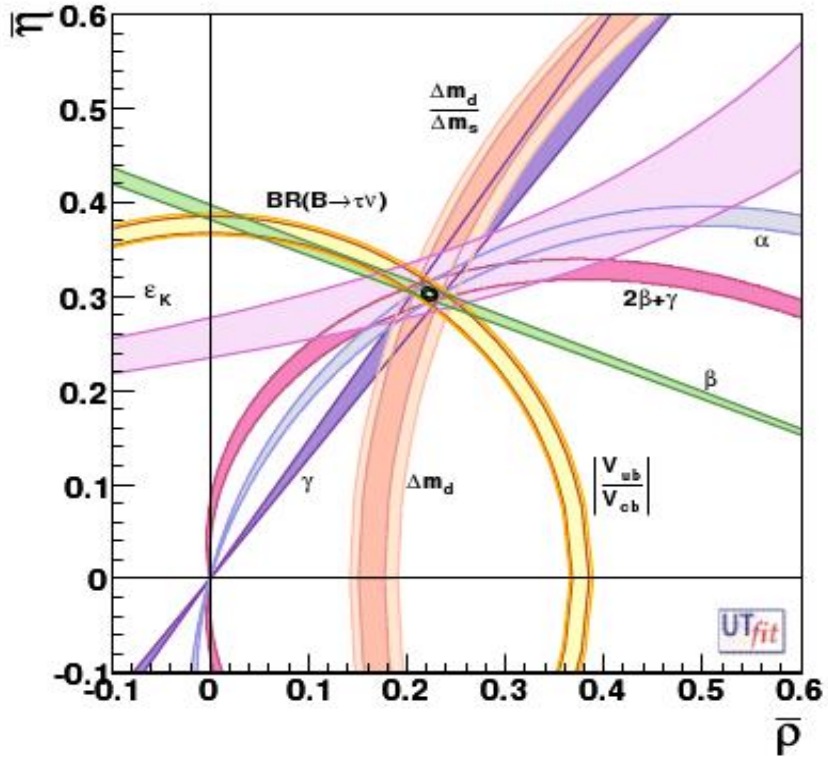
SuperB Workshop, LNF, 4-7 April 2011

Result from Test Beam: reconstruction and muon ID



G.Cibinetto, N.Gagliardi and M.Rotondo

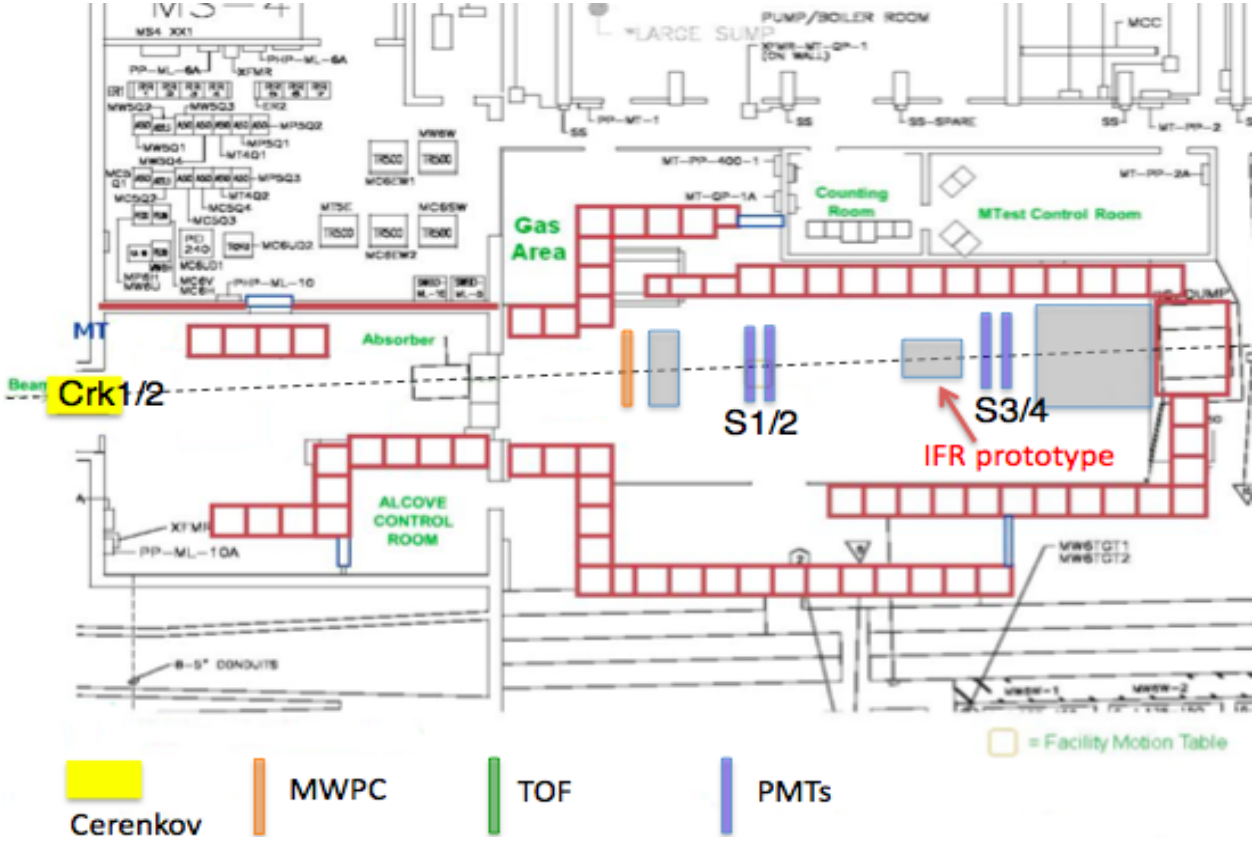
Outline

- Goal;
- Layout;
- Data;
- Strategy;
- Track Direction Correction;
  - ✔ X hits;
  - ✔ Y hits
  - ✔ Z hits;
- Last Layer;
- Data-MC comparison;
- Simulation of the pion time development;
- Conclusions.

Prototype Data Analysis: Goal

- Muon/Pion separation on real data;
  - Check hadronic shower models (QGSB_BERT, QGSB_HR,...);
  - Define a model for Detector Response (Digitization);
  - Both aspects important for Detector Geometry optimization and for future SuperB full simulation;
- Hadronic shower tails are crucial to define:
  - The total amount of material;
  - The optimal segmentation;
- Many studies on the shower development available above 10 GeV, few old studies available in the “GeV” regime;
- The analysis of the prototype requires close interplay with simulation.

Prototype Data Analysis: Layout



- Scintillator $S_{1\text{-}2}$ used to select events
- Scintillator $S_{3\text{-}4}$ used to evaluate the leak per track
- For the time being: Analyze only BIRO channels TDC will follow

Selection

$$\mu \Rightarrow S1 \times S2 \times \overline{C}_e \times C_\mu$$

$$\pi \Rightarrow S1 \times S2 \times \overline{C}_e \times \overline{C}_\mu$$

Distance between Crk1/2 and prototype is ~22m, the pion decays are an issue:

- 4 GeV: 8%
- 8 GeV: 4%

Simulation needed to subtract this component

Prototype Data Analysis: Data

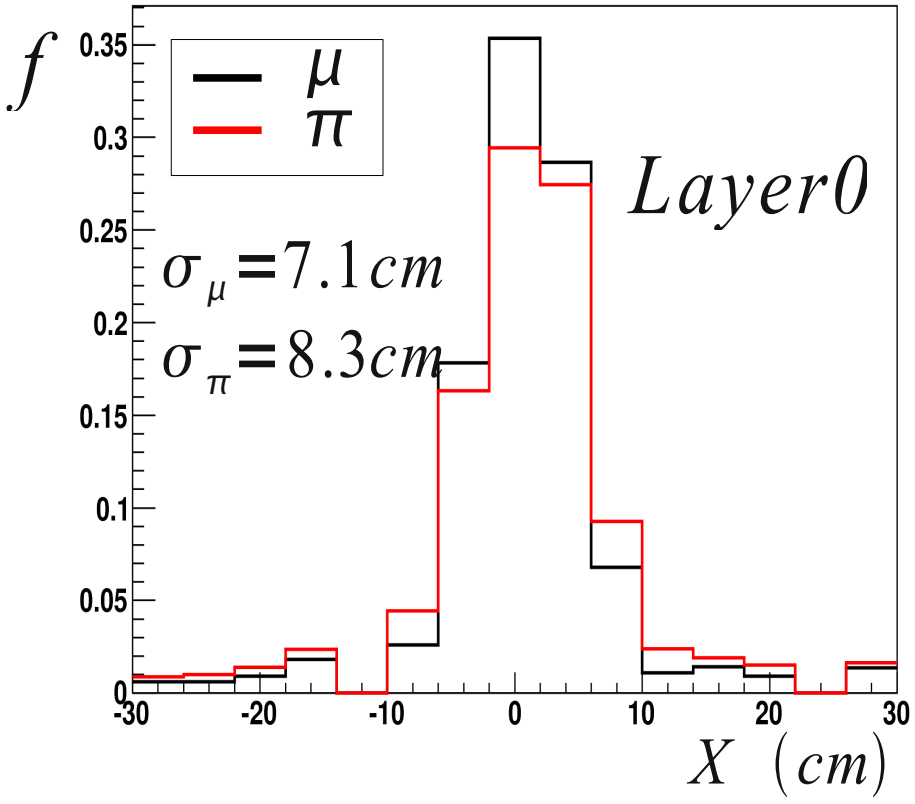
	Trig	N_{tot}	$S_{1\text{-}2}$ μ	$S_{1\text{-}2}$ π	$S_{3\text{-}4}$ μ	$S_{3\text{-}4}$ π
4 GeV	μ	35320	28,9%	16,2%	25,5%	12,6%
	μ+π	48420	2,4%	71,2%	25,4%	11,3%
5 GeV	μ	51113	40,3%	13,2%	43,9%	12,3%
	μ+π	118635	2,2%	78,8%	48,0%	10,4%
6 GeV	μ	51860	52,4%	6,8%	64,3%	13,7%
	μ+π	57342	3,4%	71,8%	52,7%	4,8%
8 GeV	μ	x	x	x	x	x
	μ+π	95326	2,8%	89,7%	81,4%	10,4%

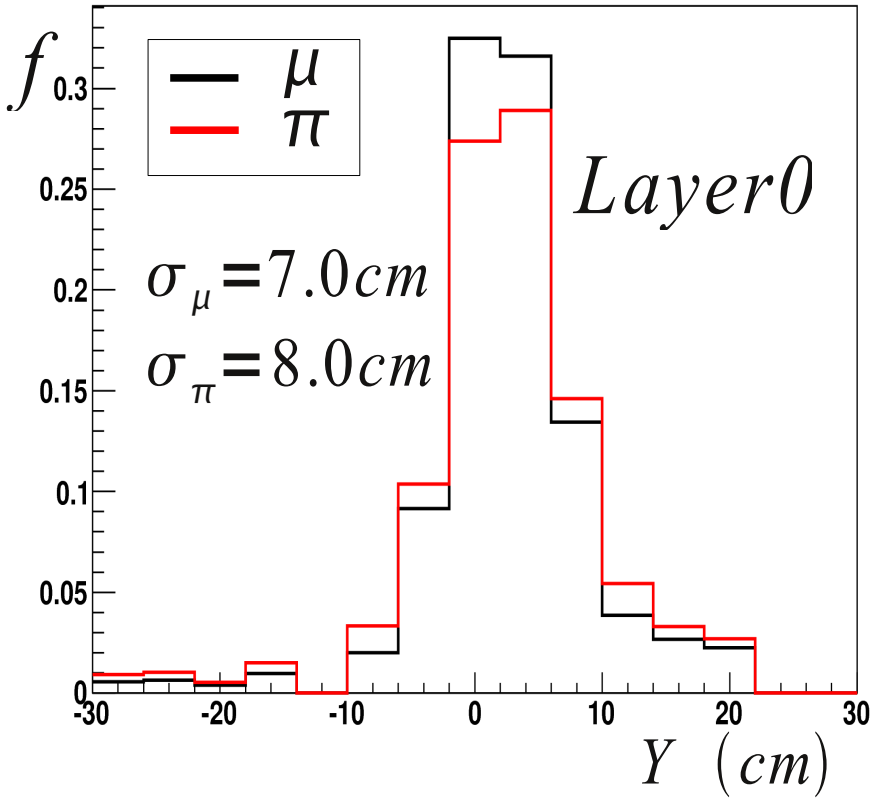
Prototype Data Analysis: Strategy

- Total number of hits/layer and lateral size for pions, strongly related to the hadronic shower shape;
- Last layer is a quantitative clear measurable quantity related to the pion punch-through;
- Evaluate the hadronic shower leak using scintillator S_3-S_4;
- Time development of the signal in IFR for muons is in the sub-ns regime, and extend to 50ns and more for hadronic;
- Analysis strategy:
  - Reduce smearing due to the beam size (~10cm) using the first 3 layers;
  - Quantitative studies on hadronic shower development cannot be done because of the rough longitudinal segmentation.

X and Y hit positions

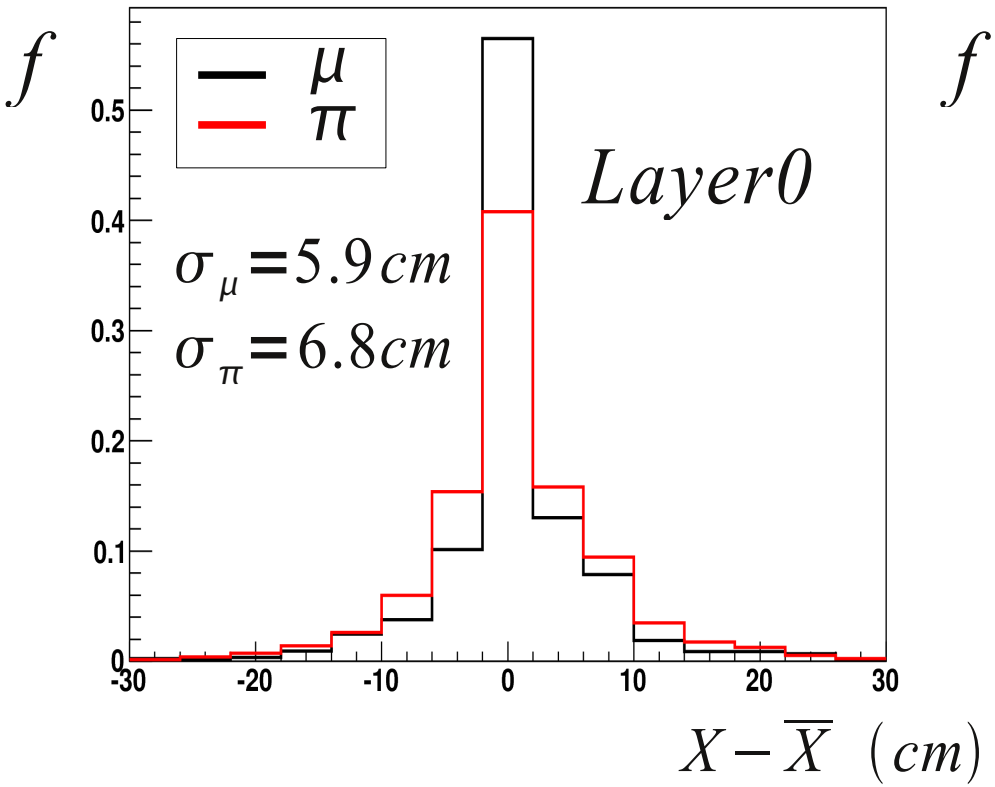
- X and Y positions show a smeared distribution due to finite dimension of the beam and MS before prototype;
- The study of the later shower size needs the knowledge of the track direction.

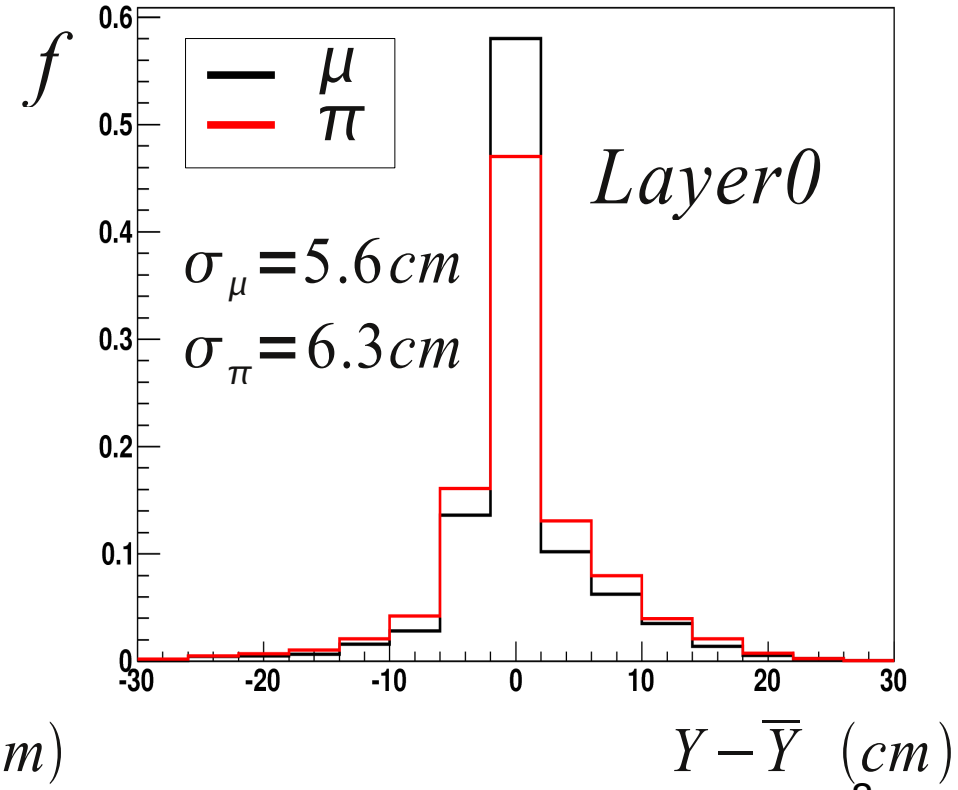




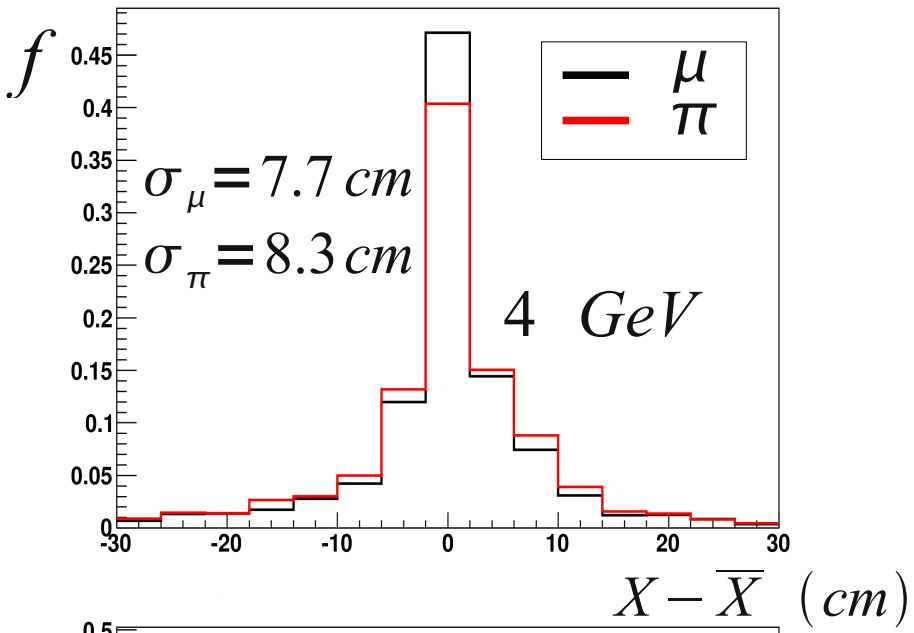
Track direction Correction

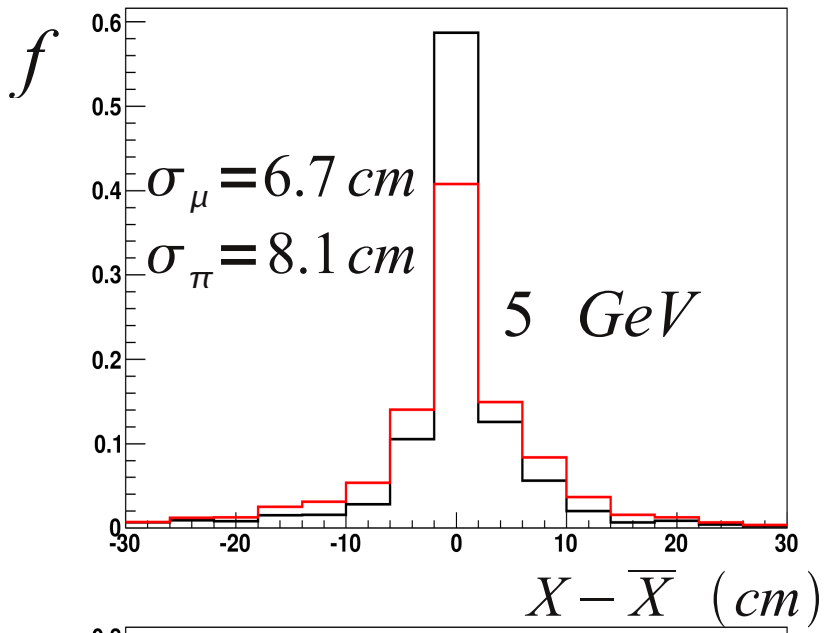
- Track direction determined from hits collected in the first three layers;
- Next Test Beam MWPC?

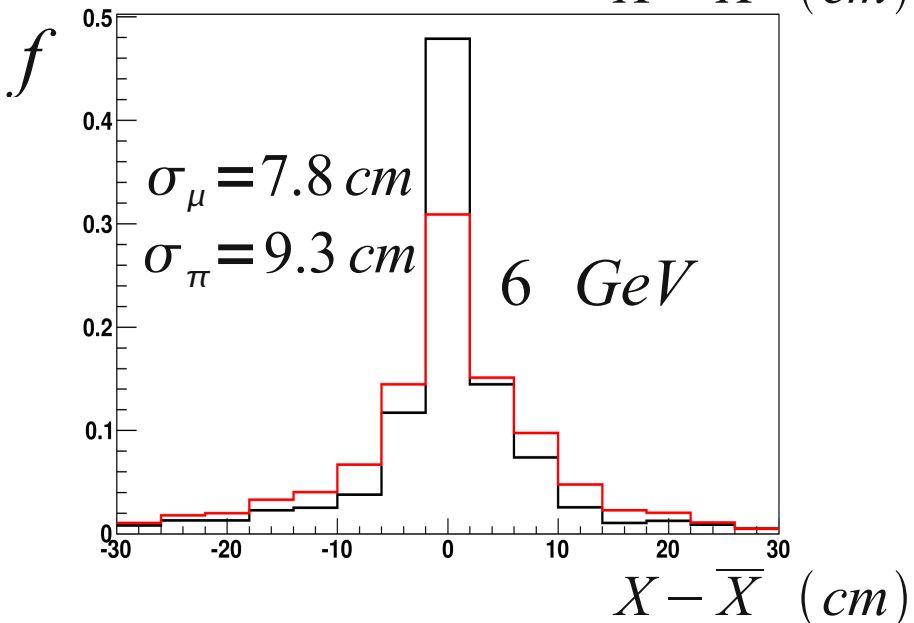


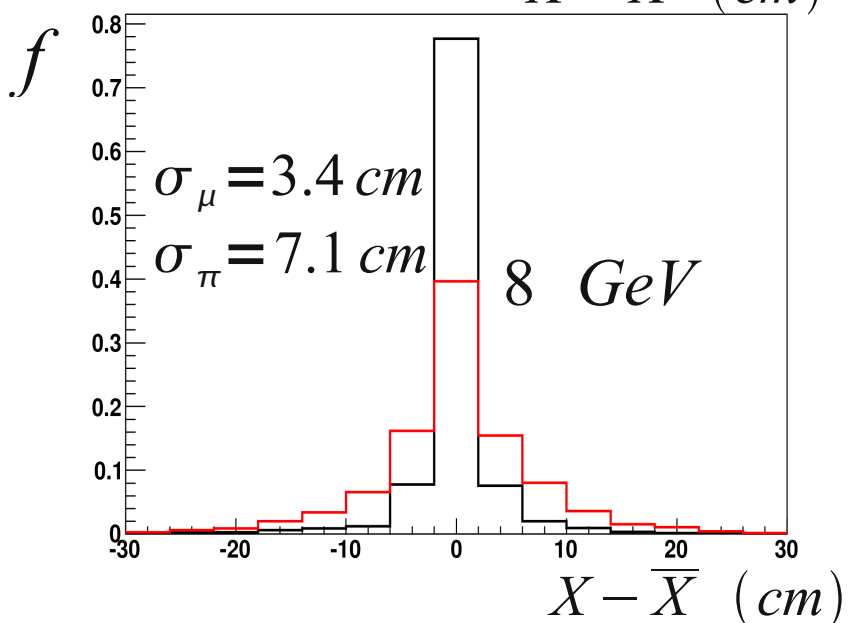


X as function of beam energy

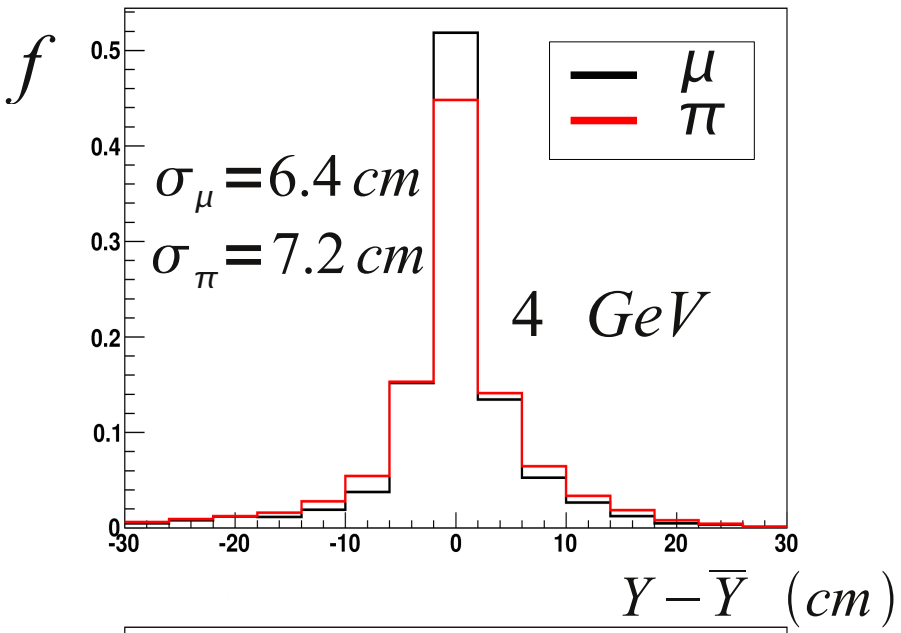


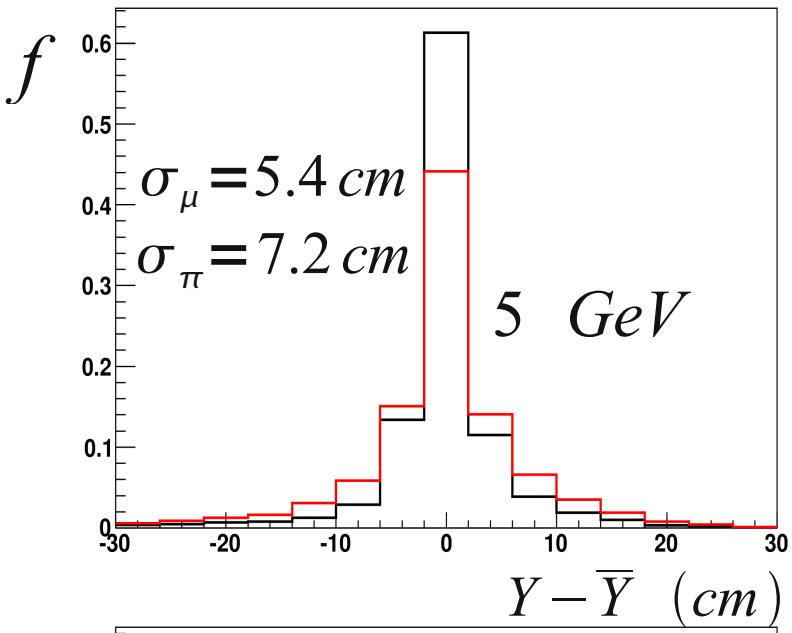


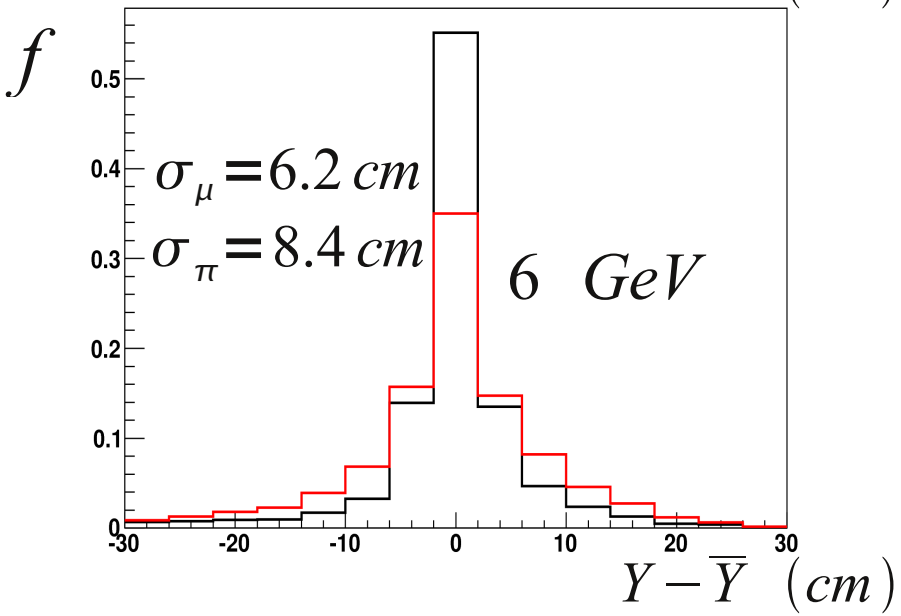


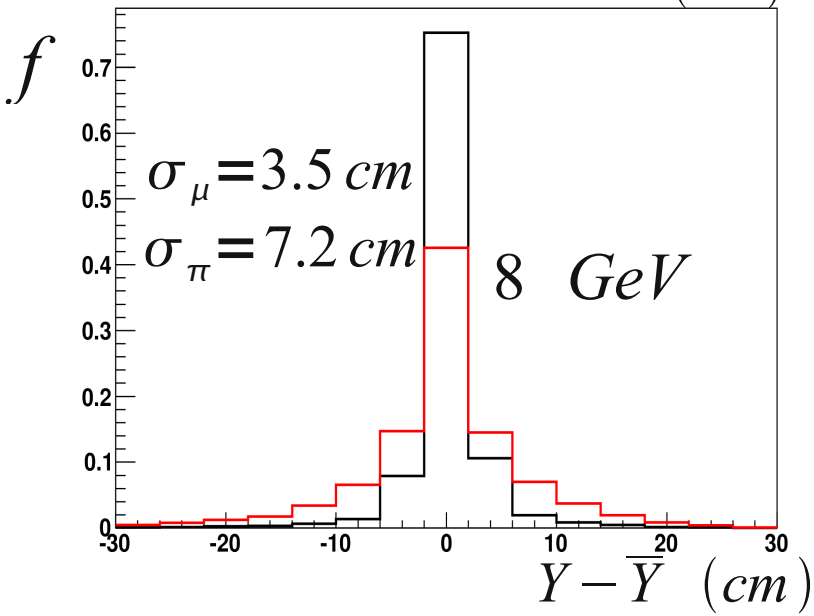


Y as function of beam energy



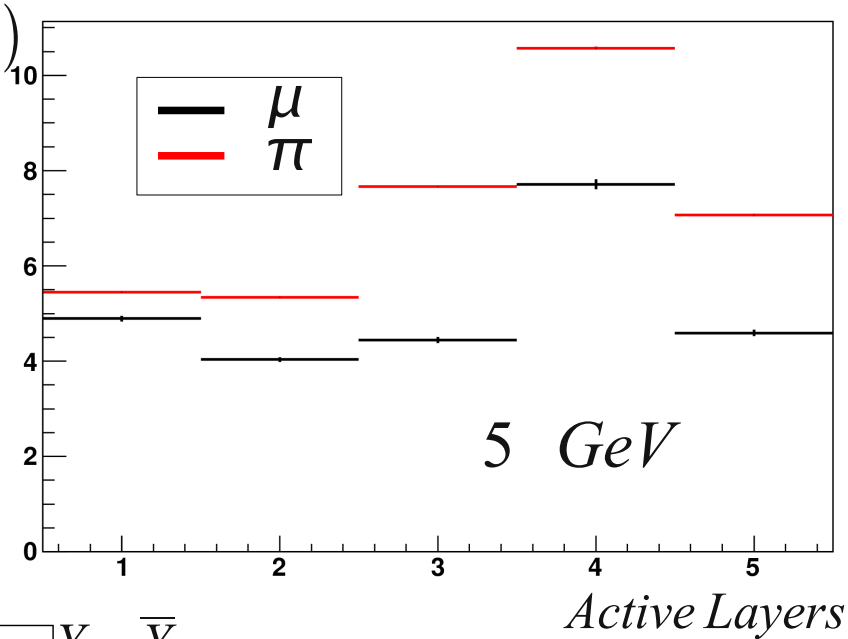




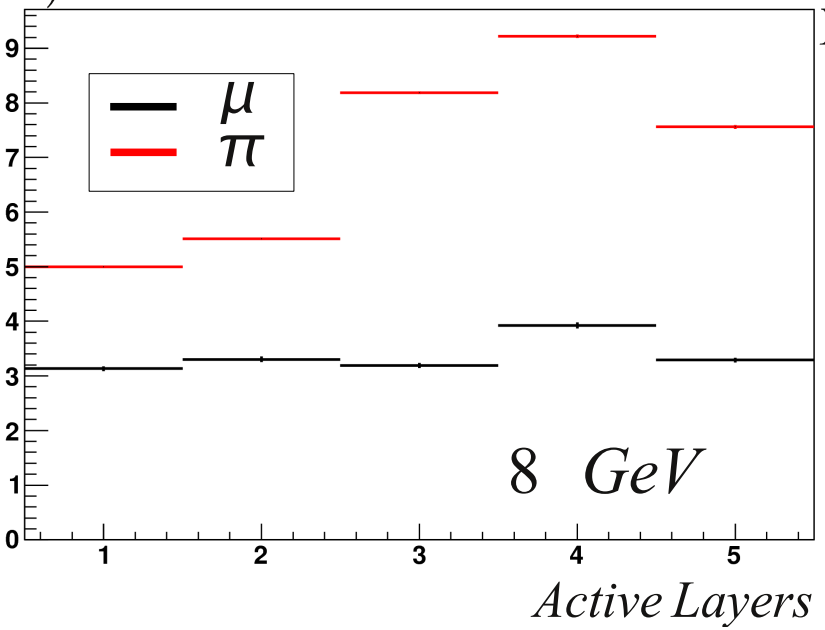


Later cluster size

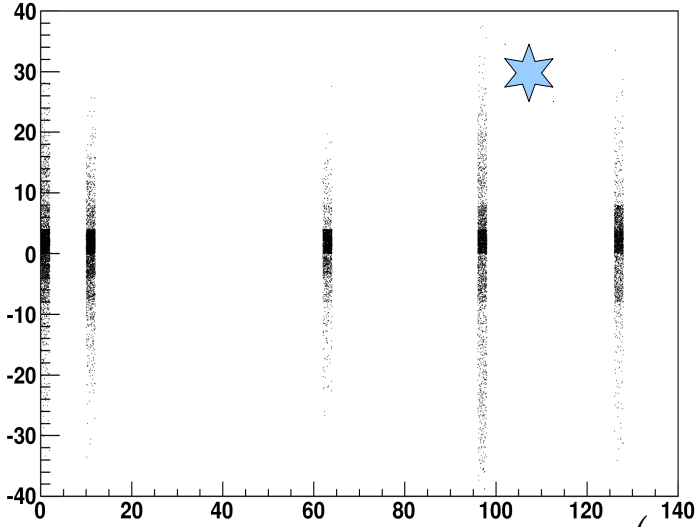
- Y distribution RMS as $\sigma\,(cm)$ function of active layers
- Differences between muons and pions are clearly visible
- Layer6 noisy(see also next slide)?



$\sigma\,(cm)$

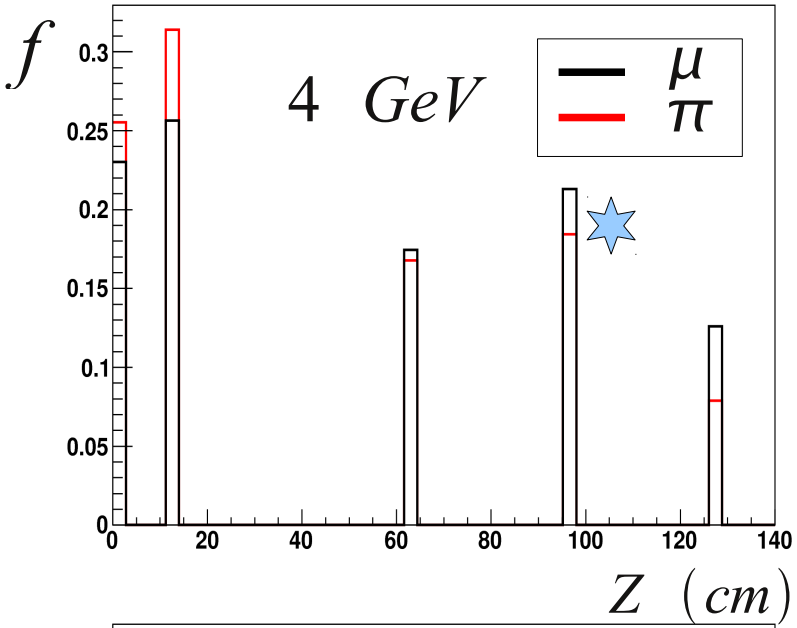


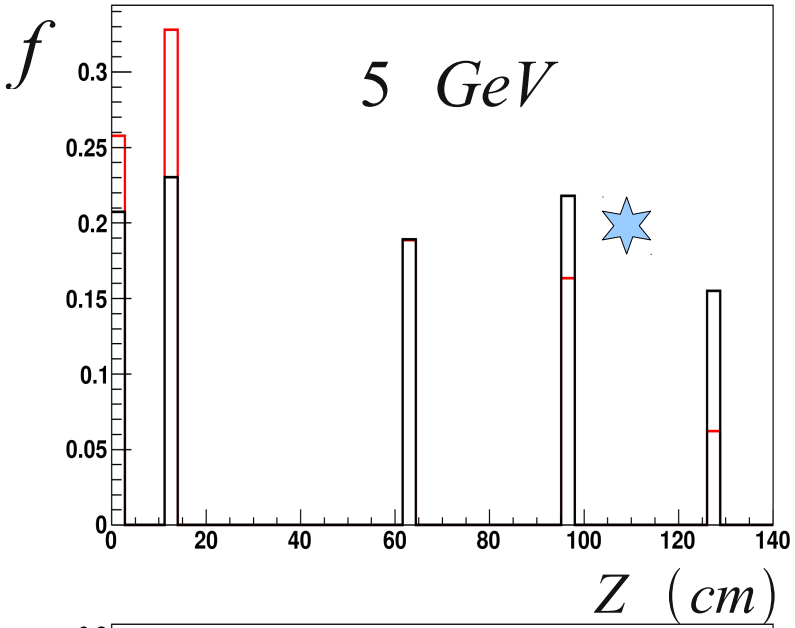
$Y-\overline{Y}$

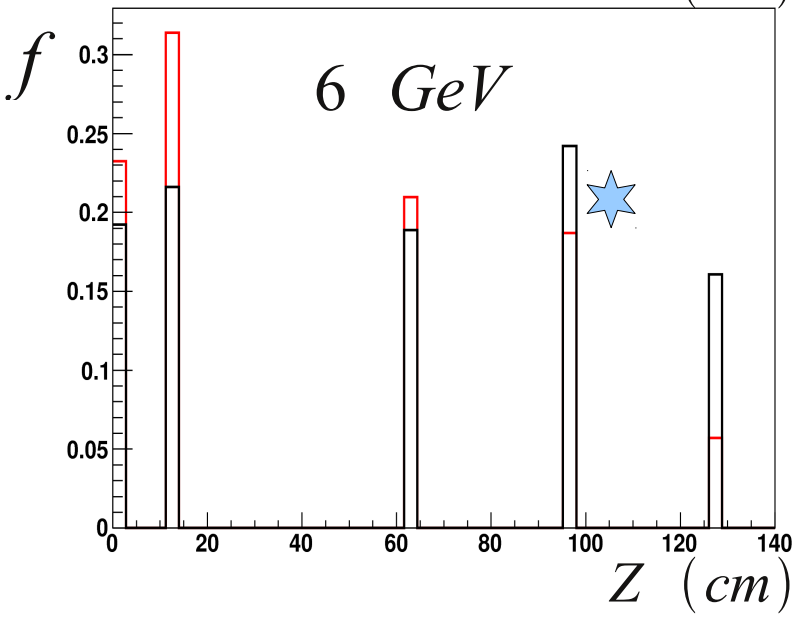


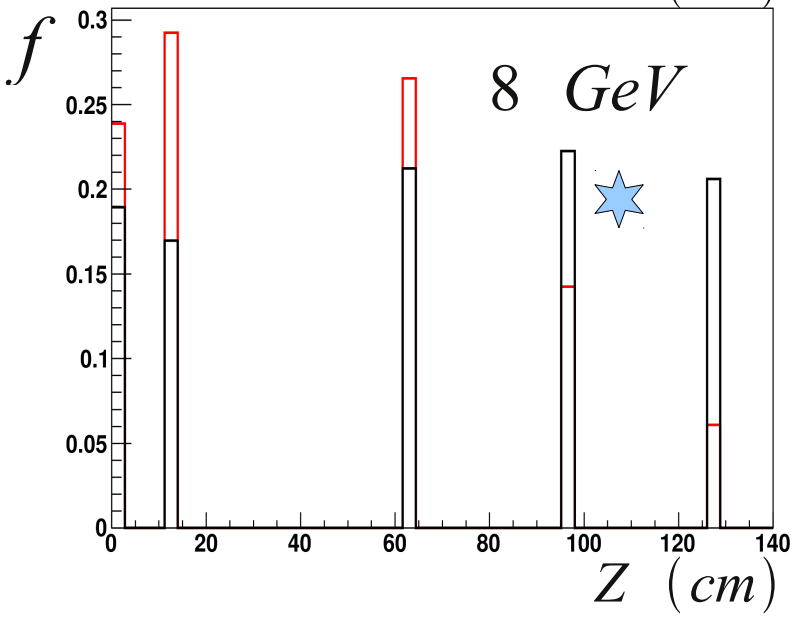
$z\,(cm)$

Z as function of beam energy

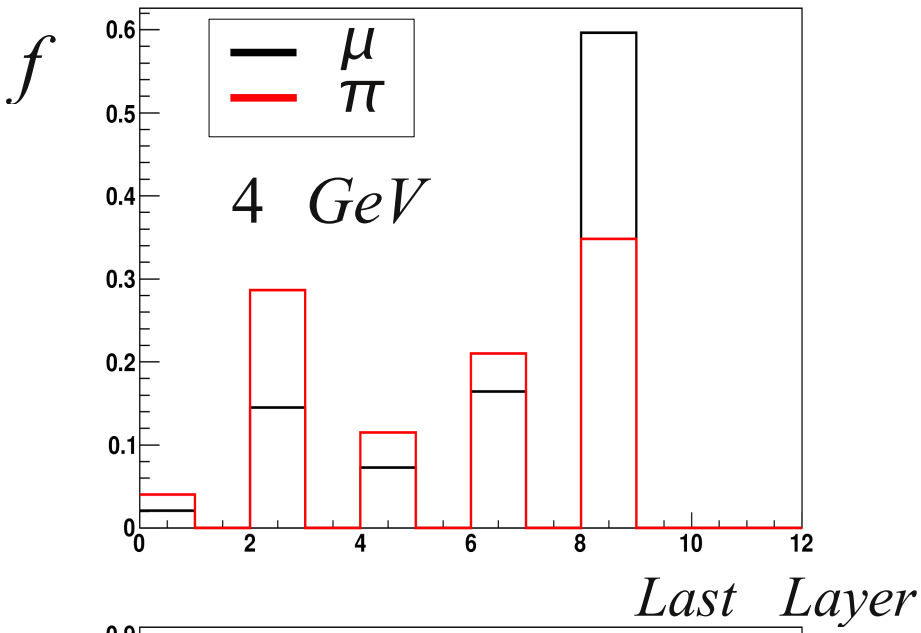


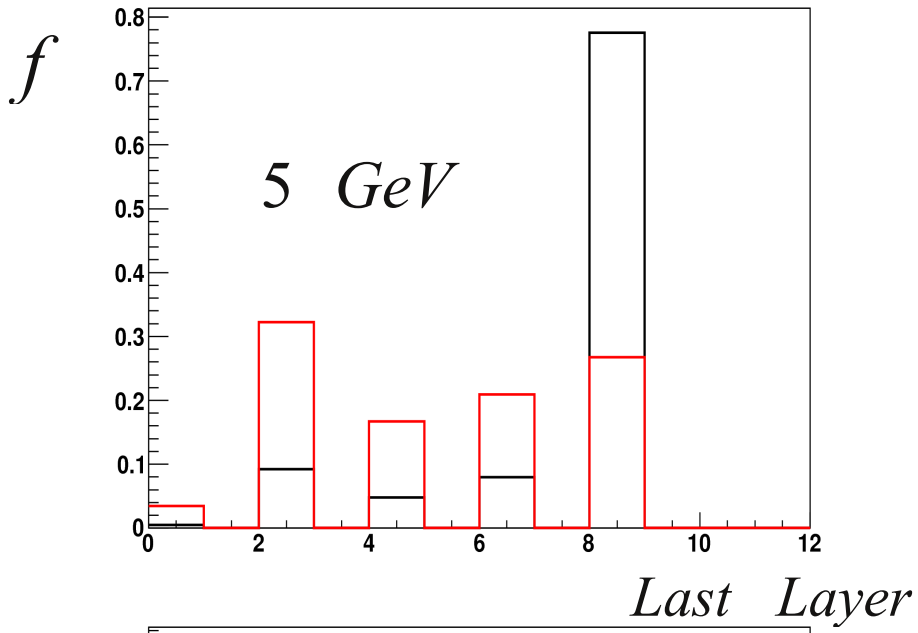


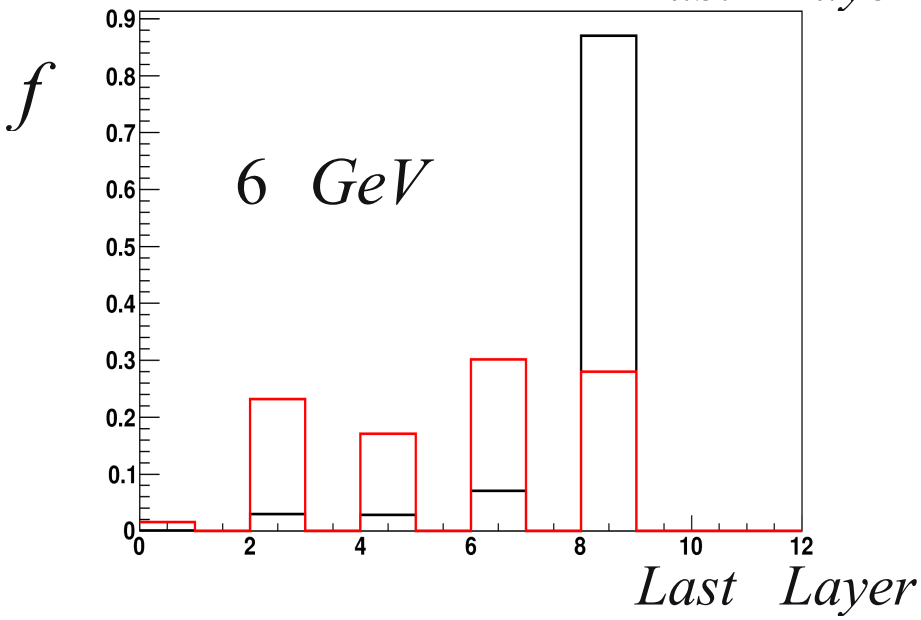


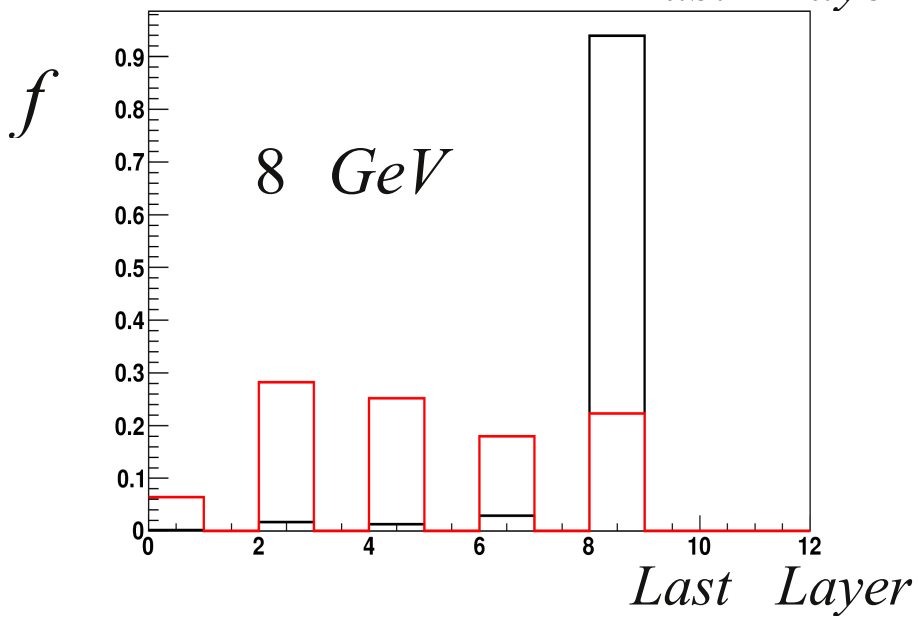


Last Layer as function of beam energy



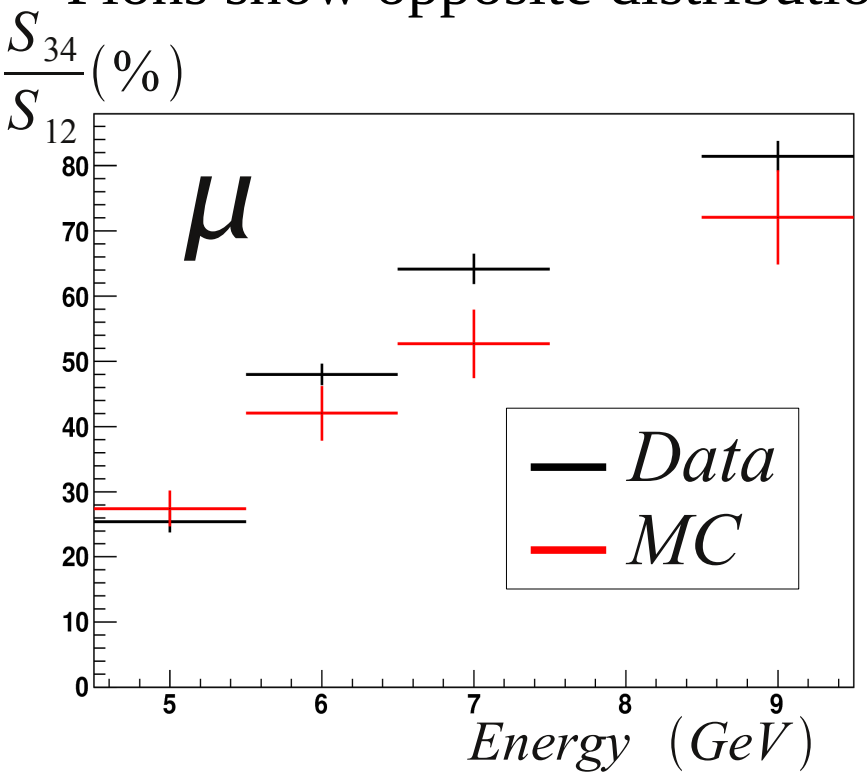


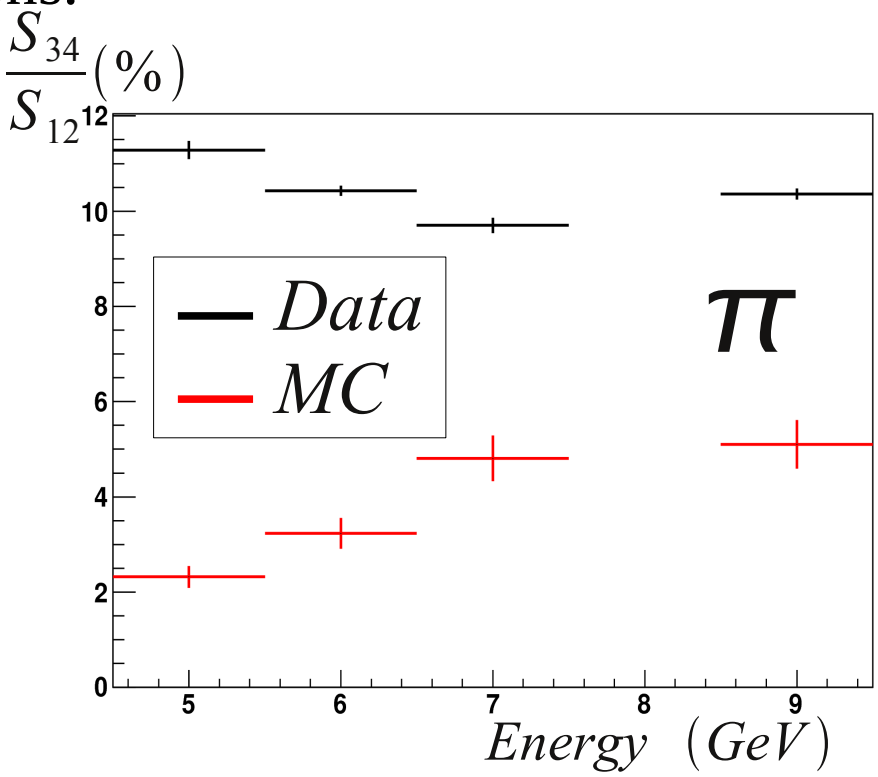




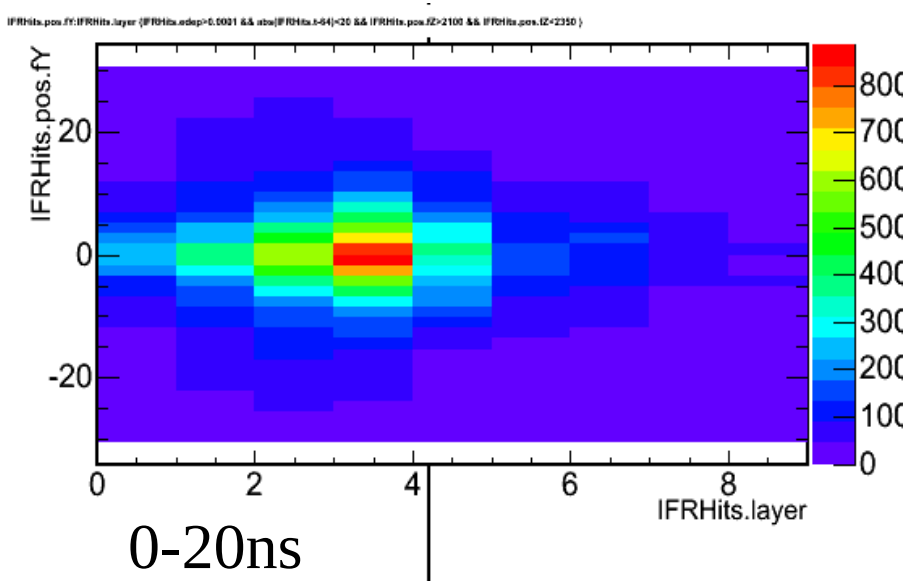
Data-MC Comparison

- Try to estimate the contamination of muons in pions sample and vice versa using MC;
- Implemented a simulation of the prototype: several information are missing (correct distances, scintillator dimensions, beam composition as function of the energy, Cerenkov efficiencies, ...) ;
- Muons fraction are quite compatible within errors;
- Pions show opposite distributions.

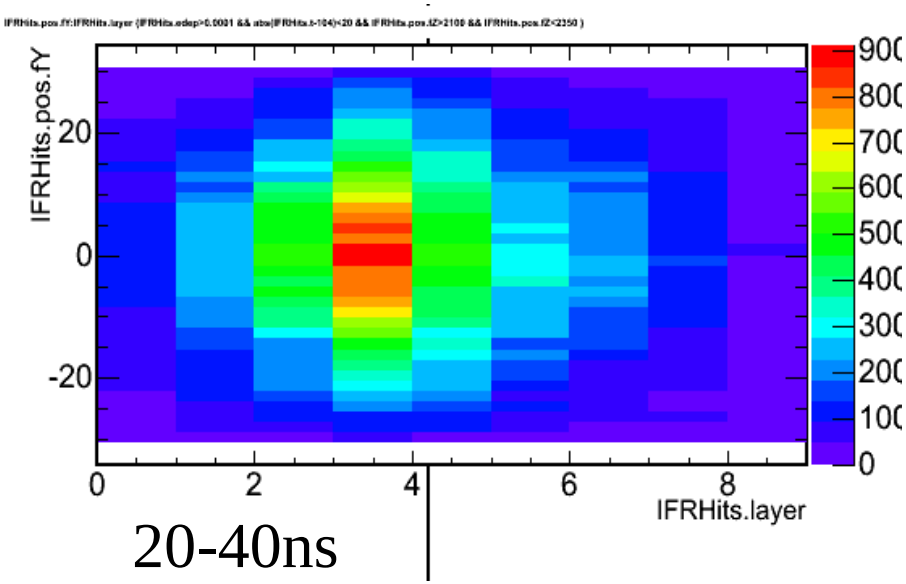




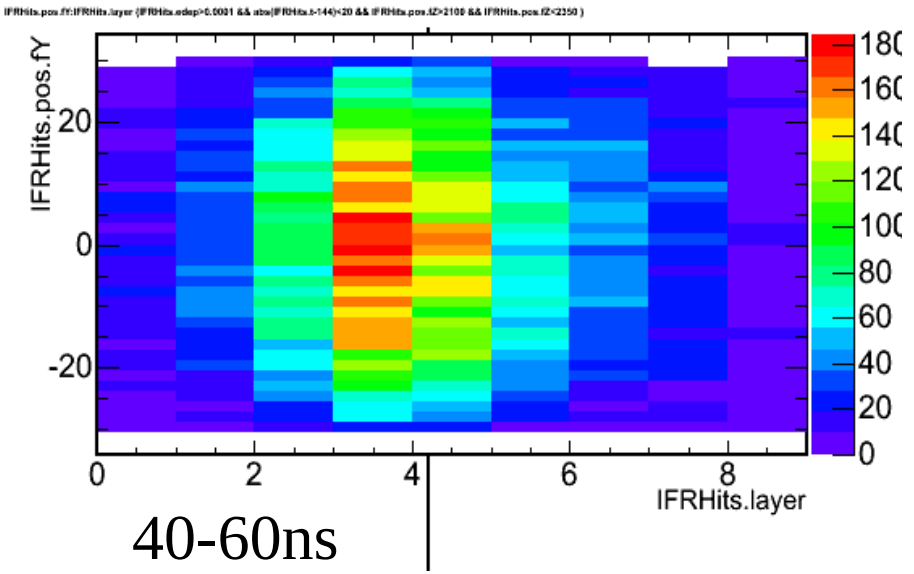
Simulation: Time development for 8 GeV π



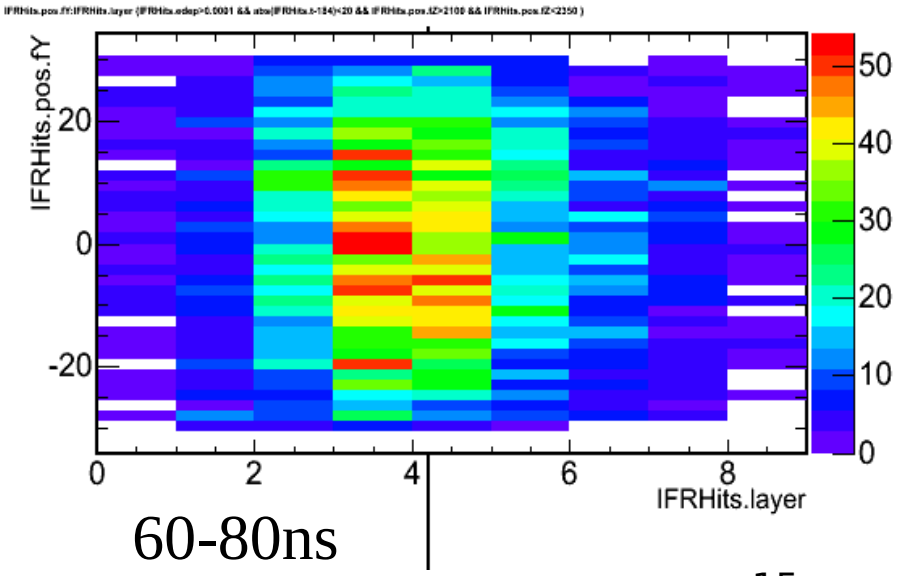
0-20ns



20-40ns



40-60ns



60-80ns

25% of hits have gTime>20 ns

Conclusions

- First study encouraging
  - Clear differences in lateral and longitudinal cluster shape in the muon and pion enriched samples;
- So far comparison with MC not clear because of:
  - Unknown beam composition and Cerenkov efficiencies;
  - Layout geometry not completely known.

- To do for Elba:
  - Look at TDC response;
  - Use Test Beam data to understand timing response of prototype and comparison with simulation;
  - Implement a muon tracker;
  - Compare “muon” selection using different configurations;
  - Final answers on geometry require tuned simulation!!!