Testing New Ideas for Calorimeters

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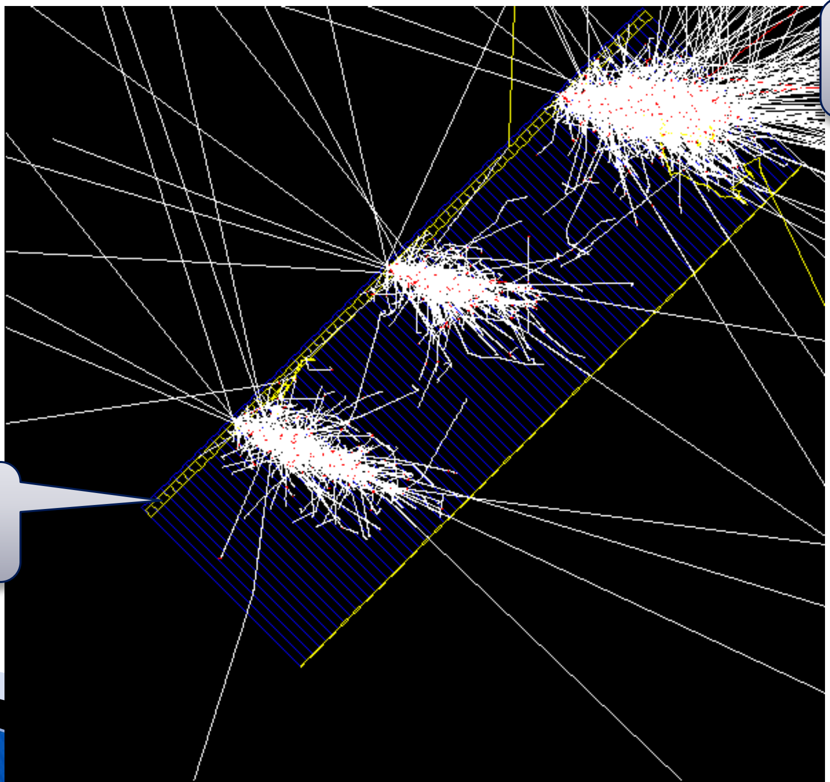
Idea 1: HERMES – LHC-b type of preshower

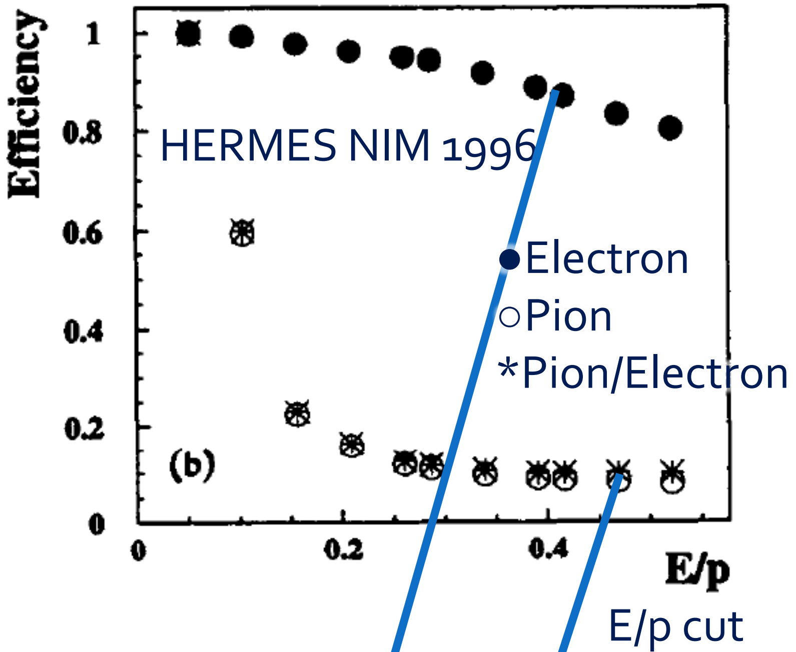
Setup – PVDIS configuration simulated

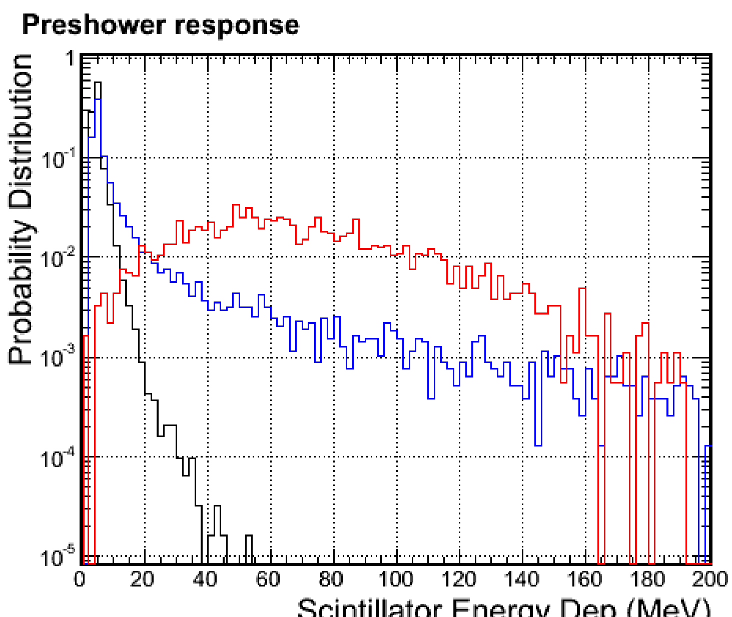
- A 2-radiation length thick Pb plate and 2 cm thick scintillator plate was added to the default Shashlik calorimeter (1.5 mm scint + 0.5 mm Pb per layer)
- Shashlik calorimeter have a single readout, serve as shower detector
- Shower length = 18 Xo with 1.5mm Scint – 0.5mm Pb sandwiches
  1/Sqrt(E) energy resolution : $\Delta E/E \sim 5\%/\sqrt{(E)}$
  compared with pure shashlik conf. with $4\%/\sqrt{(E)}$

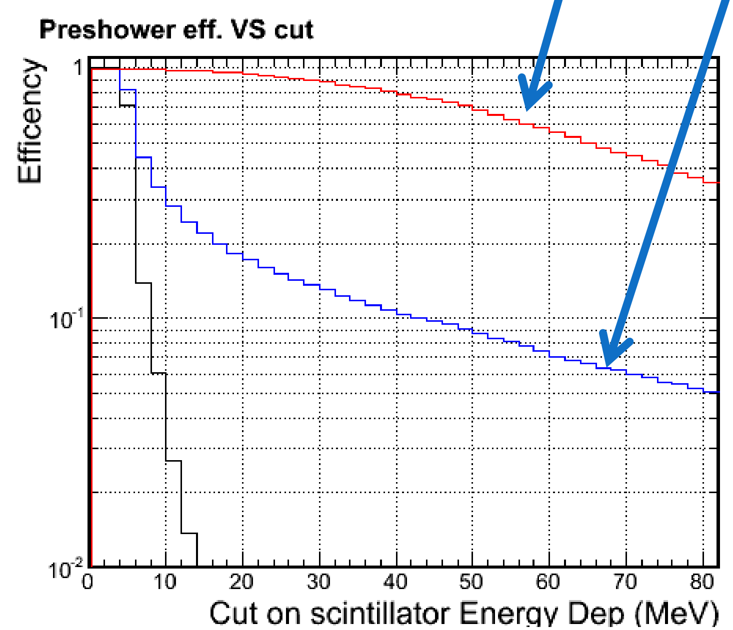


Preshower response

- Preshower alone, cut eff.
  ~15% (pion) VS ~95% (electron)
- Similar performance for Shashlik preshower
- Legend : Electron; Pion; Muon



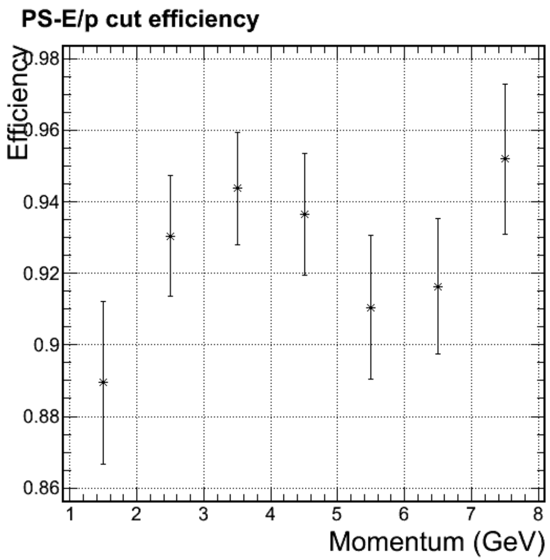




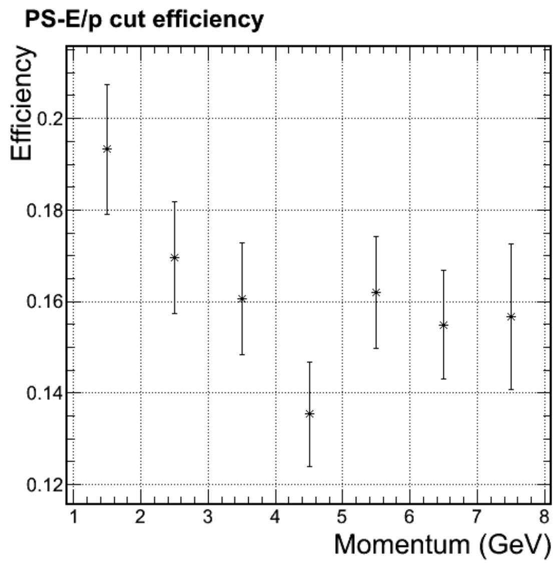
Momentum dependent cuts and eff. Preshower cut only

Shown in last meeting, which is consistent level compared with Shashlyk preshower

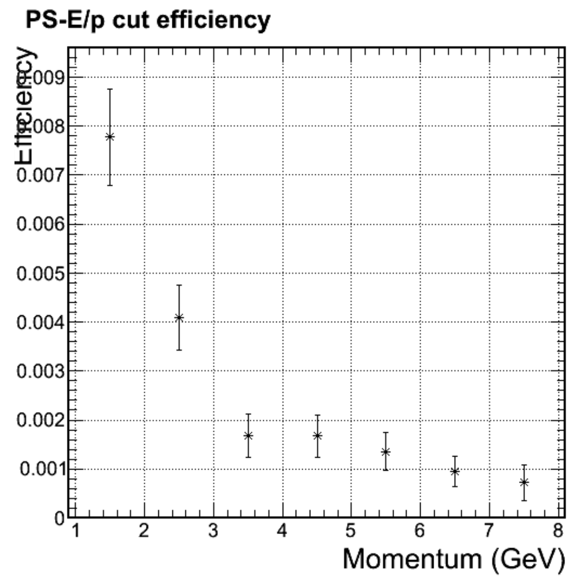
Electron



Pion

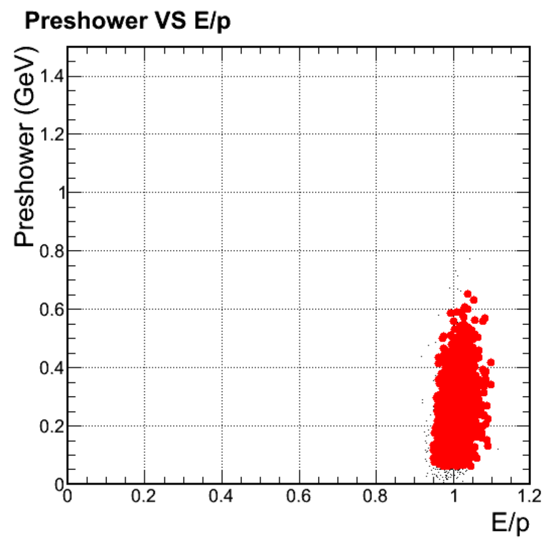


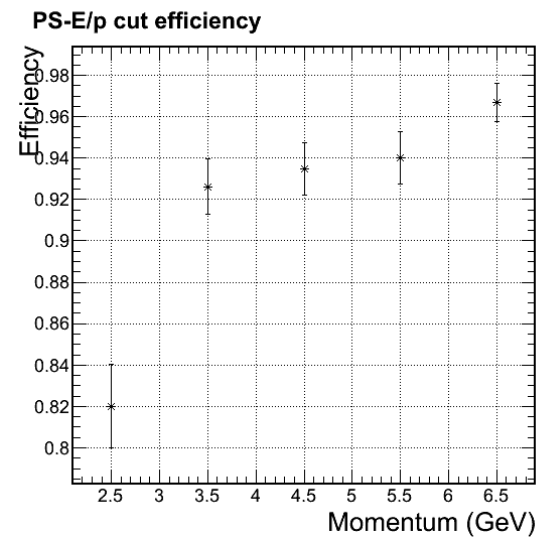
Muon



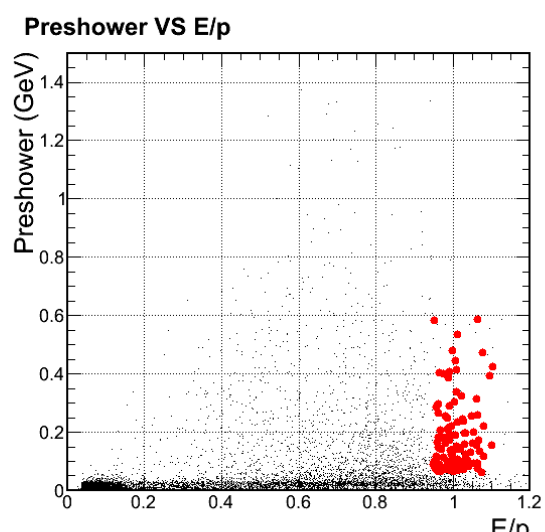
Preshower + shower rejection
- not better than full Shashlik design

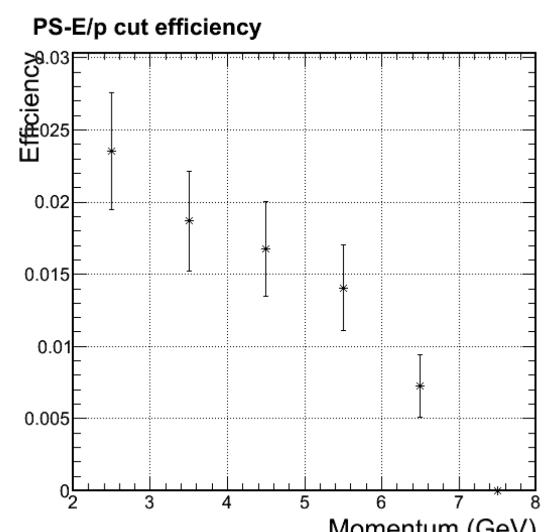
Electron





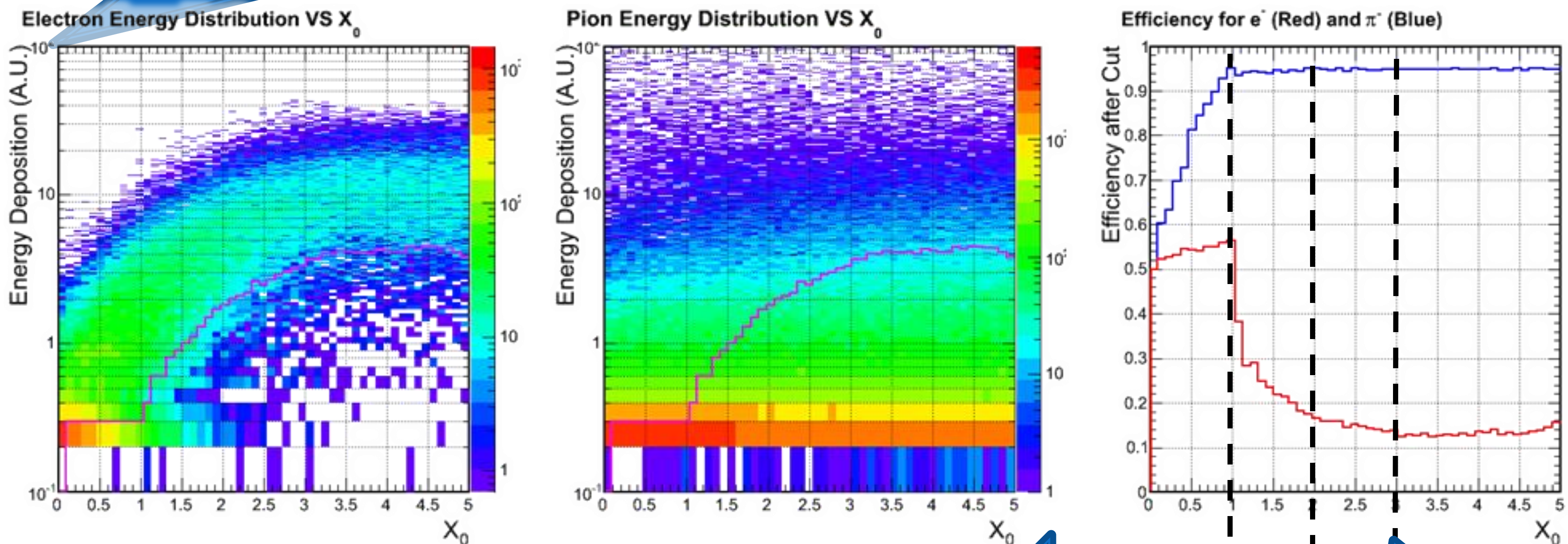
Pion





Other choice? Radiator thickness scan

Energy deposition in scintillator pad



Thickness of passive radiator

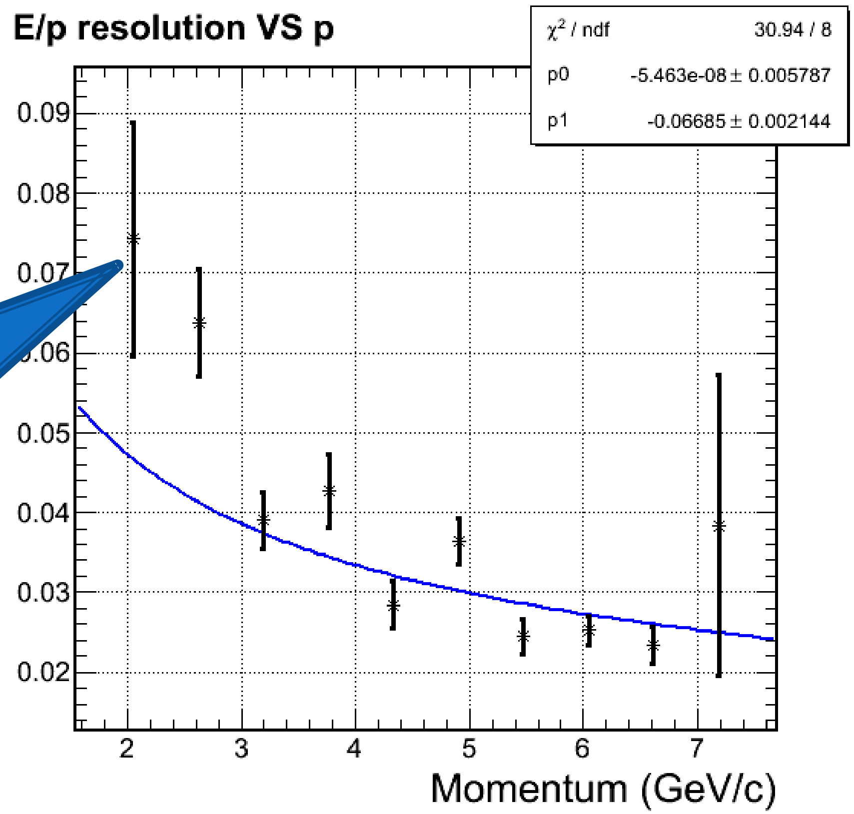
No diff.

Give Another Try

HERMES

Give another try: radiator = 3 X_0 Lead

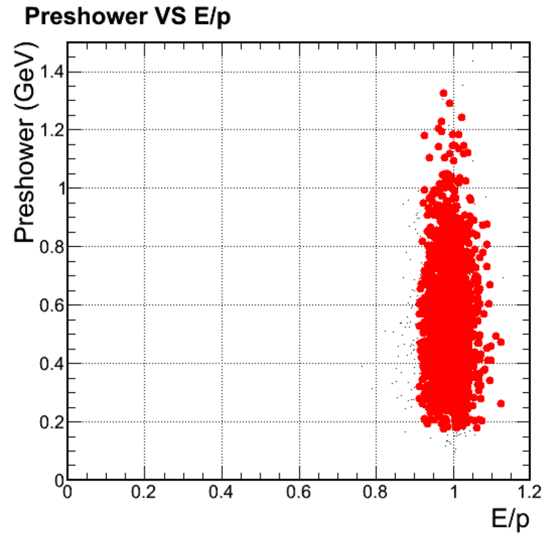
- Resolution is significantly degraded with $3X_0$ passive radiator

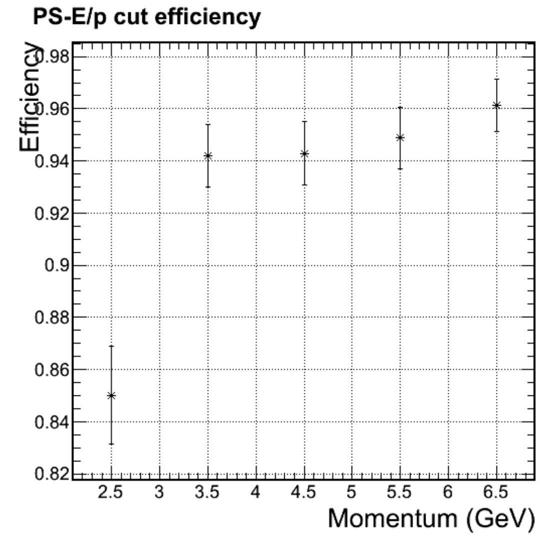


Significant contribution of 1/E term (~10%/E)

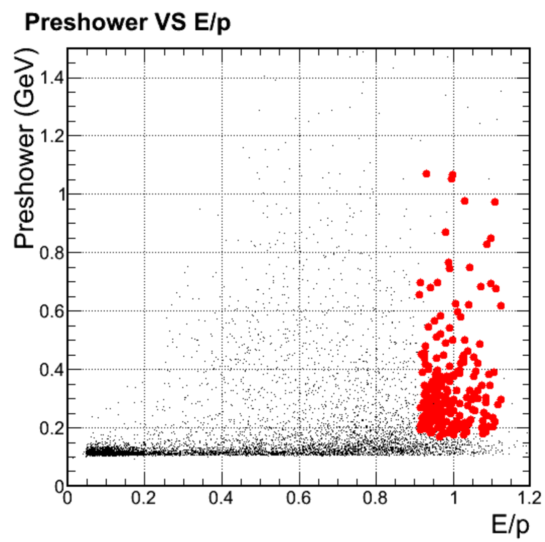
Preshower + shower rejection - worse than the HERMES design

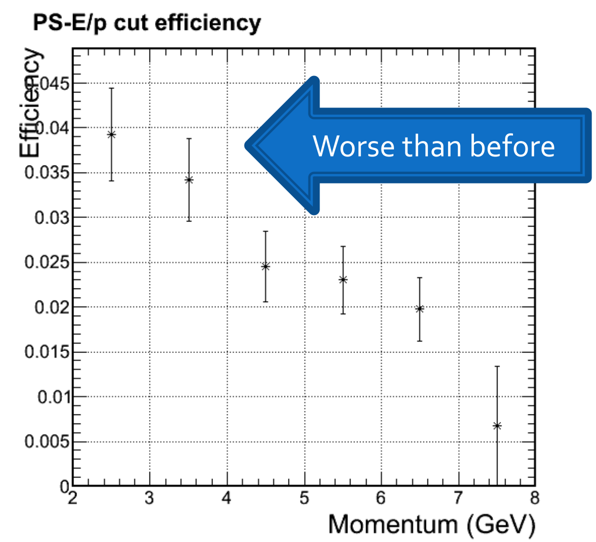
Electron





Pion

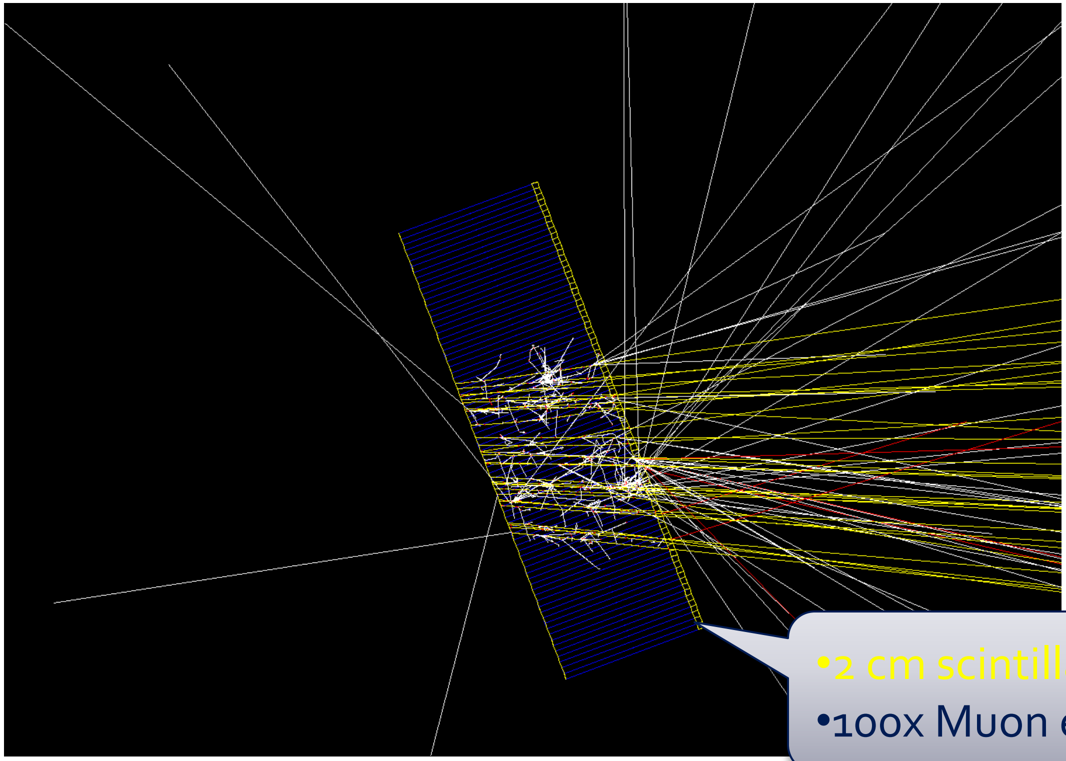




Idea 2: Hadron detector at end of calorimeter

Setup
indenting angle of 22°-27° simulated

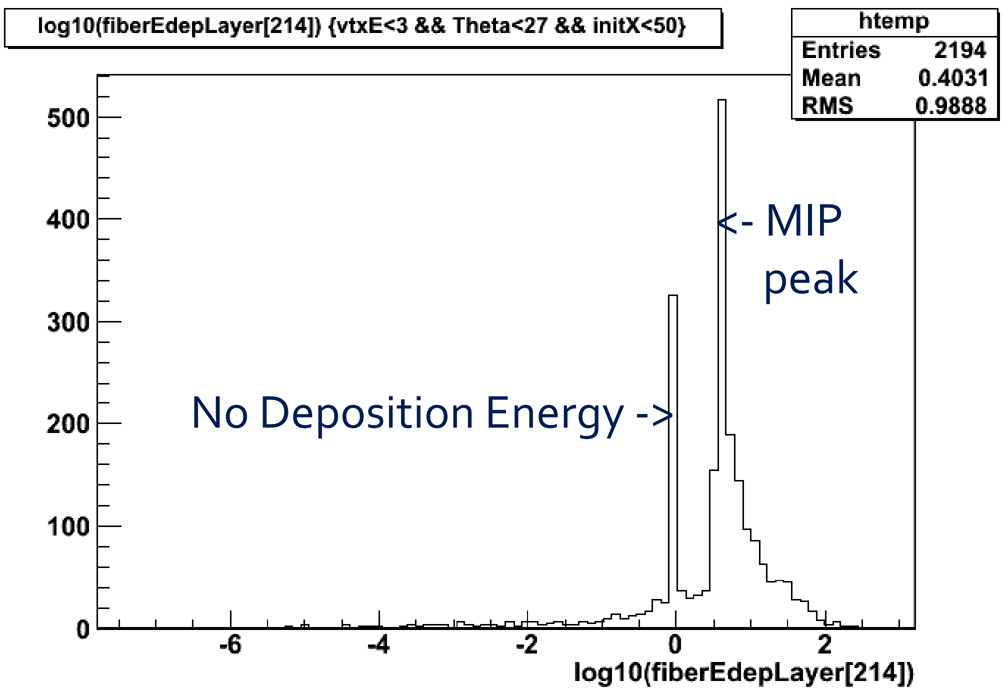
- 2 cm of scintillator at the end of 20 Xo Shashlyk detector
- Expect hadronic shower leak to this scintillator , while EM shower is fully absorbed



•2 cm scintillator
•100x Muon events shown

Turn out that low energy pion can not punch trough too …

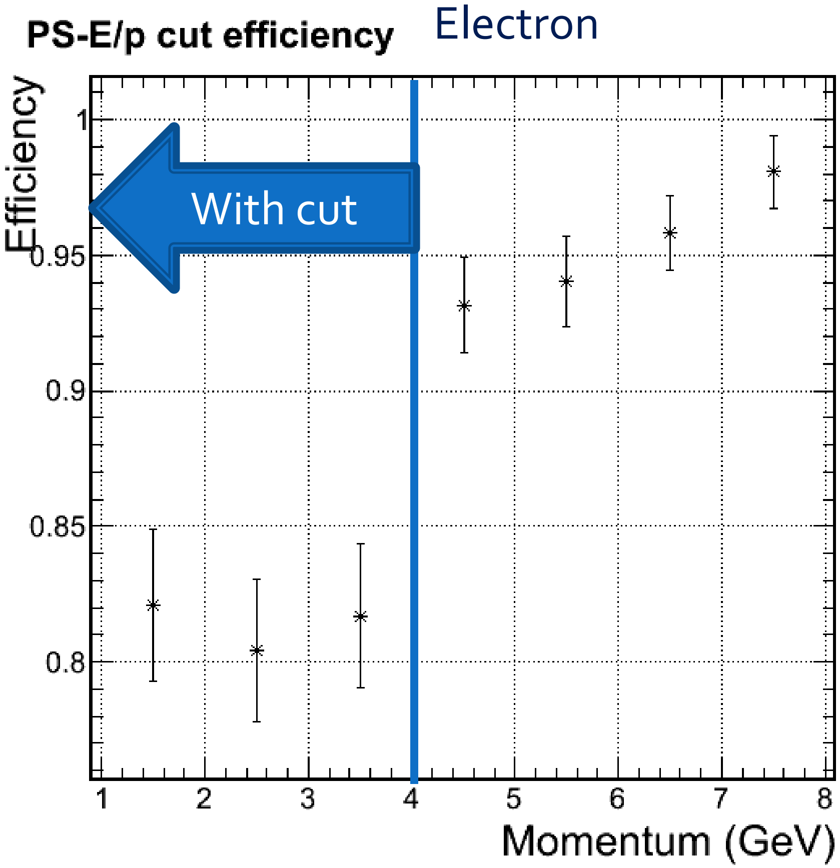
- 1/3 lower energy pions do not reach this layer
  - Absorbed or track significantly deflected

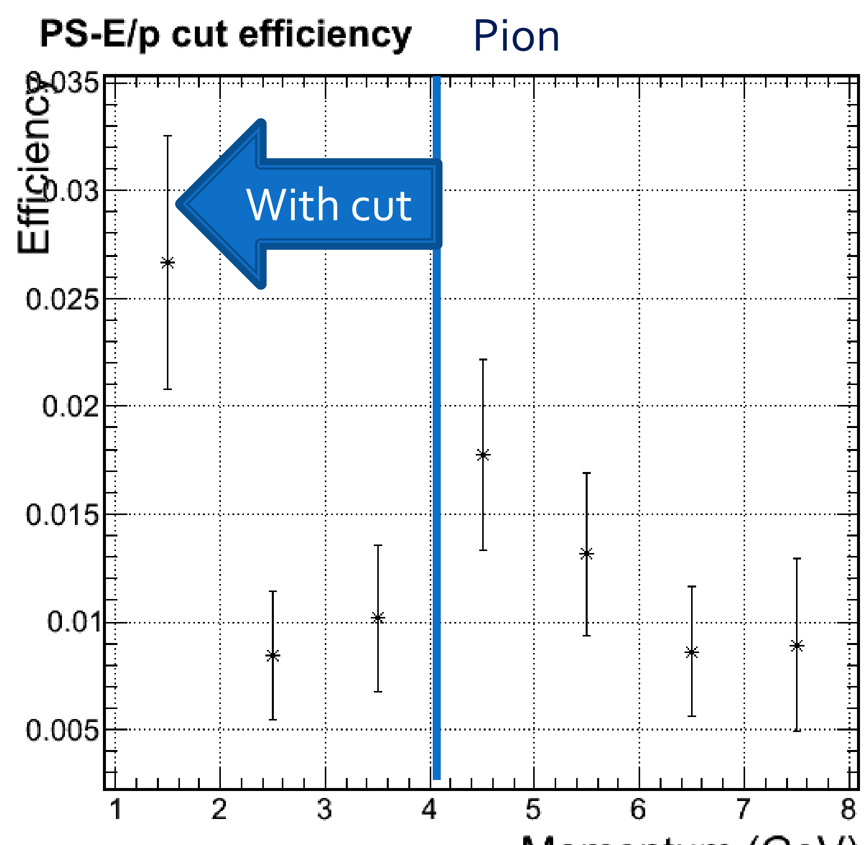


Log 10 of energy deposition

Conclusion

- Can help reject some low energy hadron but left with ~80% electron efficiency





Idea 3: Lower efficiency to trade for rejection

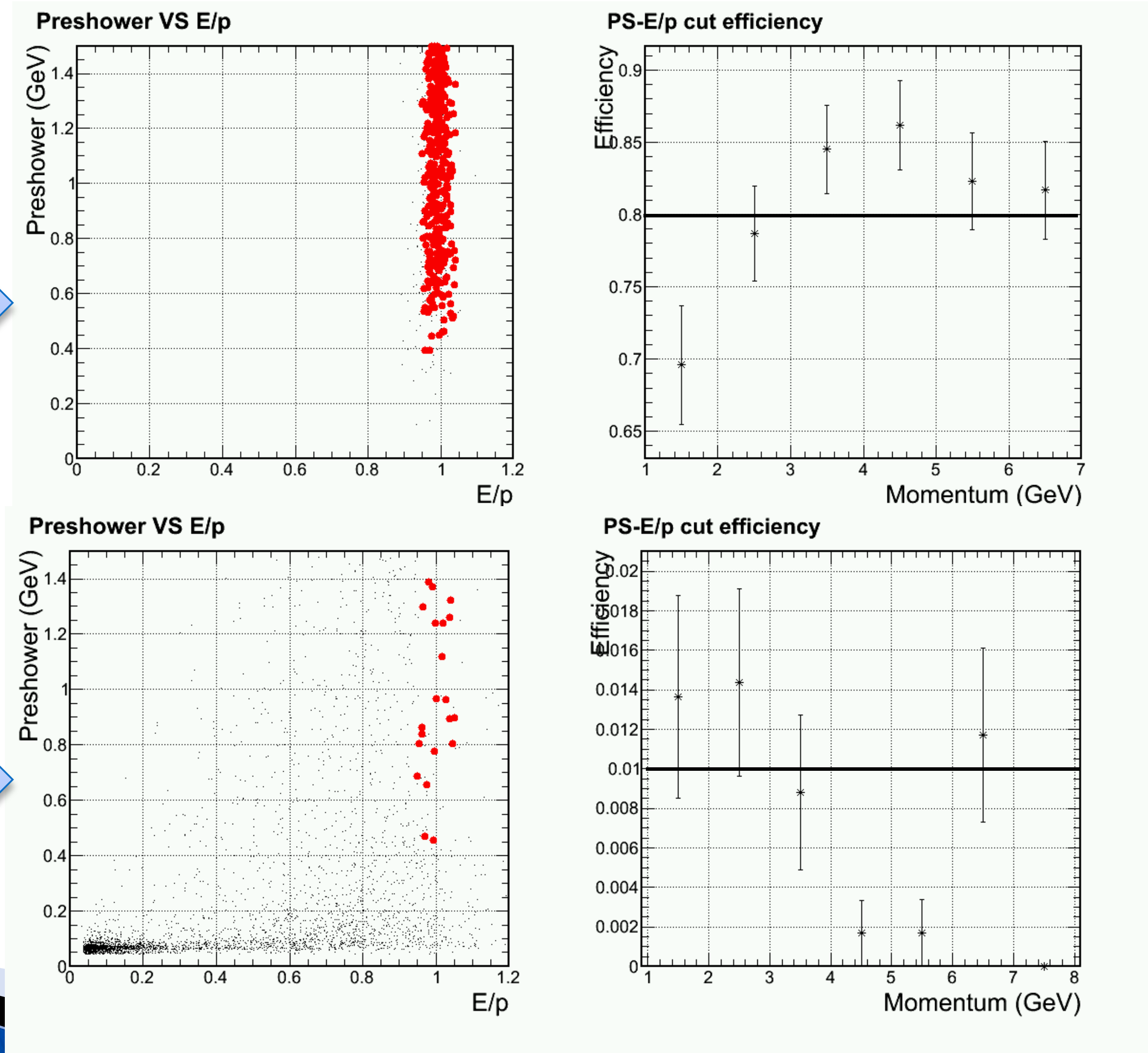
The idea

- Sacrifice efficiency to trade for pion rejection
  - The idea came from Ed
  - He concern that we quote too high efficiency which might degrade due to practical reasons (noise, background, …) and push us to the corner to archive high pion rejection too
  - He suggest that we lower efficiency to ~80%, which may be more realistic and make rejection easier
- We probably want to do so for low-P region
  - Low-P region have larger cross section which can sacrifice some efficiency
  - Low-P region have larger pion/e ratio
  - Low-P region have smaller pion rejection

It is an effective way to enhance rejection

Electron

Pion



Idea 4: Try new Physics List

Physics List QGSP_BERT -> FTFP_BERT