

# Cosmic Rays @ the Near Detector

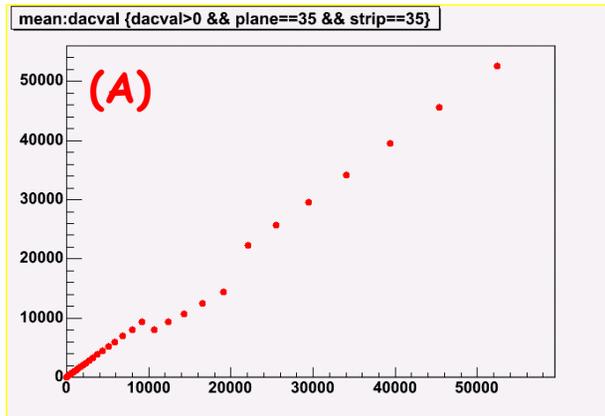
N. Saoulidou, Fermilab

# Outline

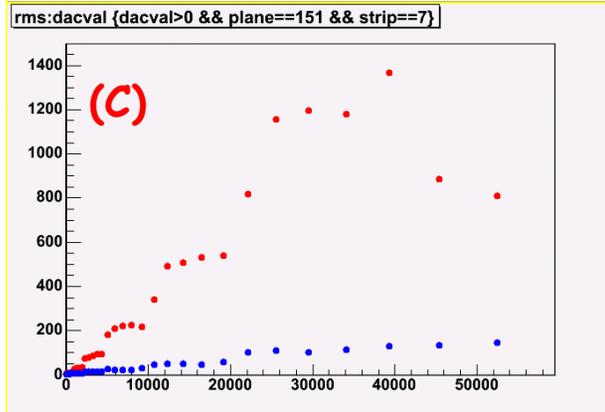
- Electronics Status
  - - Calibration Checks
    - Pedestals
- Track characteristics
  - Reconstruction efficiency
  - Residuals (U and V)
  - Plane efficiency
  - Pulse height
  - Rate
- Strip & Plane occupancy
- Pathologies
- Summary On-going work

# Near Check Cal. (Runs : 3377 3379)

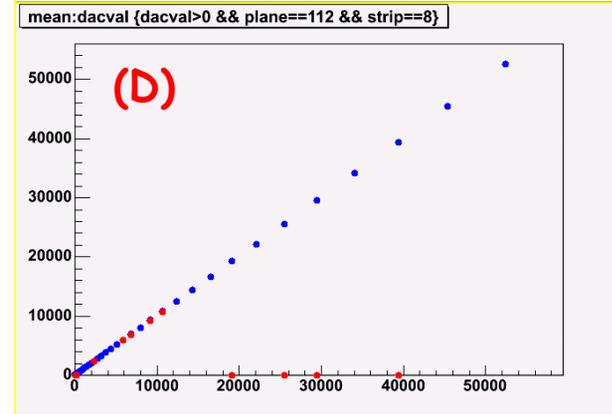
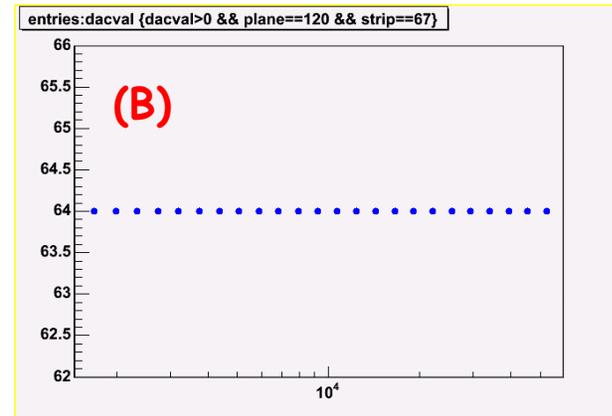
Mean vs DAC value



RMS vs Mean



Mean vs DAC value Entries vs DAC value



Blue : normal channel

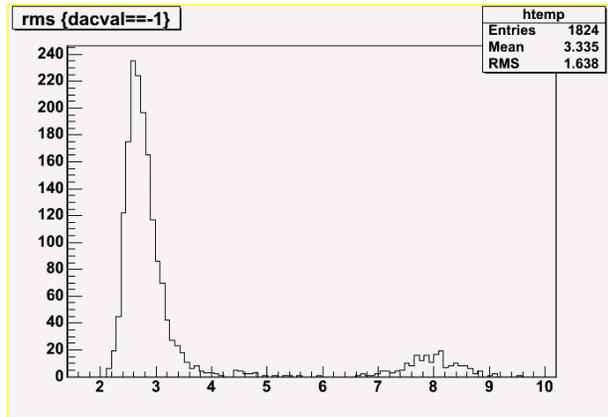
Red : problematic channel

- There is a relatively large number of electronics channels that show various pathologies like :

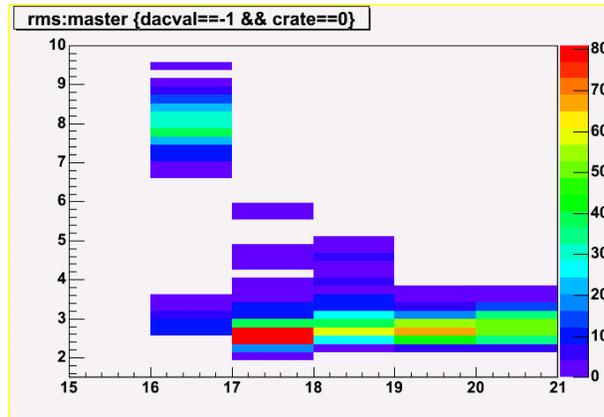
- (A) Wrong calibration constants (B) Missing data points (3/4 CAPIDs missing)

- (C) Large RMSs (D) Missing data points in the MEAN vs DACVALUE distribution

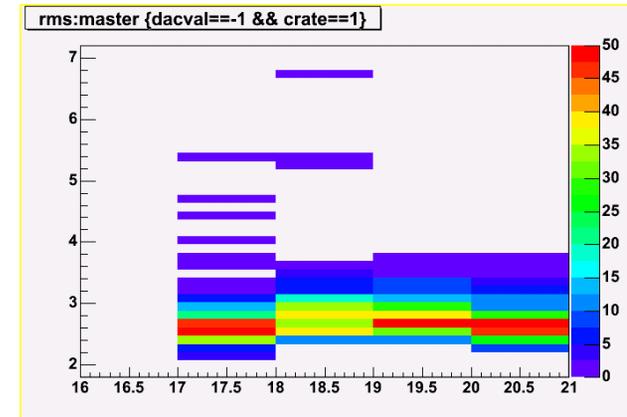
# Pedestals (Run : 3304)



Pedestal RMS  
(spectrometer)



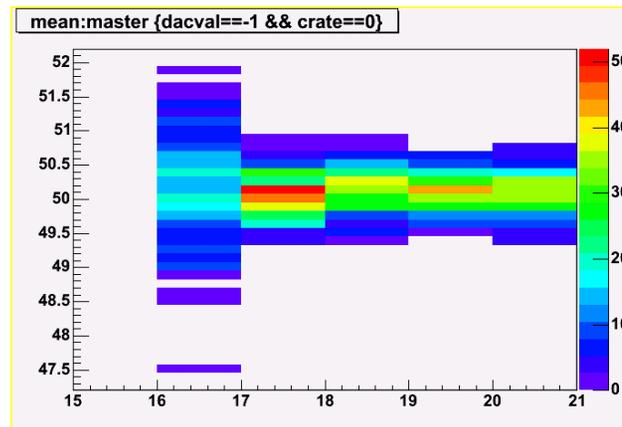
Pedestal RMS vs Master Slot  
crate 0 (spectrometer)



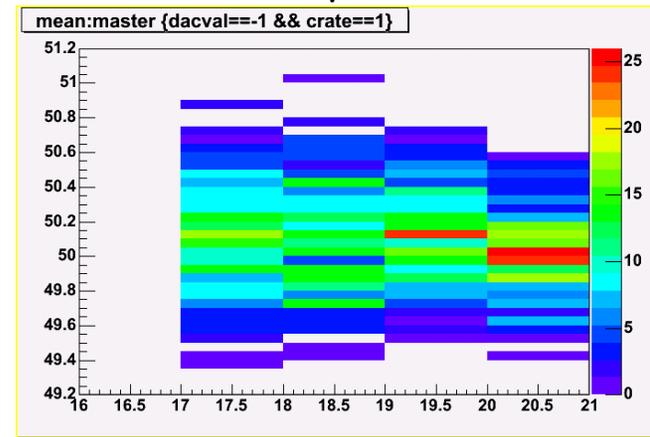
Pedestal RMS vs Master Slot  
crate 1 (spectrometer)

- Pedestals for crate 0 master slot 16 show large RMSs (pedestal fluctuating) with the MEAN being practically unchanged

- All these problems have been documented in the CRL (electronics problems) and the JIRA ND database.

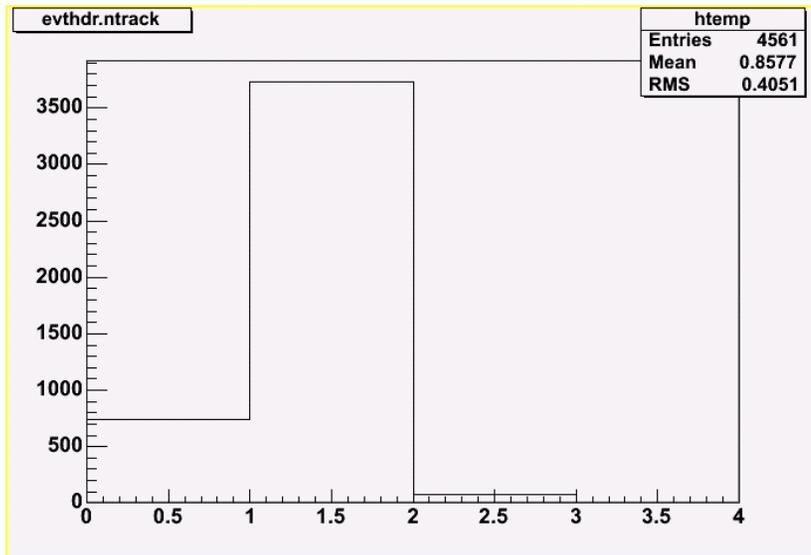


Pedestal MEAN vs Master Slot  
crate 0 (spectrometer)

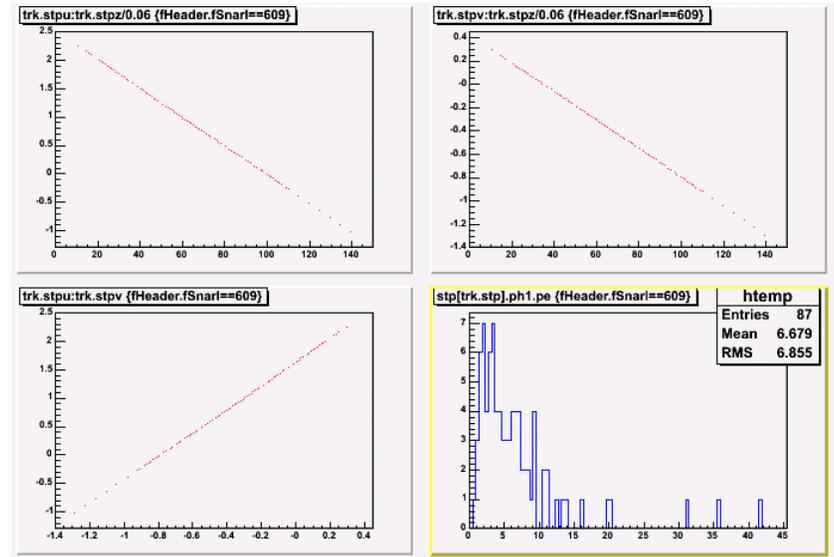


Pedestal MEAN vs Master Slot  
crate 1 (spectrometer)

# Cosmic Run (Run : 3303 10/12 trigger)

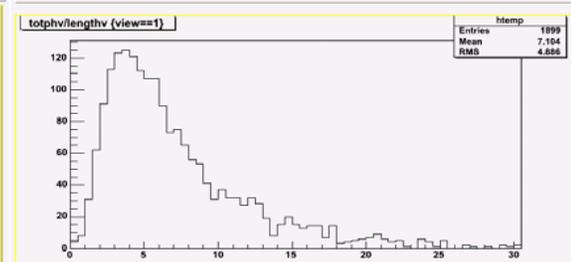
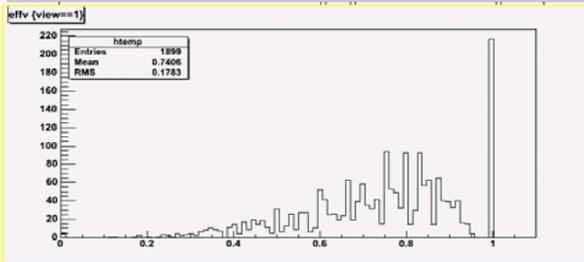
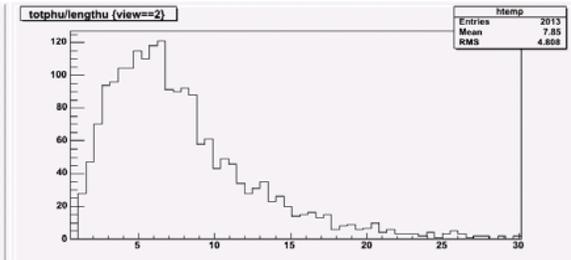
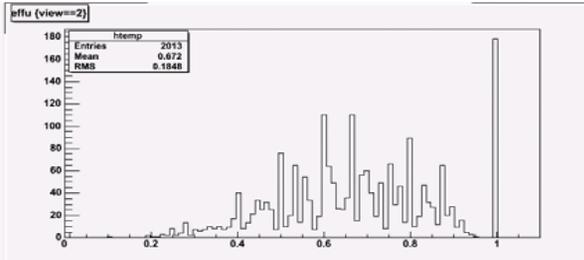
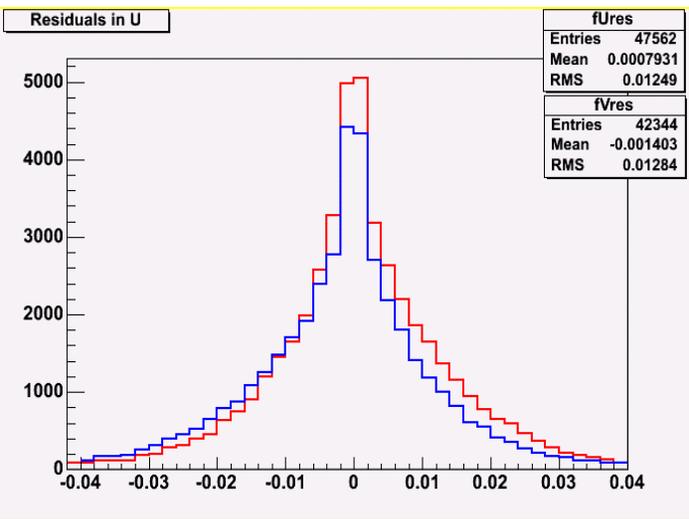


Tracks per event



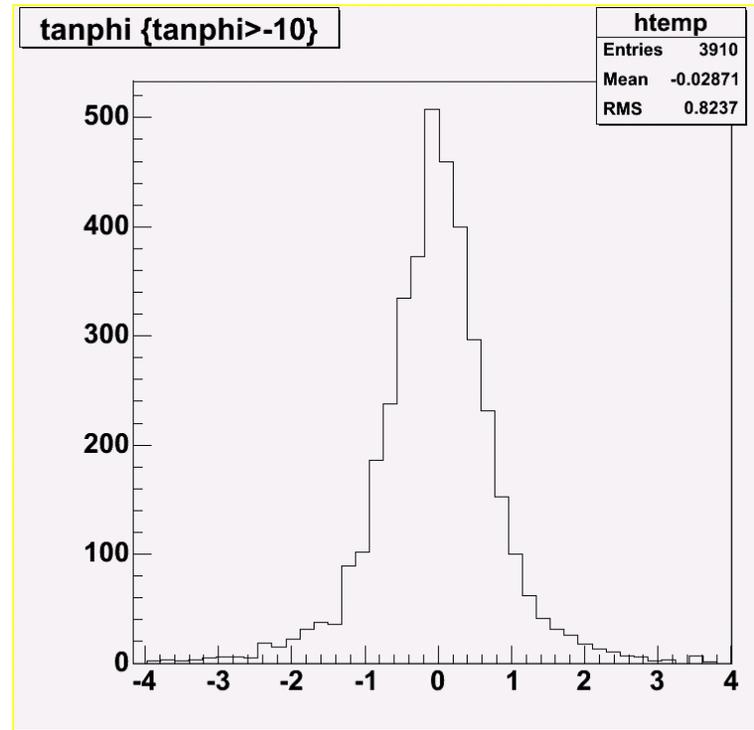
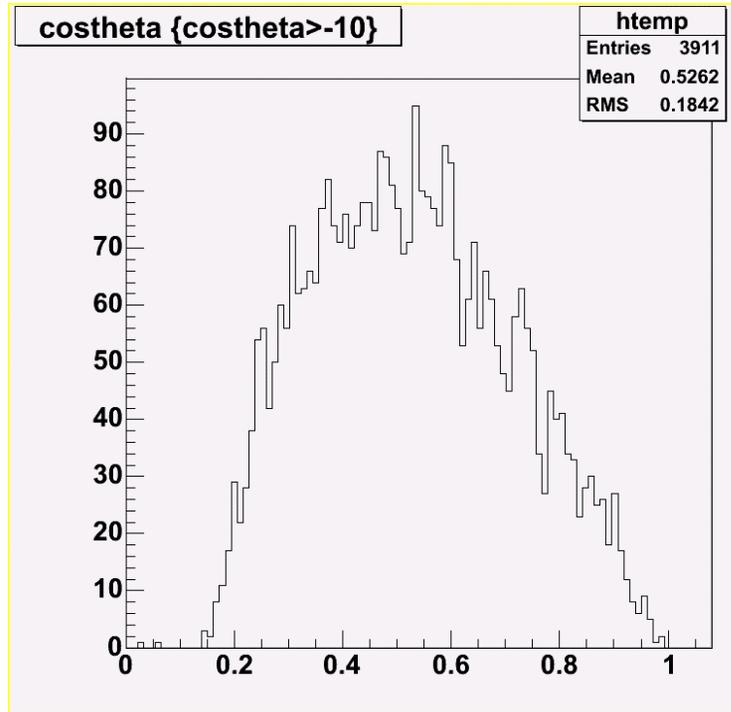
- Run 3303 was taken after re-calibrating the whole detector, with the HV on for long and with a 10/12 trigger implemented. The run lasted 582 sec.
- The number of events written are 4561 out of which 3821 tracks were reconstructed using the offline software but not properly tuned for NEAR Cosmic (the code crashes when we attempt to do that... I am going to investigate why).
- **The track reconstruction efficiency is ~ 84 % (given that all events are tracks) (when the track is configured for cosmic the efficiency will be higher)**

# Cosmic Run : Track Characteristics



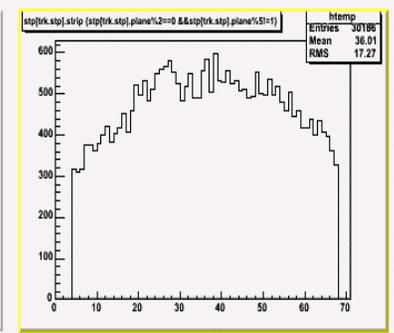
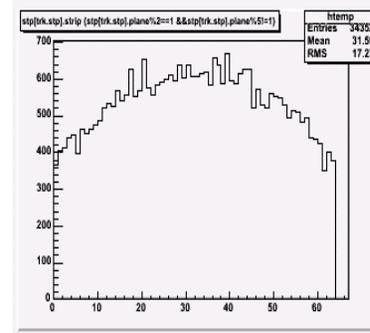
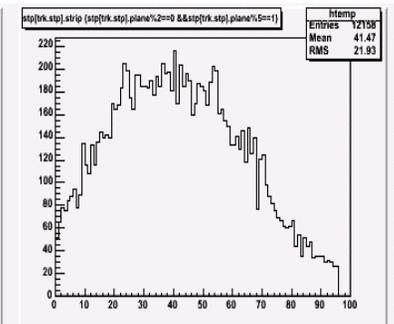
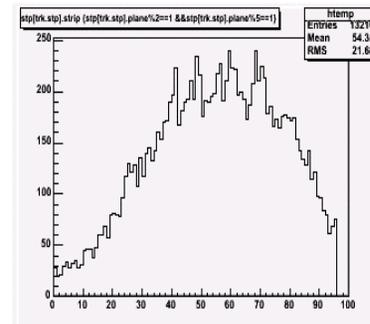
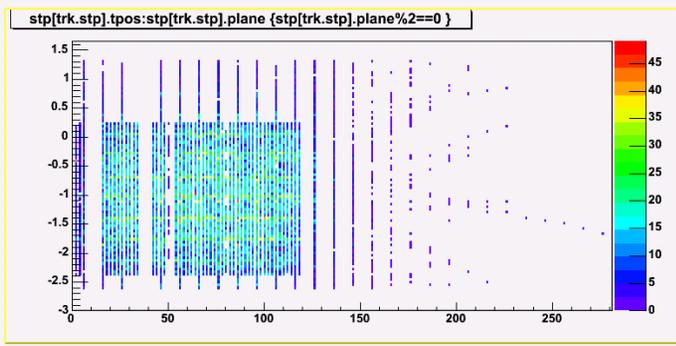
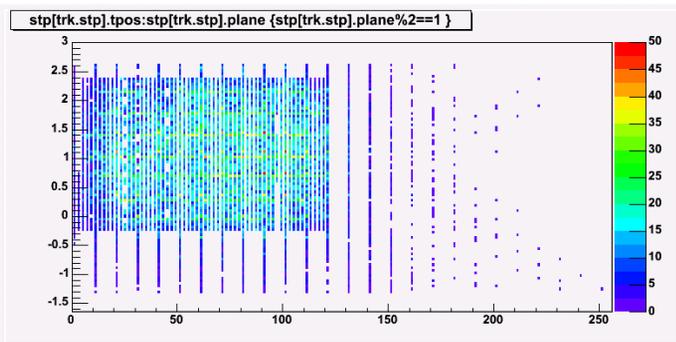
- Track residuals for U and V 2D lines are relatively small (less than 1 strip) and are quite similar. There is a small shift in negative values for the V planes that I need to investigate.
- Track plane efficiency is slightly better for the V view and it would be interesting to see how it changes after electronics problems (that create "holes" to the detector for the moment) are fixed.
- The average number of PE s per plane is very close to what expected ( 7-8 ). The U planes show a slightly higher average than the V (needs to be understood and re-examined with better statistics).

# Cosmic Run : Muon Direction



- The zenith and azimuth angle distributions don't show any "suspicious" features:
  - Very few muons horizontal muons (due to the small duration of the run), very few vertical muons due to the 10/12 trigger.
  - Very few muons with 90 degrees azimuth angle due to the 10/12 trigger.
- These distributions will be re-examined with higher statistics.

# Cosmic Run : Strip & Plane occupancies



- Because there is no trigger in the spectrometer region and the partially instrumented region of the detector we need to take data for  $\sim 15$  hours in order to have  $\sim 1000$  straight muons :
  - There are  $\sim 10$  events with zenith angle  $< 0.2$  for 582 sec so we need  $582 \times 100 = 16$  hours for 1000 straight tracks that will eventually be triggered.
- Then we will also have enough data for the strip to strip corrections (as seen from the strip occupancy plots for partial and full planes).

## Cosmic Run : Rate

- The rate recorded in this cosmic run is  $\sim 8$  Hz.
- Using the numbers of NUMI - L 232 for the NEAR detector expected muon rate we estimate  $\sim 27$  Hz without any 10/12 trigger implemented. It is difficult to calculate how the trigger requirement affects the flux but the two numbers are relatively close.

# Summary -Ongoing work

- There are quite a few problems related with the electronics that will start being fixed this week.
- Overall, nothing unusual or “pathological” is observed with the reconstructed cosmic muons.
- There are quite a few things that need to be further investigated and understood.
- I plan to continue looking at longer cosmic muon runs after the electronics are in a more stable and healthy state.