EM Calibrations and Data Analysis

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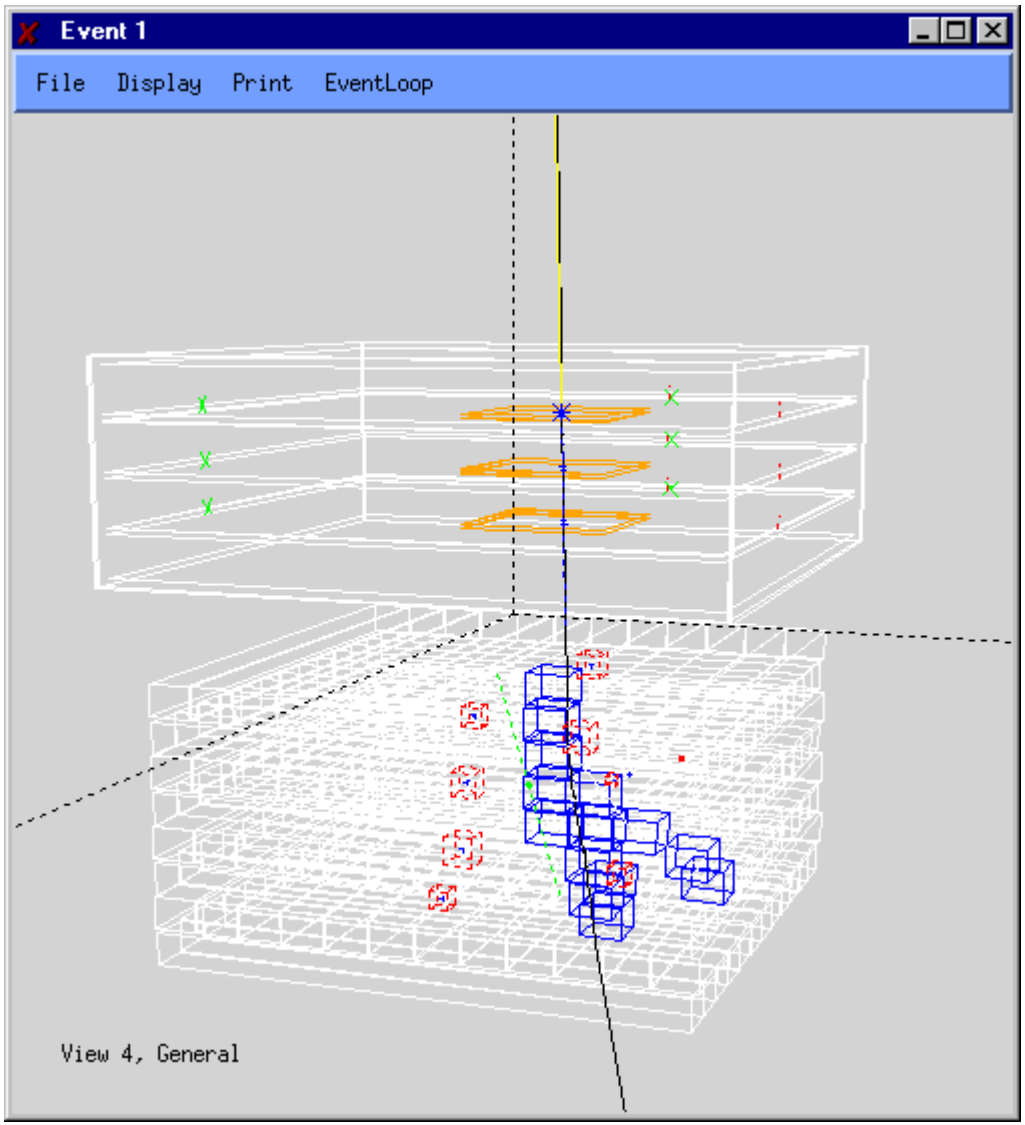
Outline

- EM data taking statistics (summary)
  - CAL Calibration
  - 17.6 MeV Photon Runs
  - Simple comparison between 1 W and 3 W geometry
- EM TOT Studies
  - Energy deposition
  - Calibration
  - Data analysis

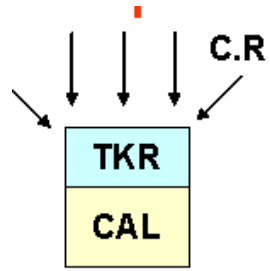
Event display of a muon passing through EM



Using GLEAM V3
the official version for EM

Mechanical support
structure is not simulated !

Muon Calibrations

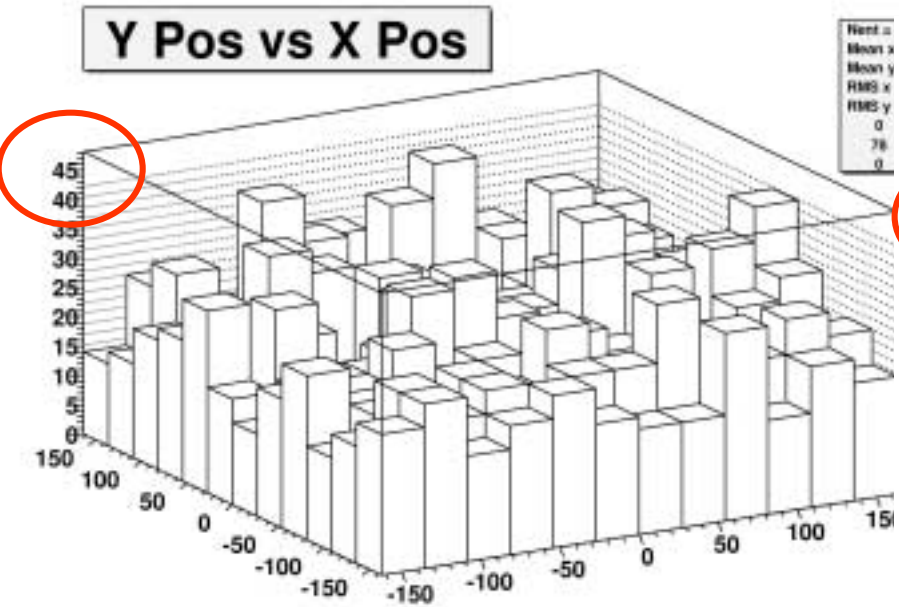


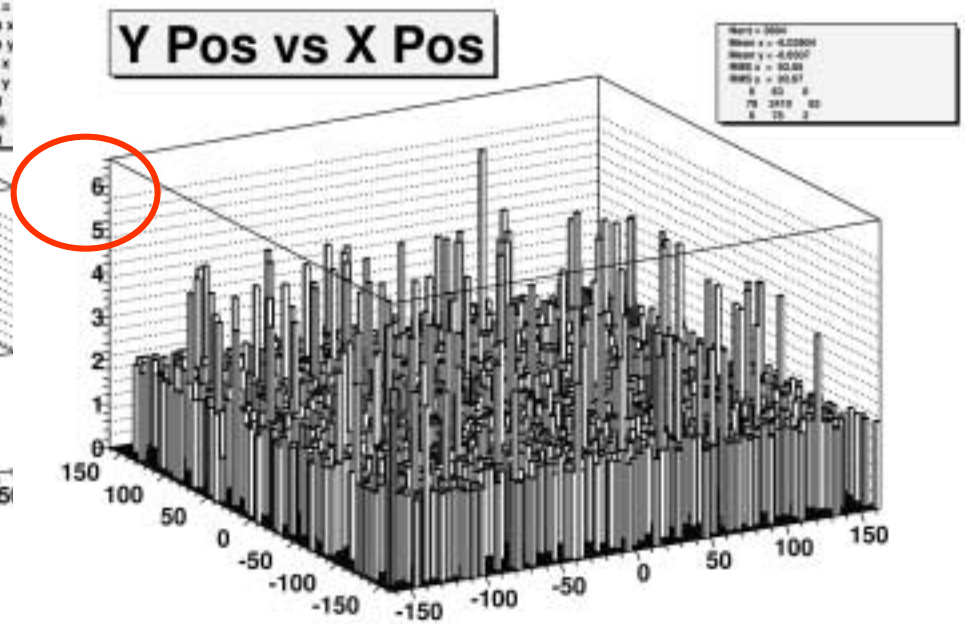
Muon rate from PDG = 1 /cm^2/min
Number of MC events generated with $\cos^2\theta$ distribution = 1,000,000
Sphere around EM = 60000 cm^2
Area of a CAL Layer = 32 x 32 = 1024 cm^2

CAL needs at least 1000 muons/bin to get 3 mm resolution

Cut			Normalized Rate		# Daily Muons	
ID	Description	Log Bin size used (cm^2)	Hz	Hz/cm^2	/cm^2	/bin
1	TKR trigger	2.7x2.7	15.52	0.0152	1310	9548
2	TKR trigger Number of Tracks > 0	2.7x2.7	13.95	0.0136	1177	8579
3	TKR trigger Number of Tracks > 0 Zdir< 10 deg w.r.t vertical	2.7x2.7	3.69	0.0036	312	2272
4	TKR trigger Number of Tracks > 0 Zdir< 10 deg w.r.t vertical	2.7x0.27	3.69	0.0036	312	227

X and Y Positions of first hit in the TKR assuming 10 degrees with respect to the vertical
(corresponds to 20 only minutes of data taking)





27 x 27 mm^2 bin

2272 muons/bin/day

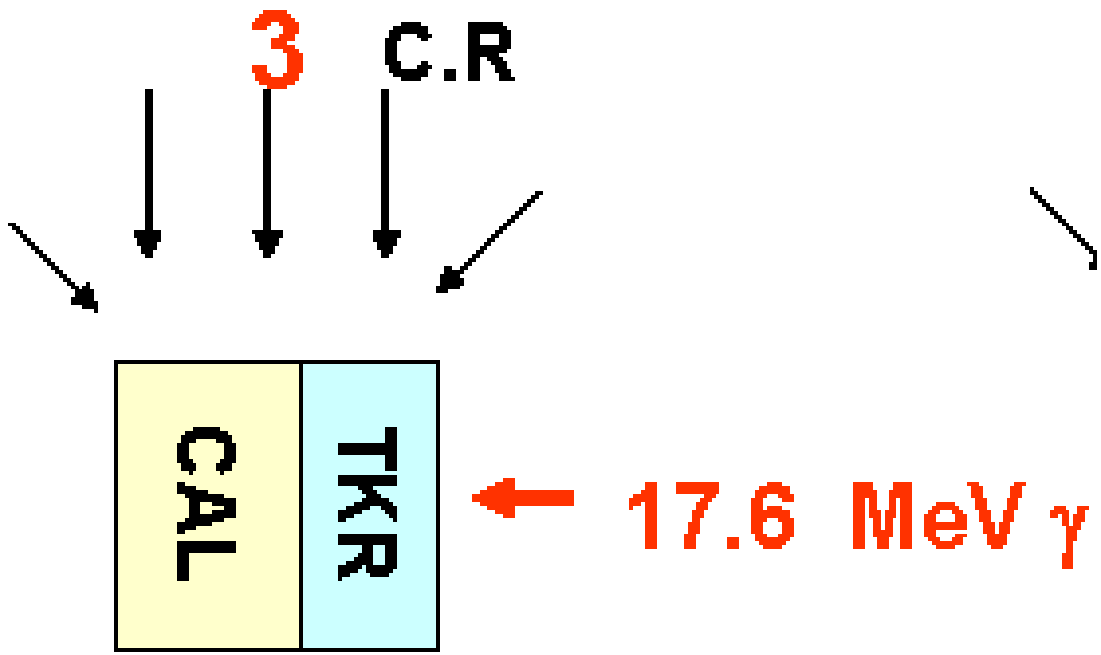
27 x 2.7 mm^2 bin

227 muons/bin/day

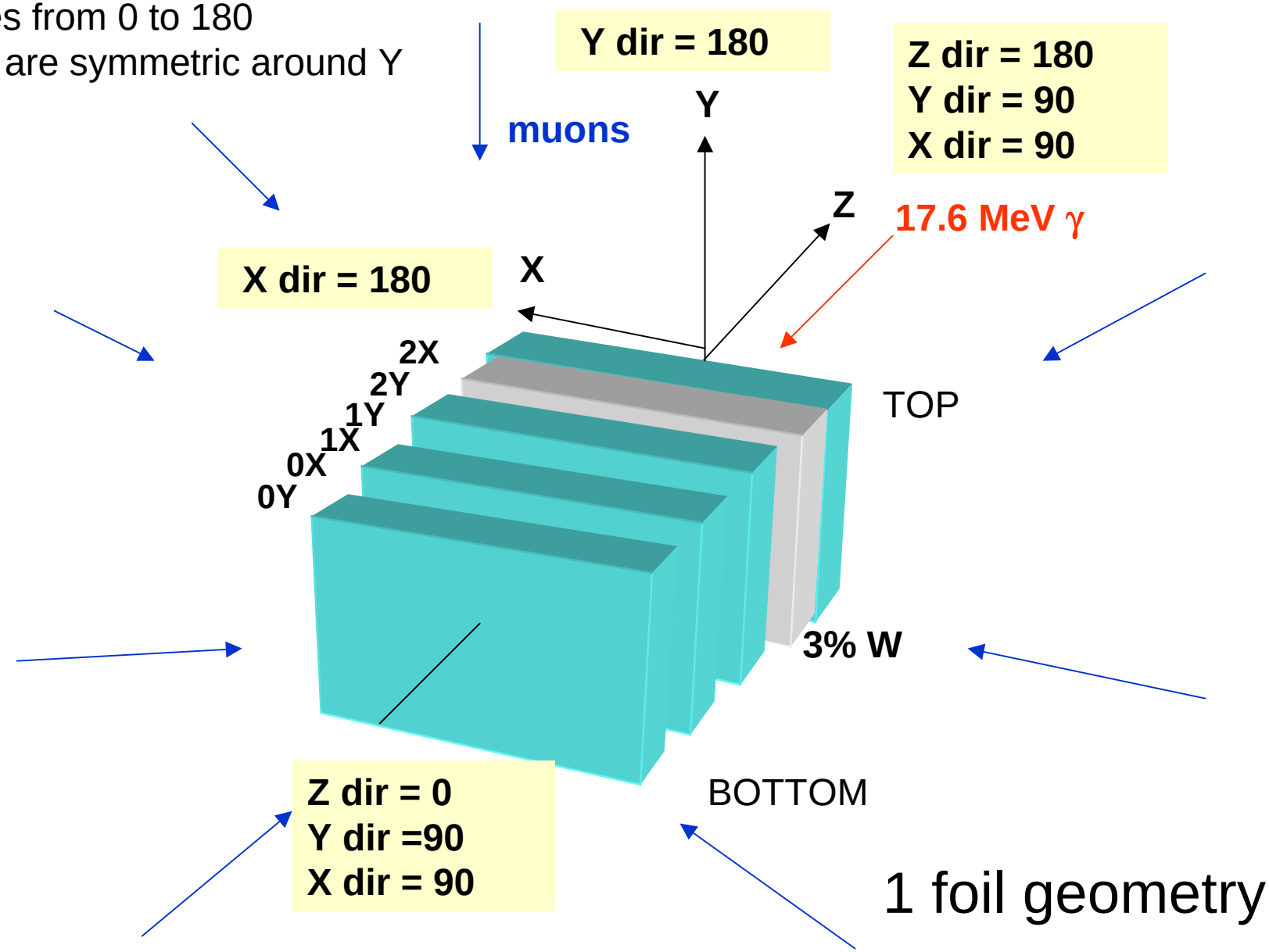
CAL requested 6 days of C.R. data taking

Data Taking Configurations

Photon Run – TKR trigger



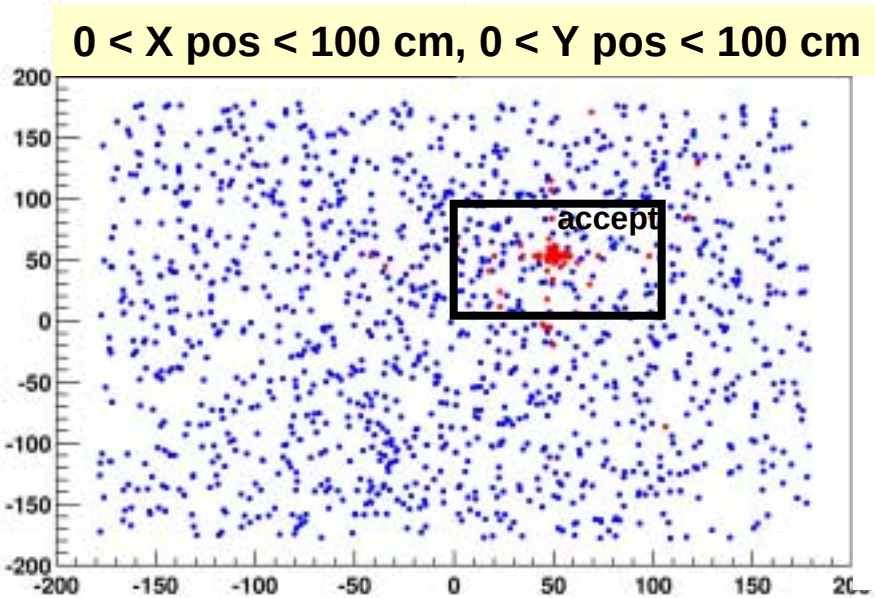
Dir goes from 0 to 180
Muons are symmetric around Y

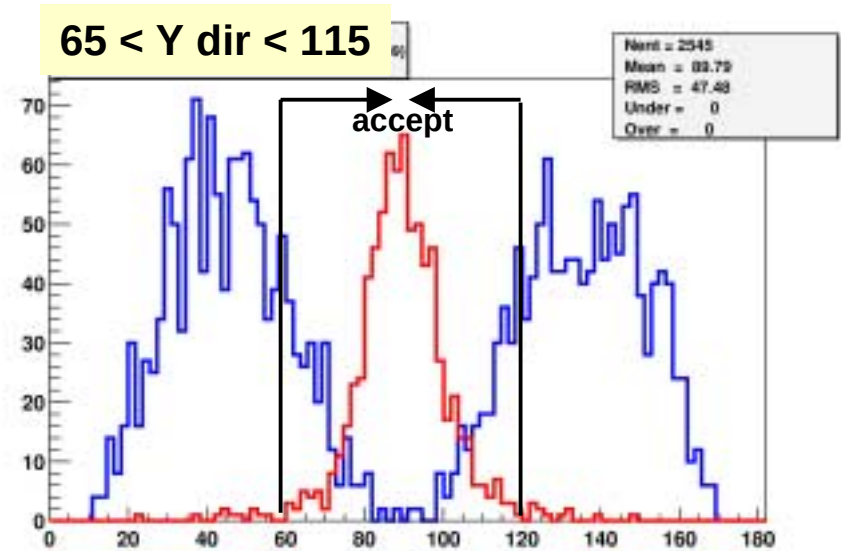


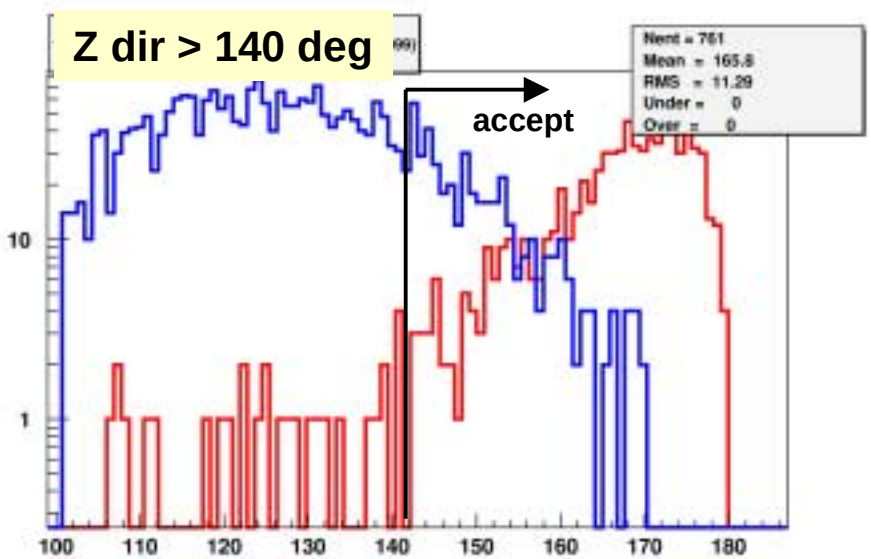
1 foil geometry

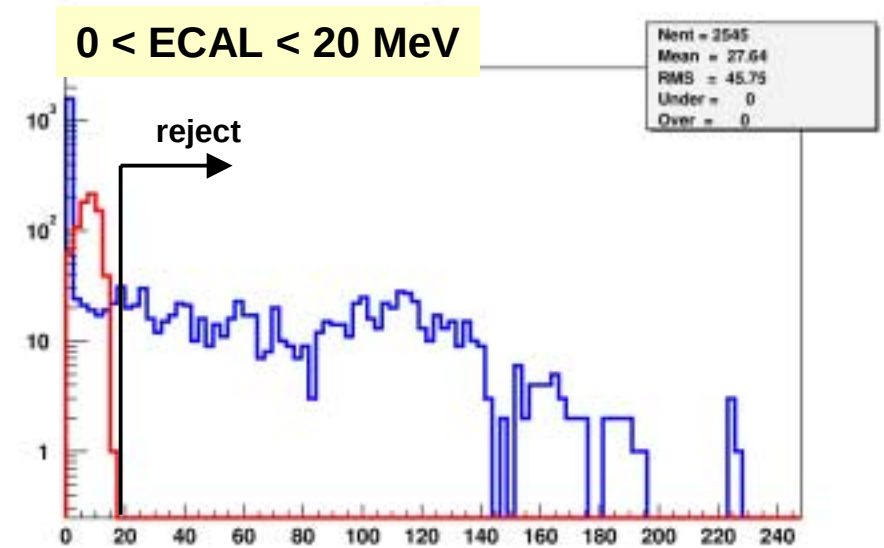
17.6 MeV γ
3 GeV μ

Expected photon rate 0.0127 Hz ~1000 photons a day





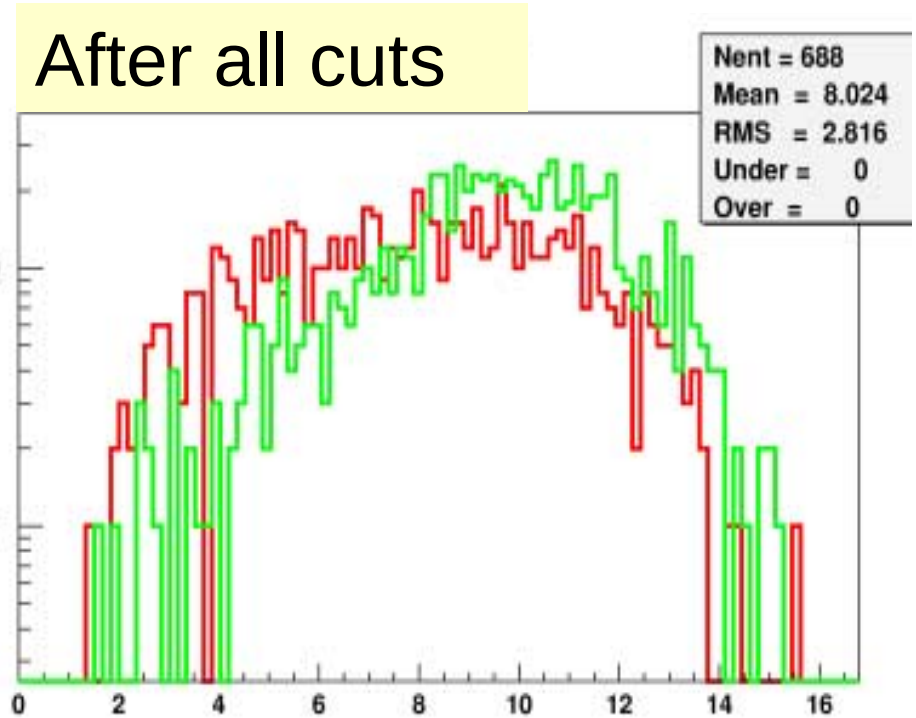




1W versus 3 W

Number of tracks

As expected pattern recognition degrades by adding more W



CAL Energy (MeV)

As expected there is less energy in the CAL when more W layers are added

SUMMARY

Config	Description	Photons (Hz)	Muons (Hz)	Days
1	Calibration	N/A	3.7	6
2	Control Sample	N/A	0.4	1
3	Photon Run TKR trigger	0.0127	0.0000*	5
4	Photon Run CAL-LO trigger	1	0.0000*	1

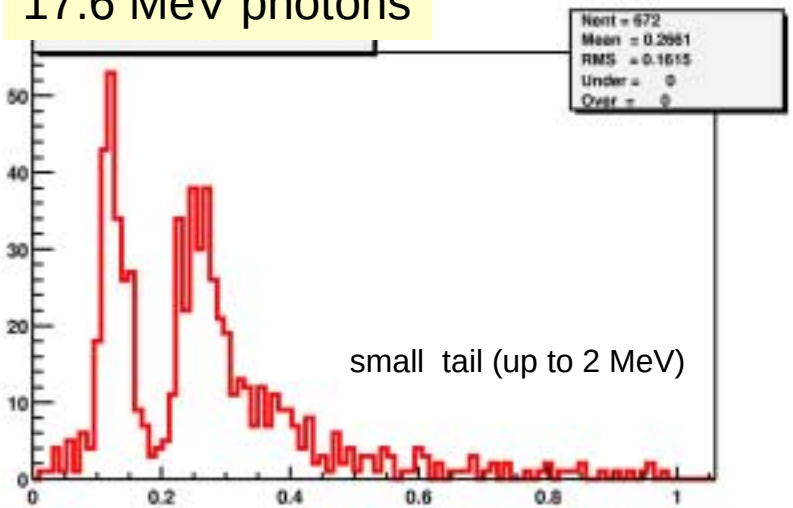
•Analysis is not completely background free since the background consists of a crude approximation to the real spectrum, photon rates depend on VdG performance. Need to work around the clock for 14 days !

Problem: Although this allows us to check the VdG operation it relies on a "beam constrained analysis"which is not realistic in orbit

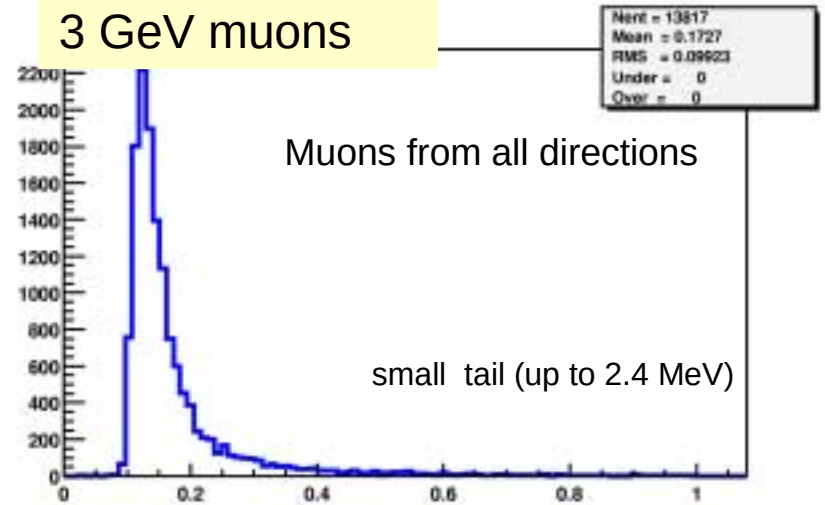
Next Step: Let's investigate a more general analysis that can use the TOT !

Si Energy Deposition (MeV) below top W Conversion Layer (MeV)

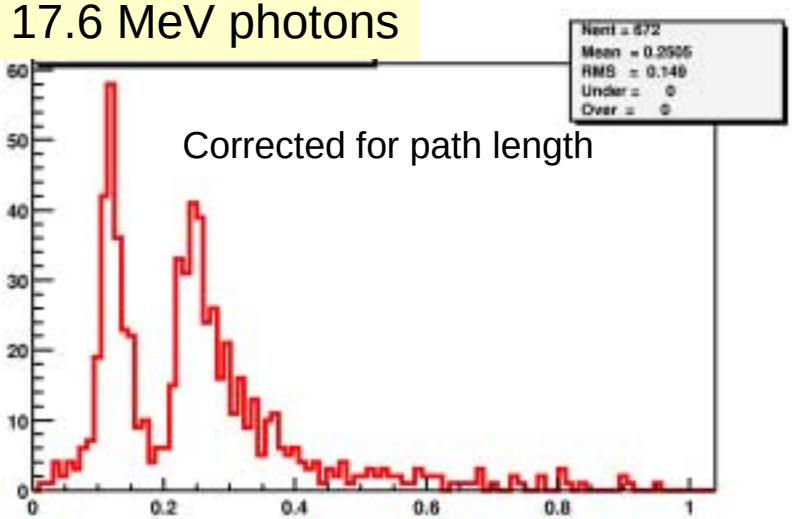
17.6 MeV photons



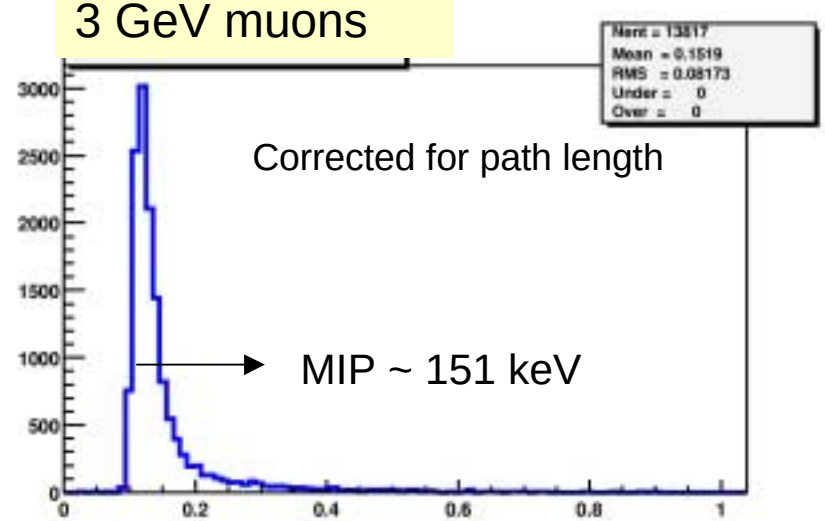
3 GeV muons



17.6 MeV photons



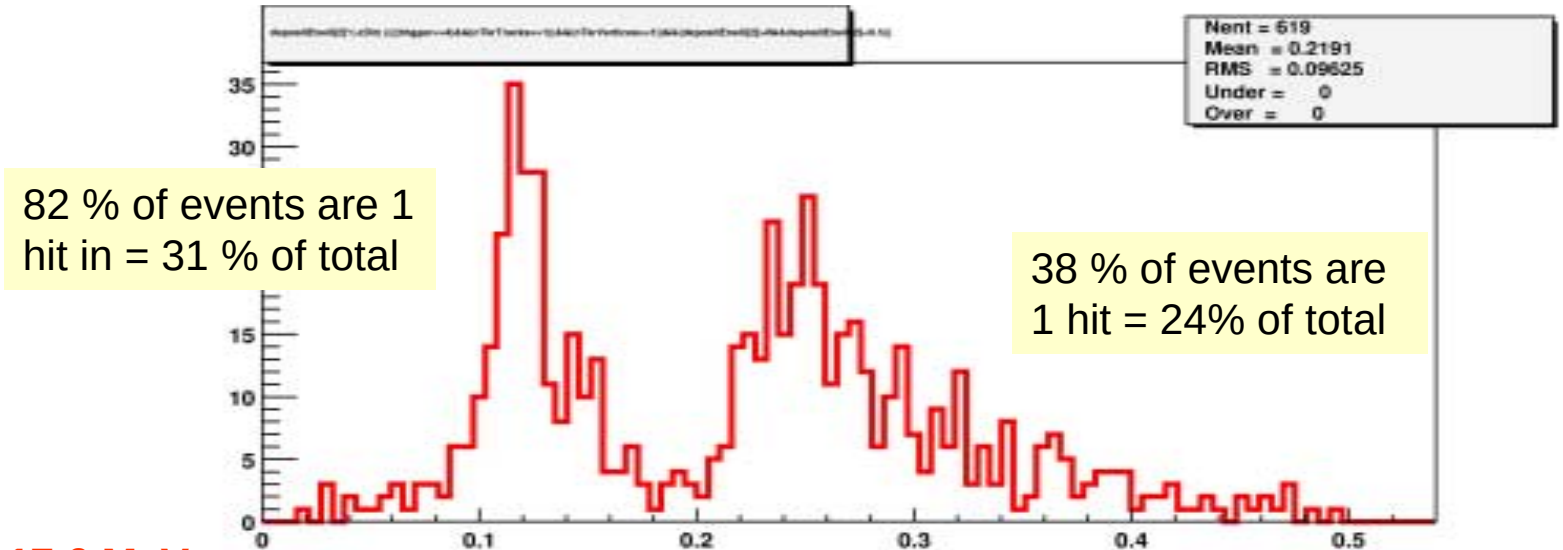
3 GeV muons



Cuts : TKR trigger, 1 track and 1 vertex, Si Energy < 1 MeV

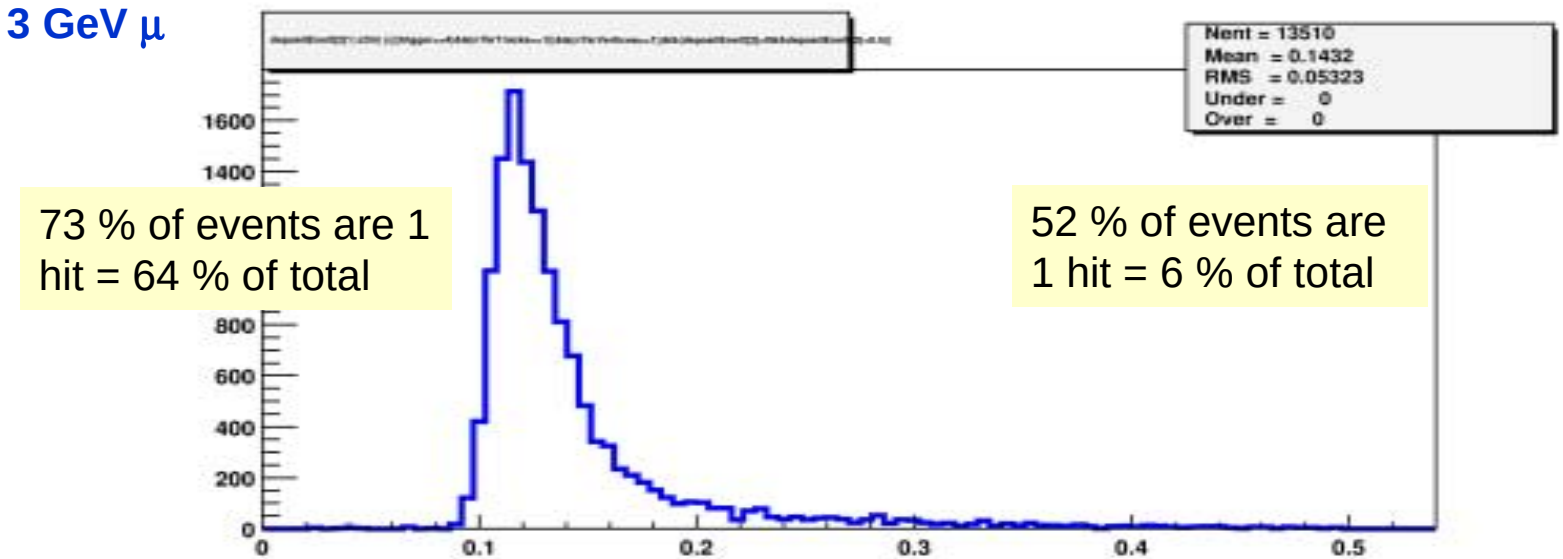
Si Energy Deposition below top W Conversion Layer (MeV)

Cuts : TKR trigger, 1 track and 1 vertex, Si Energy < 0.5 MeV



17.6 MeV γ

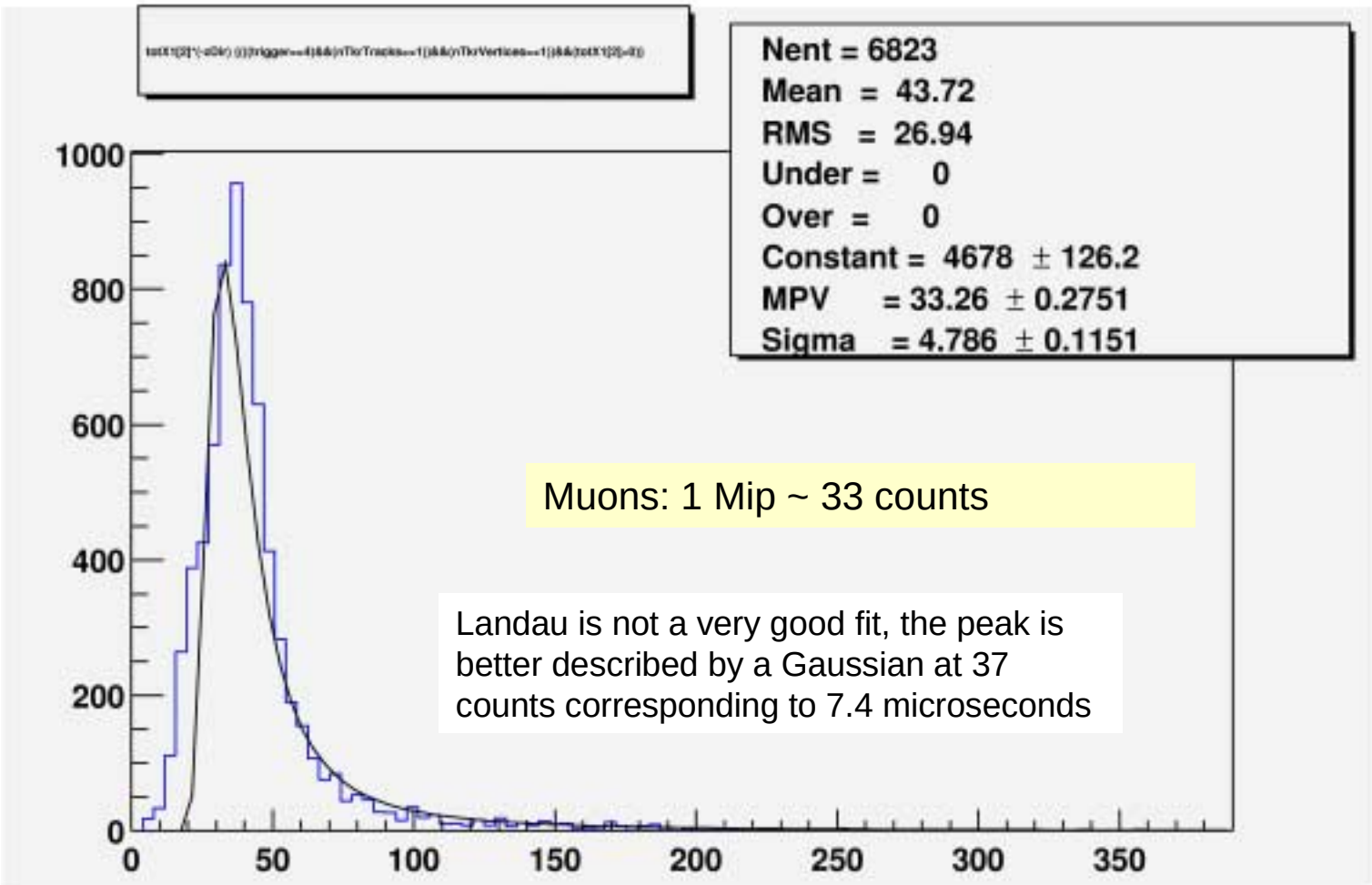
3 GeV μ



By requiring **1 hit and and E > 200 keV** we reject 64% of C.R at the expense of 31% of photons but keeping on the second peak 24% of Photons and 6% of CR. So if we bring the S/N ratio down using other cuts we can use this an an extra handle on background rejection

TOT “Calibration”

Cuts : TKR trigger, 1 track and 1 vertex

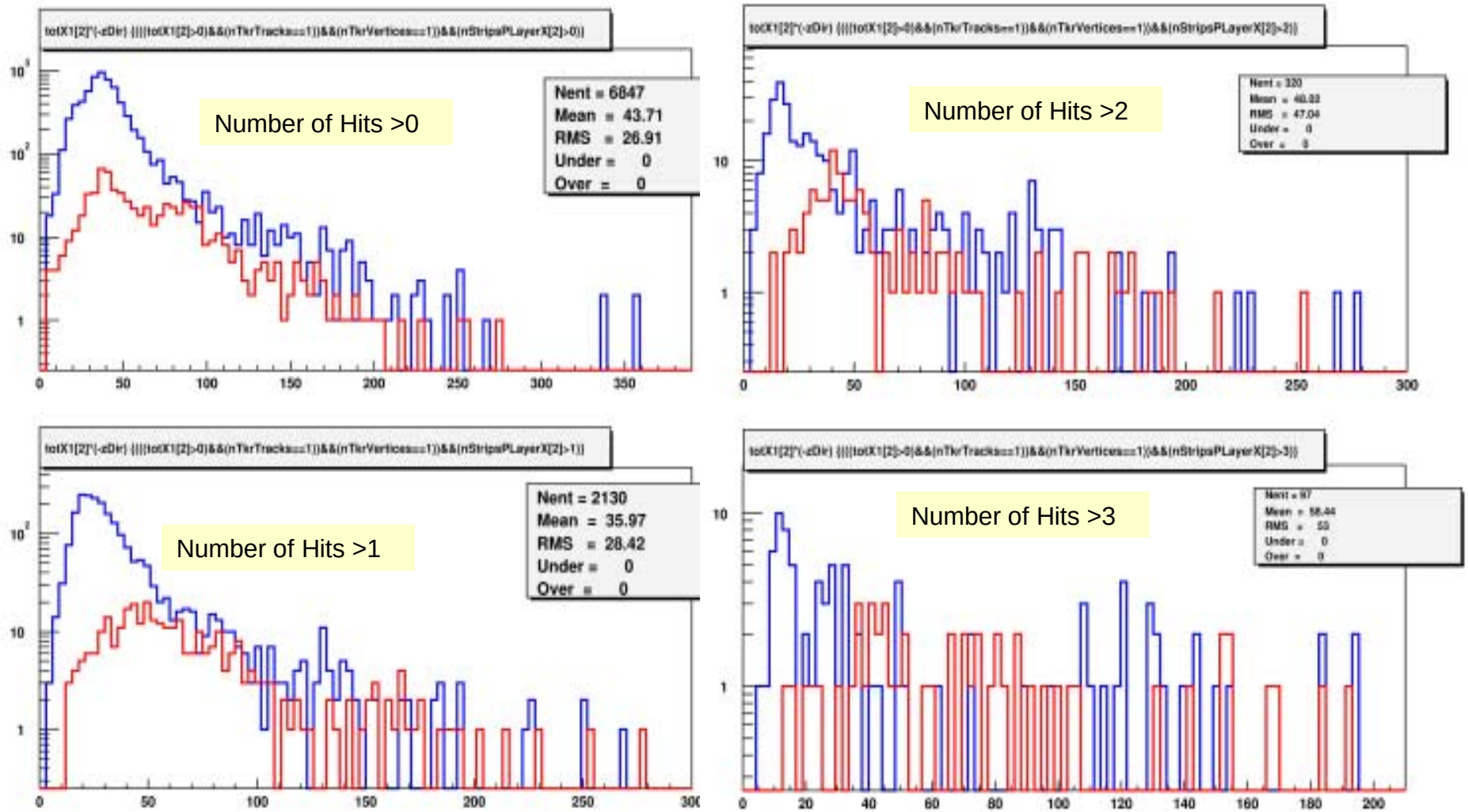


Muons: 1 Mip ~ 33 counts

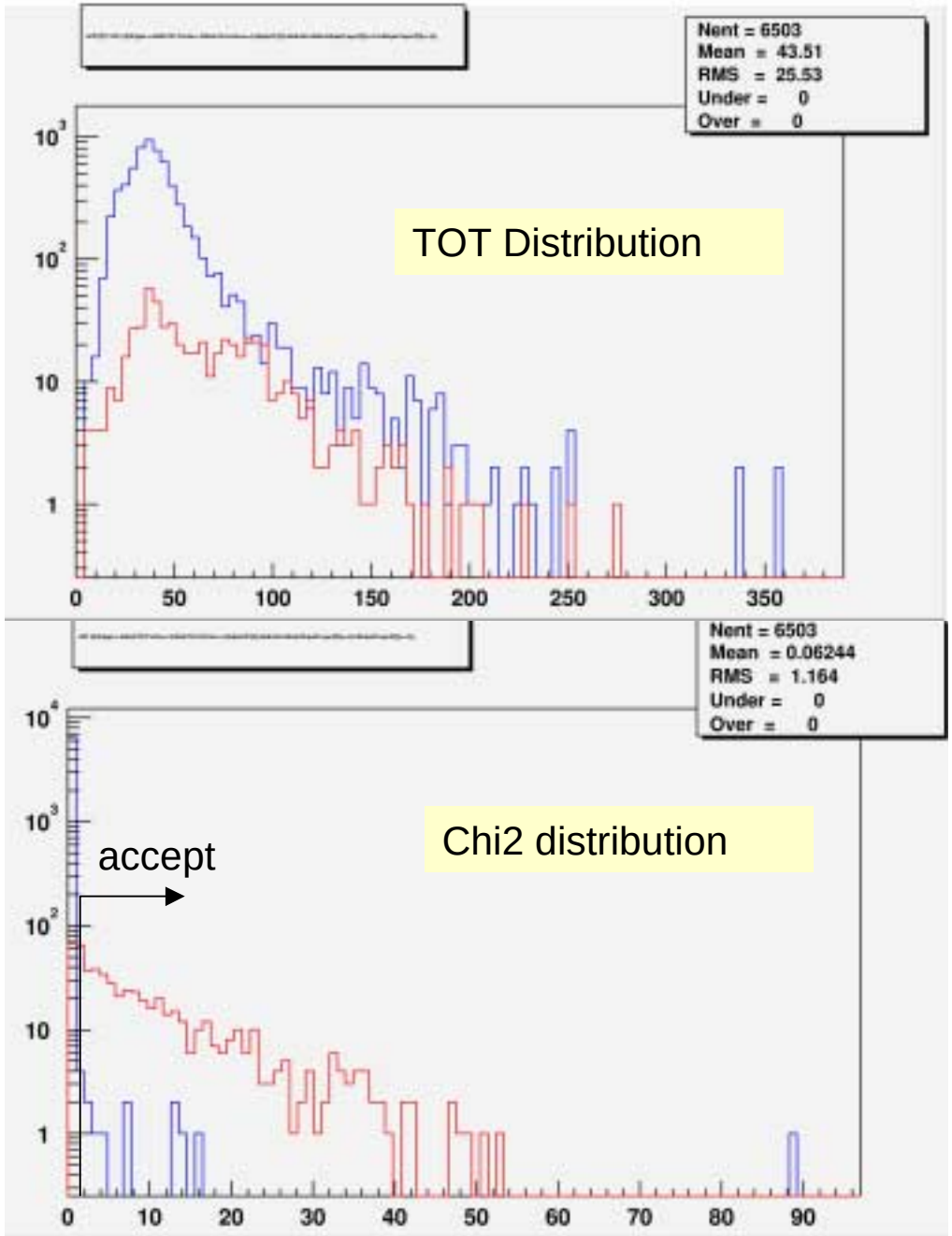
Landau is not a very good fit, the peak is better described by a Gaussian at 37 counts corresponding to 7.4 microseconds

17.6 MeV γ
3 GeV μ

TOT Distributions



Cuts : TKR trigger, 1 track and 1 vertex, Si Energy > 0

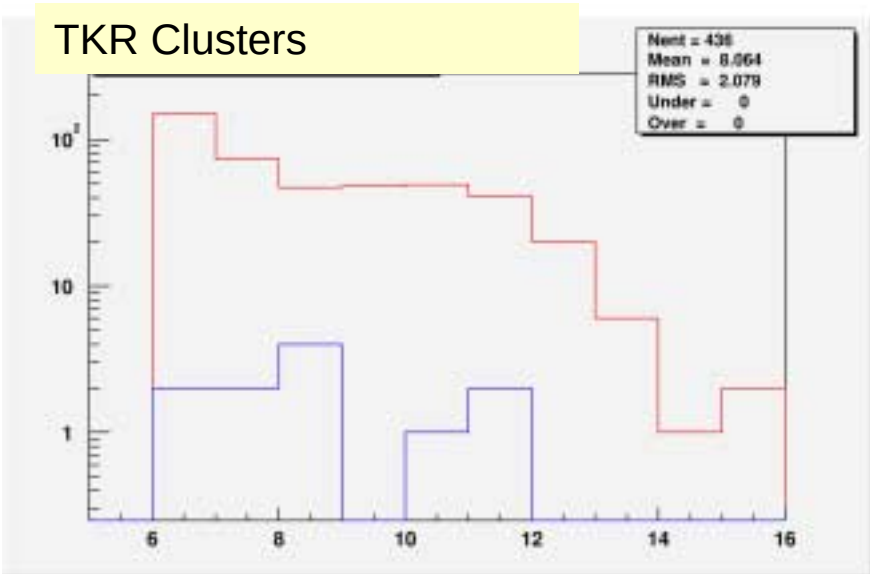


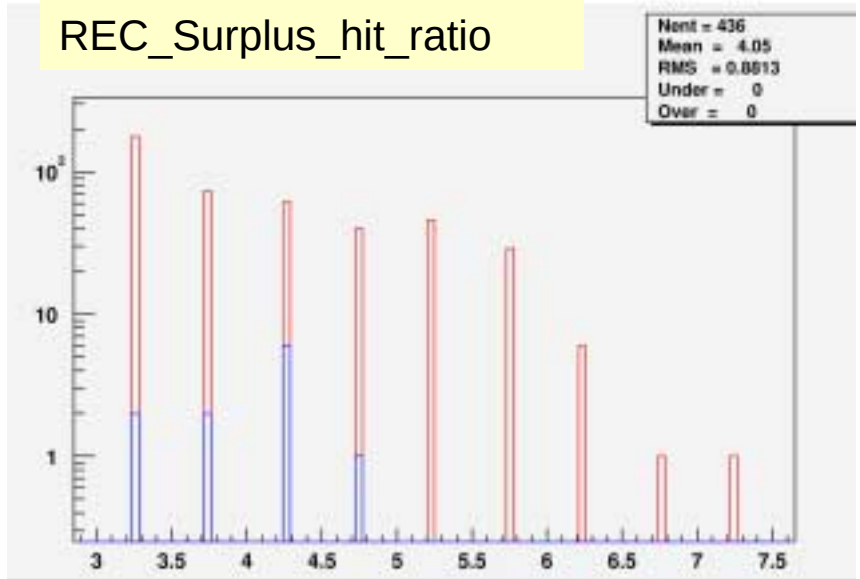
17.6 MeV γ
3 GeV μ

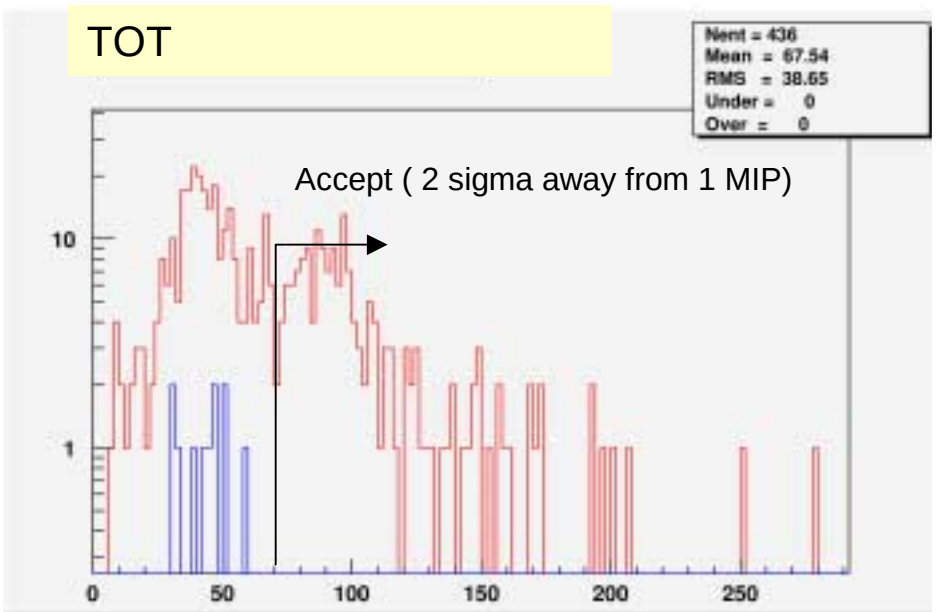
Cuts applied
- 1 track
- 1 vertex
- 1 or 2 hits in the layer immediately below W where conversion occurred

Suggests we should apply A chi2 cut > 2

After chi2 cut…







Cuts applied

17.6 MeV γ

3 GeV μ

- 1 track
- 1 vertex
- 1 or 2 hits in the layer immediately below W where conversion occurred
- chi2 > 2

SUMMARY

- Using the TOT we can retain a very pure sample of photons with low efficiency (20% normalized to the triggered rate on TKR triggers) and without beam constrained cuts
- Maybe the TOT can be used as an extra handle on background rejection (beyond the ACD) . Lots of work ahead of us…
- We expect 14 days of data taking during EM operations with following caveats
    - assumes 1 Hz rate from VDG
    - Hiro and Xin are modifying the cosmic ray spectrum so that we can have a more realistic estimation of the background rates for the EM and also for CU alignment
    - analysis is based on low statistics
    - no contingency yet in the plan