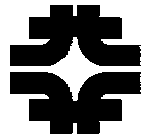


Track reconstruction in the Near Detector & Near – Far comparisons

N. Saoulidou, Fermilab

Outline

- Summary of Corrections & Modifications done so far (after the previous Collaboration Meeting).

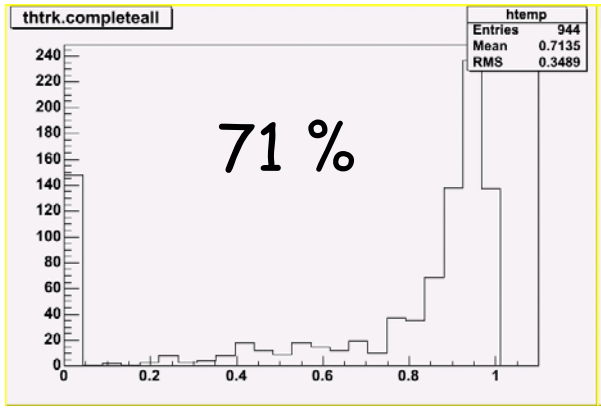
- Improvement (Initial & Final Results) on
  - Track reconstruction efficiency
  - Track Completeness (and Effect of Slicing)
  - Track Purity
- Resolution of momentum reconstruction in the ND
- Near – Far tracking comparisons:
  - Efficiencies
  - Completeness
  - Purity
  - Reconstructed momentum resolution
- Conclusions – On going work

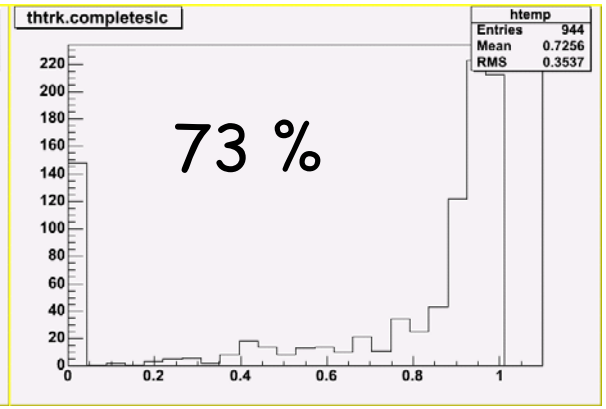
Modifications & Corrections on ND tracking

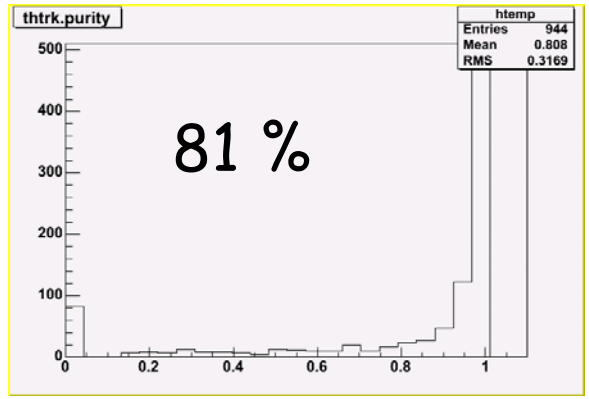
- Code tuning, related with how the code handles events occurring in the partially covered plane area (which is identical to the spectrometer region (1/5 planes instrumented) except from the Plex .
- Modification on the way "duplicate" 3D tracks are examined :
  - Initially the percentage of identical hits was examined for all track strips (U and V together).
  - There were some cases were false 3D solutions existed having the correct 2D Line in one view and the wrong 2D Line in the other view.
  - The code is now modified to examine percentage of identical strips in each view and keep the solution with the largest number of planes.
- Corrections on the plane number from which the Plex starts from > 121 to >=121!
  - Due to that error a few quite clear tracks were missed because the code was unable to reconstruct the correct 2D line in the U view.

Track Reconstruction Completeness, Completeness after slicing and Purity (All tracks).

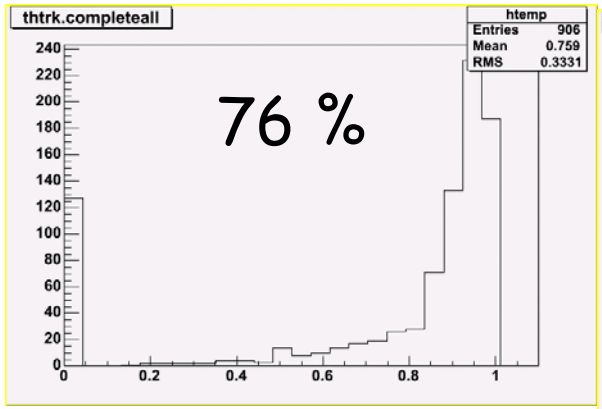
Initial

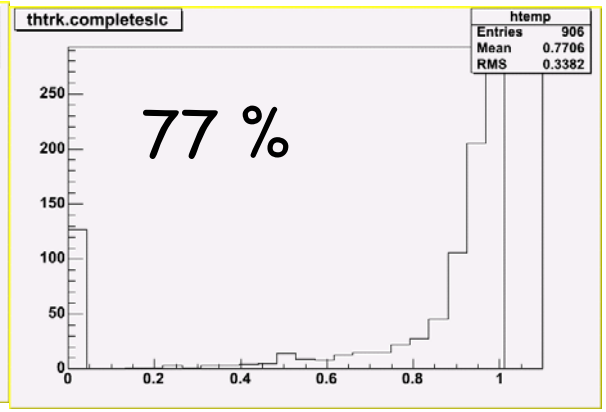


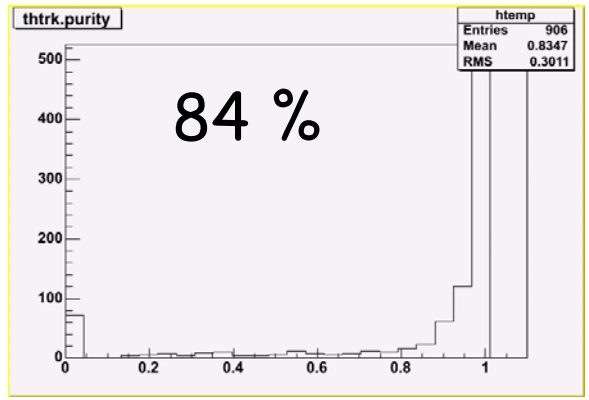




Final



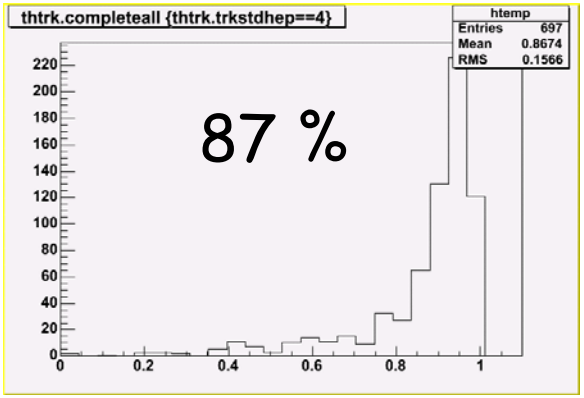


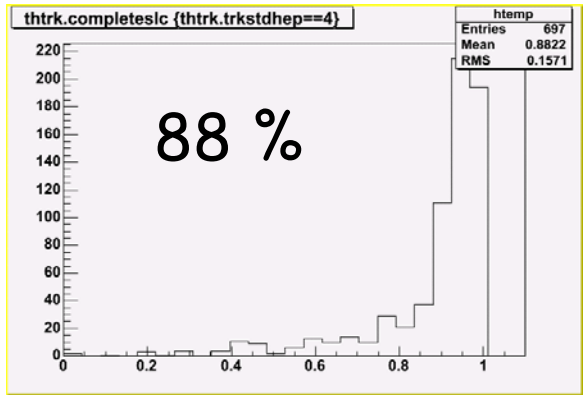


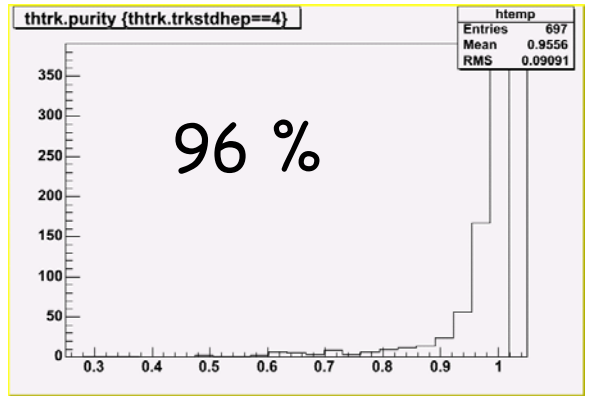
- Track completeness (71%->76%) Track completeness (after slicing) (73%->77%) & Track purity (81%->84%) have improved quite significantly.

Track Reconstruction Completeness, Completeness after slicing and Purity (MUONS).

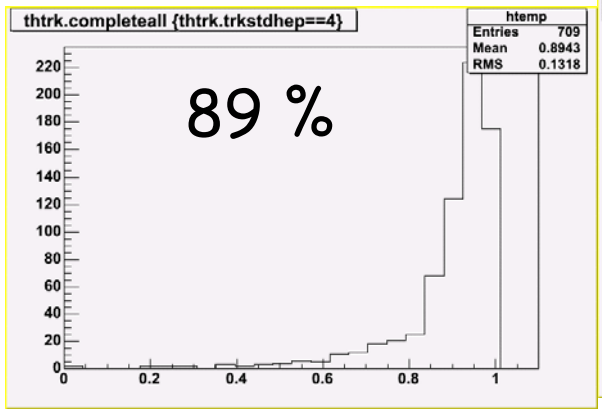
Initial

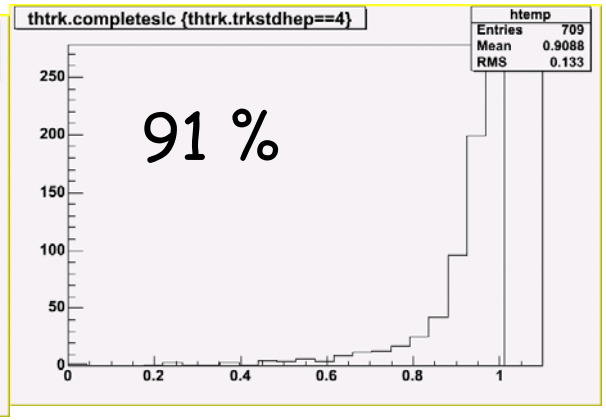


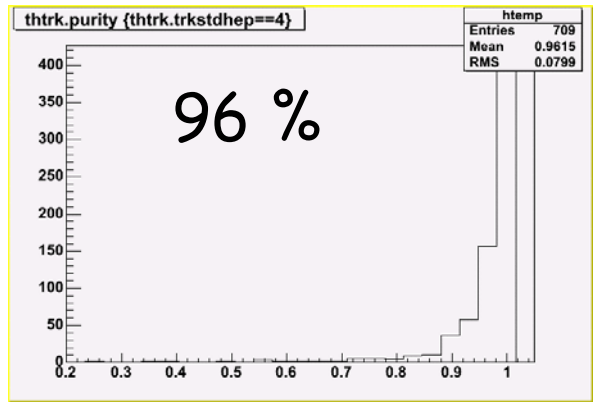




Final

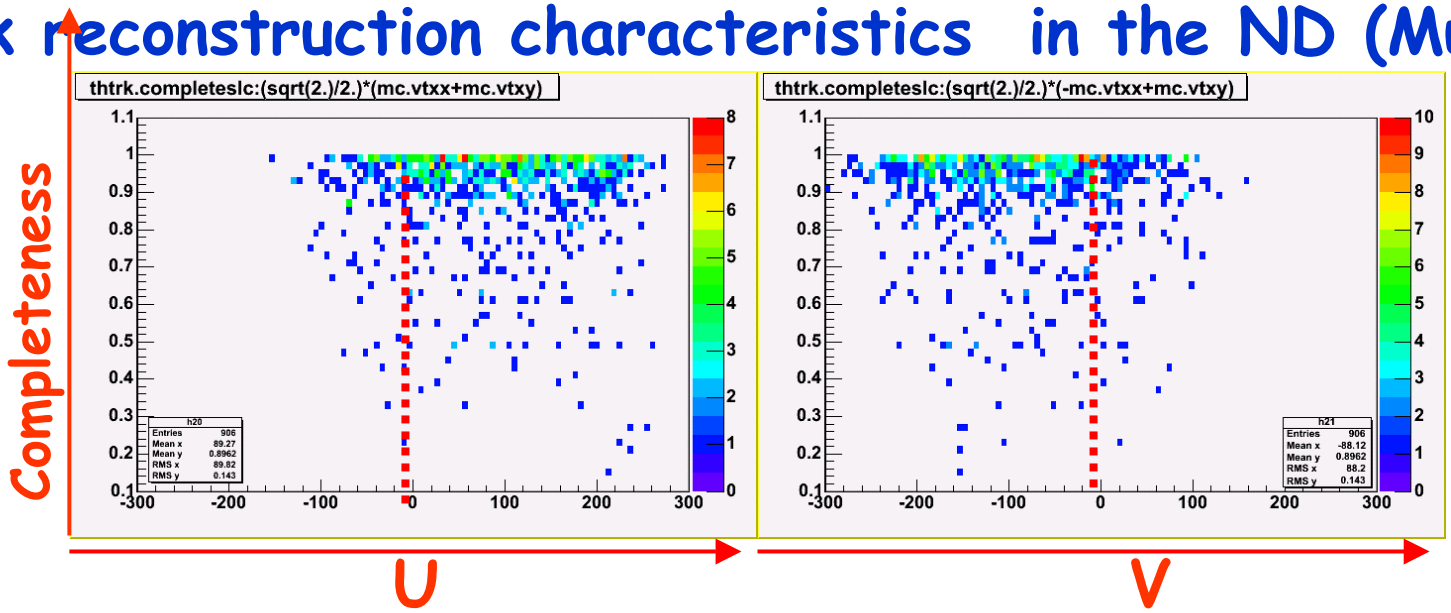


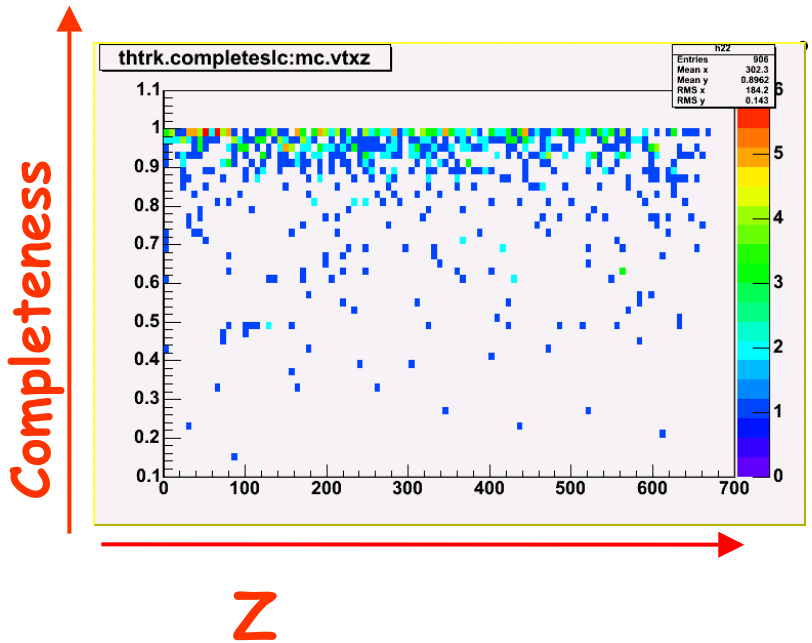




• Track completeness (87%->89%) Track completeness (after slicing) (88%->91%) & Track purity (96%->96%) have also improved.

Track reconstruction characteristics in the ND (Muons)



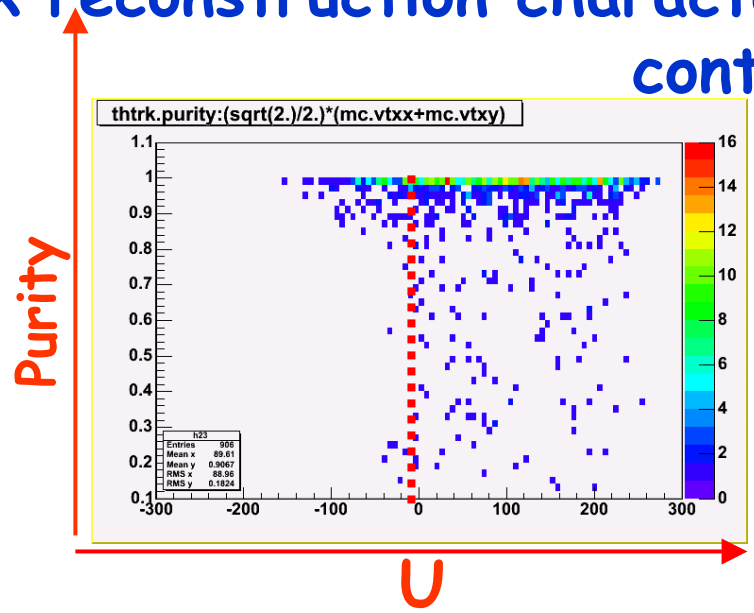


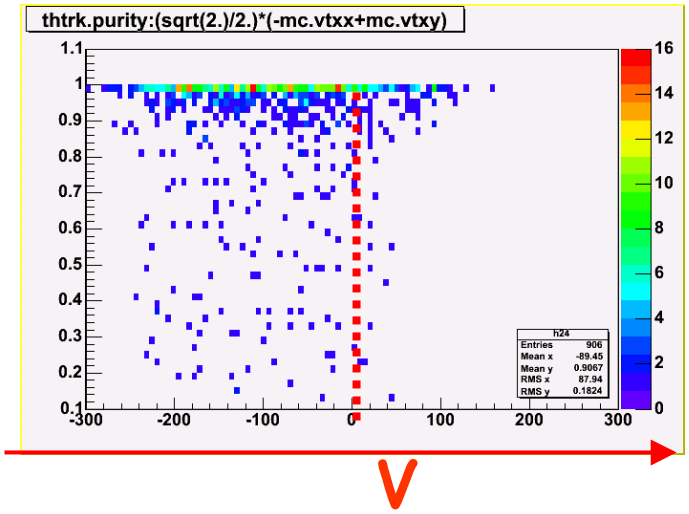
These plots show that :

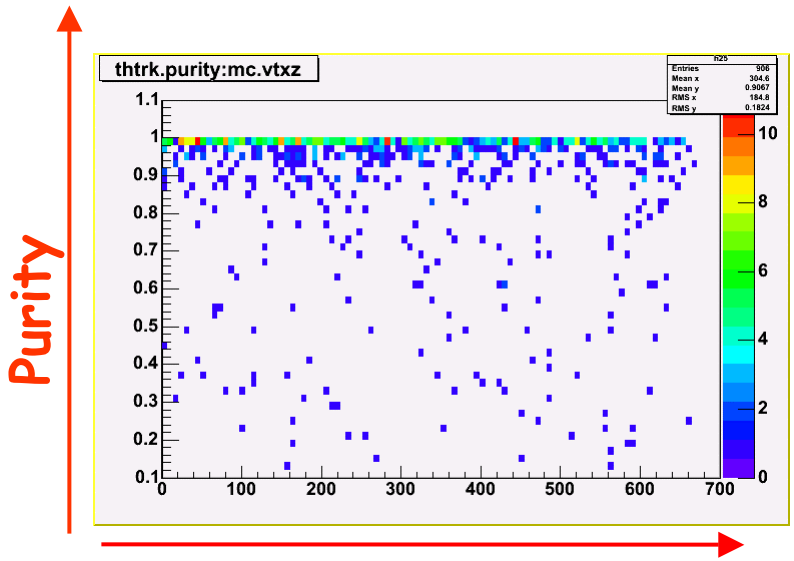
-There is a clear preference in the number of reconstructed muon tracks towards the fully instrumented ND region, which is not so pronounce (or not pronounce at all) for the z position of the neutrino vertex with respect to the Plexed region.

- But the track completeness is ~ the same for all U V Z positions

Track reconstruction characteristics in the ND (Muons) cont'd







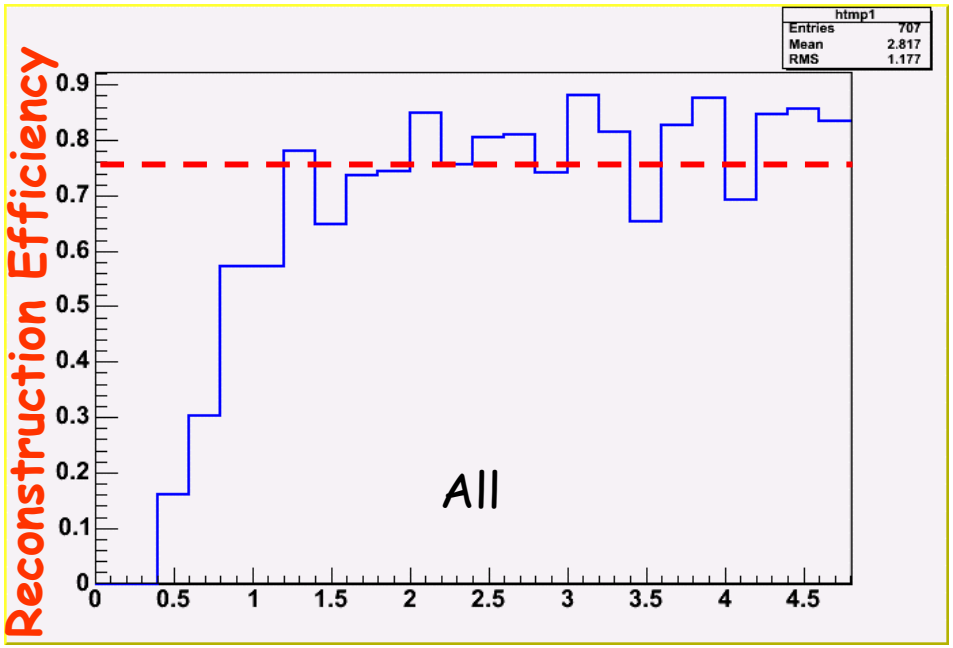
- These plots show that :

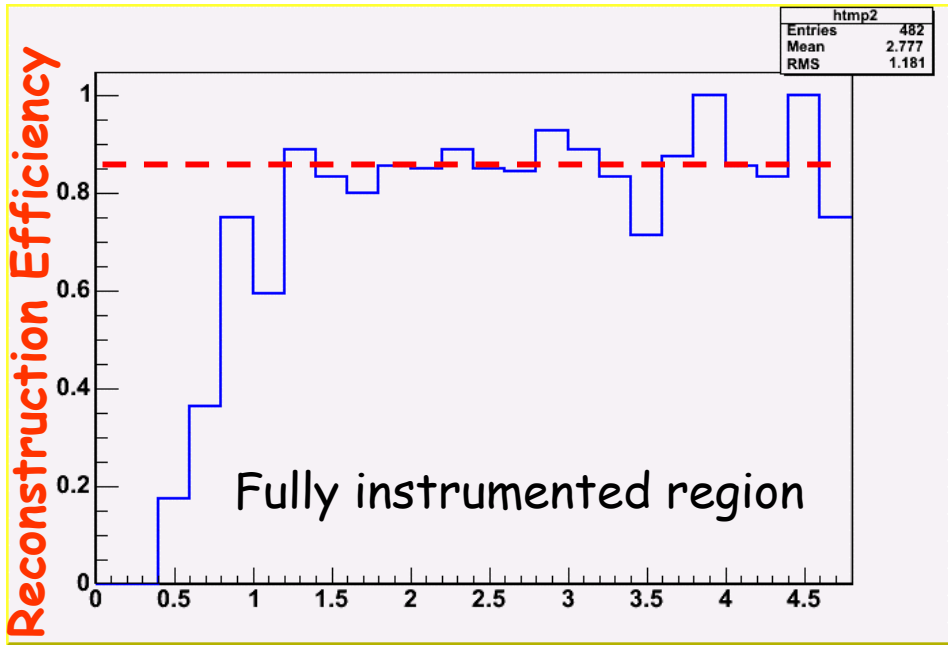
  -There is a clear preference in the number of reconstructed muon tracks towards the fully instrumented ND region, which is not so pronounce (or not pronounce at all) for the z position of the neutrino vertex with respect to the Plexed region.

  - But the track purity is ~ the same for all U V Z positions

Track reconstruction characteristics in the ND

Reconstruction efficiencies as a function of muon true momentum

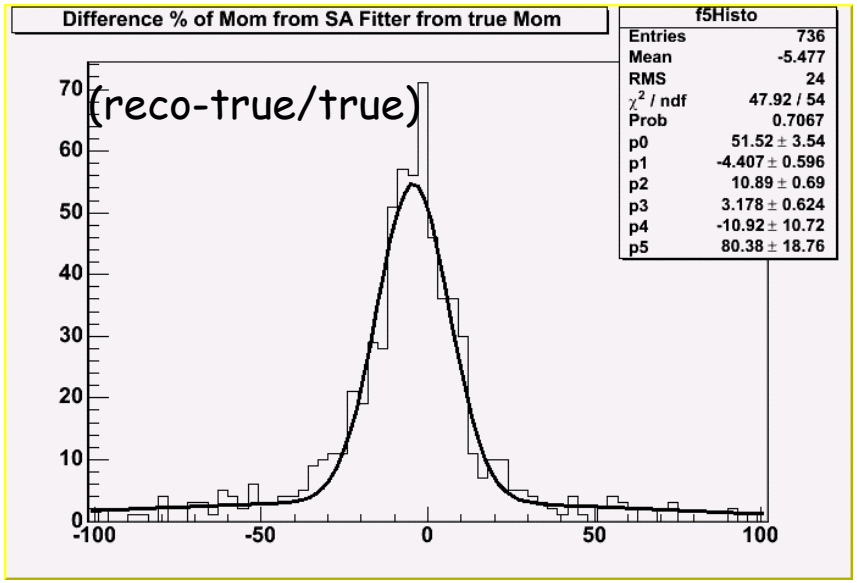


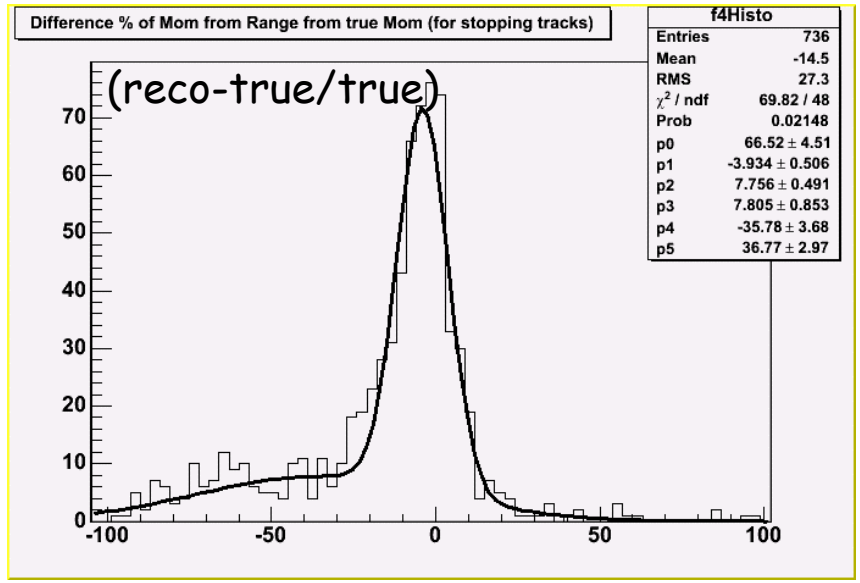


- The ND muon track reconstruction efficiency below 1 GeV is small and that is a feature of the tracking code and not the ND geometry.
- The ND muon track reconstruction efficiency is :
  - **76 % considering all upstream region**
  - **86 % considering upstream fully instrumented region**

Track reconstruction characteristics in the ND

Reconstructed momentum resolution





Momentum from fit

Momentum from range when "stopping" and from fit when exiting

- The **resolution** of the muon track momentum reconstruction from fit is **~ 10%** (for the majority of the tracks) with a clear **asymmetry** at negative values (**mean @ ~ -4%**).

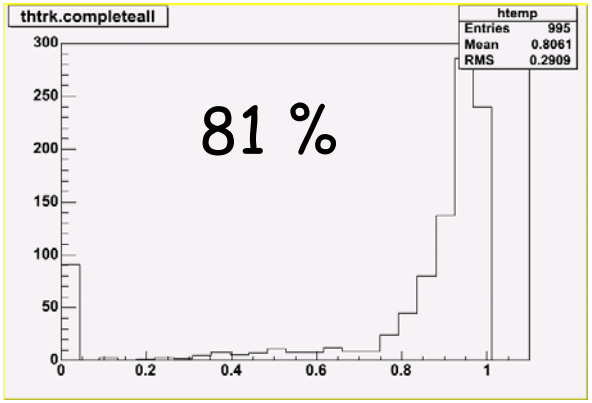
- When momentum from range is used for "stoping" tracks then the majority of the tracks has a **resolution** of **~ 7.8%** with a clear asymmetry in negative values (**mean @ ~ -4 %)** and also o pronounce "bump" in more negative values due most probably to :

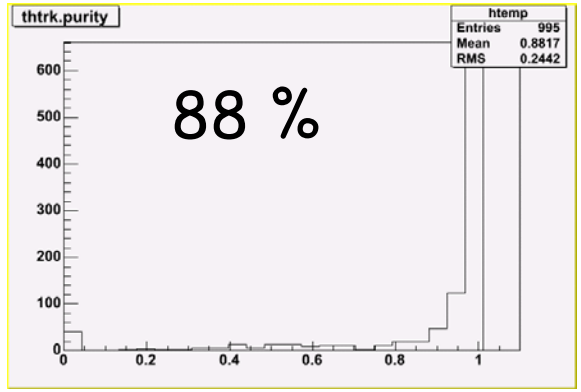
  -ND geometry

  -Pure definition of "stopping" tracks

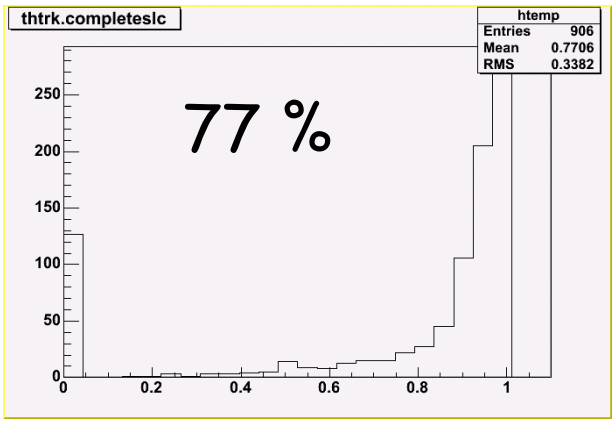
Track Reconstruction Completeness (after slicing) and Purity (All tracks) ND -FD

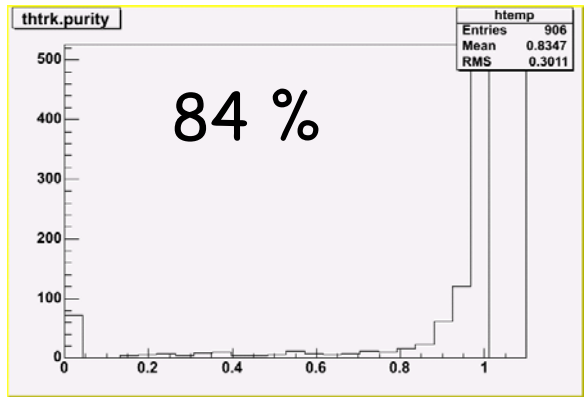
FAR





NEAR

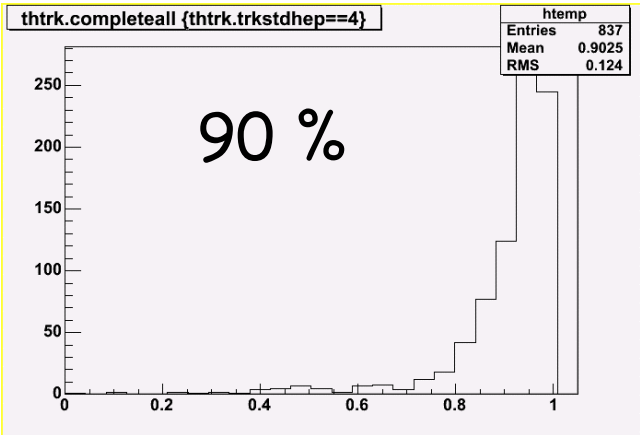


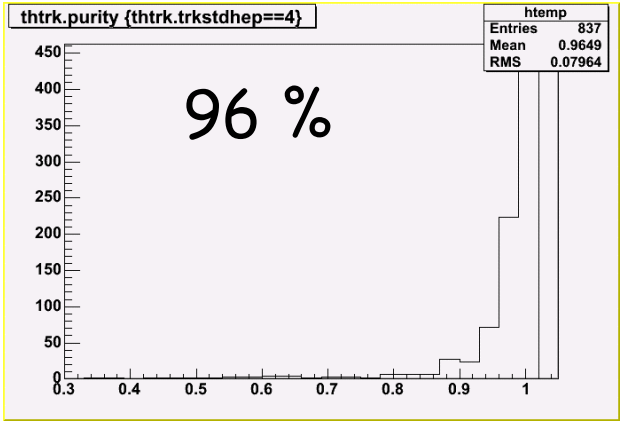


- Track completeness & purity in the FAR detector is 4 % better than in NEAR.

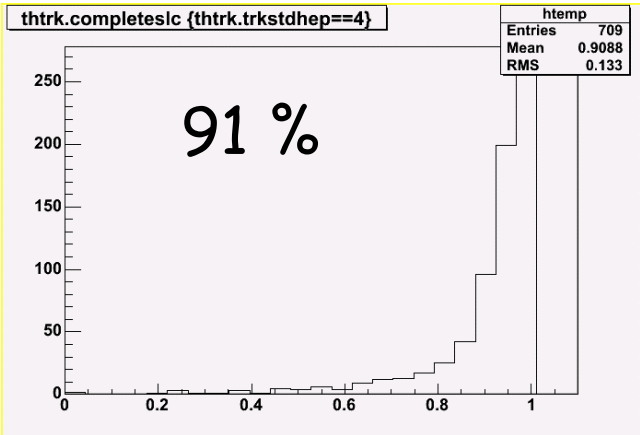
Track Reconstruction Completeness (after slicing) and Purity (MUONS) ND -FD

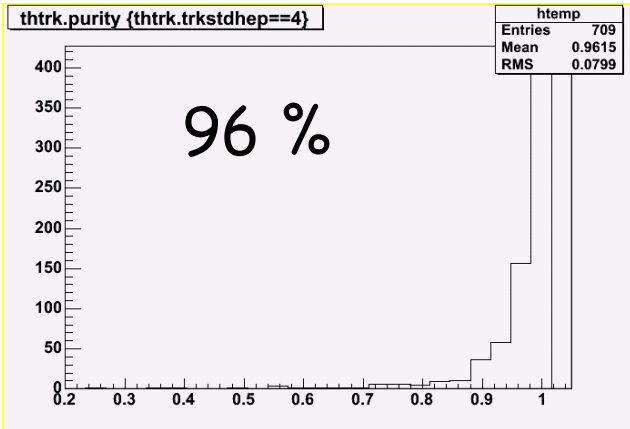
FAR





NEAR

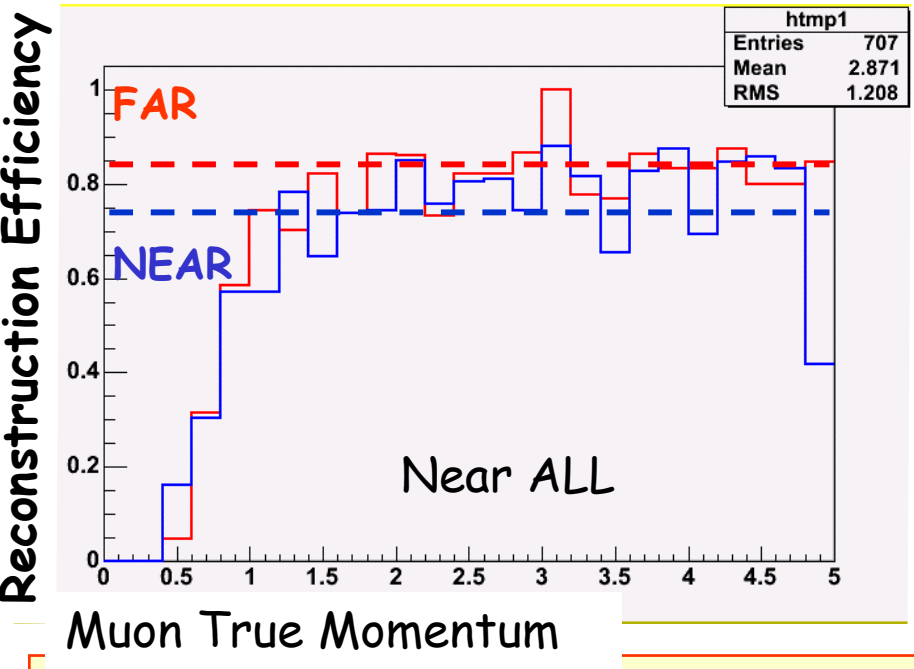


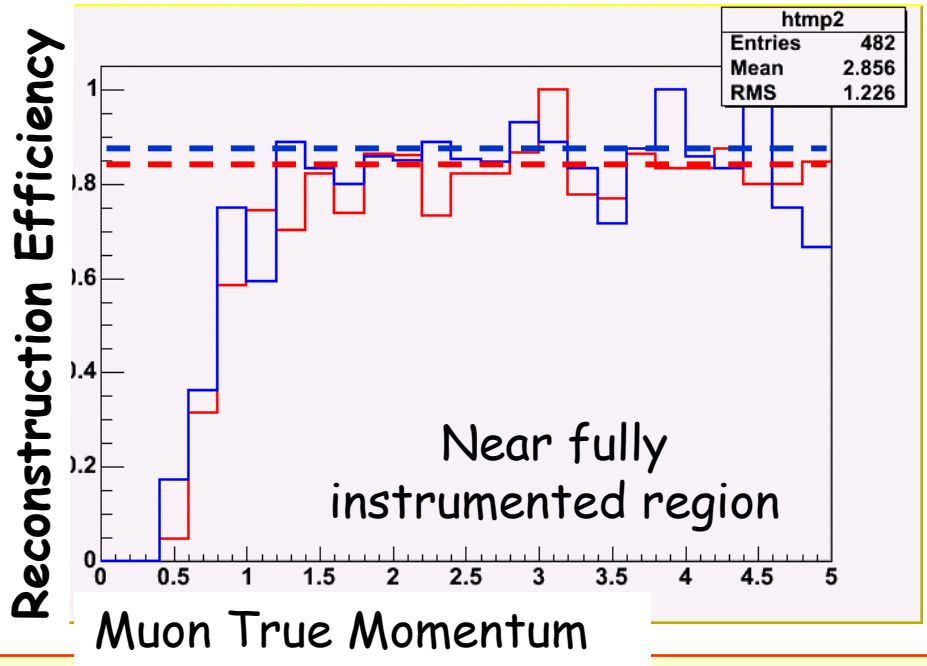


- Muon track completeness & purity in the FAR detector and NEAR detector are **THE SAME.**

Track reconstruction characteristics ND-FD

Reconstruction efficiencies as a function of muon true momentum



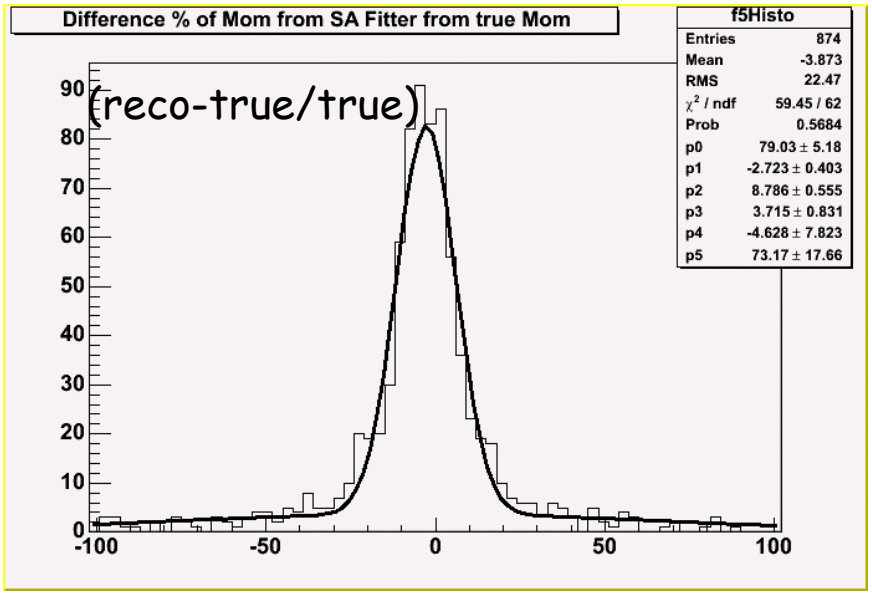


- Muon track reconstruction efficiency :
  - **ND : 76 % (considering all upstream region)** **FD : 83 %**
  - **ND : 86 % (considering upstream fully instrumented region) FD: 83 %**

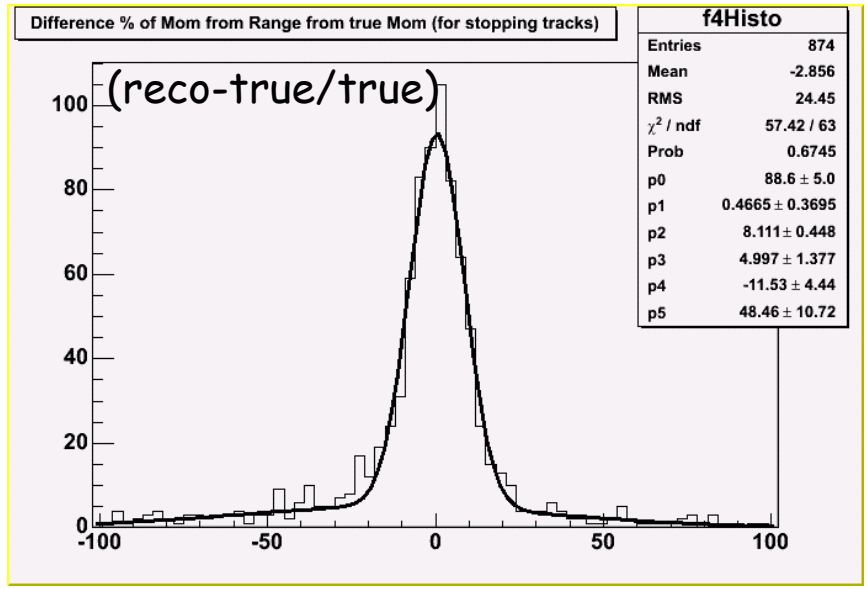
- Muon track reconstruction efficiency is lower in the NEAR detector due to different topology of scintillator planes.
- Muon track reconstruction efficiency is higher in the fully instrumented area of the NEAR detector due to absence of multiplexing.

Track reconstruction characteristics in the FD

Reconstructed momentum resolution



Momentum from fit



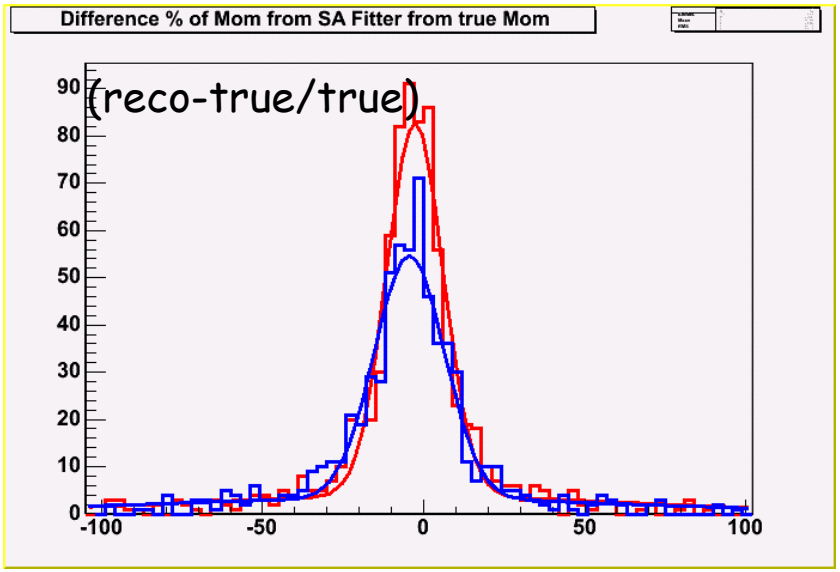
Momentum from range when "stopping" and from fit when exiting

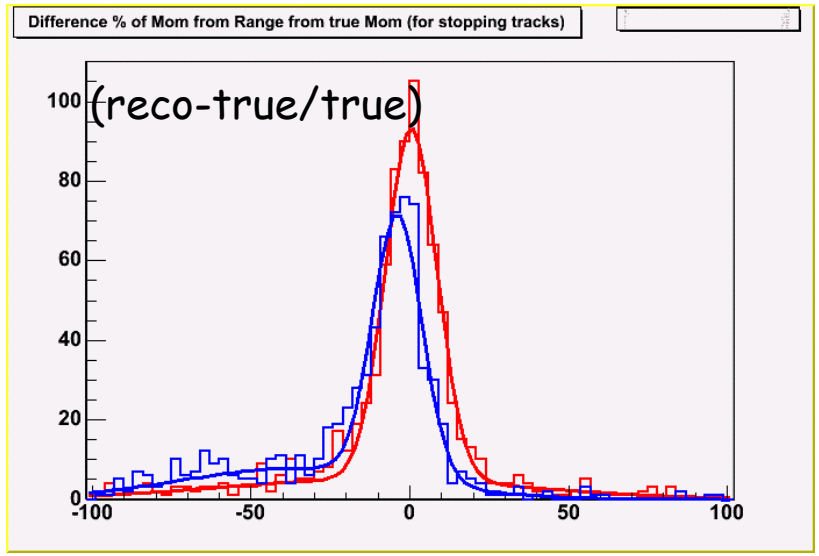
- The **resolution** of the muon track momentum reconstruction from fit is **~ 8.8%** (for the majority of the tracks) with a clear **asymmetry** at negative values (**mean @ ~ -3%**).

- When momentum from range is used for "stoping" tracks then the majority of the tracks has a **resolution** of **~ 8.1%** with a slight asymmetry only for a small fraction of events

Track reconstruction characteristics in the ND-FD

Reconstructed momentum resolution





Momentum from fit

Momentum from range when "stopping" and from fit when exiting

- The **resolution** of the muon track momentum reconstruction from fit is **better** in the **FD (~ 8.8%)** than for the **ND (~ 10%)** and the asymmetry to negative values is slightly less pronounce **(-3% FD & -4% ND)**.
- When momentum from range is used for "stoping" tracks then the momentum resolution for the FD is ~ the same as for the ND **(7.8% ND & 8.1 % FD)**, however the ND shows a clear asymmetry .

Conclusions & On going work

- Making various improvements to the ND tracking code the track reconstruction efficiency and all track characteristics (completeness & purity) have been increased.

- The 86% of track reconstruction efficiency in the fully instrumented region of the ND, the 91% of track completeness and 96 % of track purity show that the ND tracking code is in quite good shape.

- Furthermore the ND and FD track characteristics and efficiencies are quite similar.

- The ND timing issue regarding the fitting seems to be solved (maybe due to the recent bug fixes in the reconstruction code or due to ND track quality improvements).

- I will focus in understanding the difference (asymmetry) between ND and FD momentum reconstruction which could be due to the different ND geometry combined with lack of an "accurate" stopping track definition.