Large Angle Calorimeter

Jin Huang
MIT
SoLID Collaboration Meeting
Mar 25, 2011, Jefferson Lab

Jefferson Lab

OUTLINE

Concept

- Goal
- General Features

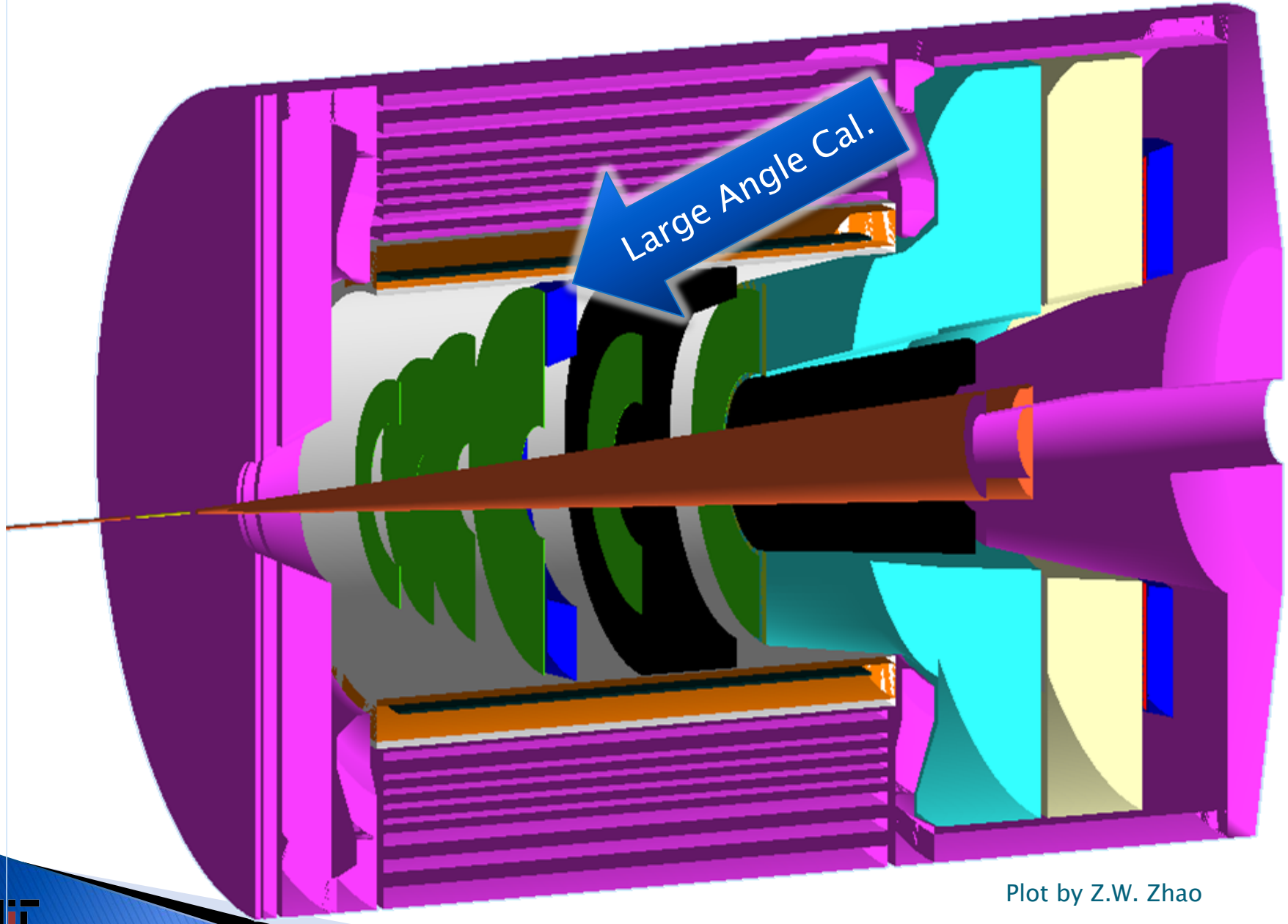
Choice of Calorimeter

- SciFi Cal. (W based/Pb Based)
- Simulation on SciFi Cal
- Shashlyk Calorimeter

Choices of Light Read Out

- outside readout
  - Fiber extension\Light guild
- In field readout

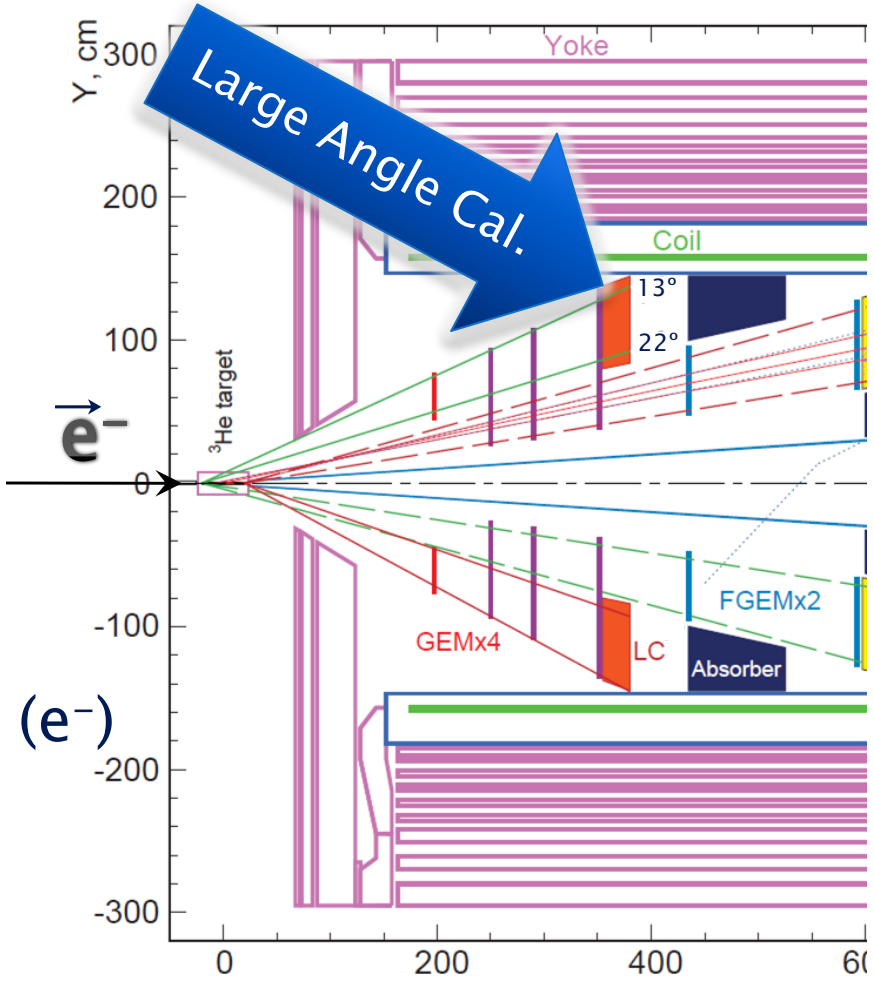
Discussions



Plot by Z.W. Zhao

Concept

- Purpose
  - Provide trigger
  - e/ π separation
    - π:e <1.5
- General features
  - Coverage
    - 13~22 degree
    - ~4m² coverage
    - 3~7GeV
  - 120kHz (high p)/11kHz (e^-)
  - In ~1.5T field
    - Mostly along track
  - Radiation hard
    - ~10Gy for high p part

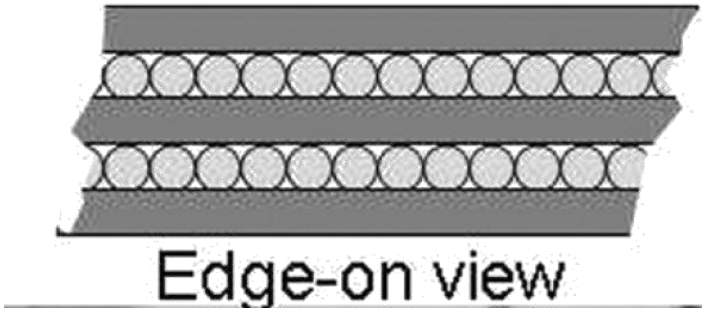


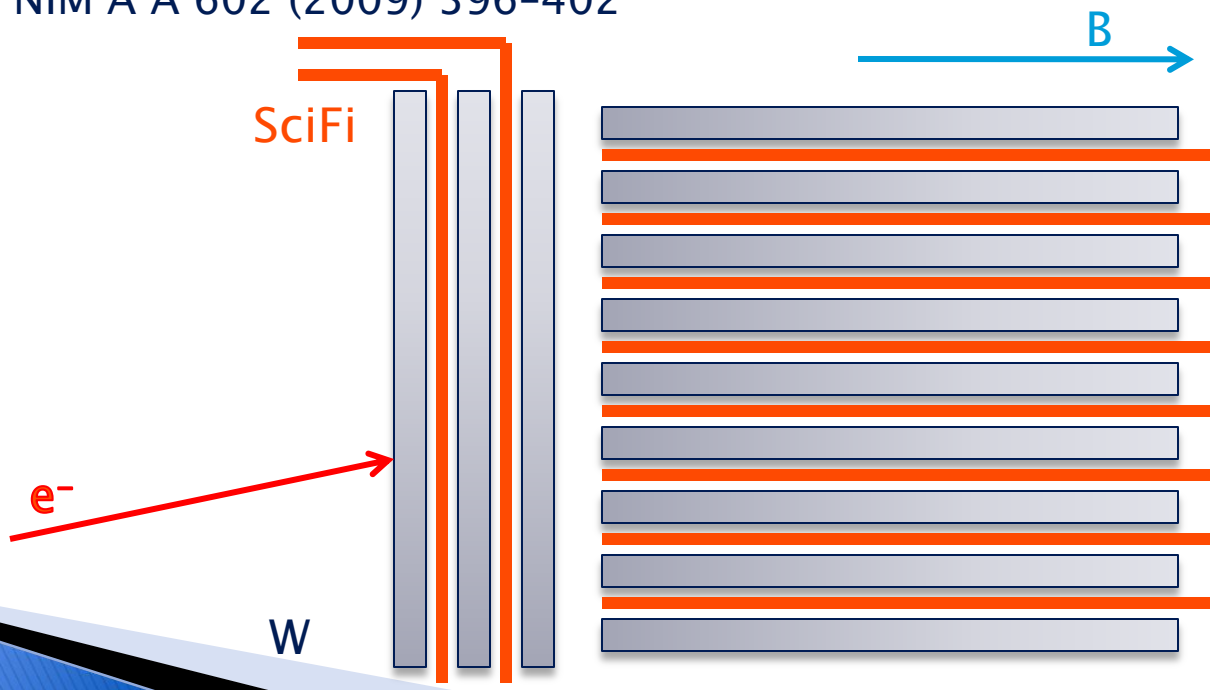
Choice of Calorimeter

- Sci-Fi Calorimeter
  Shashlyk Calorimeter

Tested design 1 – Tungsten based SciFi

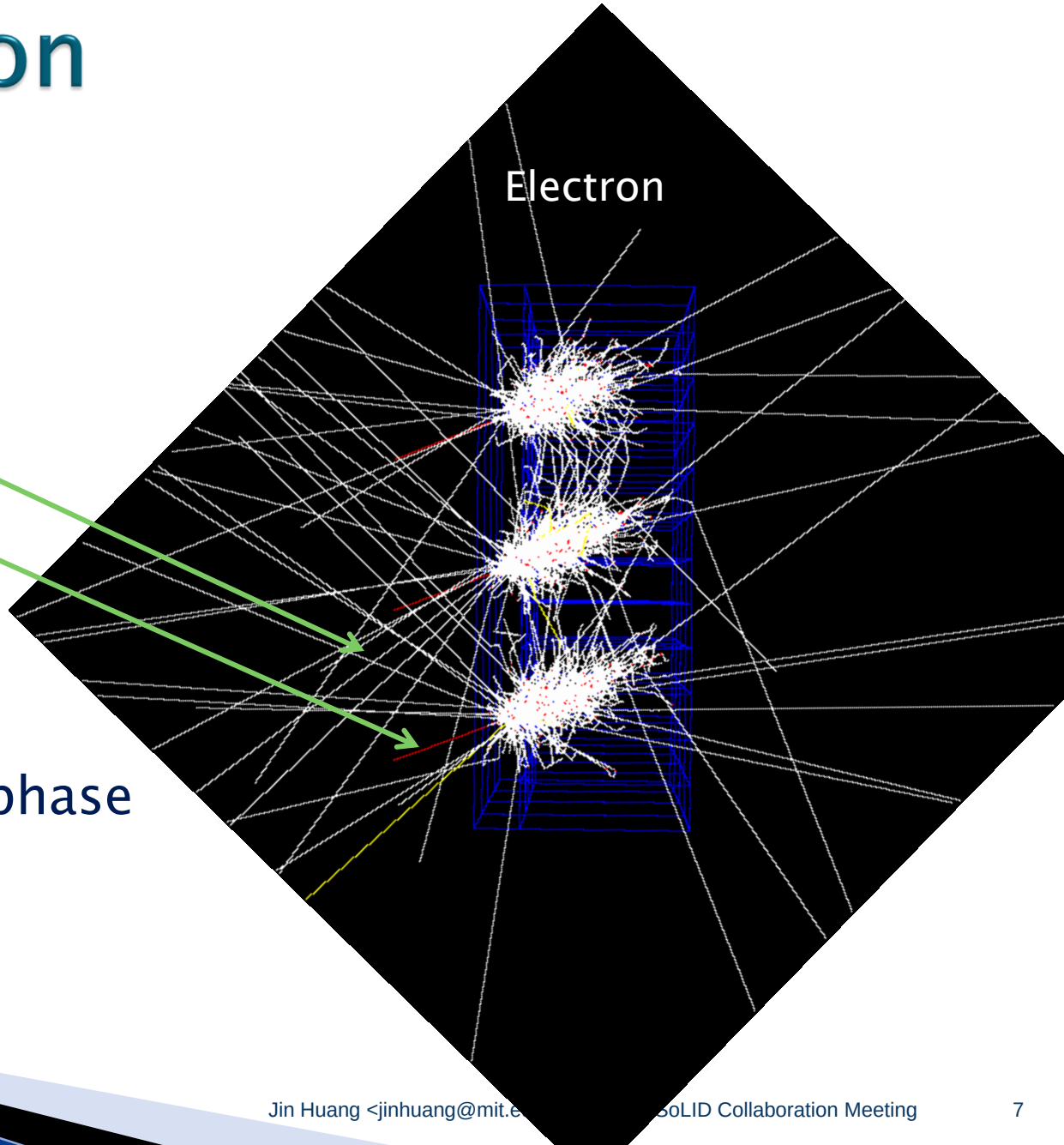
- FNL g-2 design
- Simple assembly
  0.5mm W plate – 0.5mm fiber
- Short radiation length
  0.69cm
- Energy resolution tested: 12%/Sqrt(E)
- McNabb, NIM A A 602 (2009) 396-402



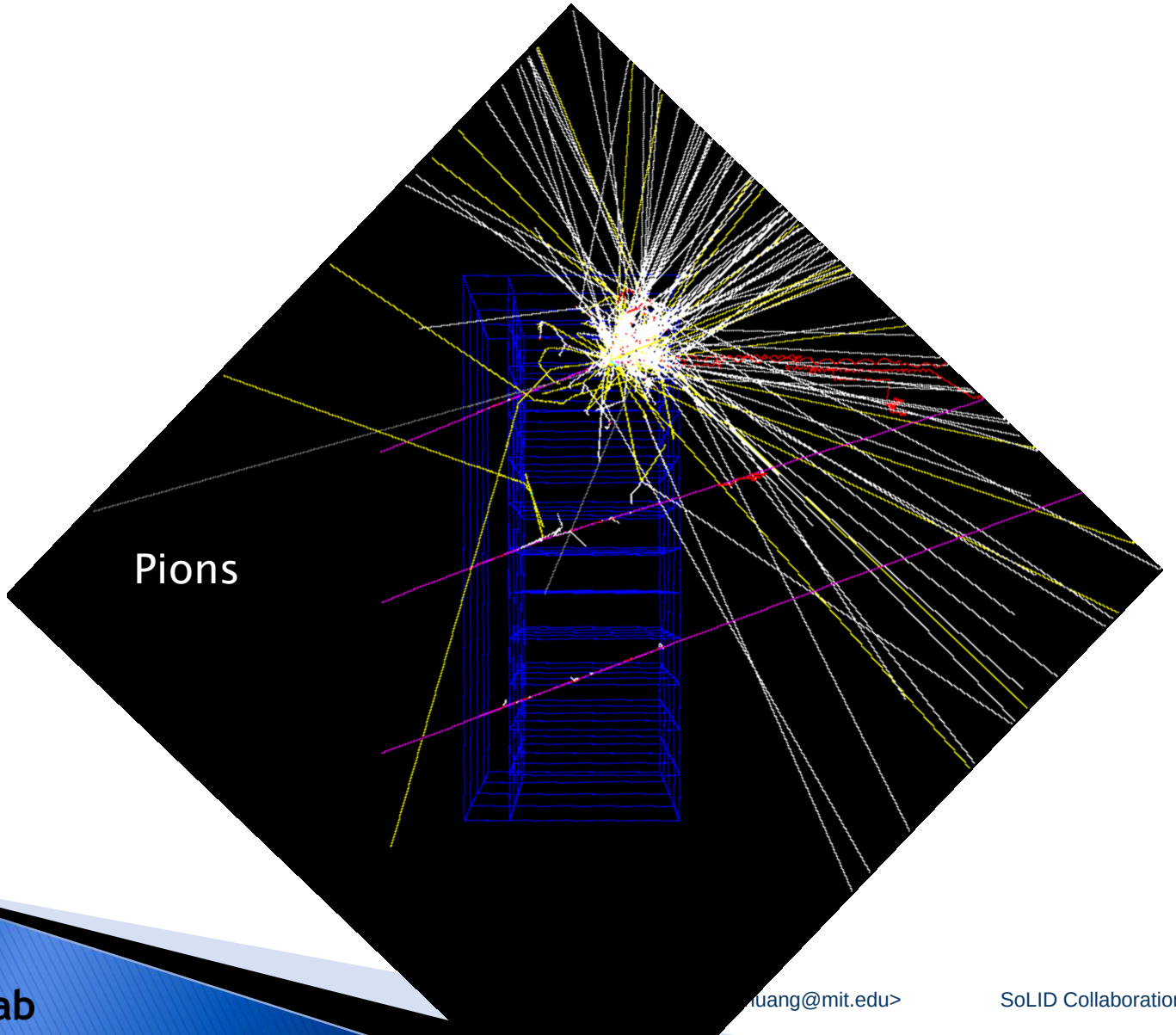


A simulation

- 4cm preshower
- 15cm shower
- Plates orientation optimized
- 1.5T Bz field
- Flat SoLID-SIDIS phase space

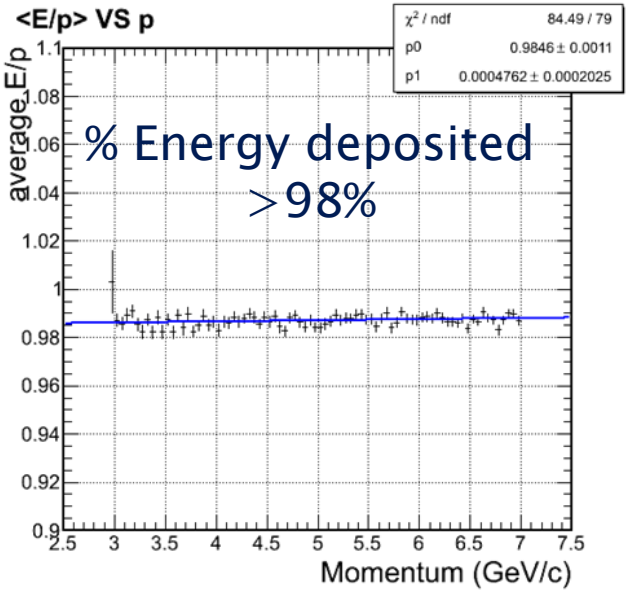


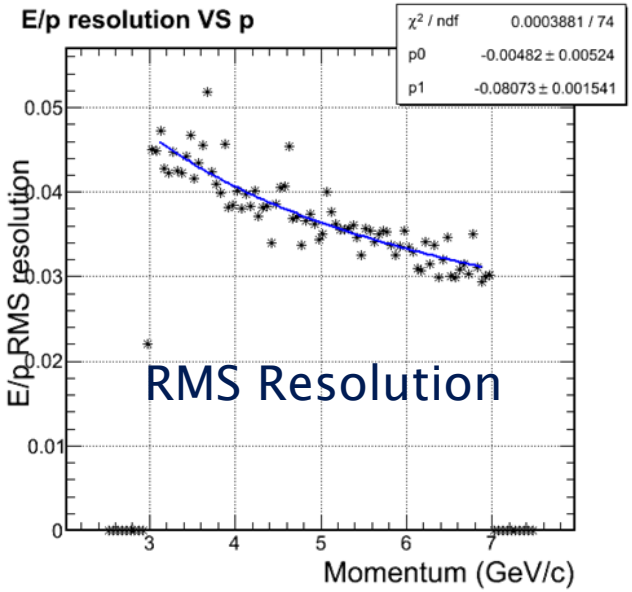
A simulation – Pions



The results – electron

- No obvious field (z direction) dependence of light output and energy resolution
- RMS resolution this configuration: 8%/Sqrt(E)

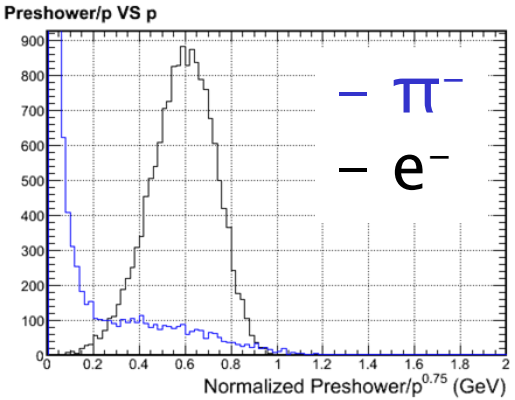


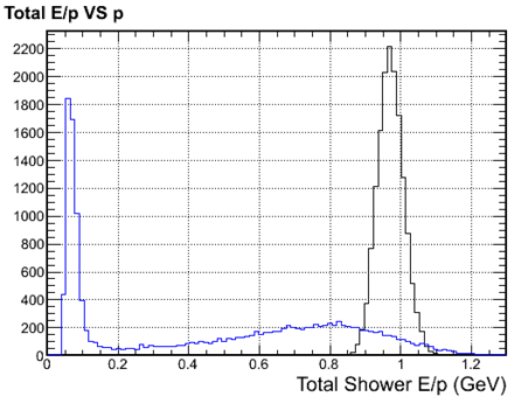


Pion rejection ratio

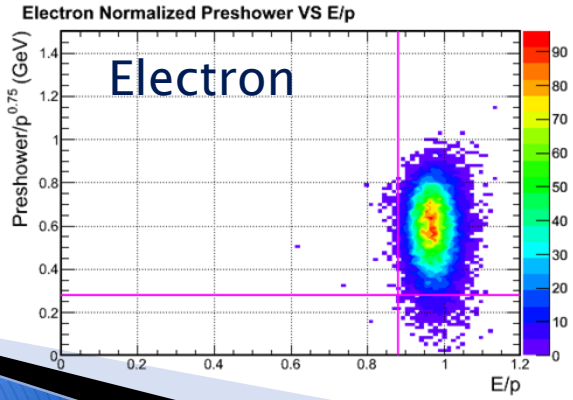
- Electron acceptance ~ 97%
- Pion rejection 20 ±1

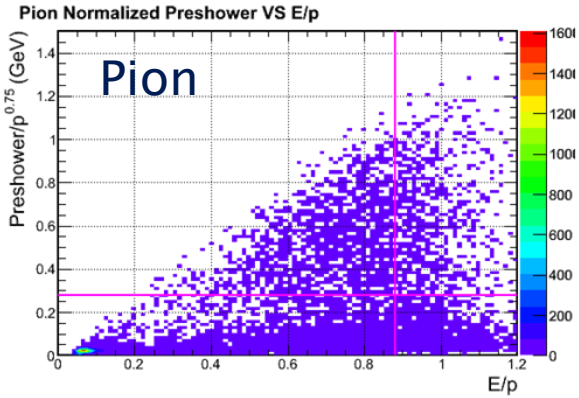
Preshower (normalized)





E/p



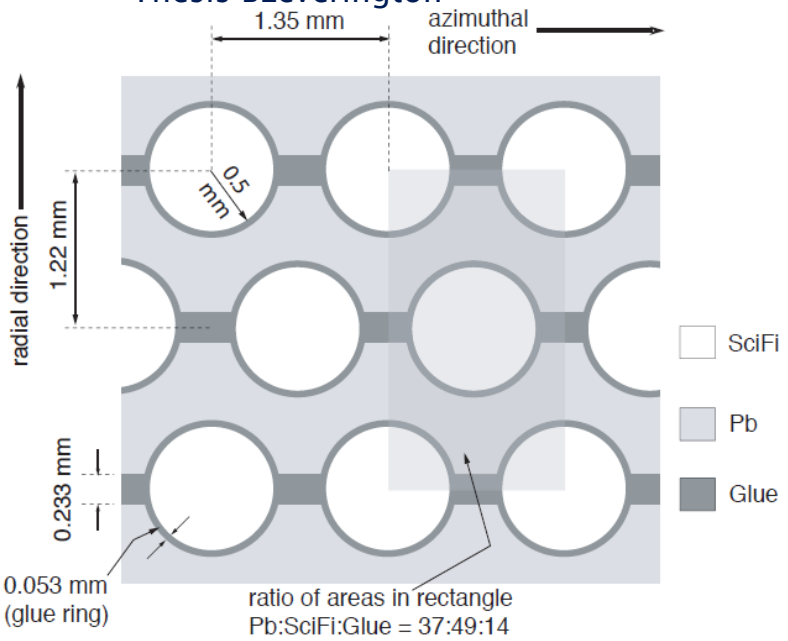


Tested design 2 – Lead based SciFi

- Similar design
  - Hall D barrel, BNL g-2
- Tested with 2 Pb/Scifi combination
- Good pion rejection and magnetic stability can be achieved

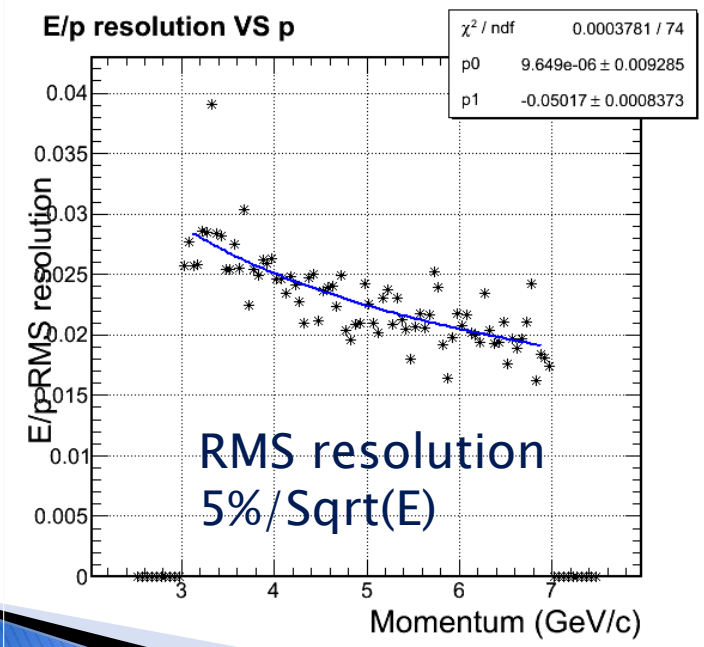
Hall D barrel Ecal Design

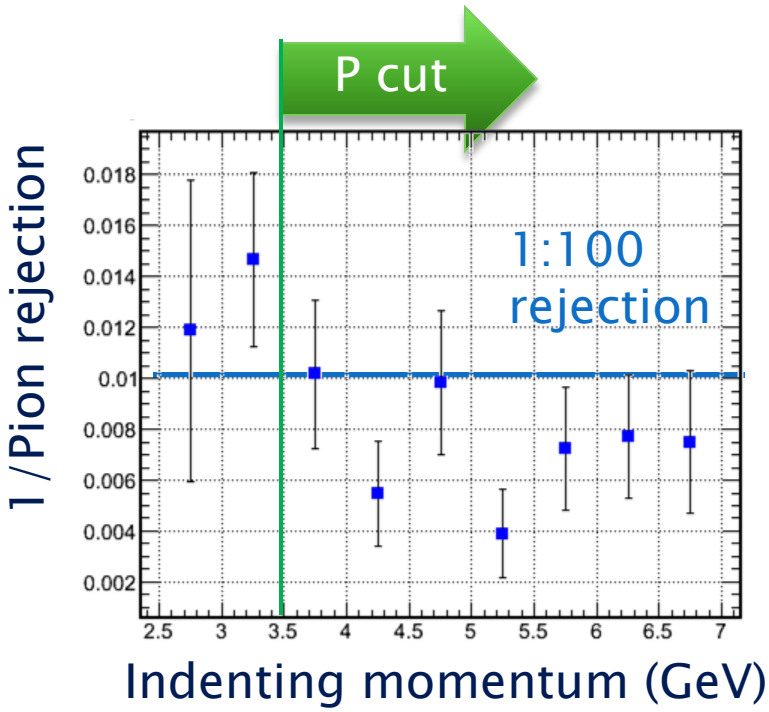
Thesis BLeverington



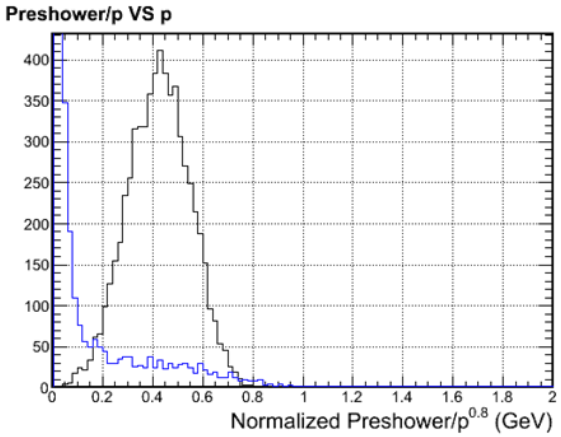
One result

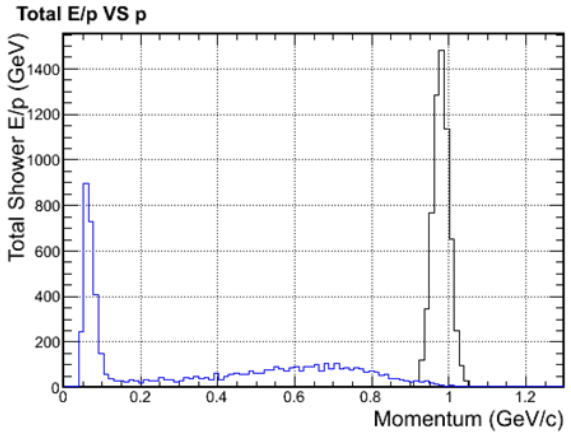
- 55:45 SciFi:Pb (area); 30cm (20 radiation len.)
- RMS resolution : 5%/Sqrt(E)
- >97% electron eff. >100:1 pion rejection
- Further space of tuning

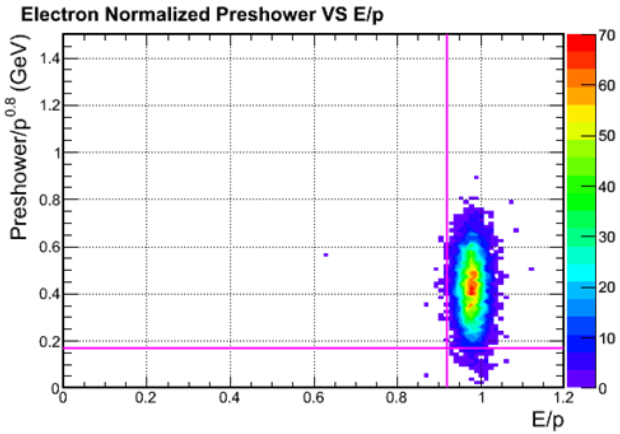


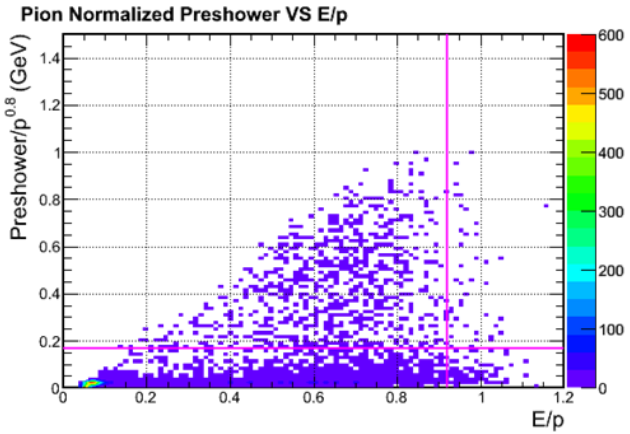


55:45 SciFi:Pb Calo.



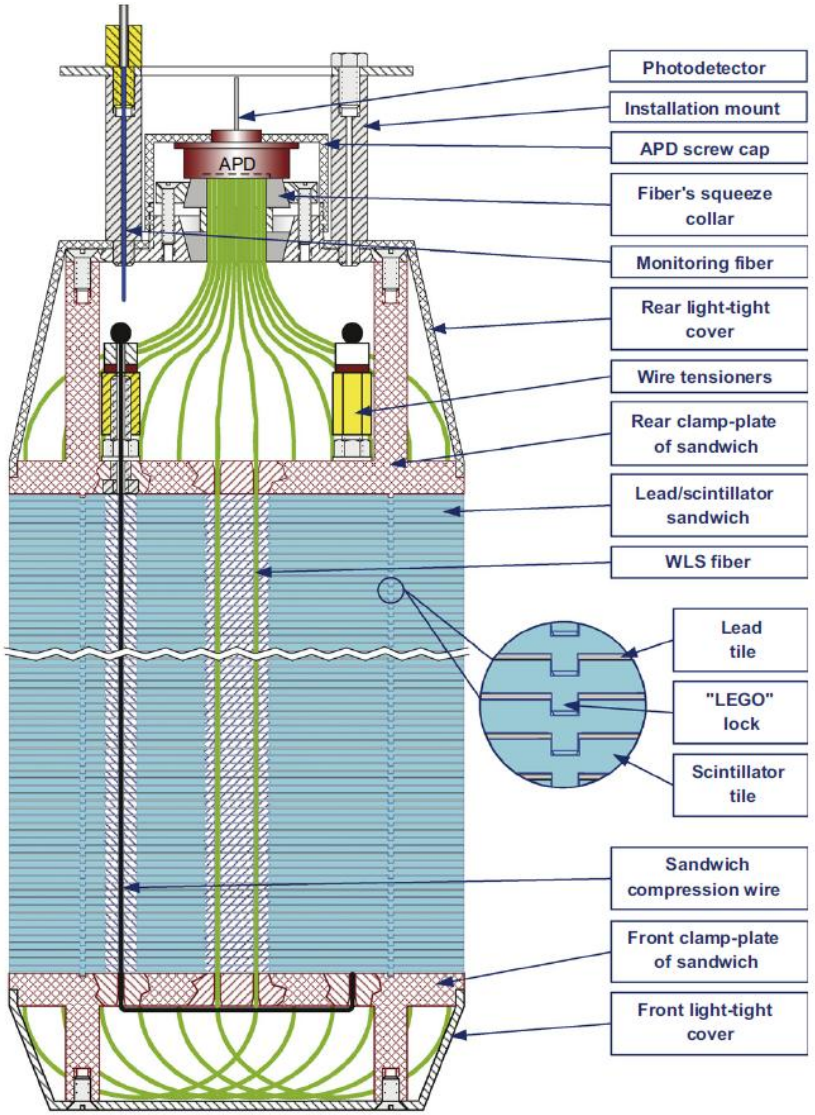






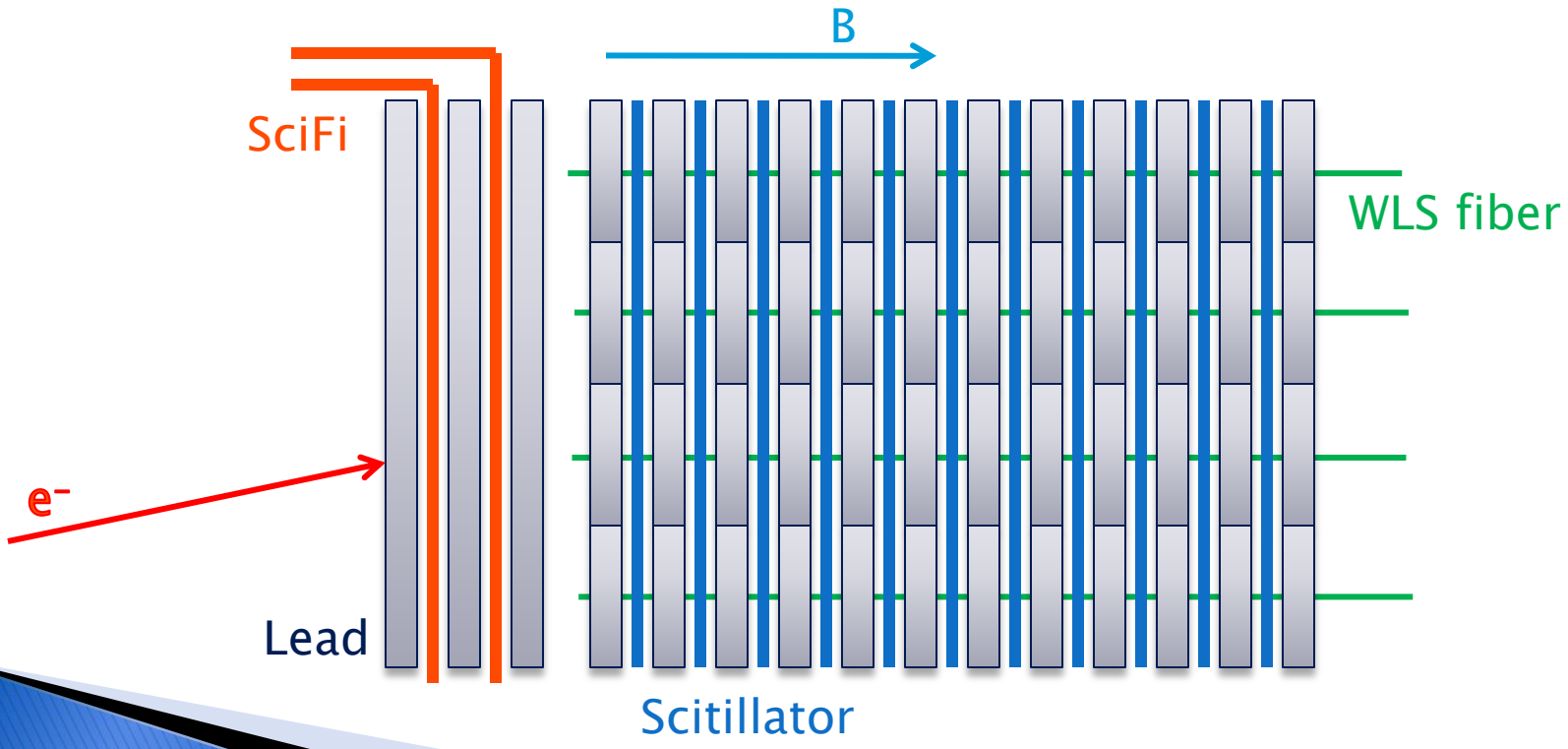
Shashlyk Calorimeter

- 3~4%/Sqrt(E) was reported
  - Lead-Sci sandwich
  - NIM. A531 (2004) 467
  - NIM.A584 (2008) 29
  - Long radiation length
- Can be optimized for SoLID case



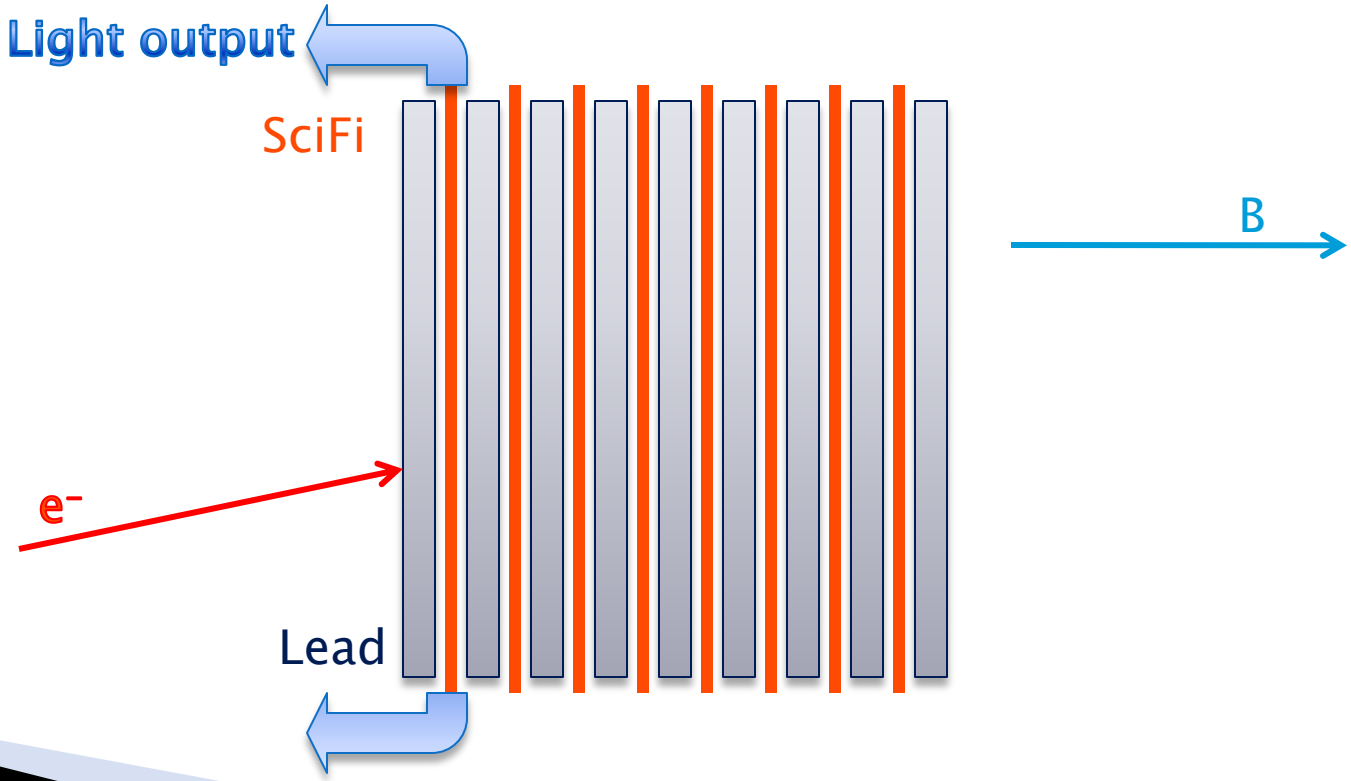
A hybrid design?

- Use SciFi for preshower
- And Shashlyk for shower



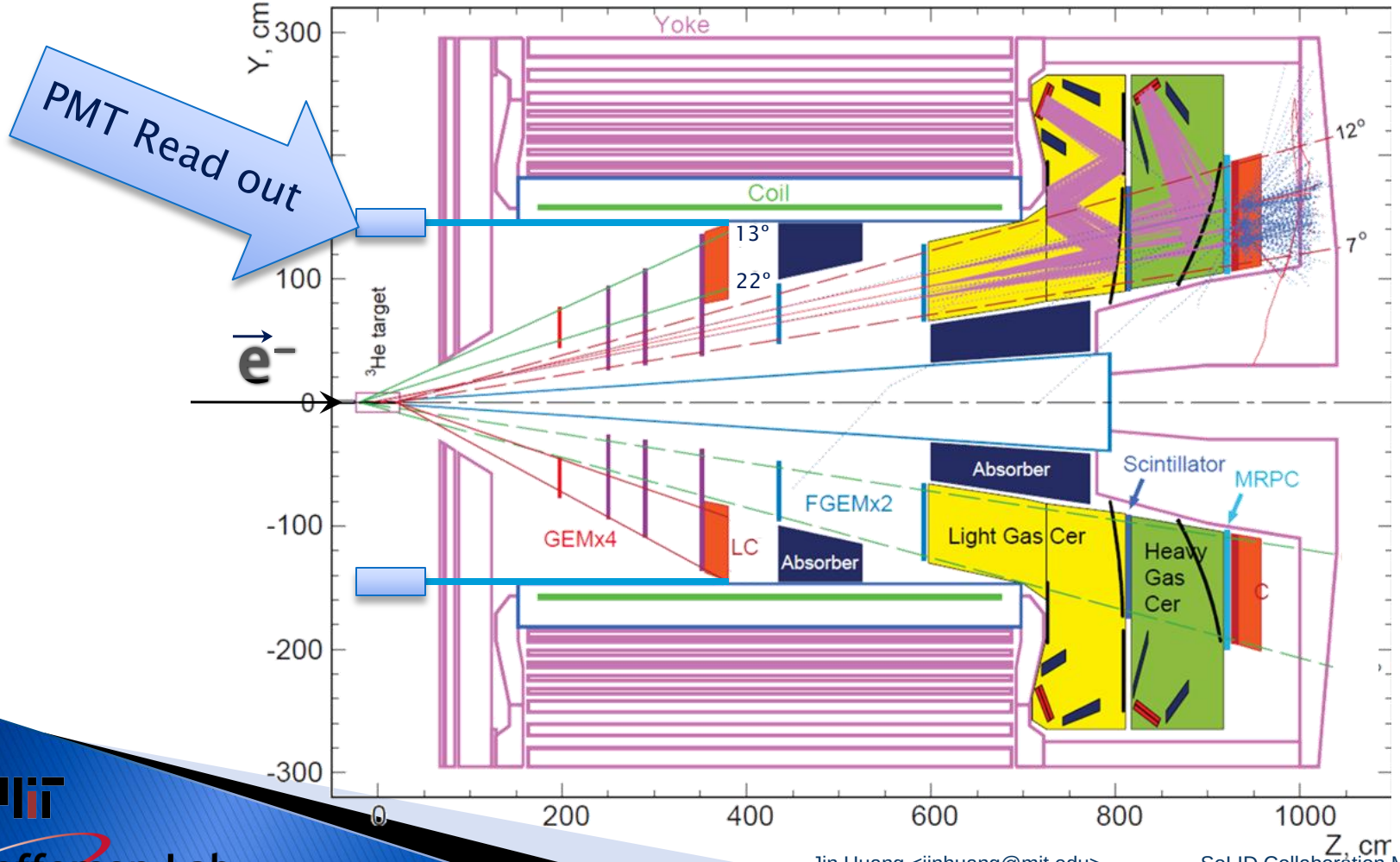
A radius SciFi design?

- Use SciFi for both preshower-shower
- Read out both end
  - take time difference for position



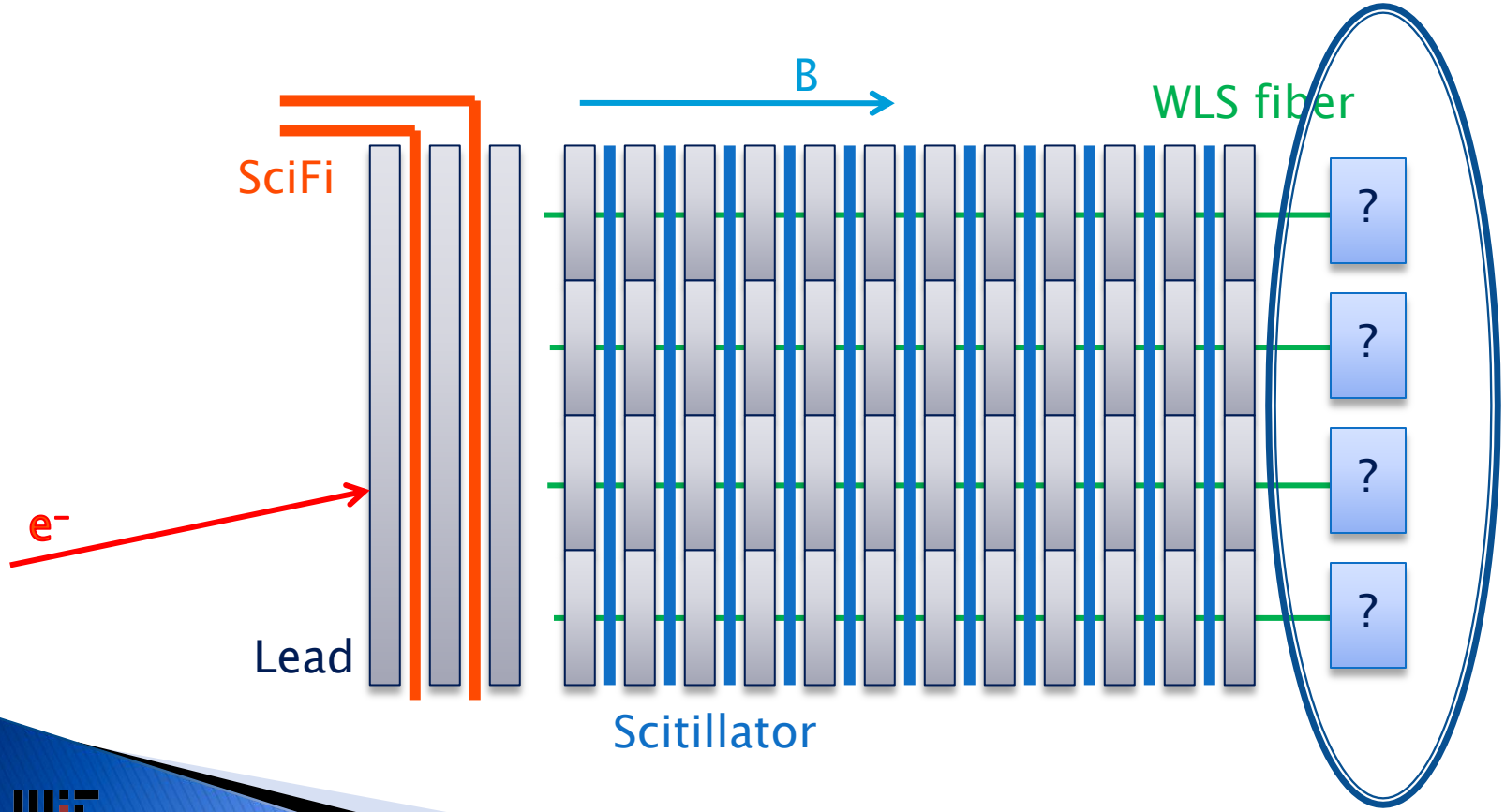
Choice of Light Read Out

- No field, use PMT
- Fiber/light guild read out: 3m in CDF design



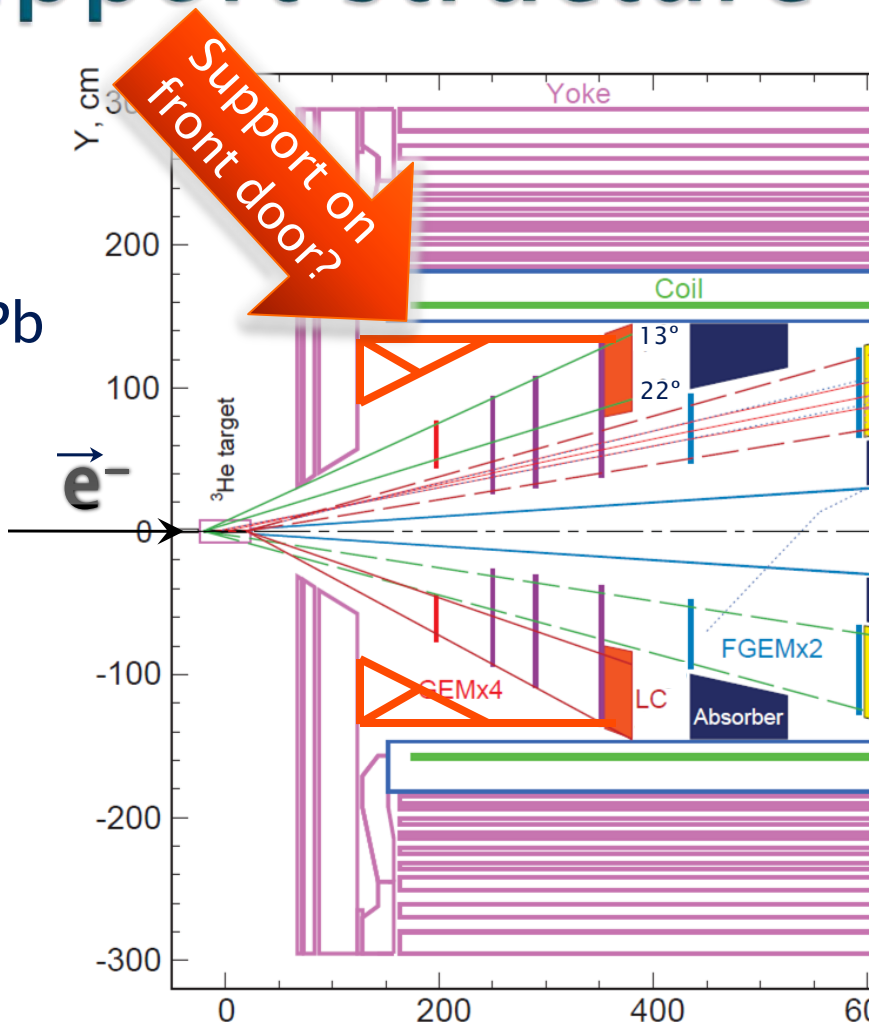
Any in field reading options

- Strong neutron background kills SiPM



Discussions/ Support structure

- Weight
  - 1 Ton/m^2 (~4Ton total)
    - for 20 radiation length Pb
  - Plus support
- One support?
  - Mount on the upstream cap?

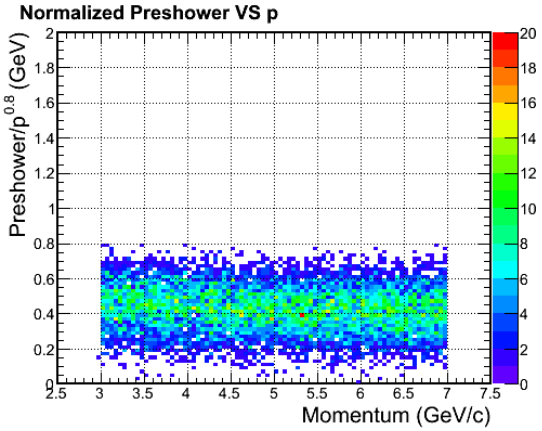


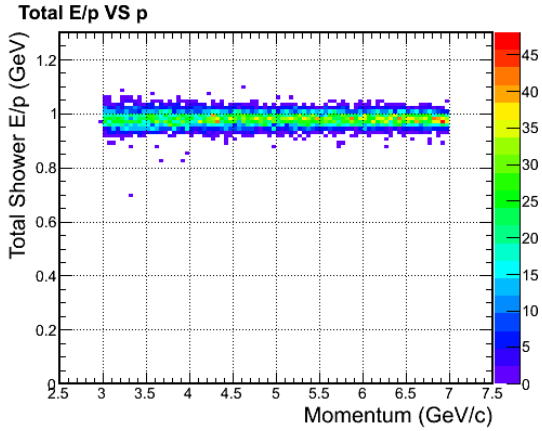
Towards next stage

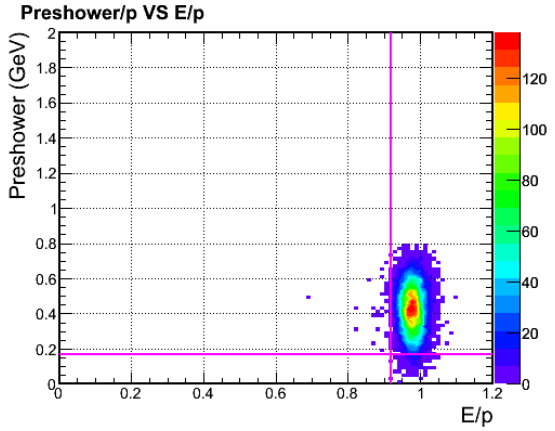
- Continue simulation study for Cal. optimization
  - Updates: https://hallaweb.jlab.org/wiki/index.php/Solid_Largeangle_Calorimeter
- Investigate read out possibilities
- Alternative design for smaller magnet?
- Prototype build/acquire, tests?

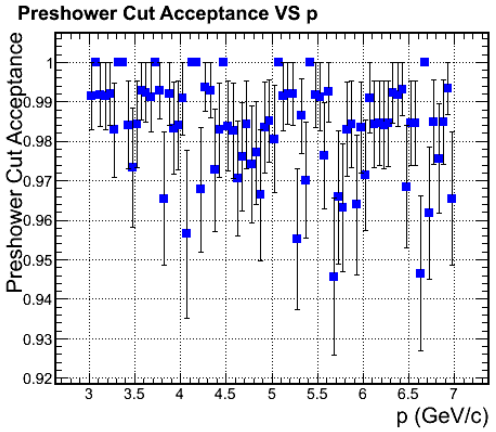
Back up slides

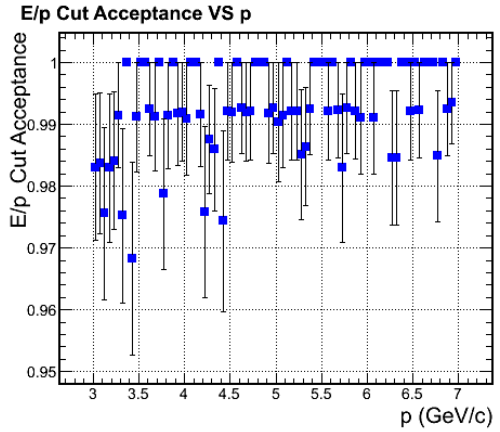
Electron response in Pb-SciFi

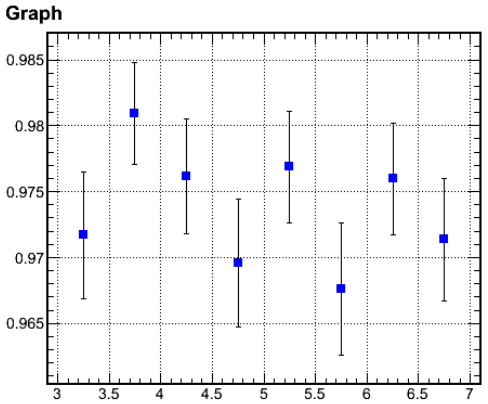




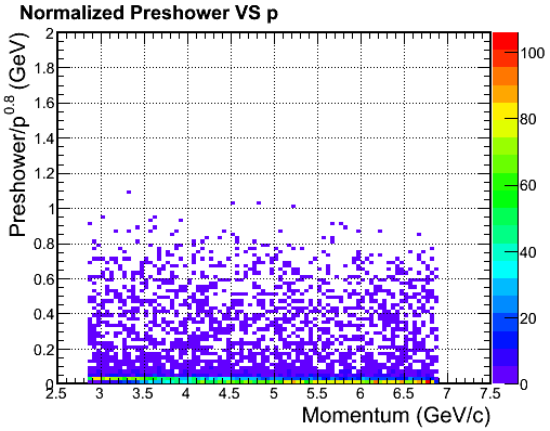


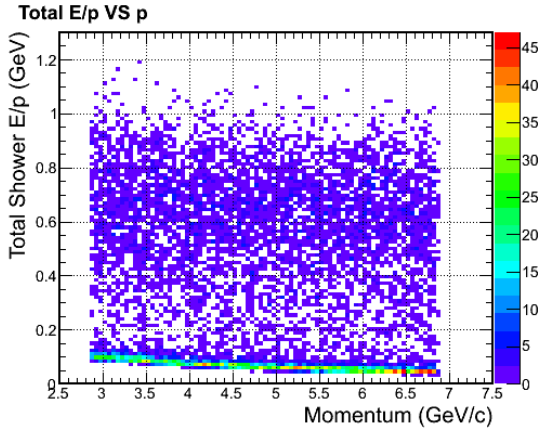


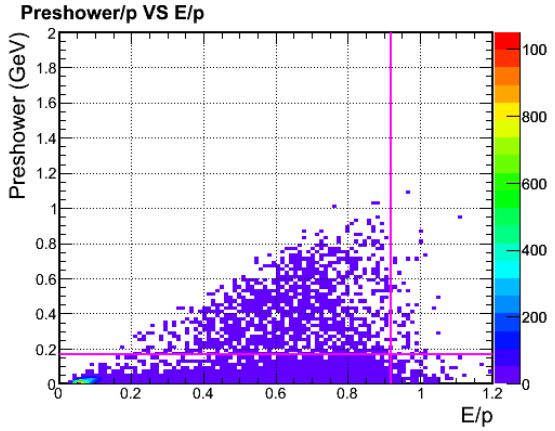


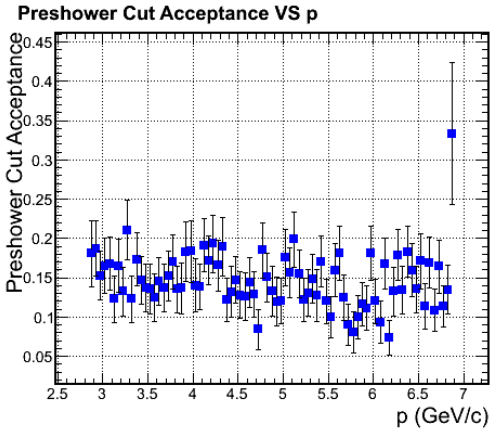


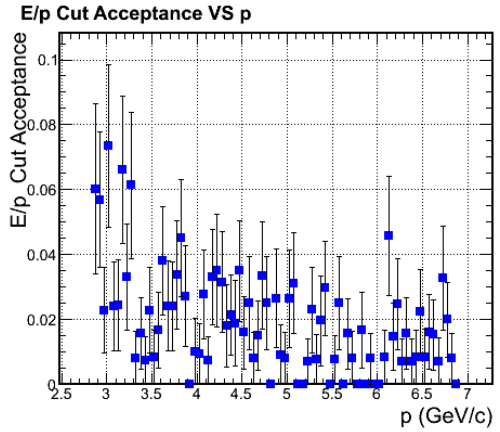
Pion response in Pb-SciFi, 0 B Field

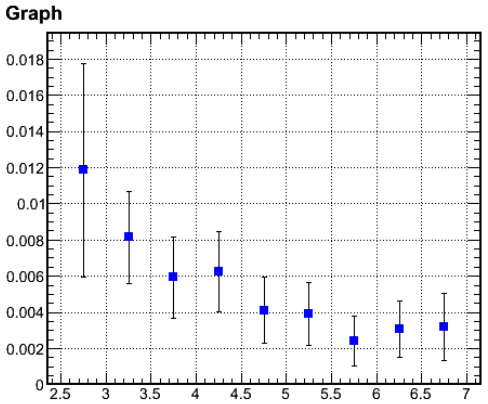




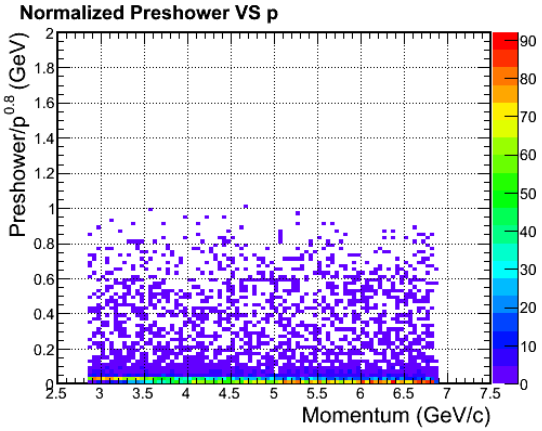


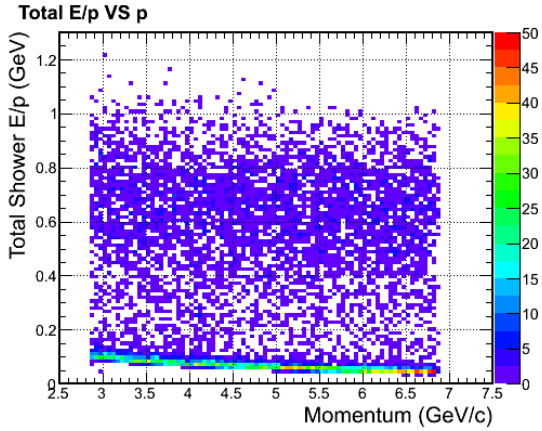


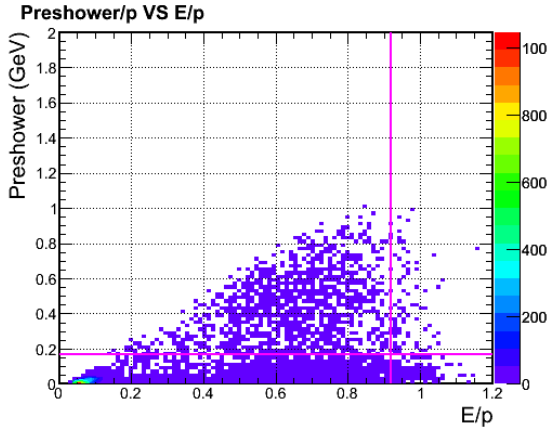


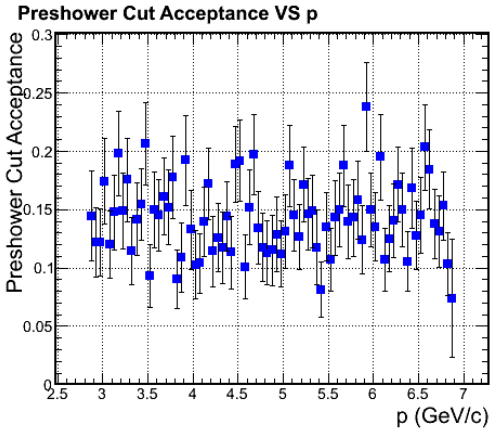


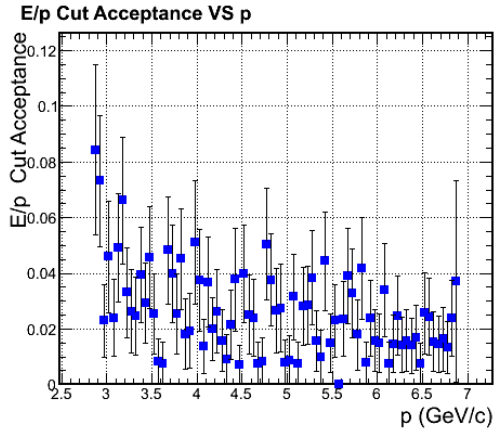
Pion response in Pb-SciFi 1.5T B Field

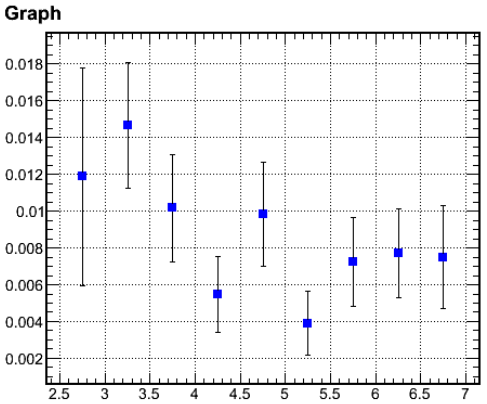












Shower profile in Pb-SciFi