Updates on Calorimeter Topics

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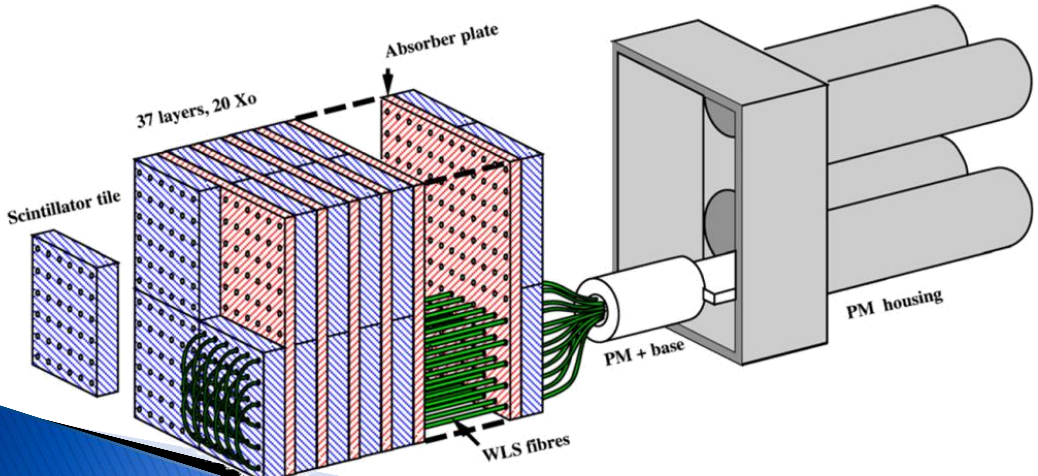
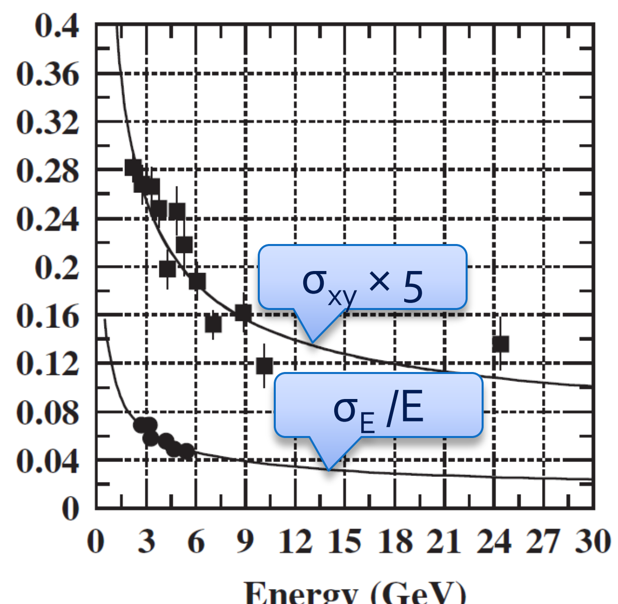
Evaluation for HERAb calorimeter

HERAb calorimeter (NIM A 580 (2007) 1209)

	HERAb (Outer layer)	SoLID default
Absorber per layer	3mm – Pb	0.5mm Pb
Scintillator per layer	6mm	1.5mm
Total length	20 Xo / 37 layer	18 Xo / 194 layer + 2Xo PS
Energy resolution (1/√E)	10.8%	4-5%





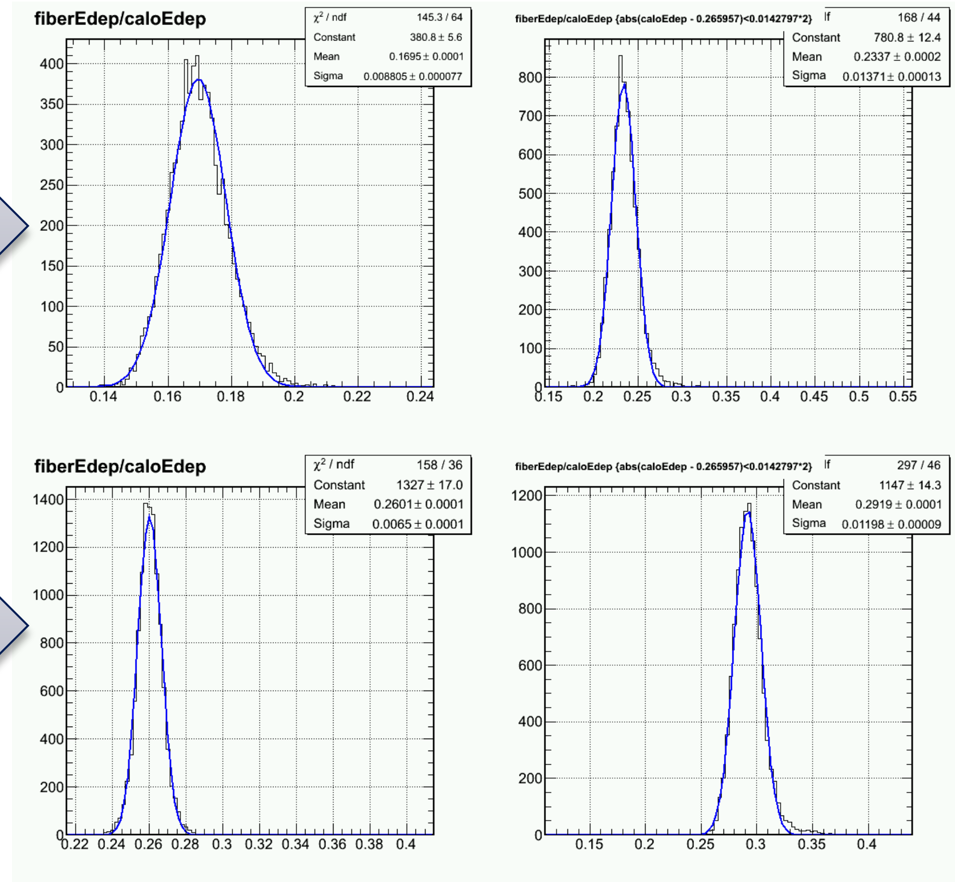
Comment on finesse of sampling

- Many experiment in our energy range use 1.5 mm Scintillator thickness (which defined absorber thickness in maintaining their ratio), which was adopted in SoLID default design.
- The fineness of sampling is related to
  - Difference in response to MIP and EM shower
    - Rough sampling lead to less sampling for EM shower compared to MIP
    - Very important to pi/e separation purpose
    - Considered in original design and lead to the choice of thinnest scintillator
    - Expected reason: low-E photon in EM shower is more likely to convert in Pb and get fully absorbed. Therefore, number of charged particle is higher in Pb compared with Scint. However, for MIP, the ratio of charged particle is 1:1 in Pb : Scint
  - Energy resolution

Sampling ratio in simulation

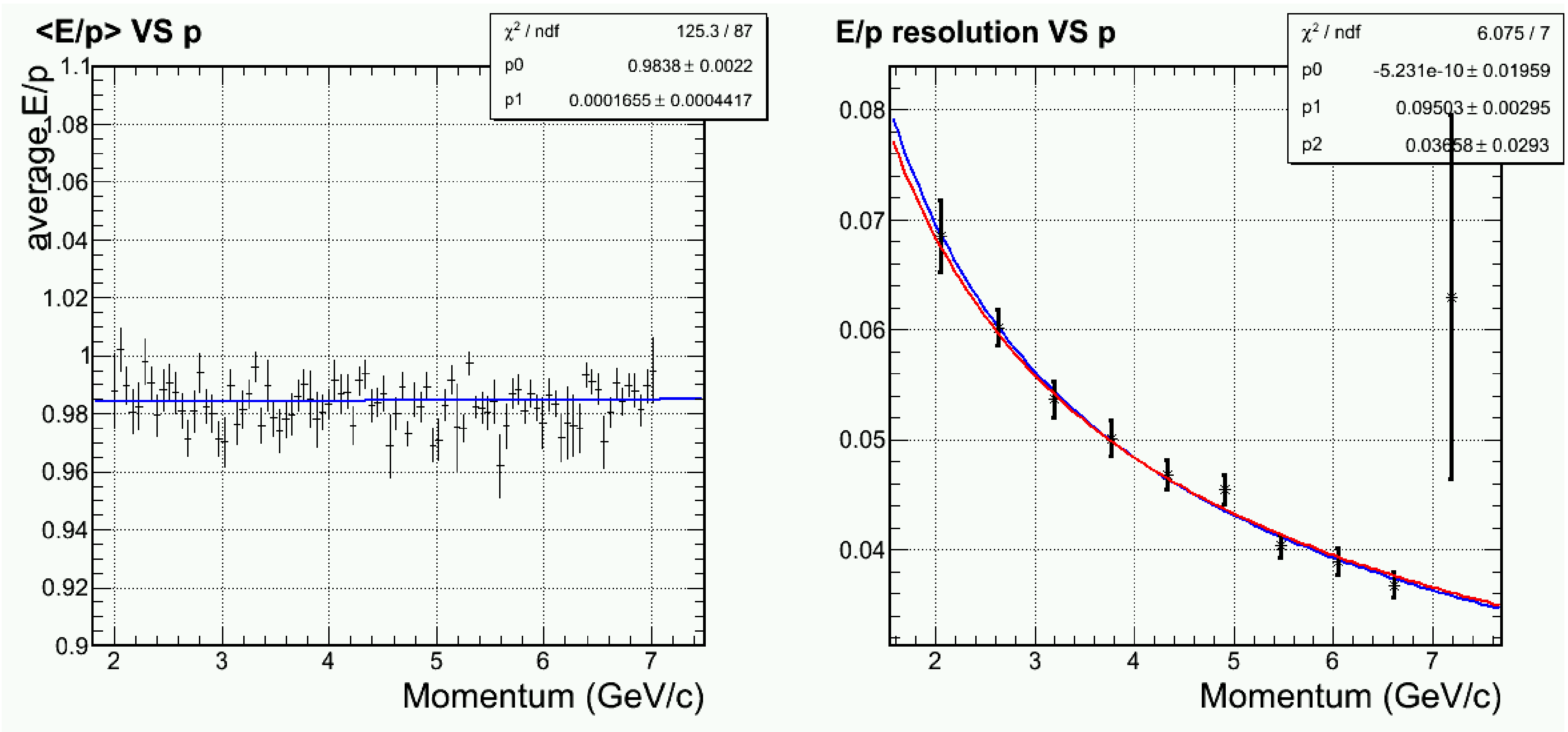
HERAb: 3mm Pb/6mm Scint
Sampling ratio for EM-Shower/MIP ~ 73:100

SoLID: 0.5mm Pb/1.5mm Scint
Sampling ratio for EM-Shower/MIP ~ 89:100



Making the Pb layer much thinner (<1/10) while maintainting Pb/Scint ratio:
EM shower retain same sampling ratio as MIP. But fail to output light through WLS

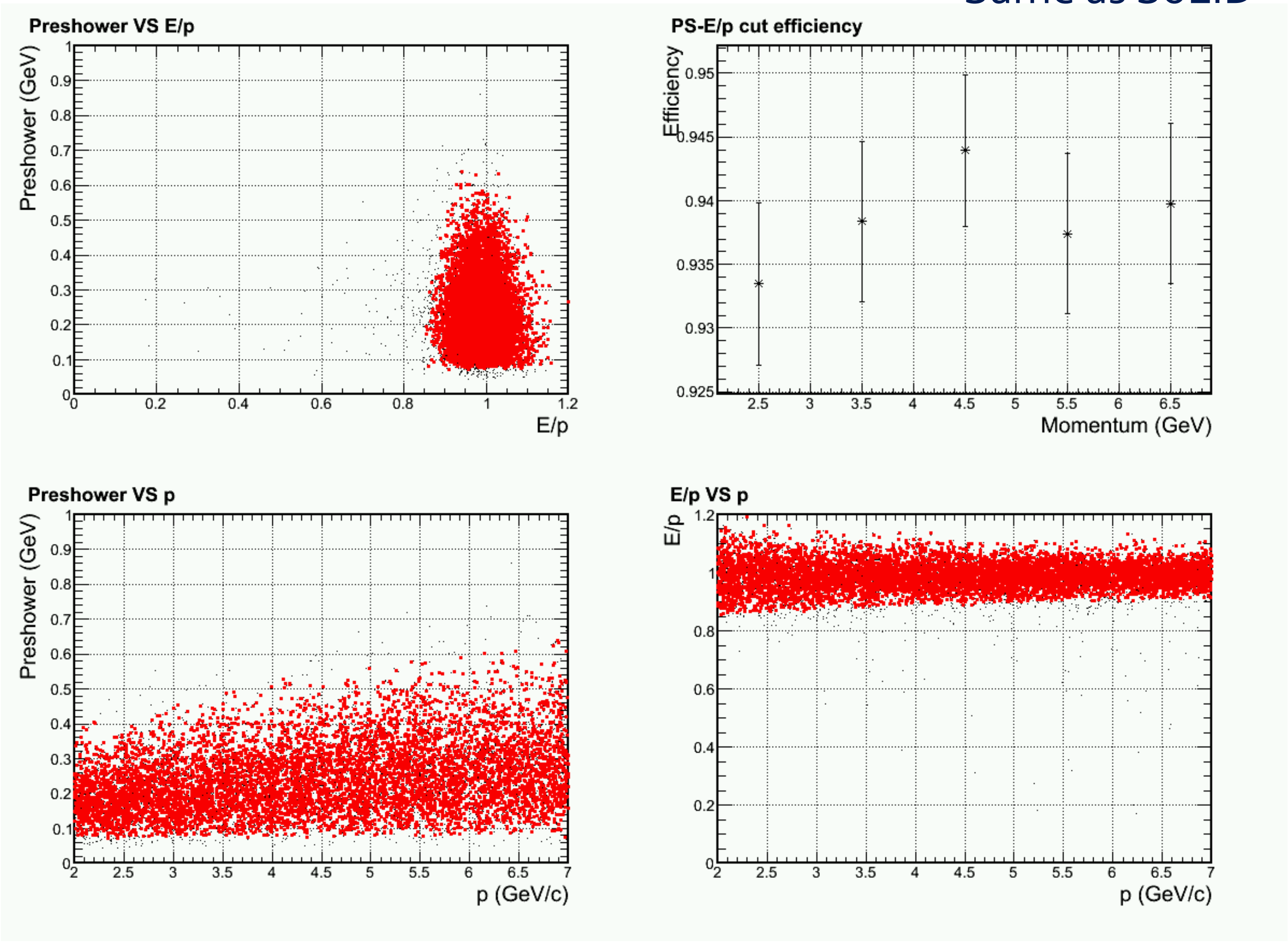
HERAb energy resolution



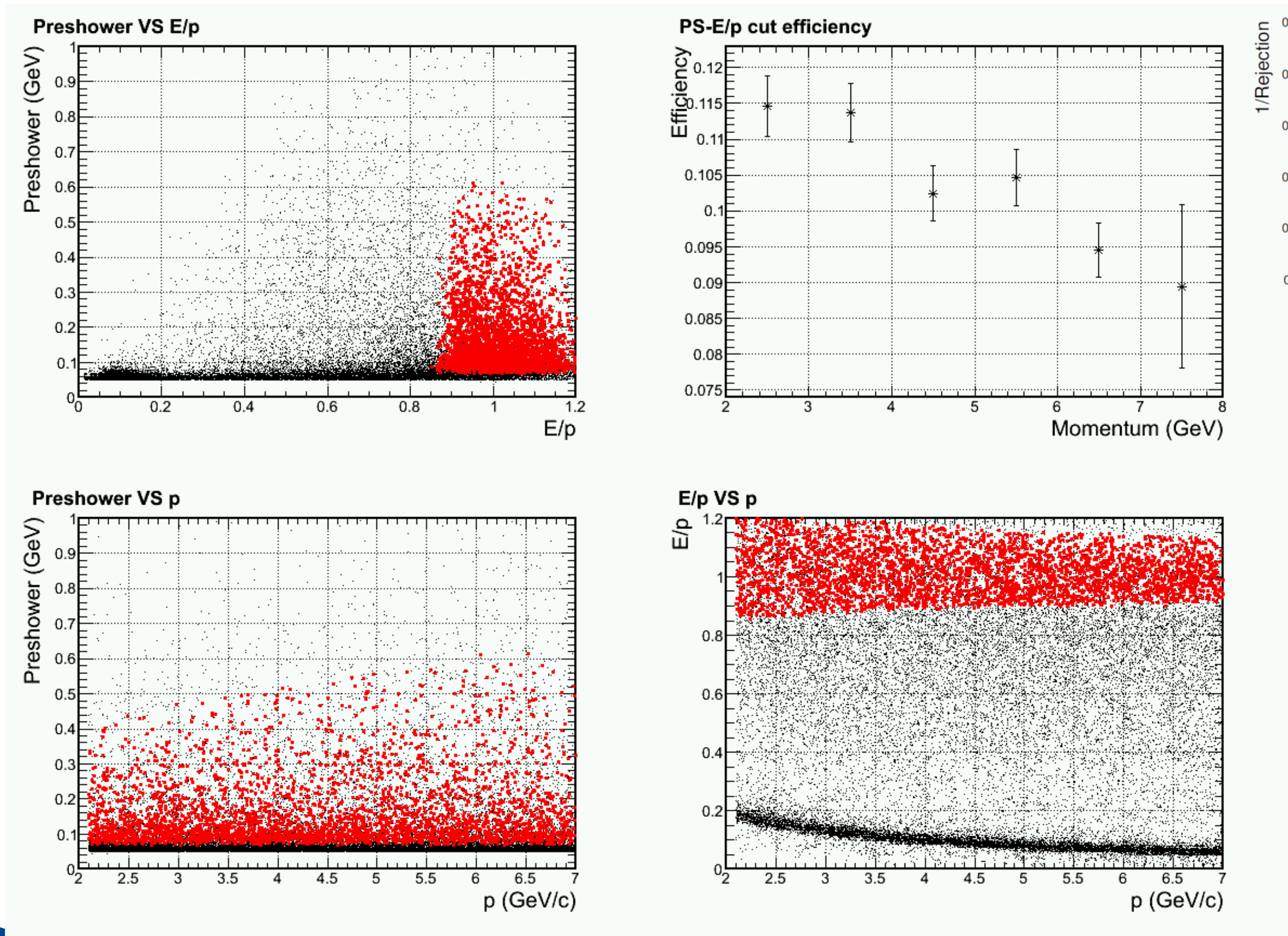
Simulation (w/pershower): σ_E/E~9.5%/√E (+) 3.7%/E
HERAb NIM (shower only): σ_E/E~10/√E (+) 1.4%

Pi/e separation – electron eff.

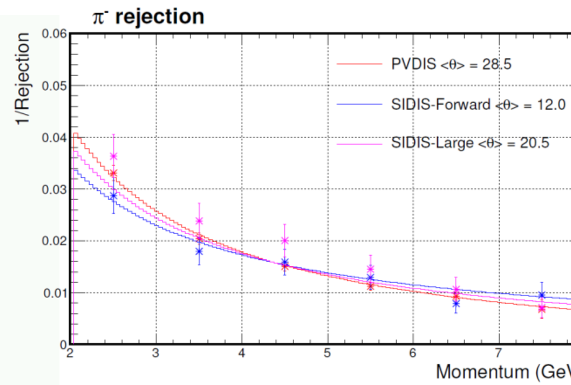
Same as SoLID



Pi/e separation – pion eff.

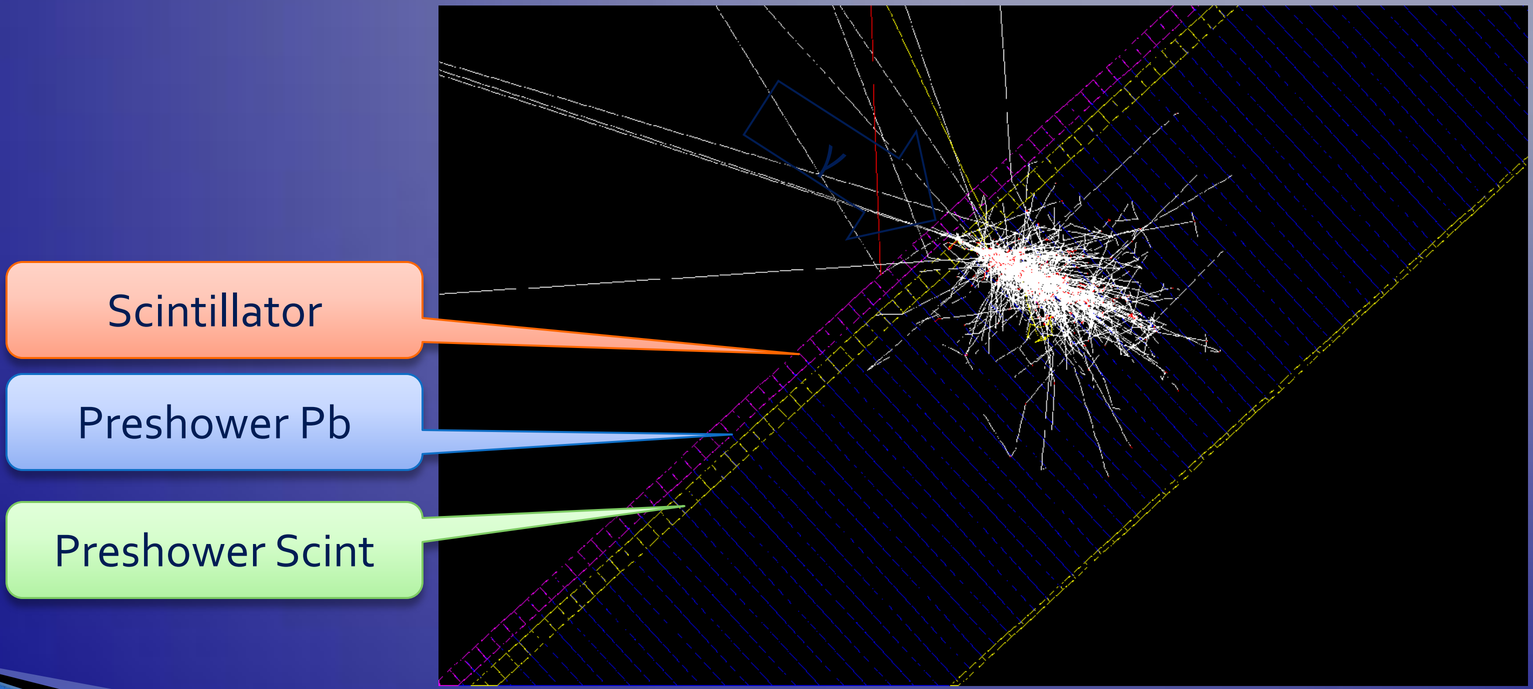


SoLID default design



- ~3 to 10 times worse than SoLID default design
- No cluster size cut applied yet

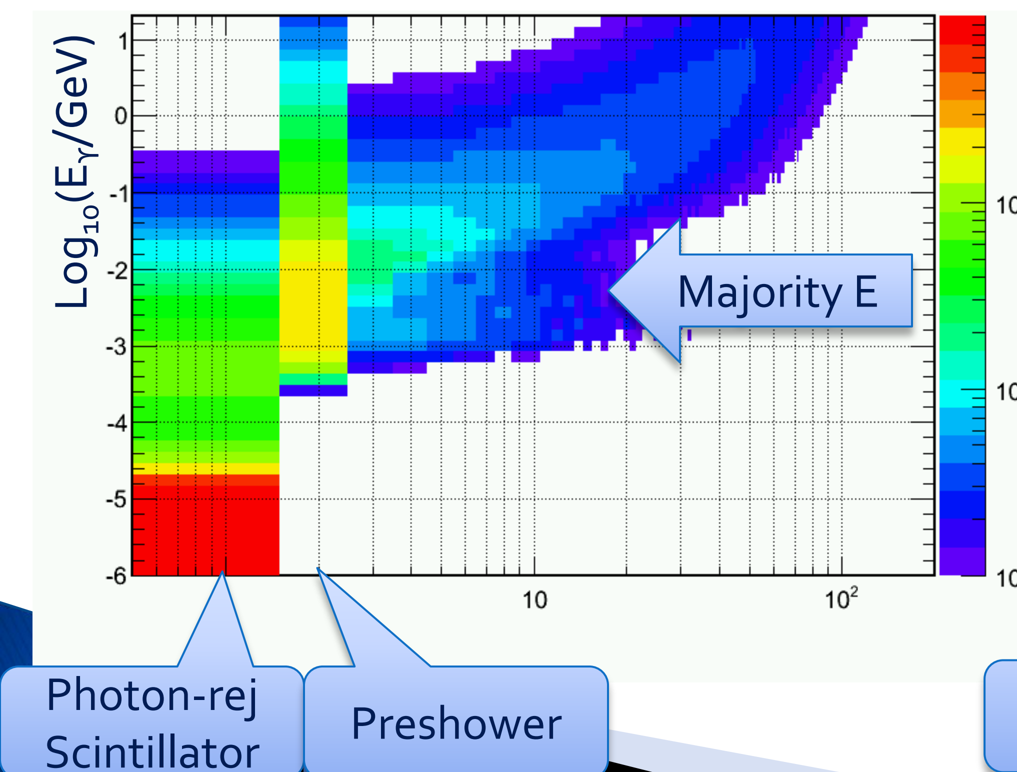
Scintillator before preshower as photon rejector

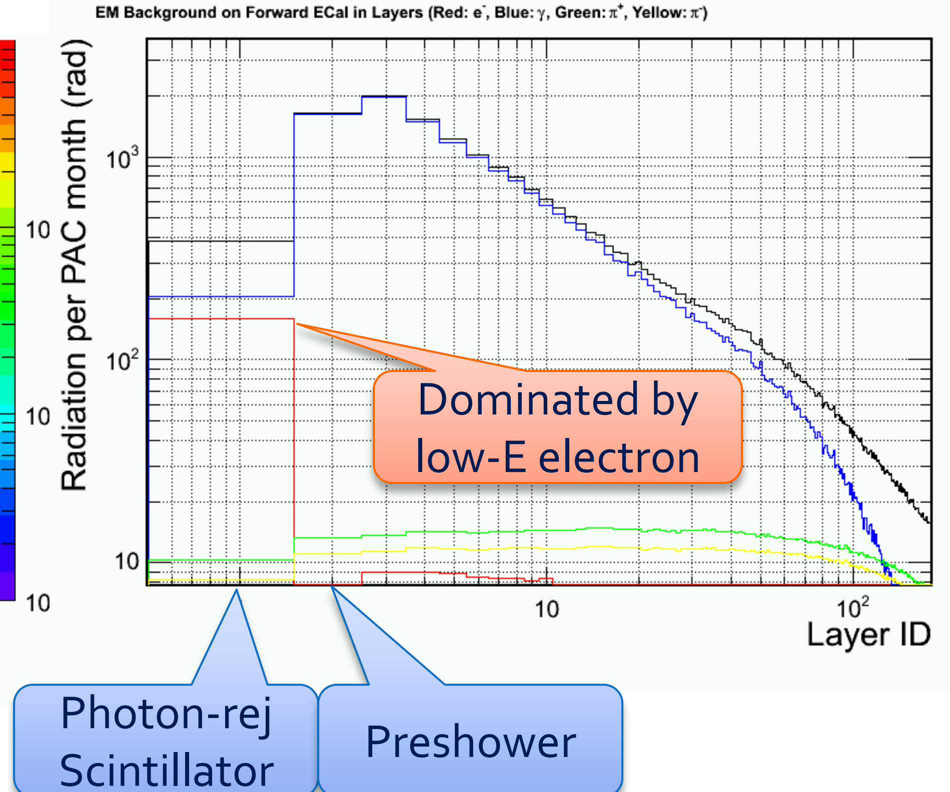


Major concern is radiation dose

- Before the preshower Pb and without protection from lower energy EM background
- Turn out to be not very bad since photon penetrate more depth

Ratio of energy deposition in active layers from a input photon





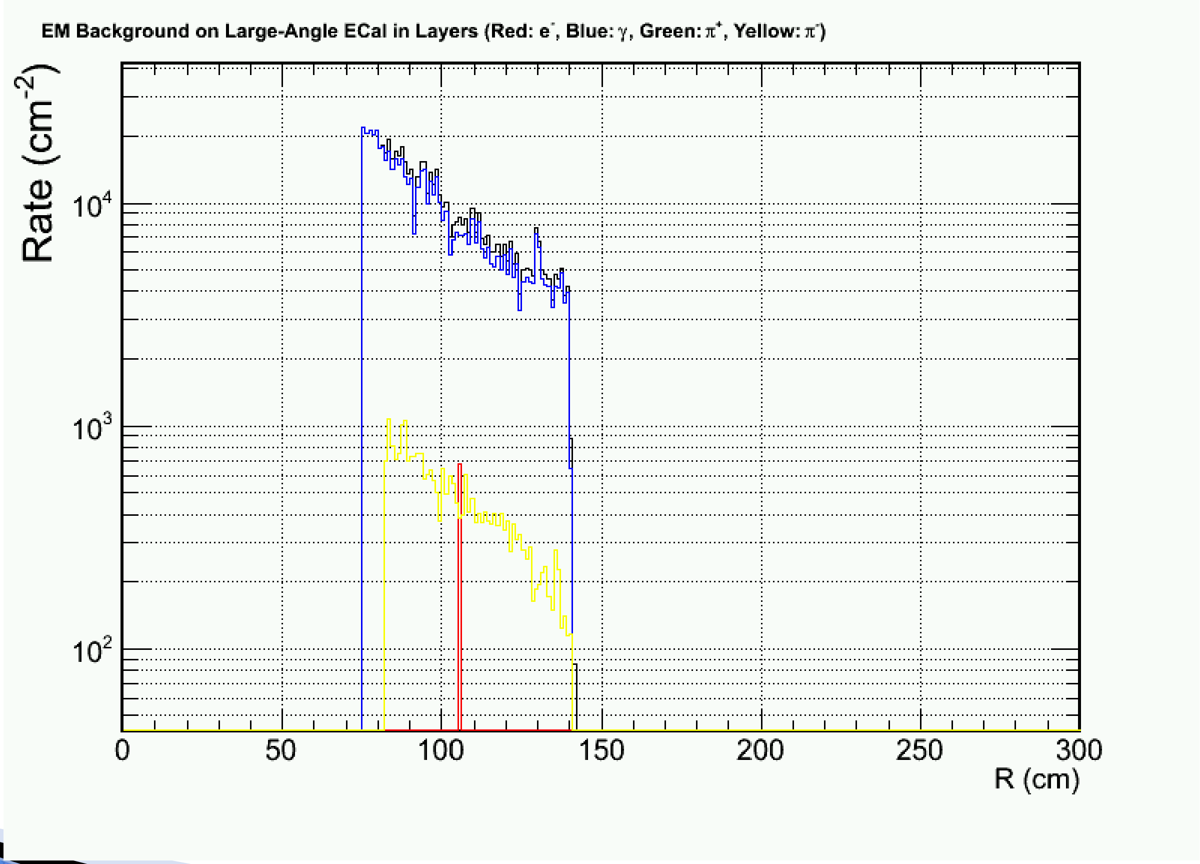
Background rate estimation

Rate estimation

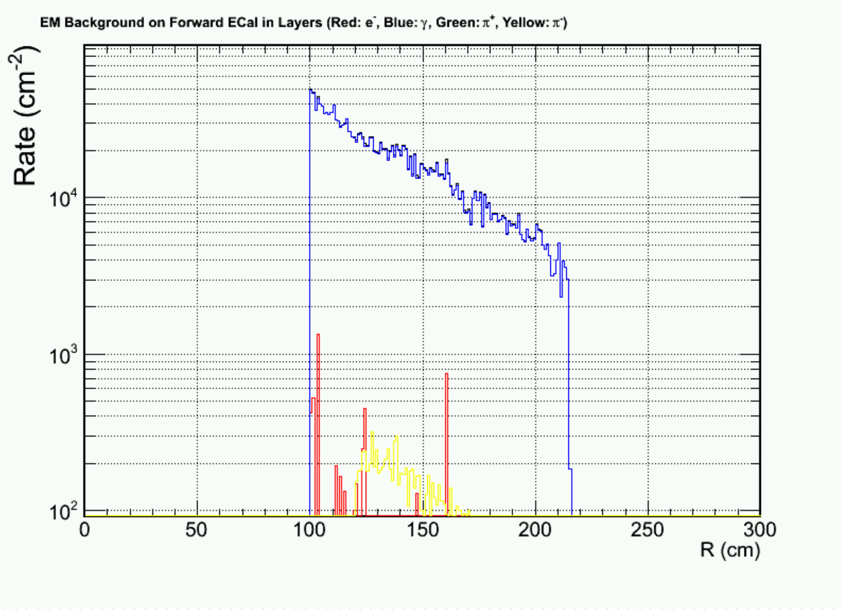
- Preshower and scintillator are more vulnerable to background, since abundance in low-E bgd produce high rate of MIP like hit in them.
- Calculate rate in preshower which produce a MIP or higher energy deposition
- Presented in Hz per cm^2 and decomposed to source at the front surface of the system (scint + preshower + shower)
- How much rate we can tolerate?
  - Assume 100ns signal length, and 10% change to see the background MIP → 1 MHz per area of readout
  - Area of readout
    - ~ 100 cm^2 to match shower
    - ~1000 cm^2 for fan shape

SIDIS large angle - preshower

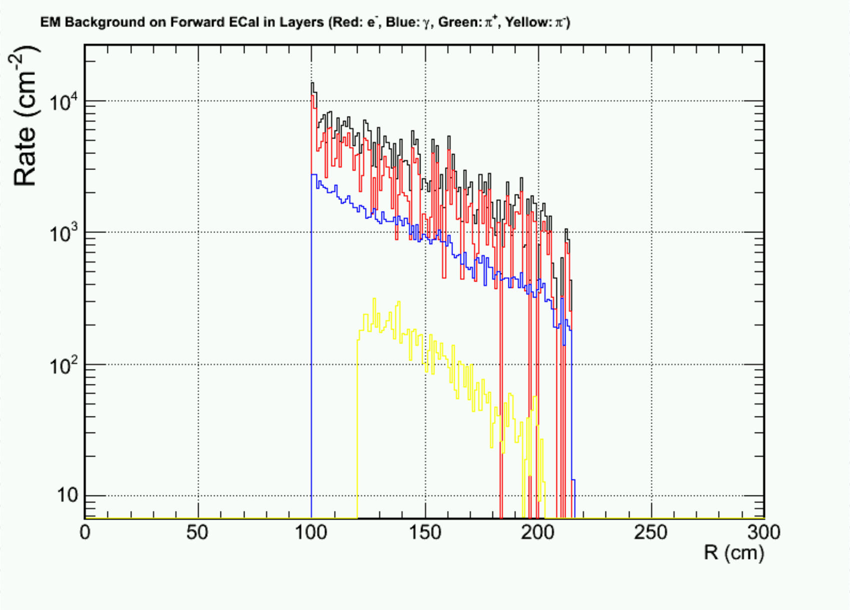
- Dominated by photons induced background rate



SIDIS forward angle



Preshower
(photon dominated)



Photon-rej scintillator
(Electron and photon dominated)

PVDIS - preshower