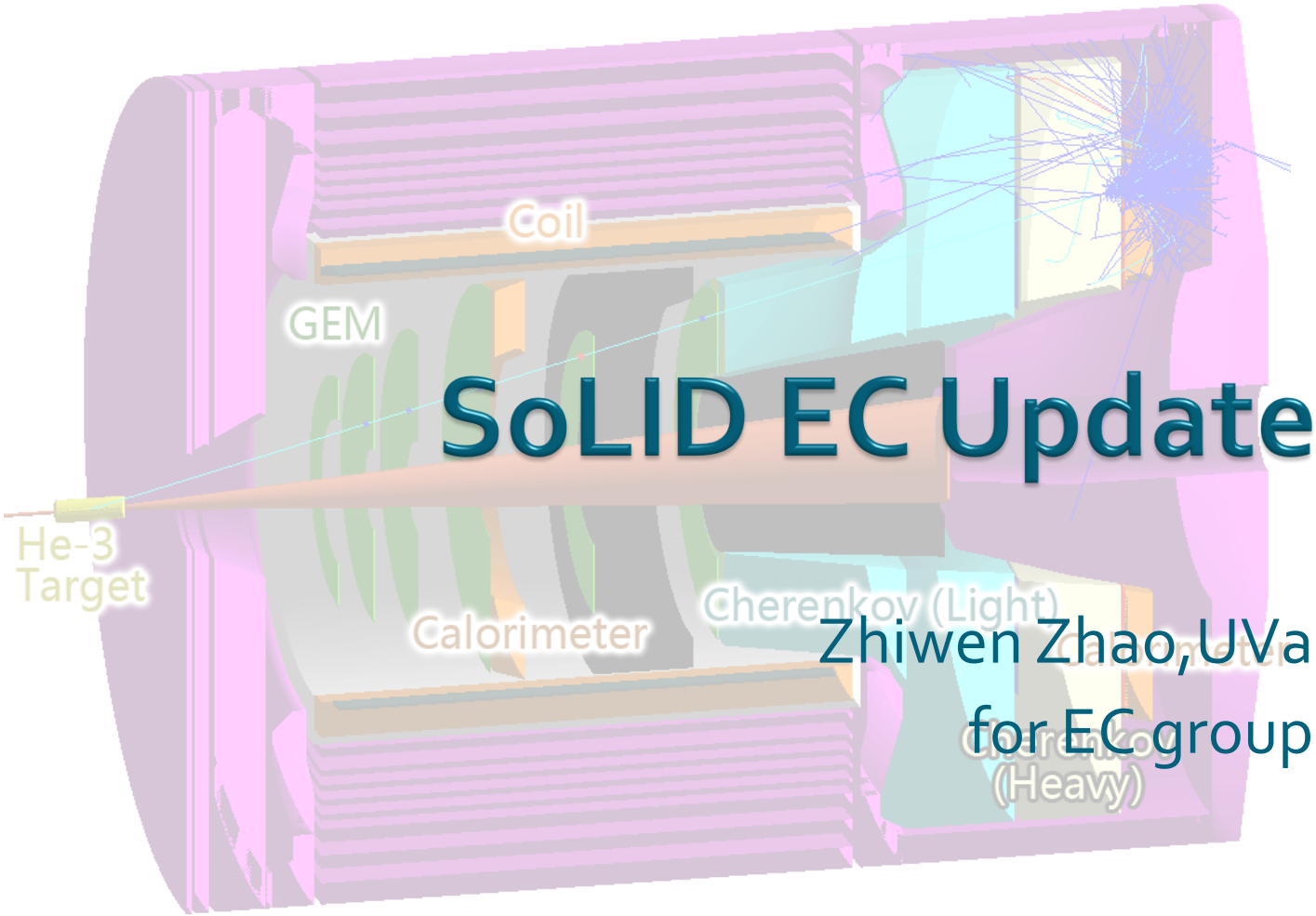


SoLID EC Update

Zhiwen Zhao, UVa
for EC group

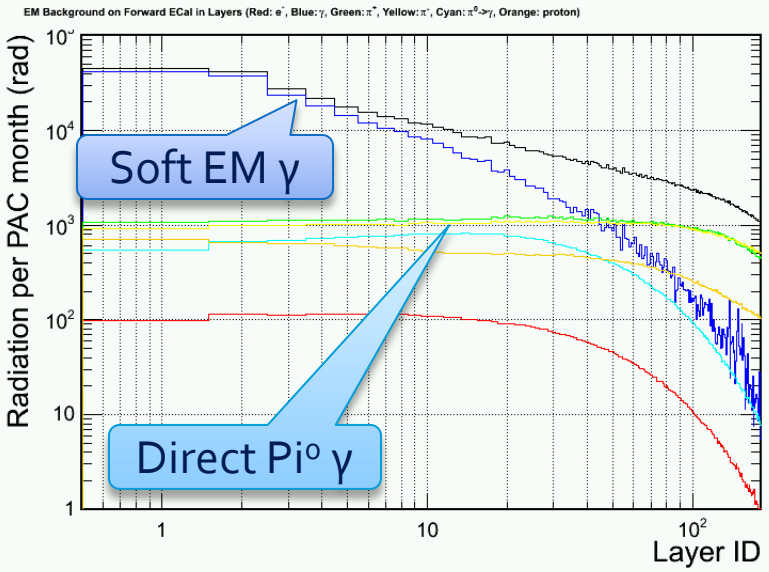
Jefferson Lab

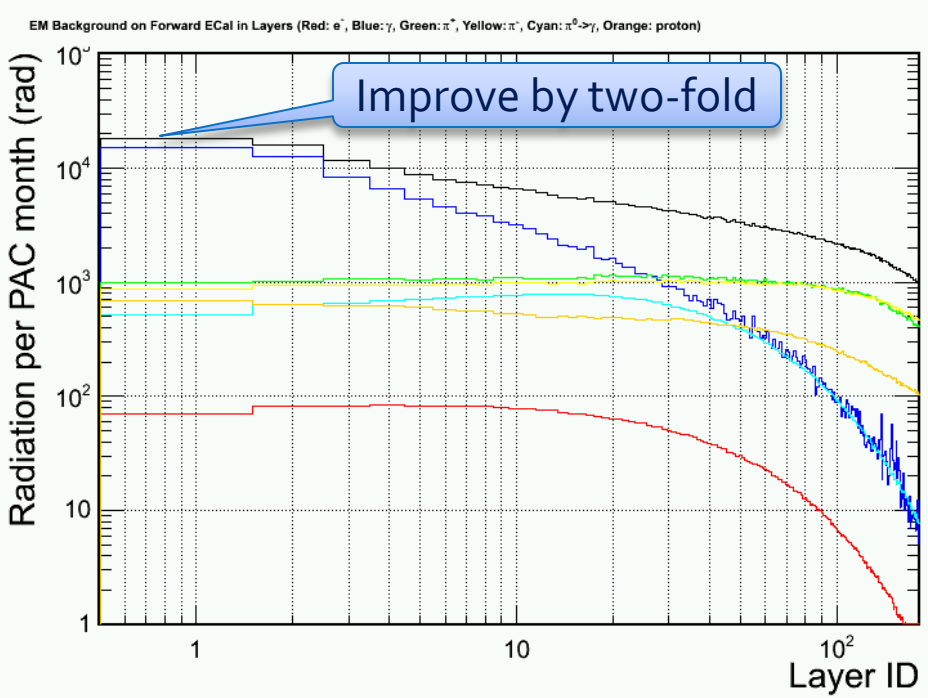
What's new

- PVDIS
  - Using background produced with 1st plane baffle inner radius at 4cm (change from 2cm) which reduces low energy photons to about half, thus we have lower radiation dose and better e- efficiency and pi rejection
  - Trigger study
- SIDIS
  - forward angle EC moves back 10cm to make room for HGCC which doesn't affect EC performance.
- Layout
- Cost update

PVDIS
Updated radiation dose VS layers (High radiation ϕ slice)

- Photon (EM) <- dominant!
- Photon (Pi^0)
- Electron
- Pion- Pion+ Proton

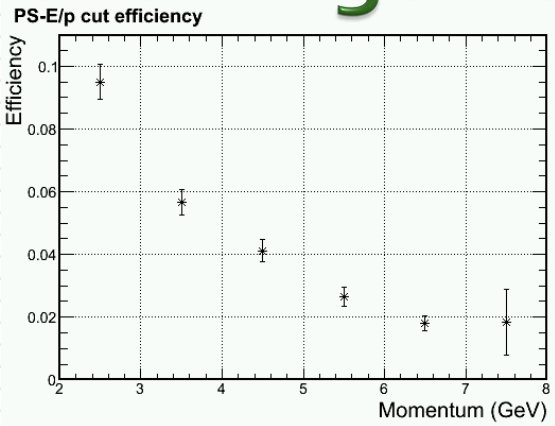


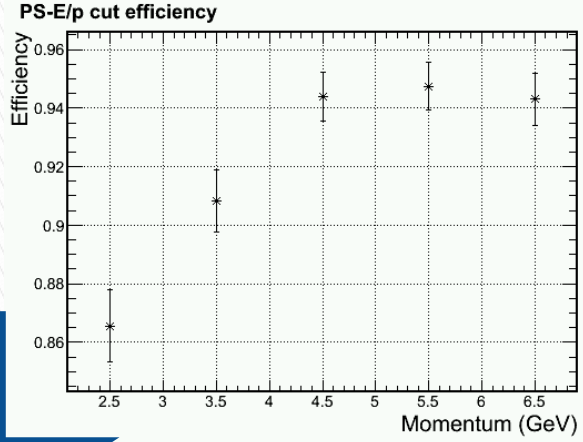


3rd Update

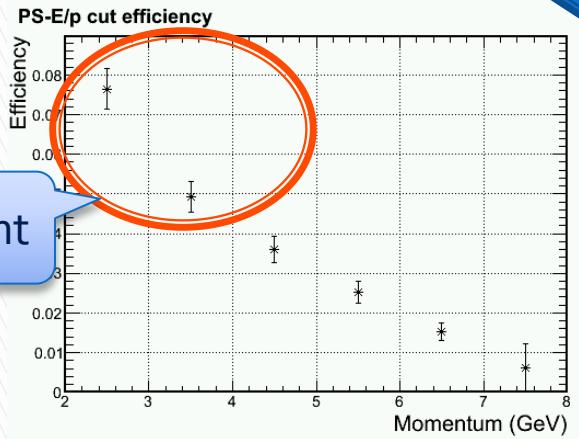
New: 4th Update

PVDIS Update on PID
Mid radius, higher γ ϕ-band shown
Other configuration also simulated

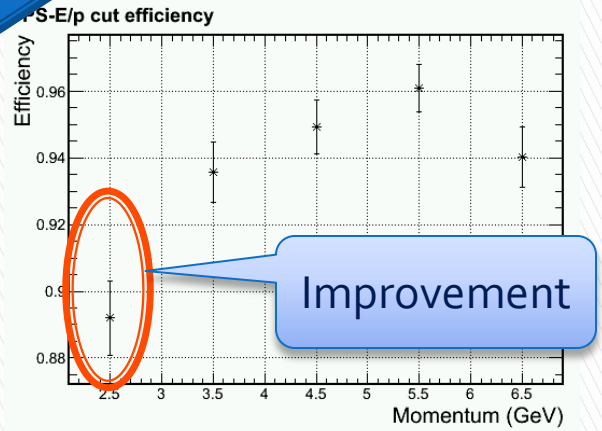




Update



Improvement

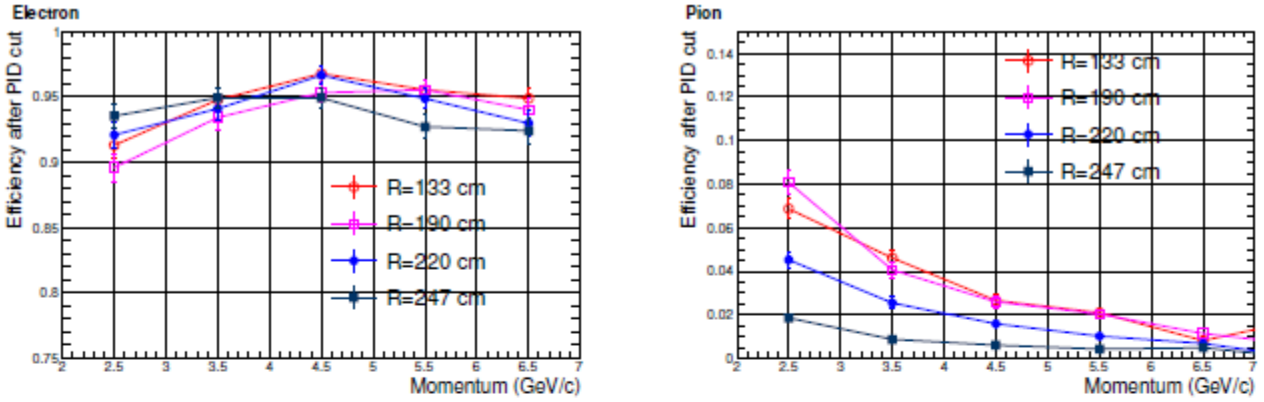


Improvement

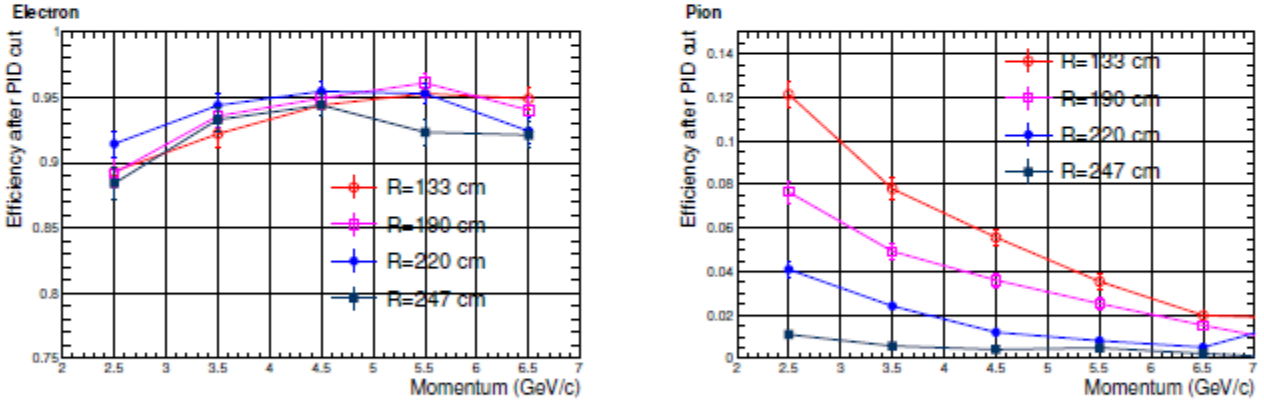
Pion Efficiency

Electron Efficiency

PVDIS EC Performance



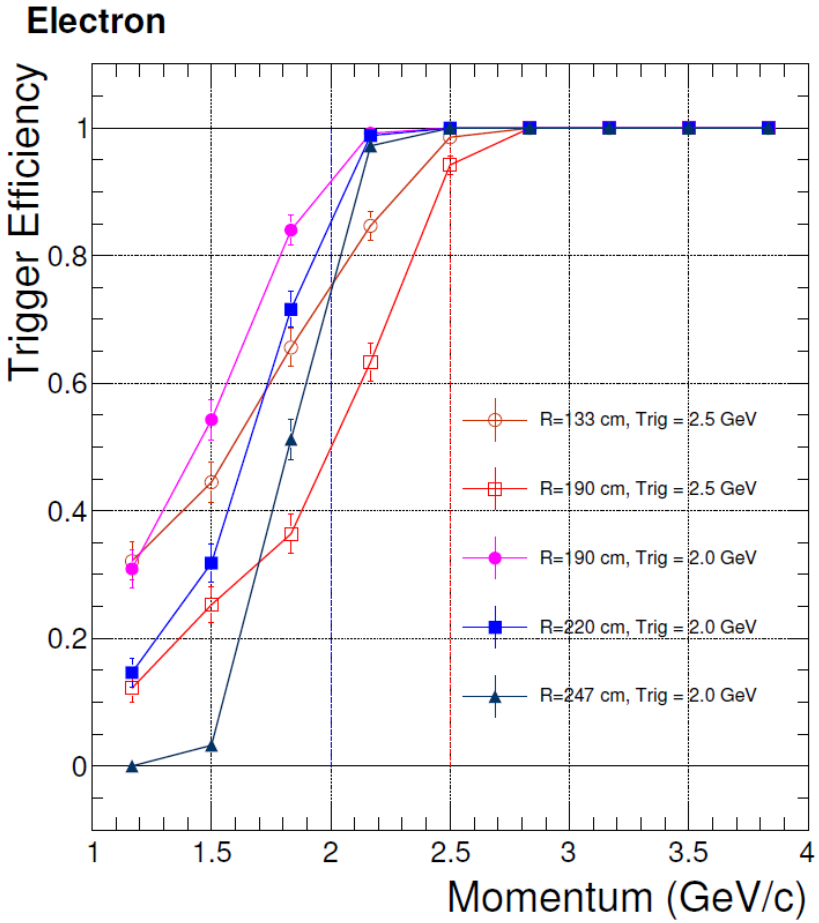
(a) lower-radiation azimuthal region

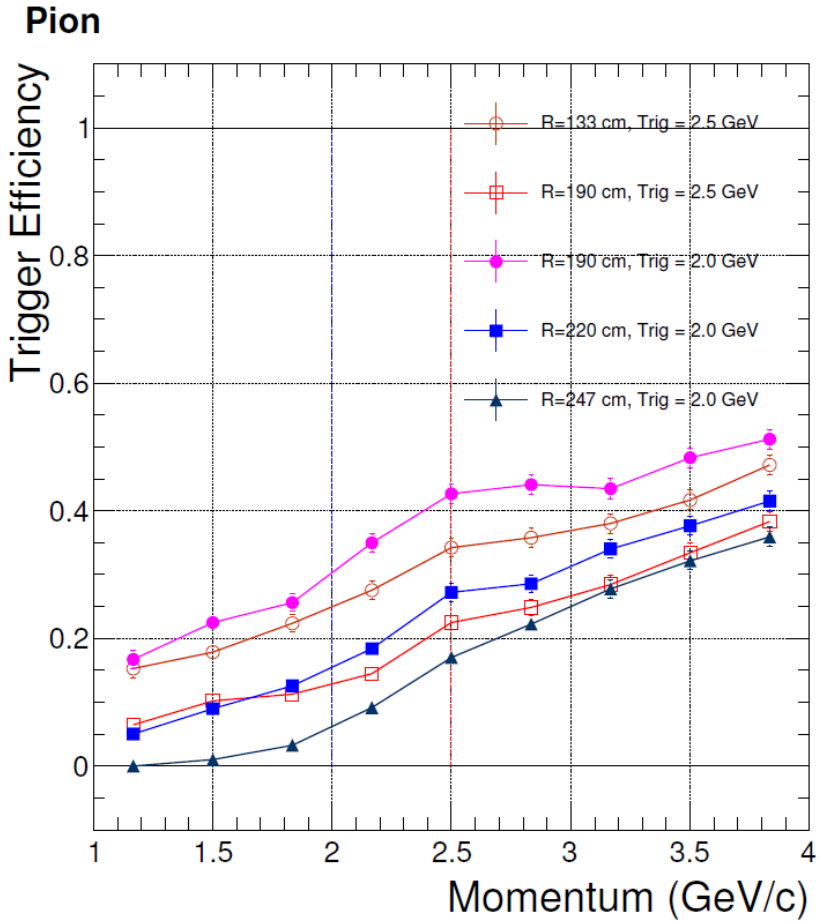


(b) higher-radiation azimuthal region

Figure 12: Calorimeter pion and electron efficiency for the PVDIS experiment, evaluated with the presence of background at eight typical regions on the calorimeter

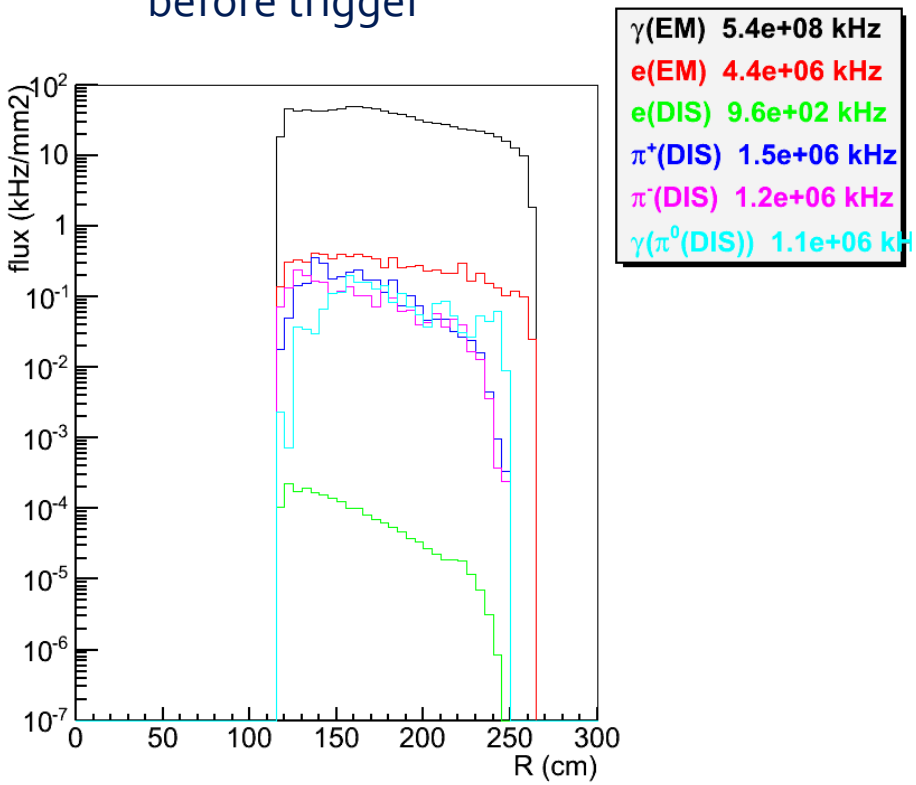
PVDIS EC Trigger Effect



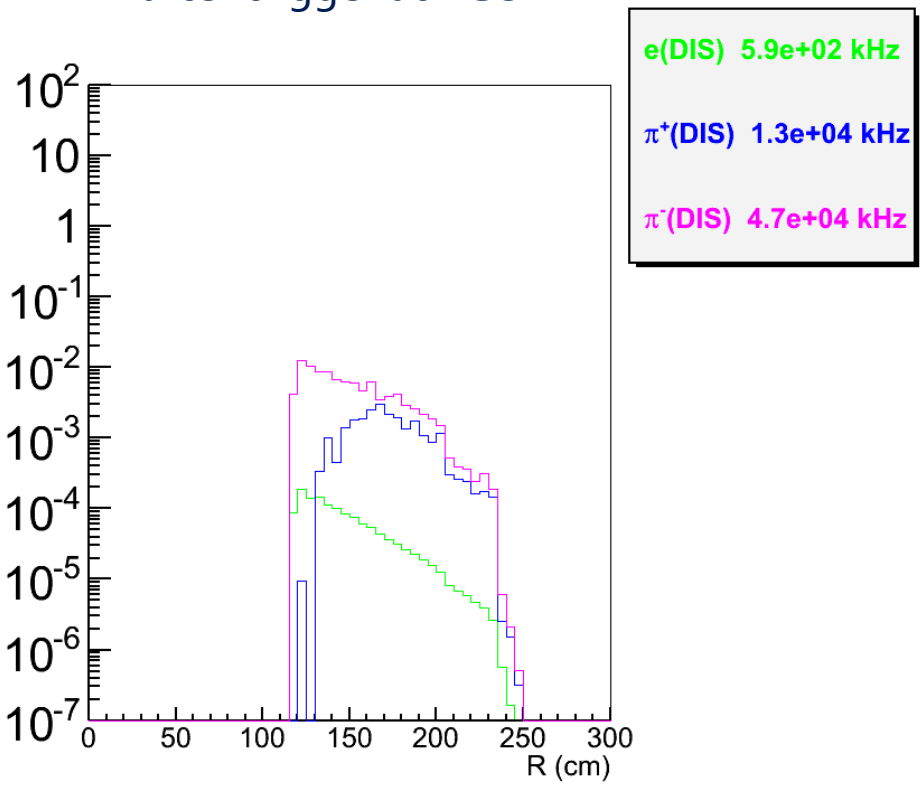


PVDIS Rate on EC

before trigger

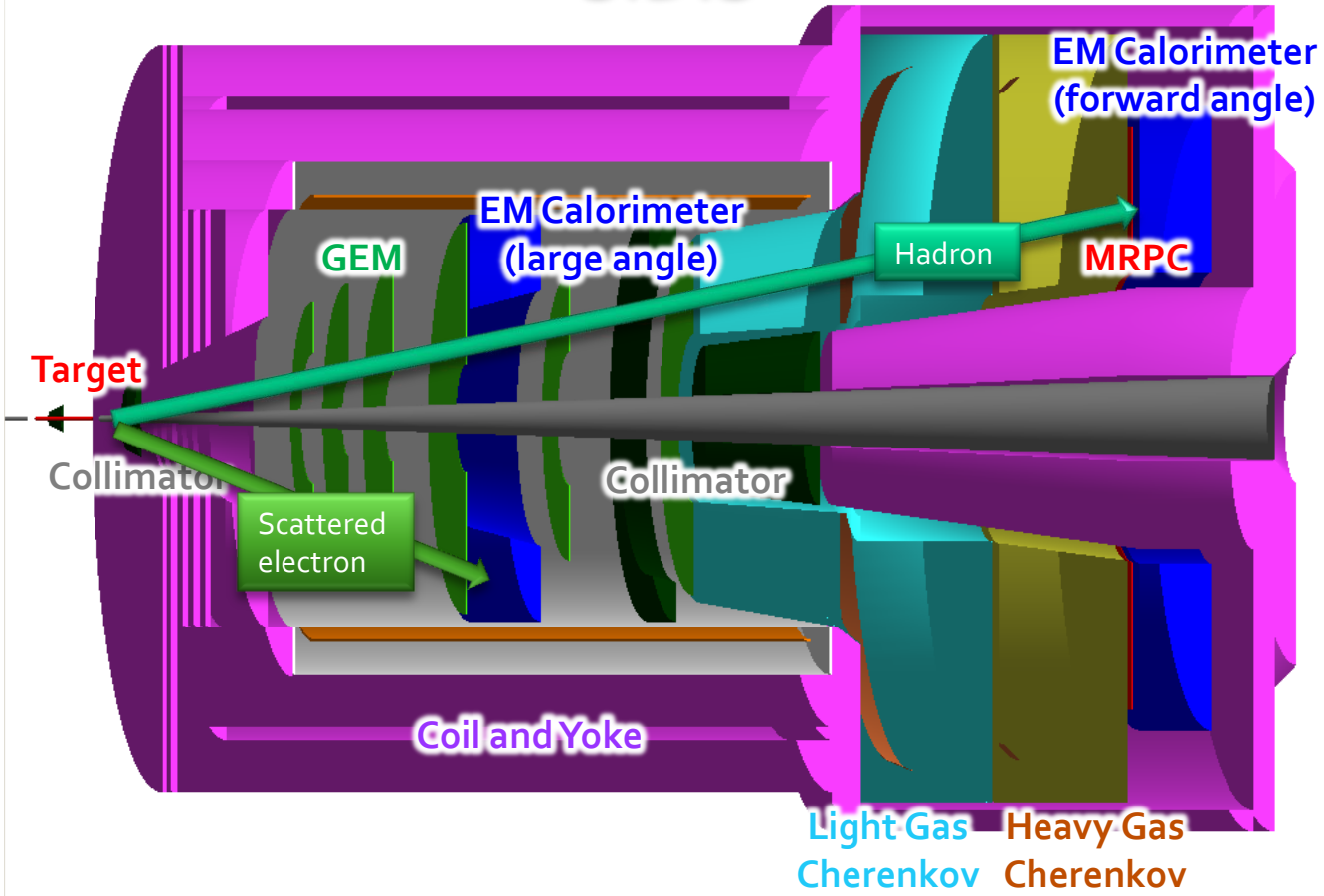


after trigger at 2GeV

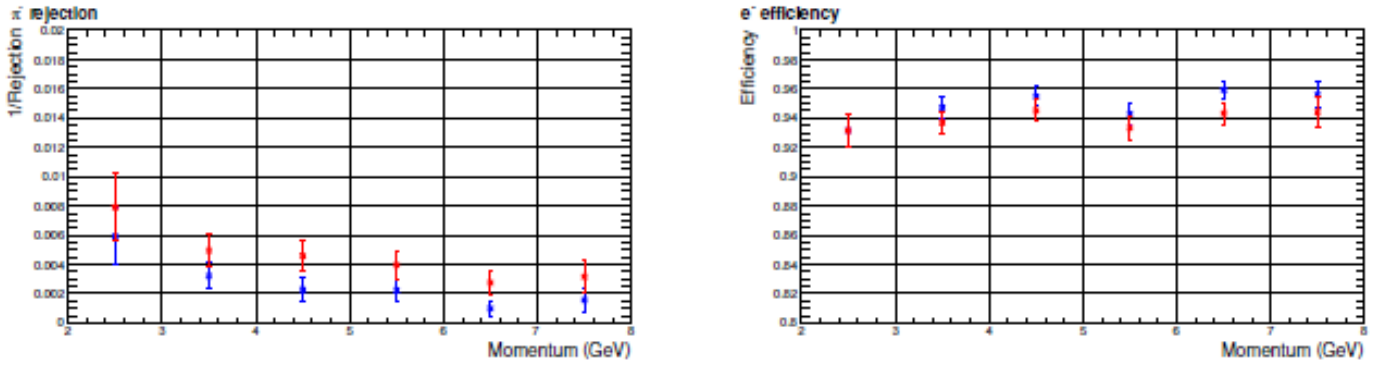


SoLID CLEO

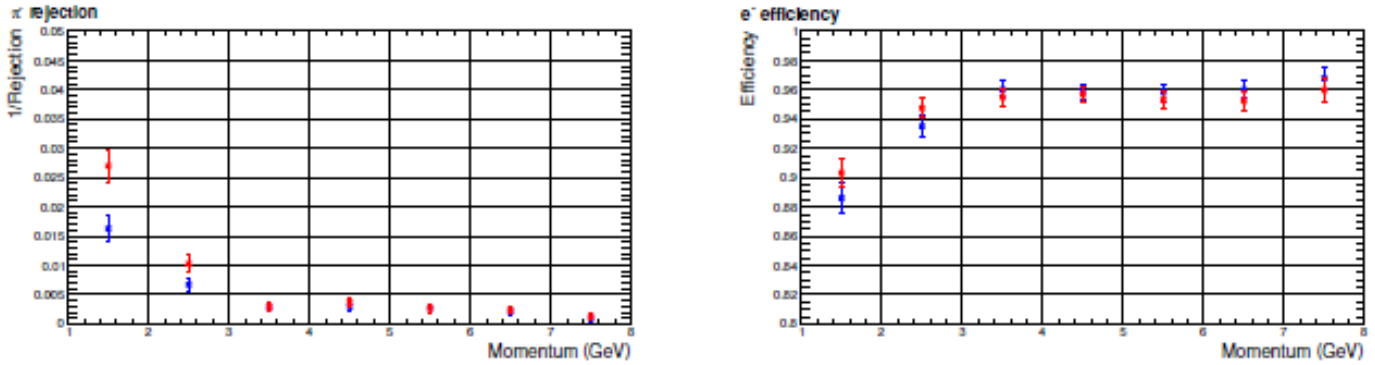
SIDIS



SIDIS EC Performance



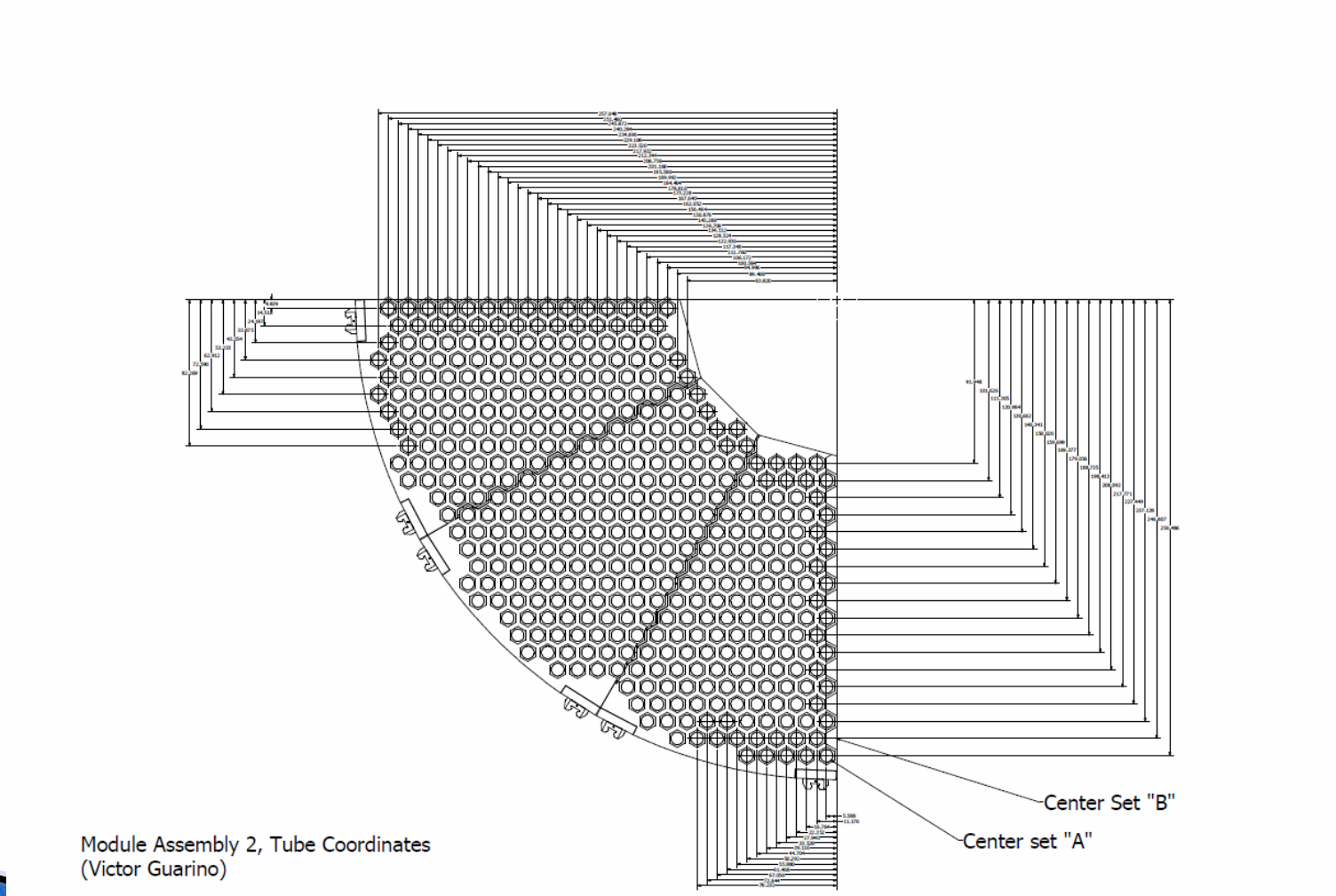
(a) SIDIS large-angle calorimeter



(b) SIDIS forward calorimeter

Figure 10: Calorimeter pion and electron efficiency before (blue) and after (red) the consideration background in the SIDIS experiment. As a bottom line for performance, worse background situation was evaluated here (inner radius region).

Layout: forward angle EC (FAEC) from ANL



Module Assembly 2, Tube Coordinates
(Victor Guarino)

Budget Estimate Update

Cost @ May 2013 Meeting

- IHEP (not including fibers) for 1700 PS+SH
  - Preshower: $112k-$120k
  - Shower: $549k-$651k
  - Structure+assembly: $255k-$340k
  - IHEP total: ($1.22-$1.51)M + 24% overhead (2012 rate) = ($1.51-$1.87)M

correction: this should be "structure and assembly each", but does not affect total IHEP $ on this page.

- Fiber connectors+tubing (Leoni+other): ~$300k
- WLS+clear fibers with diamond-cutting: $777k+$448k (S.G.) - $1.66M (Kuraray)
- PMTs: $640x2x(~1900)=$2.43M
- Total from above (no contingency): **($5.3M-$5.7M)** if using S.G.
- Labor? Shipping? Contingency?

Cost @ May 2013 Meeting

- Based on 1700 modules
- No quote yet for SPD
- No quote yet for Shower fiber mirrors (IHEP)
- Updated fiber cost with diamond-tool cutting (do not know yet if IHEP can cut the fibers)

Cost Update

- Will be based on 1800 modules;
- SPD quote: $(40-70)k (IHEP very rough estimate)
- Quote for WLS fiber cutting, polishing, adding mirrors (IHEP): $50/piece a few years ago, now (20-30)% higher → $(108-117)k
- Need to order all WLS fibers in spools and ship to IHEP, need (10-15)% longer length to allow cutting.
- We still need to cut the other end of WLS fibers and all clear fibers (CLAS12 cutters).

Cost Update

- IHEP (not including fibers) for 1800 PS+SH
  - Preshower: $113k-$122k
  - Shower: $570k-$678k
  - Structure+assembly: $540k-$720k
  - Fiber cutting + mirrors: $108k-$117k
  - IHEP total: ($1.38-$1.70)M + 30% overhead (changed from 24% for a conservative estimate) = ($1.80-$2.21)M
- Fiber connectors+tubing (Leoni+other): ~$300k
- WLS+clear fibers (S.G), rough ends: $234k+$564k
- PMTs: $640x2x(~1900)=$2.43M
- Total from above (no contingency): **($5.33M-$5.74M)**
- Labor ($0.75M)? Shipping ($0.5M)? Contingency (30%): → **$8.6M - $9.2M**

Plan for Budgeting

- Plan to reduce cost:
  - MAPMT study, now it's clear can do gain-matching at the FADC level. Any need for small-scale tests? – potential saving of up to $800k;
  - Get a MAPMT quote;
  - Customized PMT bases? (current base cost is $912k);
  - Smaller PMTs for Preshower?

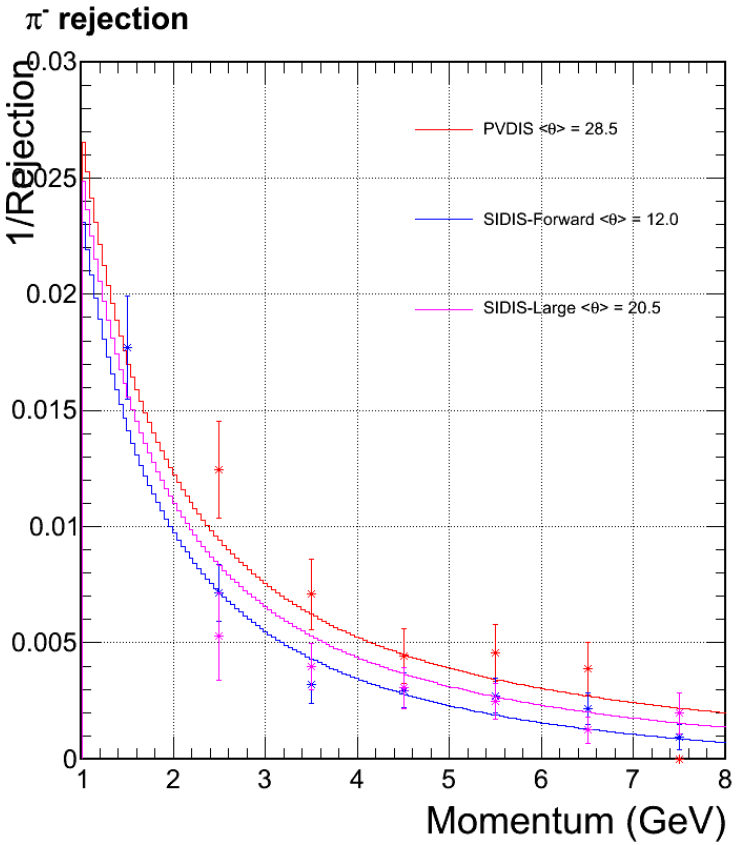
Possible Design Update – Multi-Anode PMTs

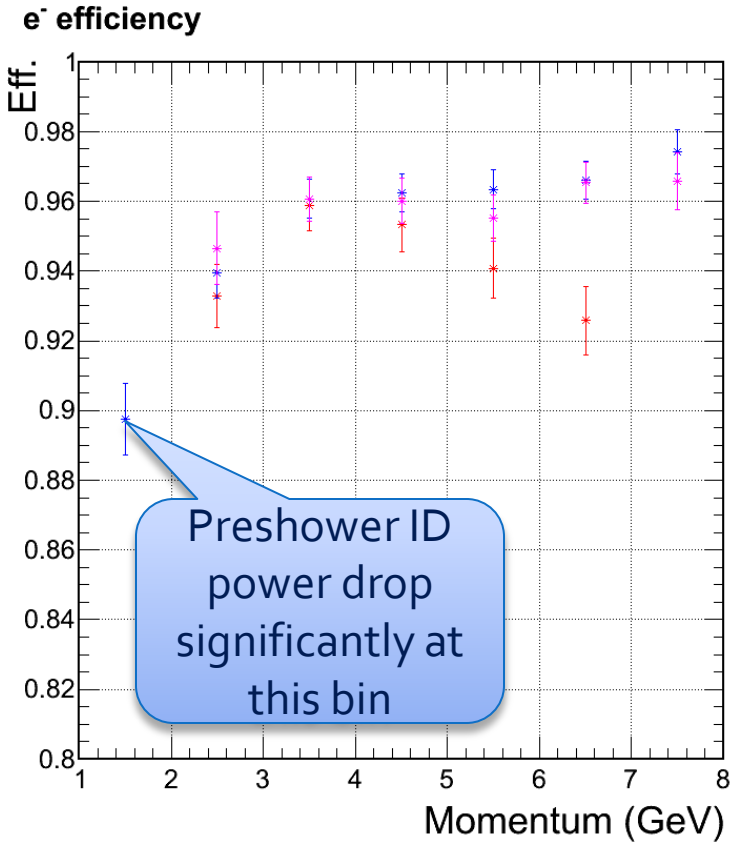
- Current Preshower readout: 1 PMT ($600)/module, but each module is read out by only a couple of fibers so we are wasting cross-sectional area of the PMT;
- MAPMT: about $100/channel → potential saving of PS PMT from $1.02M to $200k;
- To be studied: gain-matching between channels of one MAPMT. LHCb used specialized front-end electronic modules to produce digital triggers. We could use FADC directly, no need for FE-electronics.

Backup

EC performance w/o background

- Cited from March collaboration Meeting



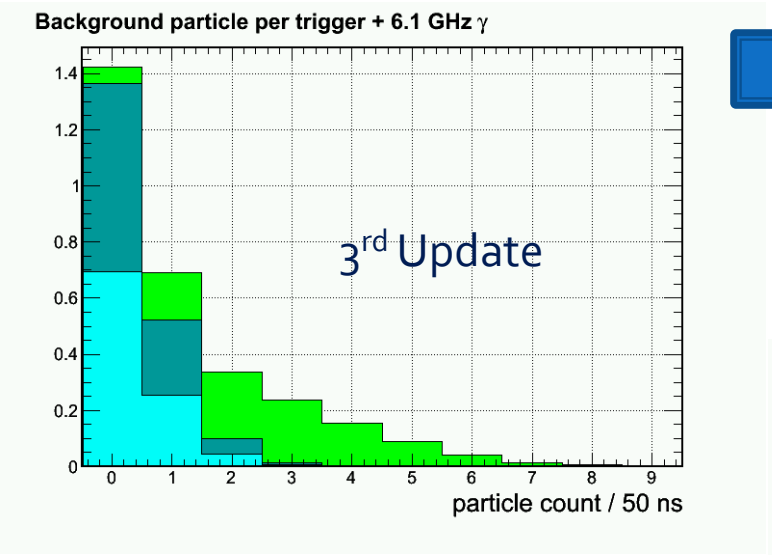


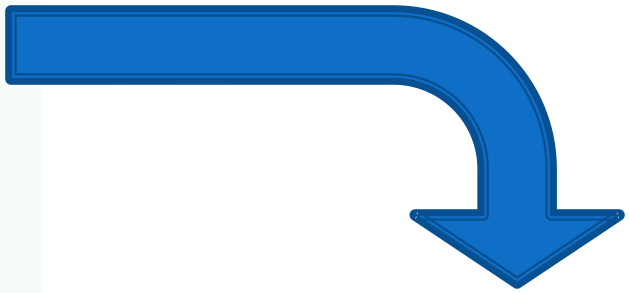
Forth update of CLEO background

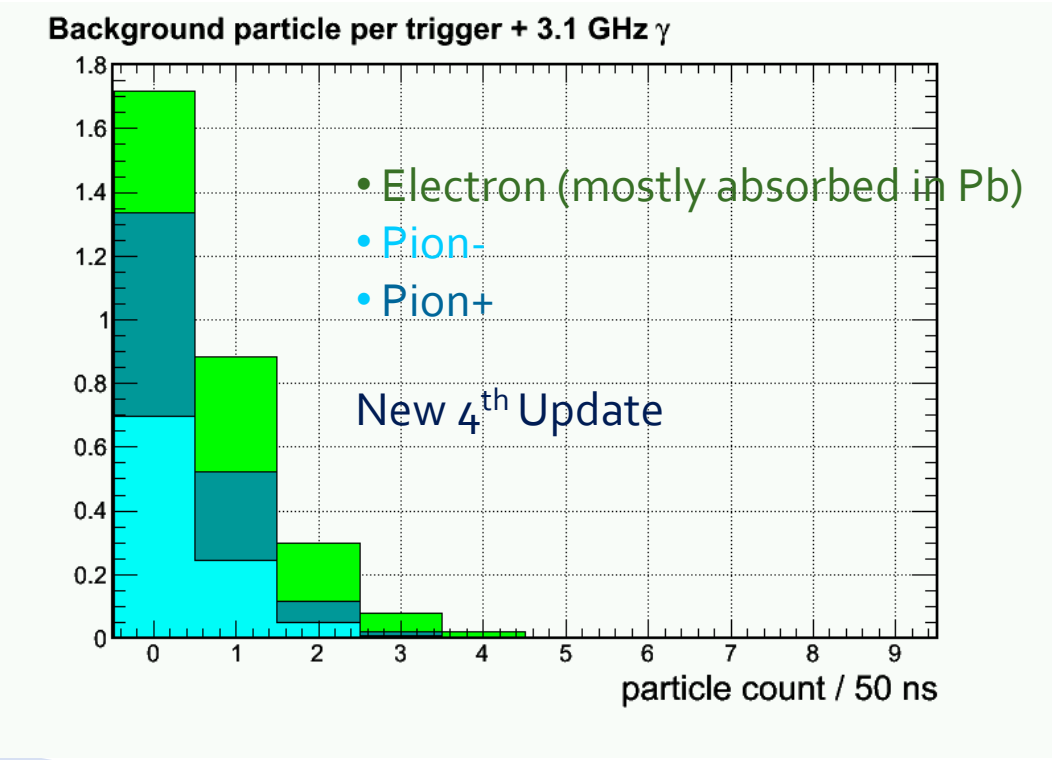
- Cutting 2cm away on 1st baffle inner radius
- Received background simulation from Zhiwen on May 24

Updated: Per-event pion rate

for 1+6 hexagon cluster at Mid radius, high radiation ϕ-slice

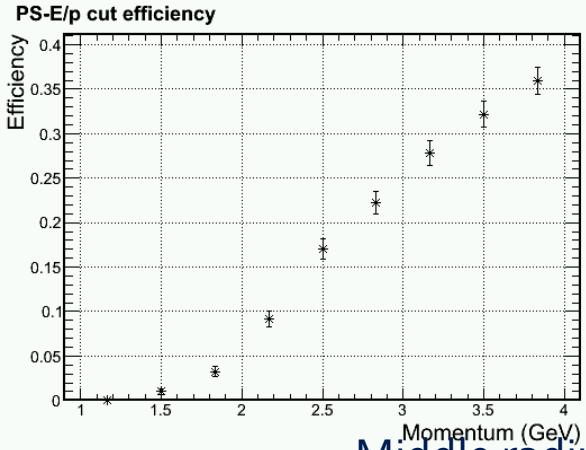


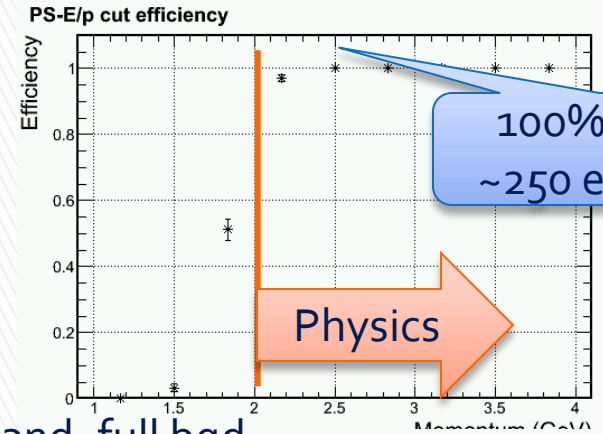




Trigger turn on curve for 2 GeV electron
Shower Hex 1+6 trigger > 1.6 GeV

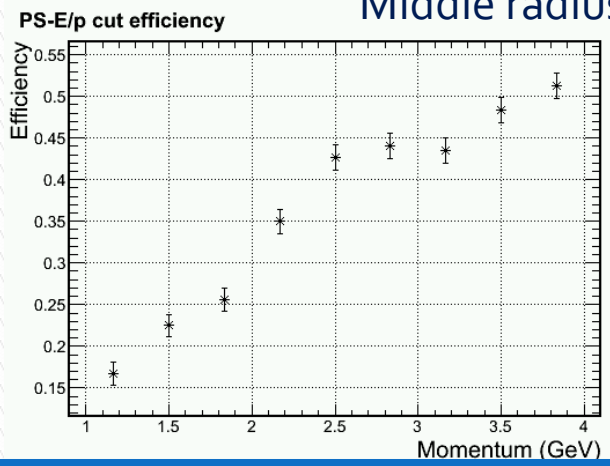
Outer radius, higher γ ϕ-band, full bgd

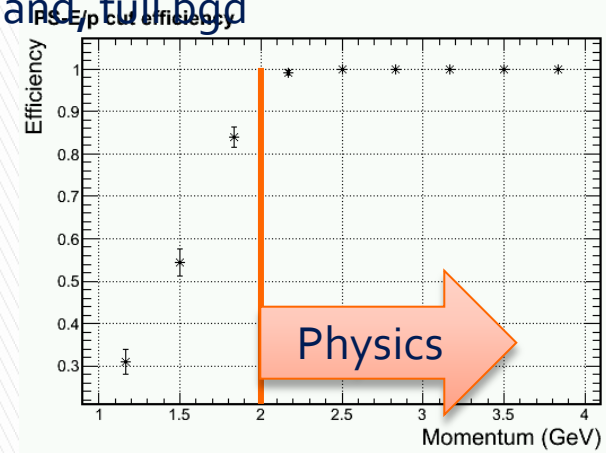




, full bgd

Middle radius, higer γ ϕ-band, full bgd



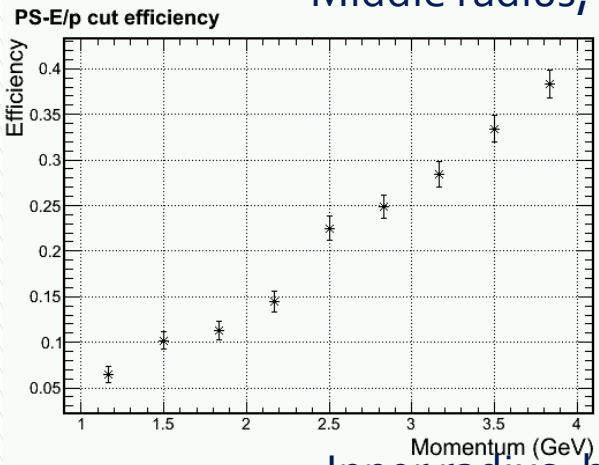


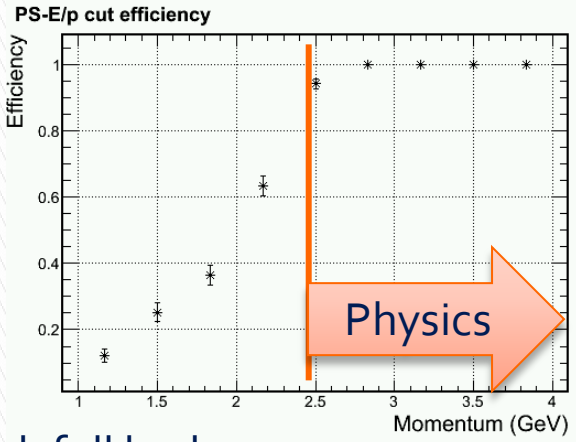
Pion Efficiency

Electron Efficiency

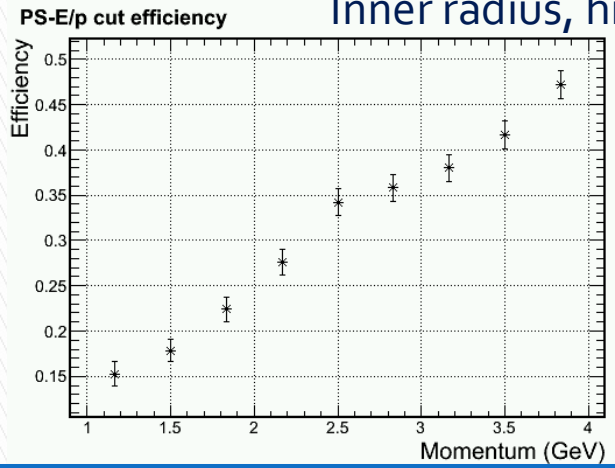
Trigger turn on curve for 2.5 GeV electron
Shower Hex 1+6 trigger > 2.1 GeV

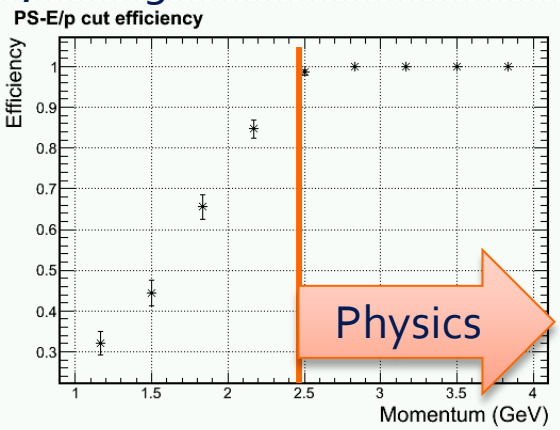
Middle radius, higher γ ϕ-band, full bgd





Inner radius, higer γ ϕ-band, full bgd

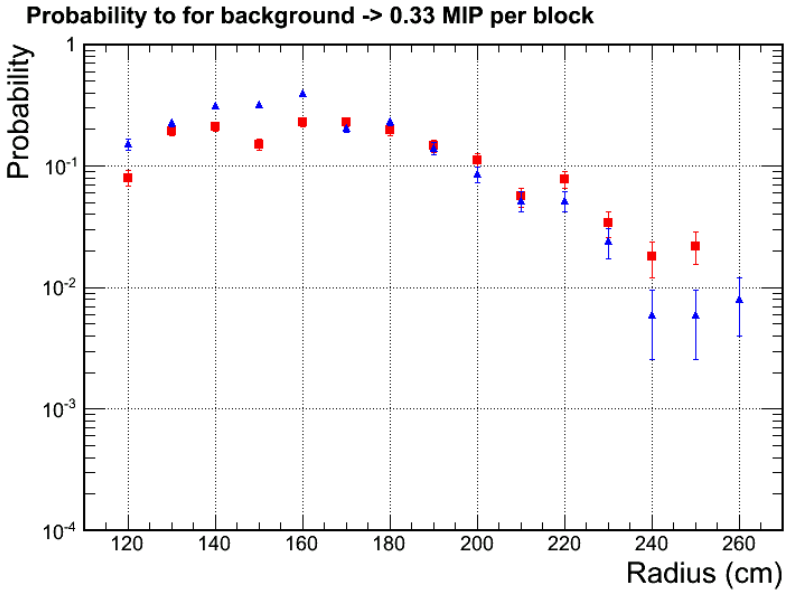


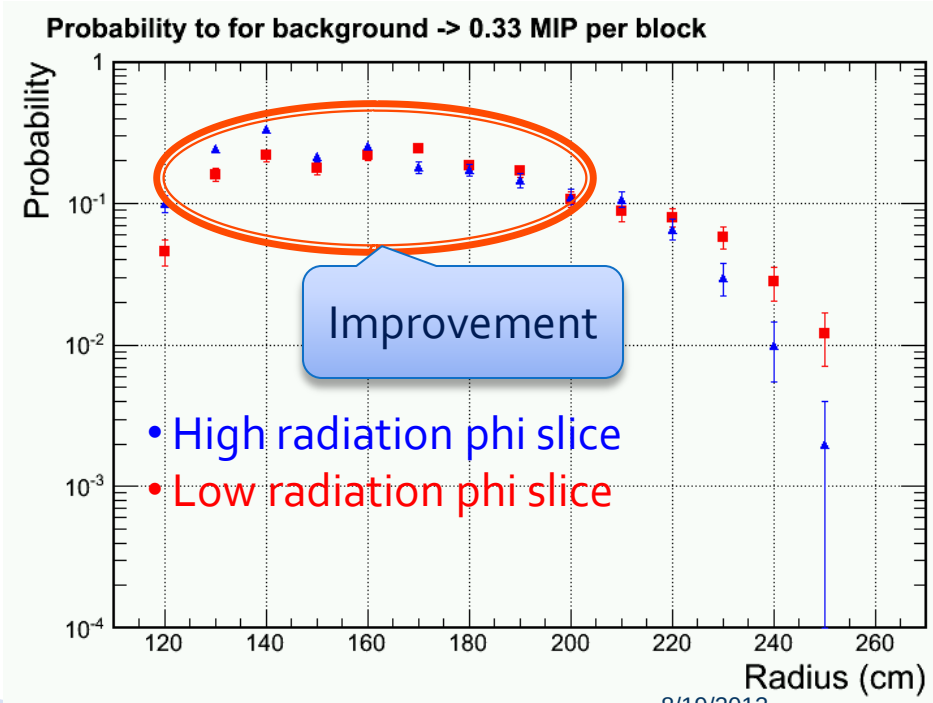


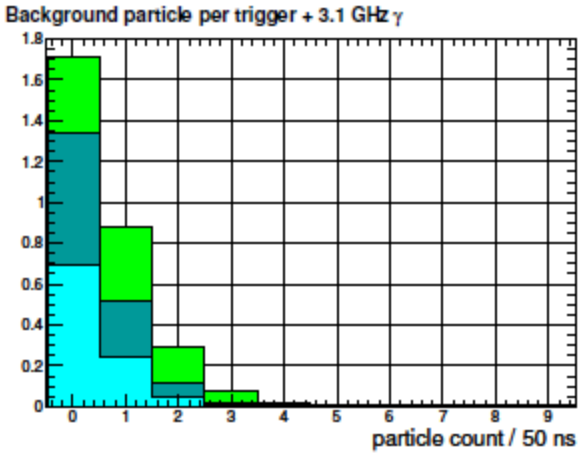
Pion Efficiency

Electron Efficiency

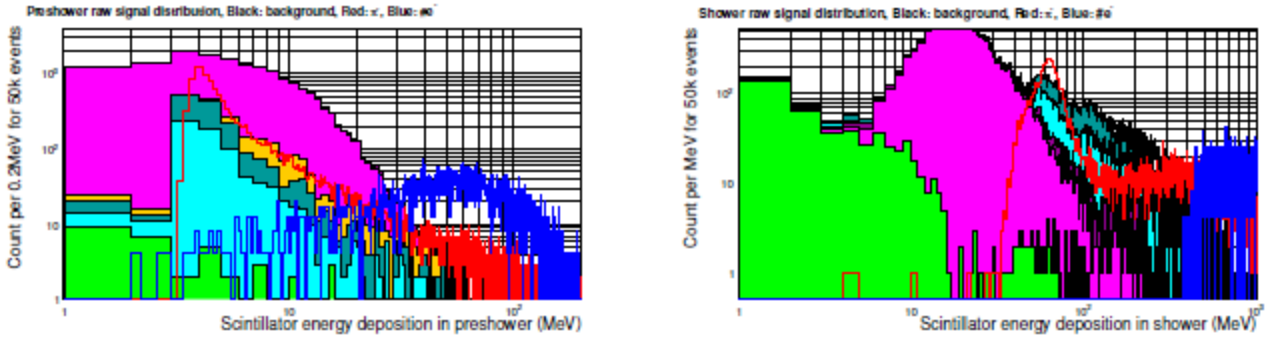
Readout occupancy per shower channel for ~75MeV zero suppression



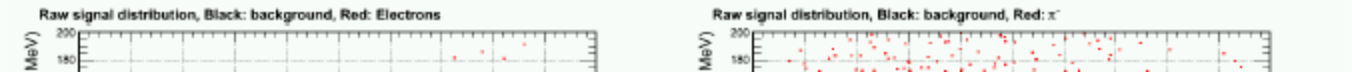




(a) Stacked probability to find number of background π^- (light blue), π^+ (dark blue) and electrons (green) at the front of preshower detector. The photons are significantly off scale at a rate of ~ 3 GHz



(b) Stacked probability (count per 50k events) to find scintillator energy deposition for incoming background particle species of electrons (green), π^- (light blue), π^+ (dark blue), protons (Yellow), EM process-originated photons (magenta) and π^0-originated photons (dark magenta). As comparison Energy deposition for high energy pion (red) and electrons (blue) are shown as non-filled curves.

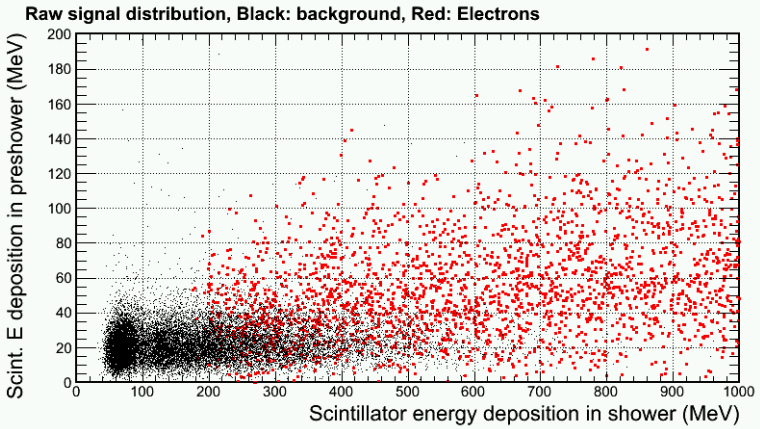


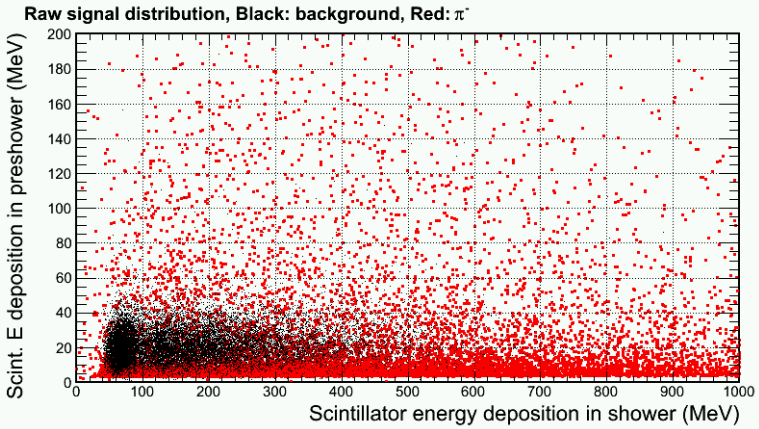
Third update of CLEO background

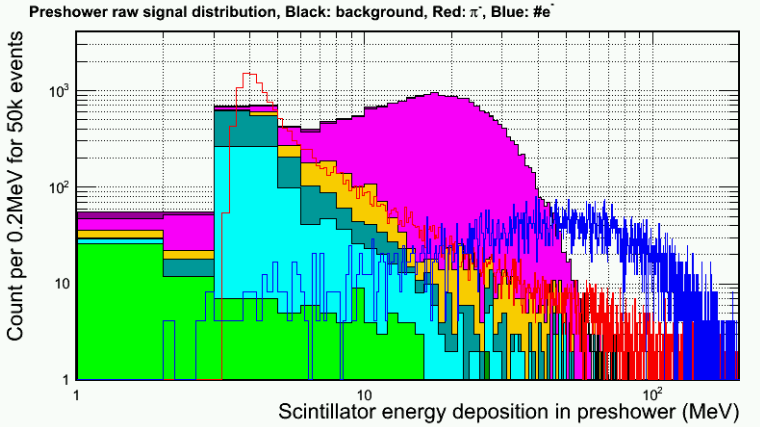
- Received background simulation from Zhiwen on May 19
- Running background imbedding

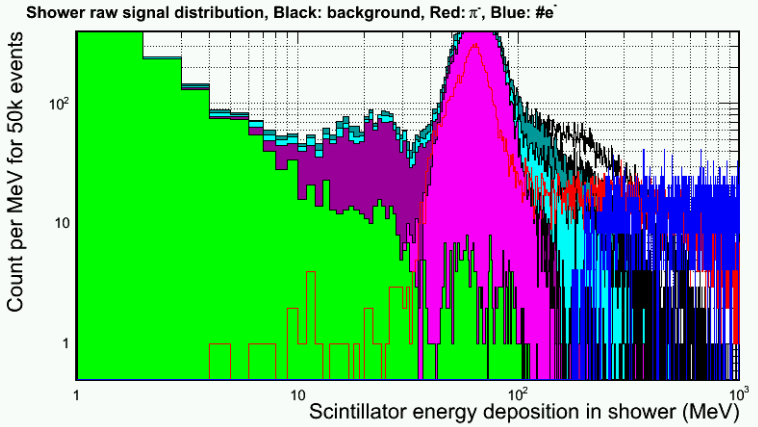
Background imbedding and distribution

Mid-R, High Radiation phi slice





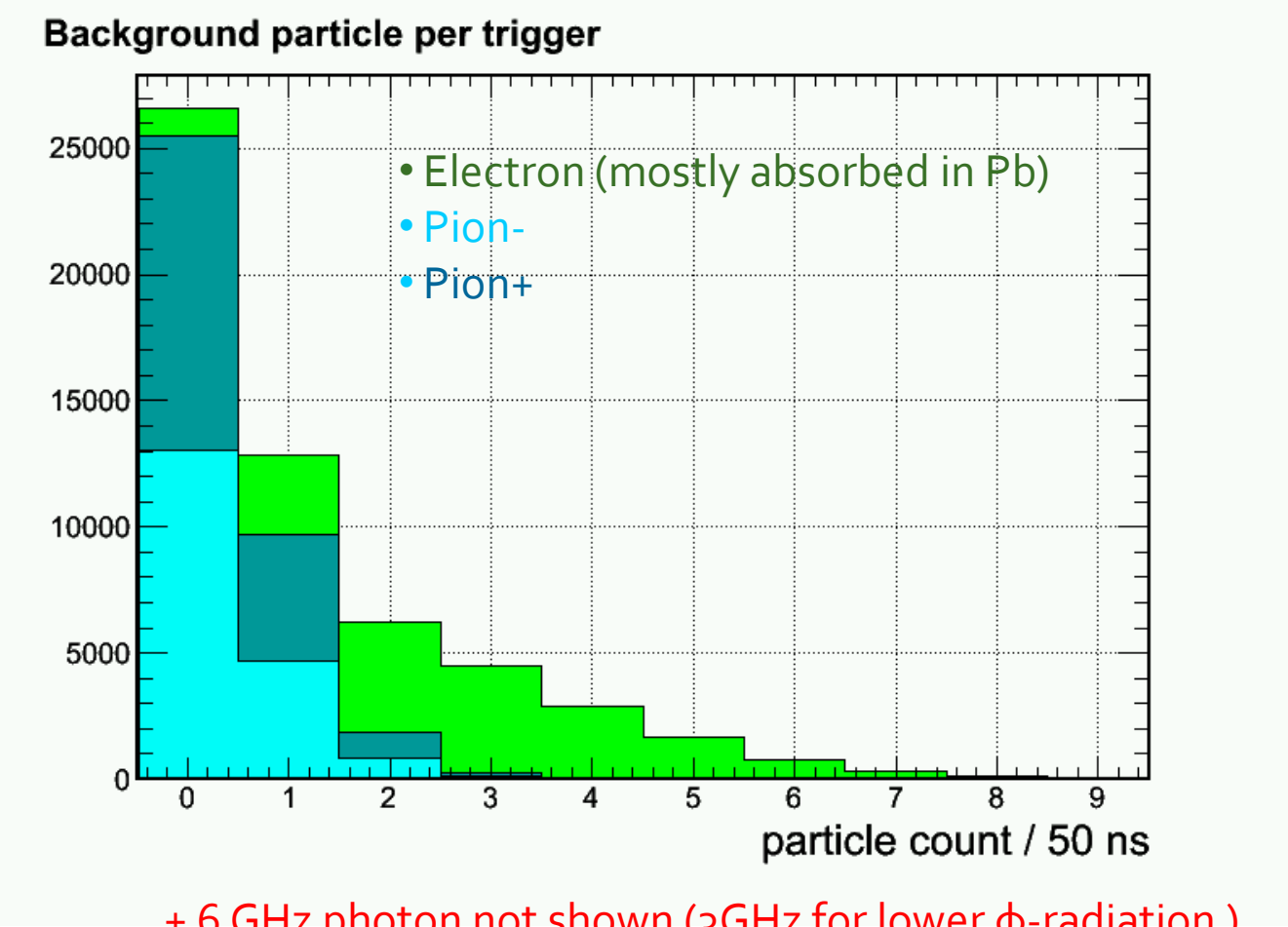




- Photon (6GHz/6+1 Hex cluster)
- Electron
- Pion- Pion+ Proton

Updated: Per-event pion rate

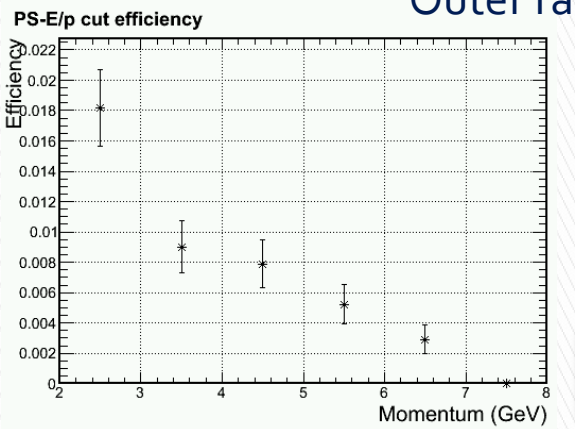
for 1+6 hexagon cluster at Mid radius, high radiation ϕ-slice

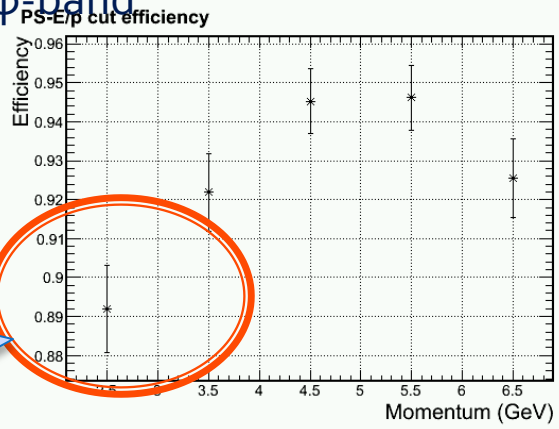


+ 6 GHz photon not shown (3GHz for lower ϕ-radiation)

Update on PID with DC component removal (PS > MIP + Bgd + (2-3) σ)

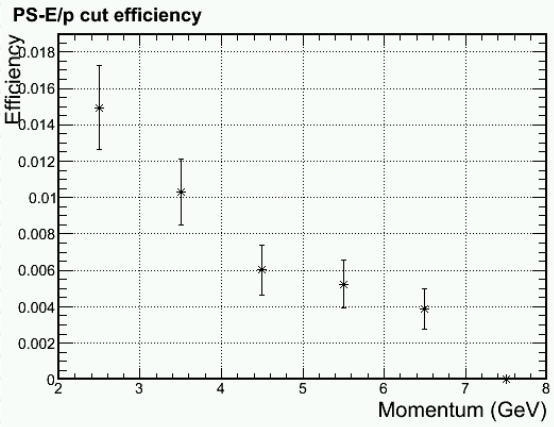
Outer radius, higher γ ϕ-band

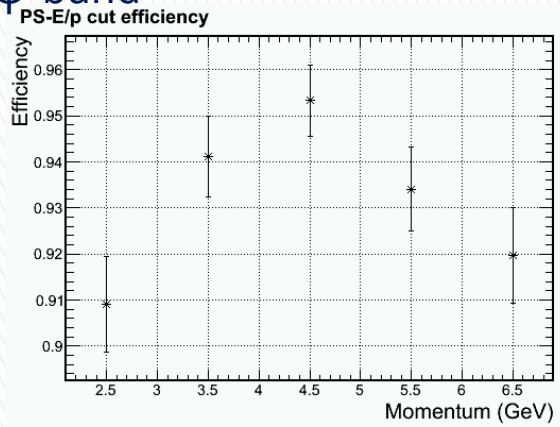




Due to Soft EM γ

Outer radius, lower γ ϕ-band



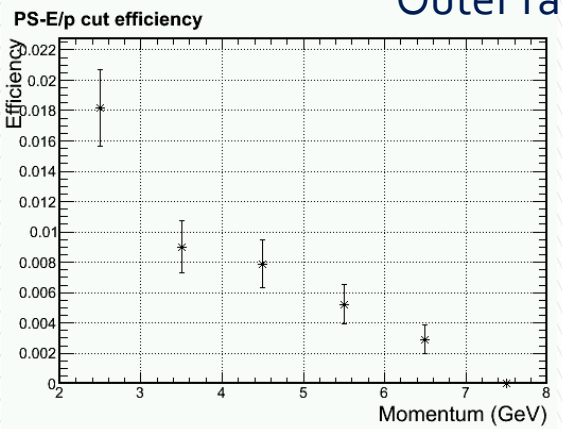


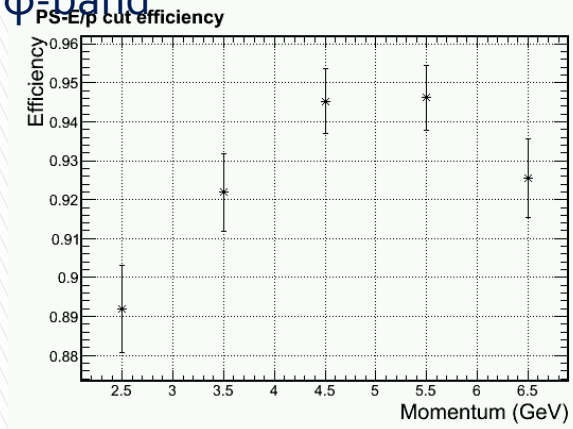
Pion Efficiency

Electron Efficiency

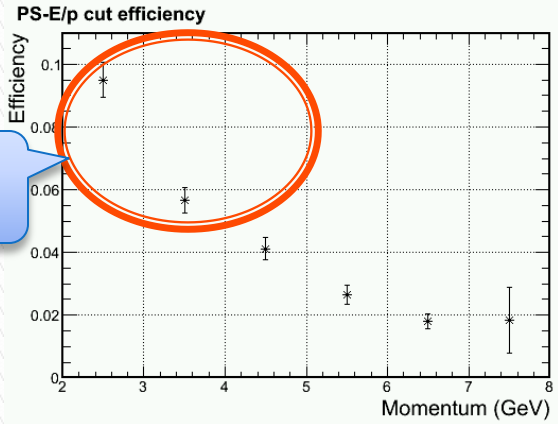
Update on PID with DC component removal (PS > MIP + Bgd + (2-3) σ)

Outer radius, higher γ ϕ-band

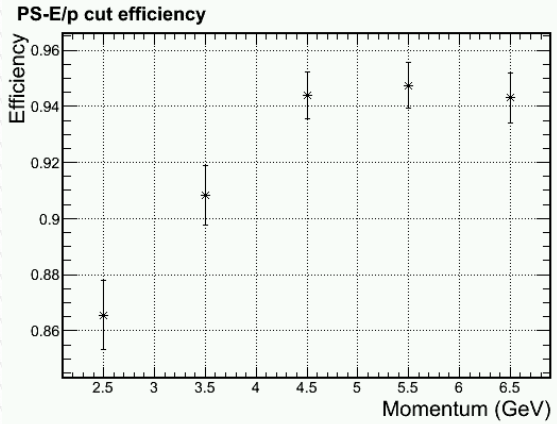




Mid radius, higher γ ϕ-band



Due to Hadron rate

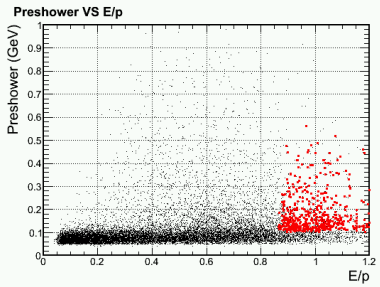


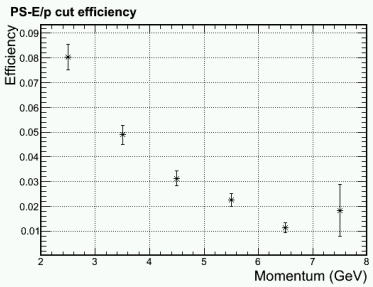
Pion Efficiency

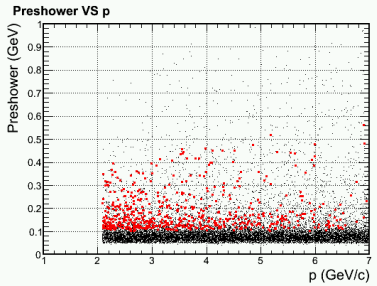
Electron Efficiency

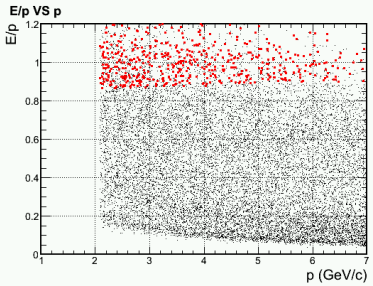
More detail in PID cut

Middle radius, lower γ ϕ-band, full bgd

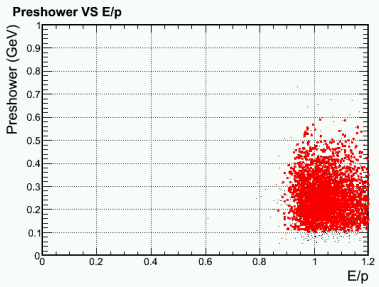


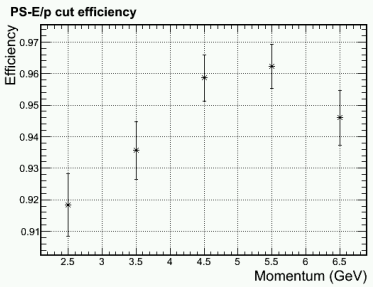


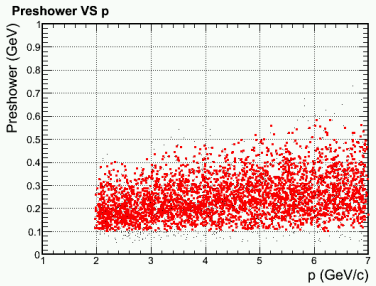


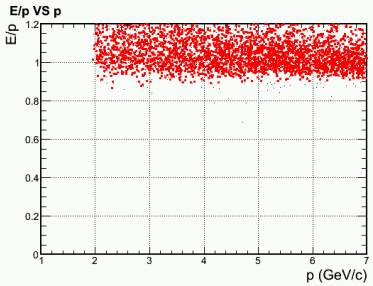


Pion Efficiency





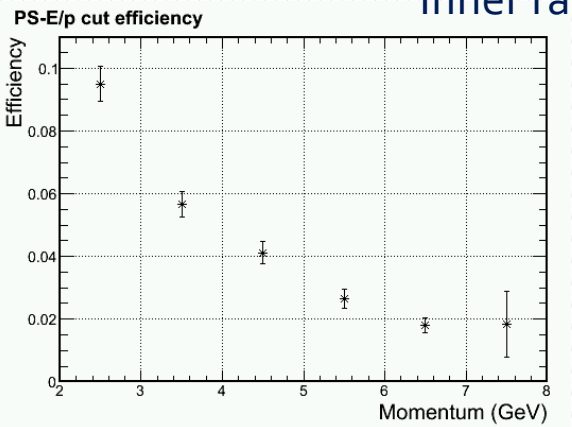


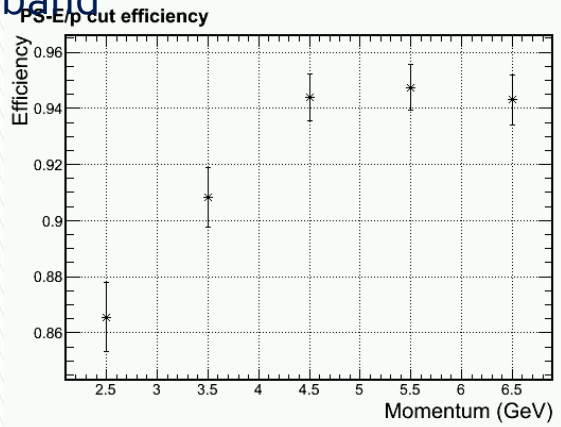


Electron Efficiency

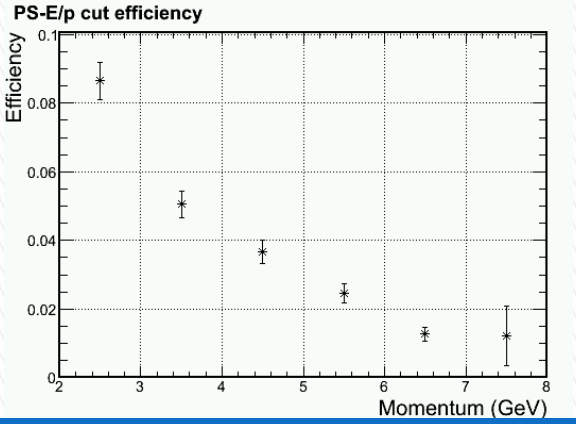
Update on PID with DC component removal (PS > MIP + Bgd + (2-3) σ)

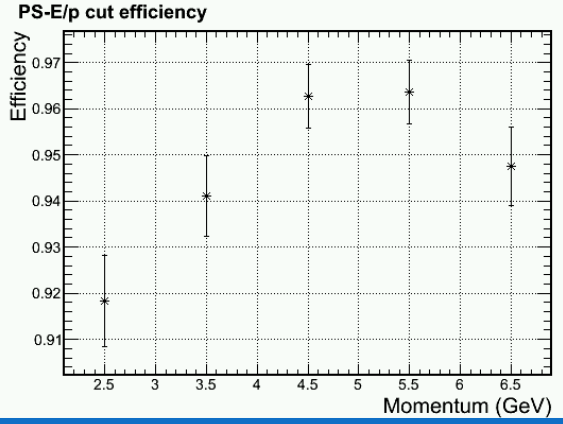
Inner radius, higher γ ϕ-band





Inner radius, lower γ ϕ-band



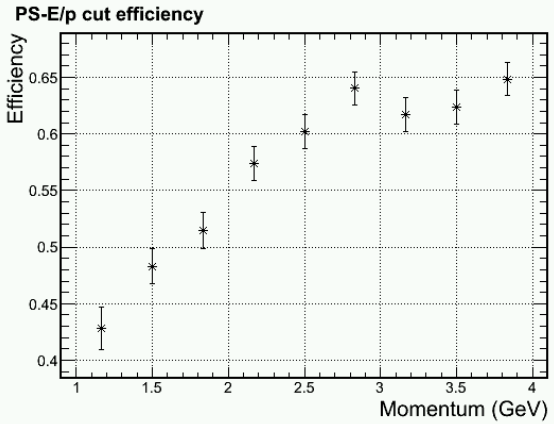


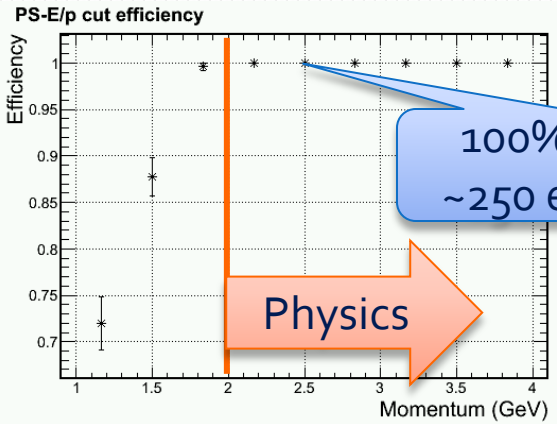
Pion Efficiency

Electron Efficiency

Trigger turn on curve for 2 GeV electron
Shower Hex 1+6 trigger > 1.6 GeV

Inner radius, higher γ ϕ-band, full bgd

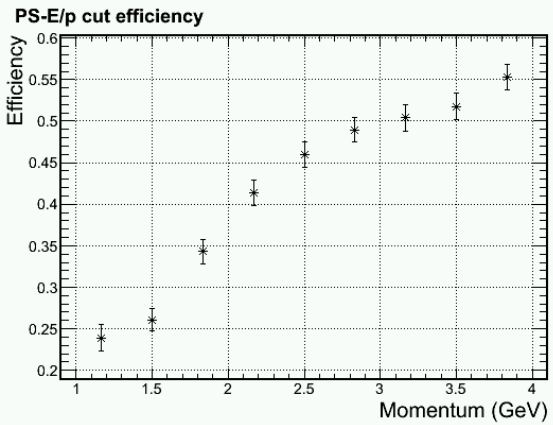


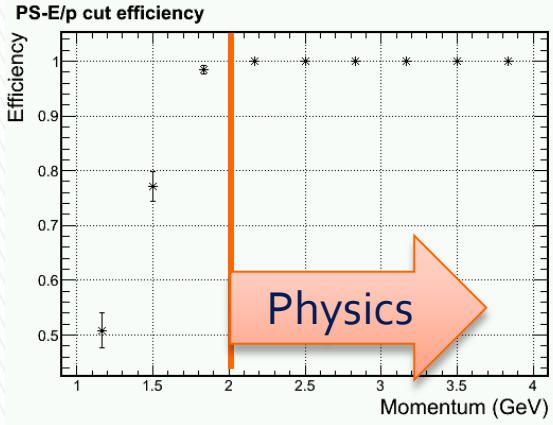


100% pass for
~250 events/bin

, full bgd

Middle radius, higer γ ϕ-band, full bgd



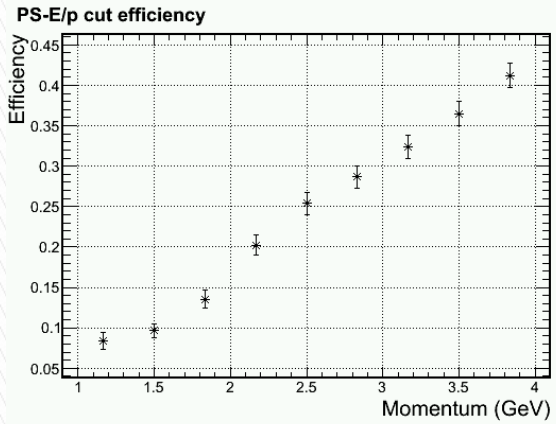


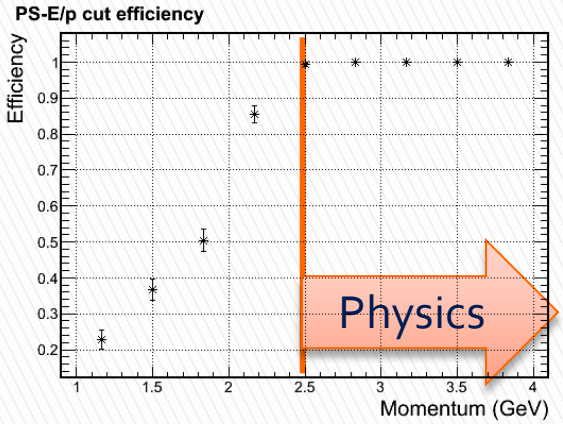
Pion Efficiency

Electron Efficiency

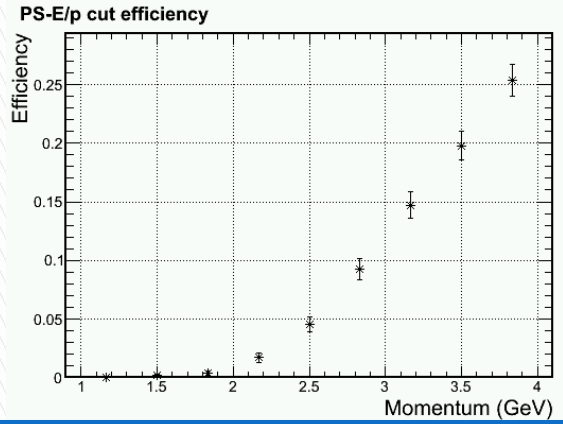
Trigger turn on curve for 2.5 GeV electron
Shower Hex 1+6 trigger > 2.1 GeV

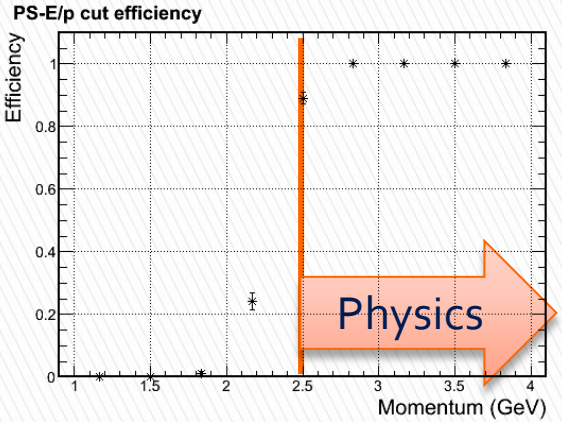
Middle radius, higher γ ϕ-band, full bgd





Outer radius, higer γ ϕ-band, full bgd





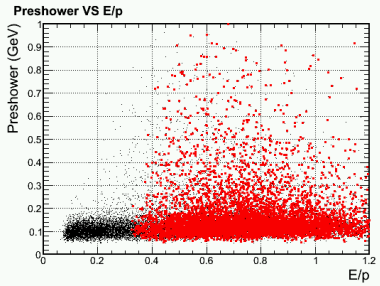
Pion Efficiency

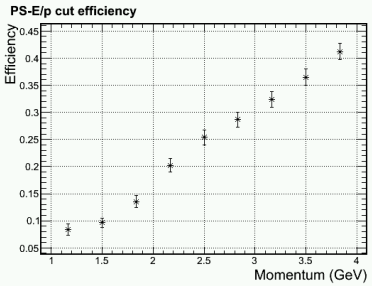
Electron Efficiency

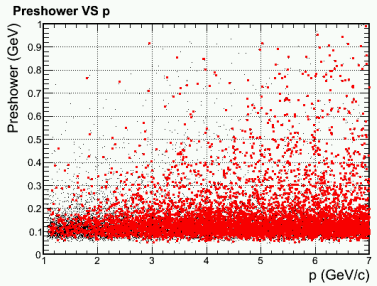
More detail in trigger cut

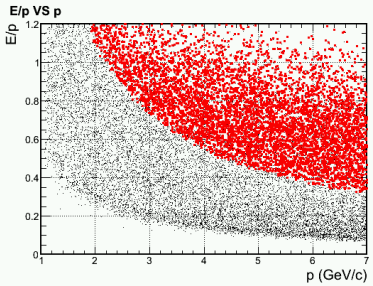
Middle radius, higher γ ϕ-band, full bgd

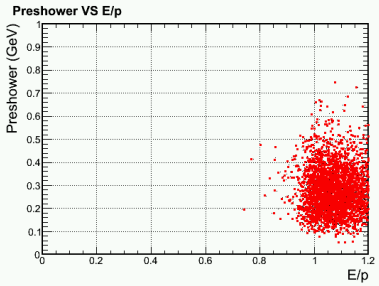
Shower Hex 1+6 trigger > 2.1 GeV

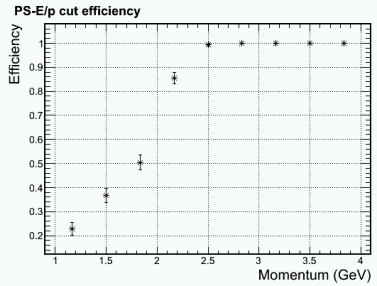


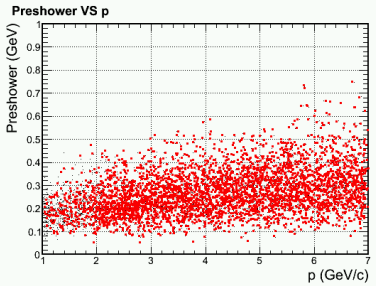


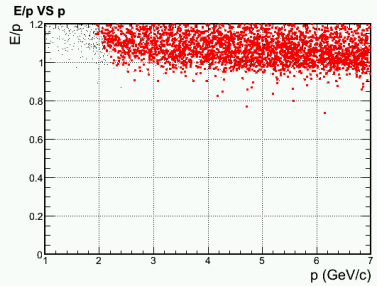












Pion Efficiency

Electron Efficiency

Readout occupancy per shower channel for ~75MeV zero suppression