IFR Fast Simulation: recent developments and plans

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Recent changes I

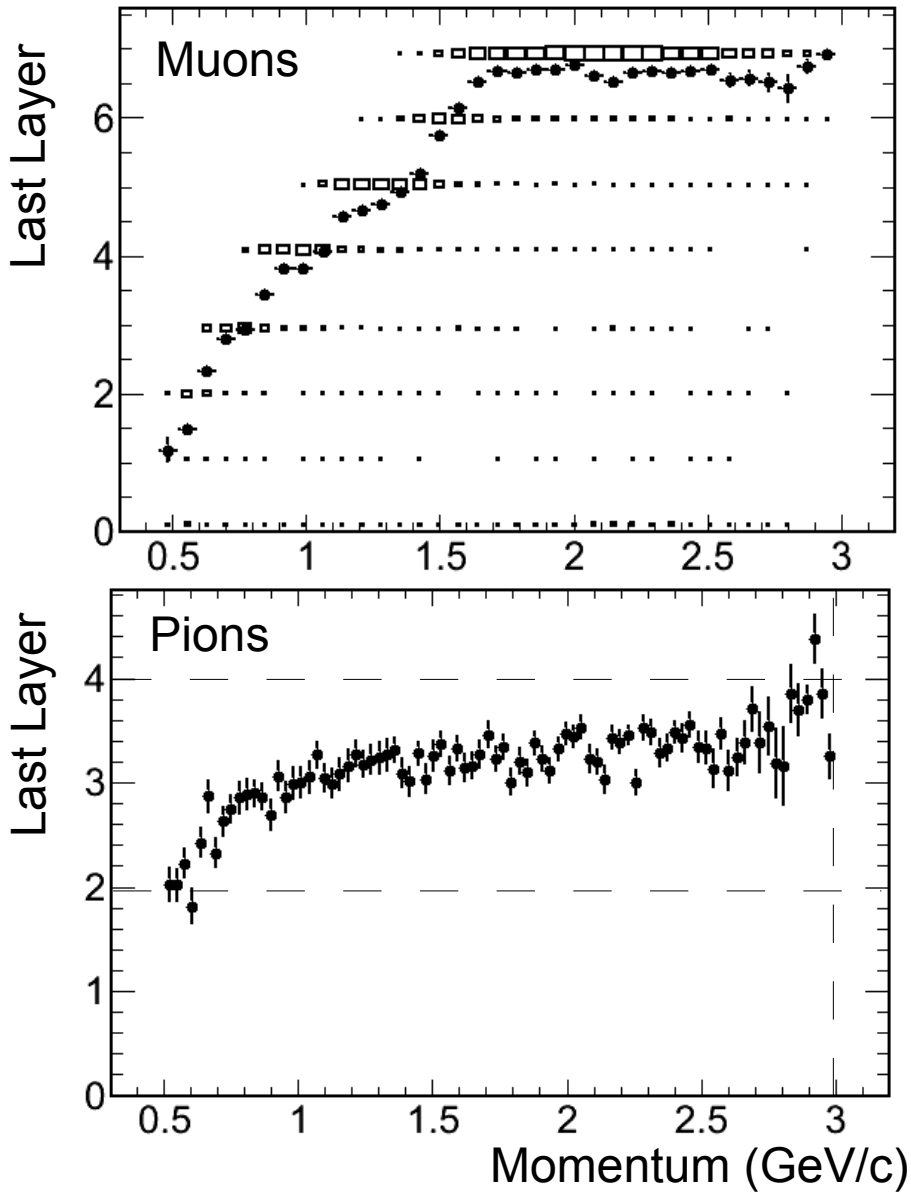
- Improve the simulation of the pion (nucleon) interaction in iron
- Pion interaction length λ_π in material is about 20% longer than the nucleon Interaction length (different cross sections)
  - PDG / PRD 7,730 (1973) / ATLAS TILECAL-99-007, 1998
  - Affect the probability for a pion to have hadronic interaction in EMC/Coil/Iron: $P(\Delta L) = \exp(-\Delta L/\lambda_\pi)$
  - Affect the hadronic shower length: change in the scale

PacSim/Material_simulation.xml

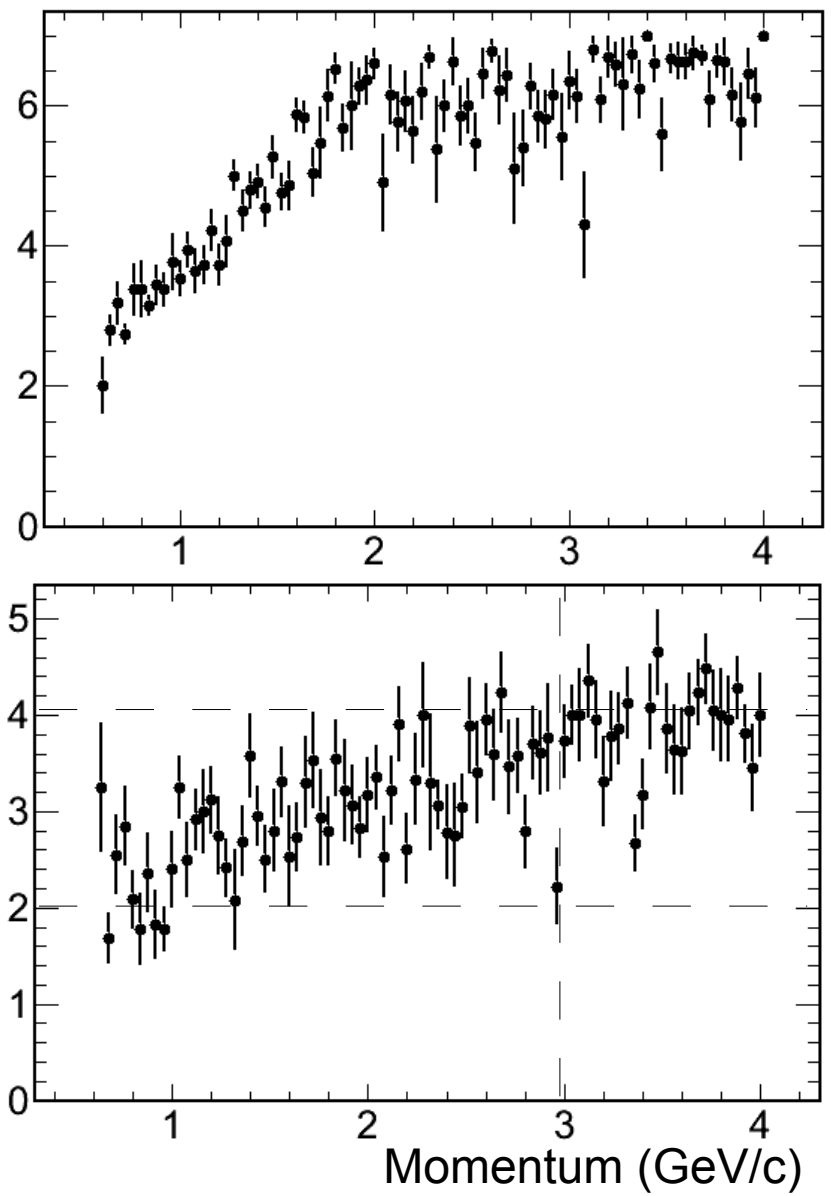
```
<sect name="PacShower">
  . . .
  <param name="pionIntLengthCorr" type="float">1.20</param>
</sect>
```

Distribution of the Last Layer (profiles)

Fast Sim V0.3.0 (+IfrSim & PacSim trunk)



Full Simulation: Bruno (Elba2011)



Recent changes II

- Improve the simulation of the lateral hit production
  - Radial distribution
    - $P(r)=f_{narrow}\exp(-r/d_{narrow}) + (1-f_{narrow})\exp(-r/d_{wide})$, $d \propto \log(E+constant)$
  - Narrow and wide size are fixed (4cm and 12cm) in the code
  - Fraction of narrow component can be changed in edml

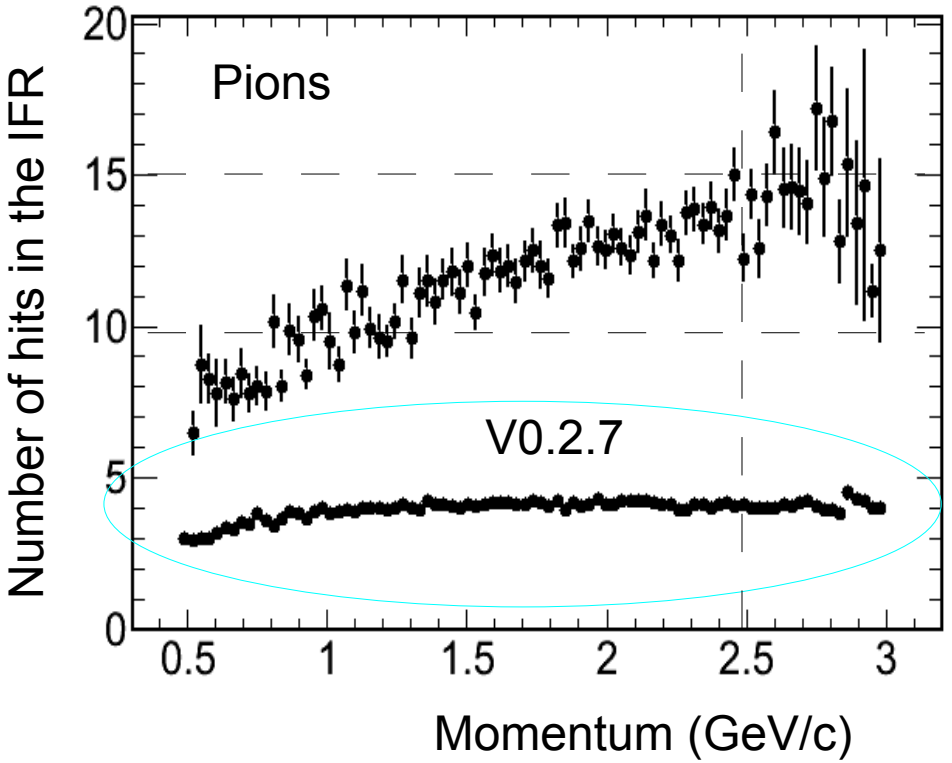
PacIfr/PacIfrGeom_SuperB.xml

```
<sect name="PacIfrGeom">
    <param name="sextantDeadSpace" type="float" > 20.0</param>
    <param name="endcapDeadSpace" type="float" > 20.0</param>
    <param name="scintBarrelWidth" type="float" > 4.0</param>
    . . .
    <param name="scintEfficiency" type="float" > 0.96</param>
    <param name="fracNarrowShape" type="float" > 0.20</param>
</sect>
```

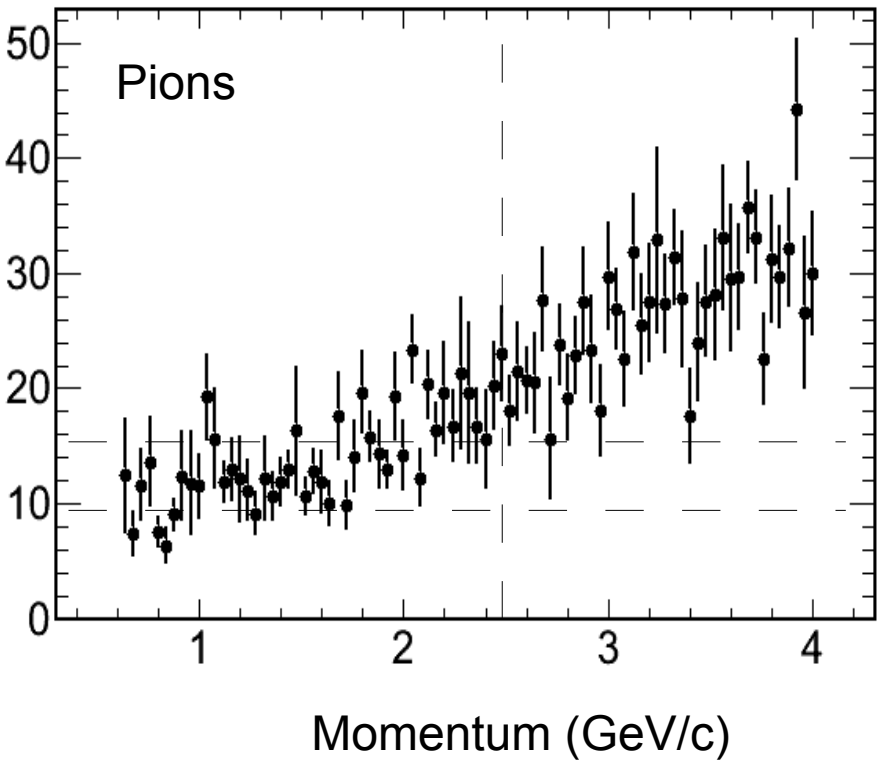
- From a PacSimHit in the IFR -> hit multiplicity generated according to P(r) and the scintillator geometry

Distribution of the Number of Hits (profiles)

Fast Sim V0.3.0 (+IfrSim & PacSim trunk)



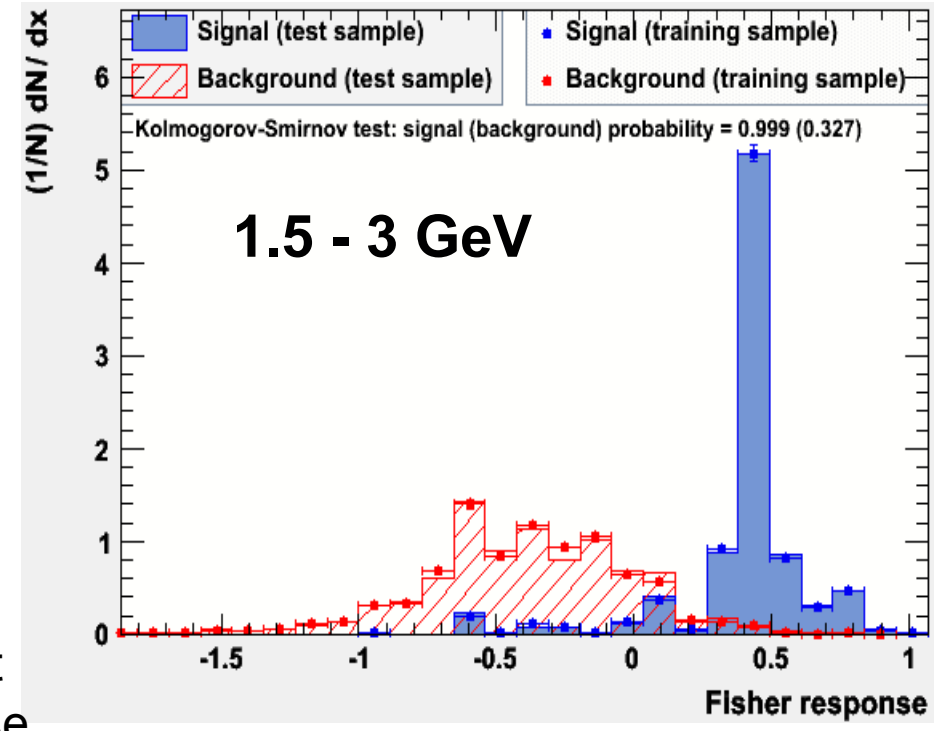
Full Simulation: Bruno (Elba)

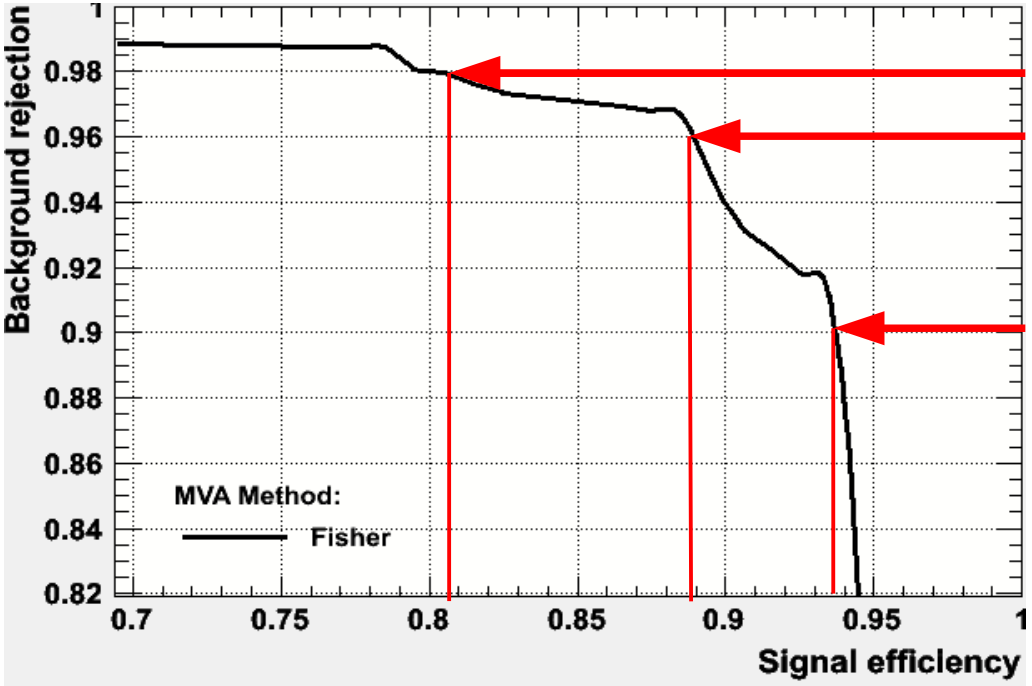


- Reasonable good agreement
  - disagreement above 2.5 GeV and shape is different
  - Could be improved but the agreement is enough for the time being!

Muon Selector

- Use TMVA to train a simple Fisher
  - Last Layer
  - Number_Hits/Active_Layer
  - Track fit chi2
  - Energy in the EMC





Tight

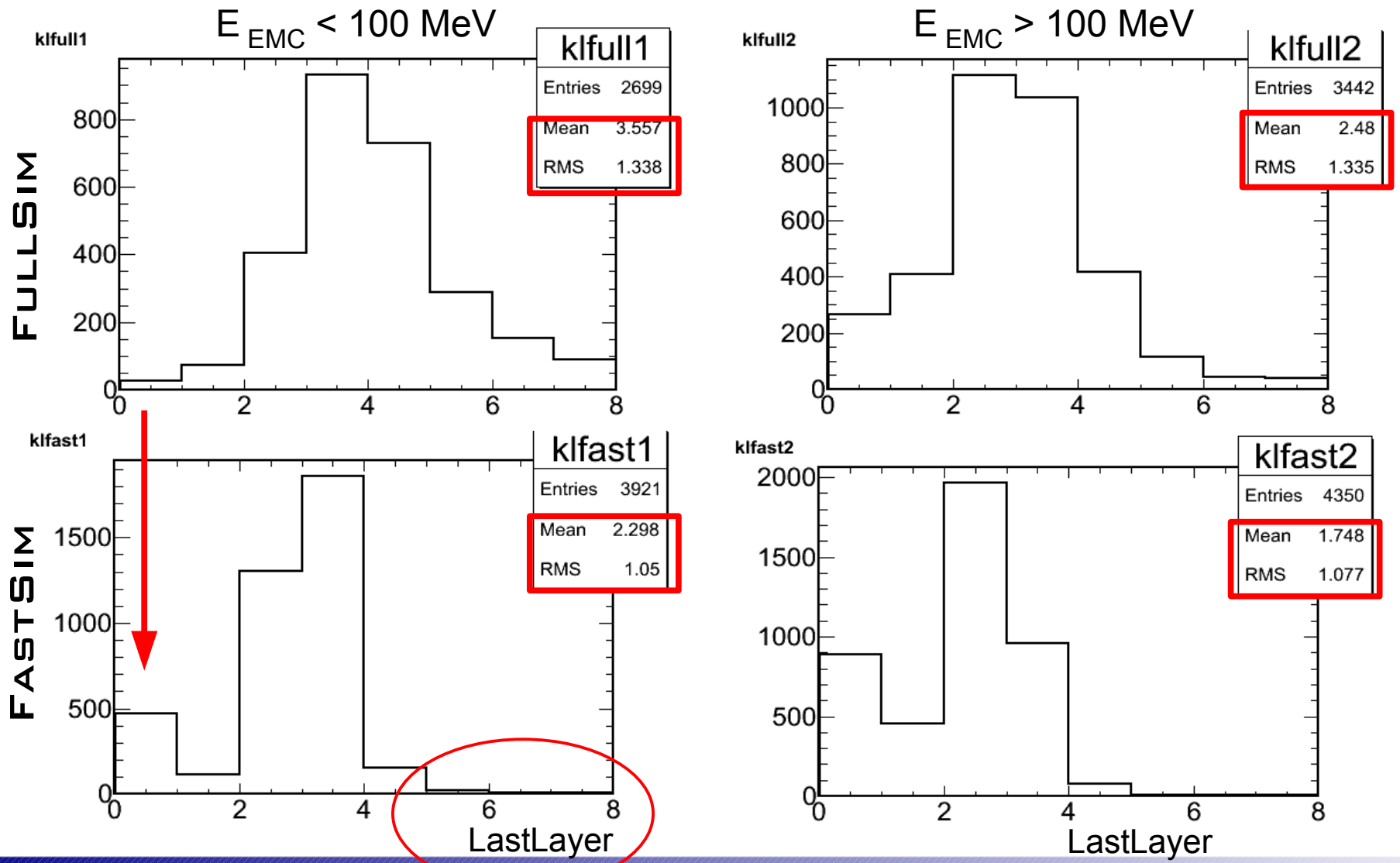
Loose

VLoose

Training will be performed
In bins of lepton momentum
(and theta ?)

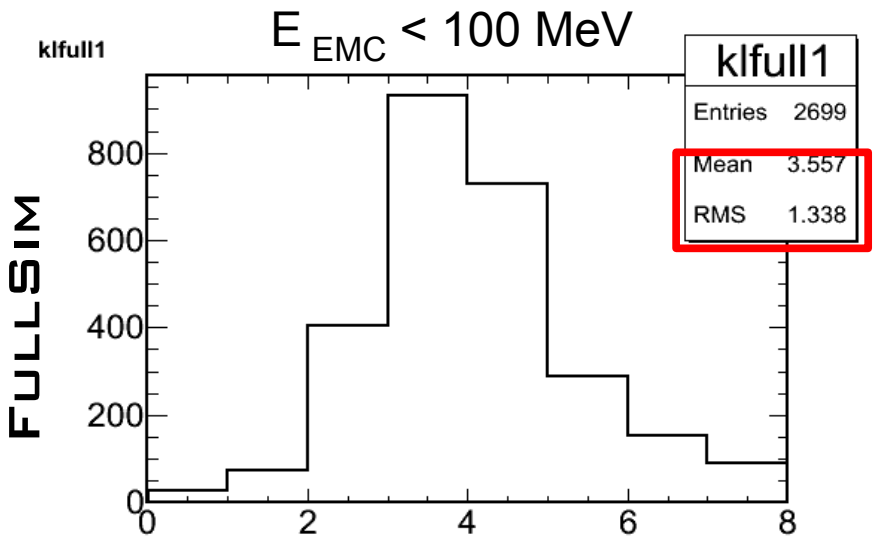
Neutral Hadrons

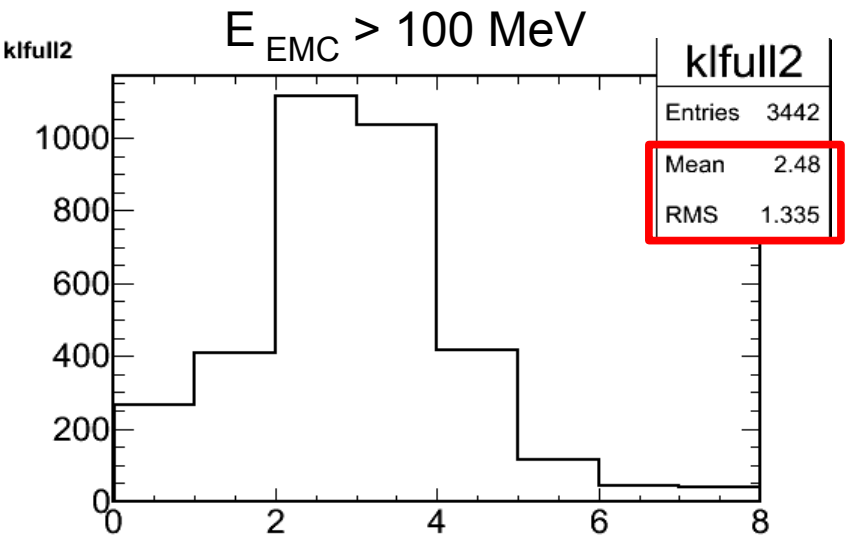
- FastSim: generate K_L from B decay ($B \to K_L \pi\pi$), and access `IfrQual()` from `CalorNeutral` objects
- FullSim: single K_L x with momentum between 0.5-5 GeV fired in the barrel with small angular distributions

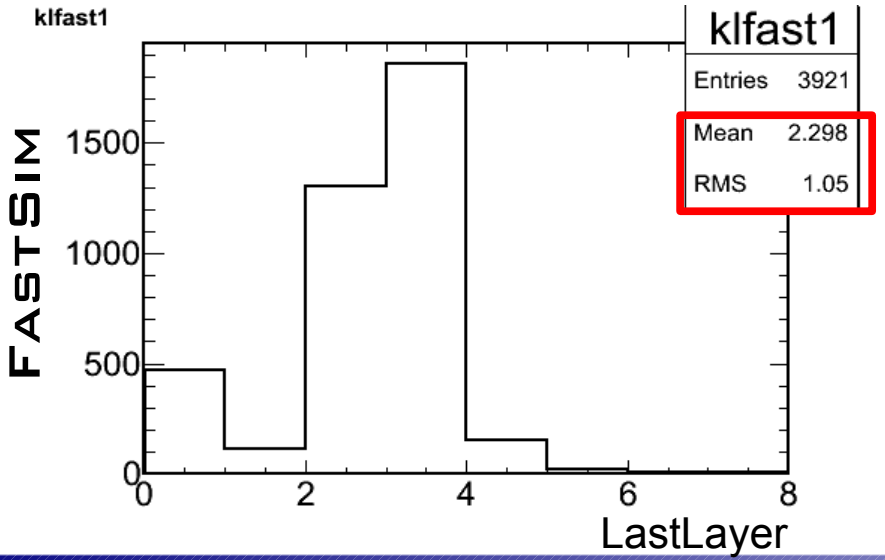


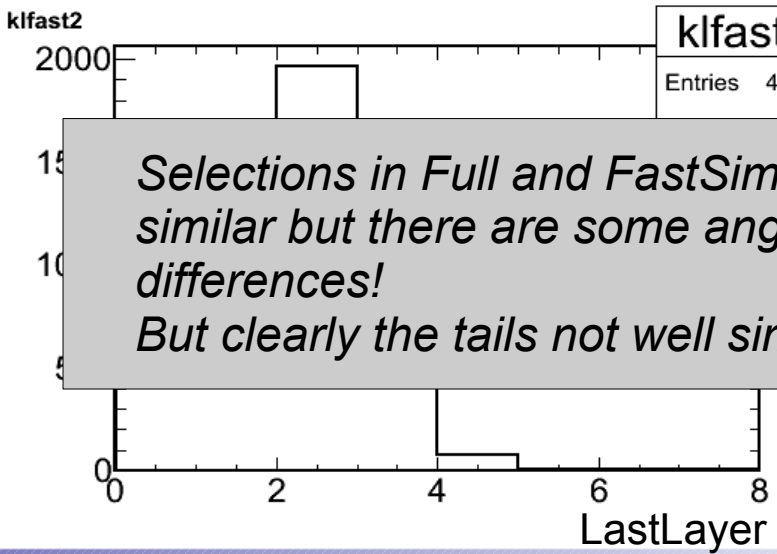
Neutral Hadrons II

- FastSim: generate K_L from B decay (B–>$K_L\pi\pi$), and access `IfrQual()` from `CalorNeutral` objects
- FullSim: single K_L x with momentum between 0.5-5 GeV fired in the barrel with small angular distributions









Selections in Full and FastSim similar but there are some angular differences!
But clearly the tails not well simulated

Summary and To Do list

- Improved simulation of π interaction within the detector
- Implementation of μ selector is ongoing
- TO DO LIST
  - Understand K_L differences and improve the simulation
  - Implement a `NeutralIfrList`
  - Implement the IFR QA module
  - Document the performances of muon selectors

    . . . and improve the documentation for the overall IFR fast sim simulation