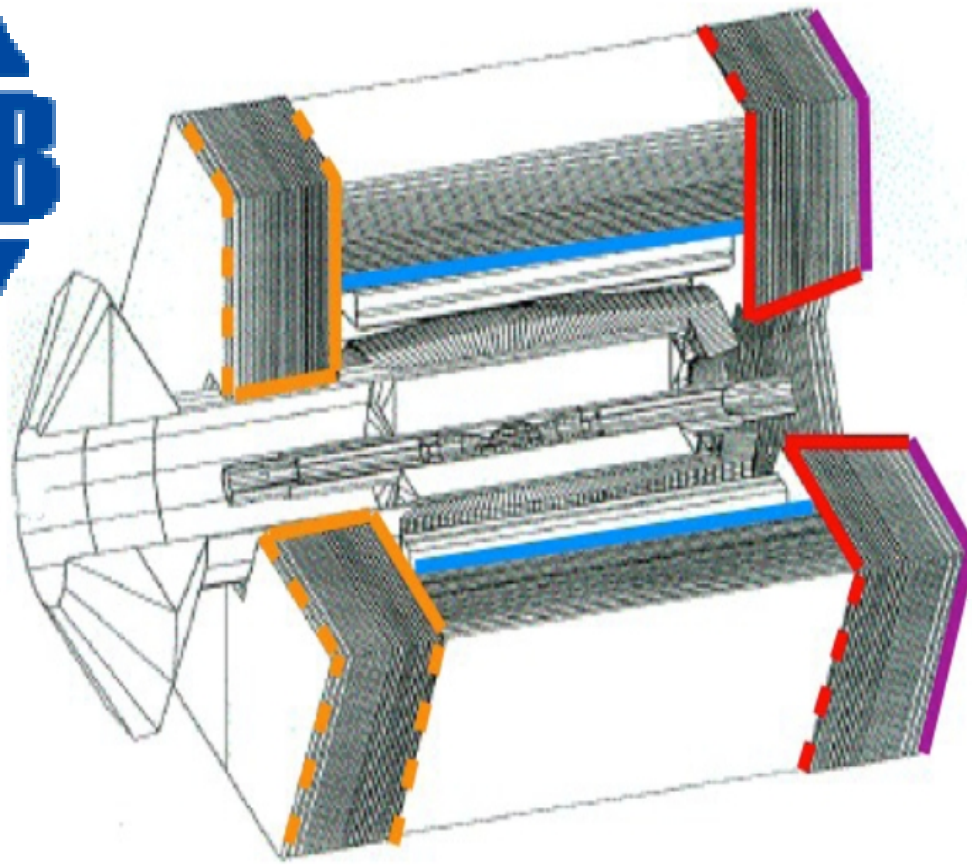
IFR Geometry Optimization



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Outline

- *IFR configurations: progresses since Annecy*
  - ✔ *Do we need an extra layer?*
  - ✔ *Preliminary results using a configuration with 8 and 9 layers*
- *K_L first studies*
  - ✔ *Analysis strategy*
  - ✔ *K_L Cluster size*
  - *Very loose K_L selector to compare 8_L and 9_L active layers*
- *To Do List*

Results presented at Annecy

```
|=|=|========|==========|==========|=======|=====|
|2|2|   16   |    24    |    24    |   14  |  10 |
```

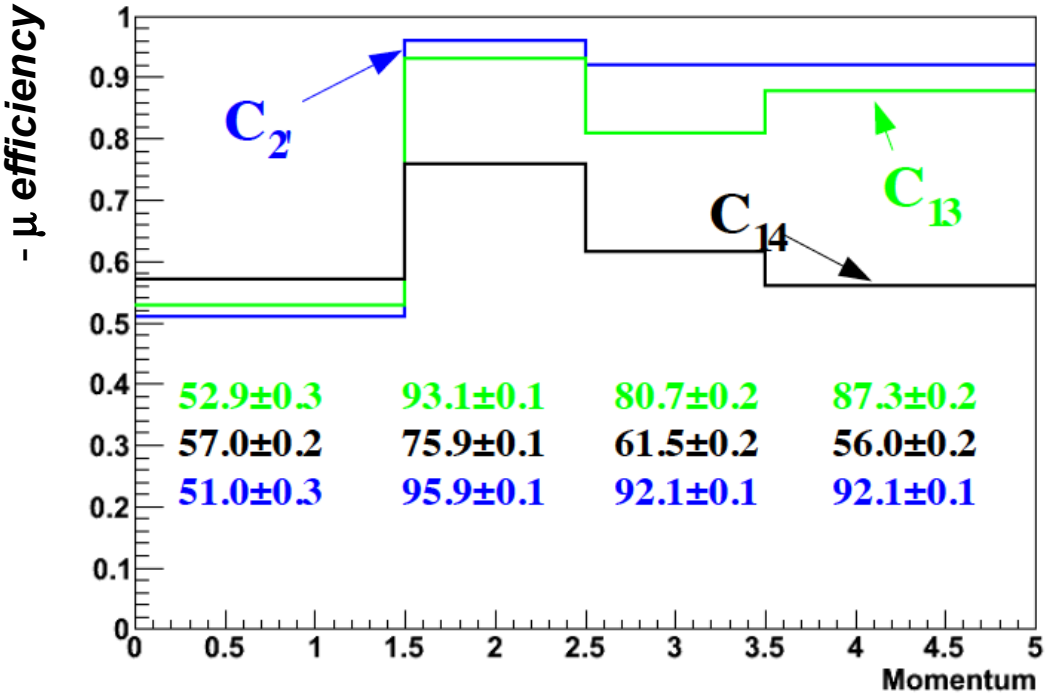
C_2' ~ 920mm ☆

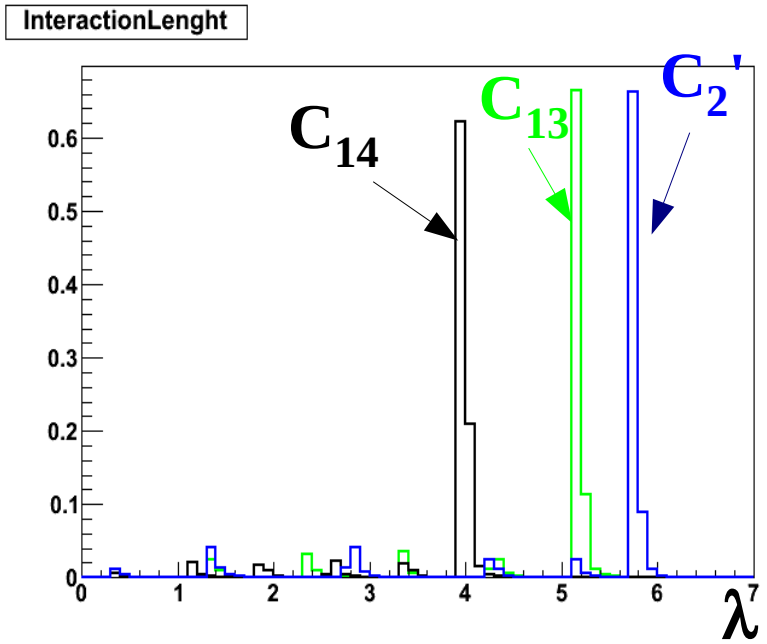
```
|=|=|========|========|========|========|=======|
|2|2|   16   |   16   |   16   |   16   |   14  |
```

C_{13} ~ 820mm

```
|=|=|======|======|======|======|=====|
|2|2|  12  |  12  |  12  |  12  |  10 |
```

C_{14} ~ 620mm





Compare 8_L with 9_L configurations

|=|=|========|==========|==========|=======|=====|
|2|2| 16 | 24 | 24 | 14 | 10 |

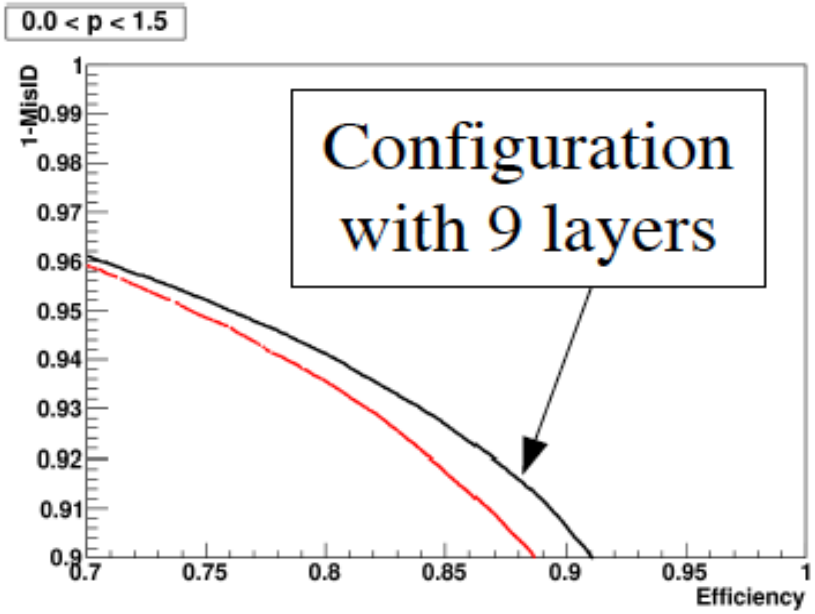
$C_{8\,L} \sim 920mm$

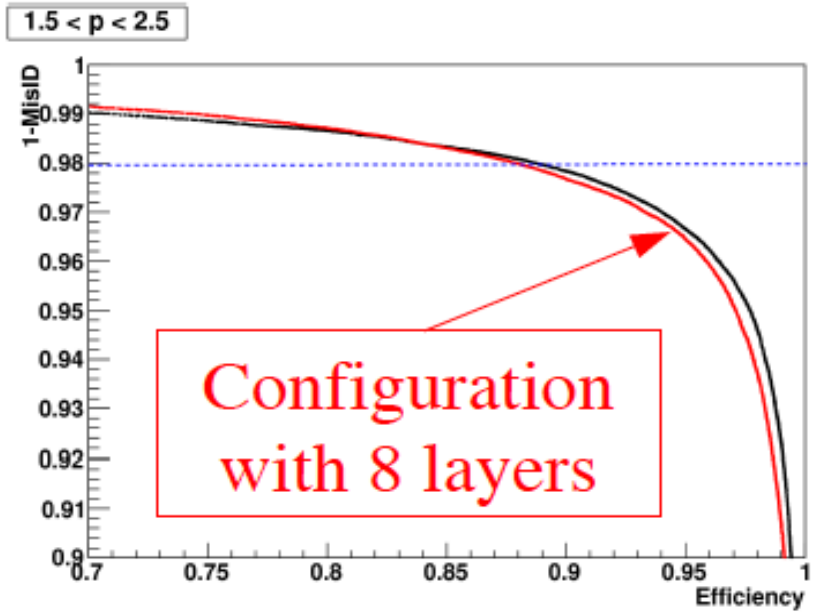
|=|=|======|======|========|==========|=======|=====|
|2|2| 12 | 12 | 16 | 24 | 14 | 10 |

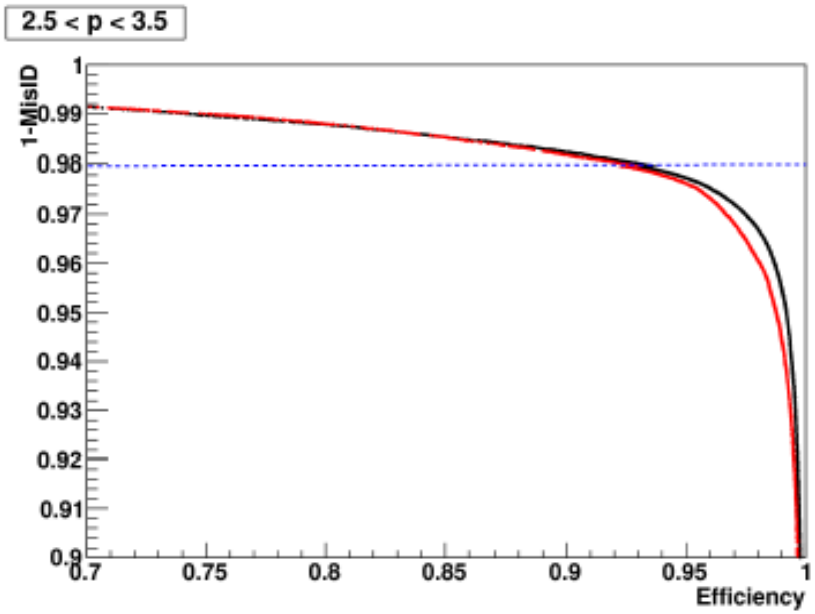
$C_{9\,L} \sim 920mm$

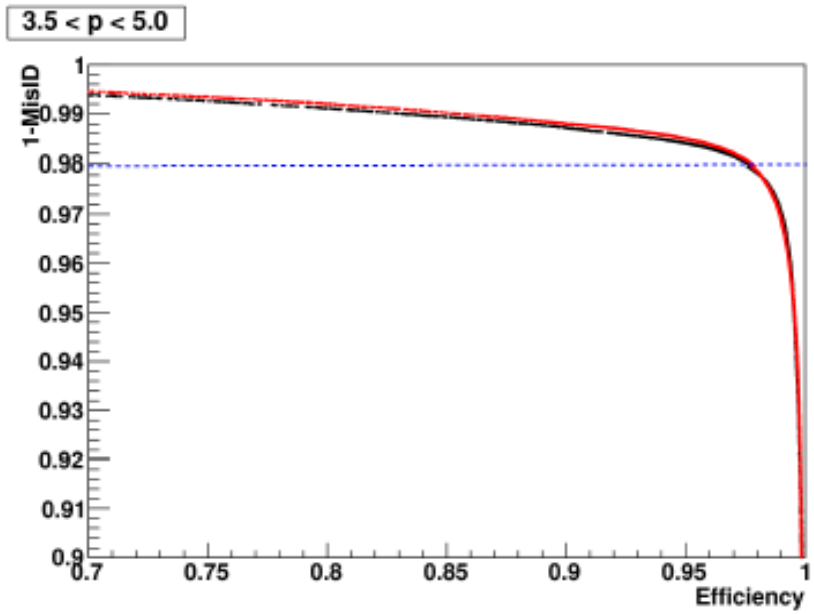
- *Extra layer to check if it is possible to increase the μ-efficiency*
- *Simulated 5M of single muons and pions for both the configurations*
- *Momentum range from 0 to 5 GeV/c with flat distribution fired in all the sextants of the barrel*
- *Configurations compared using a BDT as multivariate classification algorithm*
  - *same 9 variables used for the previews comparison (C_{13},$C_{1\,4}$,C_2')*
- *BDT analysis performed in 4 momentum bins*
  - *check how the result changes adding 1.5% of noise*

BDT Optimization (noise=0)



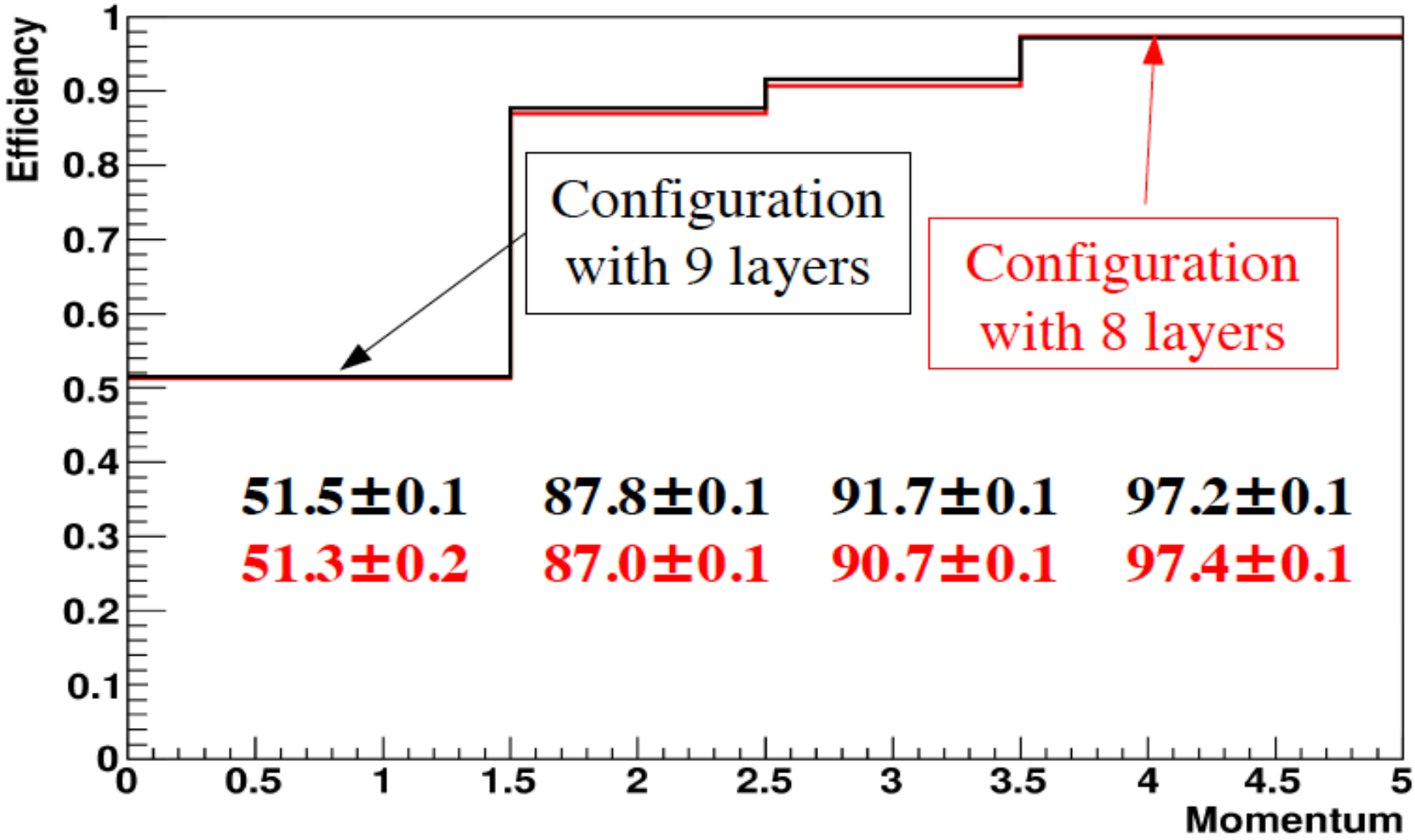






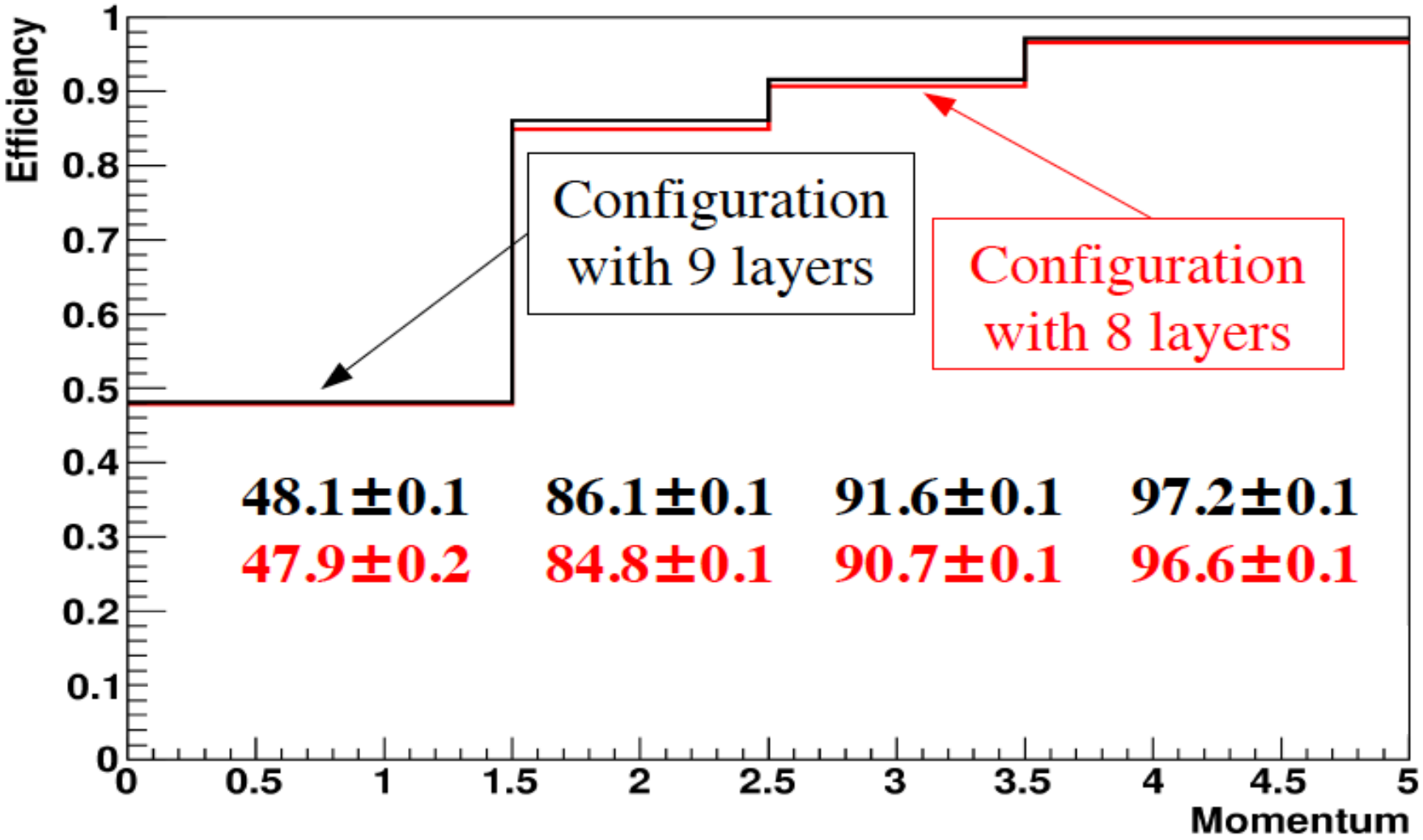
BDT Optimization (noise = 0)

- *Muon efficiency requiring pion mis-ID = 2%*



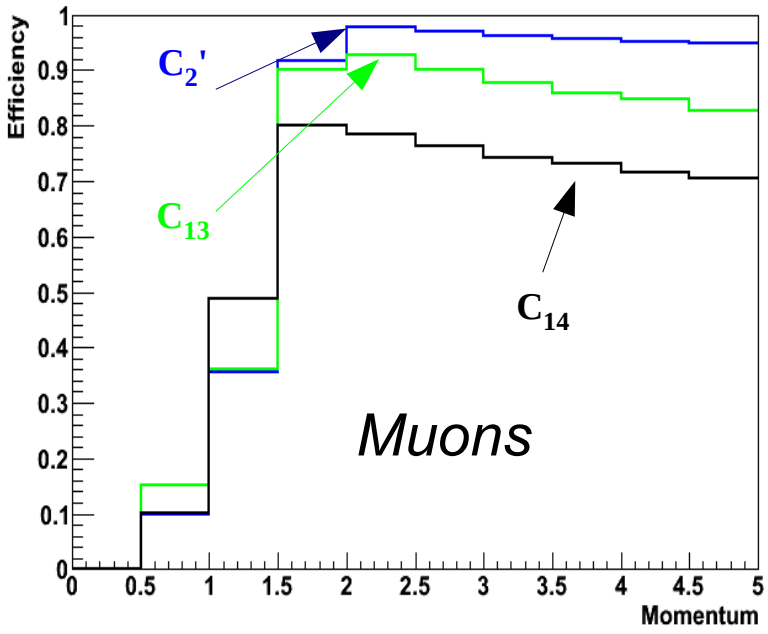
BDT Optimization (noise = 1.5%)

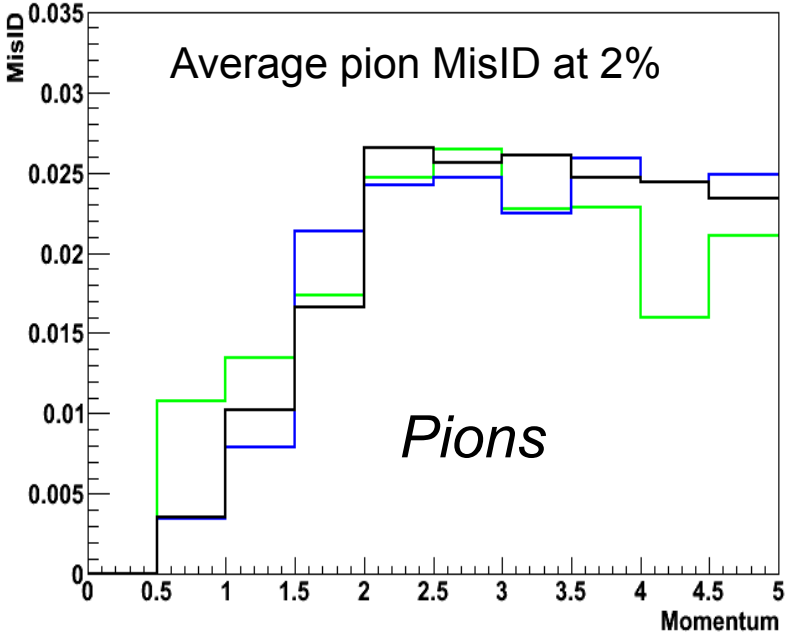
- *Muon efficiency requiring pion mis-ID = 2%*



Test IFR geometry using FastSim

- *Produce PID Tables, one for each configuration*
- *Make available these tables in FastSim before the start of the next production (July)*
  - *Study the impact of different configuration on specifi signal channel*
    - *$B \to K^*\mu\mu$, $B \to \mu\mu$, ?*
    - *and on analysis that use SL $B \to D(*)\mu\nu$ tag*

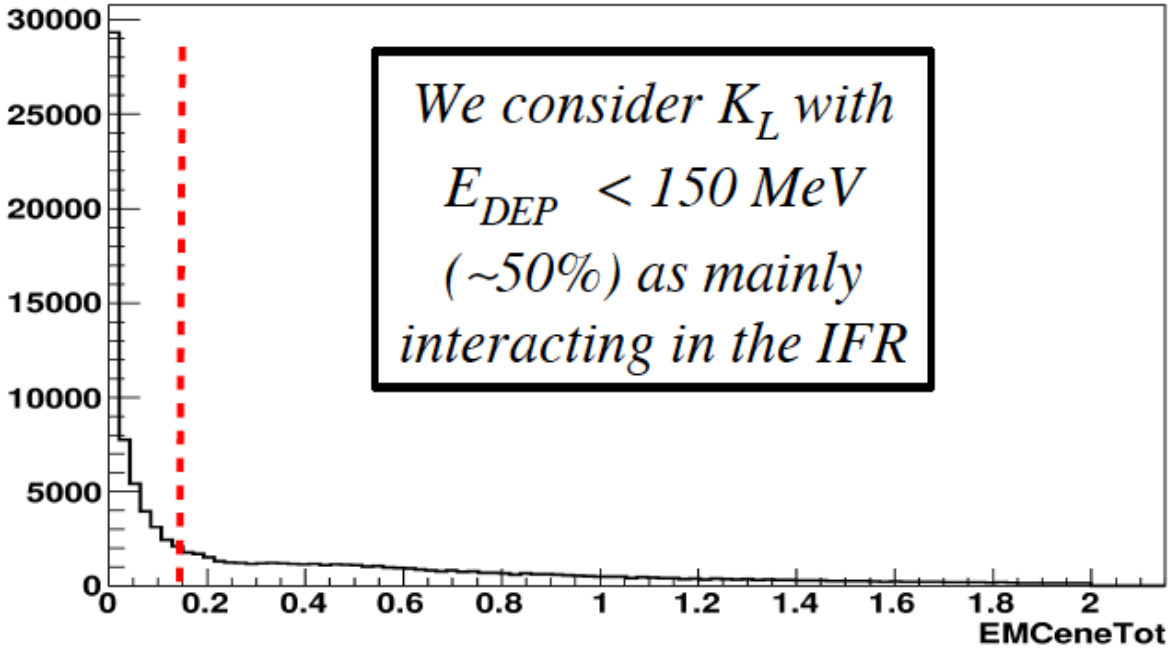




First look at K_L

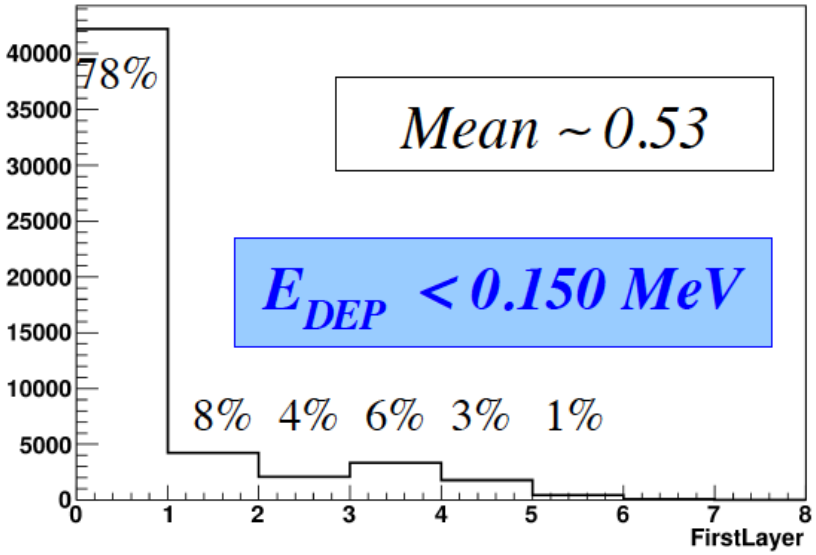
K_L: analysis strategy

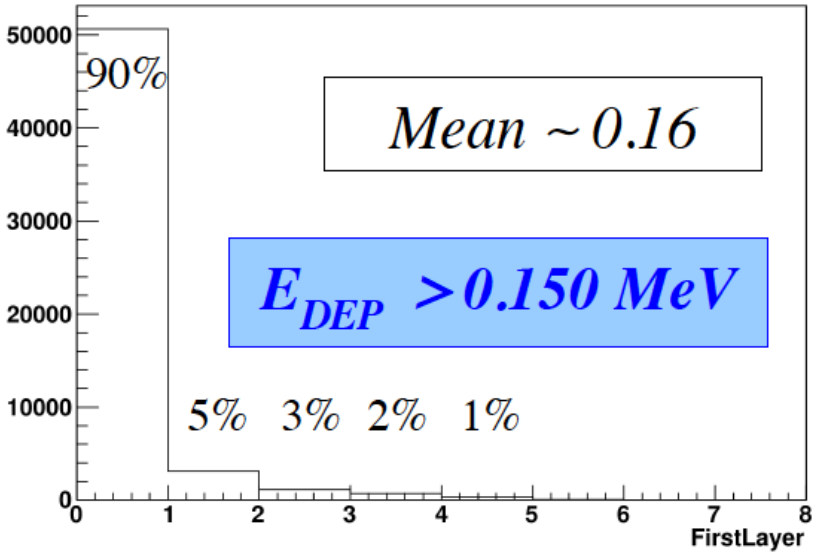
- *Simulated 110K single K_L using C_2' configuration and 10K using C_2' with 9 active layers;*
  - *Momentum range from 0.6 MeV to 4.5 GeV/c with flat distribution, fired orthogonally to the top-sextant of the barrel*
- *Distinguish K_L interacting in the EMC from K_L interacting in the IFR volume*
  - *Use total energy released in the EMC to distinguish these K_L categories*

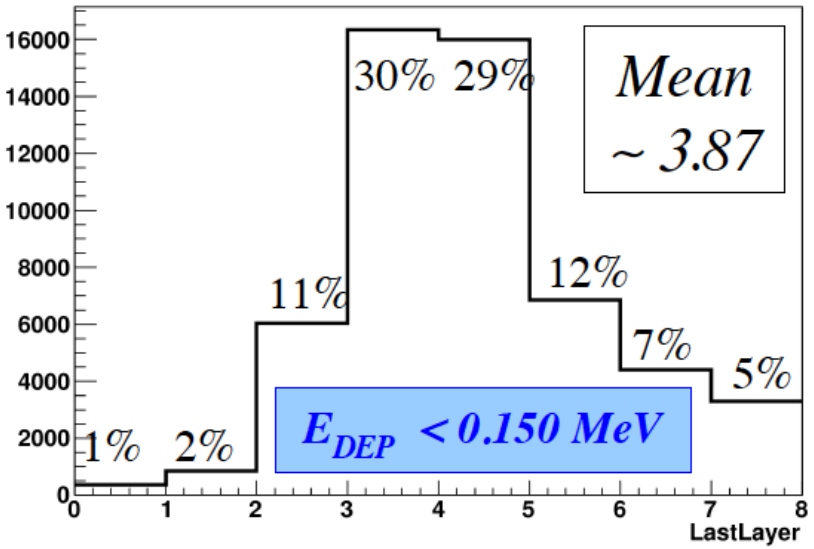


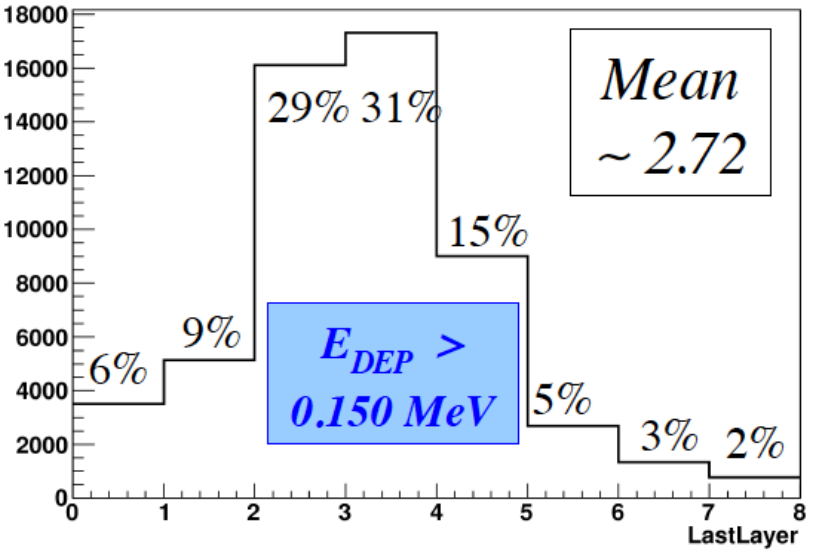
K_L: some distributions

- *Distribution of the **first layer** hit, and the **last layer** hit*



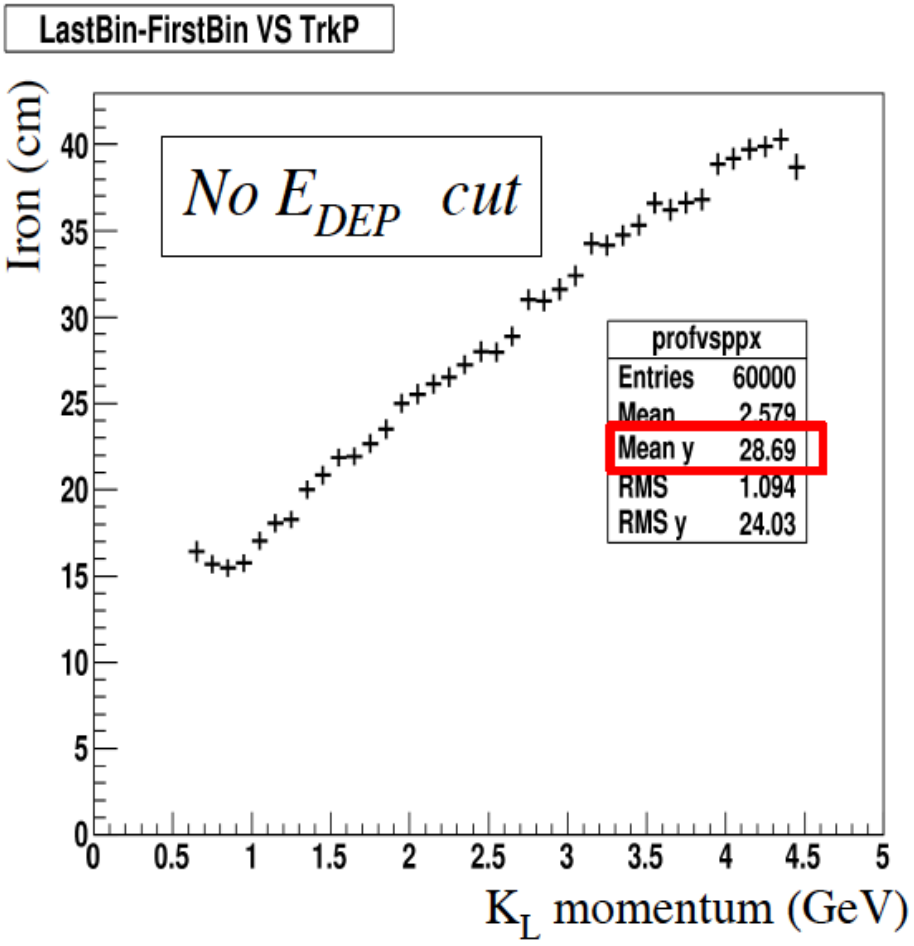


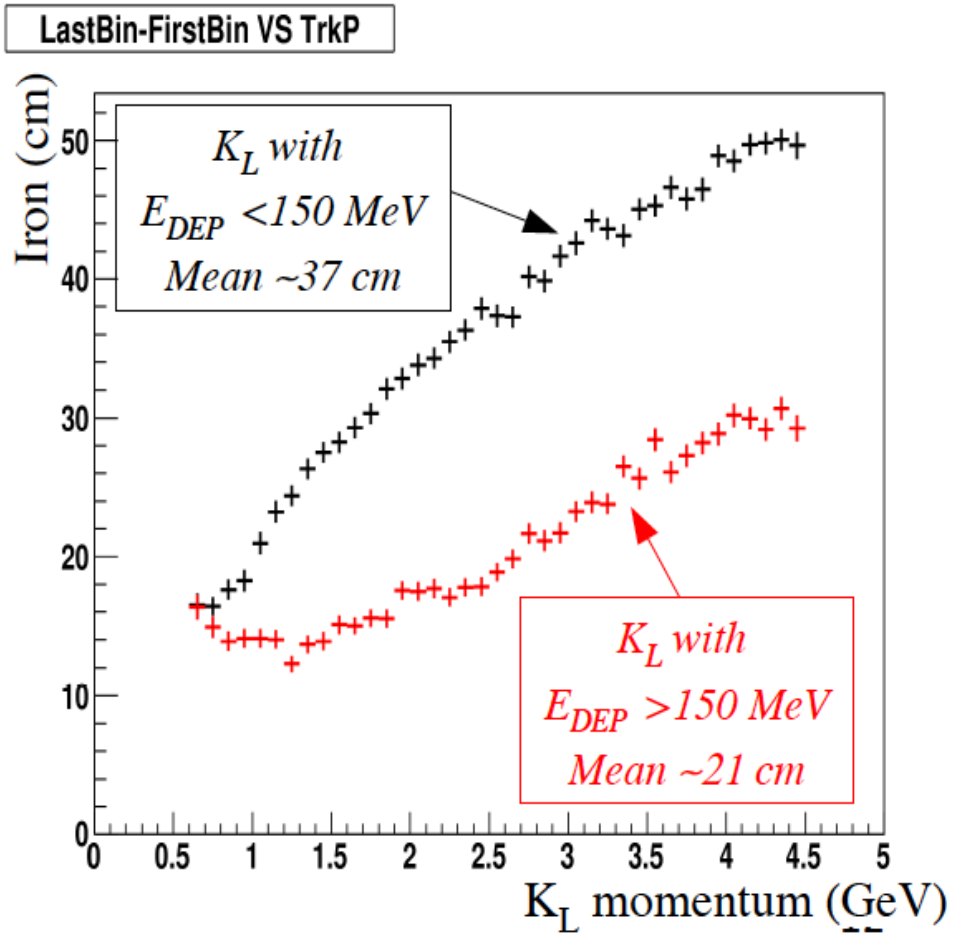




K_L cluster size

- *Analyzing the distribution of LastLayer-FirstLayer as function of the momentum is possible to infer the K_L cluster size (iron cm)*
- *Different K_L cluster size depending by E_{DEP}*

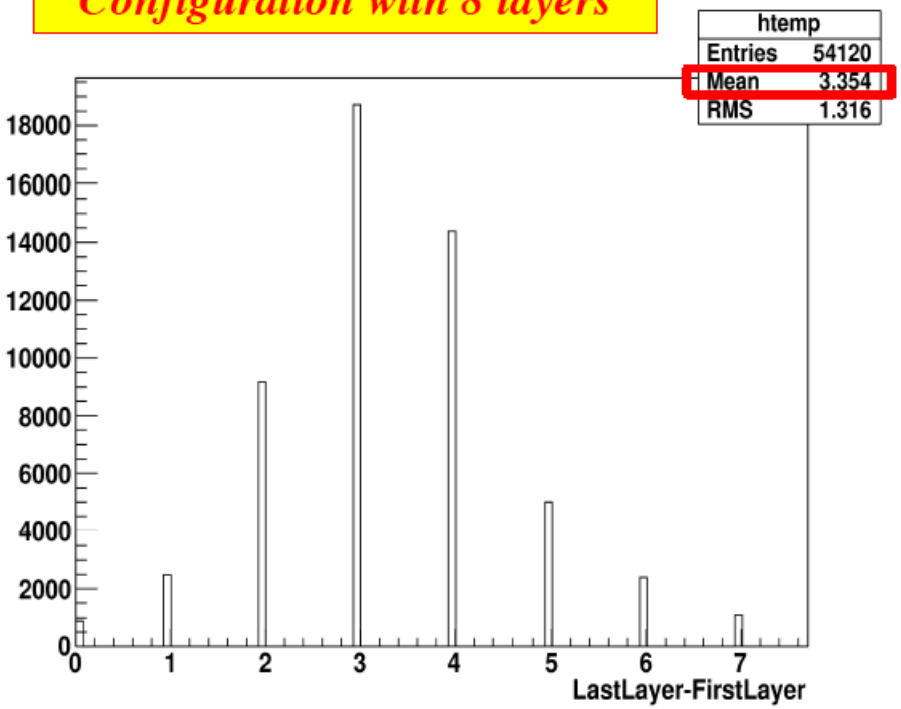




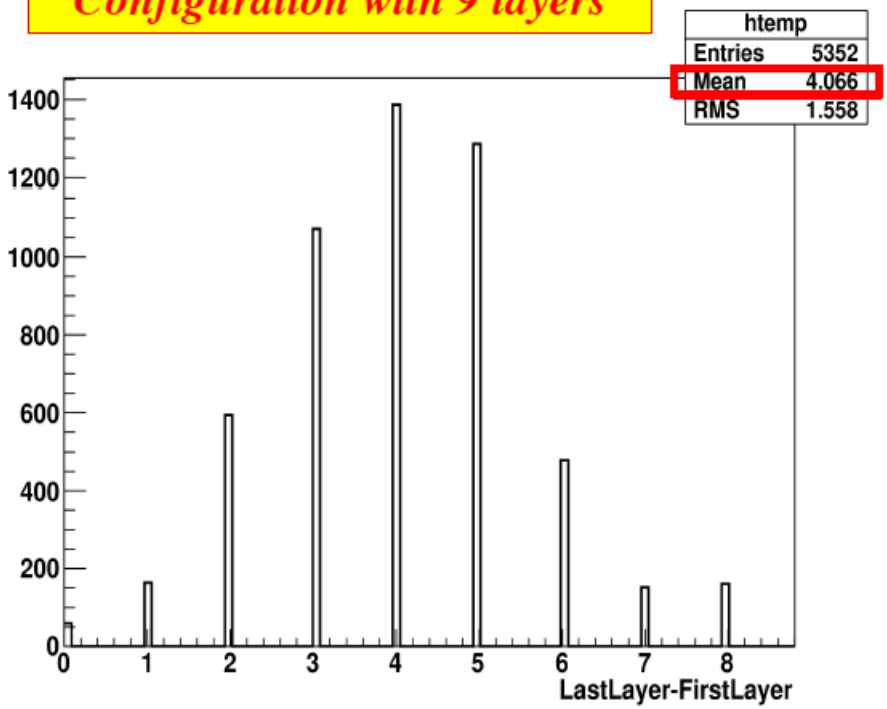
Basic K_L Selector

- *Designed a K_L selector in order to compare 8L and 9L configurations*
- *Require K_L with $E_{D\,E\,P}$<0.150 MeV and an enough number of consecutive layers*
- *Study the K_L selection efficiency as function of the momentum*

Configuration with 8 layers

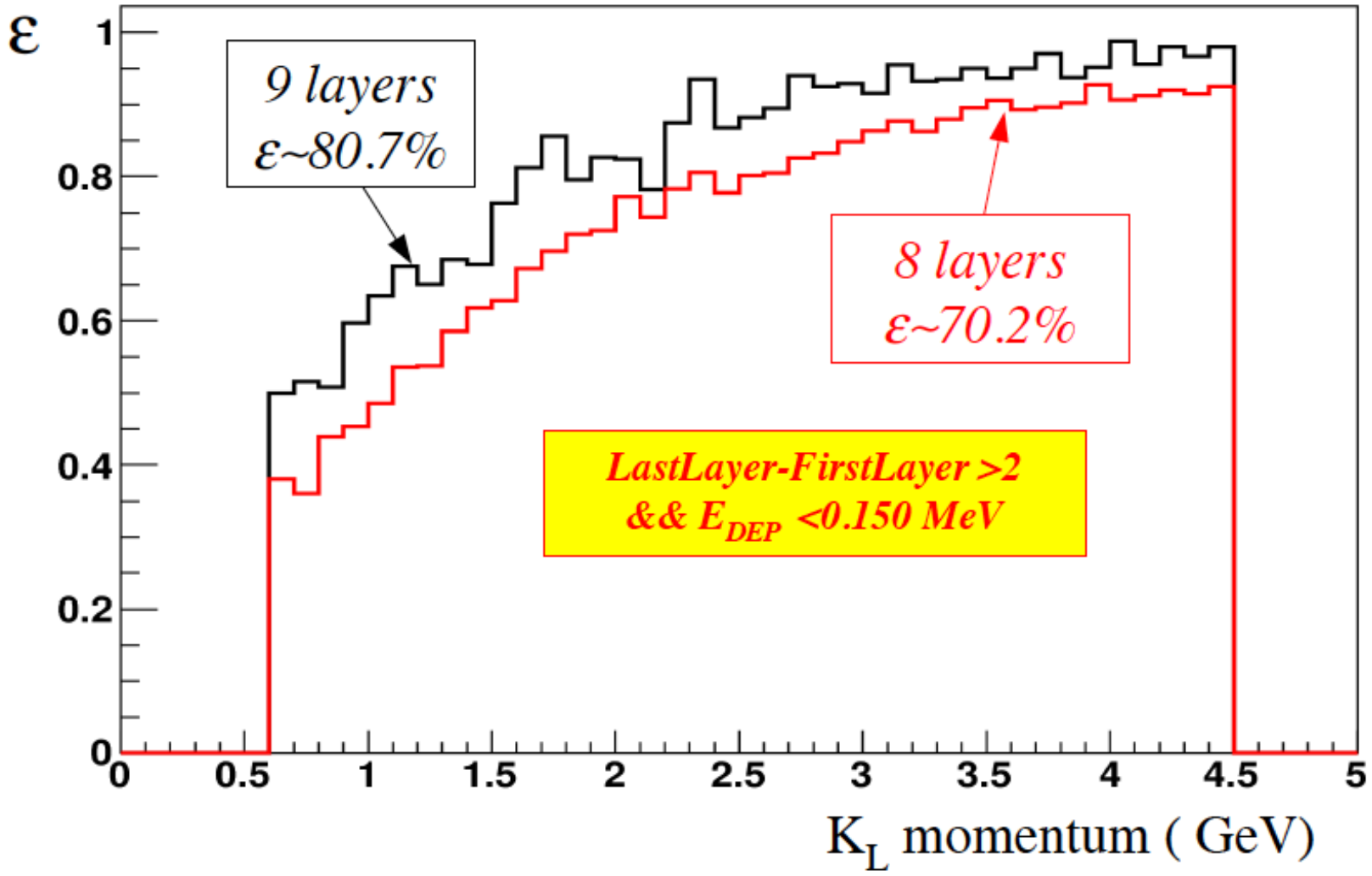


Configuration with 9 layers



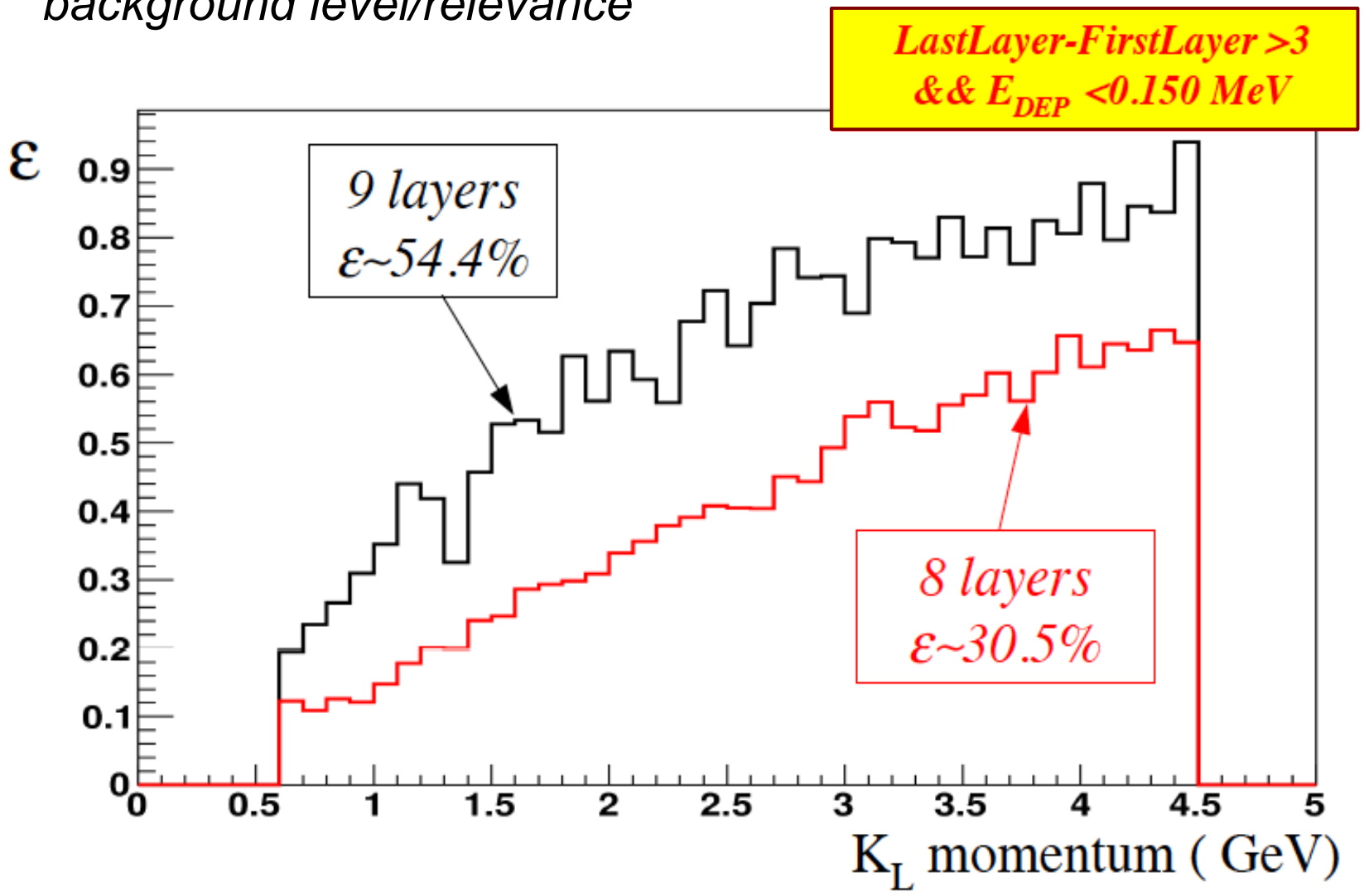
K_L: Efficiency .vs. Momentum

- *Requiring at least 4 layers*



K_L: Efficiency .vs. Momentum

- *Requiring at least 5 layers: the cut will depend on the background level/relevance*



To do list

- *Finalize the optimization studies for μ–π separation*
  - *Preliminary studies show an extra layer doesn't improve the μ efficiency if we require high π suppression (misID=2%)*
  - *Write PID tables and replace the BaBar ones used at present in FastSim: study of specific physics channels are crucial to optimize the iron in the IFR*
- *K_L studies just started:*
  - *About 50% interact within the IFR*
  - *Simple selector to compare various configurations: we should also start to look at lateral size of the K_L clusters*
  - *Preliminary studies show that for K_L the number of layers could be important*
  - *Crucial to start to look at realistic source of backgrounds:*
    - *Machine bkg, hard γ, pions*

Muon momentum from B->D semileptonic decay

- *Momentum distribution in SuperB are different from BaBar due to the change in the boost*

Muon ID depends by the Event kinematics

Different boost play an Important role on the Angular momentum Distribution

Study the impact of various IFR Configurations On physics channel:
- channel that require high Efficiency
- channel that require high pi->mu rejection