



# Occupancy Studies using Tracks

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Tracking & Alignment Workshop 29.01.20010

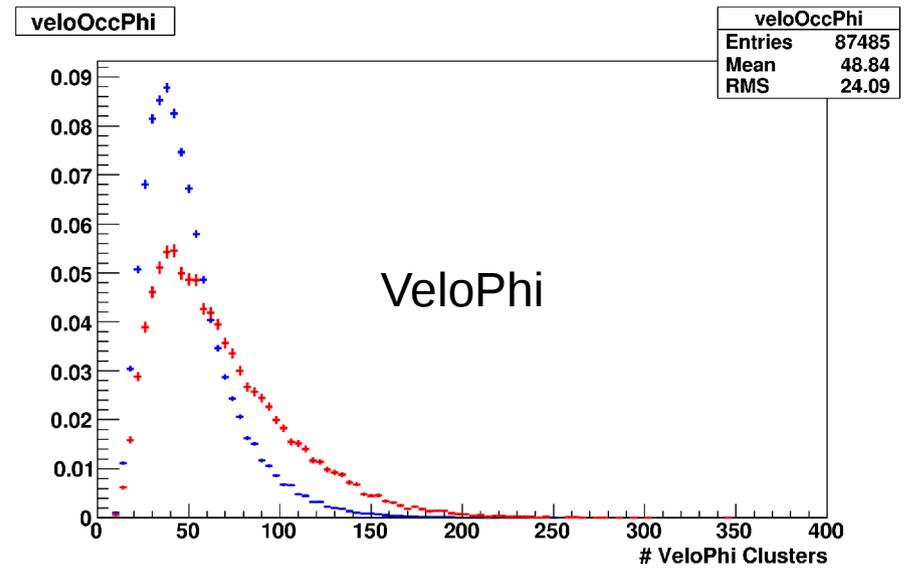
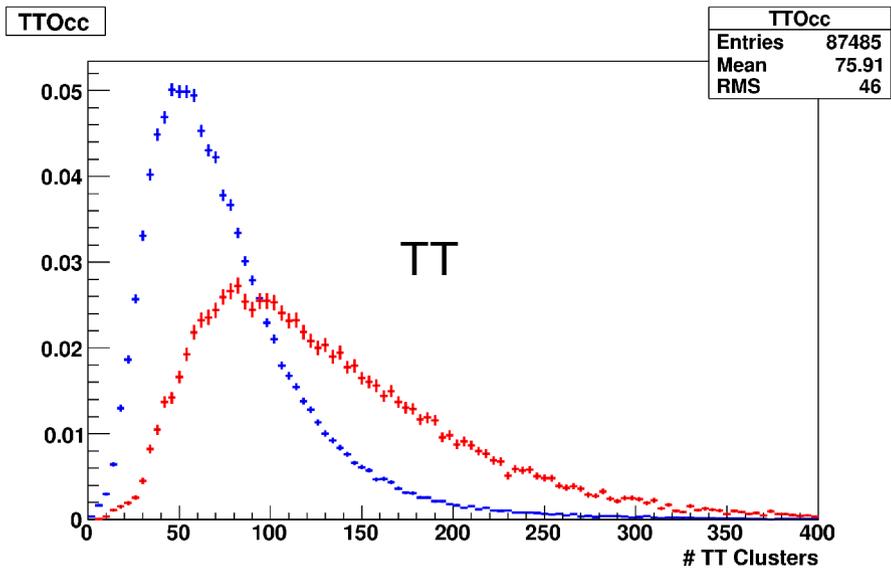
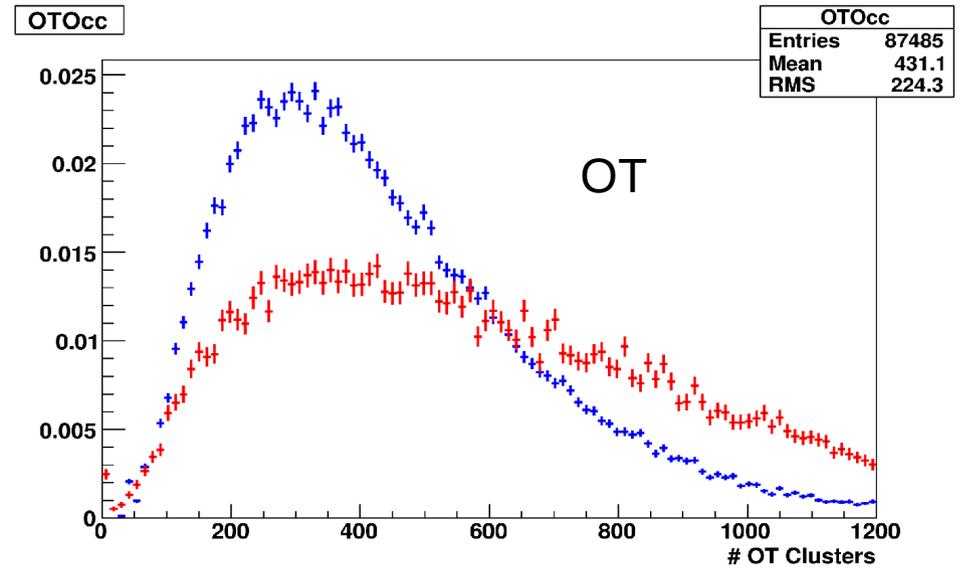
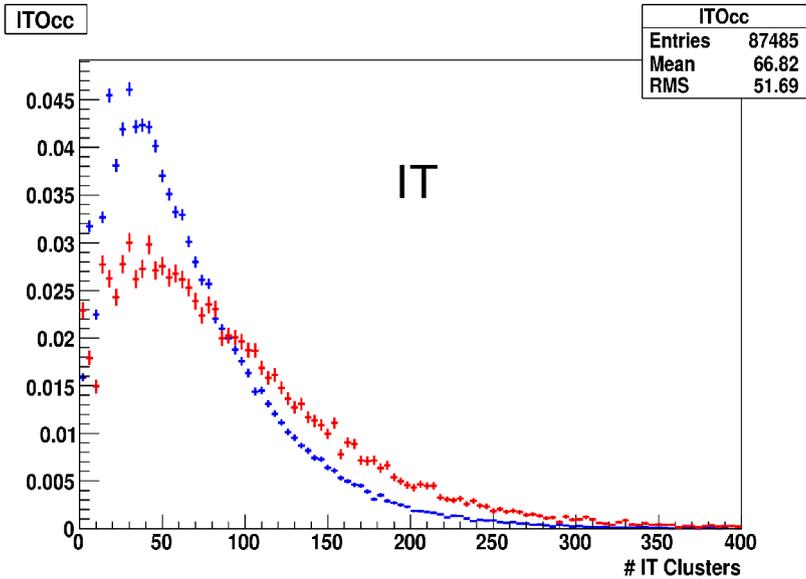
# Analysis Set-Up

- Data reproduced with early data tuning (medium loose PV reco) and latest alignment (including internal TT alignment) using runs from 63690 on (with Velo at 15 mm)
- Monte Carlo with proper L0 information (provided by Thomas) reproduced with early data tuning (medium loose PV reco), no delta-ray tuning
- Looking at events in which all tracking detectors were switched on and one PV is reconstructed (requires 3 velo tracks), require L0=yes
- All data events are beam gas subtracted
- Apologize to all detector experts, I just plain count clusters in the various detector systems (no noise subtraction etc.)
- Aim: Where does the higher occupancy in data comes from
  - noisy detectors?
  - some material interaction not properly described in MC?

# Occupancies

Blue: MC

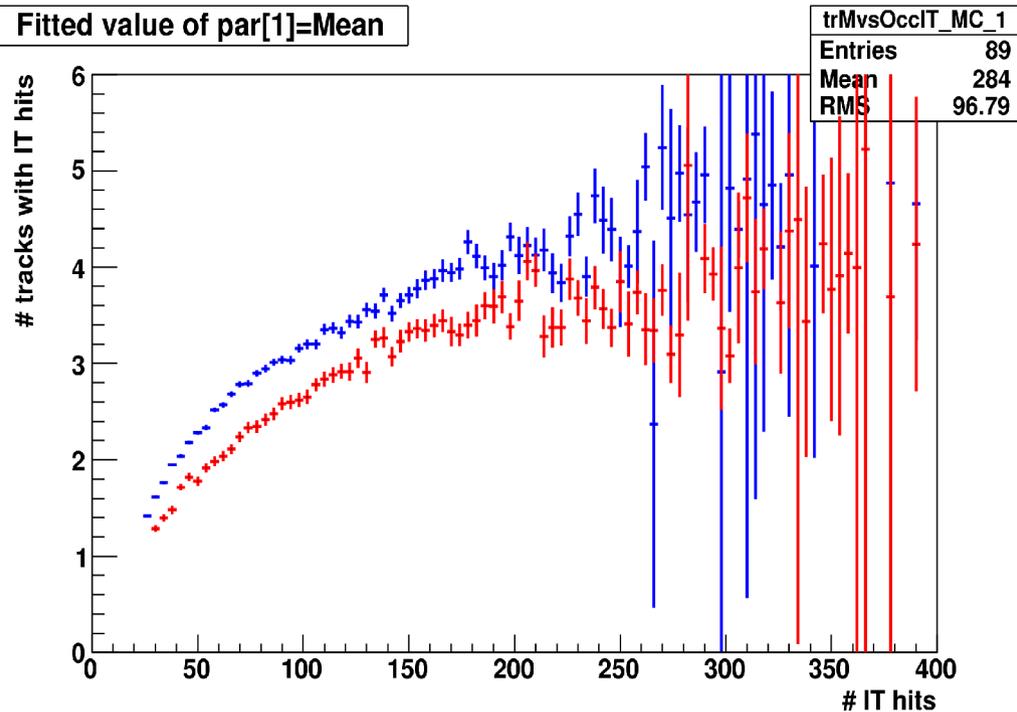
Rec: data



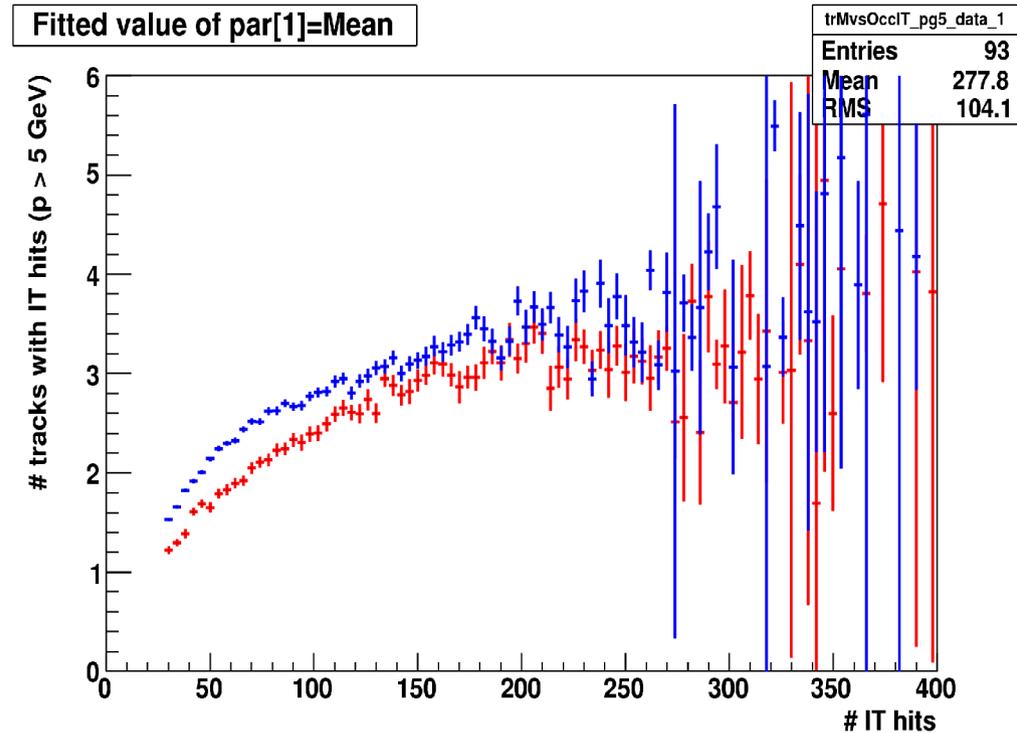
# Track-Multiplicity vs. Occupancies - IT

Blue: MC  
Rec: data

Tracks with IT hits and not OT hits included, all track types



all tracks



$p > 5$  GeV

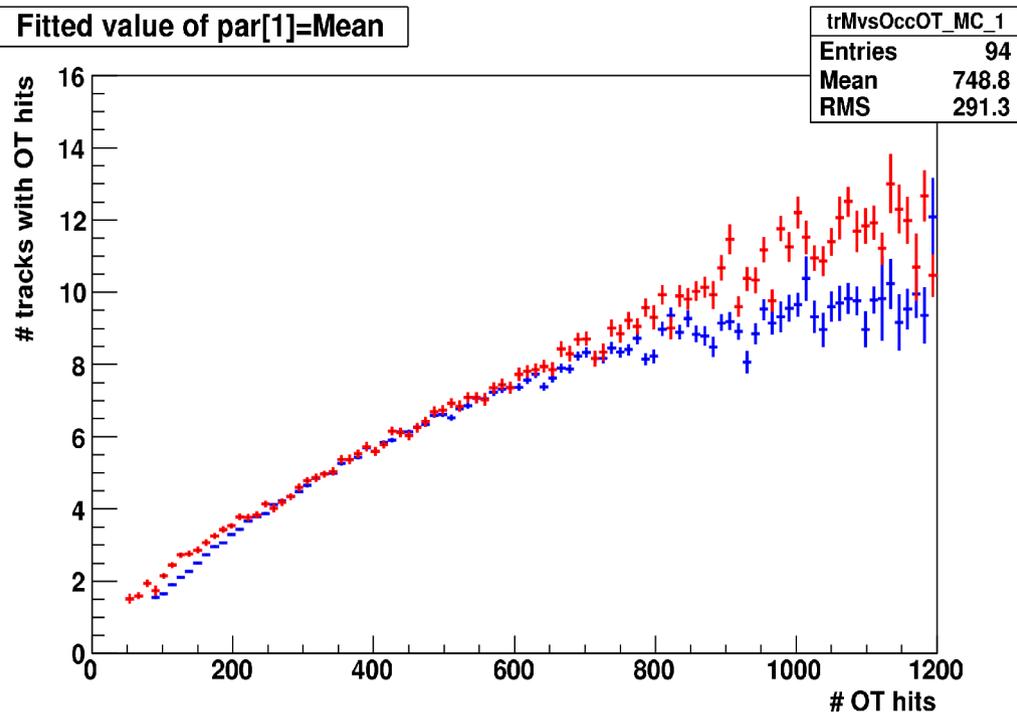
shape looks very similar!

keep in mind tracking efficiency expected to be lower in data due to misalignment.

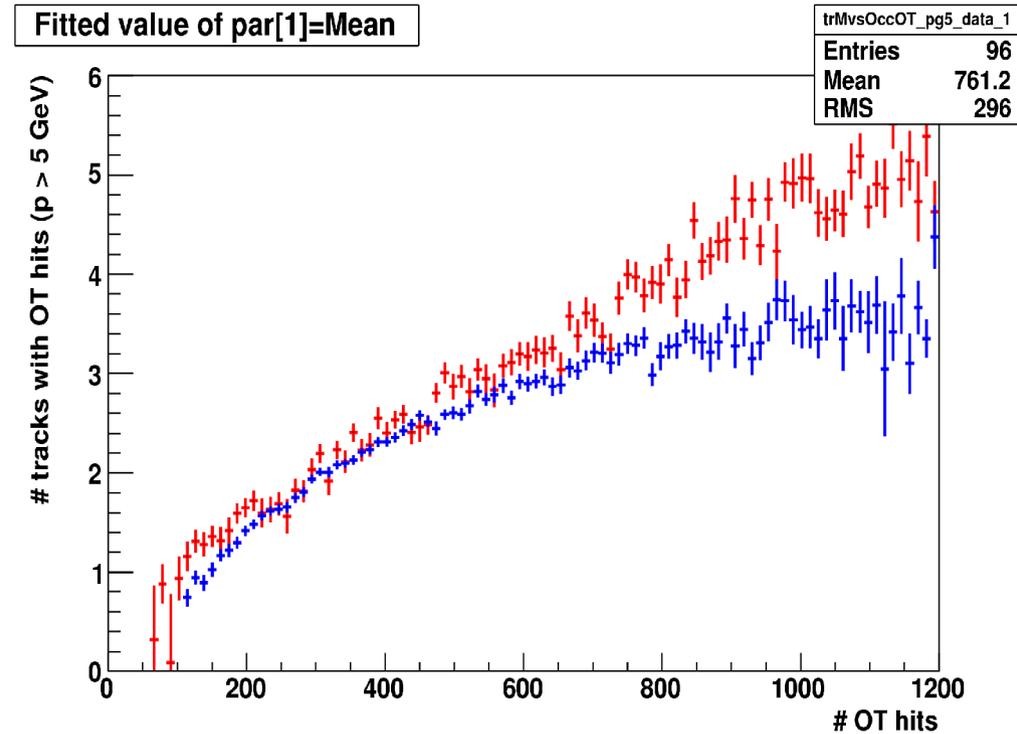
# Track-Multiplicity vs. Occupancies - OT

Blue: MC  
Rec: data

Only tracks with OT hits and no IT hits included (all tracktypes)



all tracks



$p > 5$  GeV

misalignment in OT not that crucial (hit resolution 0.2 mm),  
good agreement at low occupancy

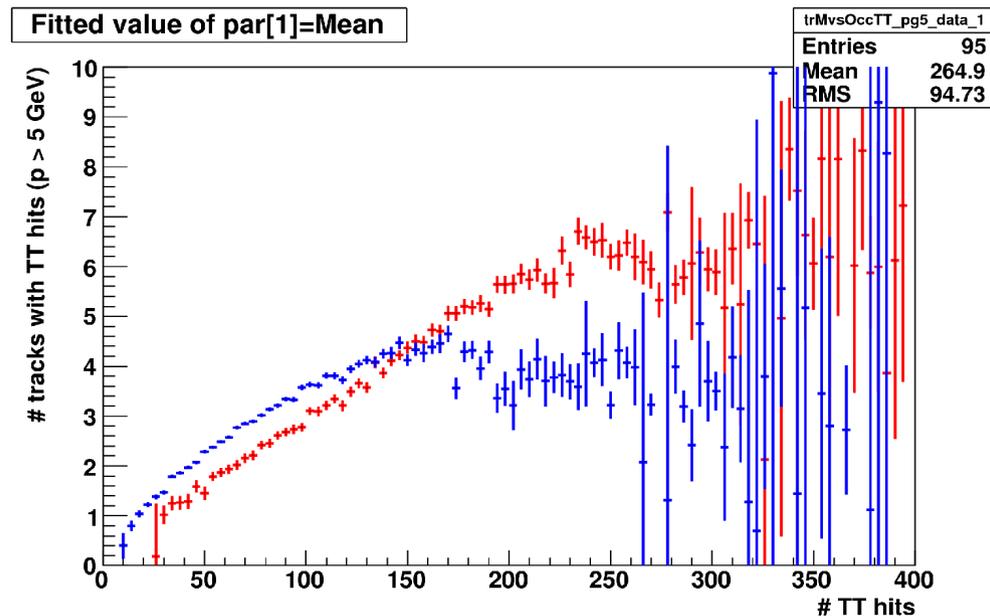
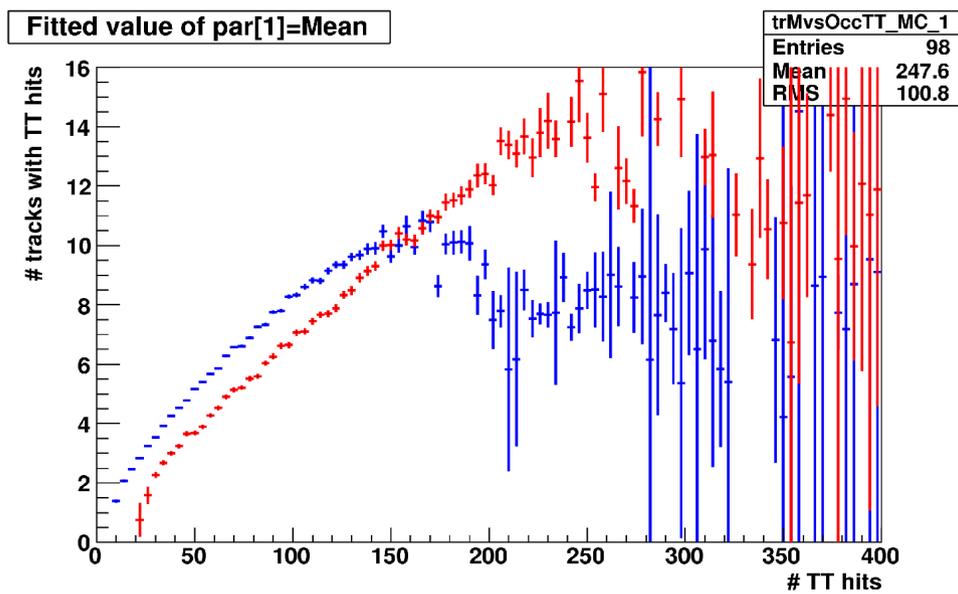
# Track-Multiplicity vs. Occupancies - TT

Blue: MC

Rec: data

Only tracks with hits in specific detector component are included, all track types

Out of best track container



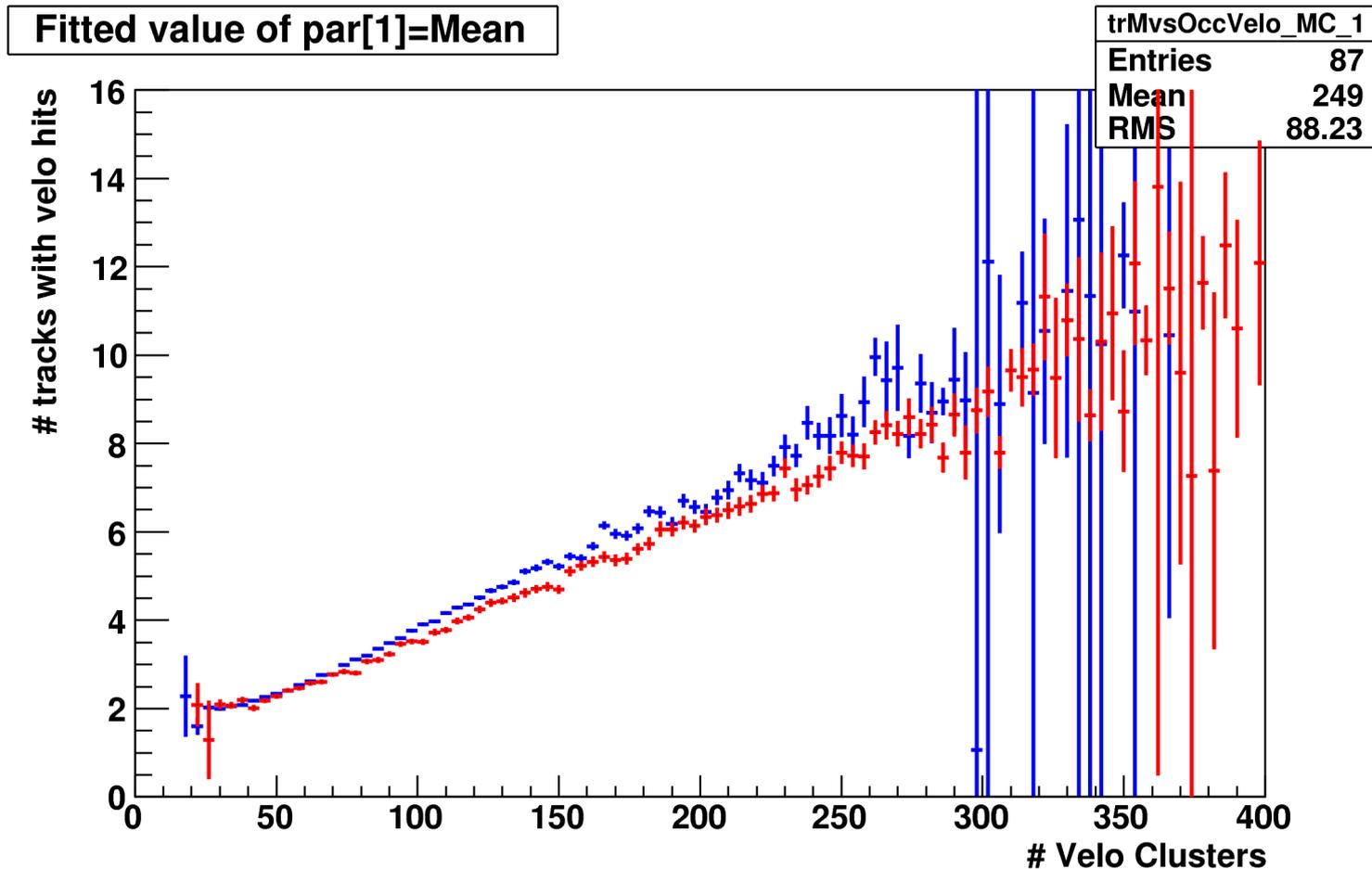
Drop is as well present in downstream track container.

Need to investigate source of shape

# Track-Multiplicity vs. Occupancies - Velo

Blue: MC  
Rec: data

All tracks with velo clusters are include (#cluster = #phi + #R clusters)

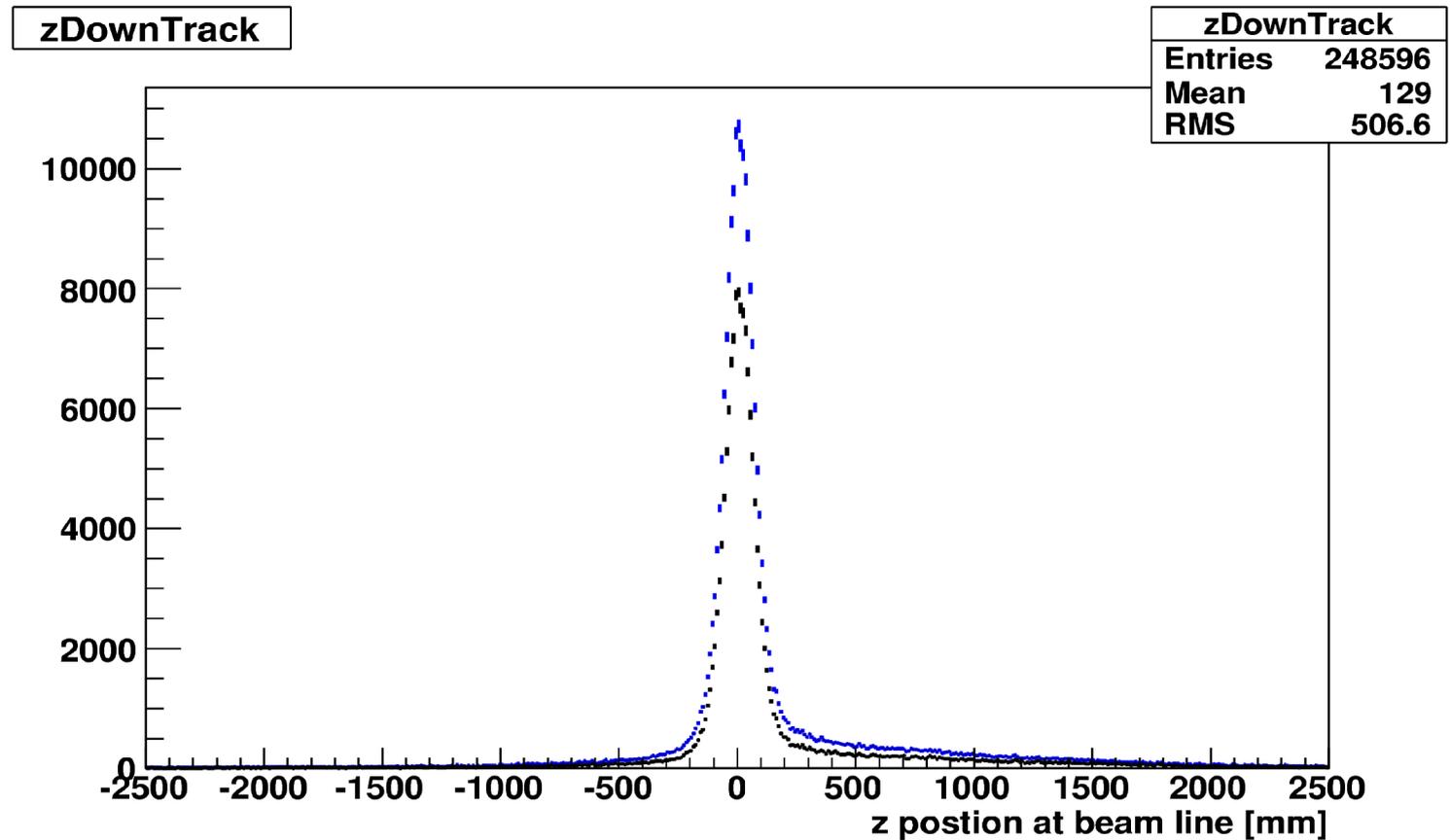


Very good agreement, slight difference might be related to misalignment

# Z Distribution of tracks (Monte Carlo)

Black: downstream tracks associated to MC truth

Blue: all down tracks



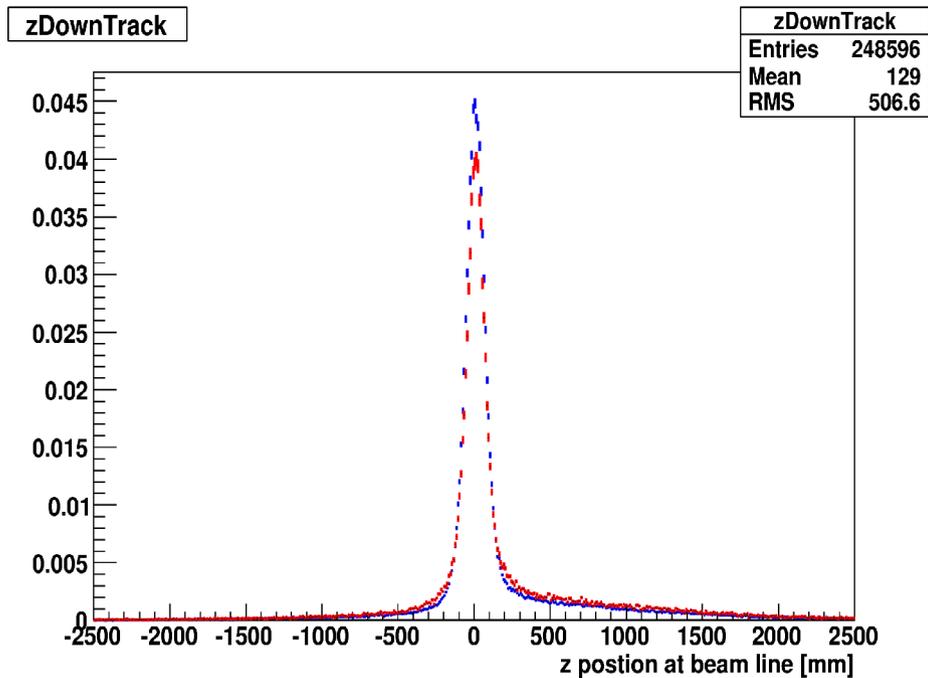
with loose reco, we are sensitive to tracks originated between velo and TT, ghost rate comparable to PV region

(extrapolate tracks to z-position which is closest to beam line)

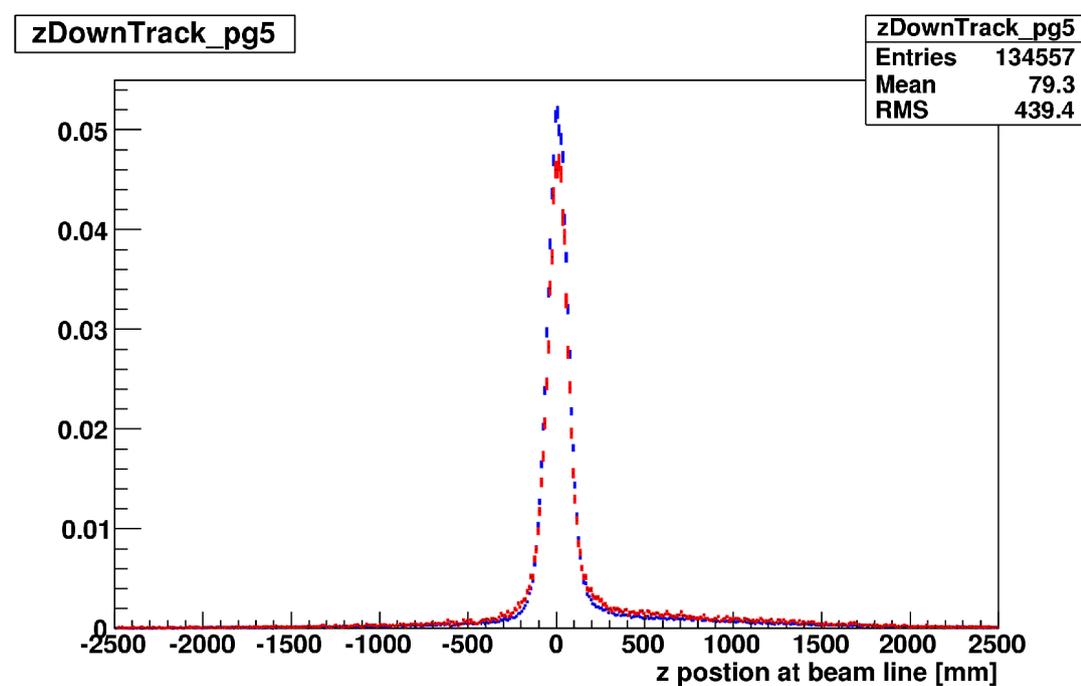
# Z Distribution of Tracks

Blue: MC

Rec: data



all tracks



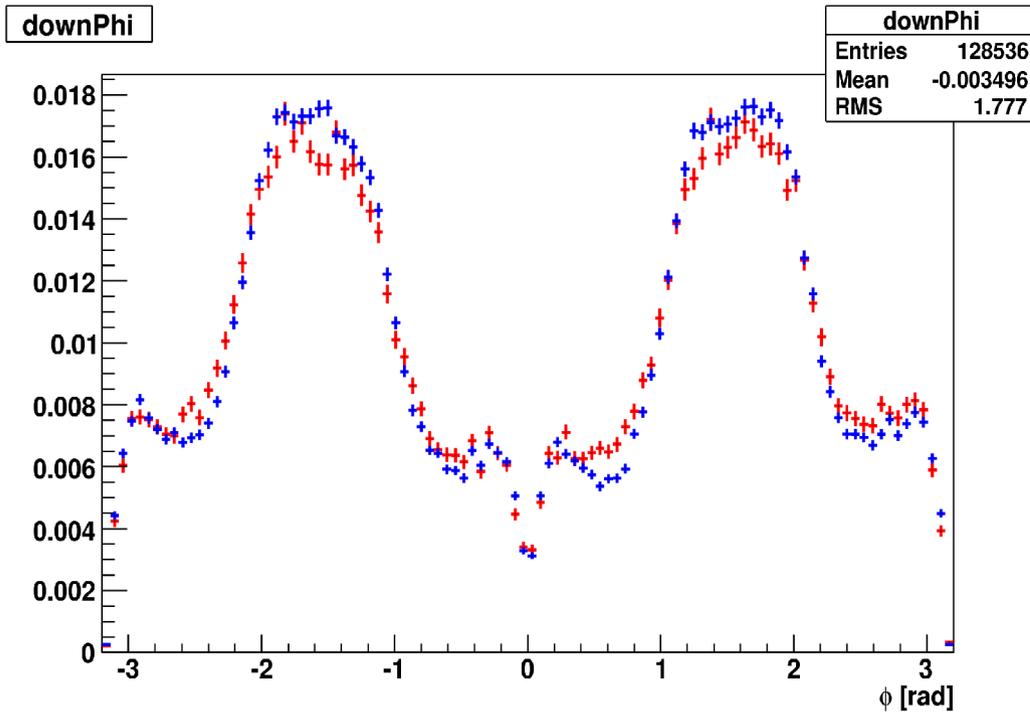
p>5 GeV

Distribution very similar between data and MC, no additional source of tracks visible (lower resolution due to misalignment, plots normalized to same area)

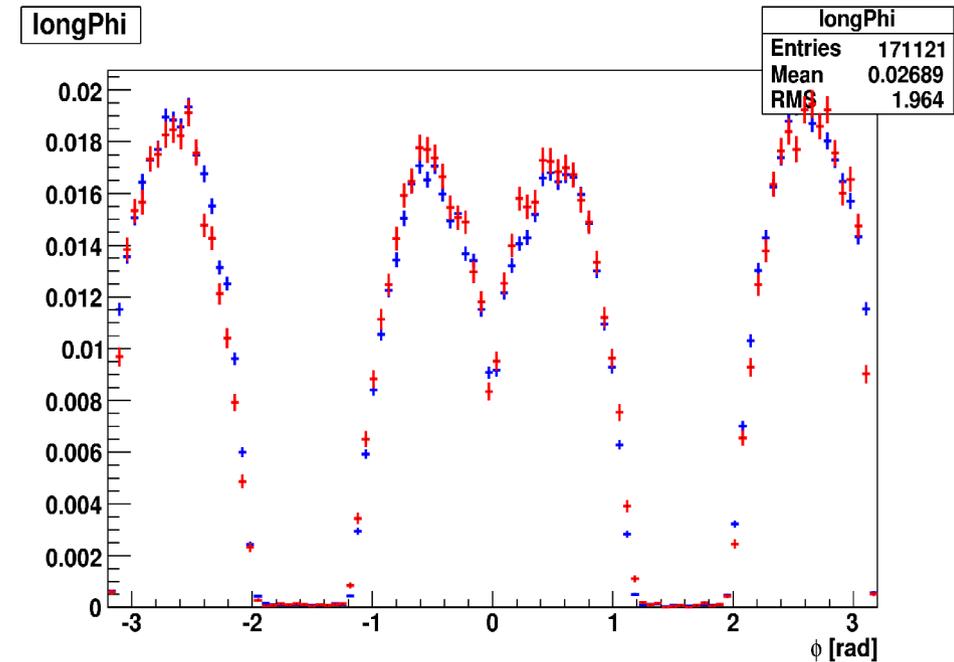
# $\Phi$ Distribution of Tracks

Blue: MC

Rec: data



Downstream tracks out of best container

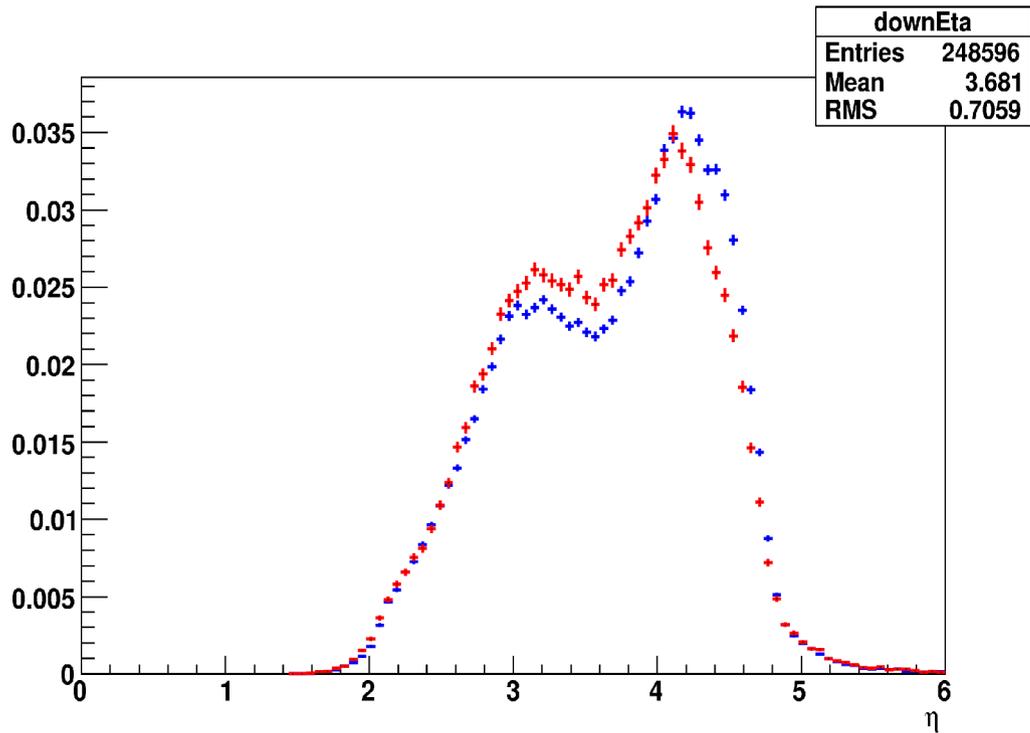


long tracks out of best container

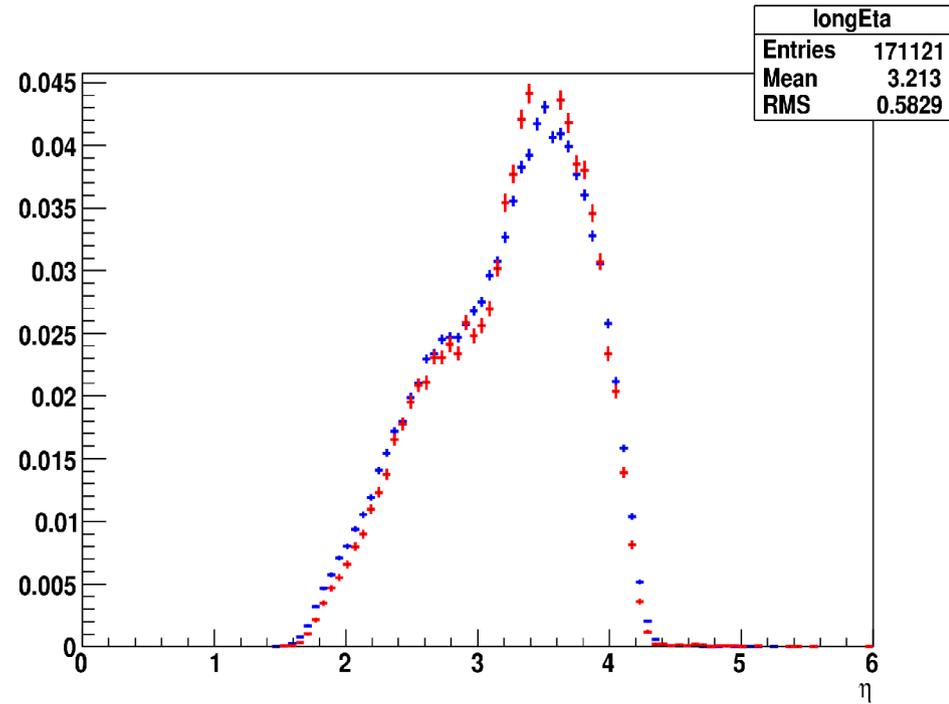
For downstream only plots see later

# $\eta$ Distribution of Tracks

Blue: MC  
Rec: data



Downstream tracks

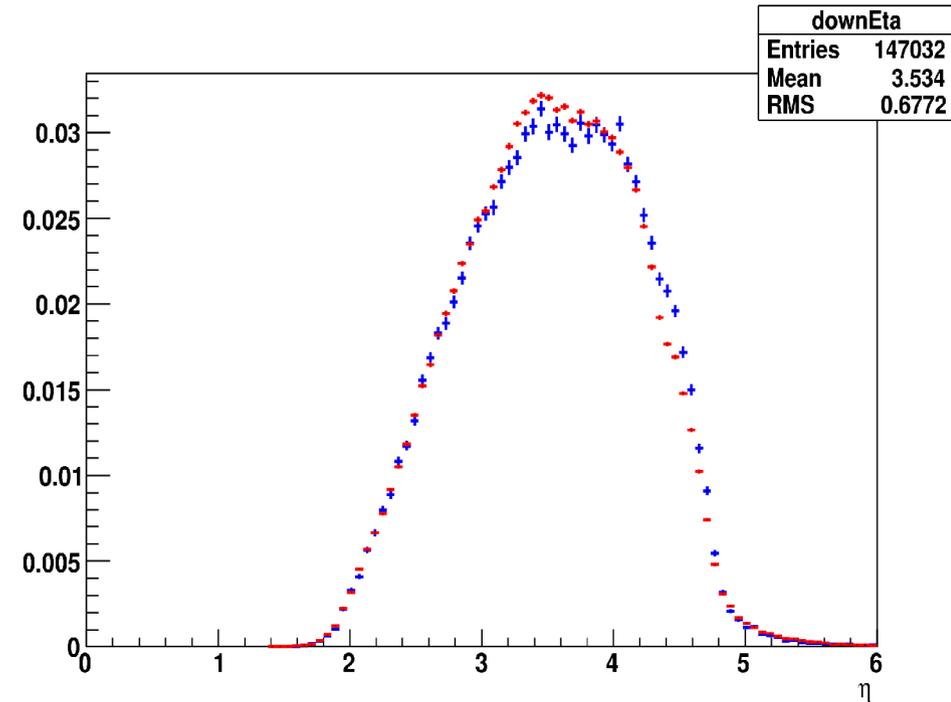
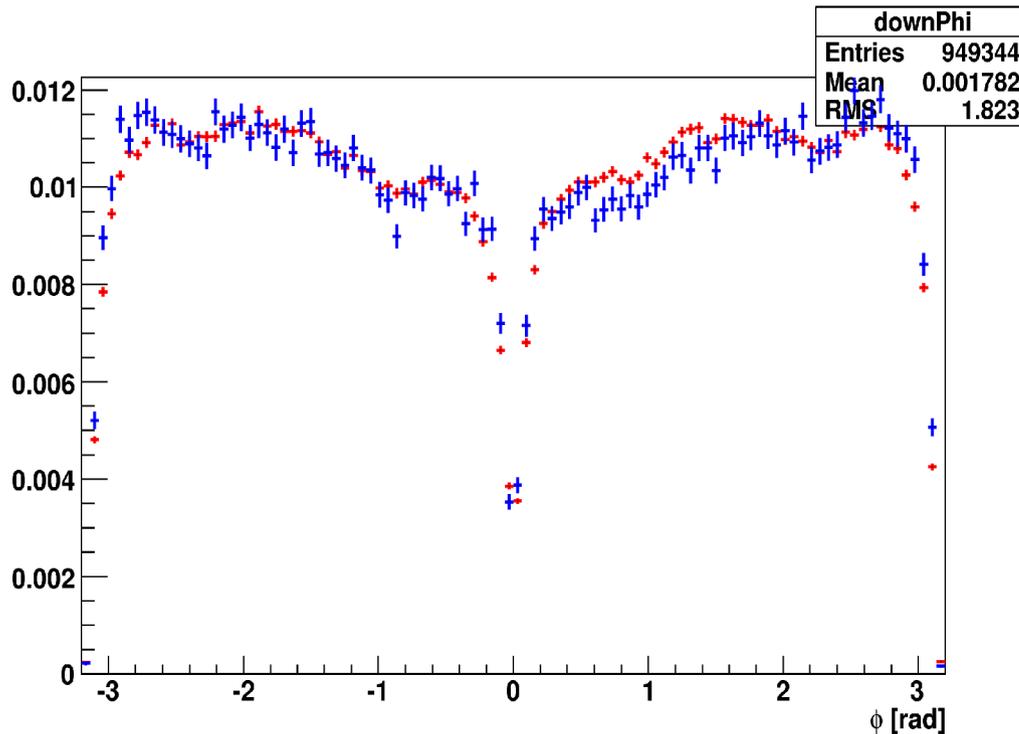


long tracks

# Tracks out of Downstream container

Blue: MC

Rec: data



Significant better agreement; different in shapes seen in downstream tracks in best container potential artefact of different long and down stream eff. In data & MC

# Summary

- Track multiplicity versus Occupancy in “kind of agreement” especially for velo and IT
  - additional hits seem to come from real tracks
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- Need to investigate origin of shapes we see in Monte Carlo (plateau in OT track multiplicity, drop in TT track multiplicity)
- z-distribution of tracks in very good agreement between data and MC
  - no hint for additional source of tracks
  - ratio of tracks from PV and tracks from material IA downstream of the velo very similar