

# Near Far tracking

N. Saoulidou, Fermilab, Reco Phone Meeting

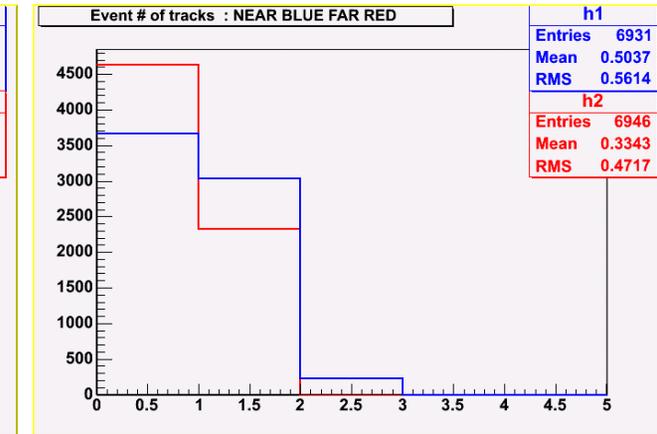
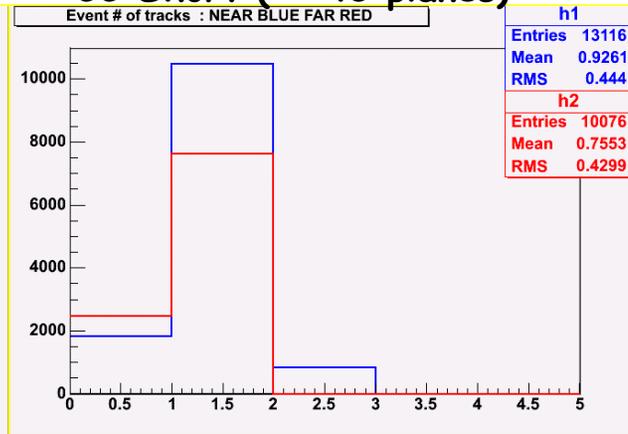
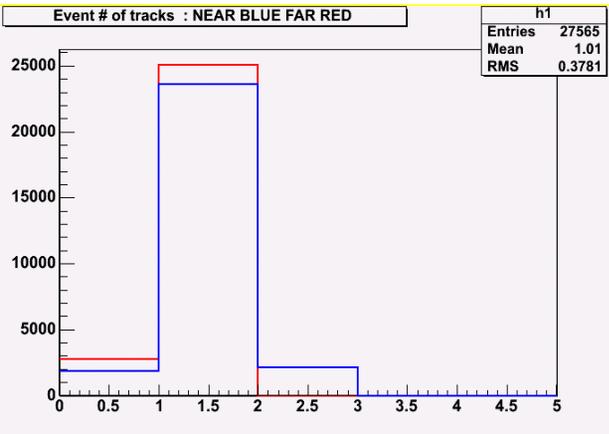
02-10-05

# Outline

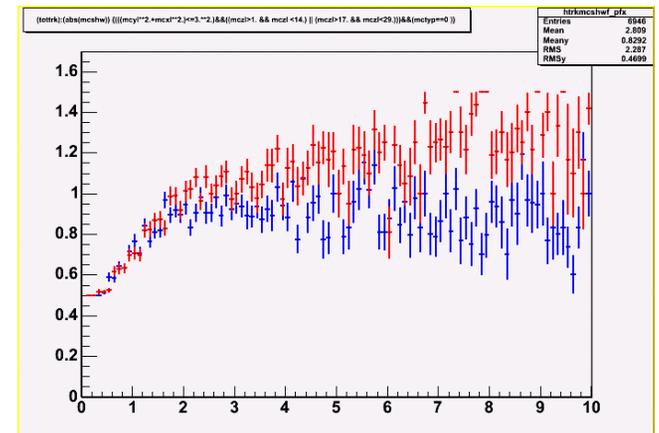
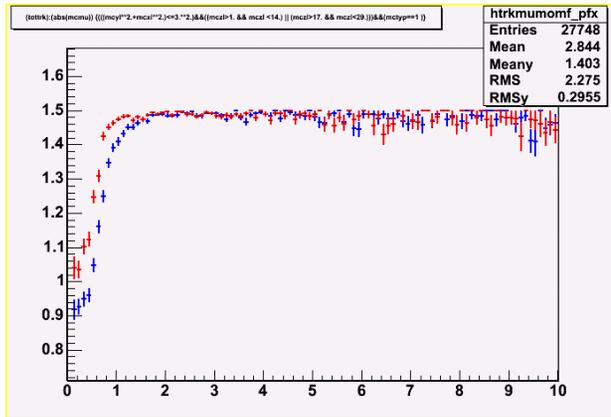
- Near Far tracking efficiency (CC & NC)
  - Current code
  - Modified code
- Near Far tracking truth info (purity & completeness)
- Summary - On going work

# ND Reconstruction, things that are not yet well understood

Number of Tracks for CC & NC Events Near - Far



COLOR CODE : RED NEAR - BLUE FAR



CC : % reconstructed tracks vs Pmu true

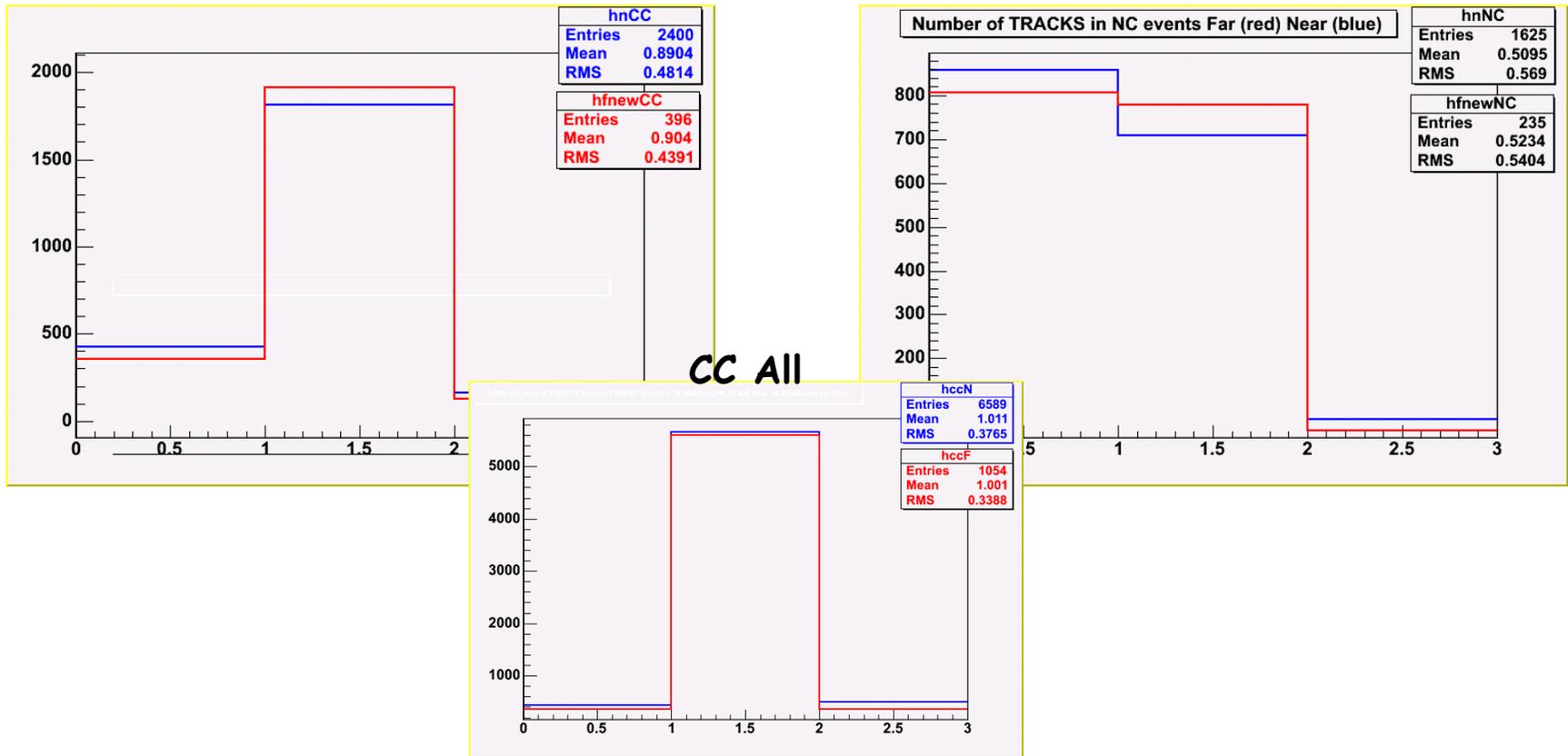
NC : % reconstructed tracks vs Eshw true

- The percentage of reconstructed tracks in the NEAR detector is higher than in the FAR and that is not a geometric effect. It is due to the looser reconstruction code cuts for the NEAR detector. ( Me & Panos are currently working on that and will have results soon)

# Number of Tracks for CC & NC Events Near - Far NEW

CC Short ( < 40 planes)

NC All



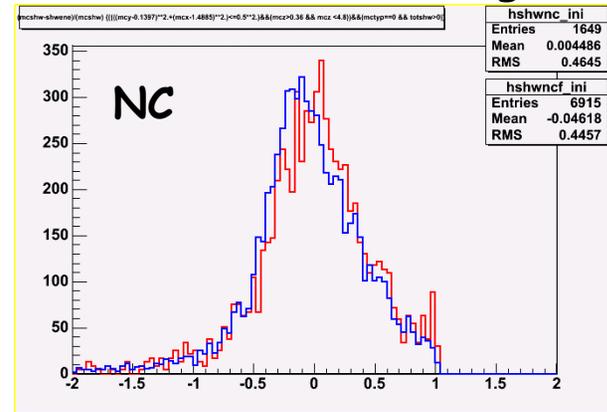
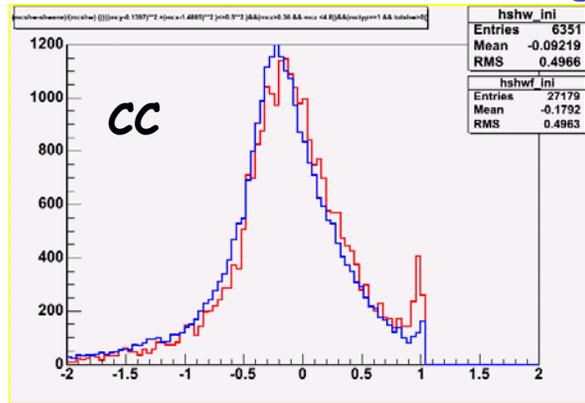
- The tracking efficiency is now the same between Near & Far detector.
- Changed FAR tracking criteria to be exactly the same as NEAR and that increased the FAR tracking efficiency for both CC and NC events.
- That clearly proves that the initial difference in tracking efficiencies between Near and Far was mainly a code effect.

## Number of Tracks for CC & NC Events Near - Far NEW con't

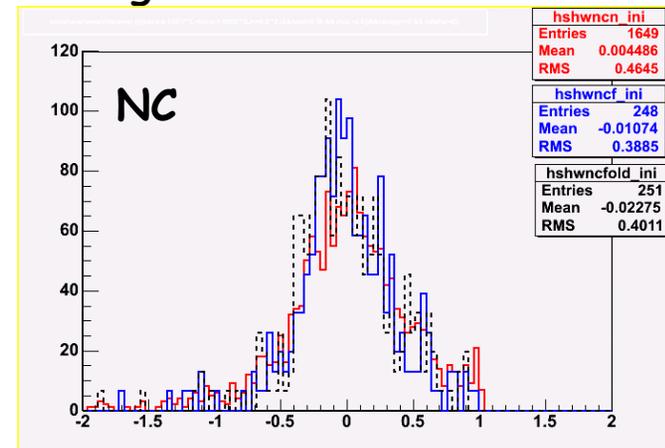
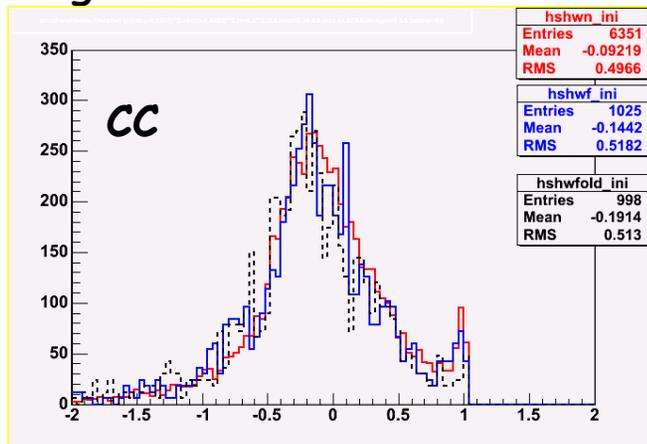
- The fact that now tracking efficiencies between Near and Far are similar and understood is good.
- However one has to think how to proceed :
  - 1. Change FAR cuts (as I did to understand the effect which means looser tracking in the Far as well)
  - 2. Change NEAR cuts ( More conservative tracking that will certainly cost on tracking efficiency in the sparse region of the detector)
  - 3. Leave things as they are ?
- I would certainly not go with 3... for mainly two reasons:
  - Tracking efficiency differences might introduce differences in event classification (track events are more CC-like than non-track events)
  - Shower (and therefore total) energy estimation differences. "Wrong" tracks in NC events reduce the estimated shower energy. Lack of true muon tracks in CC events increase the estimated shower energy and the event energy. Therefore Shower energy in Near detector would be higher than in Far (which is something that we see)...

# Number of Tracks for CC & NC Events Near - Far NEW con't

... Therefore Shower energy in Near detector (**red histogram**) would be higher than in Far (**blue histogram**) (which is something that we see)...



- The difference in shower energy between Near-Far seems to decrease (given statistics, I need to check with more events) with the changes in tracking cuts that made Near Far tracking efficiencies similar.



(Eshtrue - Eshwreco) / Eshwtrue

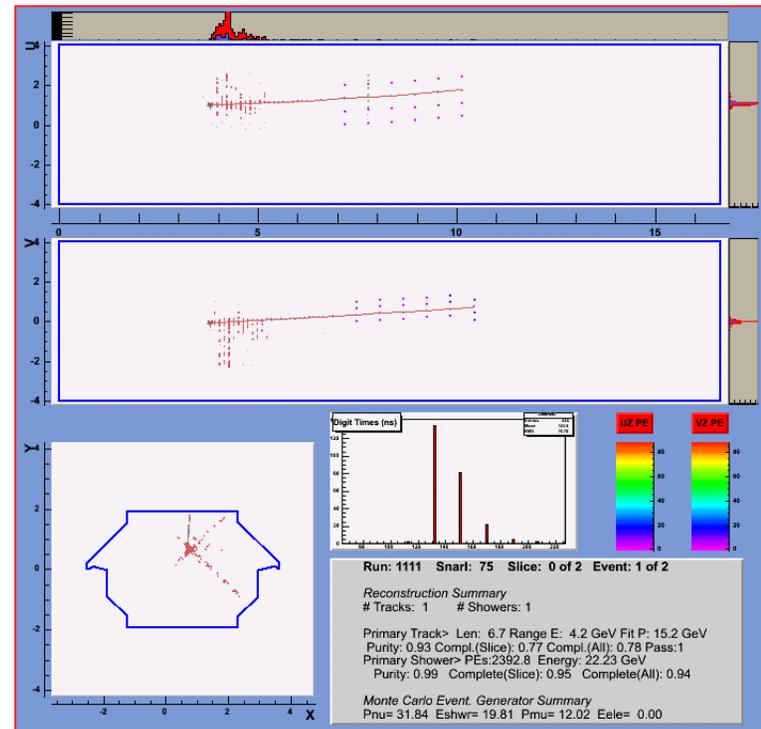
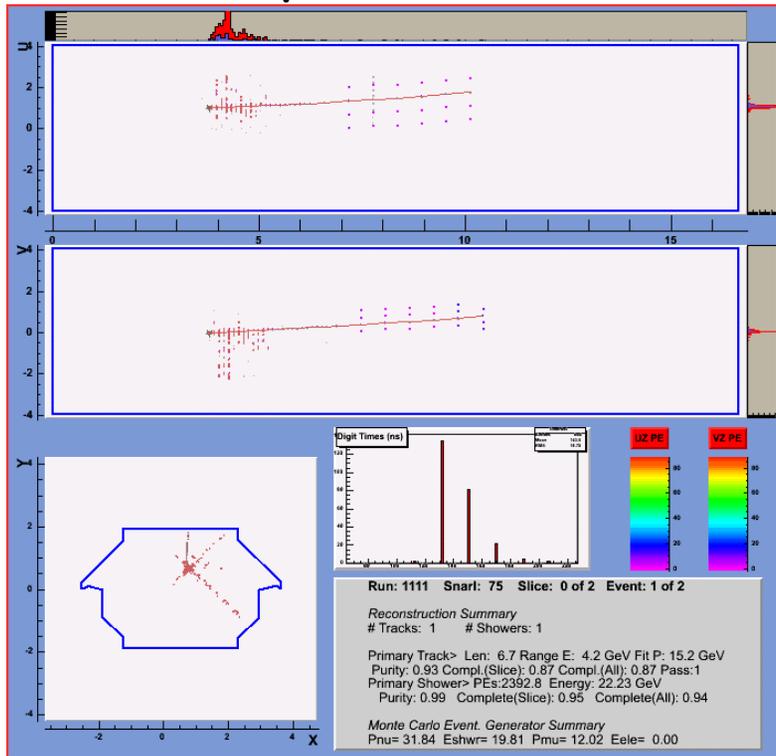
## Number of Tracks for CC & NC Events Near - Far NEW con't

- Given the previous observations on shower energy estimation (that I won't to verify and quantify better using more events) tracking needs to become similar between Near and Far.
- One additional thing I wanted to check was track characteristics like purity and completeness for both Near & Far with the set of cuts that make efficiencies the same.
- In the process of doing that I found that the definition of track completeness and purity in the code especially for the Near detector is somewhat problematic.

# Track Completeness (Near Detector)

NEW: Completeness 87 %

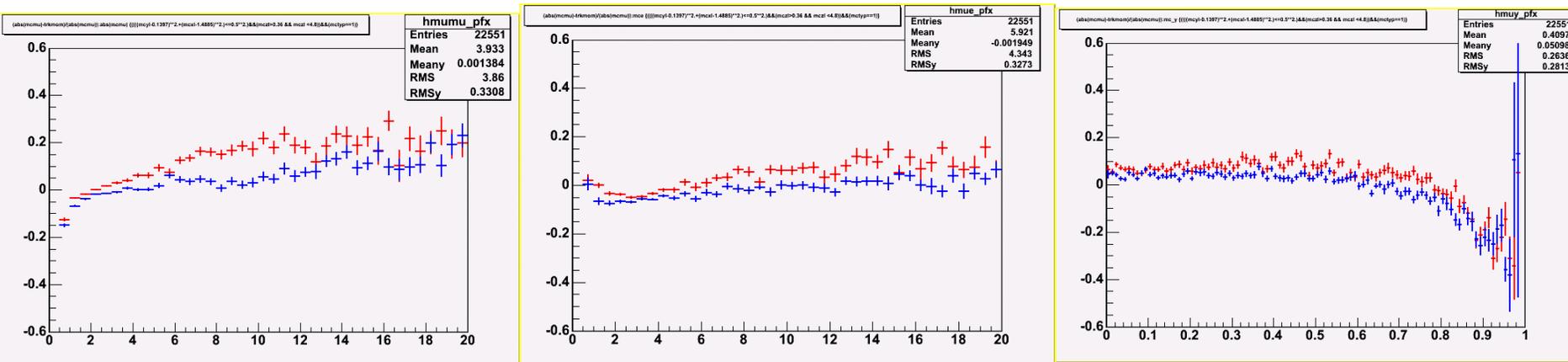
OLD: Completeness 77%



- There was double (triple) counting some times for the strips in the spectrometer... I don't yet fully understand why is that but I fixed the completeness and purity definition (I plane to commit the changes soon).
- Even the current definition of completeness gives lower completeness than the logical expected since MC hits that come I.e from delta rays emitted by the muon (and do not belong in the straight line that we call track) are "assigned" to the actual muon track...

# ND Reconstruction, things that are not yet well understood

## Estimated muon momentum ( $Dp/p$ ) vs $P_{mu}$ Enu and $Y$ Near - Far



**COLOR CODE : RED NEAR - BLUE FAR**

- Profiling histograms of  $Dp/p$  (True - Reco/True) vs  $P_{mu}$  true, Enu true and  $Y$ .
- Near detector shows systematically lower estimated muon momentum than true and than the FAR detector.
- Alysia Marino is currently working on correcting estimation of momentum from range that is currently incorrect and different for Near & Far (due to different geometry of dense and sparse regions).
- I am looking into that from a different perspective more track reconstruction related.

# Summary

- I am working on understanding Near Far reco related issues that I (or other people) raised in the Collaboration meeting.
- At the moment I am focusing on tracking differences.
- The tracking efficiency difference I believe is now understood but the decision of how to proceed needs to be discussed.
- There is constant “bug” fixing of various things that come up in the reconstruction.
- Next I plan to closely investigate differences in estimation of muon momentum between Near & Far.