

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

Stacking Dimass Properly and MET Preselection

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Summary

- 1 Updates From Last Week
- 2 Mistake in Weighting the Stacks?
- 3 MET Preselection
- 4 Signal Estimates
- 5 Backup
 - NJet vs. NLep

Updates From Last Week

- Problem with weighing the stacks.
- Dimass value now requires opposite-sign leptons
- Missing Energy Preselection

NLep and NJet Count

For "WHtrilep" I ran 10^6 fhgs6f ($HW \rightarrow WWW$) events through Diboson_v15 WITH my trilepton filter on to get an ntuple with 10,019 events for comparison. 4,638 of these fell into the NLep=3 bin.

Process	total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
WH(160)	409,012	27,929 (0.0683)	20,887 (0.0511)	5,473 (0.0134)	1,569 (0.00384)
WHtrilep	10,019	4,638 (0.463)	3,459 (0.0345)	919 (0.0917)	260 (0.0260)
WW	3,805,444	1002 (0.000263)	805 (0.000212)	153 (0.0000402)	44 (0.0000116)
WZ	7,158,862	874,963 (0.122)	681,304 (0.0952)	153,347 (0.0214)	40,312 (0.00563)
ZZ	4,155,633	181,542 (0.437)	75,496 (0.0182)	81,666 (0.0197)	24,380 (0.00587)
Zee	5,459,642	1,235 (0.000226)	985 (0.000180)	199 (0.0000364)	51 (0.00000934)
Z $\mu\mu$	5,737,968	1,267 (0.000221)	1,020 (0.000178)	195 (0.0000340)	52 (0.00000906)
Z $\tau\tau$	157,508	27 (0.000171)	21 (0.000133)	6 (0.0000381)	0
t $\bar{t}$	359,234	101 (0.000281)	1 (0.00000278)	10 (0.0000278)	90 (0.000251)

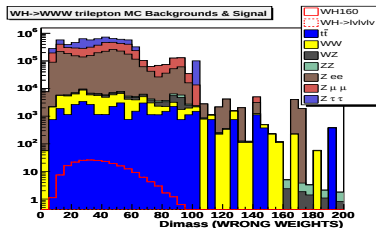
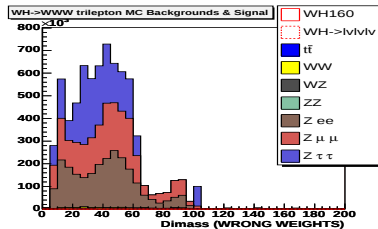
Table: Total counts from Diboson_v15 files and sorted into NLep == 3 and NJet bins. In parentheses are the fractions of total count in the ntuple(divided by 2nd column).

Original Weighting

```
TH1F* WH160Dimass;  
const Double_t WH160_XSection = 0.0459561; // cross section * BR(H->WW)  
  
// Normalize to 1.0  
Double_t norm = 1.0;  
Double_t WH160_scale;  
if(WH160Dimass->GetEntries() != 0.0)  
    WH160_scale = norm/WH160Dimass->GetEntries();  
else  
    WH160_scale = 0.0;  
  
// Apply the scale to normalize to 1.0  
WH160Dimass -> Scale(WH160_scale);  
  
// Now the histogram is normalized to 1.0, scale by the cross section  
WH160Dimass -> Scale(WH160_XSection);  
  
// Finally, scale by the amount of data we want to normalize to (4.8 fb-1 here)  
Double_t dataNormalizedTo = 4800.0; // in pb  
WH160Dimass -> Scale(dataNormalizedTo);
```

Last Week's Dimass (NLep=3, All Jet Bins)

Normalized to 4.8 fb^{-1} :



Process	Integral (After Weighting/Normalizing)
WH(160)	220.55
WHtrilep	3.5736 (correct)
WW	55856
WZ	16601
ZZ	7245

Table: Normalized to 4.8 fb^{-1} .

Process	Integral (After Weighting/Normalizing)
Zee	2.35×10^6
Z $\mu\mu$	2.35×10^6
Z $\tau\tau$	2.35×10^6
$t\bar{t}$	37843

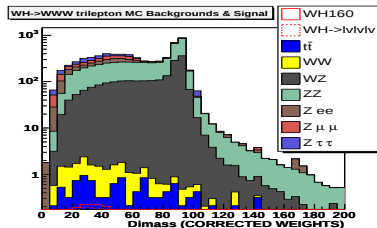
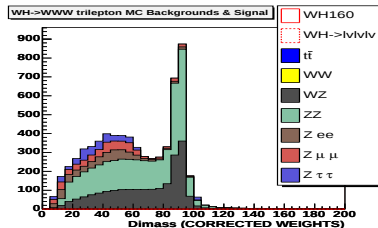
Table: Normalized to 4.8 fb^{-1} .

Problem/Solution

- Obviously, 220 events for WH in 4.8 fb^{-1} is much too large.
- Problem: Only the $N_{\text{Lep}}=3$ events are plotted, but the branching ratio for each production process to a trilepton signature not taken into account. (Example: $Z \rightarrow e\bar{e}$ produces at 490 pb, but does not produce TRILEPTONS at 490 pb).
- Solution: Must multiply by proper branching ratios through to trileptons and multiply by the ratio that go to the $N_{\text{Lep}}=3$ bin to estimate.

Last Week's Dimass Fixed (NLep=3, all jet bins)

Normalized to 4.8 fb^{-1} :



Process	Integral (After Weighting/Normalizing)
WH(160)	1.944
WHtrilep	1.656
WW	14.7
WZ	2024.8
ZZ	3164.7

Process	Integral (After Weighting/Normalizing)
Zee	532.8
Z $\mu\mu$	518.4
Z $\tau\tau$	401.8
t $\bar{t}$	10.66

Table: Normalized to 4.8 fb^{-1} .

Table: Normalized to 4.8 fb^{-1} .

MET Preselection

(CDF Note 9764: HWW Public Note for 3.6 fb^{-1}) "To suppress the Drell-Yan background, we require $\text{MET}_{spec} > 25 \text{ GeV}$ for dielectron and dimuon events, and $\text{MET}_{spec} > 15 \text{ GeV}$ for electron-muon events where MET_{spec} is defined as":

$$\text{MET}_{spec} \equiv \text{MET} \text{ if } \Delta\phi(\text{MET}, \text{nearest lepton or jet}) > \frac{\pi}{2}$$

$$\text{MET}_{spec} \equiv \text{MET} \cdot \sin(\Delta\phi) \text{ if } \Delta\phi(\text{MET}, \text{nearest lepton or jet}) < \frac{\pi}{2}$$

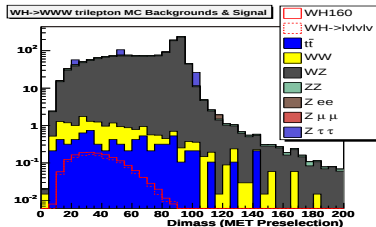
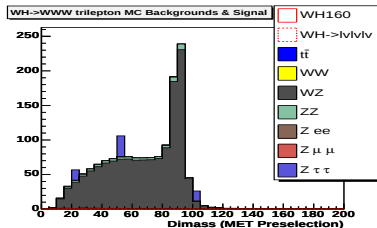
Background Count After MET Preselection

Process	total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet>=2
<i>WH</i> (160)	409,012	23,050 (0.0564)	17,716 (0.0433)	4,220 (0.0103)	1,114 (0.00272)
<i>WH</i> trilep	10,019	3,861 (0.385)	2,959 (0.295)	720 (0.0719)	182 (0.0182)
<i>WW</i>	3,805,444	738 (0.000194)	599 (0.000157)	109 (0.0000286)	30 (0.00000788)
<i>WZ</i>	7,158,862	592766 (0.0828)	476051 (0.0665)	95026 (0.0133)	21689 (0.00303)
<i>ZZ</i>	4,155,633	44371 (0.0107)	31098 (0.00748)	10347 (0.00249)	2935 (0.000706)
<i>Zee</i>	5,459,642	9 (0.00000165)	6 (0.00000110)	3 (0.000000549)	0
<i>Z$\mu\mu$</i>	5,737,968	4 (0.000000697)	2 (0.000000349)	1 (0.000000174)	1 (0.000000174)
<i>Z$\tau\tau$</i>	157,508	4 (0.0000254)	3 (0.0000190)	1 (0.00000635)	0
<i>t$\bar{t}$</i>	359,234	71 (0.000198)	1 (0.00000278)	8 (0.0000223)	62 (0.000173)

Table: Total counts from Diboson_v15 files and sorted into NLep == 3 and NJet bins. In parentheses are the fractions of total count in the ntuple(divided by 2nd column).

Dimass After MET Preselection (NLep=3, all jet bins)

Normalized to 4.8 fb^{-1} :



Process	Integral (After Weighting/Normalizing)
WH(160)	1.60
WHtrilep	1.38
WW	10.8
WZ	1372
ZZ	59.0

Process	Integral (After Weighting/Normalizing)
Zee	3.87
Z $\mu\mu$	1.64
Z $\tau\tau$	59.5
$t\bar{t}$	7.49

Table: Normalized to 4.8 fb^{-1} .

Table: Normalized to 4.8 fb^{-1} .

Signal Counts Before MET Preselection

Process	total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
<i>WH</i> (160)	409,012	27,929 (0.0683)	20,887 (0.0511)	5,473 (0.0134)	1,569 (0.00384)
<i>ZH</i> (160)	274,538	34,813 (0.127)	4,022 (0.0147)	10,535 (0.0384)	20,256 (0.0738)
VBF	928,471	157 (0.000169)	3 (0.00000323)	31 (0.0000334)	123 (0.000132)
<i>ggH</i>	511,268	50 (0.0000978)	19 (0.0000372)	23 (0.0000450)	8 (0.0000156)
<i>WH</i> trilep	10,019	4,638 (0.463)	3,459 (0.0345)	919 (0.0917)	260 (0.0260)

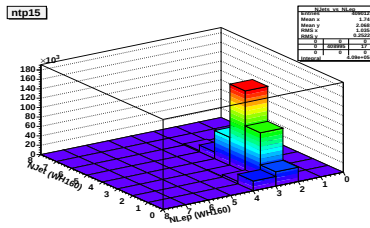
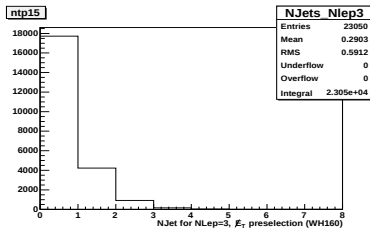
Table: Total counts from Diboson_v15 files and sorted into NLep == 3 and NJet bins. In parentheses are the fractions of total count in the ntuple(divided by 2nd column).

Signal Counts After MET Preselection

Process	total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
<i>WH</i> (160)	409,012	23,050 (0.0564)	17,716 (0.0433)	4,220 (0.0103)	1,114 (0.00272)
<i>ZH</i> (160)	274,538	19,757 (0.0720)	3,288 (0.0120)	7,020 (0.0256)	9,449 (0.0344)
<i>VBF</i>	928,471	114 (0.000123)	3 (0.00000323)	24 (0.0000258)	87 (0.0000937)
<i>ggH</i>	511,268	36 (0.0000704)	18 (0.0000352)	15 (0.0000293)	3 (0.00000587)
<i>WH</i> trilep	10,019	3,861 (0.385)	2,959 (0.295)	720 (0.0719)	182 (0.0182)

Table: Total counts from Diboson_v15 files and sorted into NLep == 3 and NJet bins. In parentheses are the fractions of total count in the ntuple(divided by 2nd column).

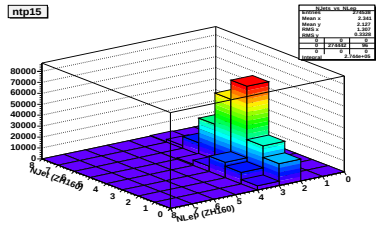
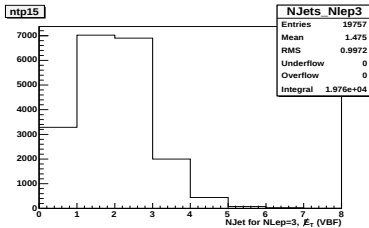
WH160: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
409,012	27,929	20,887	5,473	1,569

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet $\geq$ 2(MET cut)
23,050	17,716	4,220	1,114

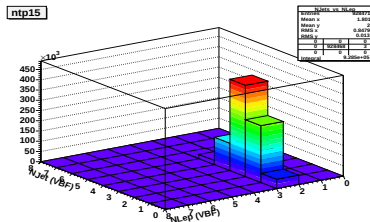
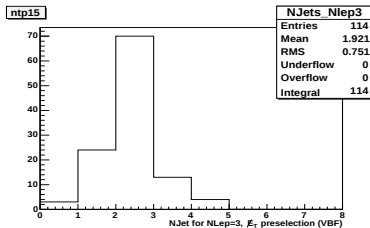
ZH160: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
274,538	34,813	4,022	10,535	20,256

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet $\geq$ 2(MET cut)
19,757	3,288	7,020	9,449

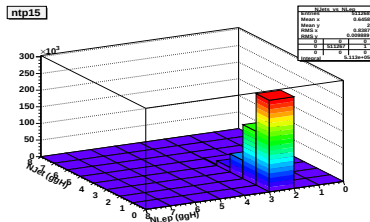
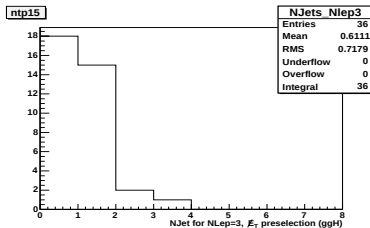
VBF: NJet vs. NLep



total in ntp	NLeP=3	NLeP=3,NJet=0	NLeP=3,NJet=1	NLeP=3,NJet ≥ 2
928,471	157	3	31	123

NLeP=3 (MET cut)	NLeP=3,NJet=0(MET cut)	NLeP=3,NJet=1(MET cut)	NLeP=3,NJet ≥ 2 (MET cut)
114	3	24	87

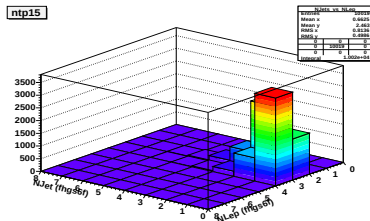
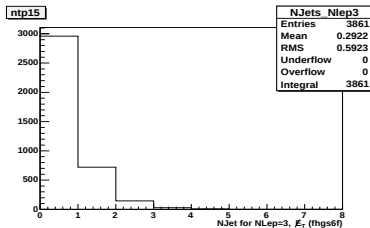
ggH: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
511,268	50	19	23	8

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet $\geq$ 2(MET cut)
36	18	15	3

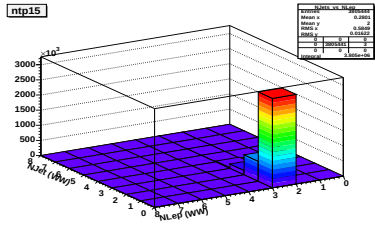
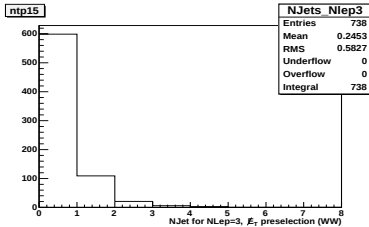
fhgs6f w/ Trilepton Filter: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
10,019	4,638	3,459	919	260

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet $\geq$ 2(MET cut)
3,861	2,959	720	182

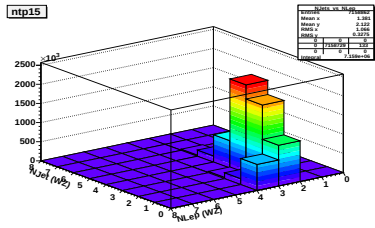
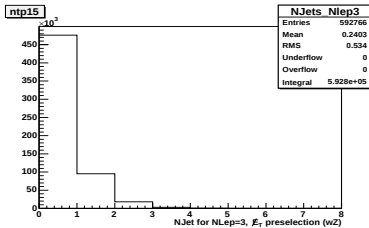
WW: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet ≥ 2
3,805,444	1002	805	153	44

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet ≥ 2 (MET cut)
738	599	109	30

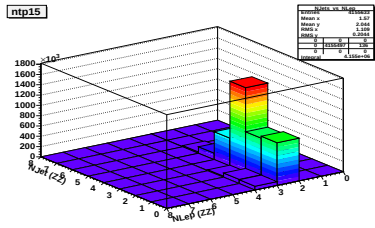
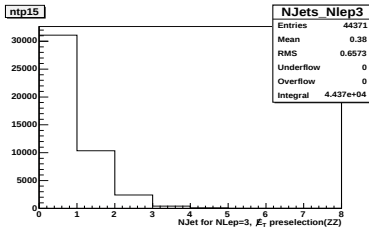
WZ: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet ≥ 2
7,158,862	874,963	681,304	153,347	40,312

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet ≥ 2 (MET cut)
592,766	476,051	95,026	21,689

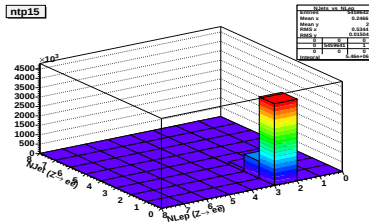
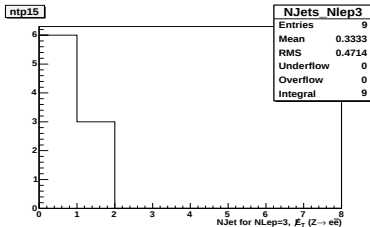
ZZ: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet ≥ 2
4,155,633	181,542	75,496	81,666	24,380

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet ≥ 2 (MET cut)
44,371	31,089	10,347	2,935

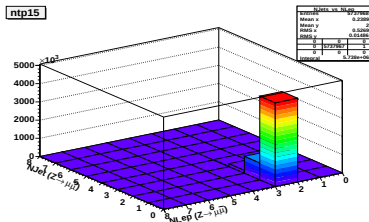
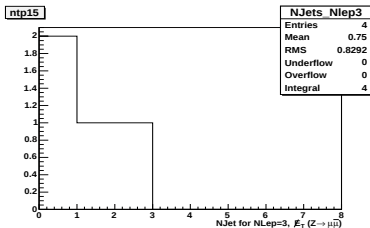
$Z \rightarrow e\bar{e}$: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet ≥ 2
5,459,642	1,235	985	199	51

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet ≥ 2 (MET cut)
9	6	3	0

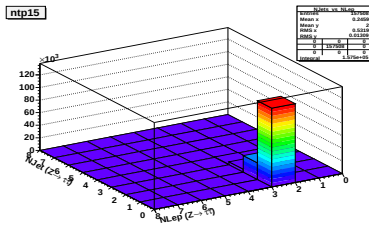
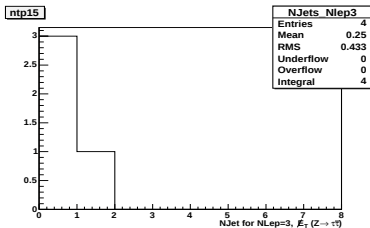
$Z \rightarrow \mu\bar{\mu}$: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
5,737,968	1,267	1,020	195	52

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet $\geq$ 2(MET cut)
4	2	1	1

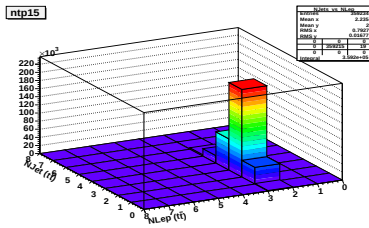
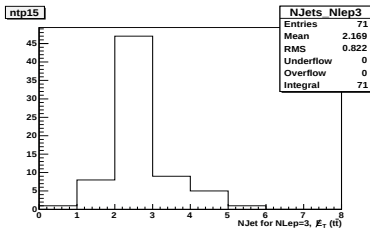
$Z \rightarrow \tau\tau$: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
157,508	27	21	6	0

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet $\geq$ 2(MET cut)
4	3	1	0

$t\bar{t}$: NJet vs. NLep



total in ntp	NLep=3	NLep=3,NJet=0	NLep=3,NJet=1	NLep=3,NJet $\geq$ 2
359,234	101	1	10	90

NLep=3 (MET cut)	NLep=3,NJet=0(MET cut)	NLep=3,NJet=1(MET cut)	NLep=3,NJet $\geq$ 2(MET cut)
71	1	8	62