



# Calorimeter Commissioning: Preshower/Crack + EM timing

- Steve Kuhlmann, Level-2 Manager
- Joey Huston, Level-3 Manager
- Institutions
  - ◆ Argonne National Laboratory
  - ◆ FNAL
  - ◆ INFN (Pisa, Roma, Trieste/Udine)
  - ◆ JINR (Dubna)
  - ◆ Kyungpook National University
  - ◆ Michigan State University
  - ◆ Rockefeller University
  - ◆ University of Tsukuba

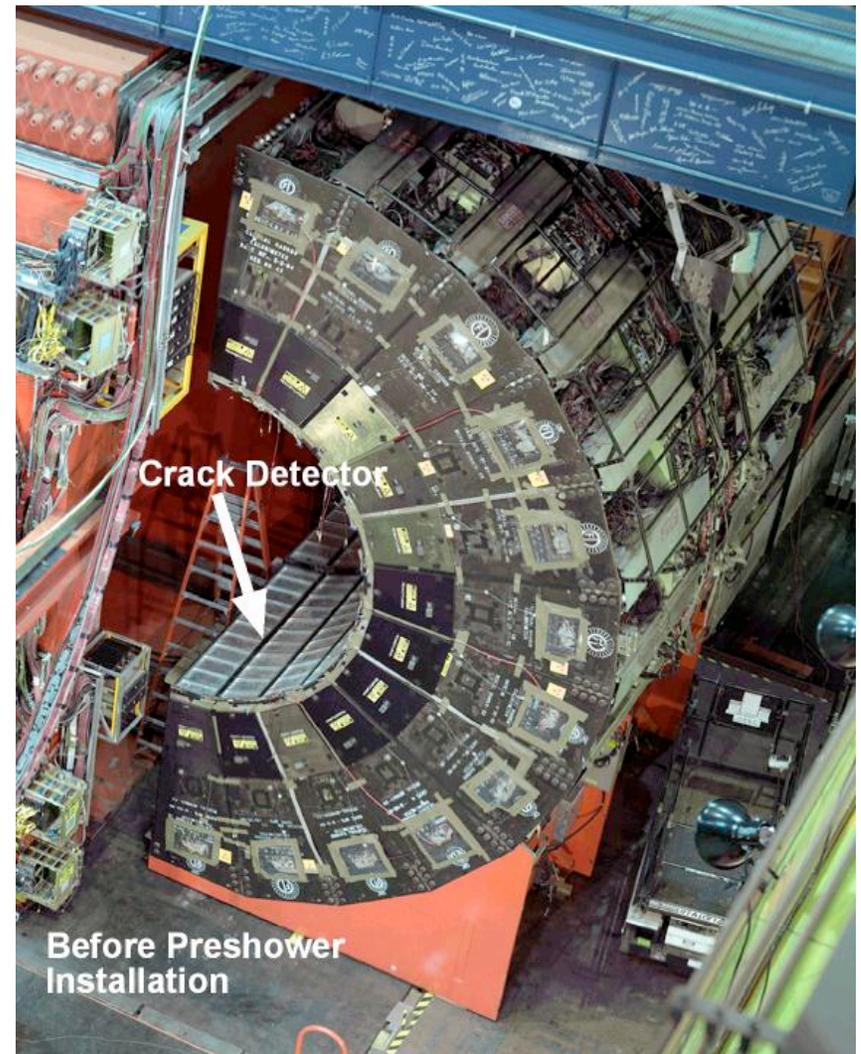
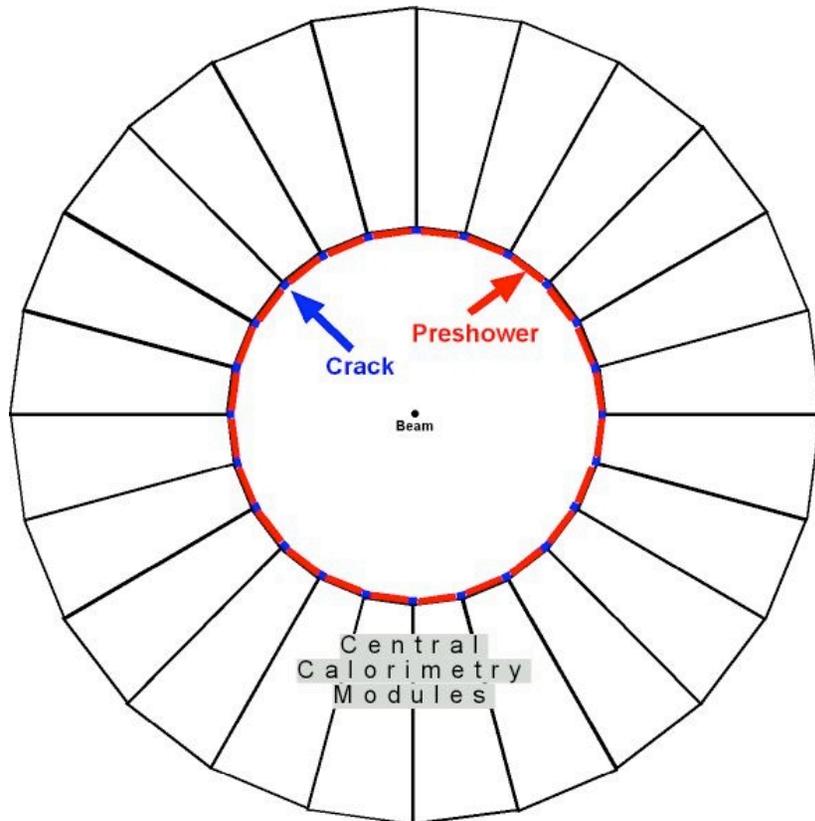
# Director's review



- Steve would normally give this talk but no one seems to have seen him since the detector was closed up

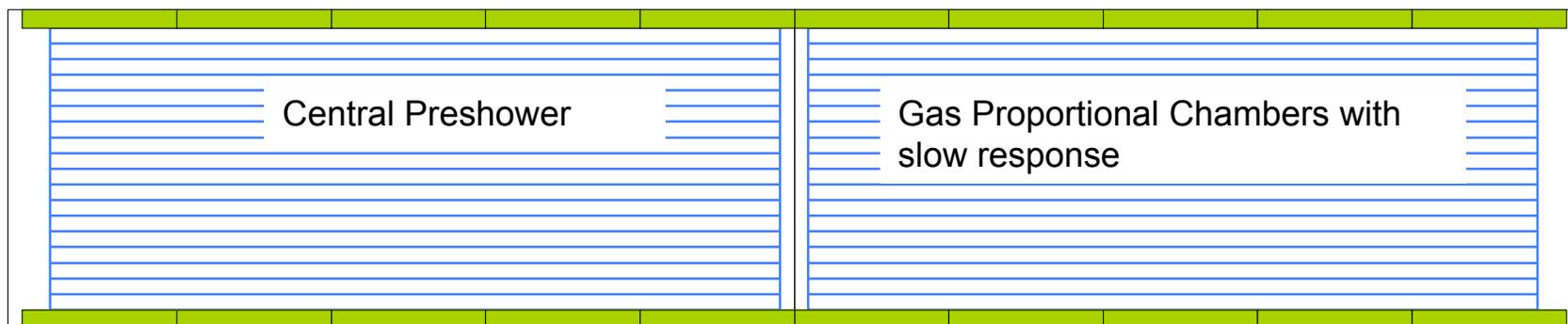


# Preshower/Crack Detectors





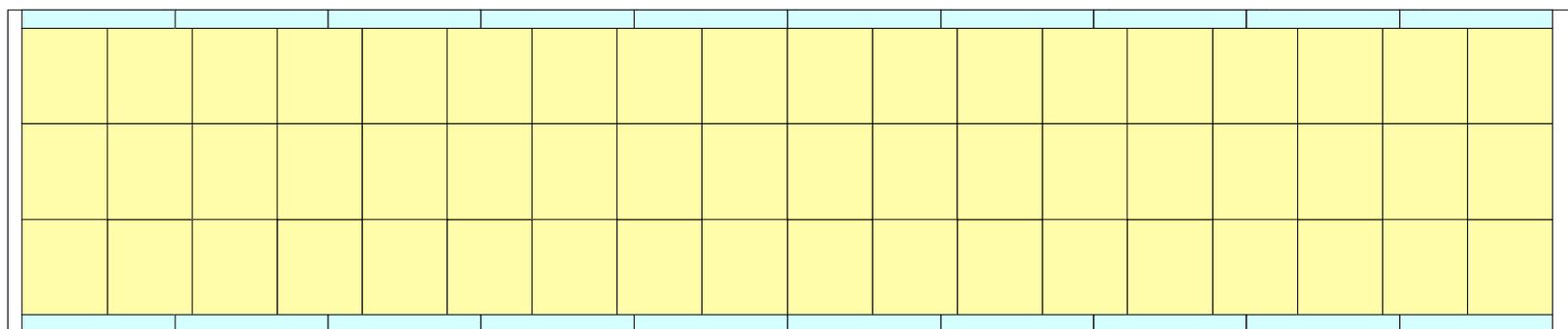
## Previous gas detectors



Central Crack Detectors behind  $8 X_0$   
Tungsten bar

More Gas Proportional Chambers with slow response

## New scintillator pad detectors



# CPR2 Overview

*Preshower Detector (CPR)*

- **24x2 Wedges**

- **Scintillator tiles**

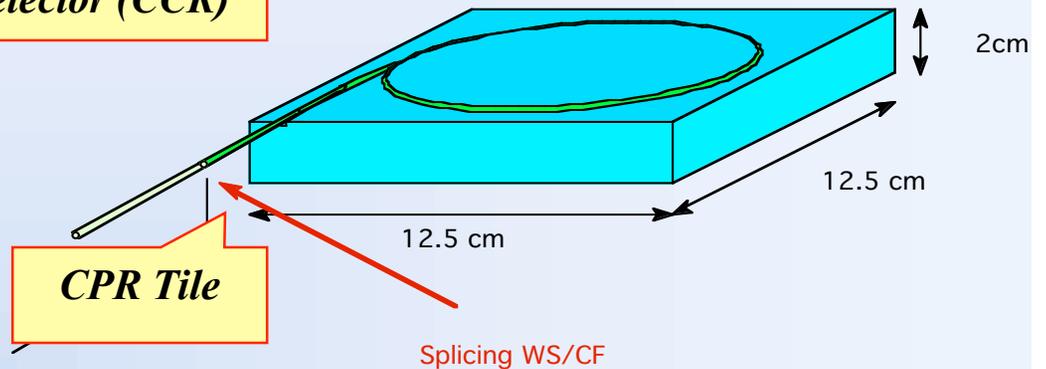
	Wedge	Total
CPR	54	2,592
CCR	10	480

- ◆ Total n. of channels=3,072
- ◆ CPR: 12.5x12.5x2 cm single tile
- ◆ ~ 810 Liters of scintillator
- ◆ CCR: 22.5x5x0.5 cm single tile

- **Photomultipliers**

- ◆ 16 channels per PMT (H6568)
- ◆ 192 HV channels
- ◆ CAEN HV SY527

*Crack Detector (CCR)*

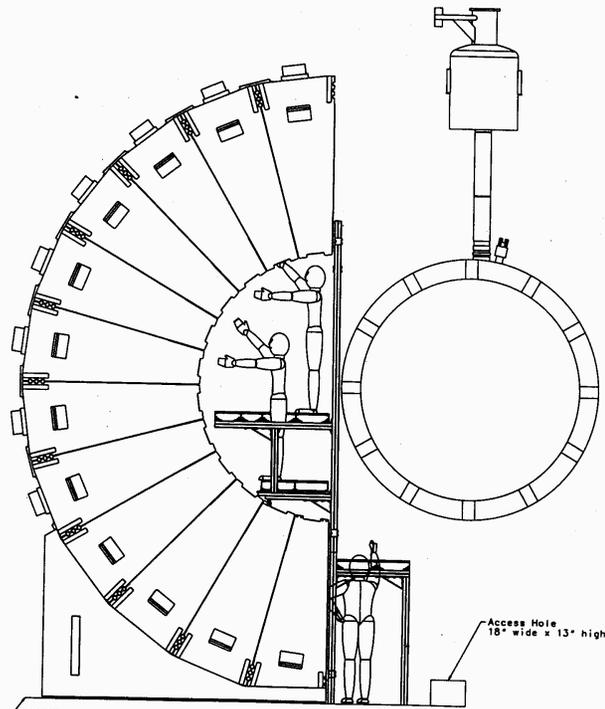


- CPR segmentation =  $2 \times 3$  ( $\eta$ - $\phi$ ) /tower
- 64 channels/wedge, exactly 2 SMD cards per wedge, to reuse present electronics
- WLS fiber into groove, spliced to clear fiber at tile exit, routed to optical connector

# Preshower/Crack Detectors



## Installation configuration



access  
point



# Installation very successful due to group below



- Argonne National Laboratory: Karen Byrum, Jim Grudzinski, SK, Zeljko Matijas, Tim Nephew, Larry Nodulman, Frank Skrzecz, Bob Wagner, Ken Wood.
- FNAL: Dervin Allen's group, Phyllis Deering's group, Eileen Hahn's group, Stefano Moccia + friends, Mike Lindgren, Rob Roser.
- INFN (Pisa, Roma, Trieste/Udine): Maurizio Iori, Stefano Lami, Aldo Penzo, Giovanni Pauletta, Nicola Turini, + many techs.
- JINR (Dubna): Akram Artikov, Julian Budagov, Guram Chlachidze, Davit Chokheli.
- Kyungpook National University: Sunghyun Chang, Minsuk Kim, Jun Suh.
- Michigan State University: Carl Bromberg, Joey Huston, Bob Miller, Mike Nila, Ron Richards.
- Purdue University: Else Lytken.
- Rockefeller University: Stefano Lami, Michele Gallinaro.
- University of Tsukuba: Fumi Ukegawa.
- Many Cable Shift helpers

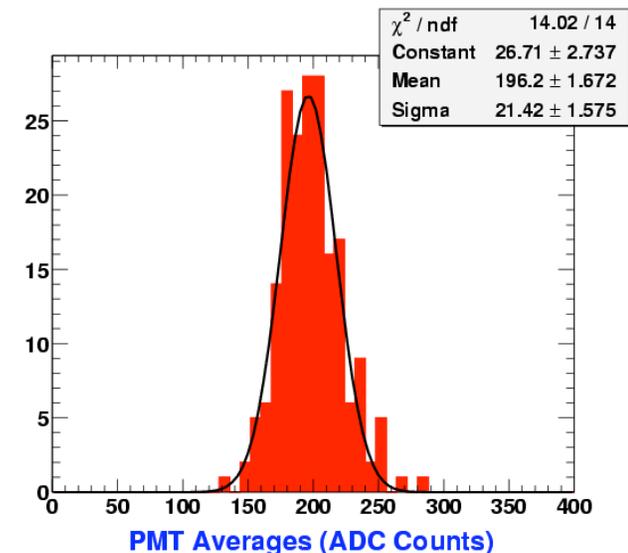
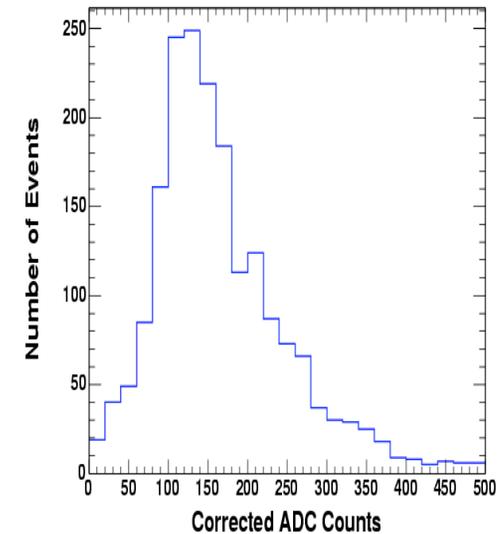
# Preshower pulse heights from cosmic ray data



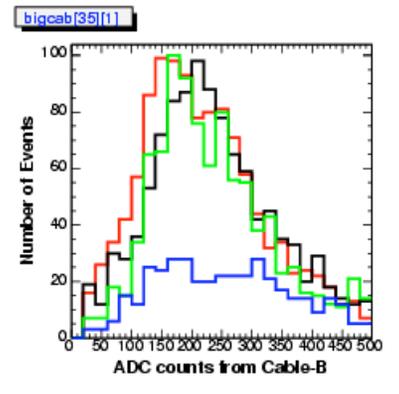
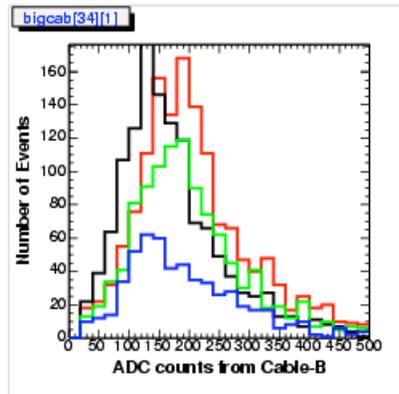
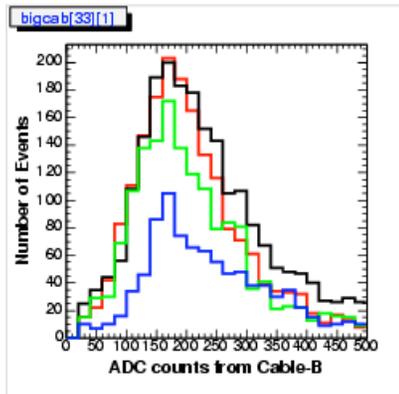
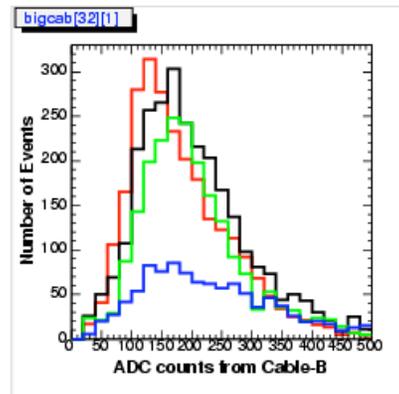
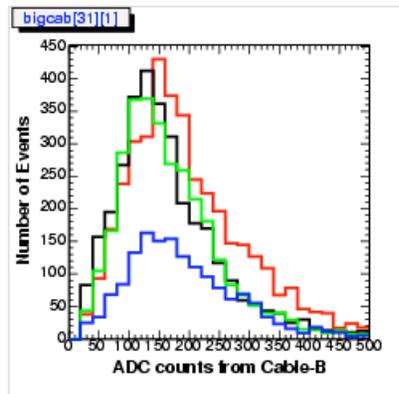
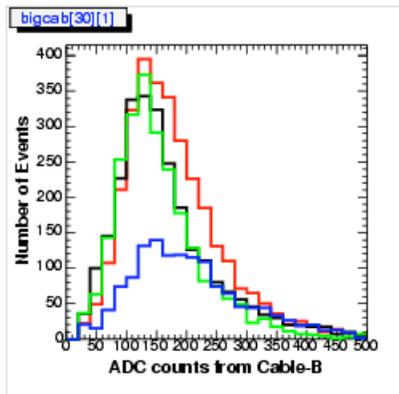
**Pulse height distribution  
from cosmic ray data  
from 54 tiles in top wedge.**

**10 counts = 1 pe/MIP with  
PMT gain of 1E6, light  
yield well above spec of 5  
pe/MIP.**

**Complete list of phototube and  
tile gains applied, 10.9% width.**



# Cosmic ray data on 6 wedges



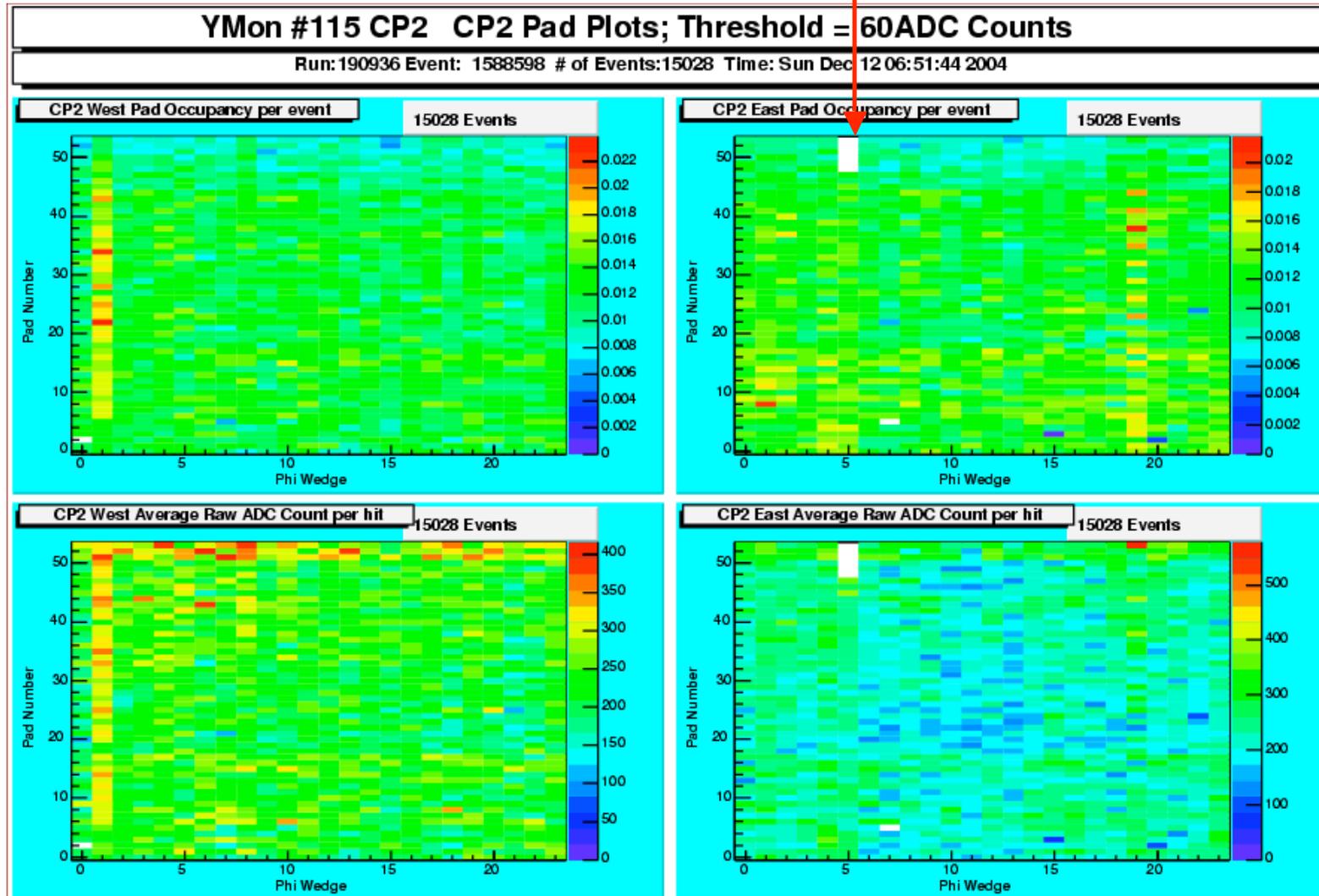
4 color  
= 4 different  
cables per  
wedge

# Now onto collision data (min bias)



99.7% alive

chimney



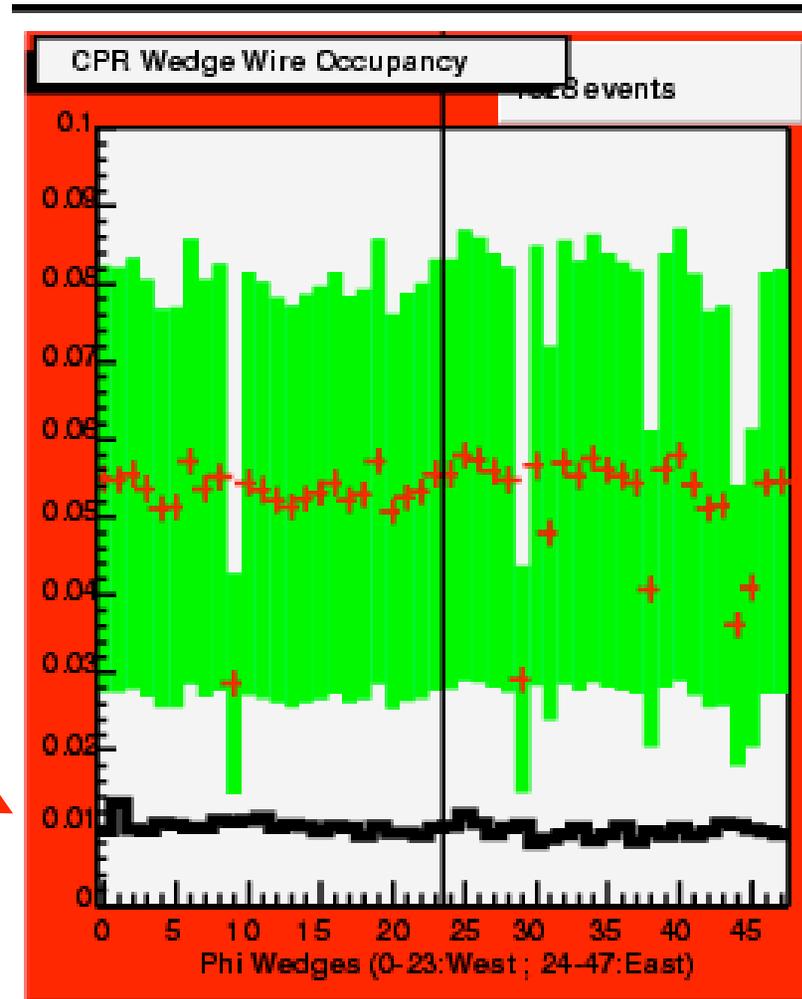
de Review

# Preshower Occupancy



Reference based  
on old detector

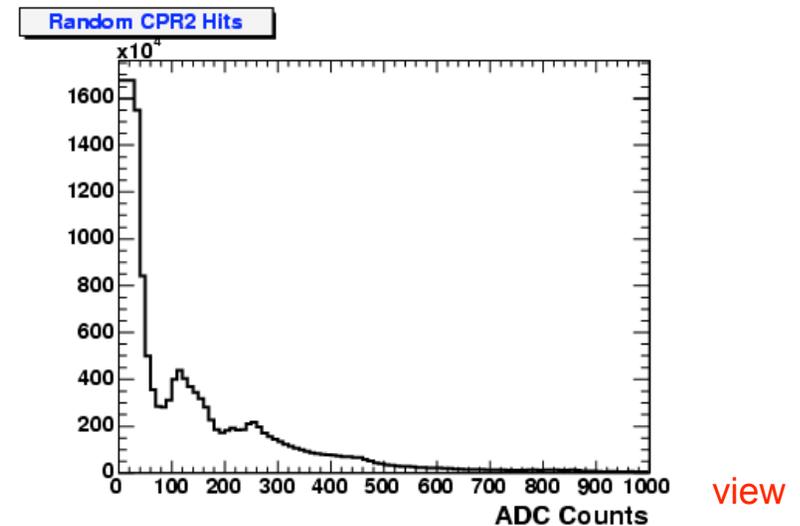
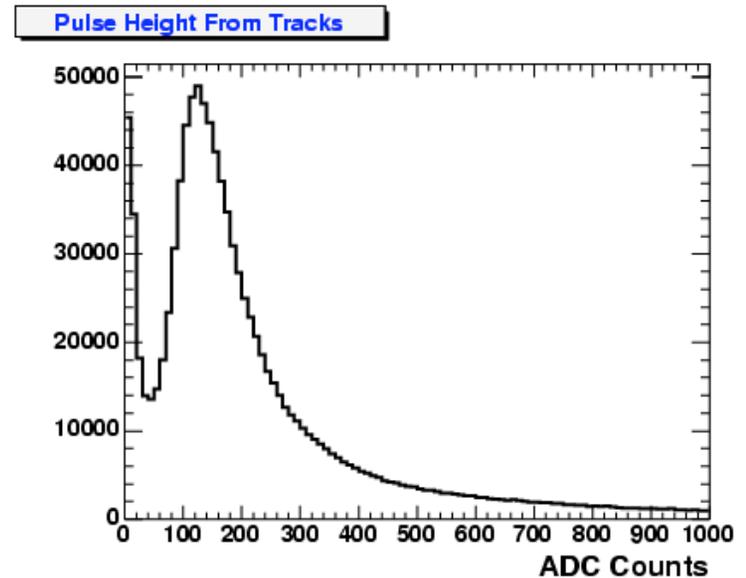
New detector, far fewer hits  
from minimum bias particles



# Collision data



- Extrapolating  $>1$  GeV L3 tracks from look area files to all CPR2 pads.
- Observe a nice MIP peak using test-stand calibrations, peak is at same place as cosmics.
- Hints of 2 and 3 mip peaks in random hits

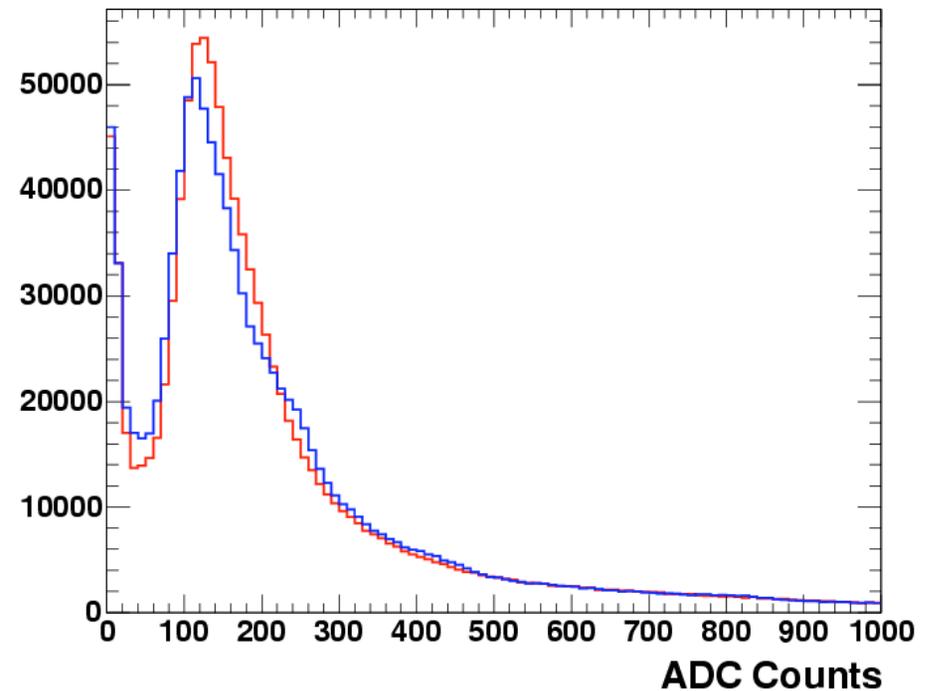


# Pulse heights



- Blue is “raw” (phototube HVs are still set to equalize overall gain, but no channel-channel corrections). Red is with channel-channel corrections from MIPs.

Pulse Height From Tracks



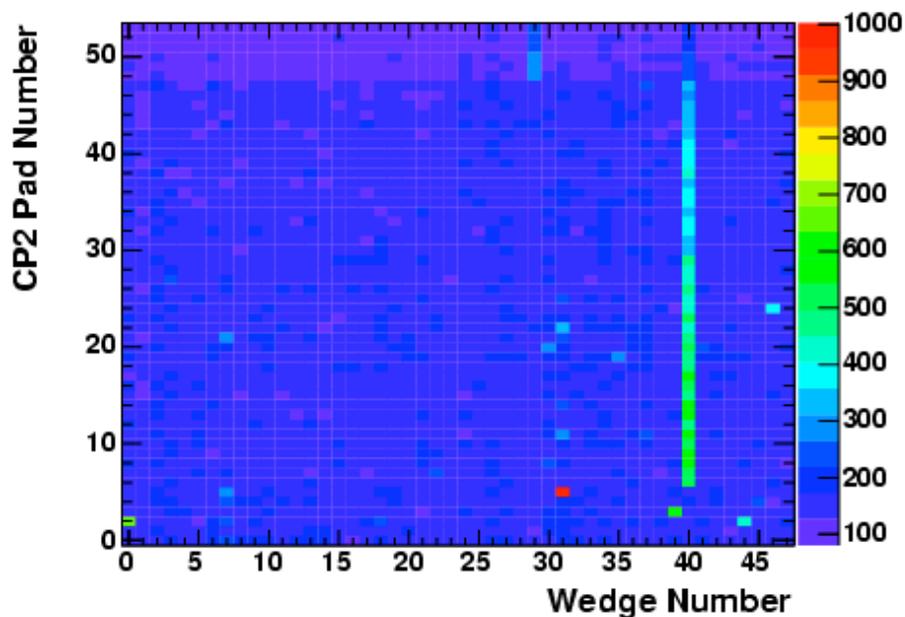
# Collision data: Tracks giving zero pulse height



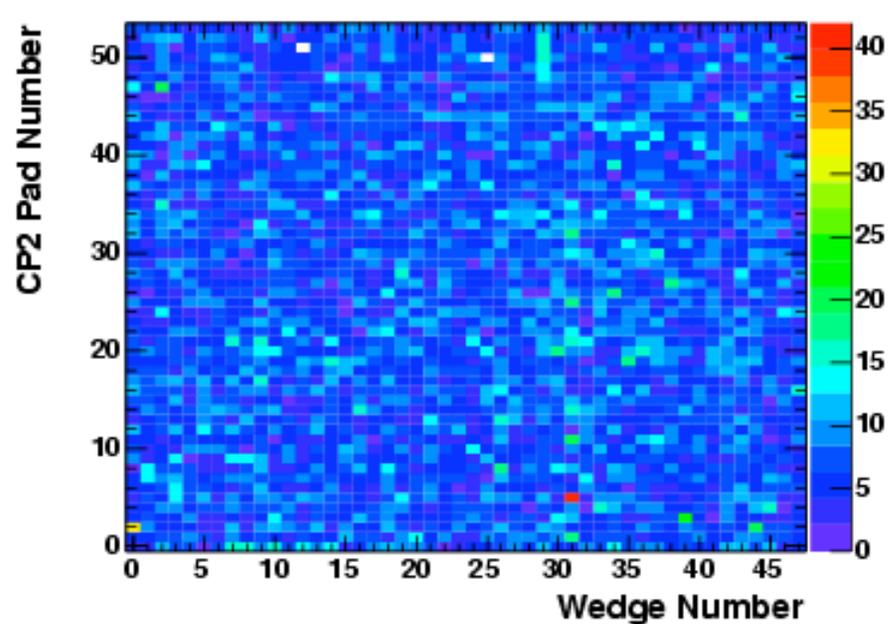
Cable swap in 16East

After swap is fixed in software

Channels with Zero Pulse Height from a Track



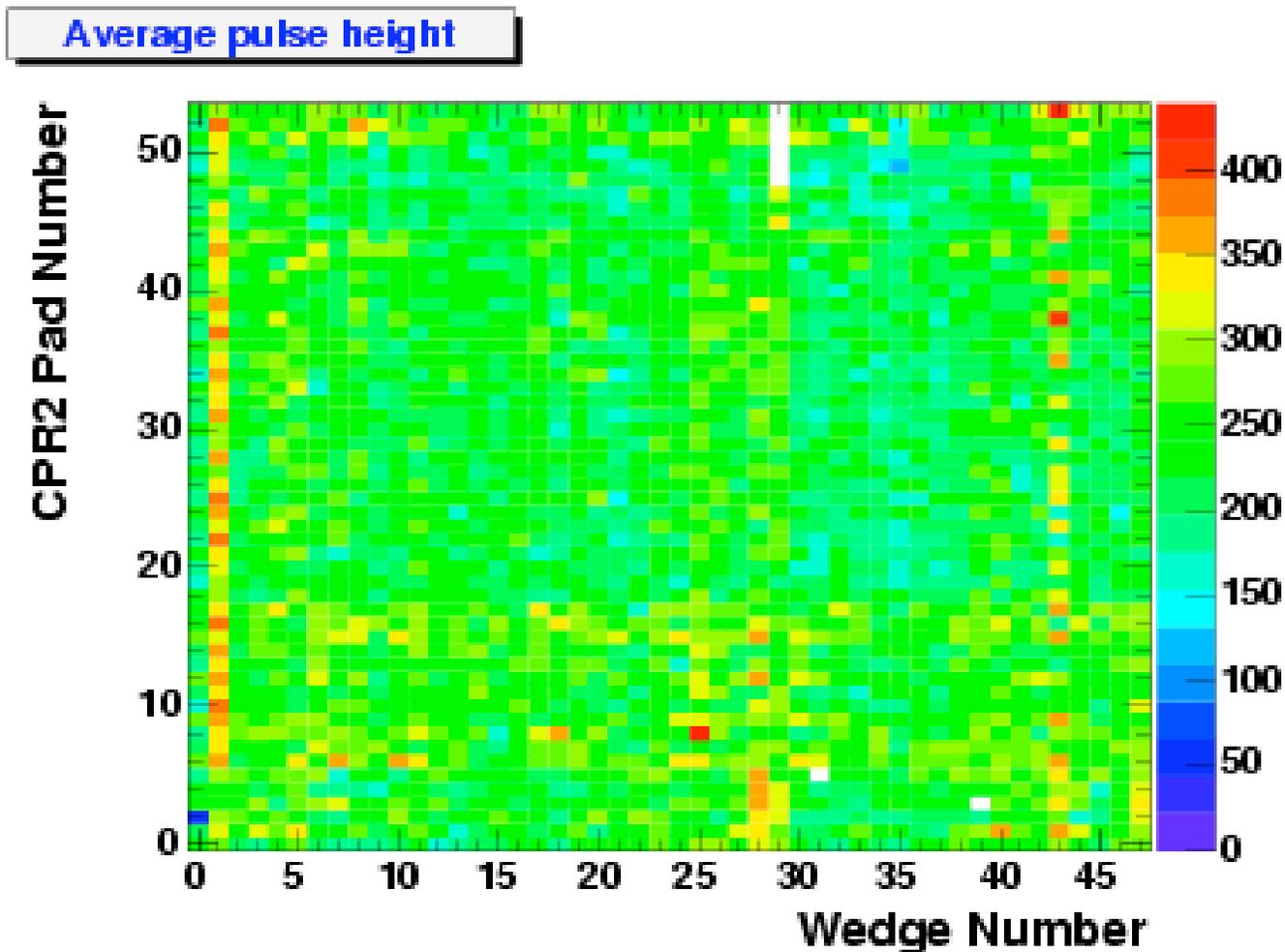
Channels with Zero Pulse Height from a Track



# Truncated means from extrapolated tracks



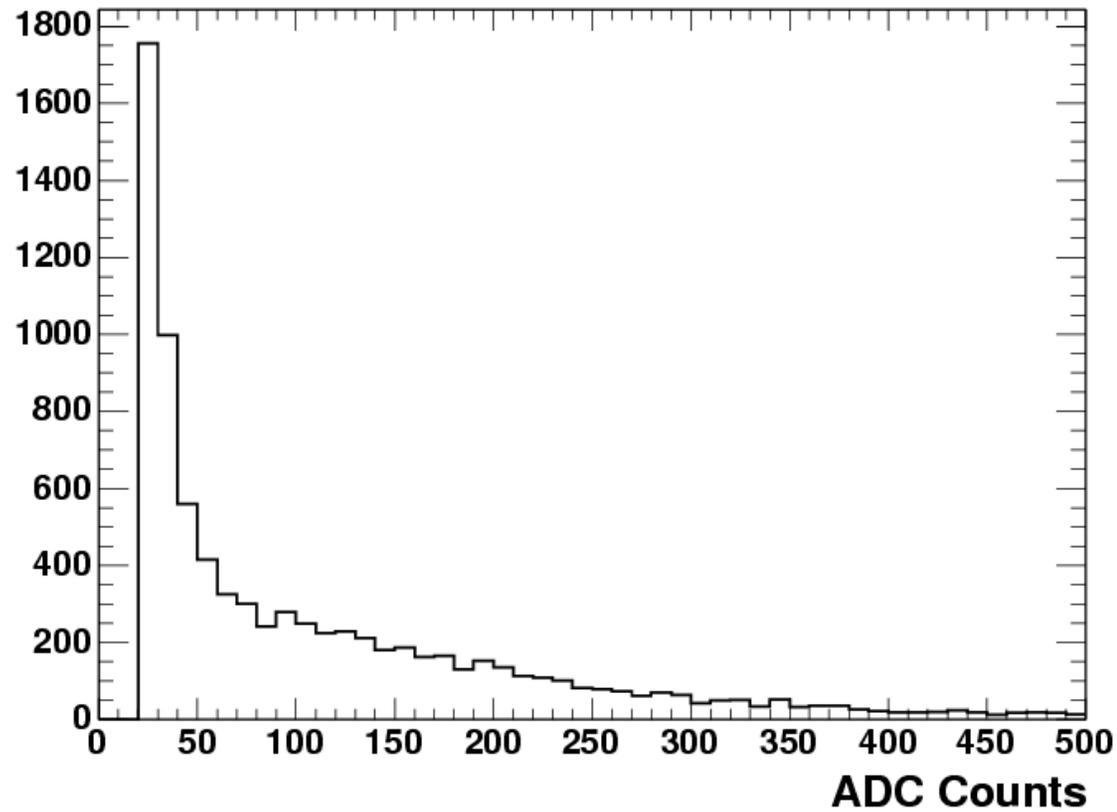
Besides the chimney module, only 2 channels with no hits from tracks.



# Min bias data



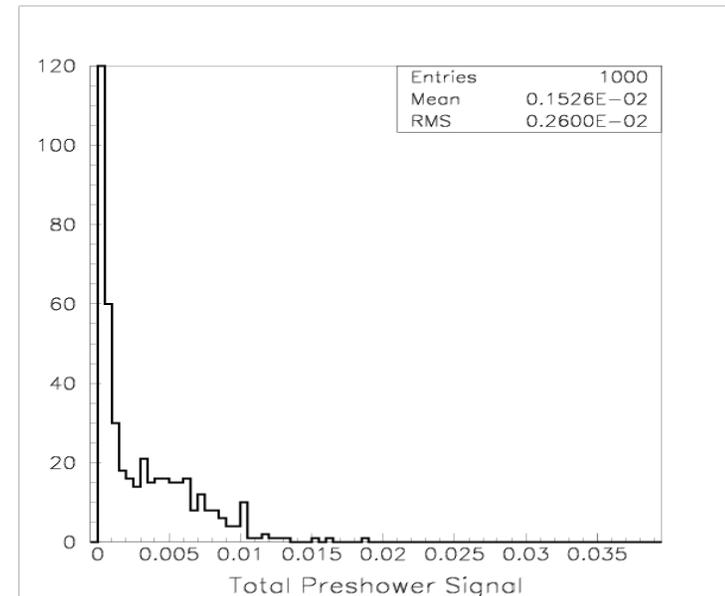
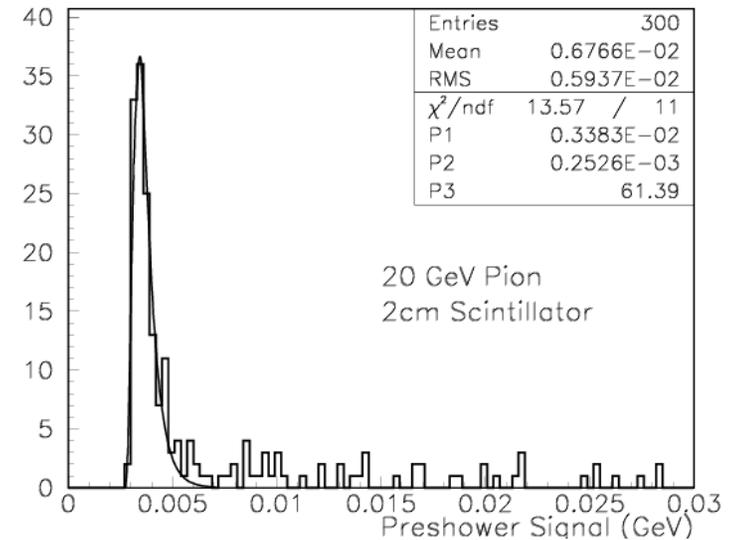
< 1 MIP hits just like old CPR



# GEANT study



- Geant study of low energy photon response in preshower.
- On top is MIP distribution from 20 GeV pions.
- On bottom are 50 MeV photons. Many  $<1$  MIP photons, presumably from low energy electrons from conversions being absorbed in tiles.

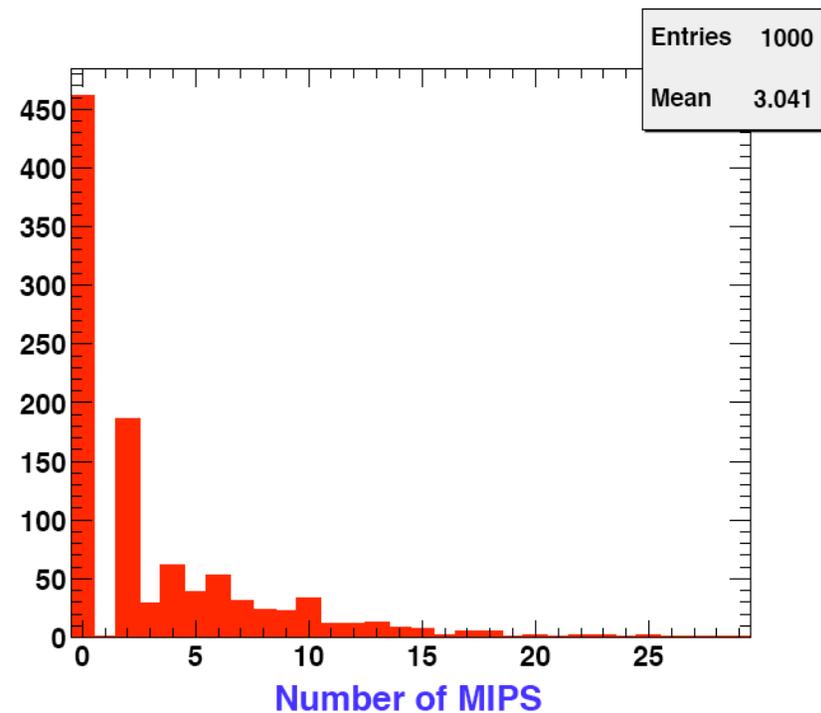


view

# CPR photon analyses



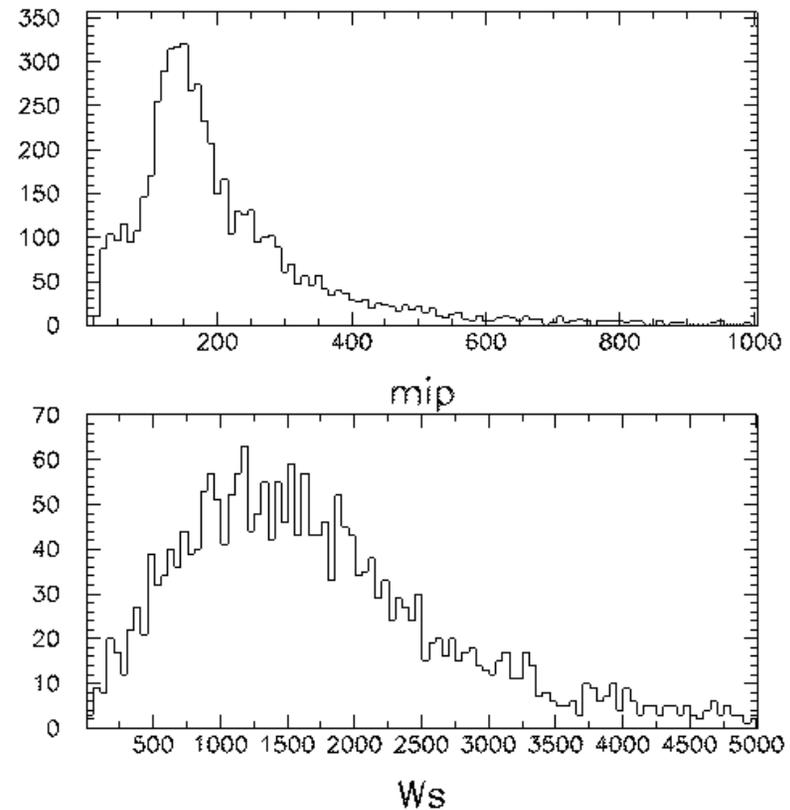
- # of mips expected for 35 GeV photons (lower cutoff for use of CPR in photon analyses)



# W->ev



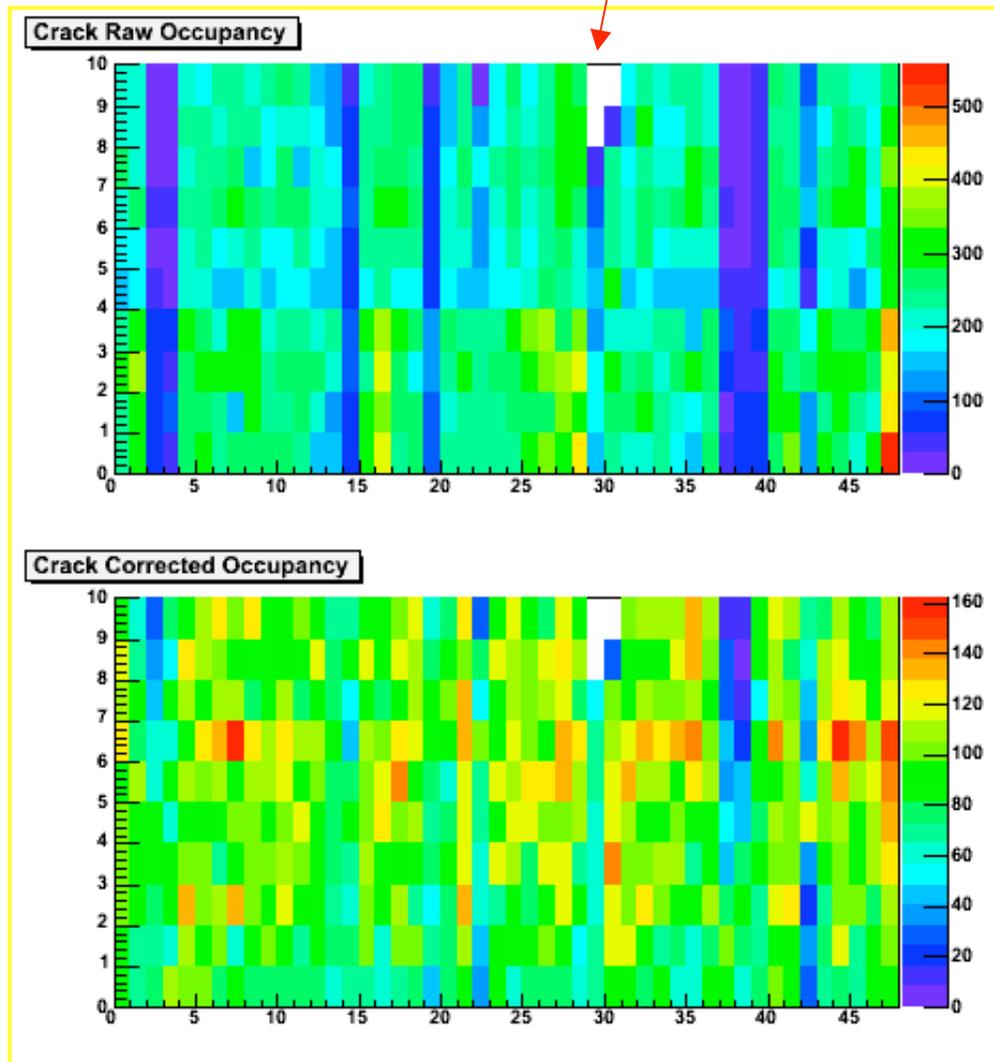
- Top plot shows pulse height in counts for mips which are fake electrons
- Bottom plot shows W electrons



# Crack occupancy



chimney



...still investigating purple spots around wedge 37

don't know about saturation in CCR yet

# Spares/contingency

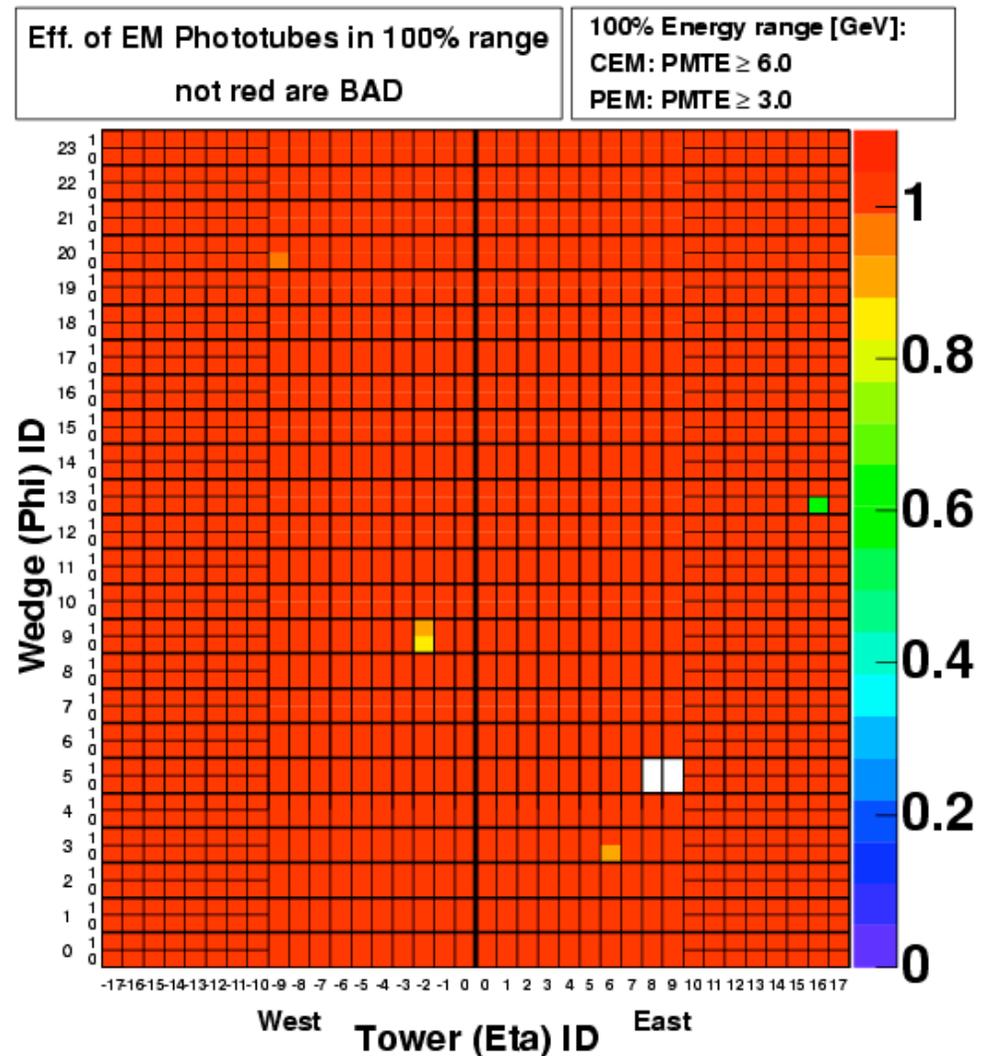


- We have ~5 spare CPR modules
  - ◆ 3 good ones plus one with a bad tile plus a chimney module spare
- We have 20% spare PMT's
- We are finishing 5 spare PMT boxes and >1/2 arch worth of spare optical cables
  - ◆ finishing optical fiber on hand
- Overall project spent 15% of contingency

# EM Timing



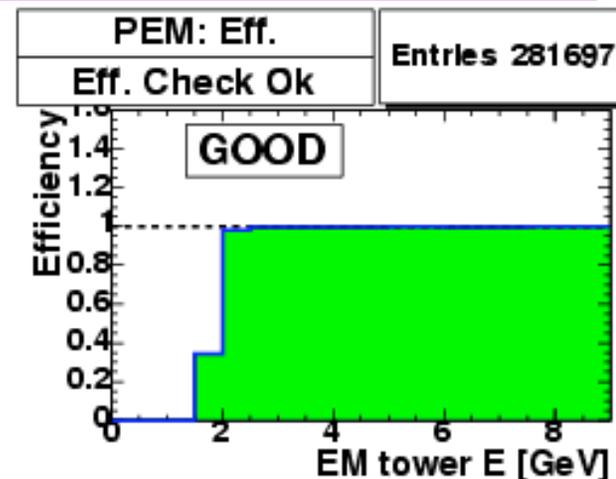
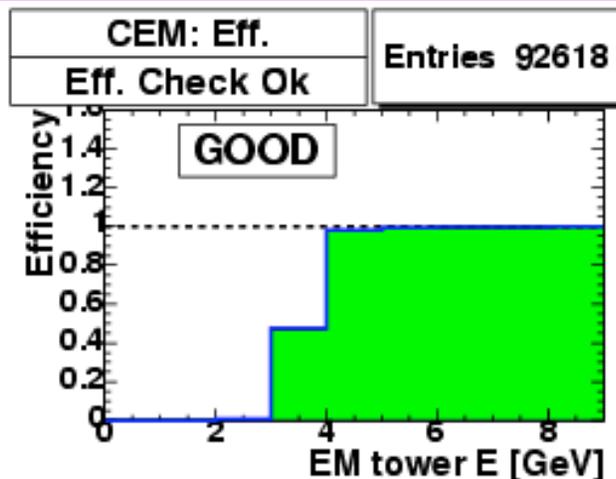
- The rest of the EM-Timing system was installed this fall
- Full system has 956 CEM channels, and 768 PEM PMT's instrumented.
- All but 3 are fully functional
  - ◆ to be fixed next access
  - ◆ fully efficient, but at larger energy threshold
- Timing resolution is  $\sim 1$  nsec



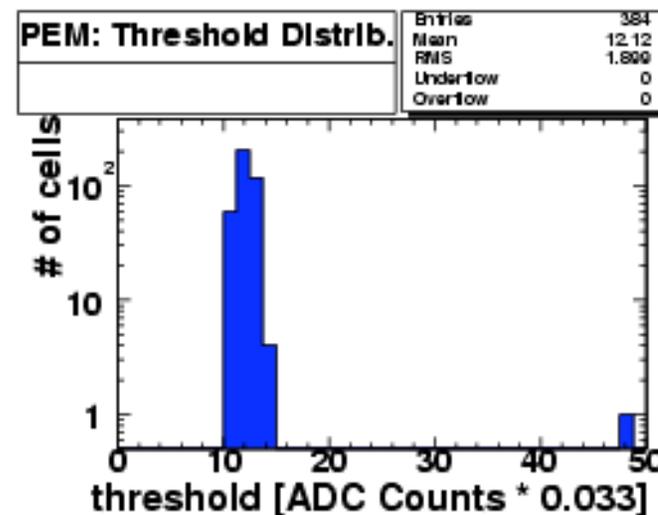
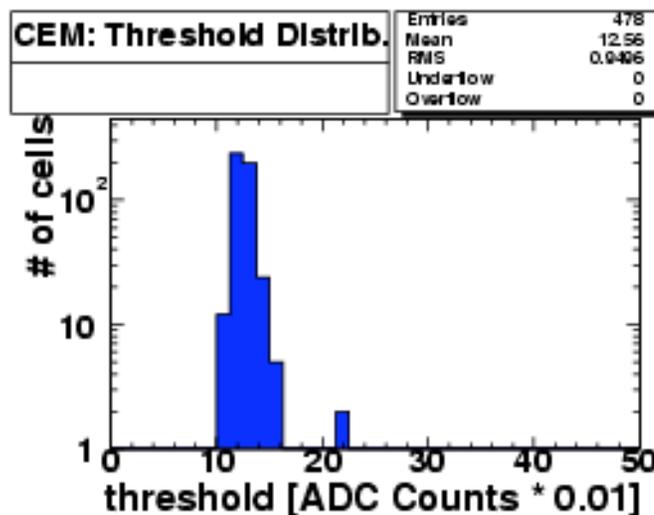


# EMTiming Continued...

- Efficiency vs. Tower energy for CEM and PEM.
- Fully efficient at 6 GeV and 3 GeV respectively



- Histogram of thresholds in ADC counts
- System is very uniform
- The single towers on the tails reflect the three known problem channels.



# Summary



- CPR/CCR are both working well
  - ◆ they have been included in on-line monitoring
  - ◆ are in the process of being built into standard offline production
- EM Timing is “functioning beautifully”
- Study/calibration ongoing; physics to follow