Study of correlation between track based MET and Calo based MET using cosmic data

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Why measuring MET with track?

- Provide an alternative measurement
- --Different detector has different un-related systematic effect
- Can associate tracks to primary vertex, can calculate MET and SumPt based on primary vertex of the event ,thus more correlated to true MET of the main physics process – important in pileup case
- Will deteriorate less than calorimeter based variables as instantaneous luminosity increase
- Has less effect due to cosmic muon and beam background
- Disadvantages :

❑ --See only charged particles

❑ --Smaller geometrical coverage

❑ --Momentum resolution get worse in higher Pt

Trackmet tool could be used in rejecting these background in W/Z analysis :

❑QCD jet background
❑Cosmic background
❑Pileup background
❑Beam halo background

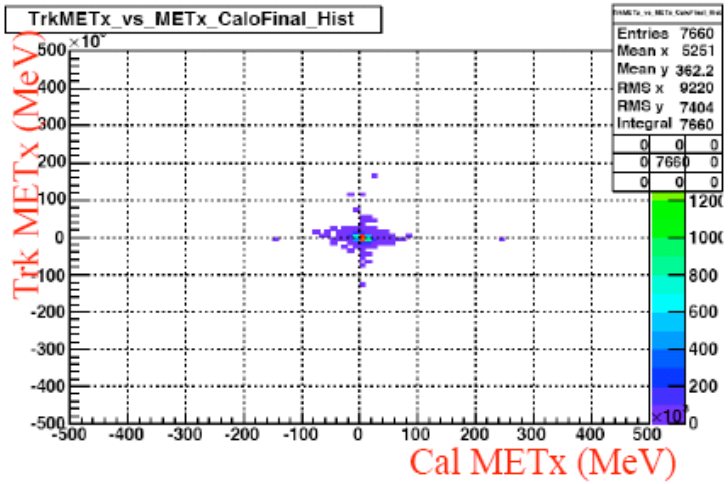
How to calculate Track based MET?
Loose track selection or tight selection ?

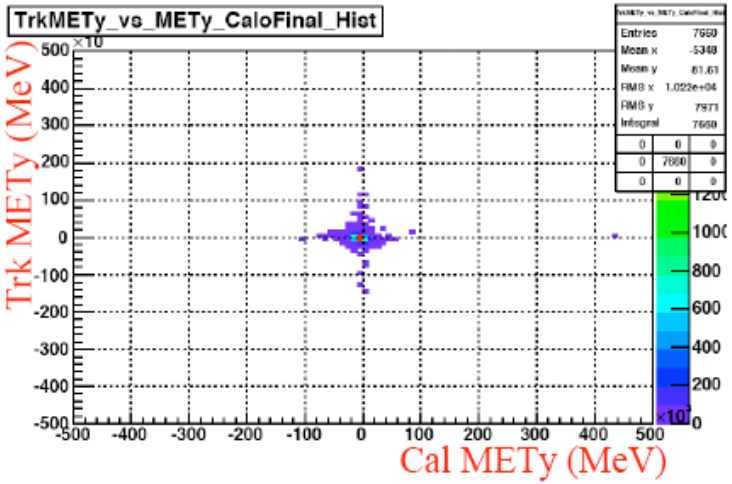
- Select good tracks for this measurement
- ❑ Select tracks from primary interaction
- ❑ Remove tracks from conversion
- Too loose or too tight could worsen Track MET resolution
- This track selection criteria need more time to do careful study
- Current track selection cut for reconstructing track MET :
- ❑ |Track _z0 respect to primary vertex |<20 mm
- ❑ |Track _d0 respect to primary vertex |<2 mm
- ❑ Track_Pt>0.5GeV , Track_Pt<300GeV
- ❑ Number of pixel hits >=2
- ❑ Number of SCT hits >=6
- ❑ Track MET = -1 *(Vector sum of the selected track momentum)
- ❑ The work of Implementation of Track based MET algorithm in official MissingET reconstuction package is on going

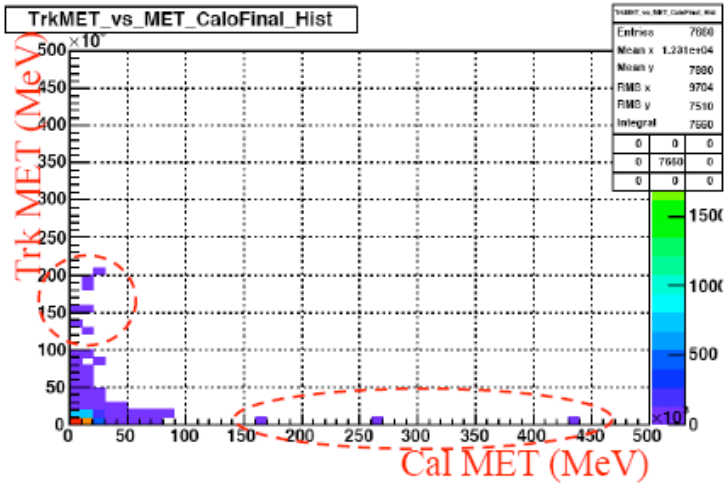
Example :using TrackMET in cosmic overlay MC sample

Track_MET VS Calo_MET

(J1 +cosmic)







- Events indicted by red circles are fake MET Events
- since they have
  - ❑ large CaloMET but small TrackMET
  - ❑or large TrackMET but Small CaloMET

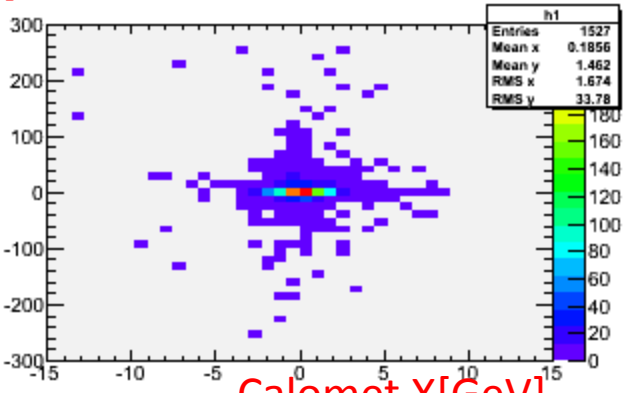
We would like to thank Ying-Chun Zhu and ketevi Assamagan for helping in understanding how to overlap events .

Example :using TrackMET in pure cosmic data 2008

- 29 Runs with Magnetic field on
- Stream: ID comm
- Event selection criteria :
- Sum Calo energy >0GeV
- Track selection criteria :
- |d0|<30mm ,|z0|<30mm

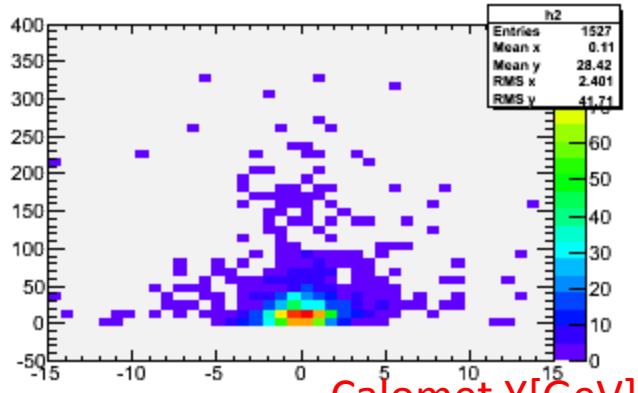
- Most cosmic events have large Track momentum but no significant Energy deposition in Calo
- No much correlation between TrackMET And CaloMET

Trackmet X[GeV]



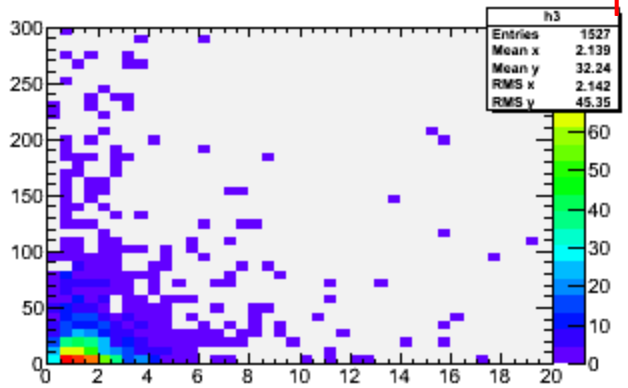
Calomet X[GeV]

Trackmet Y[GeV]



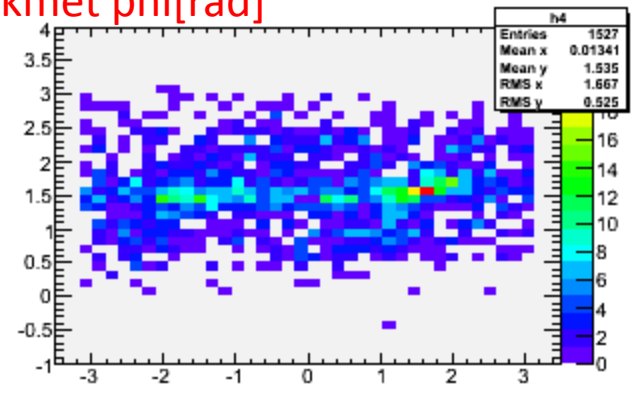
Calomet Y[GeV]

Trackmet [GeV]



Calomet [GeV]

Trackmet phi[rad]



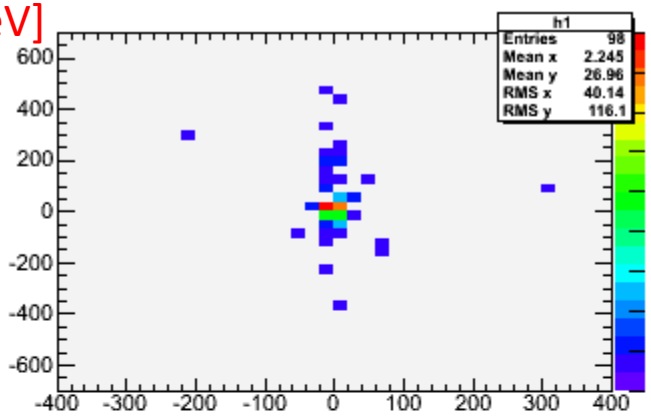
Calomet phi[rad]

Example :using TrackMET in pure cosmic data 2008

- 29 Runs with Magnetic field on
- Stream: ID comm
- Event selection criteria :
- Sum Calo energy >13GeV
- Track selection criteria :
- |d0|<30mm ,|z0|<30mm

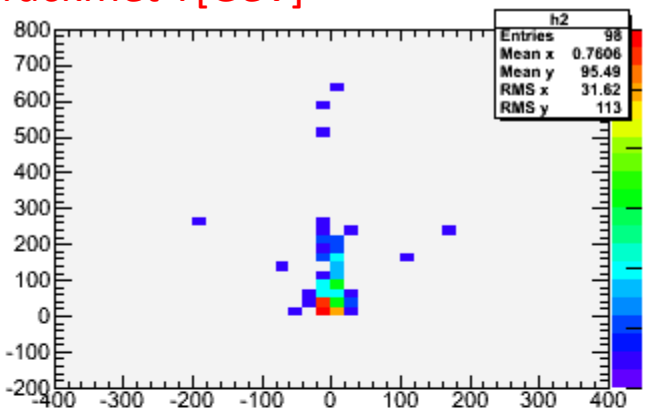
- Add one more cut on Sum Calo energy
- Biased events with large Cao deposition
- Begin to observe some correlation between TrackMET And CaloMET

Trackmet X[GeV]



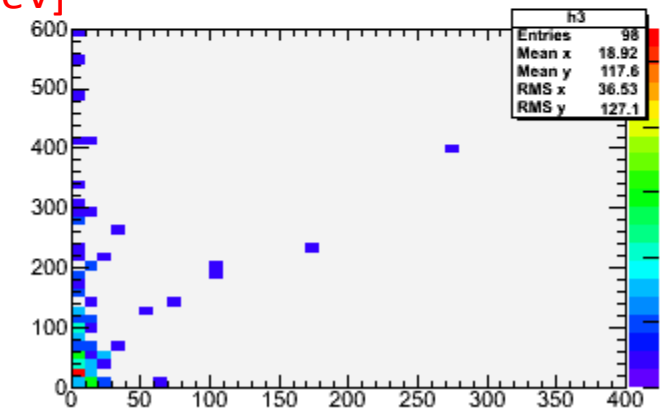
Calomet X[GeV]

Trackmet Y[GeV]



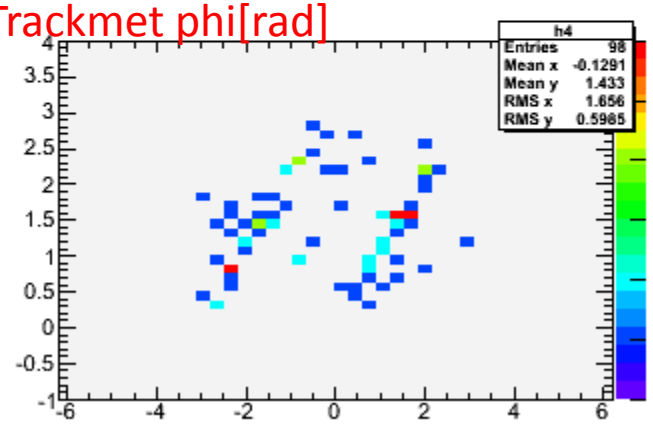
Calomet Y[GeV]

Trackmet [GeV]



Calomet [GeV]

Trackmet phi[rad]



Calomet phi[rad]

Summary

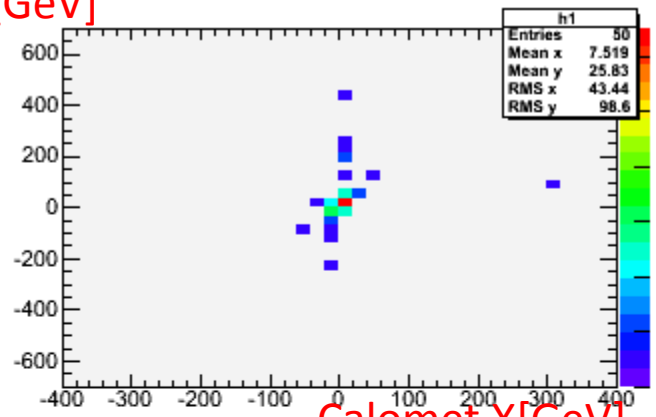
- TrackMET tool have potential in rejecting cosmic background in collision data.
- First result has been shown in pure cosmic data and cosmic overlay MC samples .

Discussion

- In page 6 lower left plot ,Where the correlation band and anti-correlation band comes from ?

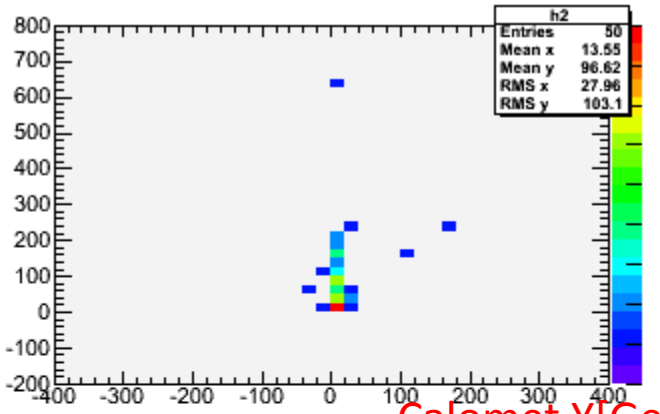
correlation band

Trackmet X[GeV]



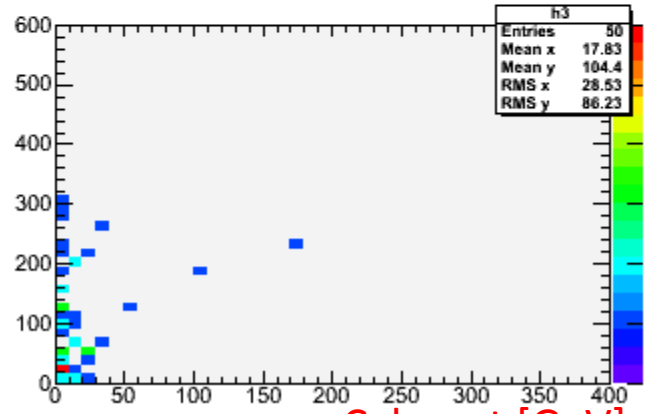
Calomet X[GeV]

Trackmet Y[GeV]



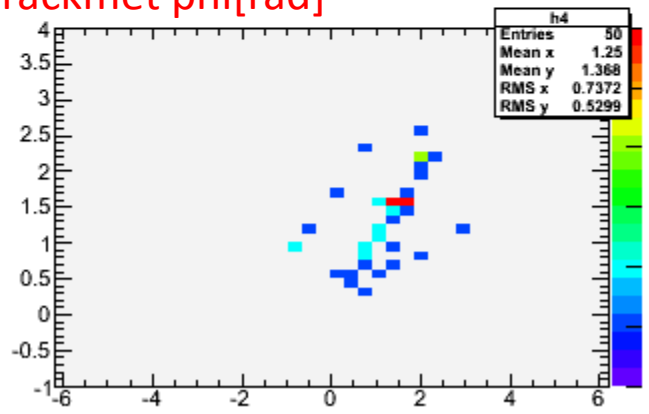
Calomet Y[GeV]

Trackmet [GeV]



Calomet [GeV]

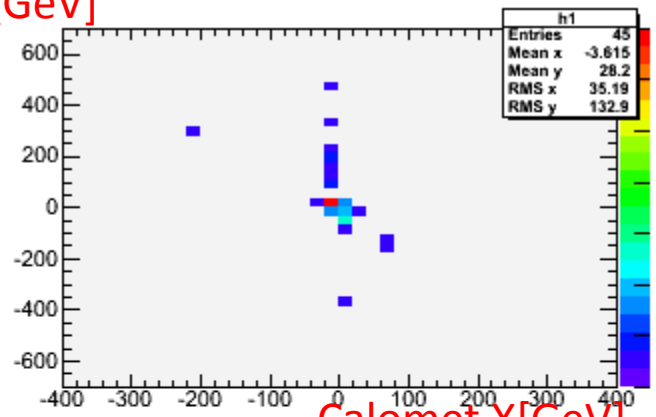
Trackmet phi[rad]



Calomet phi[rad]

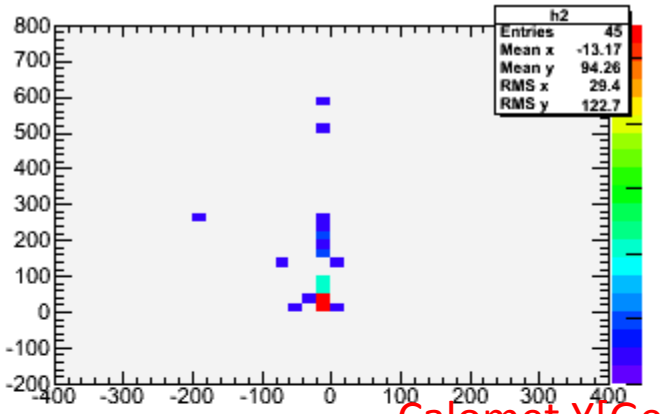
Anti correlation band

Trackmet X[GeV]



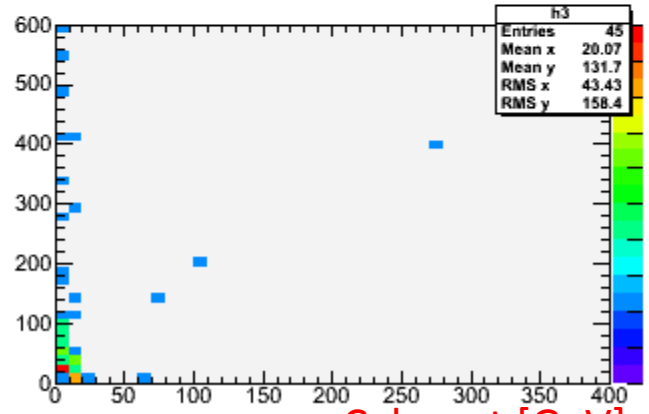
Calomet X[GeV]

Trackmet Y[GeV]



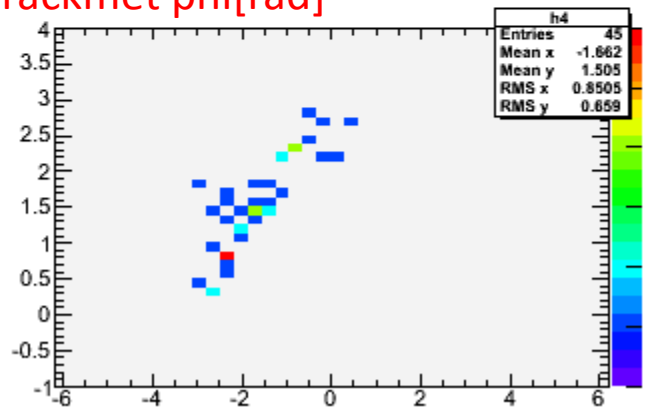
Calomet Y[GeV]

Trackmet [GeV]



Calomet [GeV]

Trackmet phi[rad]



Calomet phi[rad]

Where the correlation band and anti-correlation band comes from ?

- We assume Track momentum is always from top to bottom
- Cosmic muon candidates pass through Calo twice .
- Events in anti-correlation band corresponds to muon deposited its energy in its first entry to Calo.
- Events in correlation band corresponds to muon deposited its energy in its second entry to Calo.

Discussion

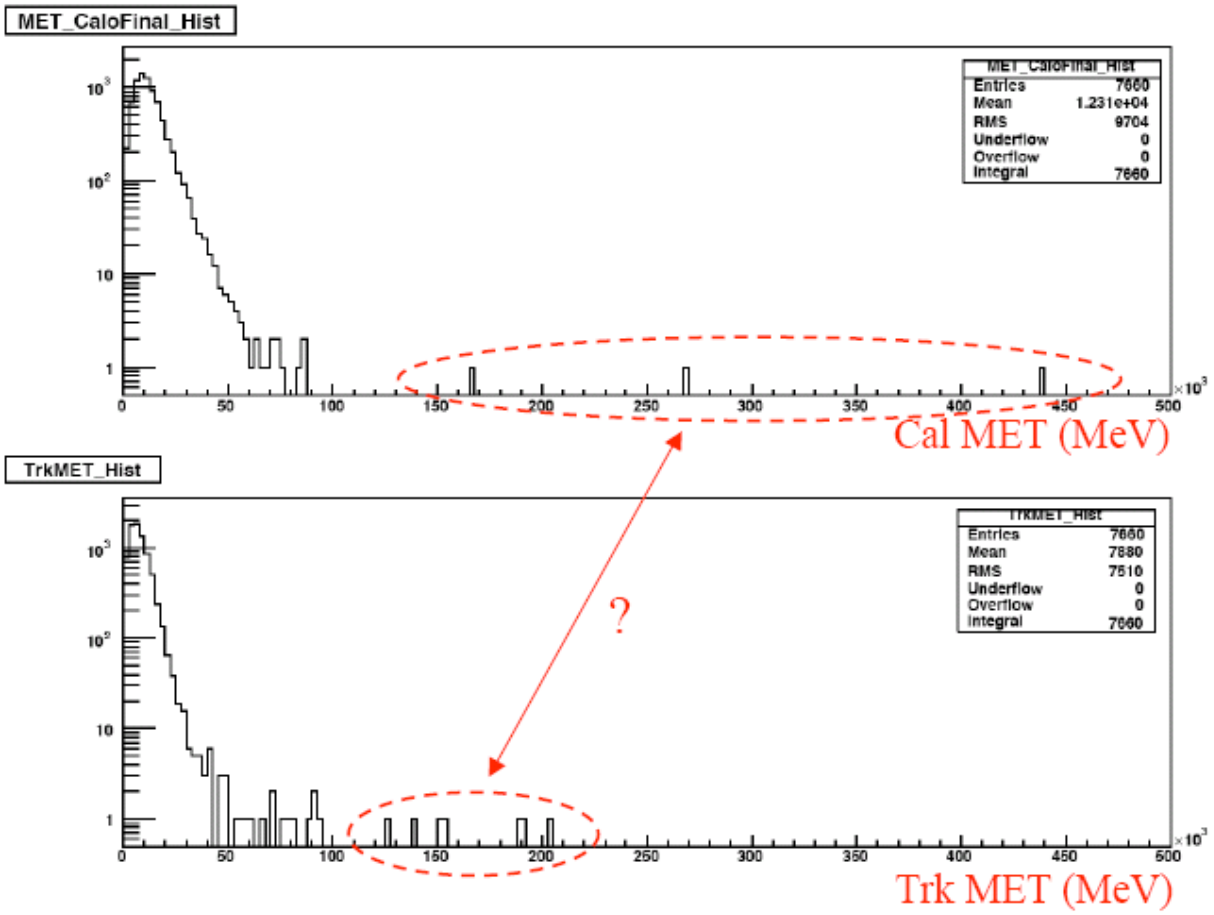
- How to understand the result in cosmic overlay MC samples ?

Using trackmet to reject Cosmic background

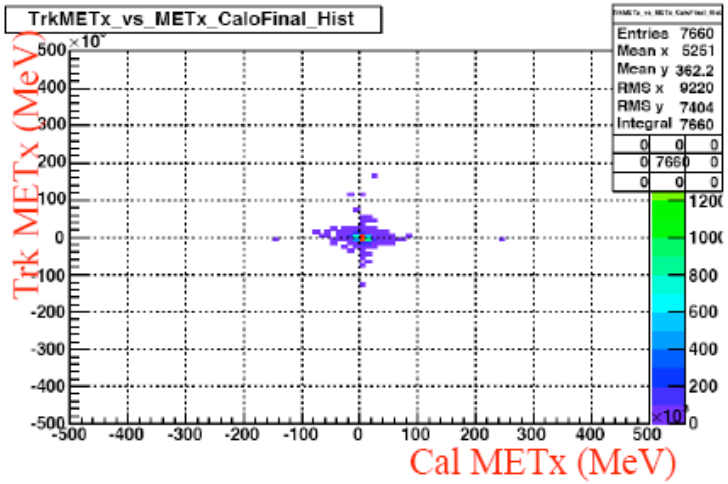
- Cosmic muon have chance to create large fake MET in case that muon shower or brem a hard photon inside calorimeter.
- If These cosmic events are in time with QCD jet events , and they will become non-collision background for W analysis.
- Trackmet tools could give some hints for us to reject such cosmic background events .
- Basic ideas is that Cosmic muon track have larger impact parameter compared to track from collision .
- So we could see energy imbalance in calorimeter , but not any momentum imbalance in tracking detectors .

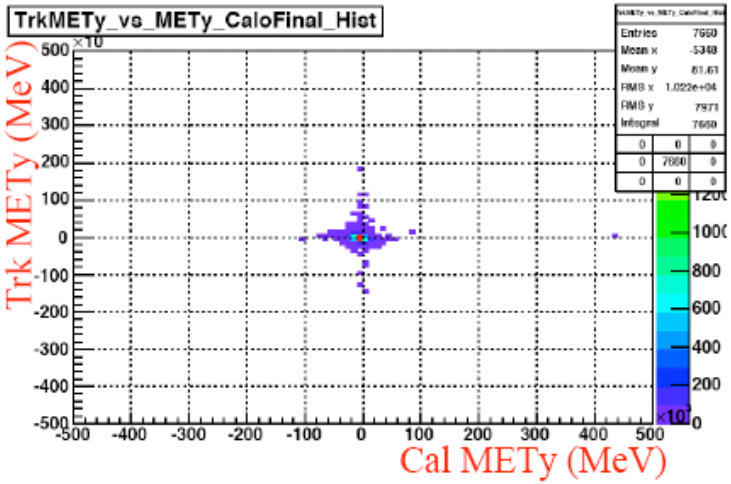
- QCD Dijet events :
- Observe no correlation between CAL_MET and Track_MET
- Can further reject QCD multi-jet background by requiring some correlation between MET measurement from calorimeter and tracking
- QCD Dijet Overlay with Cosmics :
- Overlay the simulated digitized hits from J1 dijet sample with cosmic muon data
- Samples :
- mc08.105010.J1_pythia_jetjet.simul.HITS.e344.s479_tid26864
- Cosmic data ,run=91890 ,IDCosmic stream
- We would like to thank Ying-Chun Zhu and ketevi Assamagan for helping in understanding how to overlap events .

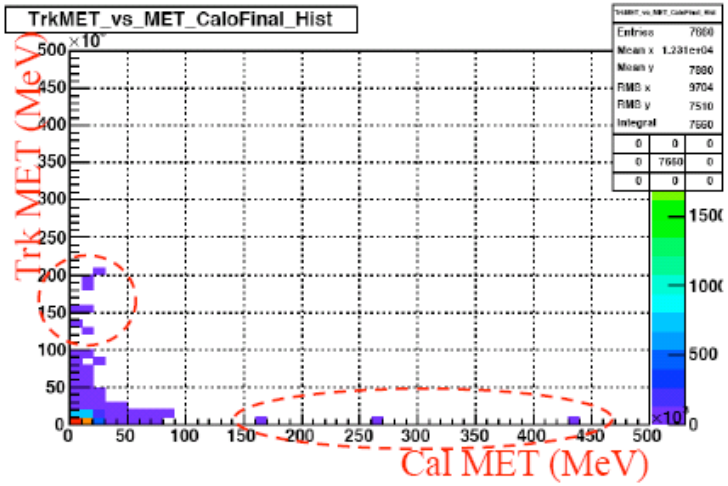
MET distribution (QCD Dijet J1+cosmic)



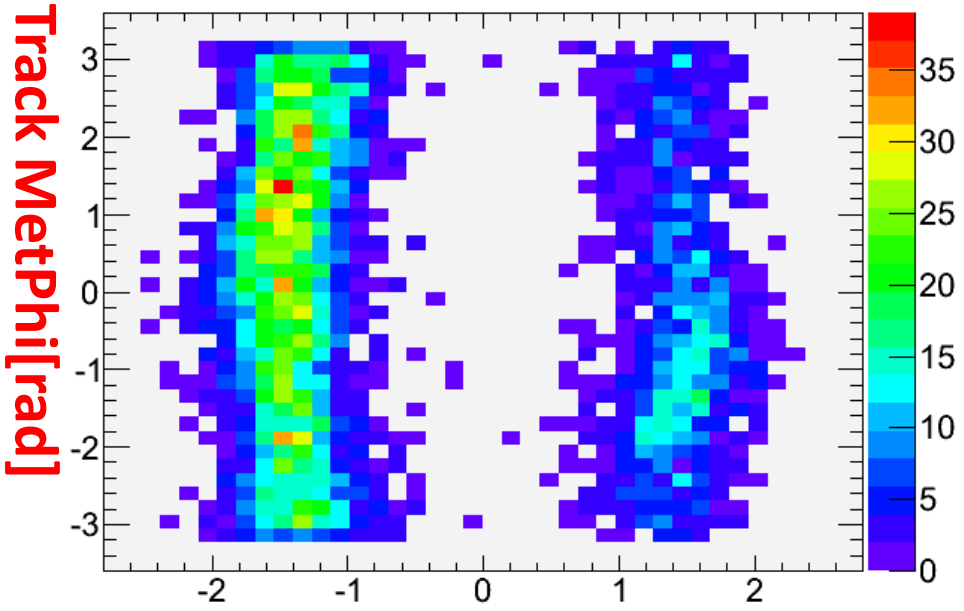
Track_MET VS Calo_MET (J1 +cosmic)

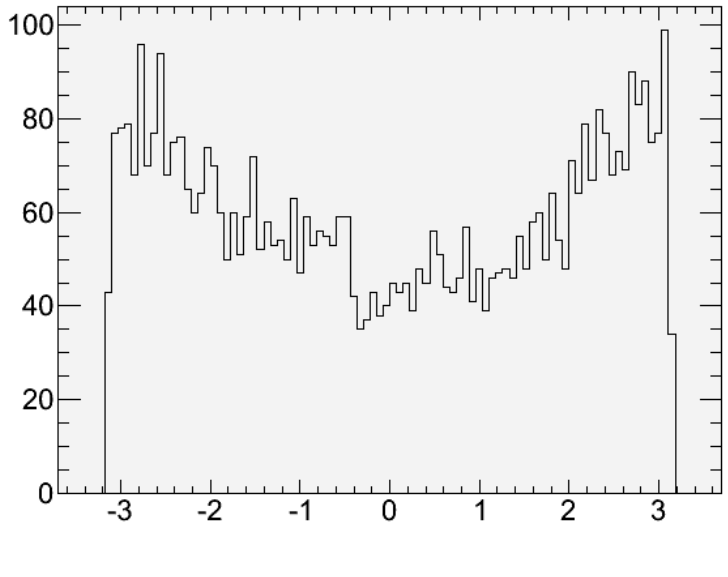






Angular correlation (J1 +cosmic)





- CaloMet phi is not uniform ,showing a typical cosmic signature
- while trackMet Phi still have uniform distribution .
- correlation between trackMET phi and Calo MET phi is still weak .

Event charge Fraction (ECF)

- Define another quantity using tracking and calorimeter information to reject non-collision background :Event Charge Fraction(ECF)
- This quantity has alson been used at CDF MET analyses to reduce non-collision background contribution .

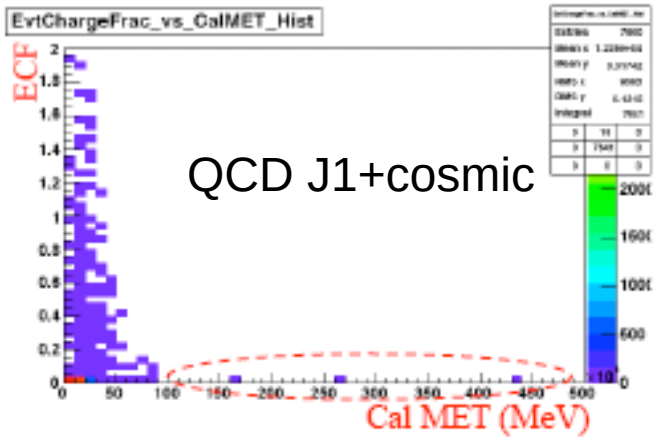
$$ECF = \frac{\sum_{i=0}^{Njet}(\sum_{j=0}^{ntrk} Pt_j)/Et_i}{Njet}$$

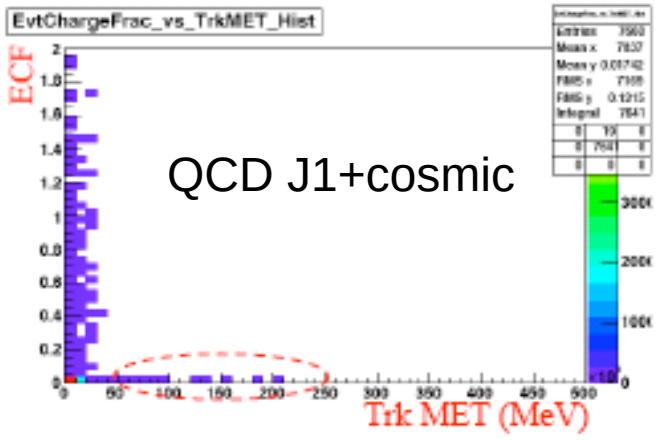
Jet :Et>15GeV , |eta|<2.5
Track:
- ❑Dr(trk,jet)<0.4
- ❑From primary vertex
- ❑Pt>0.5GeV
- ❑At least one silicon hit

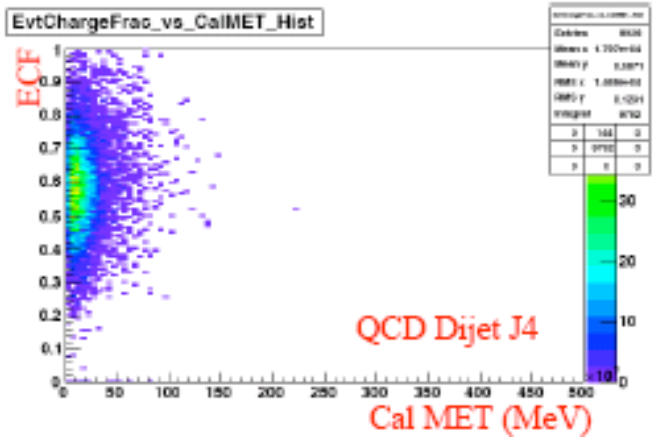
We expect :

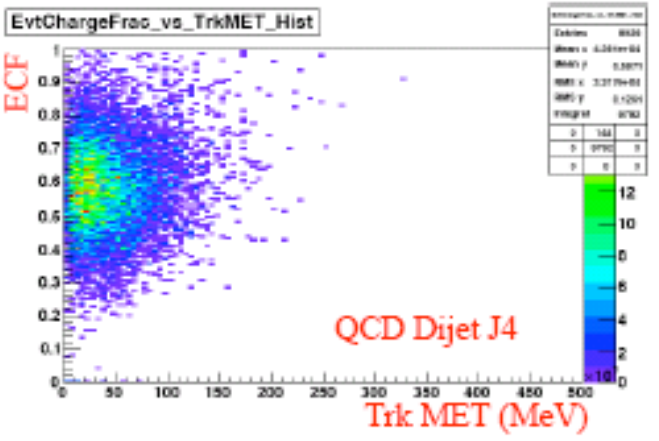
- ❑For collision events :ECF>0
- ❑For non- collision events :ECF~0

J1+cosmic


EvtChargeFrac_vs_CalMET_Hist
ECF
QCD J1+cosmic
Cal MET (MeV)

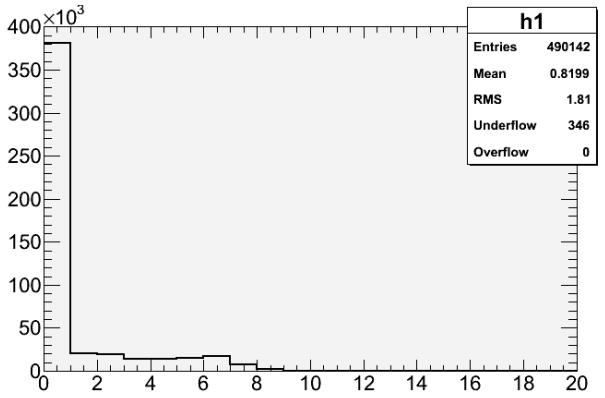

EvtChargeFrac_vs_TrkMET_Hist
ECF
QCD J1+cosmic
Trk MET (MeV)


EvtChargeFrac_vs_CalMET_Hist
ECF
QCD Dijet J4
Cal MET (MeV)

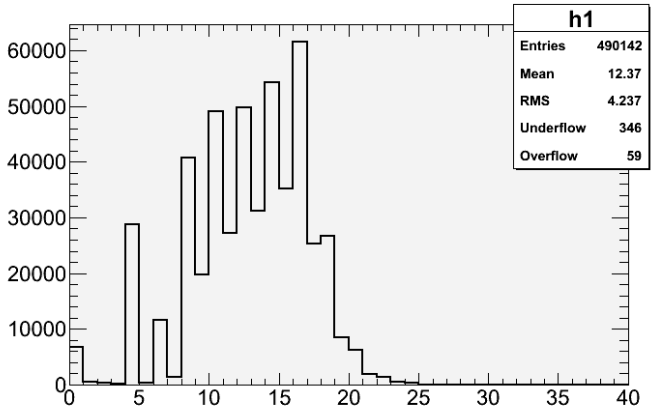

EvtChargeFrac_vs_TrkMET_Hist
ECF
QCD Dijet J4
Trk MET (MeV)

Backup : Track quality in Cosmic data 2008

Number of pixel and SCT hits per track

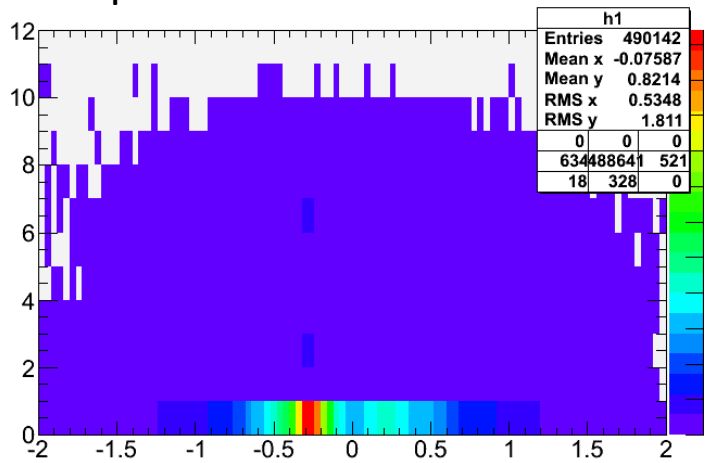


Number of pixel hits



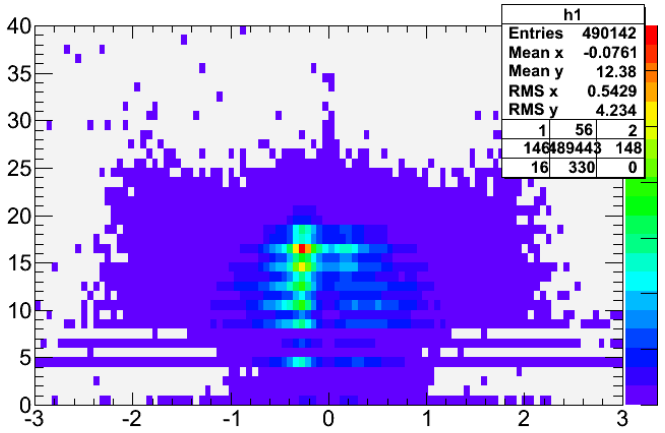
Number of SCThits

Number of pixel hits



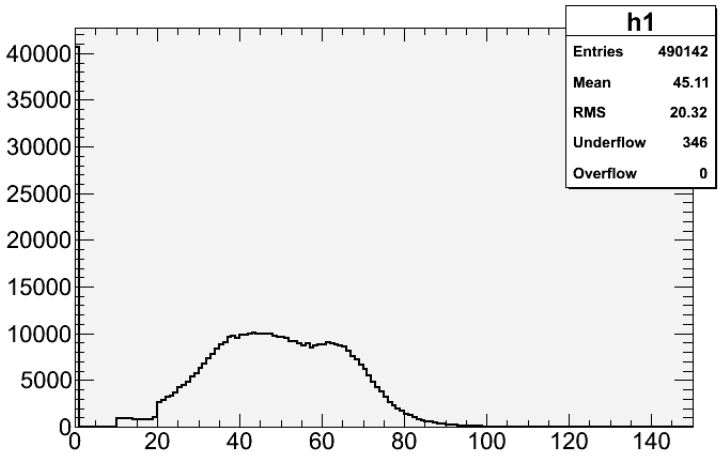
eta

Number of SCThits



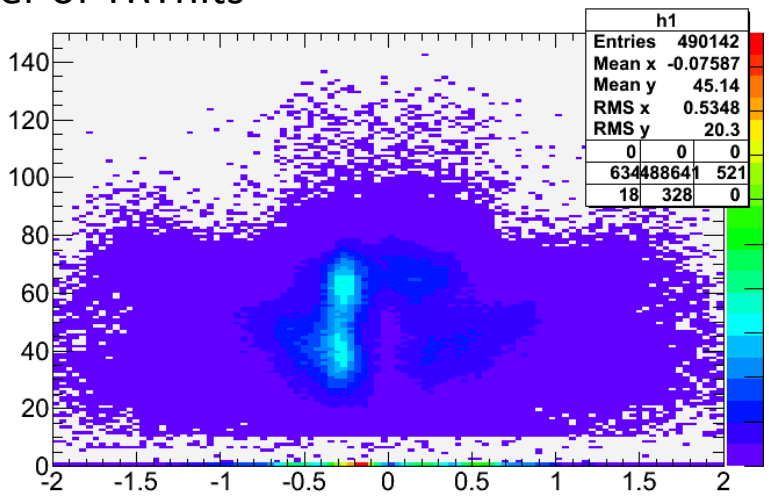
eta

Number of TRT hits per track



Number of TRThits

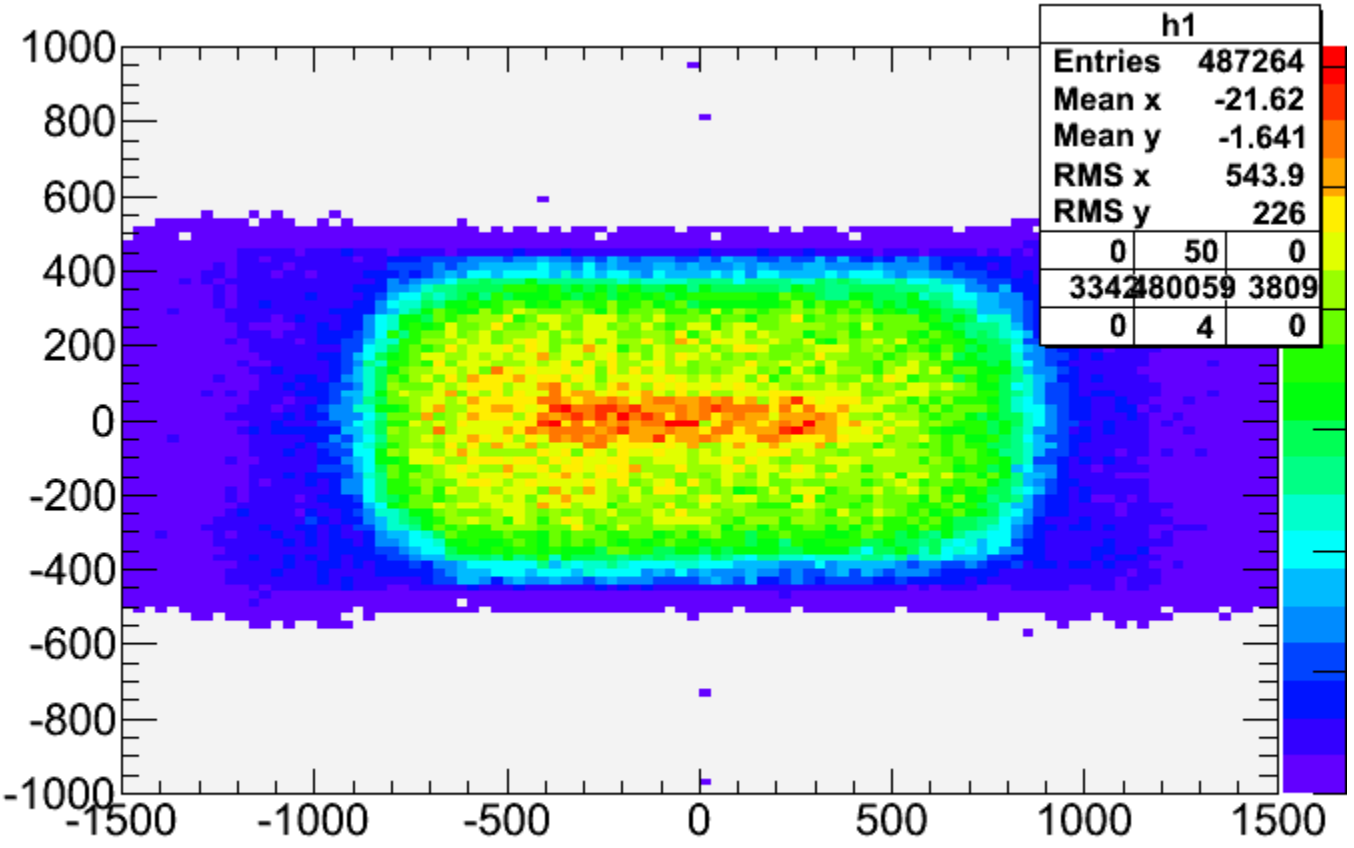
Number of TRThits



eta

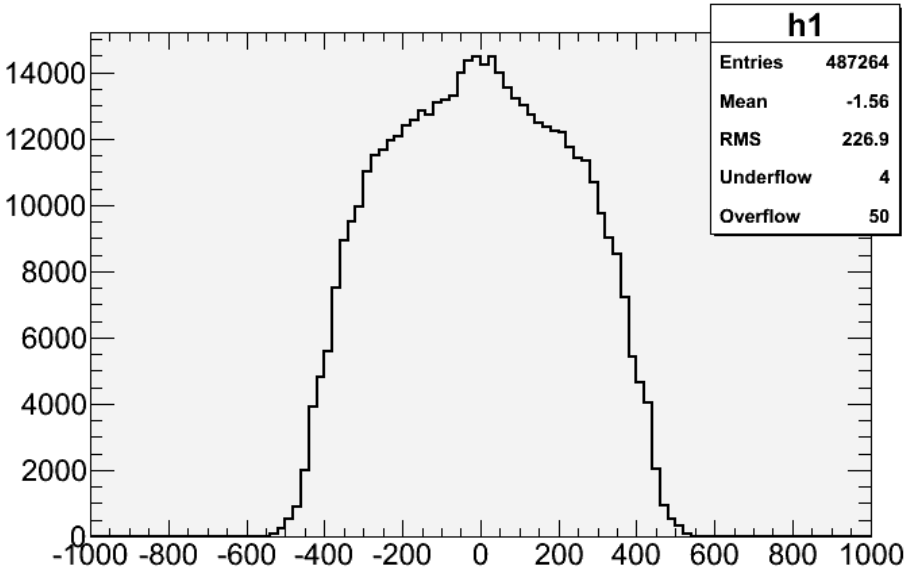
Track impact parameter in ID comm stream
Z0 VS D0

d0(mm)

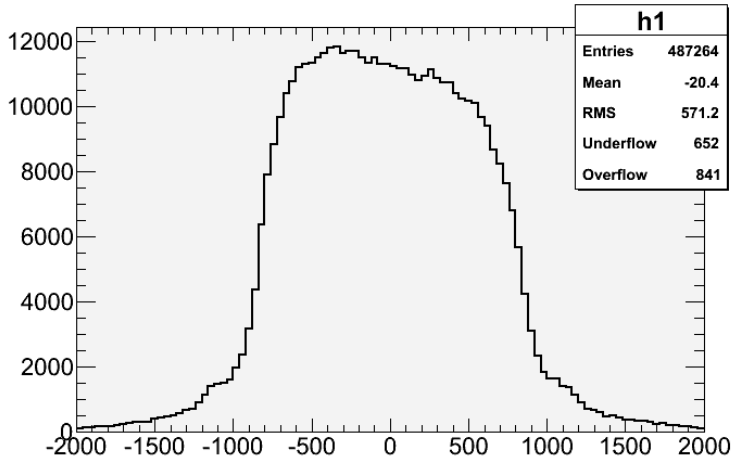


Z0(mm)

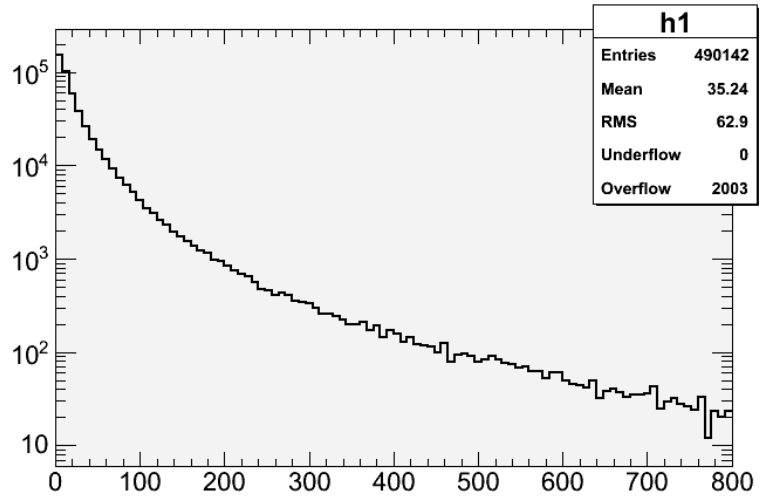
Track impact parameter in ID comm stream



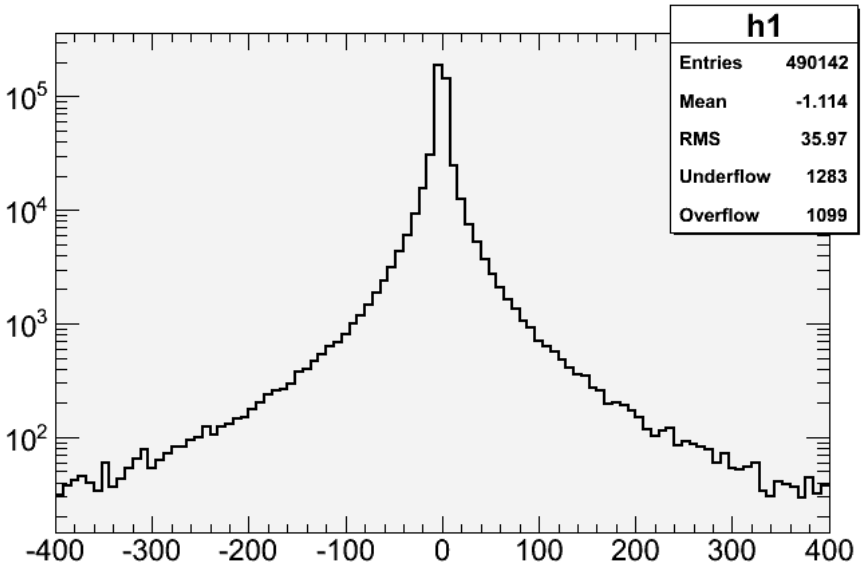
D0(mm)



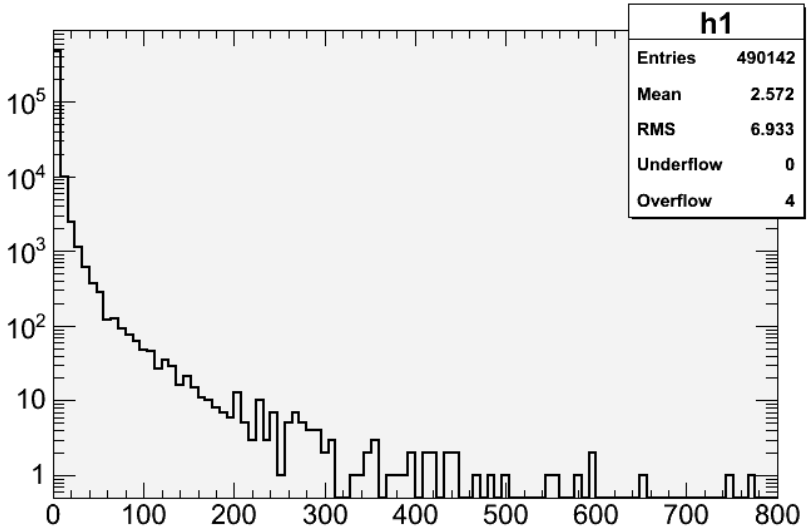
Z0(mm)



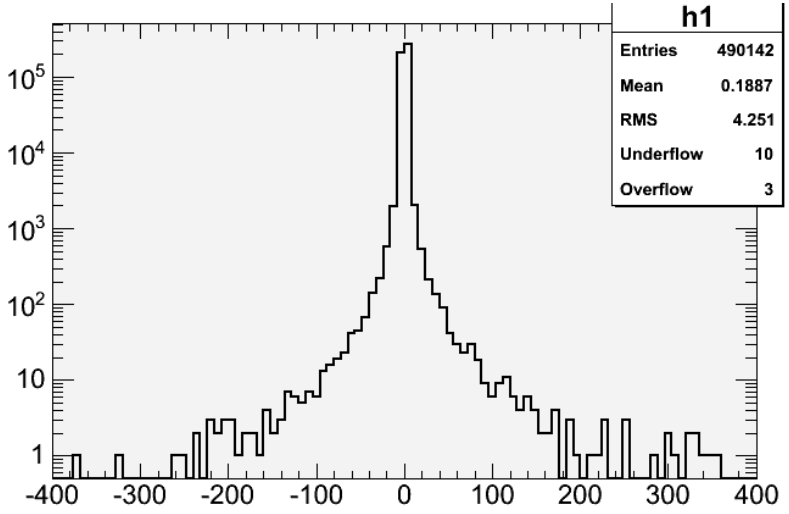
Trackmet[GeV]



Trackmetx[GeV]



Calomet[GeV]



Calometx[GeV]