Trilepton Analysis: The $WH \rightarrow WWW \rightarrow l\nu l\nu l\nu$ Signal

More w/ Trilepton Backgrounds

Jason Nett

University of Wisconsin - Madison

Collider Detector at Fermilab

13 July 2009

Summary

Changes From Last Week

- Last week's material DID have a bad bug.
- Include weighted distributions w/ signal (at $\times 10$), normalized to 1000 pb^{-1}.
- Look at all trilepton (`NLep == 3`) events.
- Redo of `NLep == 3, NJet == 0`
- Look at `NLep == 3, NJet == 1`
- Look at `NLep == 3, NJet` $\geq$ `2`

Dilepton Invariant Mass, Normalized to 1000 pb^{-1}

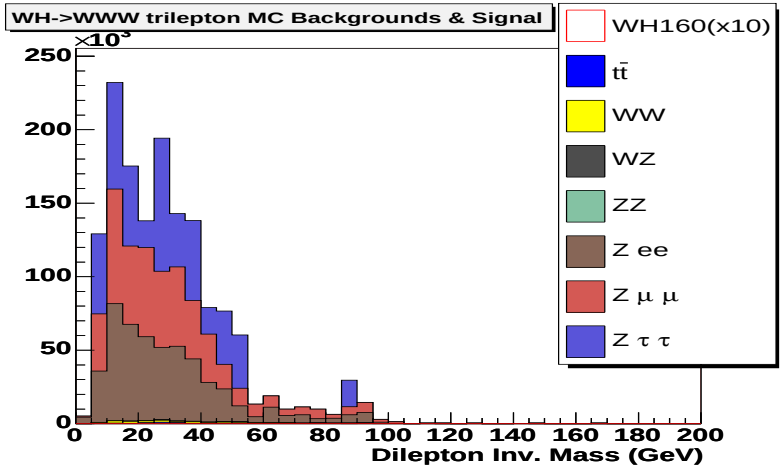


Figure: Dilepton Inv. Mass for all `NLep == 3`

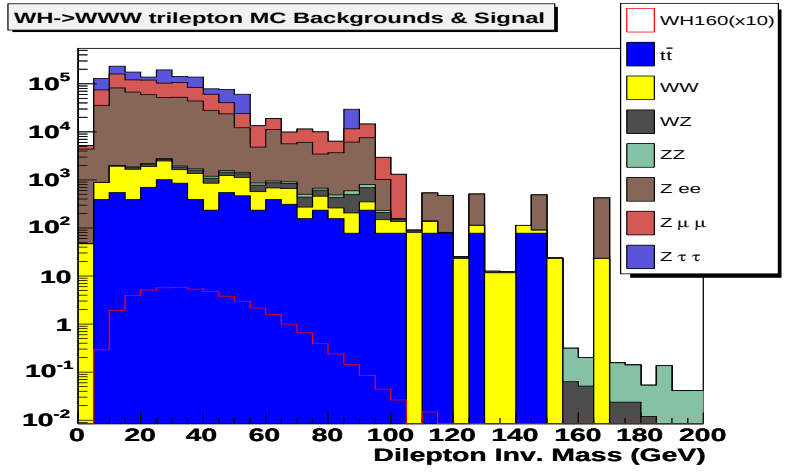
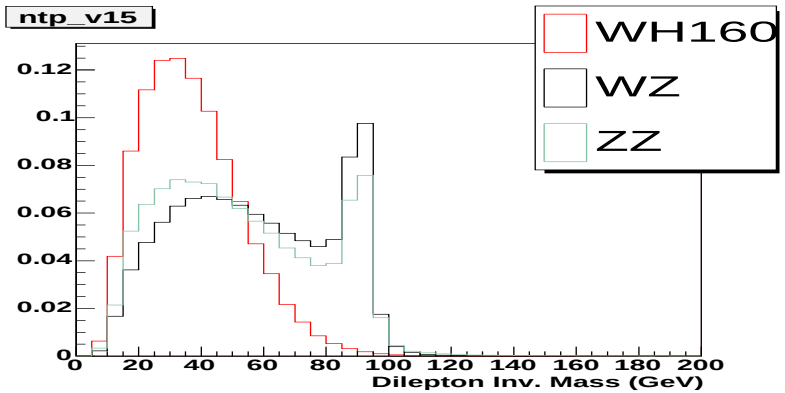
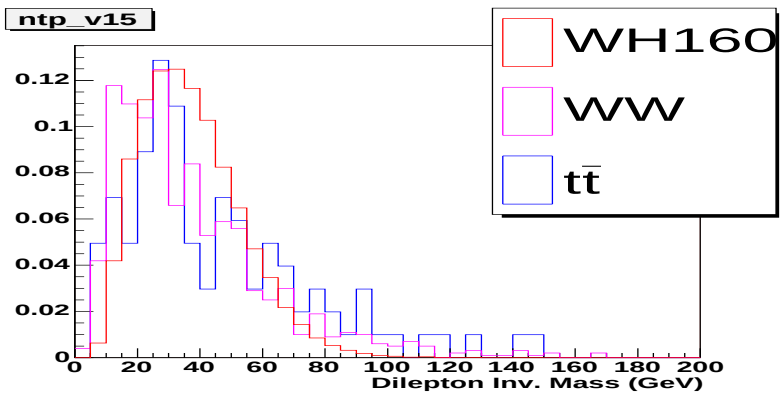


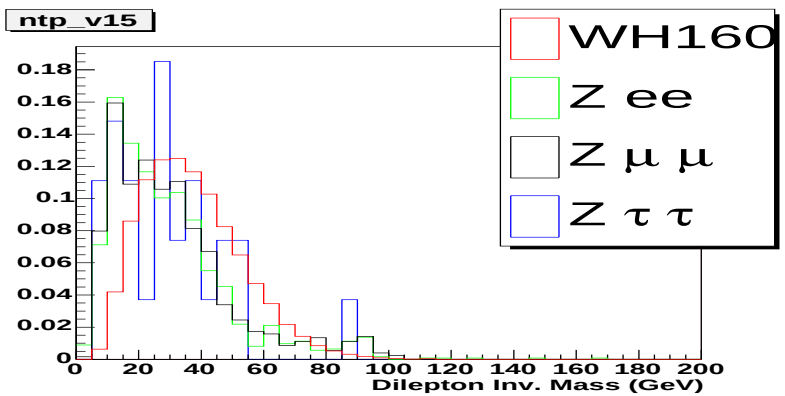
Figure: Dilepton Inv. Mass for all `NLep == 3`

Dimass, Equal Weights (NLep = 3)

The dilepton invariant mass shapes of backgrounds are similar to that of the signal, except for the Z peak which may be cut out anyways.

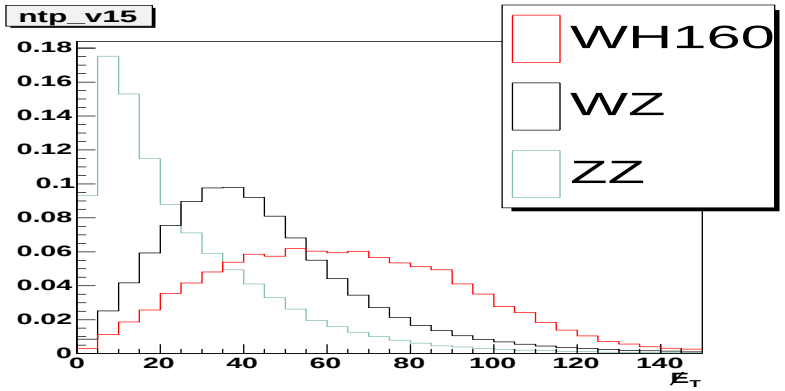


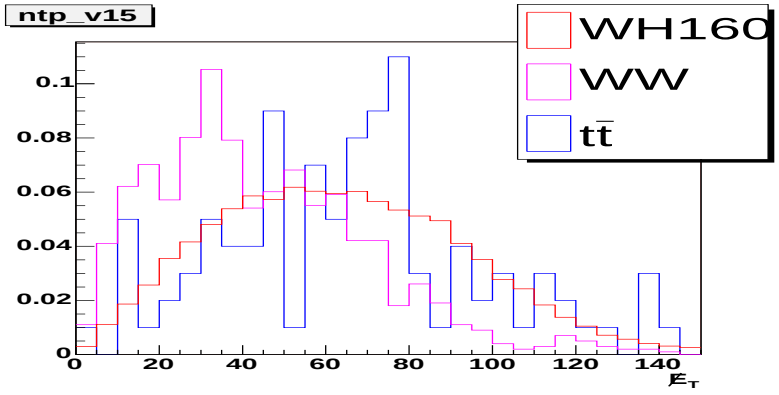


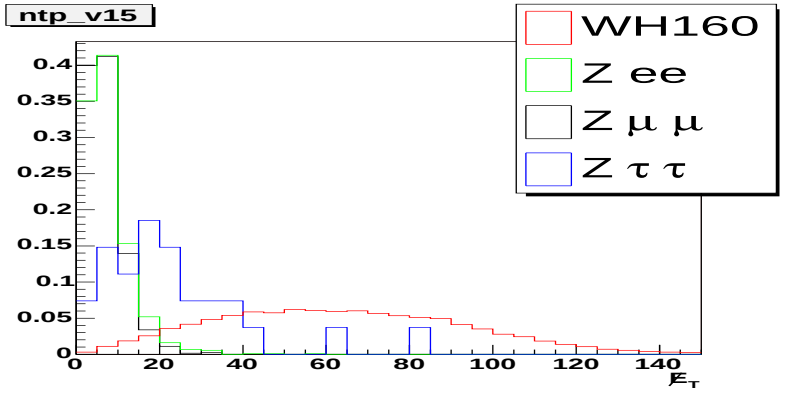


MET

The missing energy appears to be distributed at significantly higher energy than the most important backgrounds ($Z \rightarrow l\bar{l}, WZ, ZZ$).







Dilepton Invariant Mass, Normalized to 1000 pb^{-1}

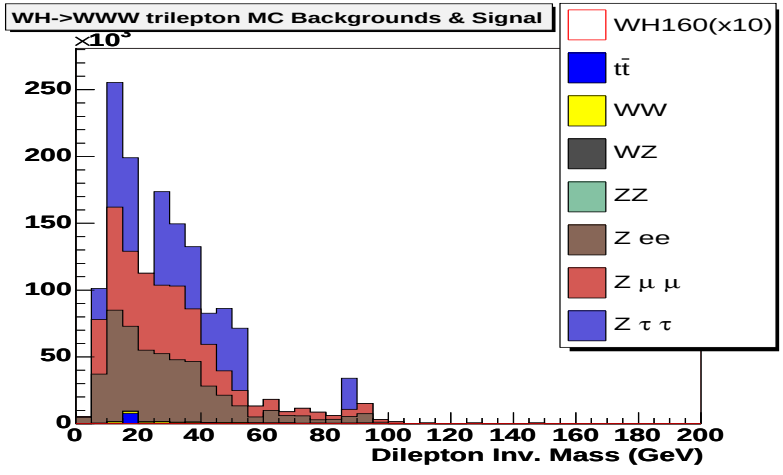


Figure: Dilepton Inv. Mass for all `NLep == 3, NJet == 0`

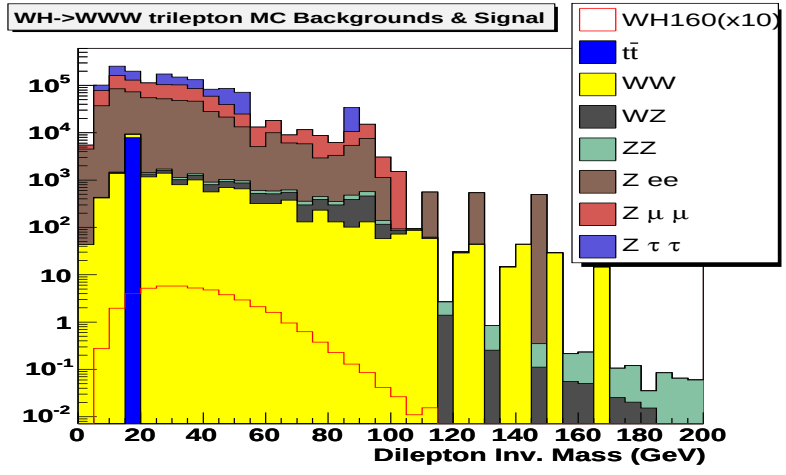
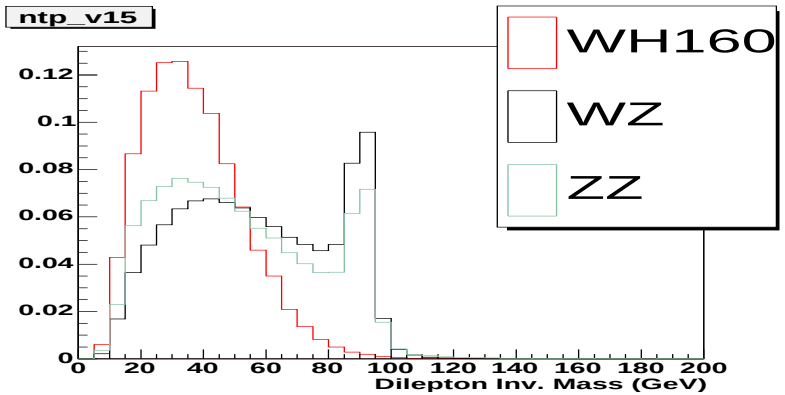
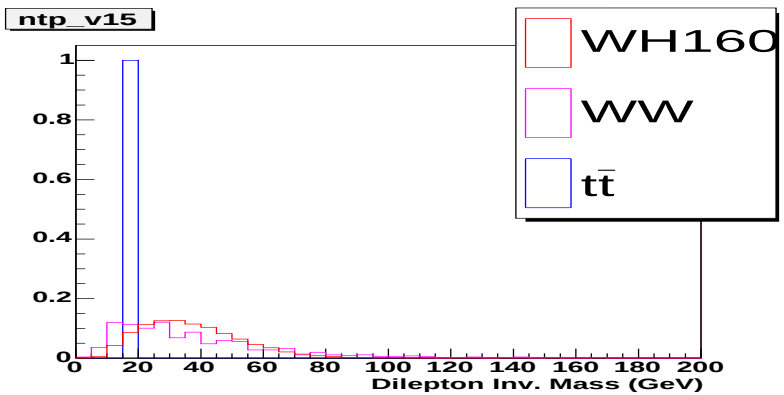


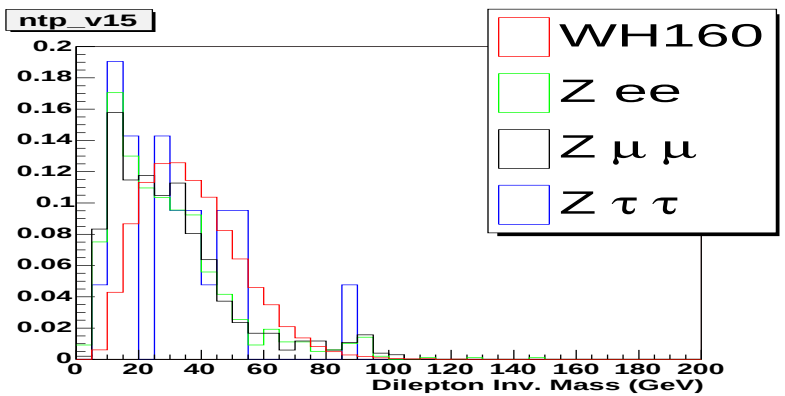
Figure: Dilepton Inv. Mass for all `NLep == 3, NJet == 0`

Dimass, Equal Weights (NLep = 3,NJet = 0)

The dilepton invariant mass shapes of backgrounds are similar to that of the signal, except for the Z peak which may be cut out anyways. $t\bar{t}$ appears miniscule in the NJet = 0 bin.







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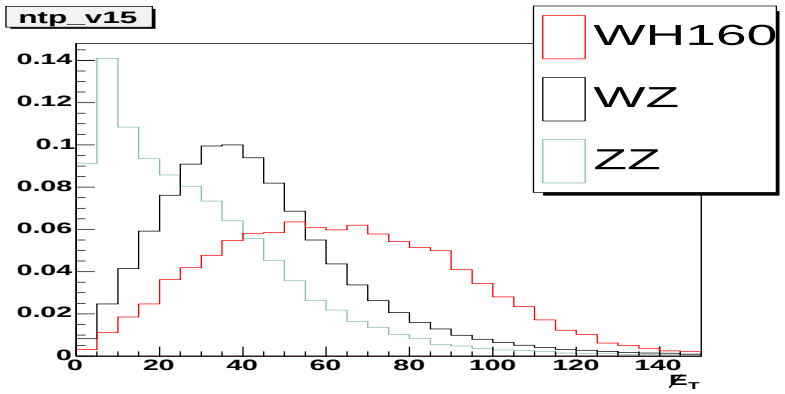

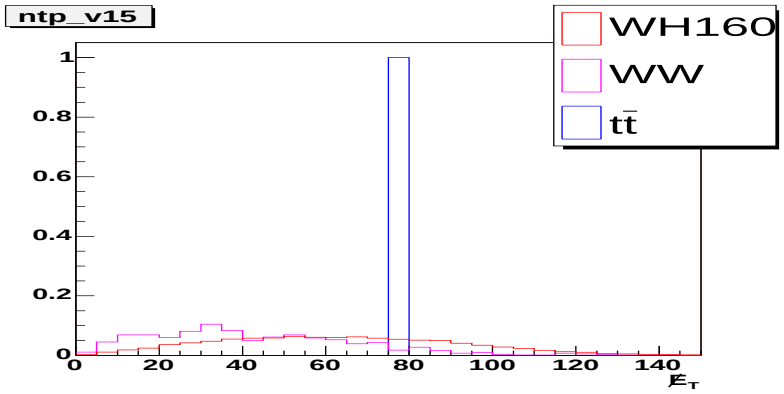

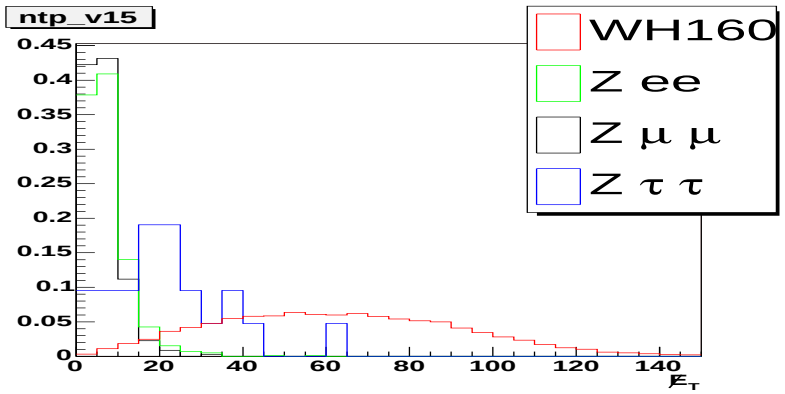

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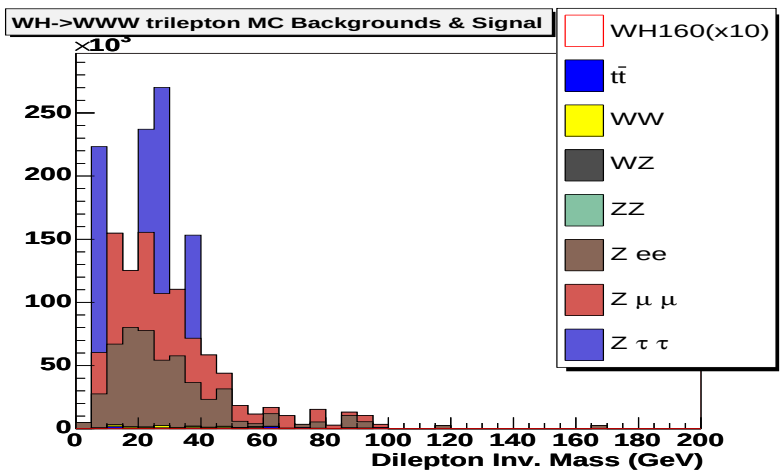
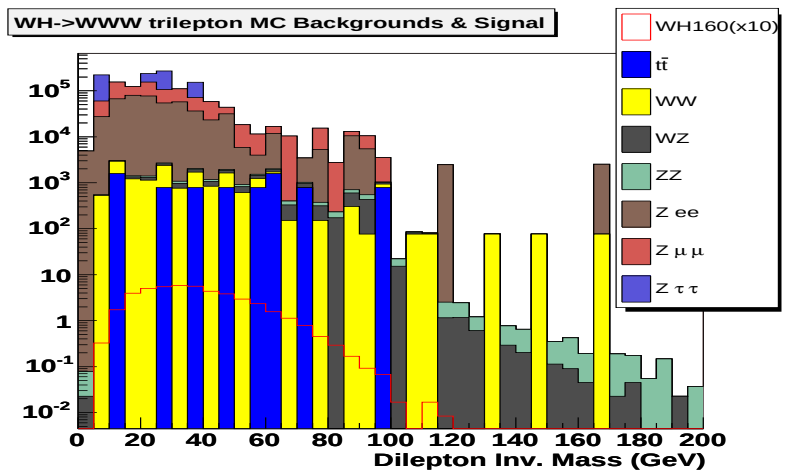


Figure: Dilepton Inv. Mass for all `NLep == 3, NJet == 1`



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Dimass, Equal Weights (NLep = 3,NJet = 1)

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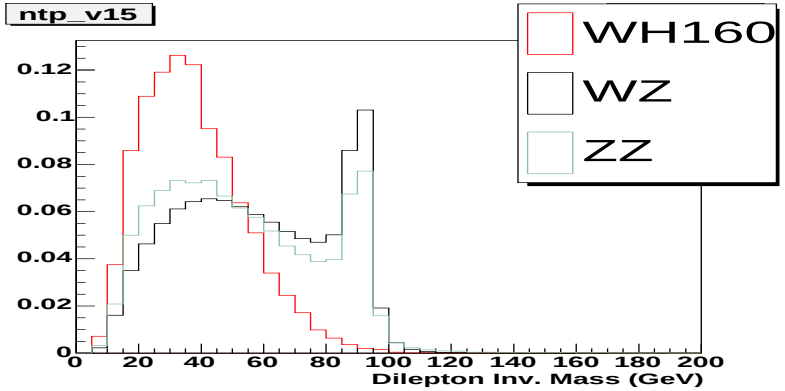

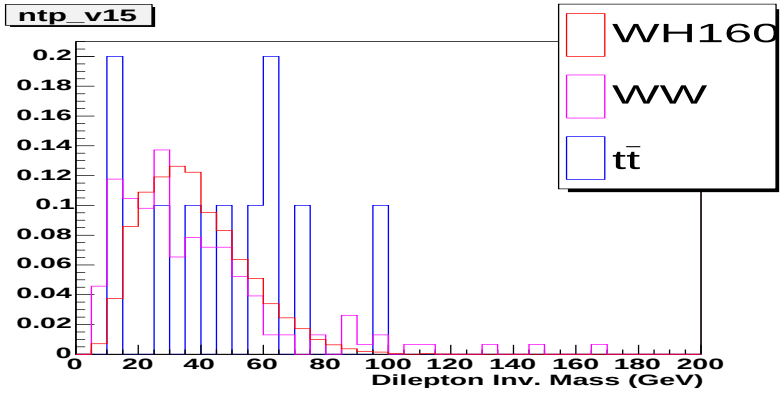

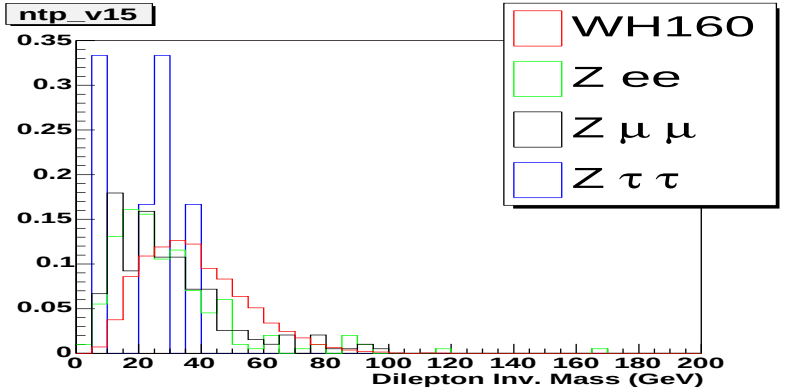

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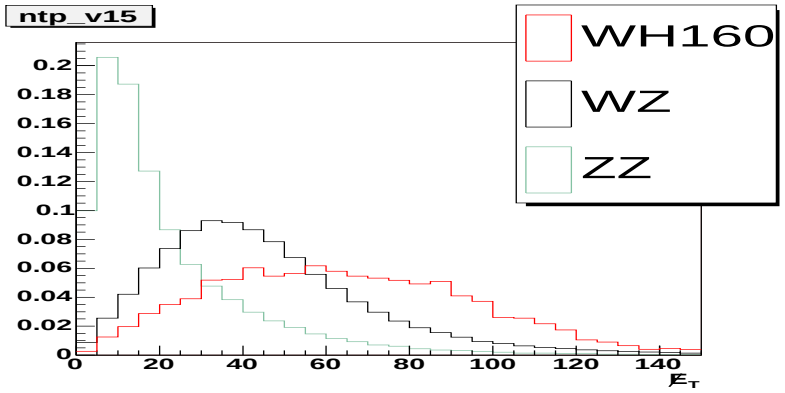

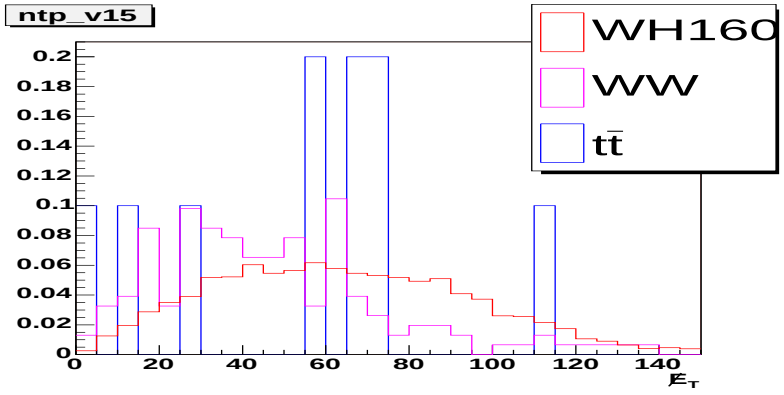

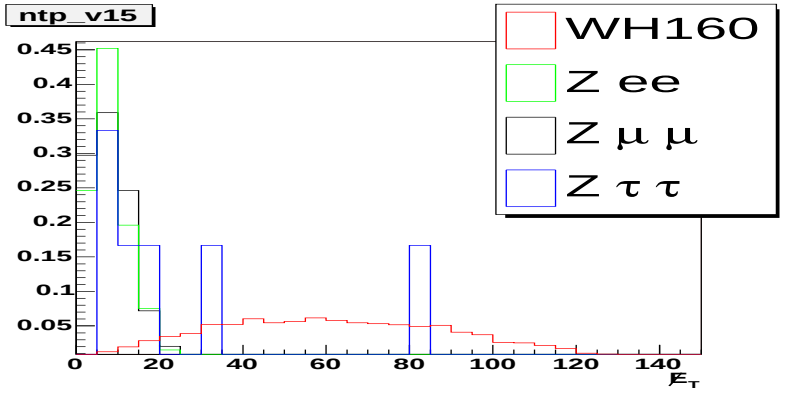

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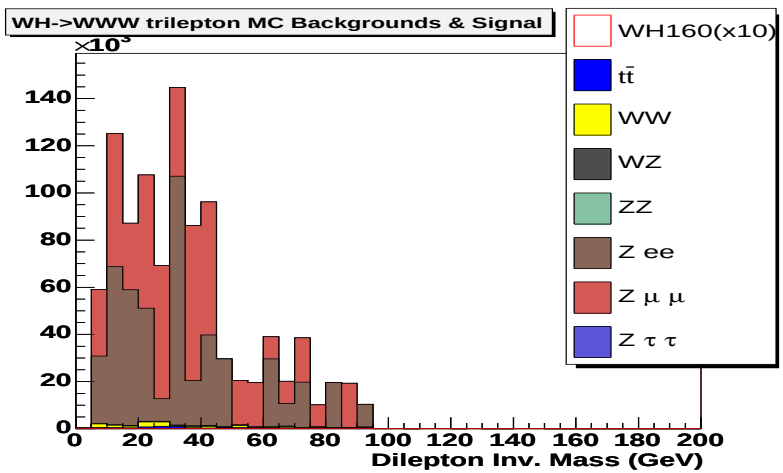

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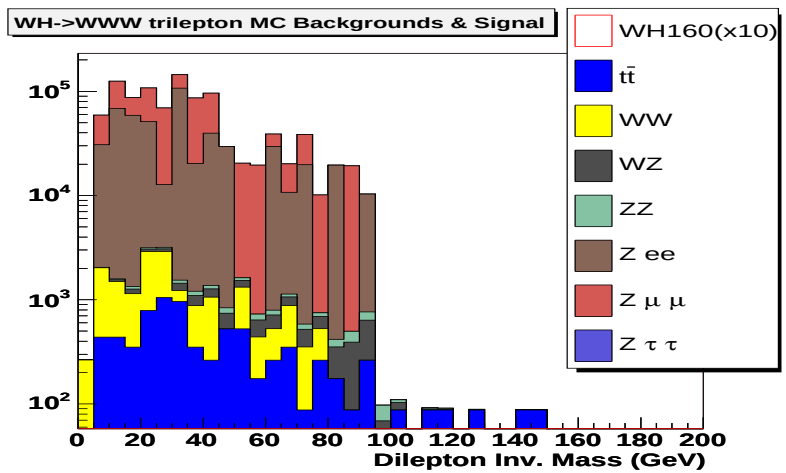

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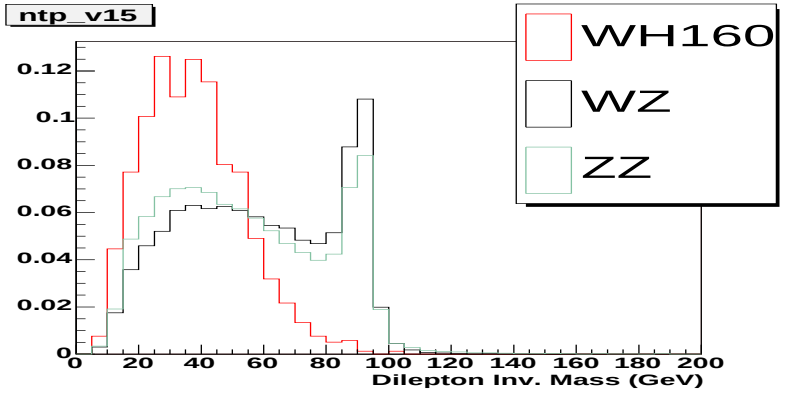

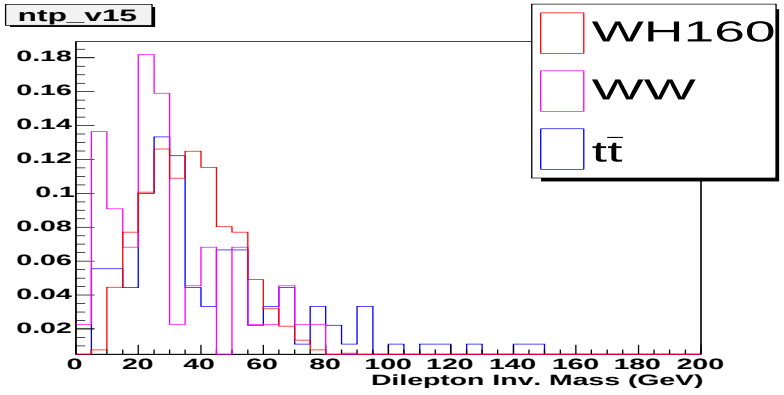

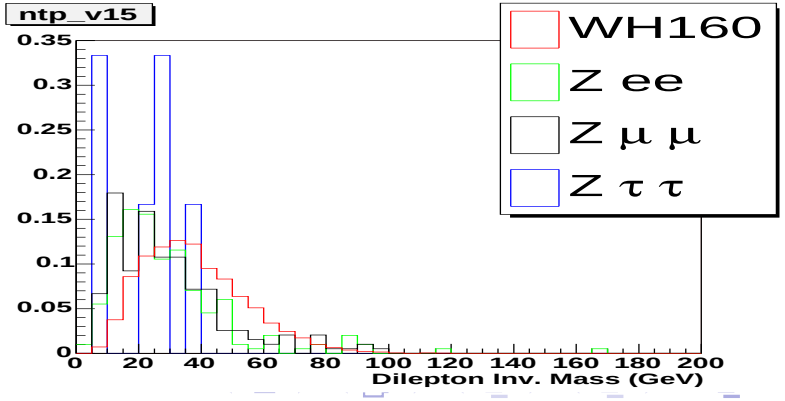

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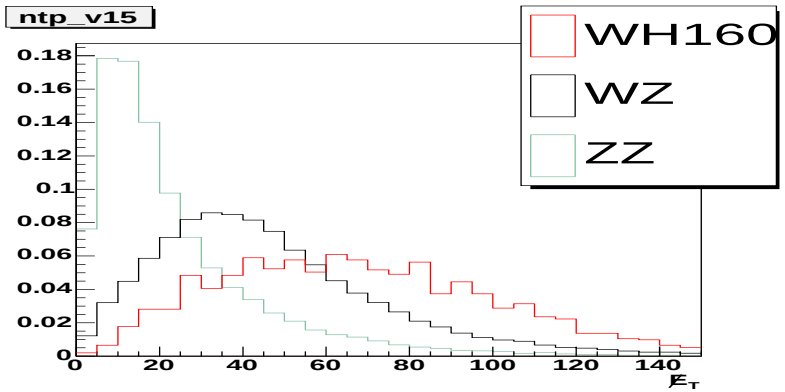

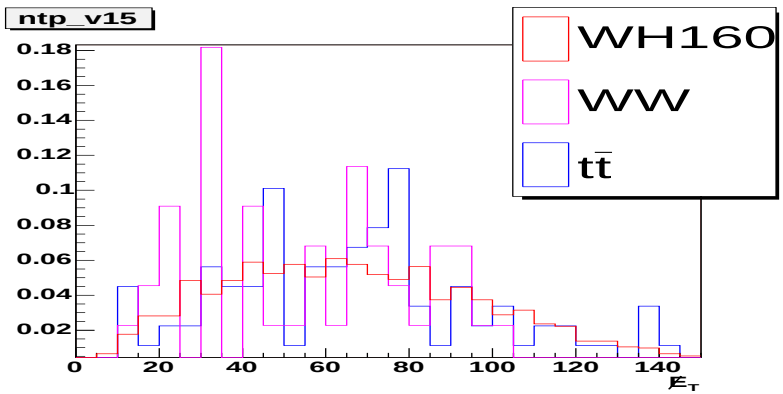

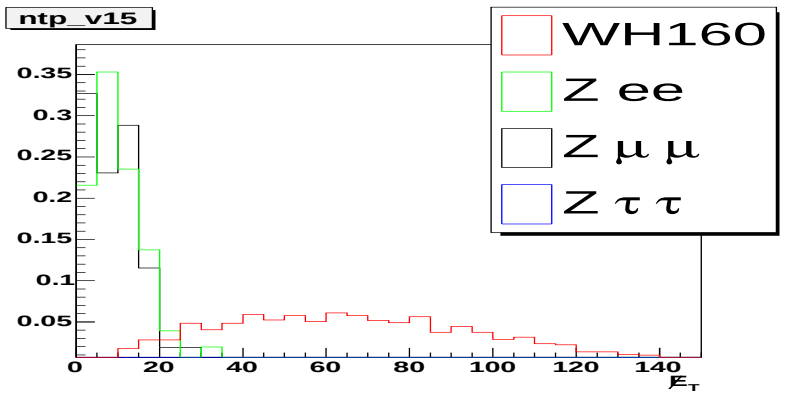

Compare to WZ and SUSY Trilepton Studies

The CDF WZ study cites the following backgrounds (http://www-cdf.fnal.gov/physics/ewk/2007/WZ_2fb/):

- $Z\gamma$
- Z+jets
- ZZ
- $t\bar{t}$

SUSY trilepton study uses (CDF Note 9817):

- $Z \rightarrow e\overline{e}$
- $Z \rightarrow \mu\overline{\mu}$
- $Z \rightarrow \tau\overline{\tau}$
- WZ, WW, ZZ
- $t\bar{t}$

I presently have available from the diboson ntuple the same categories that the SUSY studies use, which also show $Z \rightarrow l\bar{l}$ to be the dominant backgrounds.

Summary

- Missing energy should be a powerful discriminator.
- $Z \rightarrow l\bar{l}$ are the dominant backgrounds because their cross sections are $\sim$ 490 pb, even though they require a 3rd lepton from elsewhere in the event.
- Meanwhile, WZ (3.5 pb) and ZZ (1.5 pb) do contribute real real trilepton events, but have much smaller cross sections.
- Good News: SM Higgs trilepton events may contribute 10's of events with 5 fb^{-1} and have high MET compared to $Z \rightarrow l\bar{l}$ backgrounds.
- Bad News: $Z \rightarrow l\bar{l}$ backgrounds have large cross sections and the dimass curve shape appears similar to the SM Higgs trilepton events.
- Conclusion: It's critical that I find more ways to discriminate against the $Z \rightarrow l\bar{l}$ backgrounds (have MET so far).