Update on QCD FeedThrough for $W \rightarrow \mu\nu$ analysis

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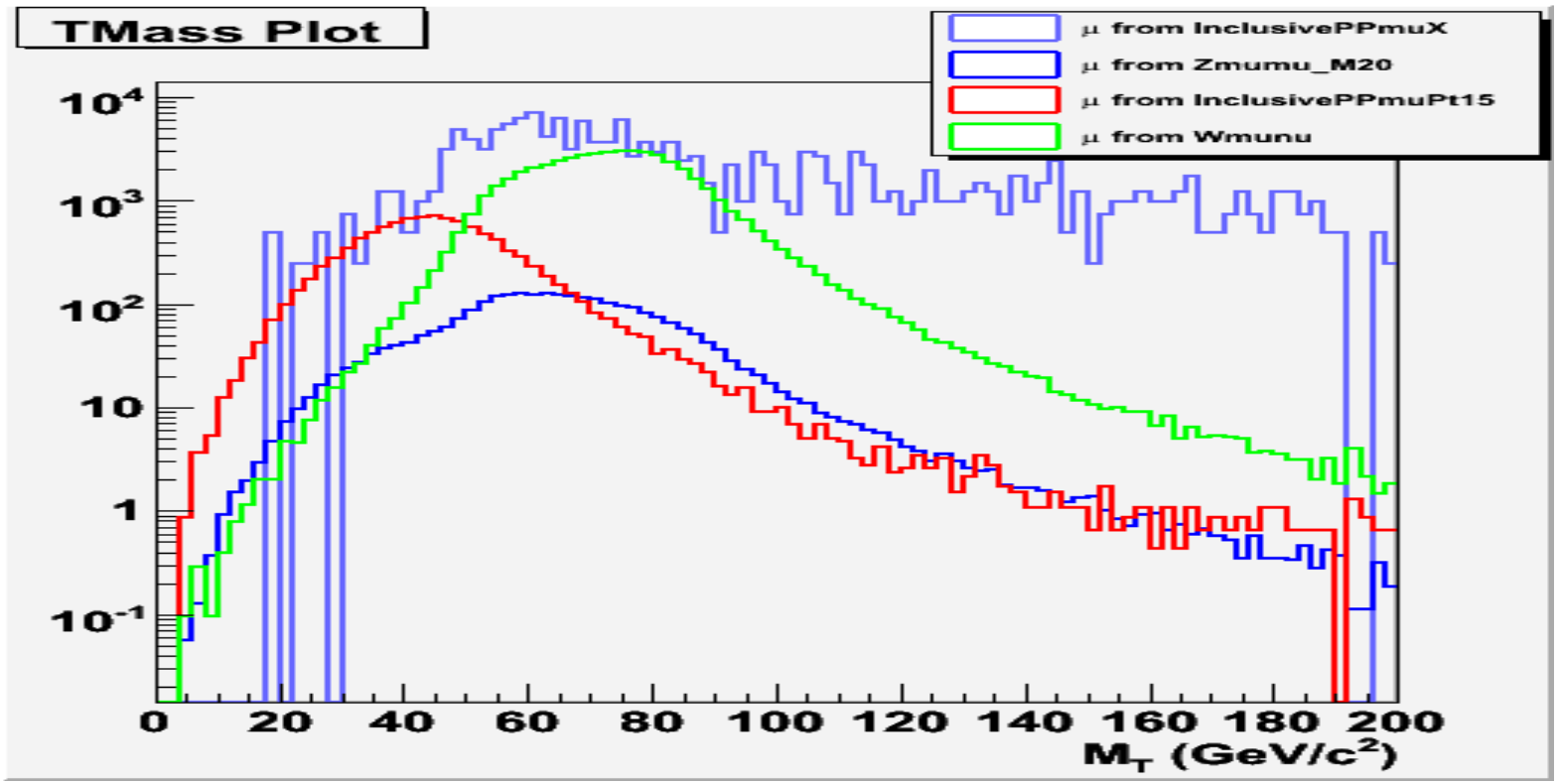
TMass (using PfMet) after all cuts including `InclusivePPmuX`



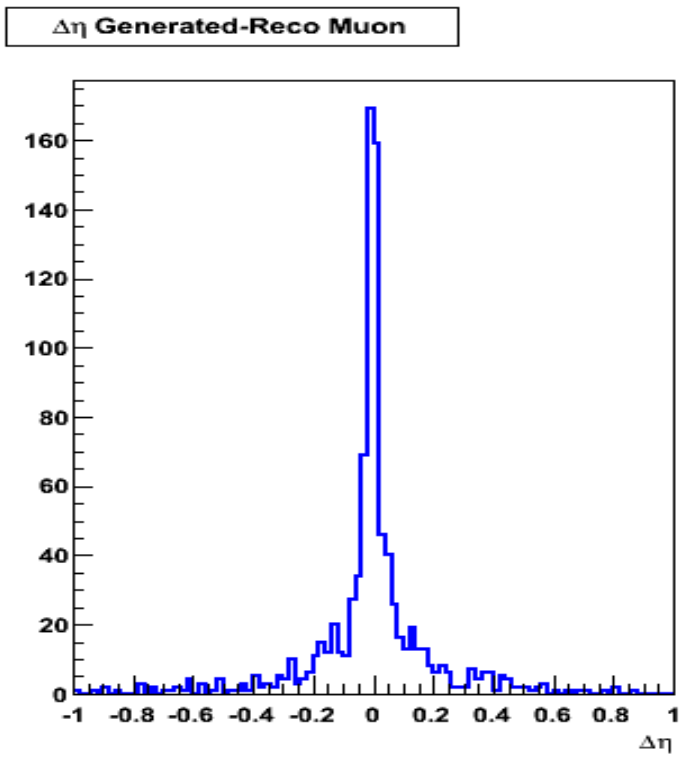
Feed-through of low pt muon *dominates* the signal

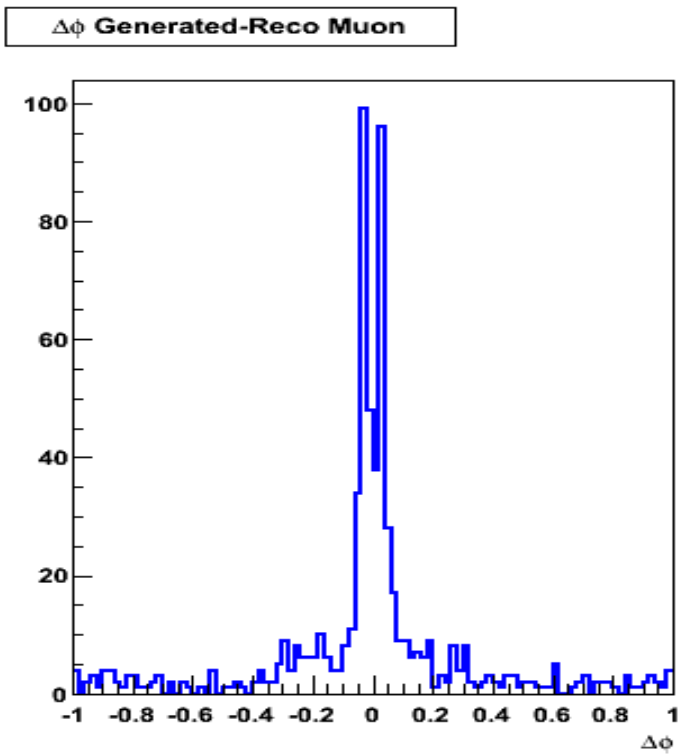
Origin of the reconstructed muons

- Search for matched generated muons in ΔR cone not so easy
- these are badly reconstructed muons, ϕ and η can be rather far from generated;
- after manual scan, just search for a generated μ with $p_t > 1$ *Gev*, anywhere
- in most of the case only 1 generated muon is present;
- $\Delta\eta$, $\Delta\phi$ wrt reconstructed shows that is the right one.

Selected 900 events which pass all cuts: all of them has a generated μ with $p_t > 1$ *Gev*.

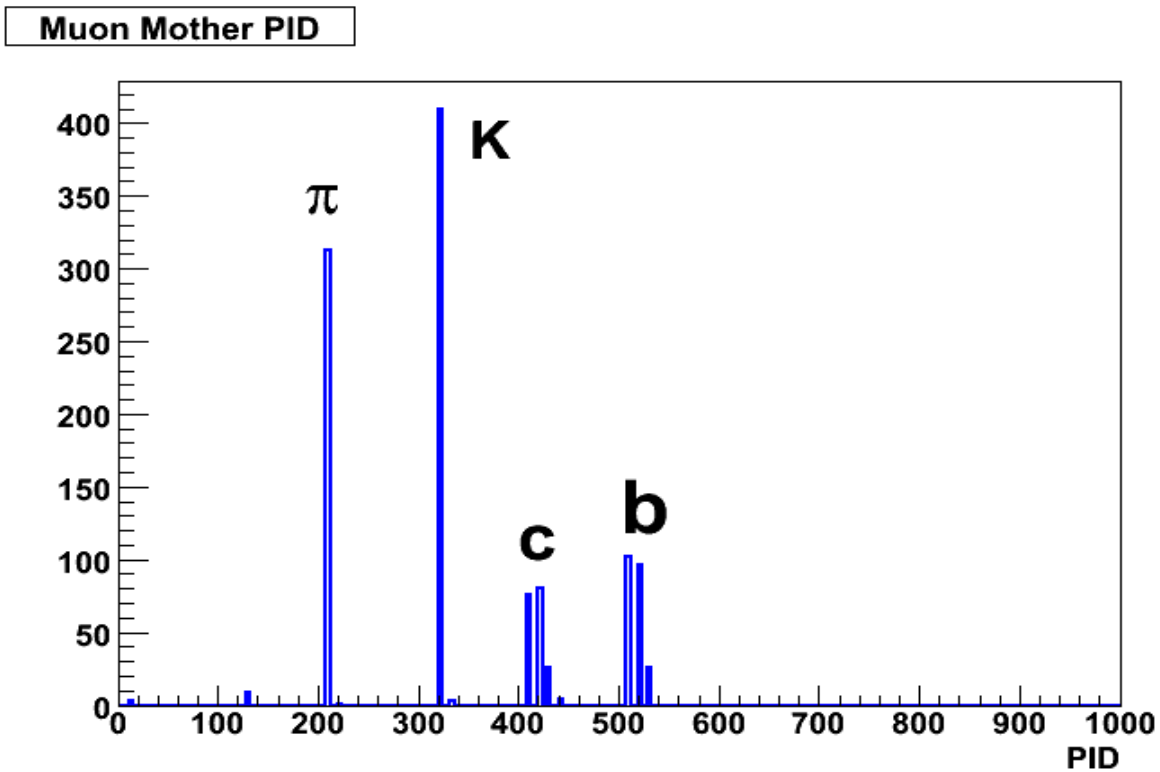
$\Delta\eta$, $\Delta\phi$ reco-gen muon





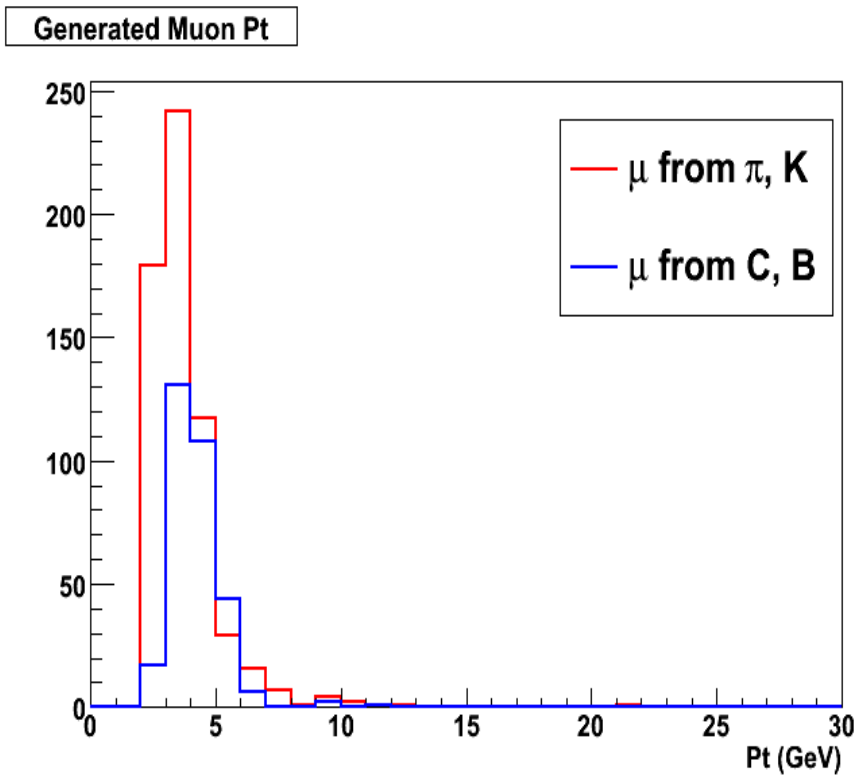
- $\Delta\eta, \phi$ is rather good: in most of the case I'm looking at the right generated muon.

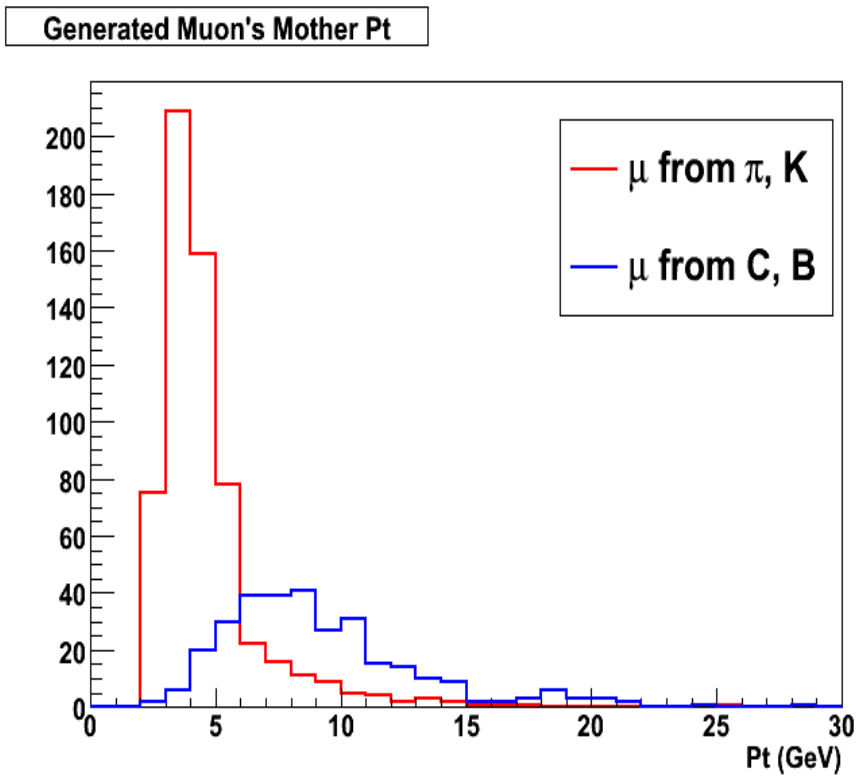
Origin of the muons



- 600/909 = 2/3 of the muons come from π/K DIF
- 309/909 = 1/3 of the muons come from c/b!

p_t of generated muons





Low Pt muons

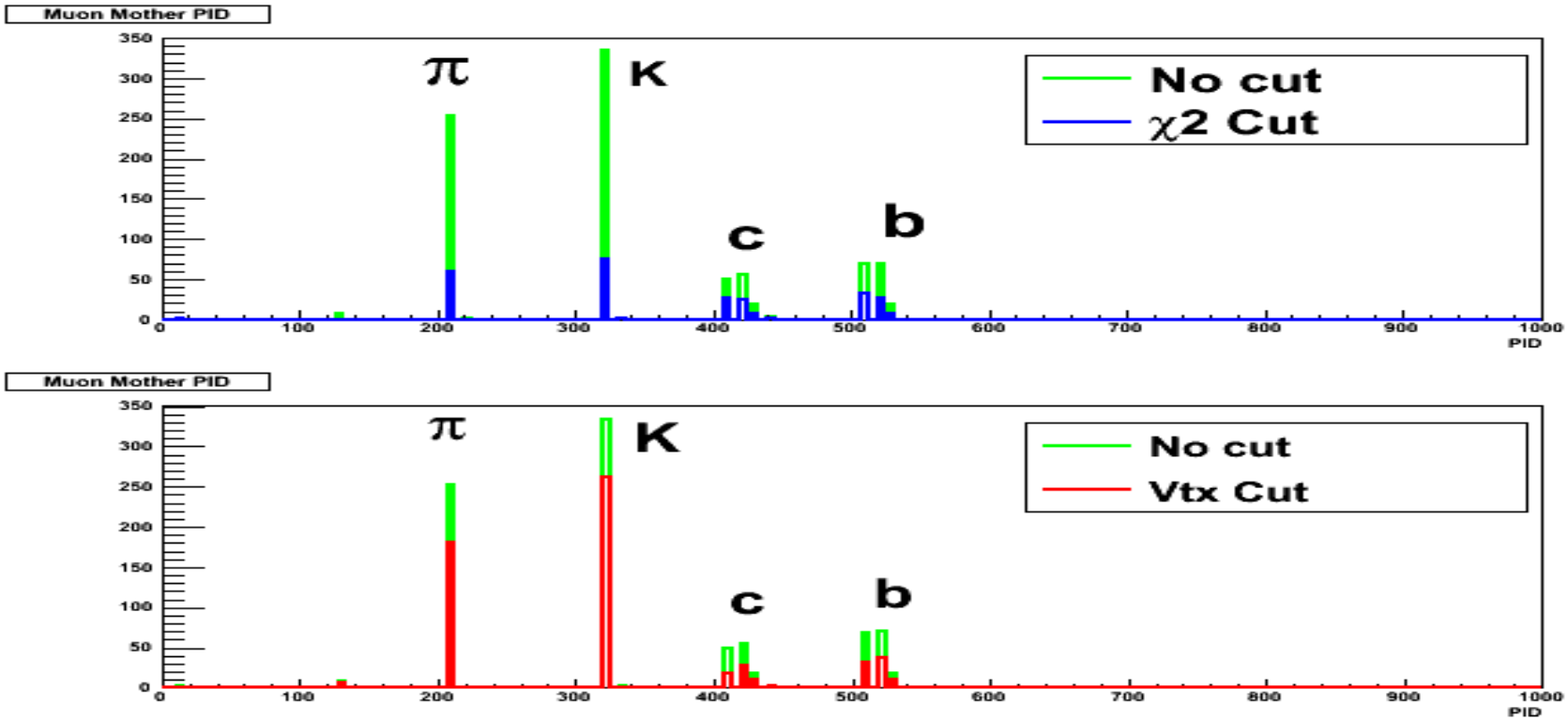
NB: Reco μ $p_t > 25$ *GeV*

Quality Cut to reject these muons

- `TMLastStationOptimizedLowPtTight` Good for Mu station
- $\chi^2/NDoF < 10$ Good reconstruction
- $vtx_\mu.rho < 20\ cm$, $|vtx_\mu.Z| < 20\ cm$ from Primary vtx
- $d0_\mu < 2\ mm$ ditto

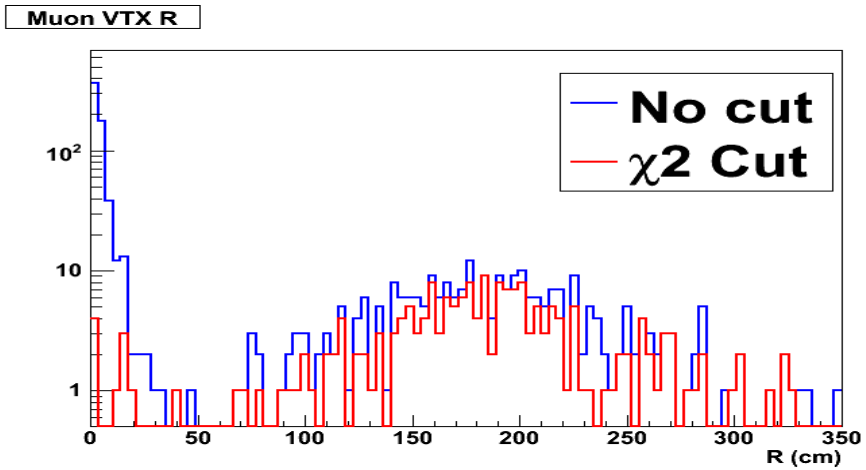
Study effect of the cuts for π/K vs b/c population.

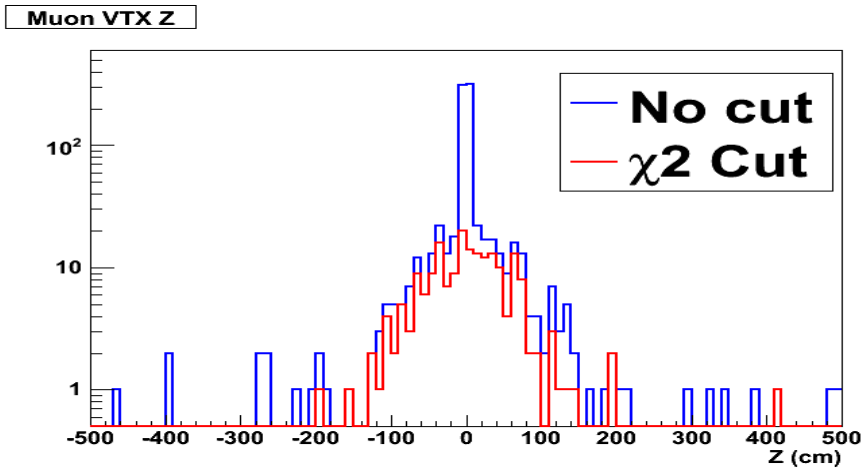
PID of muon's mother after cuts

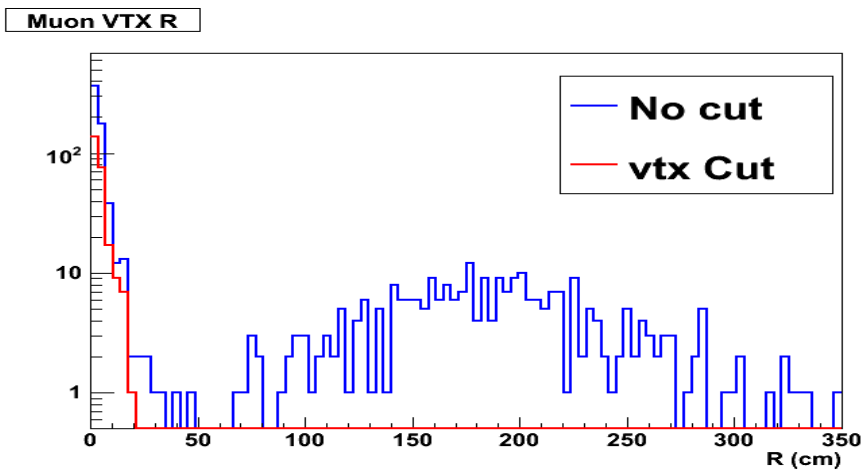


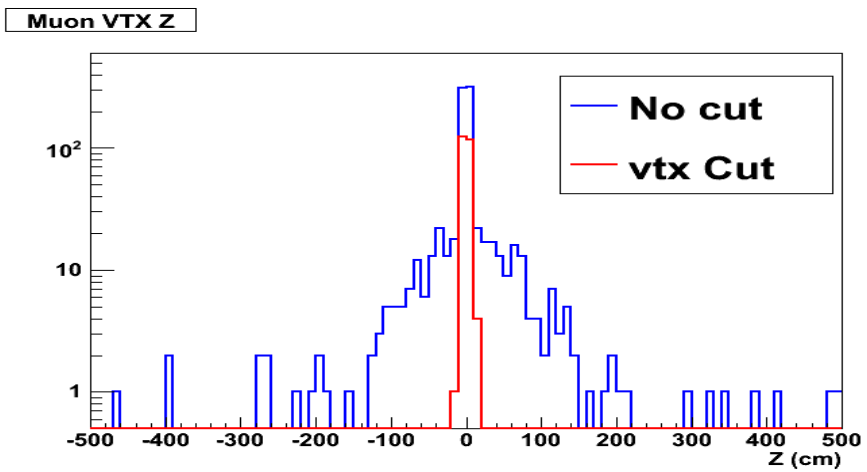
- Vertex cut rejects more b/c than π/K;
- χ^2 cut rejects mostly π/K;
- π/K should come from decay in flight!

χ^2 and vtx cuts effect on μ distance from IP



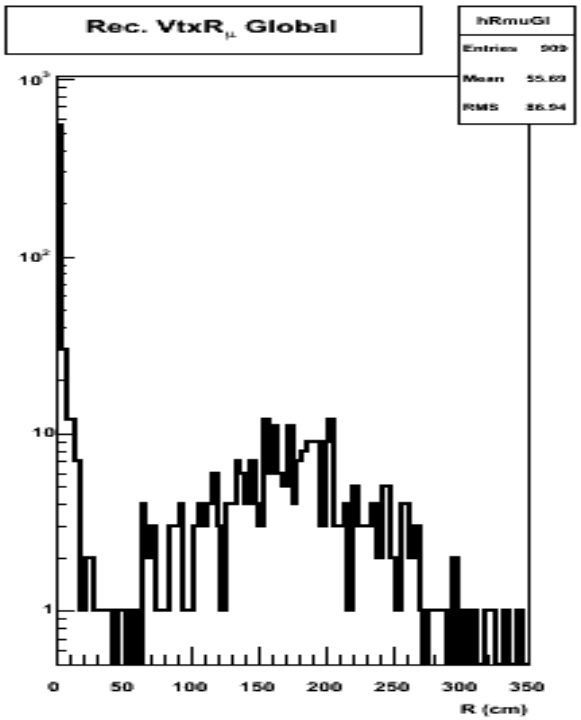


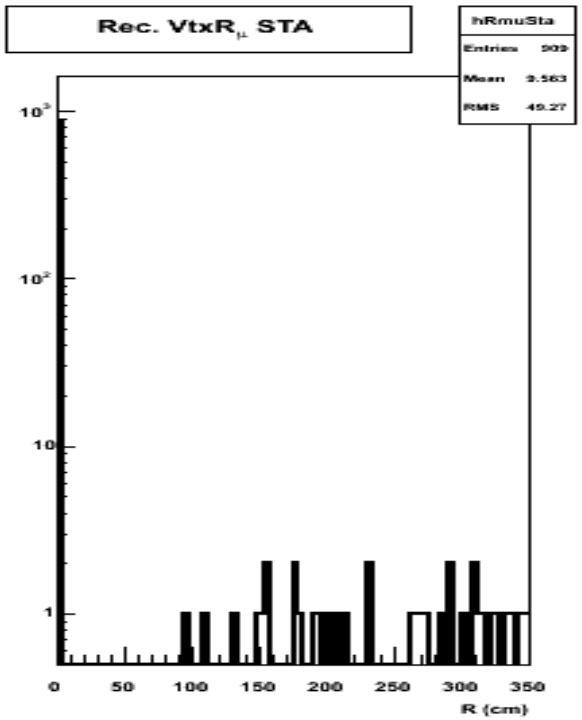


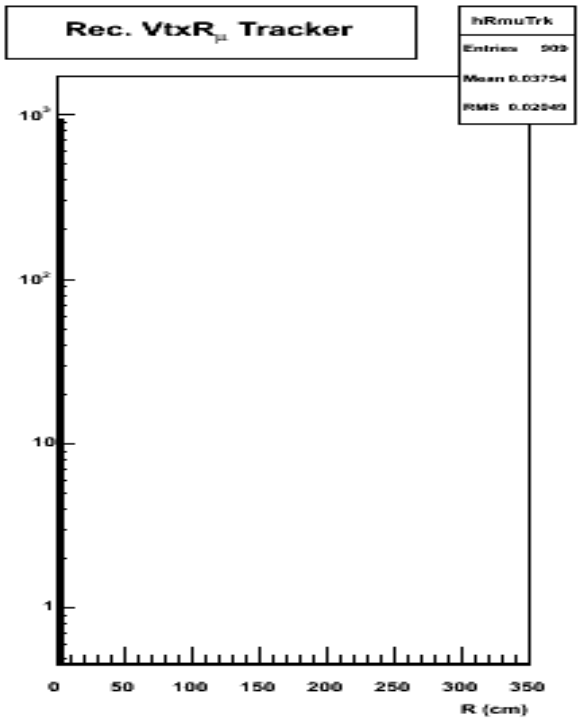


χ^2 does NOT cut μ far from IP

μ distance from IP



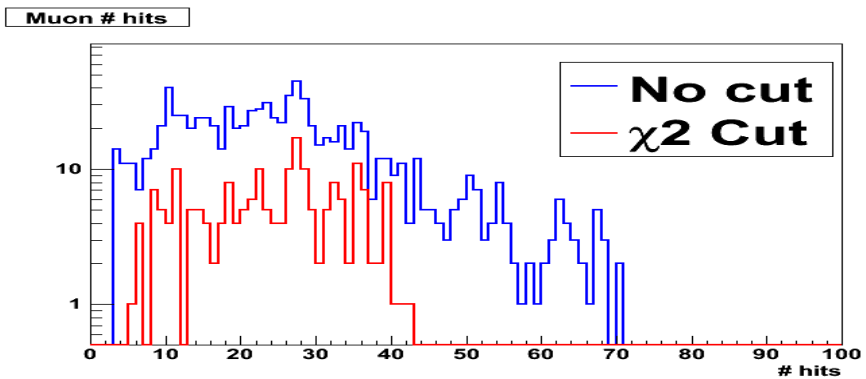


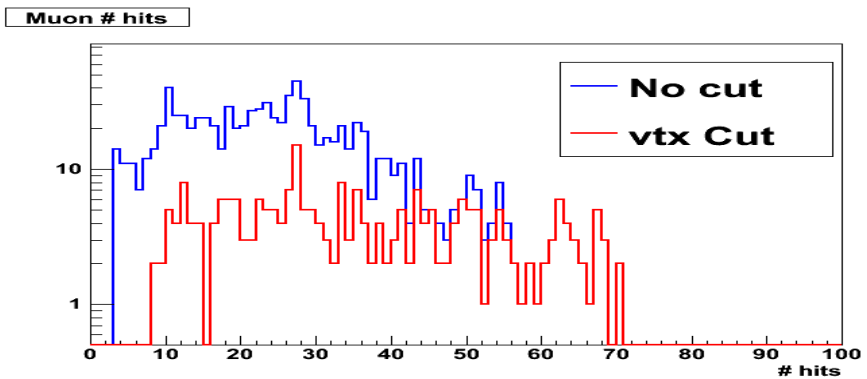


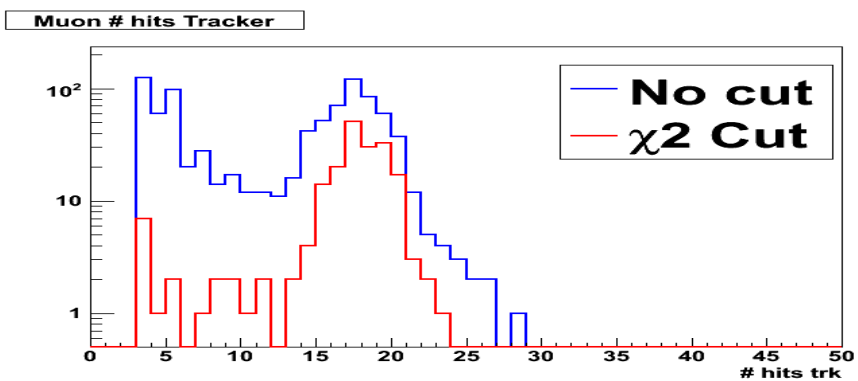
For Global, OuterTrack and InnerTrack

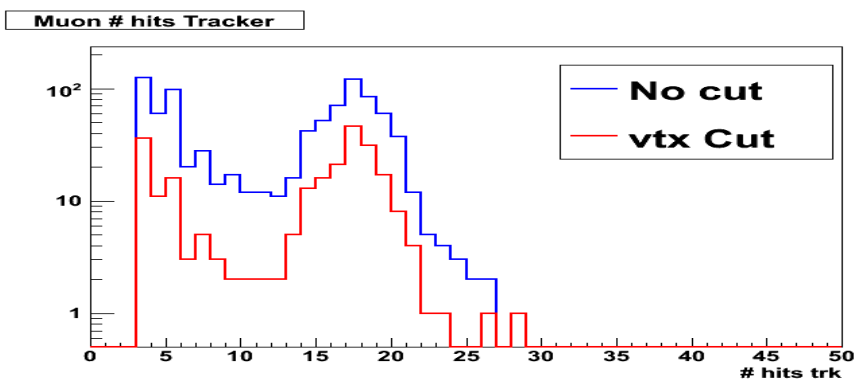
```
mu->vertex().rho();
mu->outerTrack()->vertex().rho();
mu->innerTrack()->vertex().rho();
```

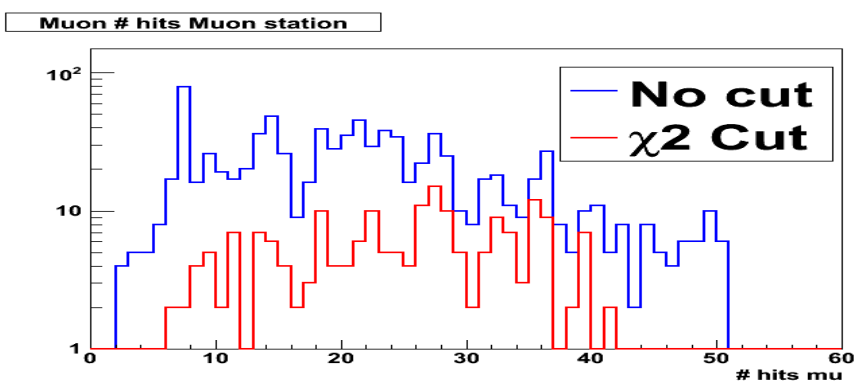
χ^2 and vtx cuts on μ # hits in Gl, Tk and Mu

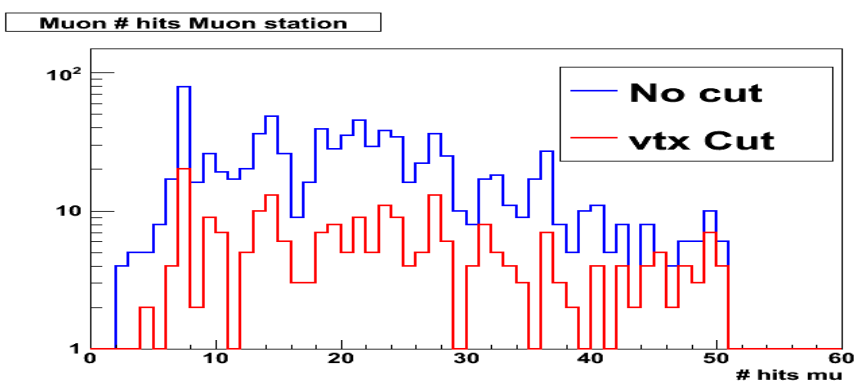




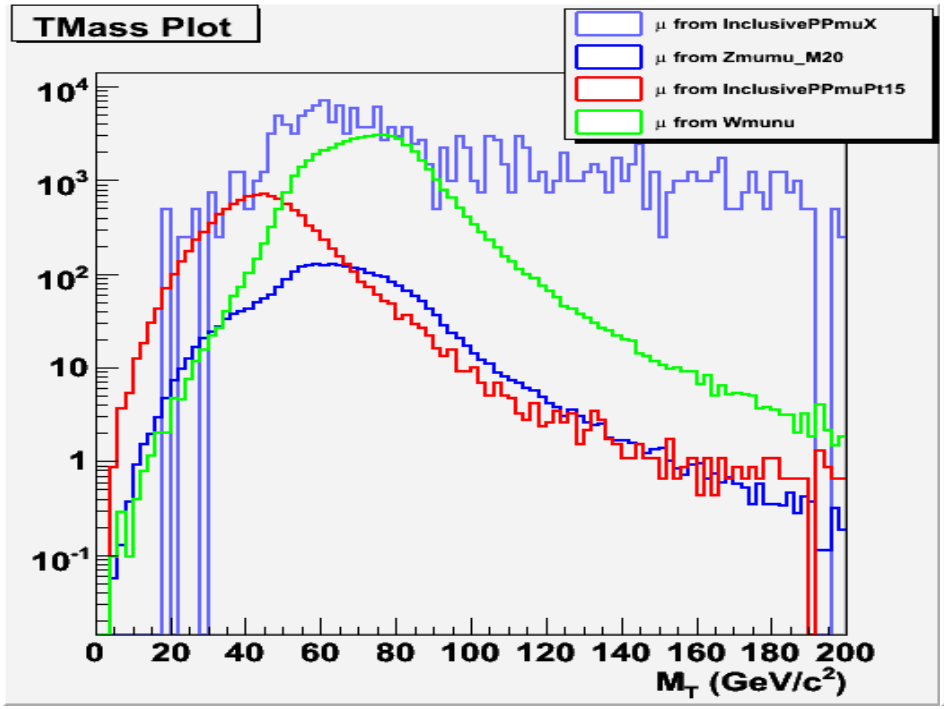


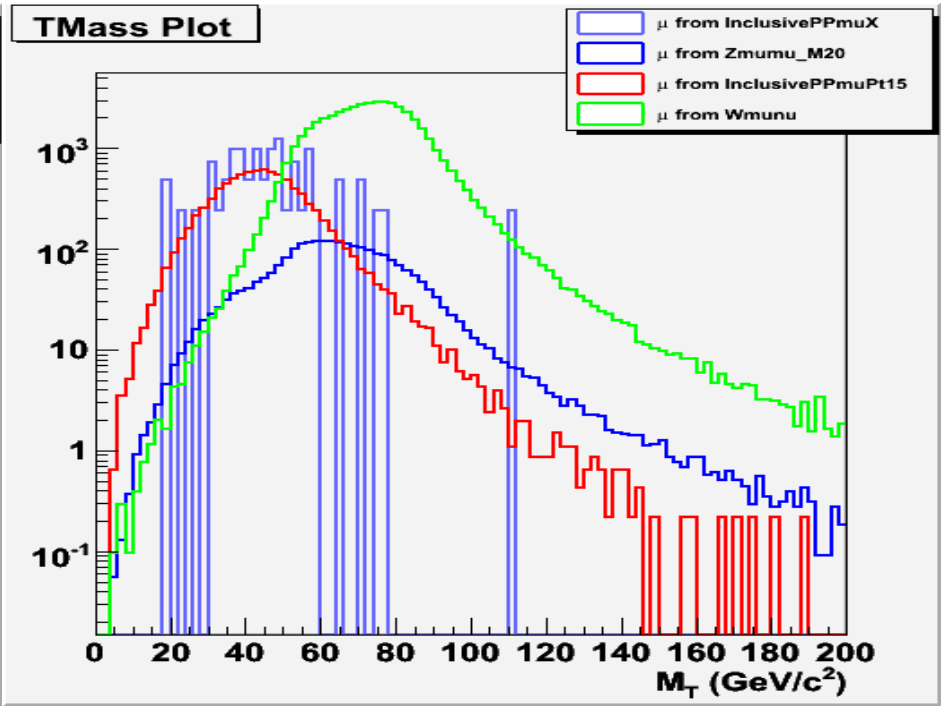






TMass plot after μ quality cut

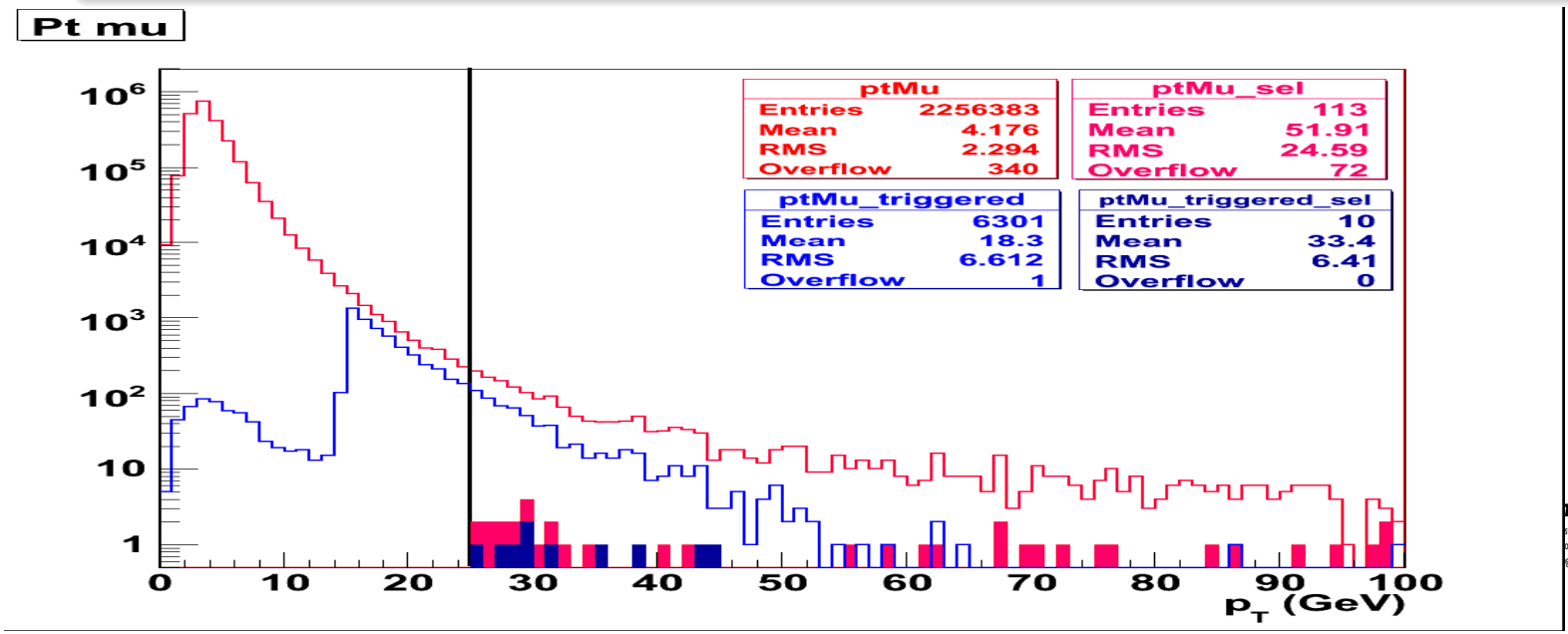




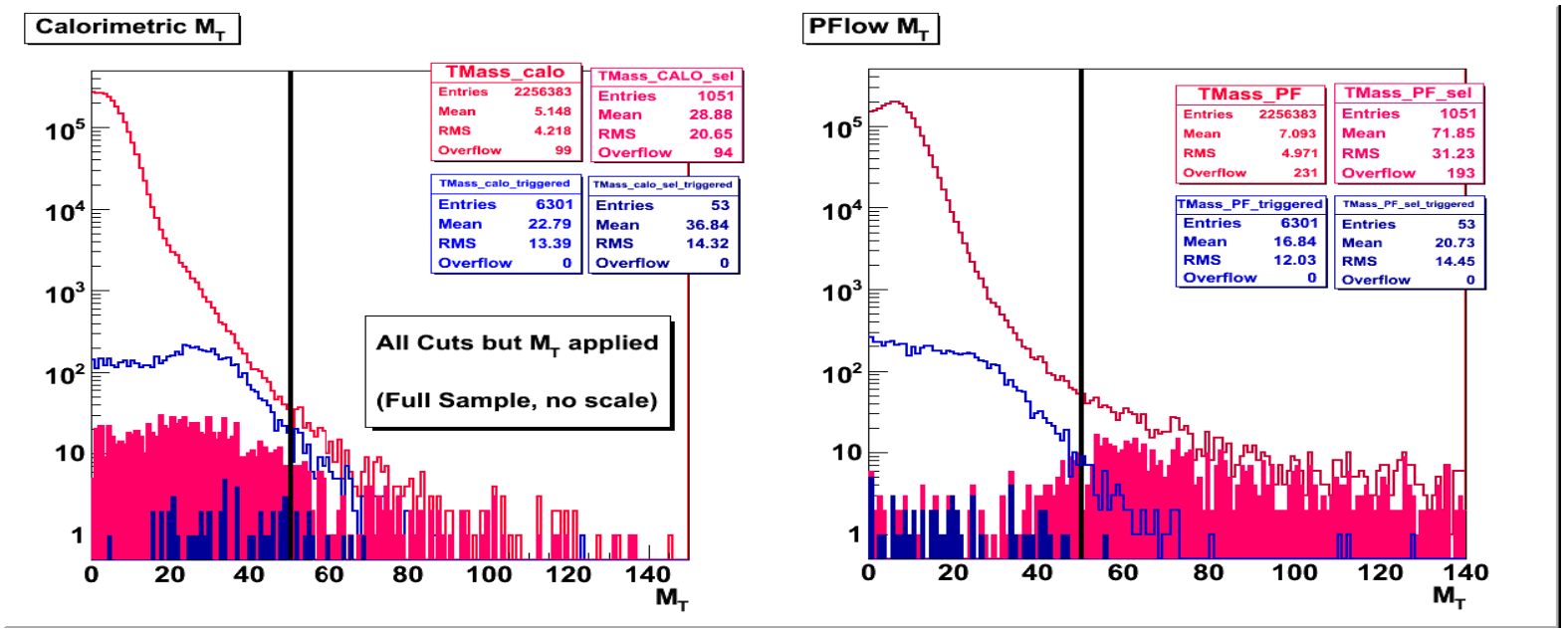
- As already shown, with μ quality cuts `InclusivePPmuX` is reduced at the level of `InclusivePPmuPt15` dataset.
- The two dataset partially overlaps for $P_t^{\mu} > 15\ GeV$, so using both can give double counting;
- Also, `InclusivePPmuPt15` background is reduced.

Effect of trigger selection on QCD rejection

- Trigger selection HLT_Mu15
- Use Muon POG MuonID quality cut
  - `GlobalMuon && TrackerMuon`;
  - $Nhits_{tracker} > 11$;
  - $\chi^2/NDoF < 10 \&\& d_0 < 2\ mm$;
- using CaloMET
- Trigger request reduce feed-through

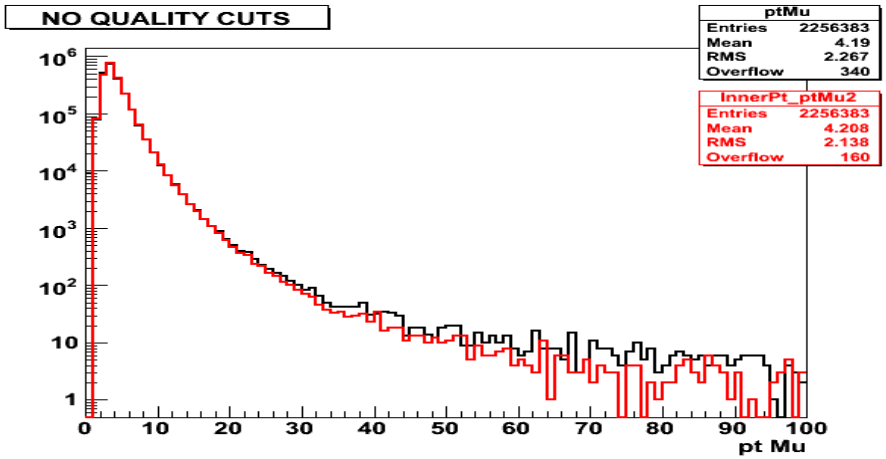


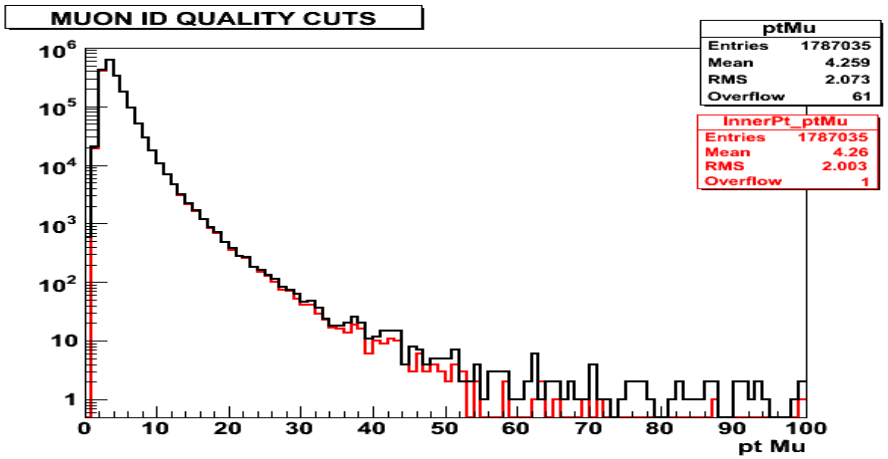
Feed-through for Calo vs PF Met

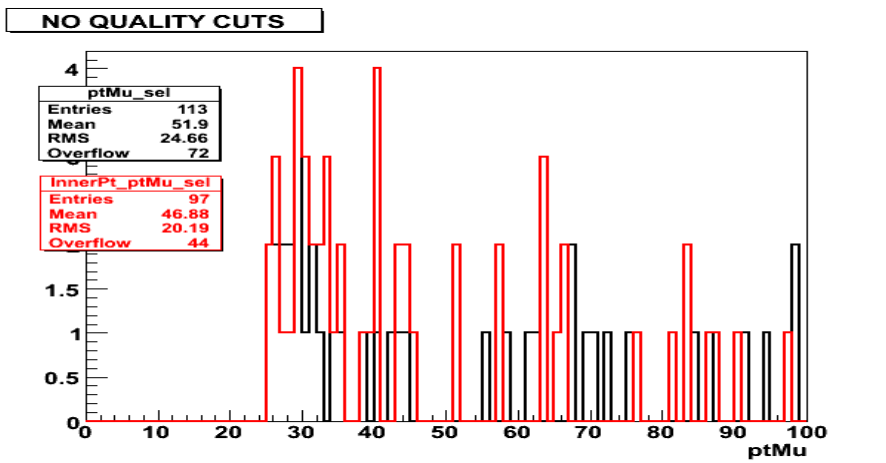


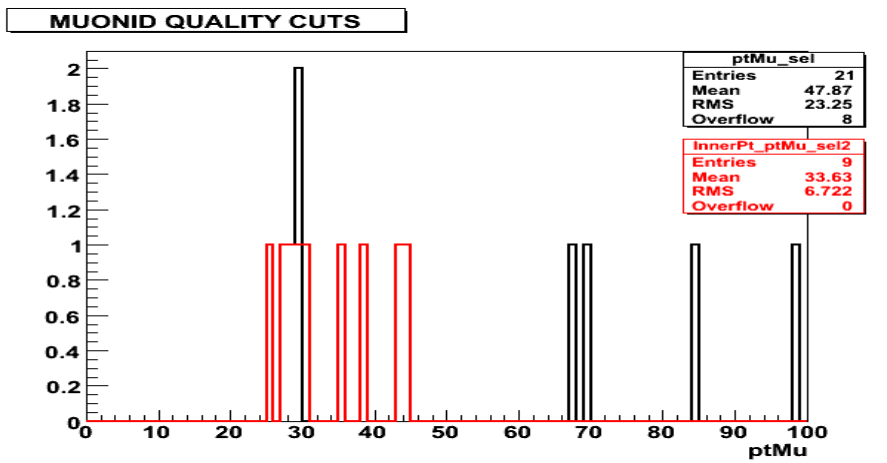
- PFMet TMass shows excess of events at high MT;
- Selected events distribution is very different!
- High MT (PFMet) events survive $W \rightarrow \mu\nu$ selection;
- Killed by trigger selection;

MuonId cut effect on feed-through



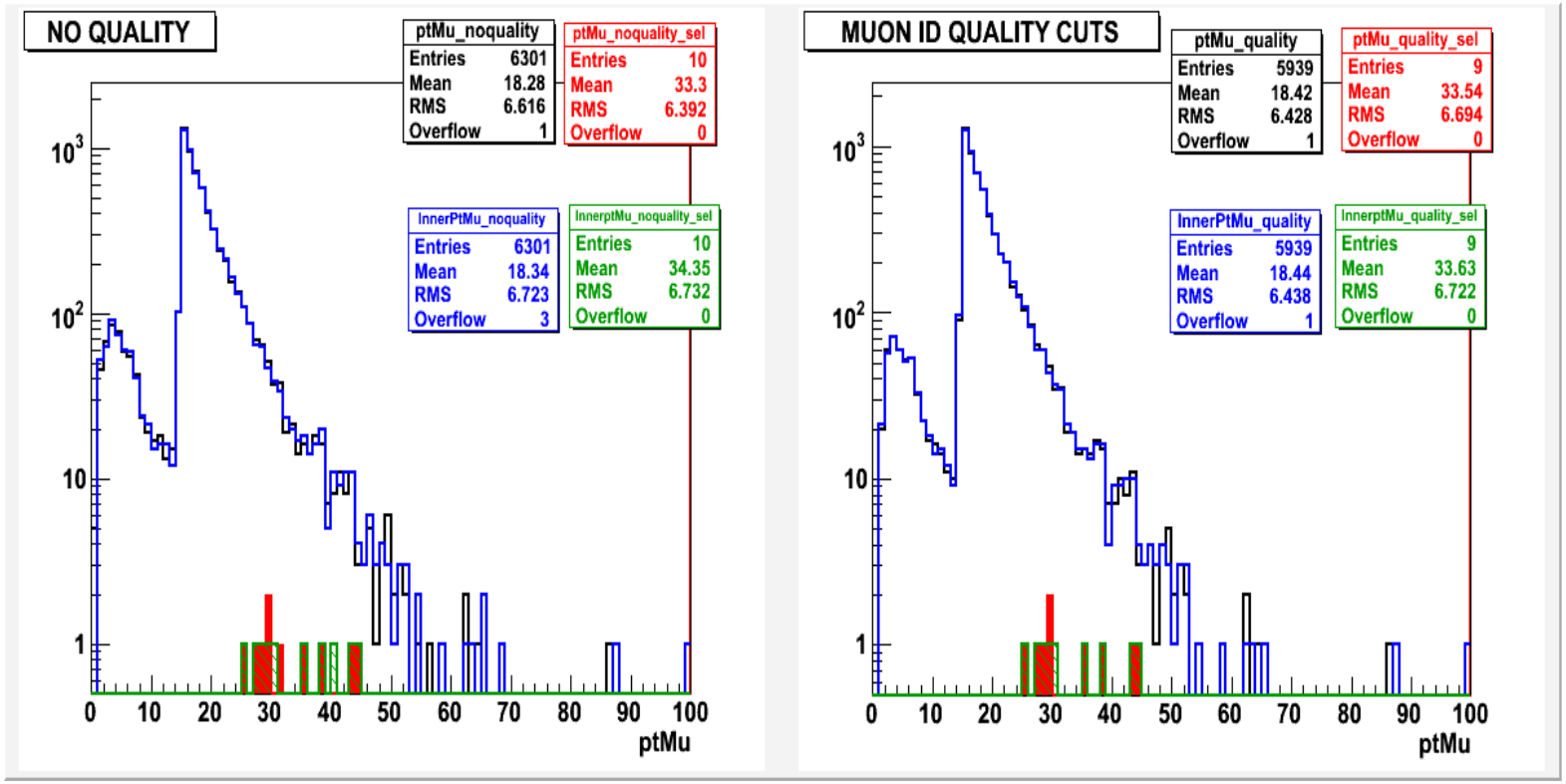






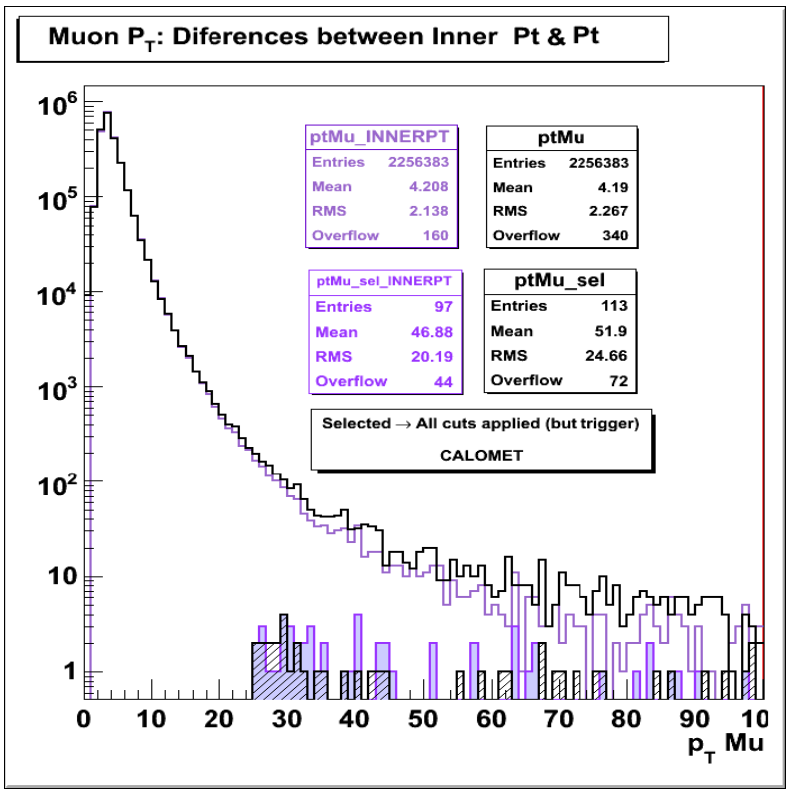
- black `global pt`, red `innerTrack pt`
- MuonID cuts reduce feed-through;
- After $W \rightarrow \mu\nu$ selections, few events survives (using CaloMet)

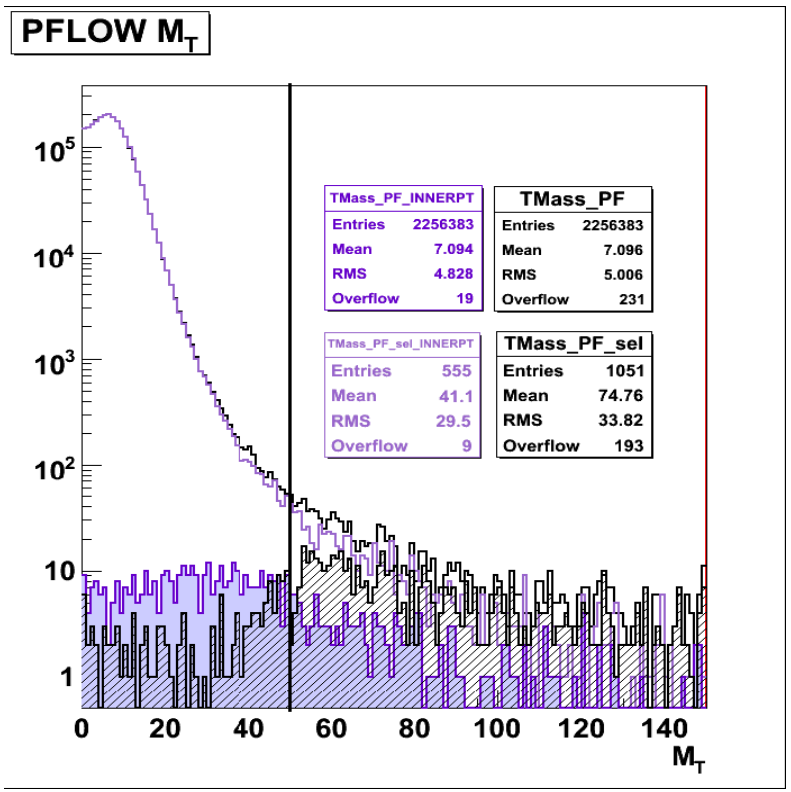
MuonId cut vs HLT_Mu15 trigger



- MuonID cuts has no effect on triggered sample;
- Trigger act like a quality cut.

Global vs Inner μ_{pt}





Difference in p_t gives difference in M_T spectrum.

Conclusions

Low p_t muons feed-trough

- FeedThrough μ comes from π/K (2/3) and c/b (1/3) decays;
- Quality cuts on muon (χ^2 and Primary Vertex) are complementary;
  - Something better for primary vertex cut?
- The cuts kill FeedThrough μ and reduce QCD background.

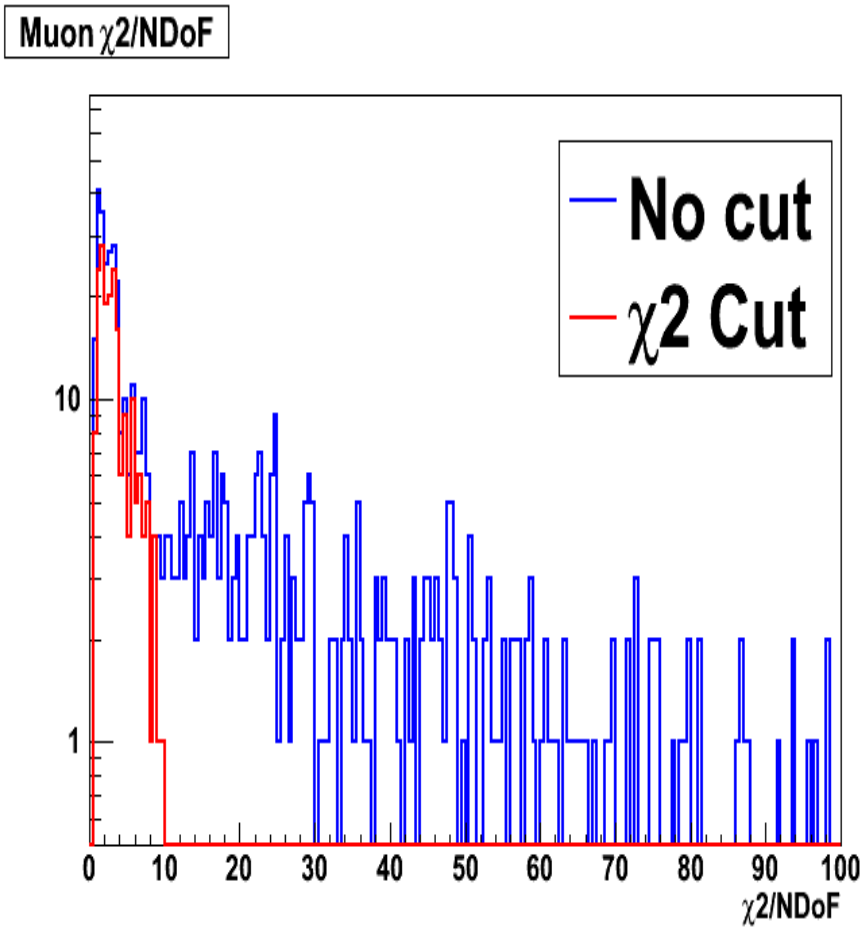
`HLT_Mu15` trigger selection

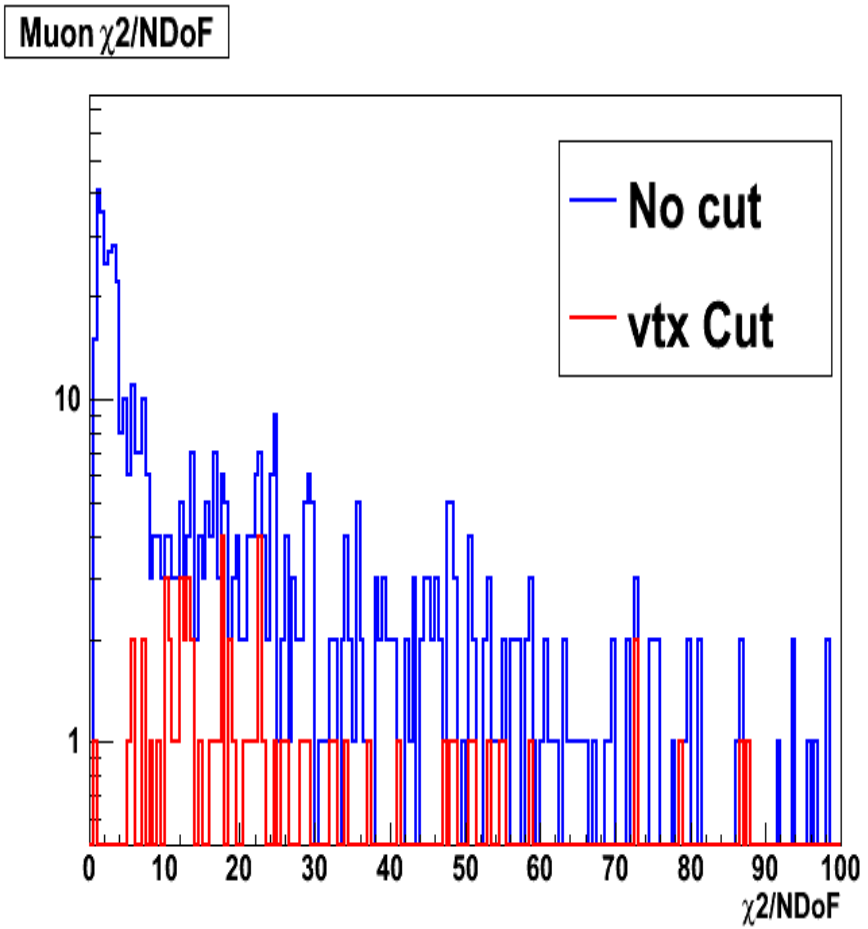
- FeedThrough reduced when using HLT_Mu15 && μPOG MuonID cuts;
- Using CaloMET of PFMet changes the amount of FeedThrough
- For low momentum, using `GlobalPt` or `InnerPt` makes difference: worth investigating.

Backup

...

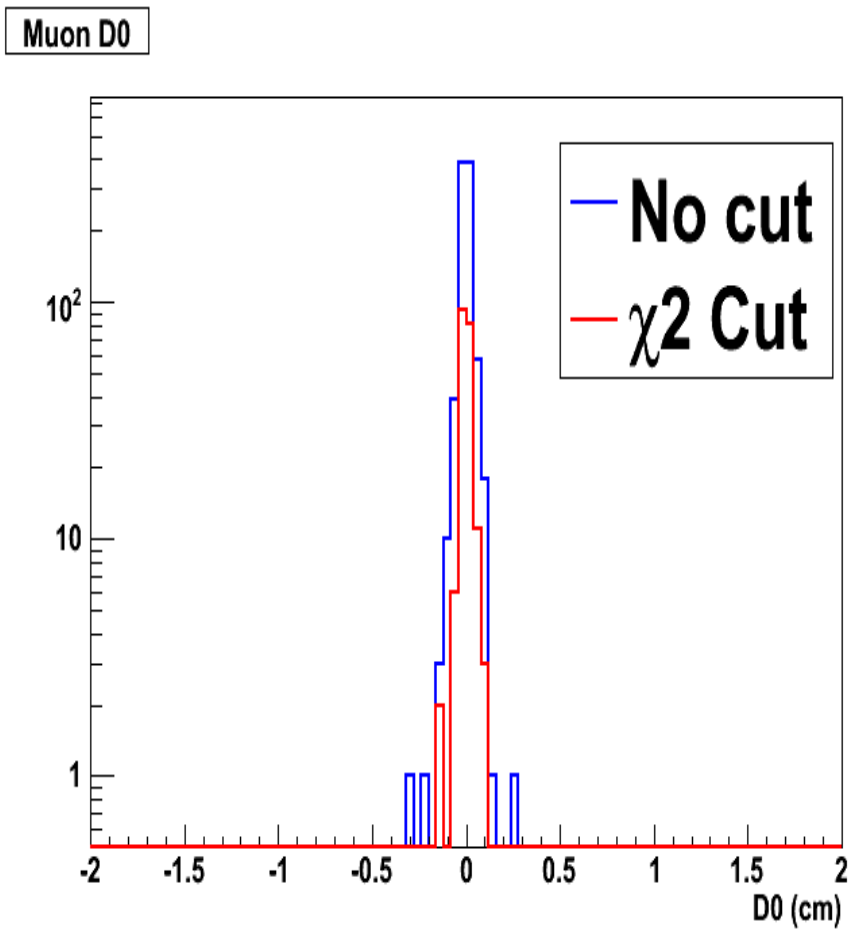
χ^2 and vtx cuts effect on μ χ^2

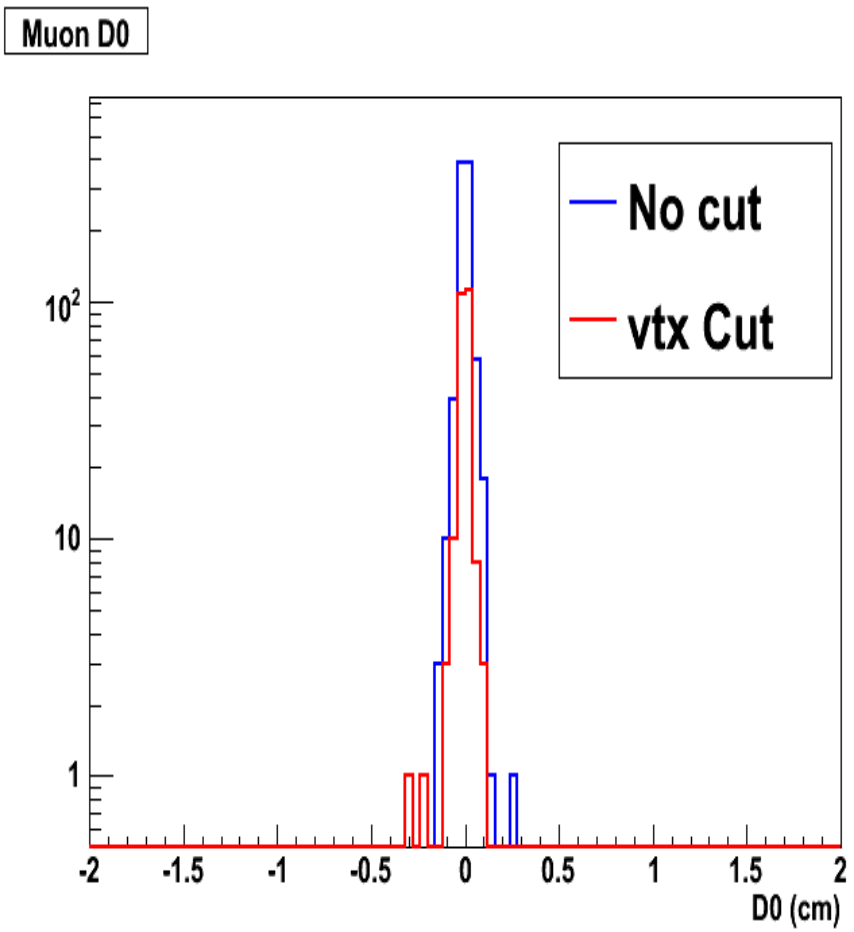




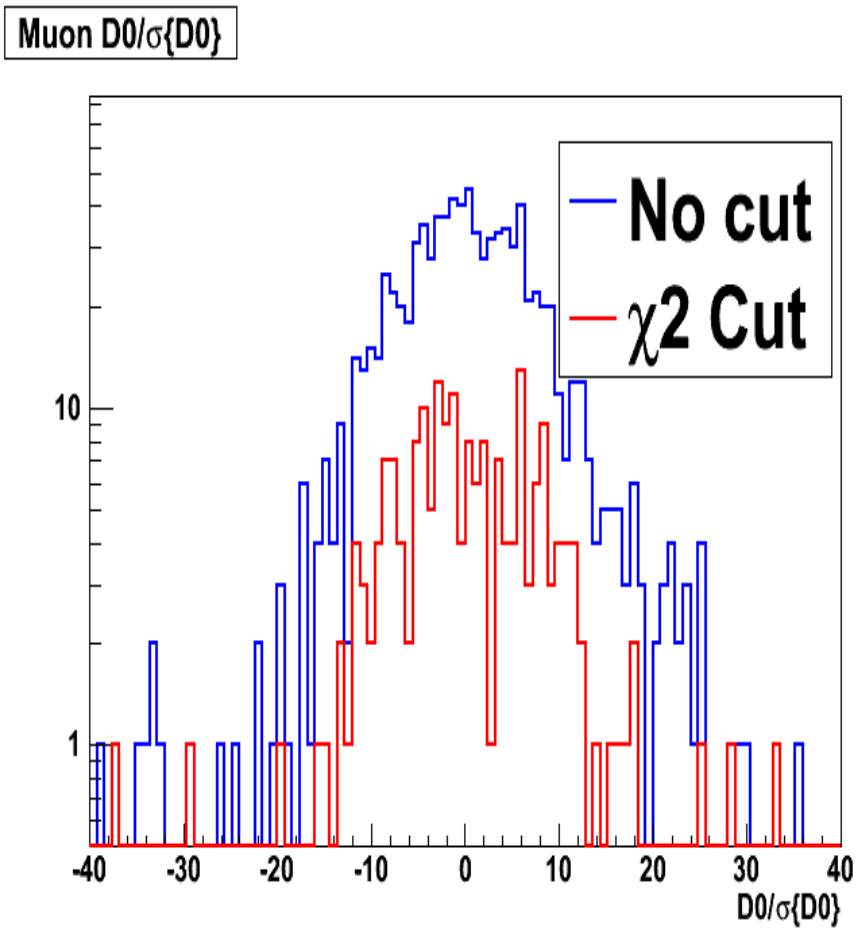
Cuts are complementary

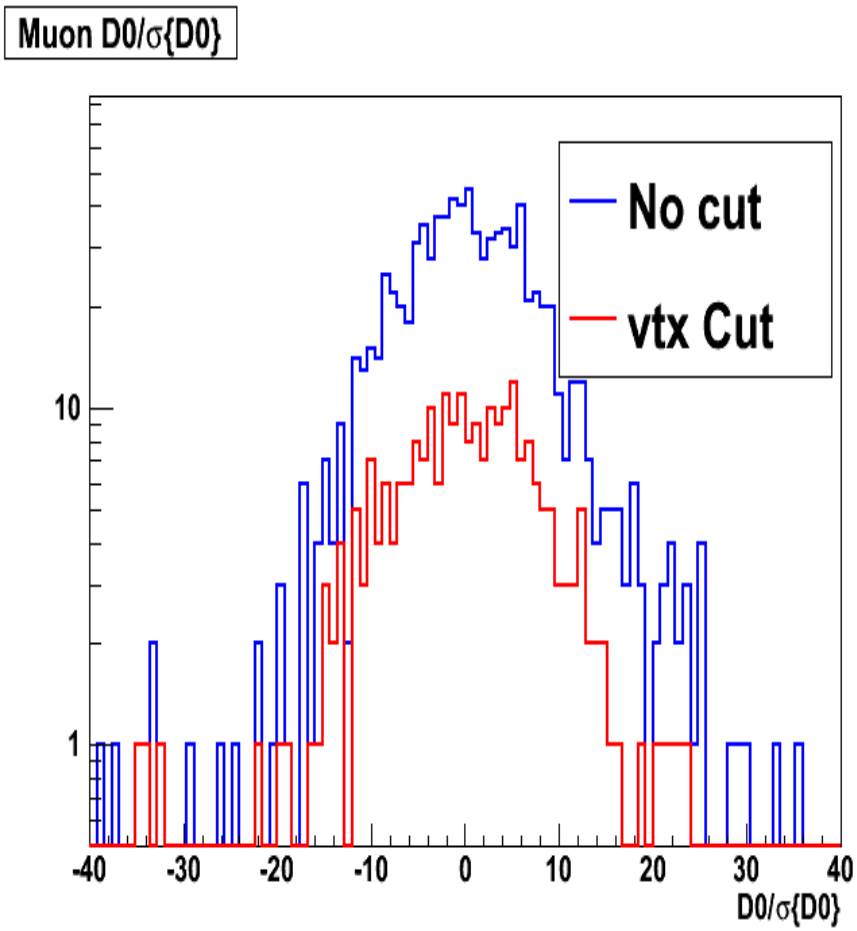
χ^2 and vtx cuts effect on μ D0



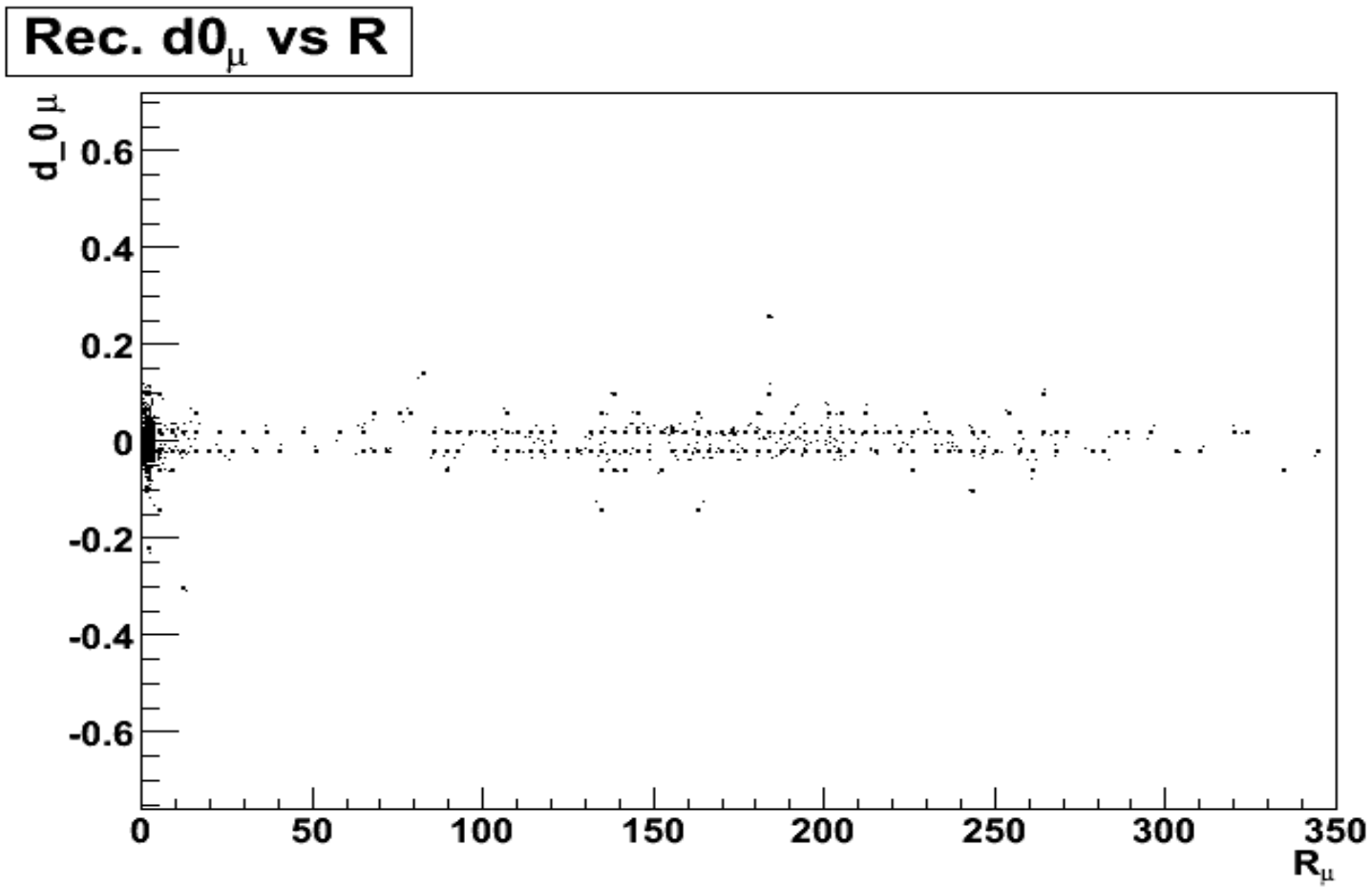


χ^2 and vtx cuts effect on μ $D0/\sigma d0$





μ D0 vs $R(\mu_{vtx})$



Reminder of cut applied for $W \rightarrow \mu\nu$ analysis

Muon cut

- GlobalMuon;
- Muon $p_t > 25\ GeV$;
- Muon $|\eta| < 2$;
- Muon isolation $\sum p_t / p_t^{\mu} < 0.09$;

Event cut

- Acoplanarity $|acop| < 1\ rad$ $(acop \in [-\pi, \pi])$;
- Cut on Z $(2\ \mu\ p_t > 20\ GeV)$;
- Reject top **not used**;
- MET cut **not used**;