EM
Energy Spectrum
from 17.6 MeV photons

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Event display of a muon passing through EM

Using GLEAM V3
the official version for EM

Mechanical support
structure is not simulated!
Data Taking Configurations

Photon Run – TKR trigger

\[ 3 \quad \text{C.R} \]

\[ \text{CAL} \quad \text{TKR} \]

17.6 MeV $\gamma$
Highest CR flux
Highest Trigger efficiency

Photons

Highest CR flux
Highest Trigger efficiency

Lowest CR flux
Highest Trigger efficiency

XZ Plane:
No Trade off between Flux and Trigger efficiency
Trigger efficiency rate is dominated by trigger efficiency

YZ Plane:
Trade off between Flux and Trigger efficiency

For cosmic rays

TKR

Highest CR flux
Lowest Trigger efficiency

Highest CR flux
Lowest Trigger efficiency

X
Dir goes from 0 to 180
Muons are symmetric around Y

17.6 MeV γ

1 foil geometry
There are 31 entries ~ 4% of the total below zero.

There are 715 entries that fall within the reconstructed position in the W ~ 89% of total.

Solid histograms correspond to events in which the reconstructed position of the converted photons lies within the W thickness (130.15 to 130.25 mm). 20% are Compton and 80% pairs.
MC G4 Negative Photon Conversions

Reconstructed at $Z = 130.2$ mm

True conversion at $Z = -26.5$ mm
Energy Spectrum in the Calorimeter (signal)

for 3-in-row reconstructed events that Converted inside the W foil (130.15 to 130.25 mm)

- 1 Track pairs ~ 75%
- 2 track pairs ~ 5%
- 1 track Compton ~ 20%
- All
Background Rate Calculation

Muon rate from PDG = 1 /cm²/min = 1.67 /cm²/s
Expect 1000 Hz from 3 GeV muons (assuming sphere around EM = 60000 cm²)
Expect 10 Hz from 100 MeV muons (assuming sphere around EM = 60000 cm²)

Area of TKR = 35.8 x 35.8 = 1282 cm²

Trigger rate = # of triggered events x 60000 cm² x 1.67 /cm²/s /1,000,000 events
Background Rate Vertical vs Horizontal

Trigger rate = # of triggered events x 60000 cm² x 1.67 /cm²/s /1,000,000 generated events

Vertical Position (3-in-a-row only) = 15.33 Hz
Vertical Position (W cut) = 13.94 Hz
Horizontal Position (W cut) = 2.54 Hz
W cut = 3-in-row reconstructed events that Converted inside the W foil (130.15 to 130.25 mm)

Energ (MeV)
Energy Spectrum in the Calorimeter (bkgd)

for 3-in-row reconstructed events that have first hit inside the W foil (130.15 to 130.25 mm)

2500 events correspond to 2.5% of the 1000000 events generated corresponds to 0.5 hours of data taking. So this must be scaled by a factor of 28 to be normalized with the photon spectrum.
Energy Spectrum in the Calorimeter

normalized to 14 hours of data taking

3 GeV $\mu$ (single energy)
17.6 MeV $\gamma$ (single energy)

Caveat: Simple scaling applied, to get a better understanding of the background we need to generate more MC events
Background rejection variables

- X and Y position of first hits (mm)
- Number of TKR clusters
- Reconstructed Y direction (deg)
- Rms of the first track

- 17.6 MeV γ
- 3 GeV µ
- 100 MeV µ
- CR Ground Dist µ
Background rejection – before the last cut

Caveat: Limited statistics for background run

X and Y position of first hits (mm)

Reconstructed Y direction (deg)

Number of TKR clusters

Rms of the first track
Energy Spectrum in the Calorimeter

normalized to 14 hours of data taking – background free

Caveat: Limited statistics for background run

1 Track pairs ~ 92%
2 track pairs ~ 2%
All 1 track Compton ~ 6%

N_{ent} = 268
Mean = 6.504
RMS = 3.125
Backup slides
From MC GEANT4 information we find that

0.83% of source events are pairs that convert inside W
0.43% of source events are pairs that convert outside W
0.23% of source events are Compton

Estimated numbers

- Probability of conversions ~ 3%
- Cross section for Pairs ~ 79%
- Cross section for Compton ~ 21% (Theory ~ 17%)
- Trigger efficiency for on axis 17.6 MeV ~ 62%
- Recon efficiency for pairs ~ 82%
- Recon efficiency for recon ~ 67%
Solid bars are the events in which the reconstructed position of the converted photons lied **outside** the W thickness (130.15 to 130.25 mm)
Energy Spectrum in the Calorimeter (signal)

3-in-row reconstructed events that Converted inside the W foil (130.15 to 130.25 mm)

715 events correspond to 1.4% of the 50000 events generated. Only 1017 triggered the 3-in-a-row. With a rate of 1 Hz from the source this corresponds to **14 hours of data taking**
MC Reconstructed directions in degrees

X recon dir

Y recon dir

Z recon dir

yPos:xPos {nTkrTracks>0}
Energy Spectrum in the Calorimeter

normalized to 14 hours of data taking – background free

Caveat: Limited statistics for background run

1 Track pairs ~ 82%

1 track Compton ~ 18 %