ACD Backsplash Update

Luis C. Reyes

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From last time:

Event selection cuts used:

Tkr1ZDir<-0.9985

Tkr1FirstLayer==17

Tkr1LastLayer==0

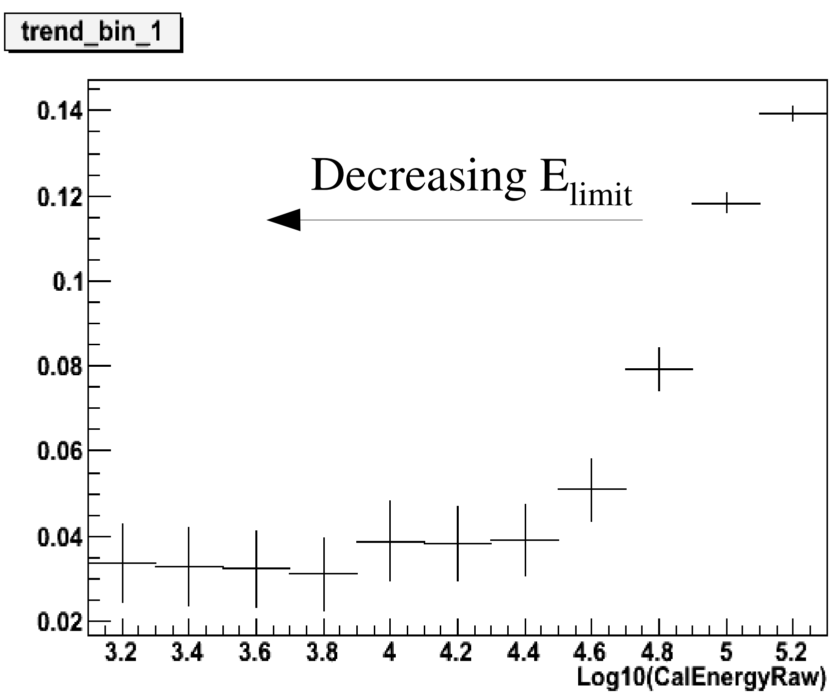
Tkr1Chisq<1.5

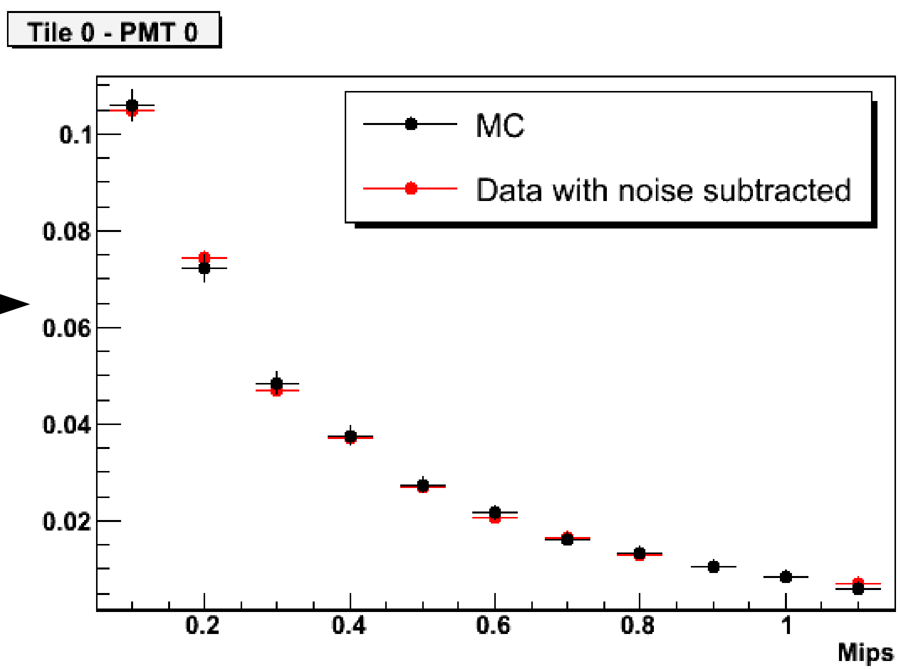
TkrHDCount<7

TkrNumTracks>0

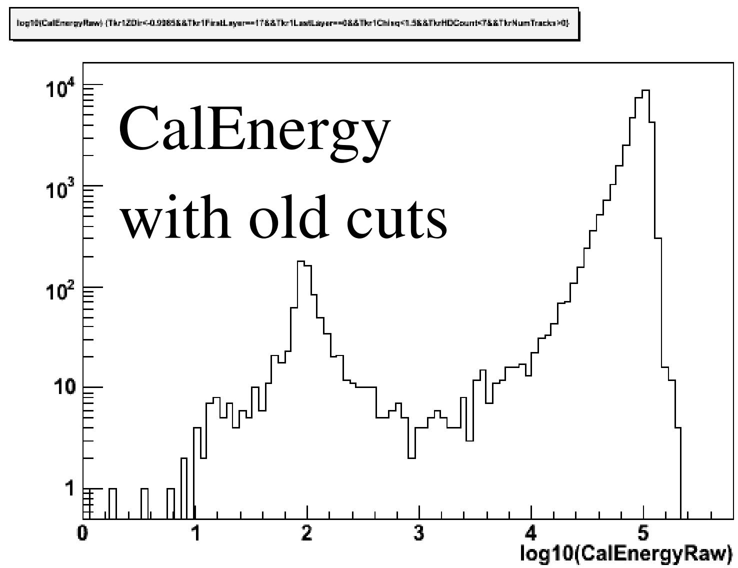
Found some leftover acd signal independent of CalEnergy.

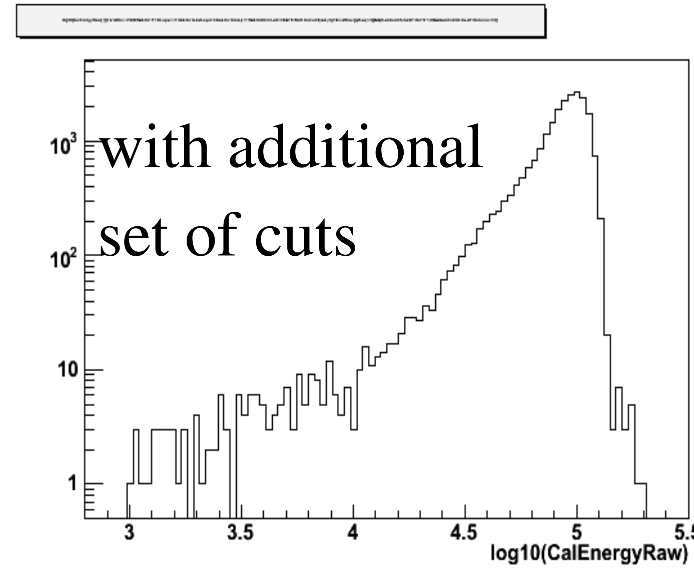
good agreement between data and MC after subtraction.





However,

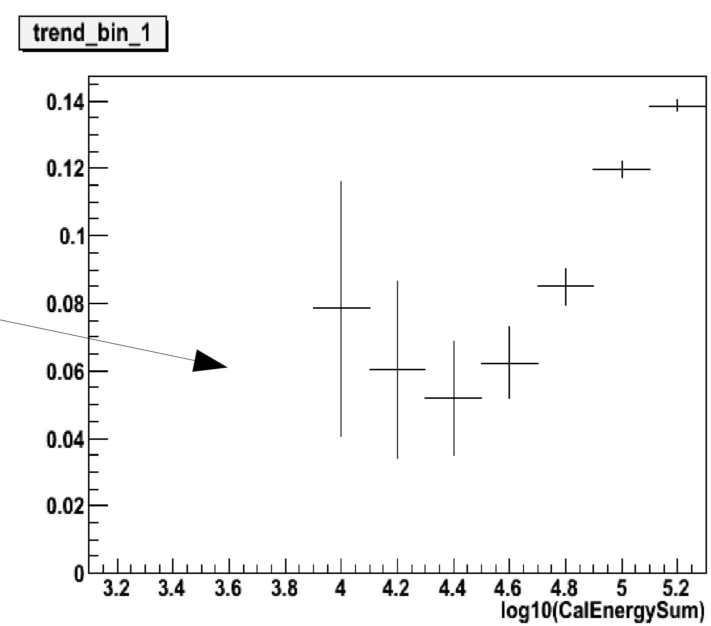




log10(CalEnergyRaw)>3
Cal Lo trigger
Tkr trigger

additional cuts

No clear trend as before



Additional cuts seem to provide good "background" rejection

Monte Carlo simulation ingredients (in sequential order):

1. Energy deposited in the tile (given by GEANT4; follows Landau)

2. Light collection uniformity at the tile edge
(changes tile to tile, we haven't measured it)

3. Poisson fluctuations in the number of photoelectrons
(we have mean number of PE per mip from calibrations)

4. Electronics noise
(expected to be low, estimated from pedestal width)

2. Light collection uniformity at the tile edge (changes tile to tile, we haven't measured it)

From ACD paper (Moissev et al. 2007):

"In this test, it was found that the light collection is acceptably uniform in the middle of the tile, but that there is 20-30% light yield reduction in the edge pixels, caused by light escape at the scintillator edges. This edge effect was further explored using a more precise 1 mm scintillating fiber hodoscope for event selection. This showed that the light yield decreases to approximately 70% at the tile edge, and recovers to 100% at ~3 cm from the tile edge."

Therefore, hereafter the MC backsplash expectation is bracketed by considering two extreme scenarios:

Poor light collection uniformity:

Efficiency is reduced within 3 cm of the edge. Efficiency goes linearly from 100% (away from the edge) to 70% (at the edge)

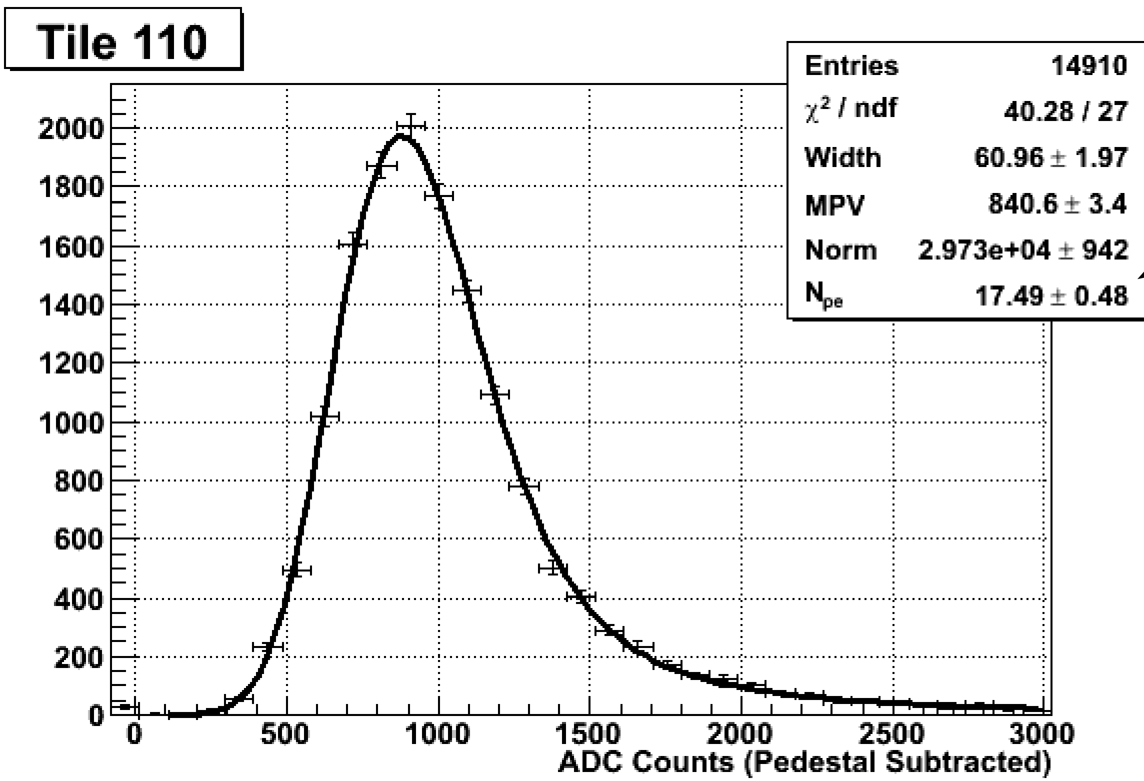
Good light collection uniformity:

Efficiency is reduced within 1 cm of the edge. Efficiency goes linearly from 100% to 90%

This will do for now, however, we can measure this with muons!

3. Poisson fluctuations in the number of photoelectrons

Calibration run:150 GeV protons at normal incidence

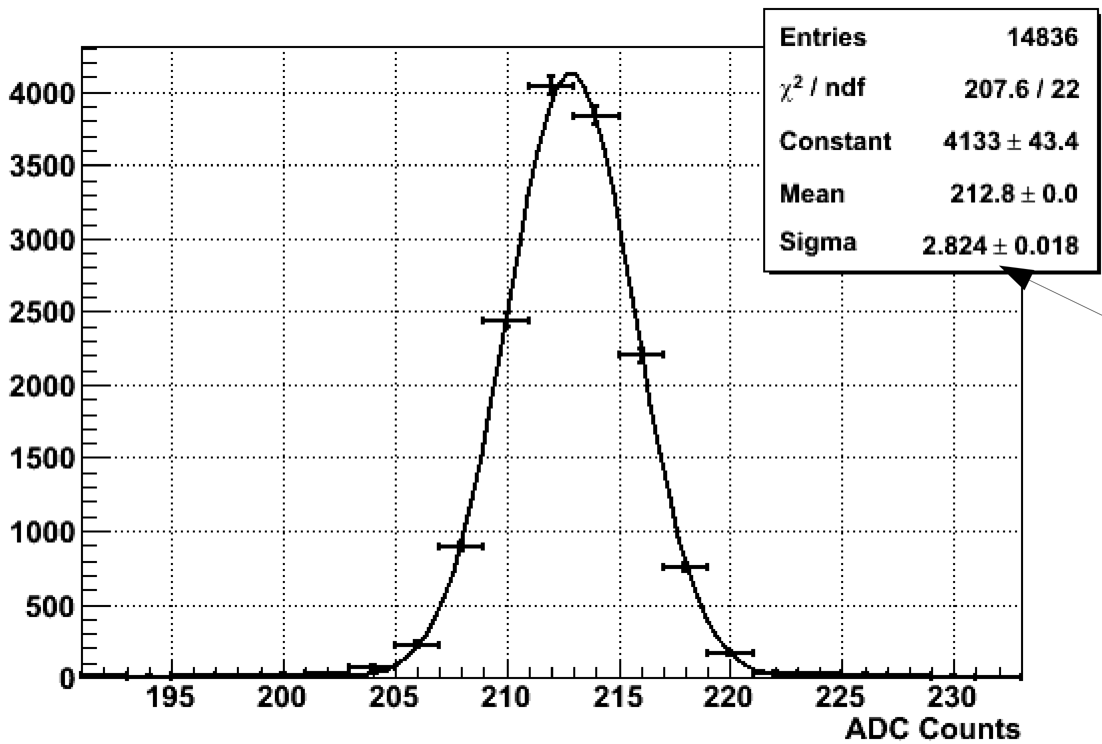


Npe from landau+Poisson fit to MIP peak

Found some issues in the simulation about the way we deal with low number of photoelectrons. Will follow-up with ACD experts (small effect)

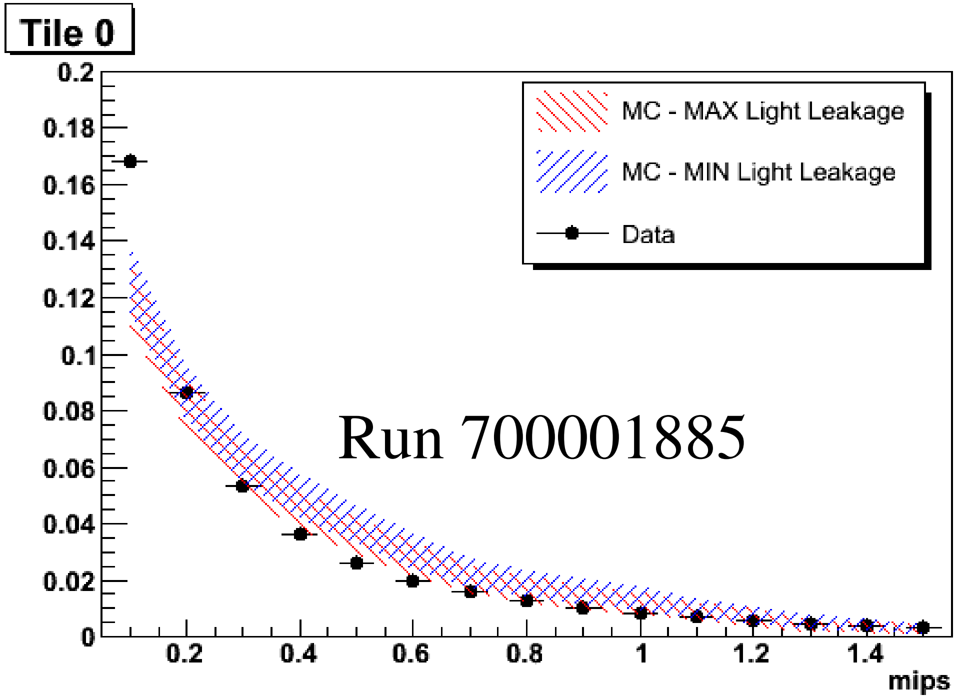
4. Electronics noise

(expected to be low, estimated from pedestal width)



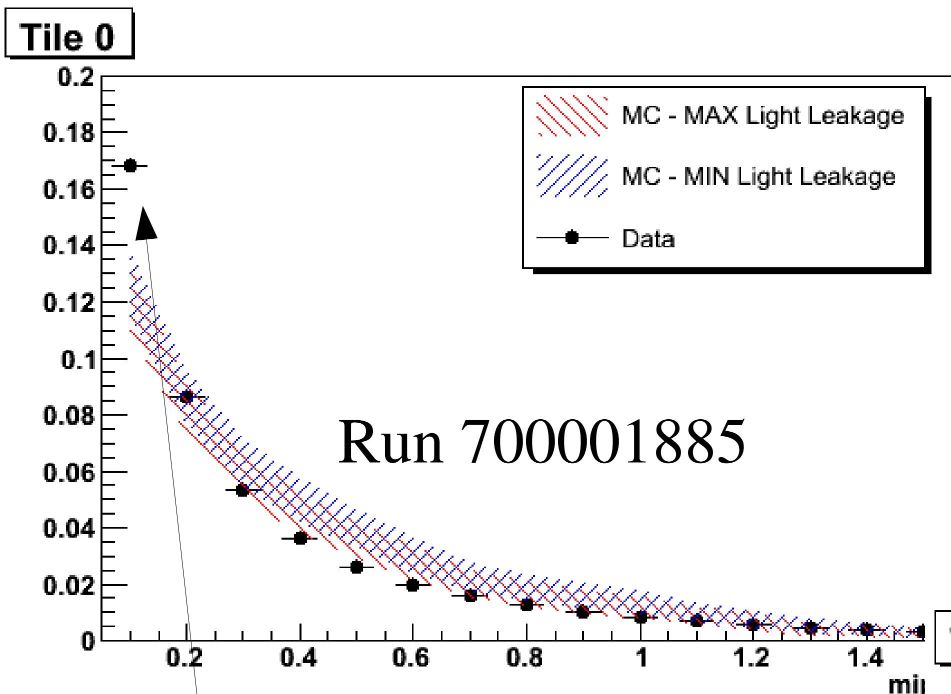
Pedestal width provides an estimate of the electronics noise : (~3x10^-3 mips on average for all tiles) negligible but still simulated

MC vs Data



- Data error bars are statistical (1 sigma)
- MC "bands" are used to bracket the expected backsplash distribution
- The width of each band is given by twice the statistical error (2 sigma) obtained from the simulation

MC vs Data



- Data error bars are statistical (1 sigma)
- MC “bands” are used to bracket the expected backsplash distribution
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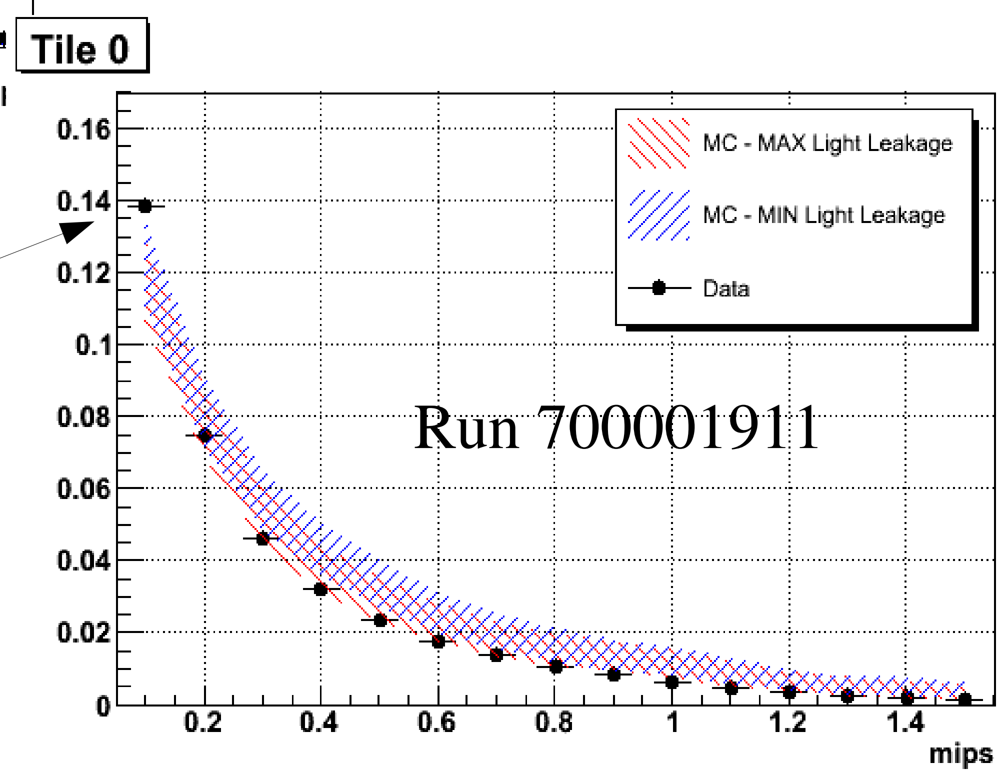
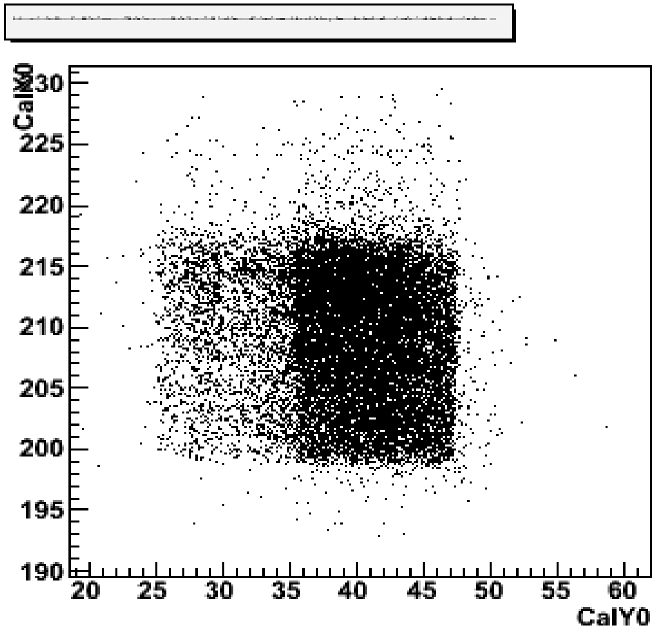
Same energy (200 GeV) and table configuration (center of tower 2, 0 deg)

why the difference?

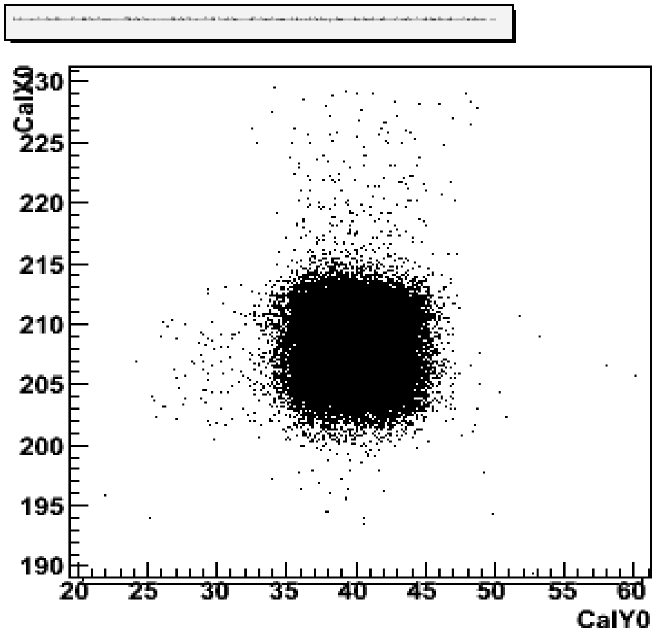


Beam profile:

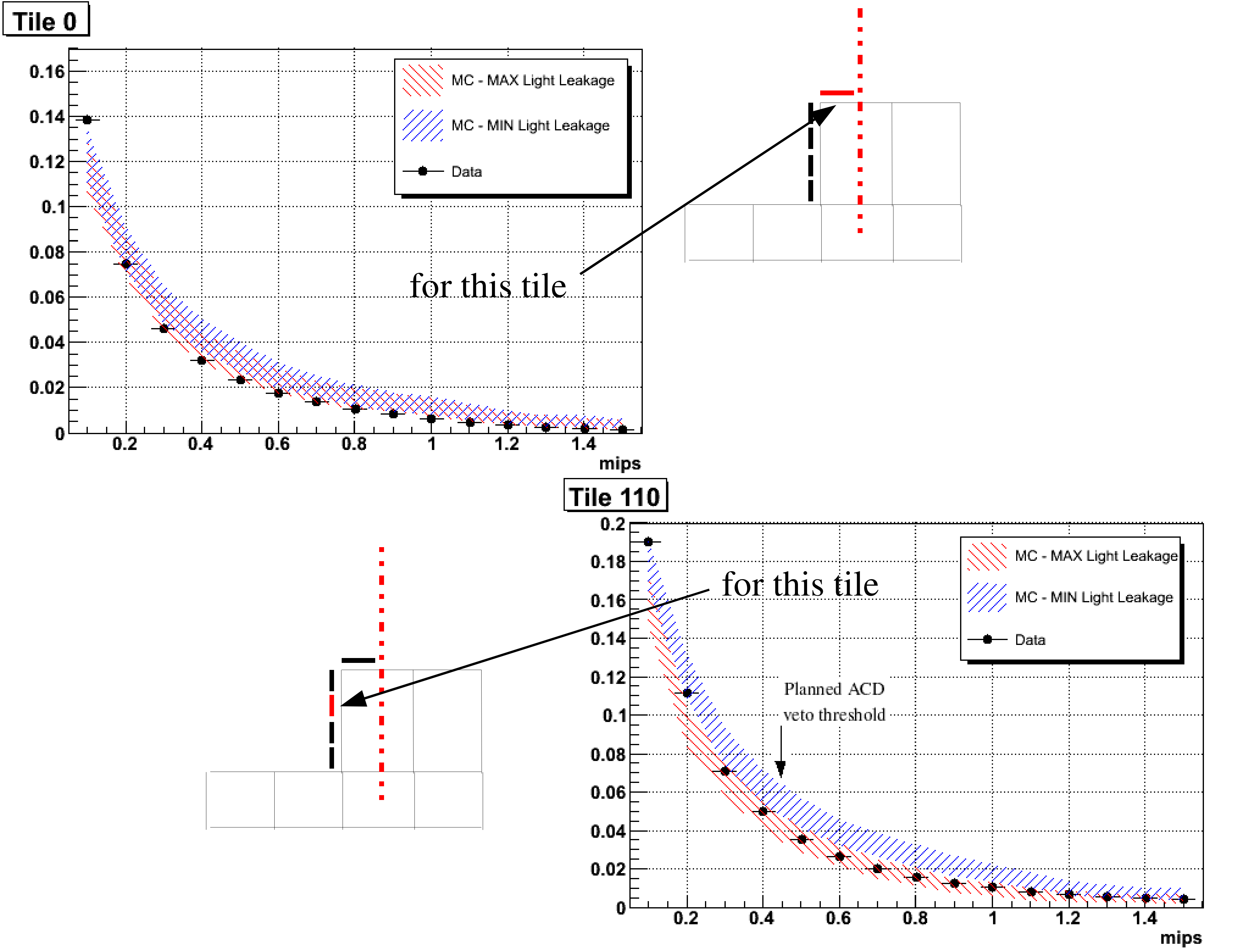
Run 700001885



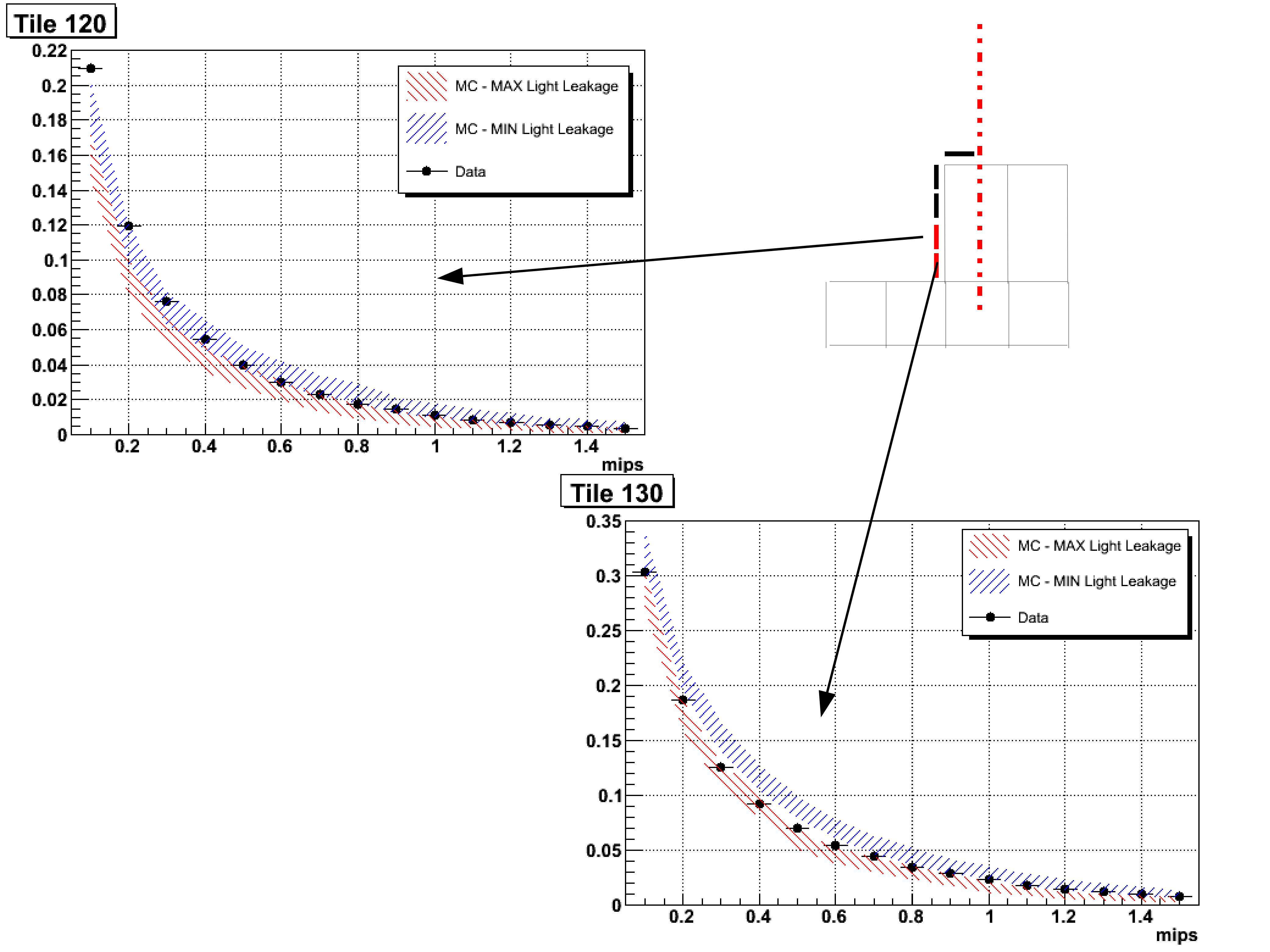
Run 700001911



let's work with the latter one...



Tile 0
MC - MAX Light Leakage
MC - MIN Light Leakage
Data
mips
for this tile
Tile 110
MC - MAX Light Leakage
MC - MIN Light Leakage
Data
Planned ACD
veto threshold
mips
for this tile

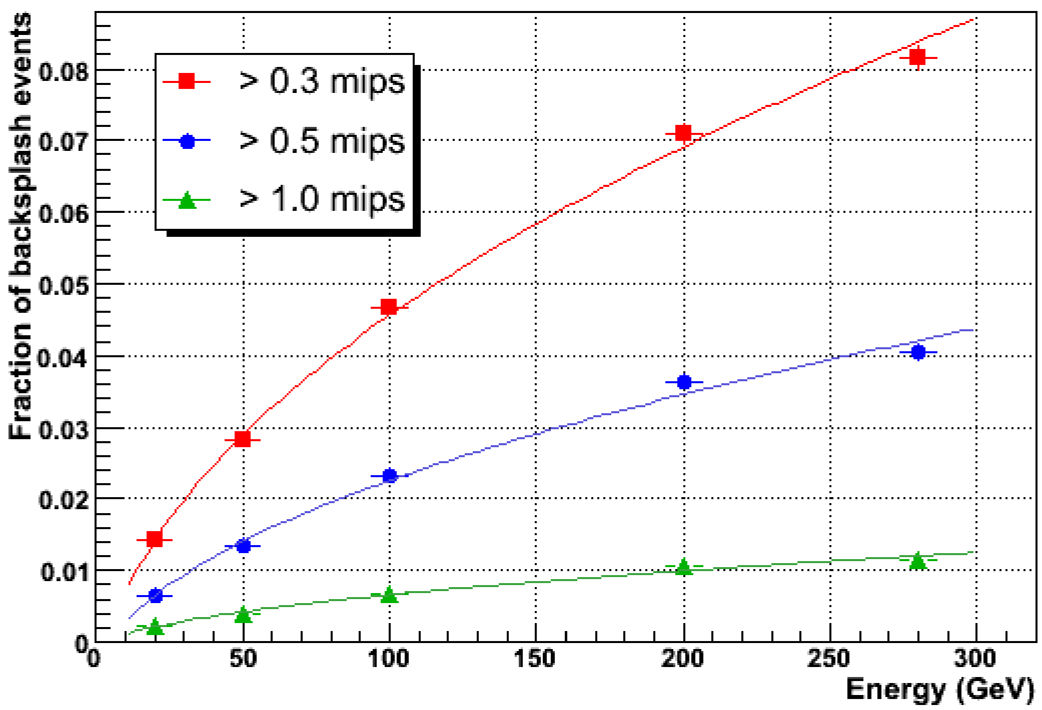


Tile 120
MC - MAX Light Leakage
MC - MIN Light Leakage
Data
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.2
0.4
0.6
0.8
1
1.2
1.4
mips
Tile 130
MC - MAX Light Leakage
MC - MIN Light Leakage
Data
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.2
0.4
0.6
0.8
1
1.2
1.4
mips

MC vs Data: Conclusion

Monte Carlo and data agree within uncertainties. Main uncertainty comes from light collection uniformity, which we don't know. But we can measure it with muons (at least for the top tiles).

Backsplash Characterization: Energy Dependence



Alex found in ACD beamtest of 2002 that backsplash probability is proportional to sqrt(E)...

Corroborated with beam test 2006