WZ resonance

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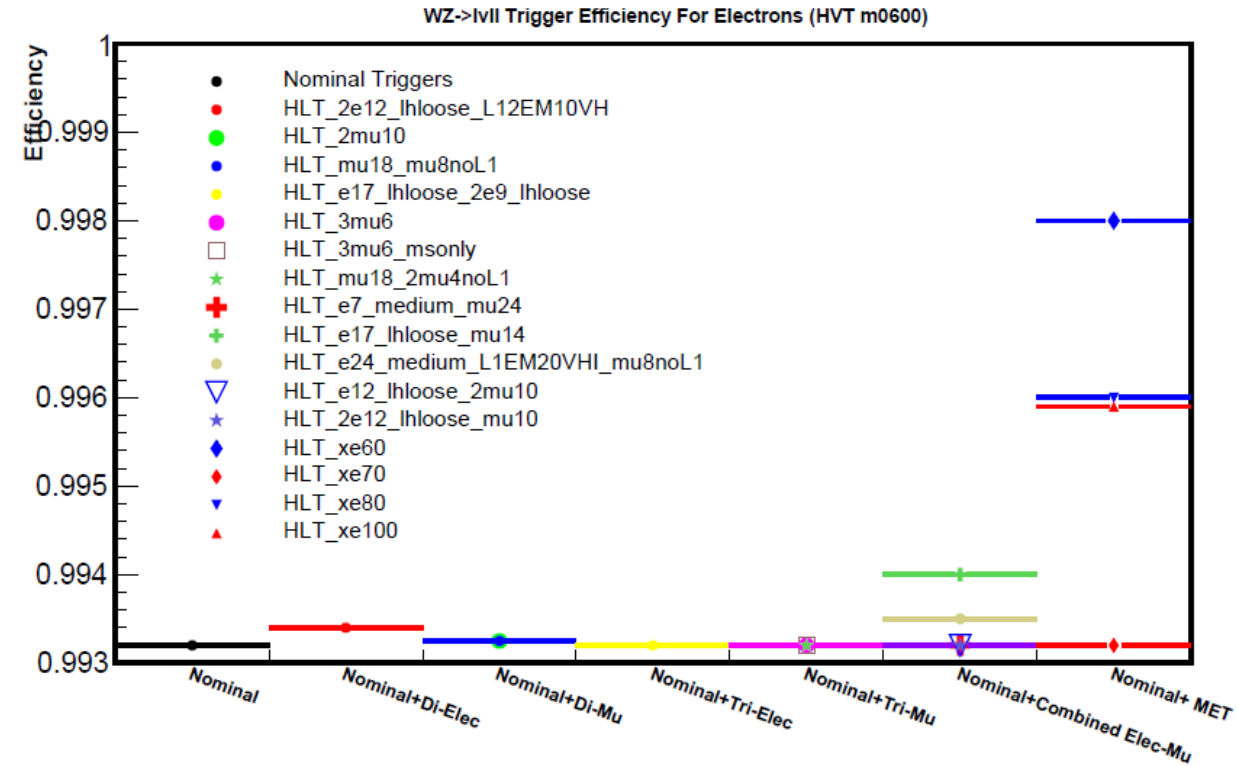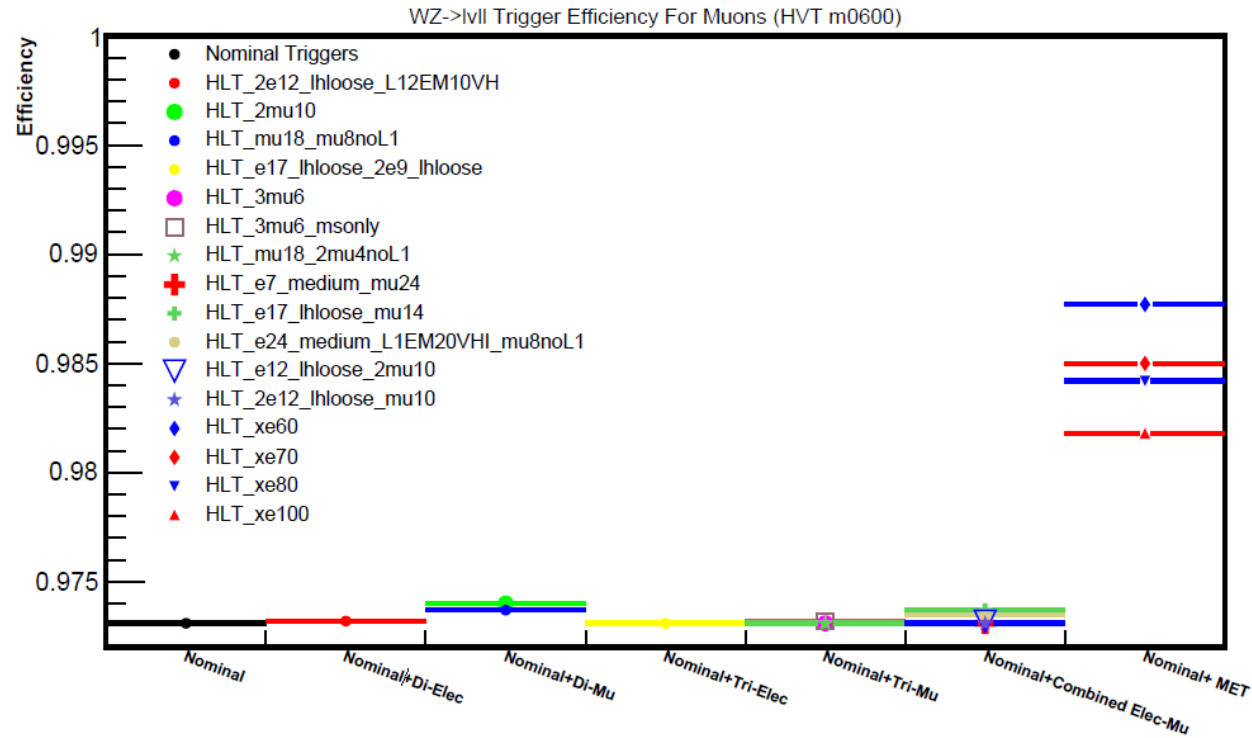
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Introduction

The aim of this study:

- Estimate the gain added by using other triggers, than the single lepton trigger currently used in this analysis.

- Comparison between four different Z+jets MC generators PowHeg(baseline), Sherpa 2.1, Sherpa 2.2, Madgraph.

- ZZ Veto of four-lepton events Optimization.

Adding Trigges to Nominal triggers

WZ→lvll Trigger Efficiency For Muons (HVT m0600)

WZ→lvll Trigger Efficiency For Electrons (HVT m0600)

- Single lepton trigger (Nominal triggers) is the trigger that provide the highest efficiency

- Less than 1% gain by adding MET triggers to Nominal triggers for Muons Channel

- About 1% gain by adding MET triggers to Nominal triggers for Electrons Channel

Trigger efficiency for HVT samples

- Calculate trigger efficiency for 3 HVT mass points using current selection and nominal triggers. Single lepton trigger is 100% efficient for 600 and 1300 GeV.

- Small drop in the 3 Muons channel at 2000 GeV

- At high mass there is a gain of ~2.63% in the muon channels by adding MET triggers

600 GeV

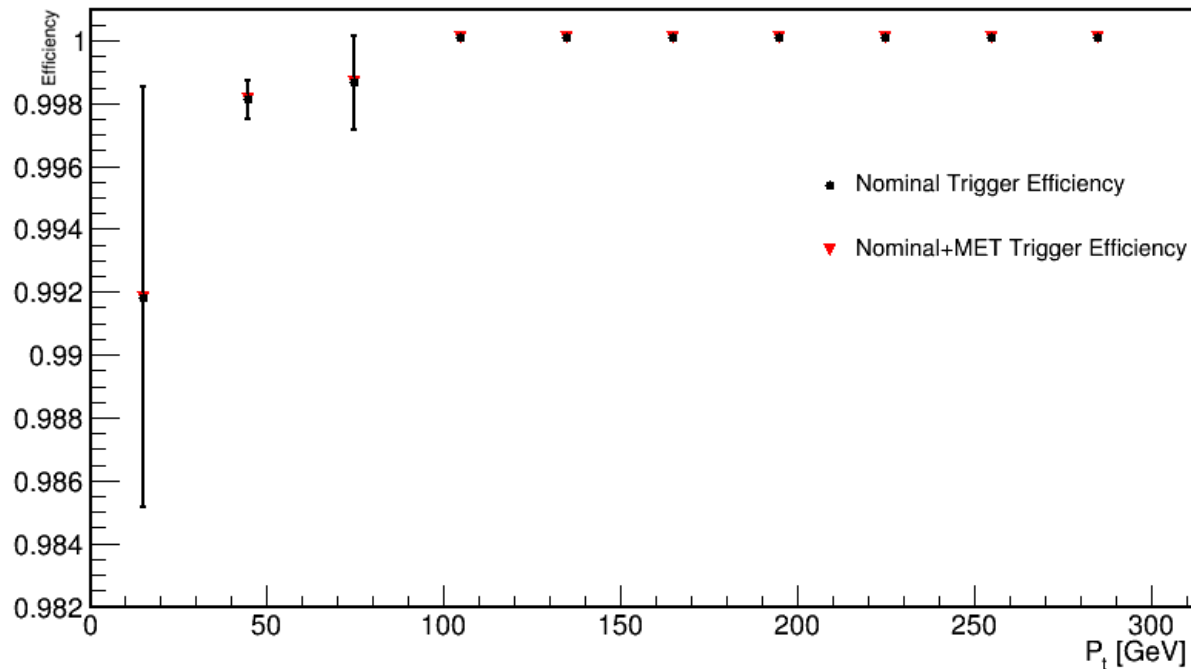
1300 GeV

97.40%

94.77%

2000 GeV
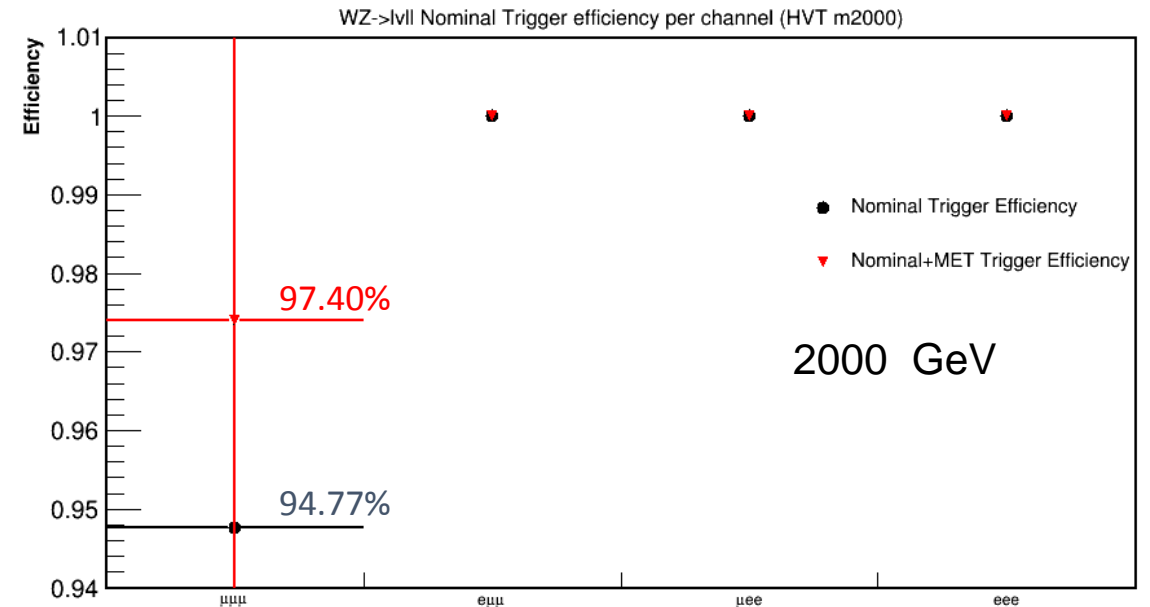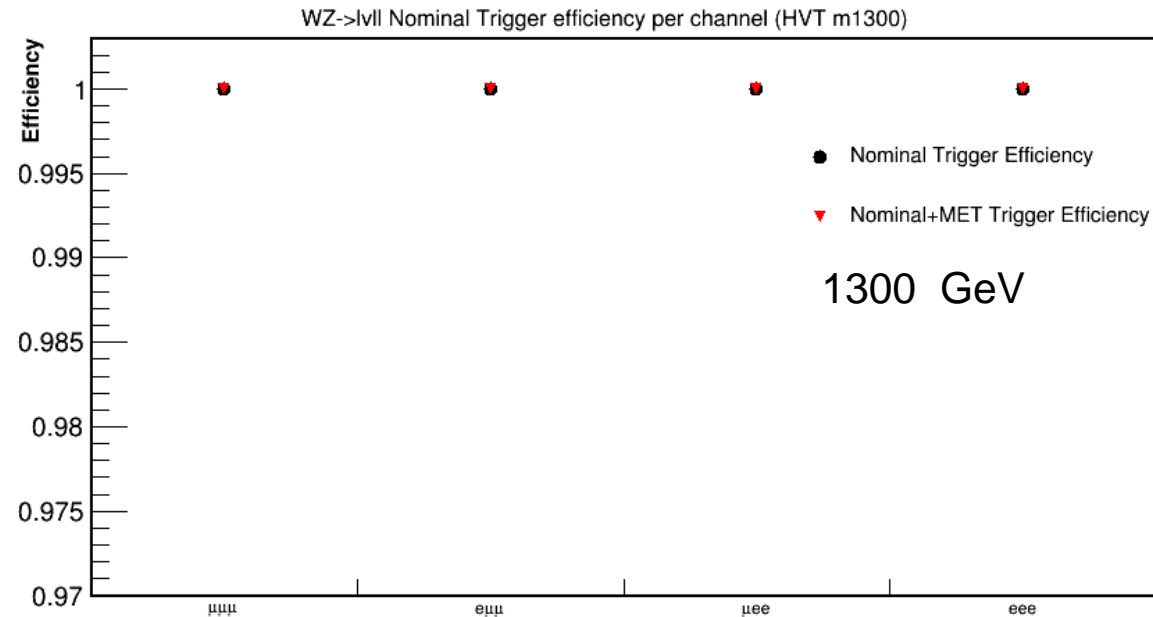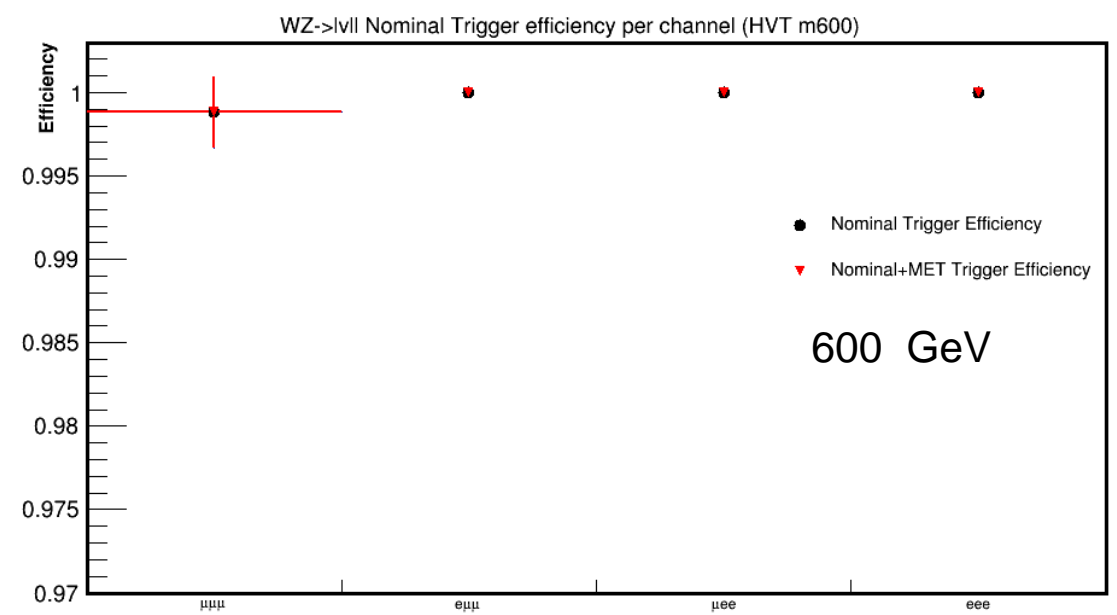
Trigger efficiency per Channel For WZ SM

- Calculate trigger efficiency using the SM sample:

    - Nominal triggers

    - Nominal+MET triggers

- Looked also at the lepton PT distribution

- There is no efficiency gain by adding MET triggers in the SM sample

WZ->lvll Nominal Trigger efficiency per channel (WZ SM)
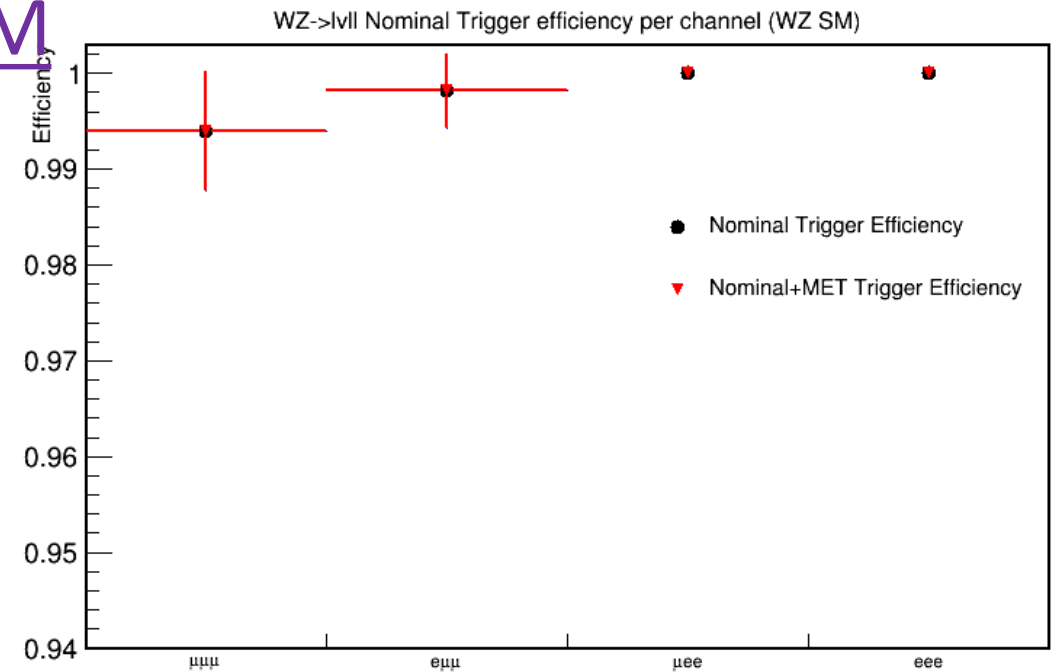
Trigger_Efficiency vs WZ Lepton Pt (WZ SM)

WZ SM Efficiency				
Triggers	μμμ	eμμ	μee	eee
Nominal+MET	99.4 %	99.8 %	100 %	100 %
Nominal	99.4 %	99.8 %	100 %	100 %
Gain %	0	0	0	0

Trigger efficiency per Channel For data15

atlas_lumi = 3.2 fb-1

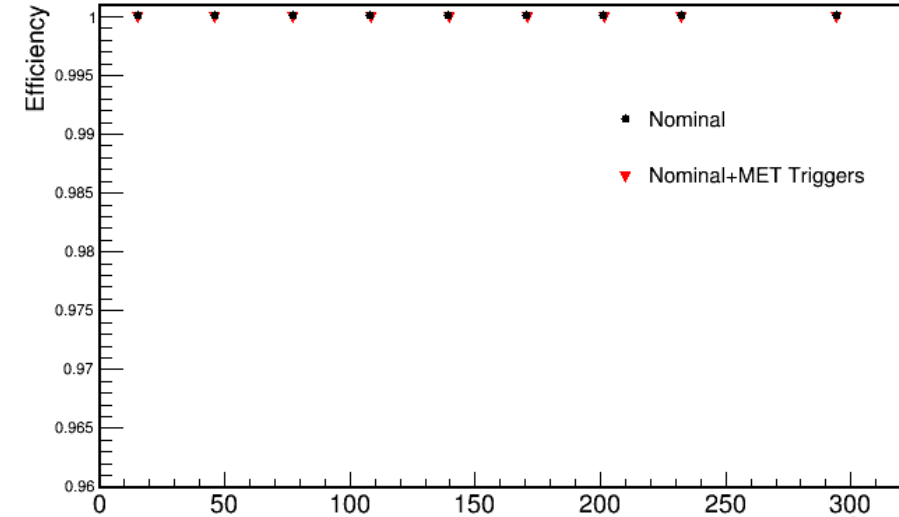WZ->lvll Trigger efficiency per channel (Data)

- Nominal
- Nominal+MET

Trigger_Efficiency vs wz_Electrons_Pt_ (Data)

- Nominal
- Nominal+MET Triggers

Trigger_Efficiency vs wz_Muons_Pt_ (Data)

- Nominal
- Nominal+MET Triggers

WZ SM Efficiency				
Triggers	μμμ	eμμ	μee	eee
Nominal+MET	99.40 %	99.25 %	100 %	100 %
Nominal	98.80 %	99.25 %	100 %	100 %
Gain %	0.6 %	0	0	0

- Adding MET triggers to the nominal selection we see a gain in efficiency in the mmm channel (0.6 %)
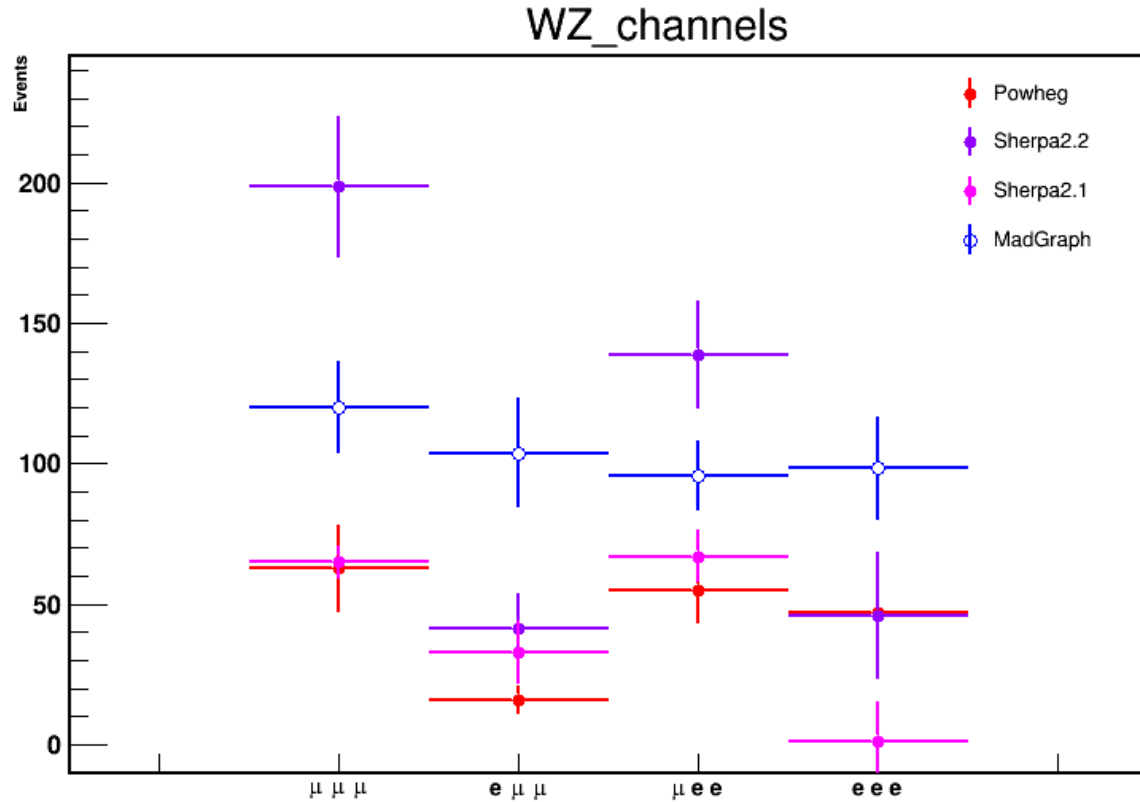- Single lepton trigger (Nominal triggers) is 100% efficient for electrons .

Zjets comparison :

WZ_channels
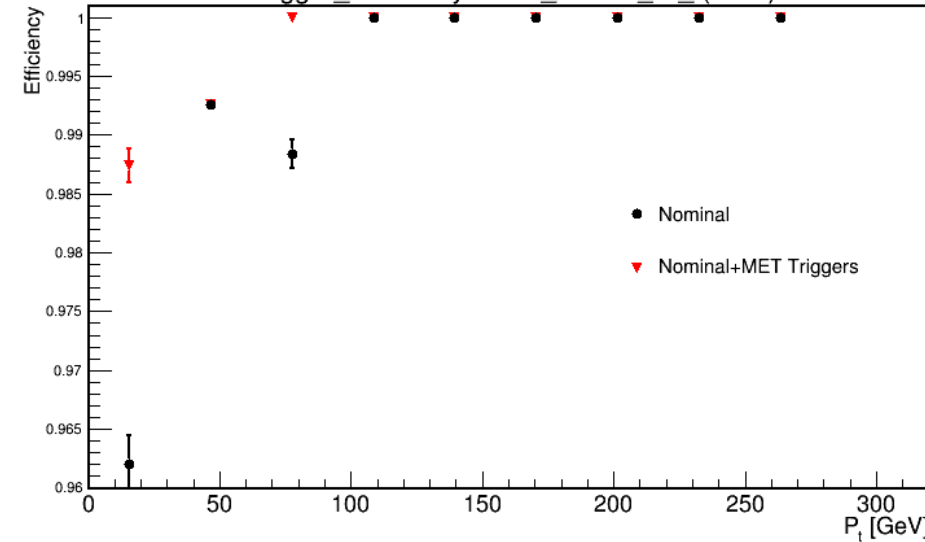
| Channel	μμμ	eμμ	μee	eee
MagGraph	119.91+-16.33	103.64+-19.53	95.65+-12.64	98.35+-18.41
Powheg	82.17+-18.47	36.94+-10.65	61.12+-13.58	52.16+-14.21
Sherpa 2.1	64.95+-6.06	32.75+-11.24	66.91+-9.34	0.96+-14.12
Sherpa2.2	198.6+-25.14	41.52+-12.07	138.68+-19.35	45.7+-22.73

- Important difference in normalisation up to factor 2 between the four generators in the fours WZ channels

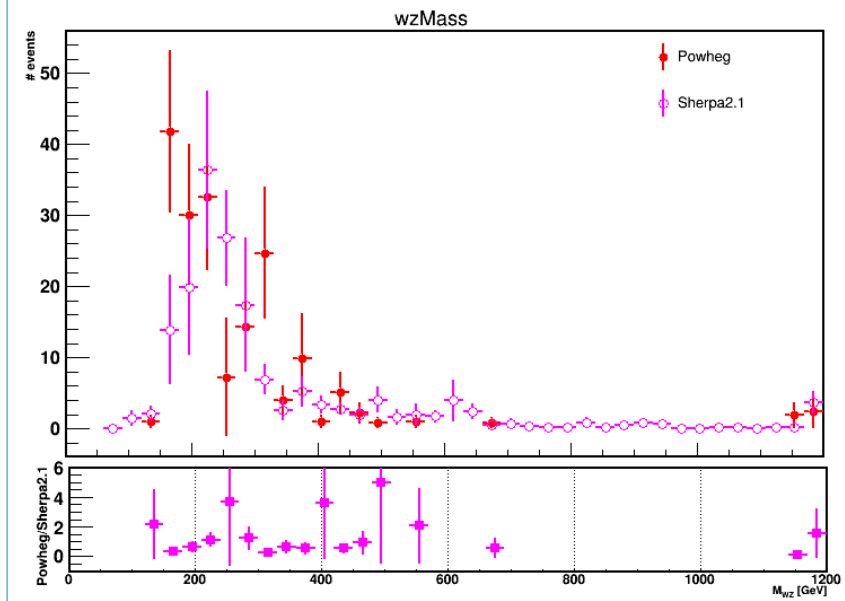# Zjets Shape comparison (normalized to cross section) : WZ Mass
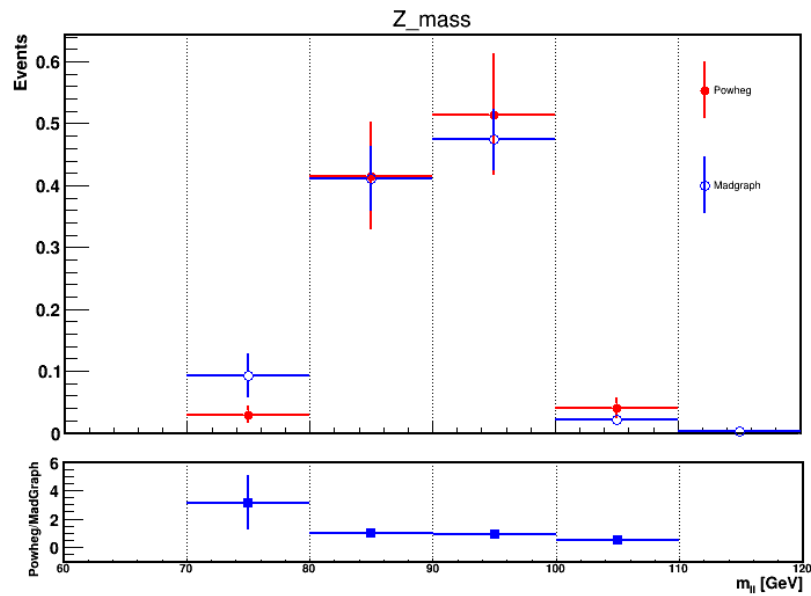
Powheg / MadGraph
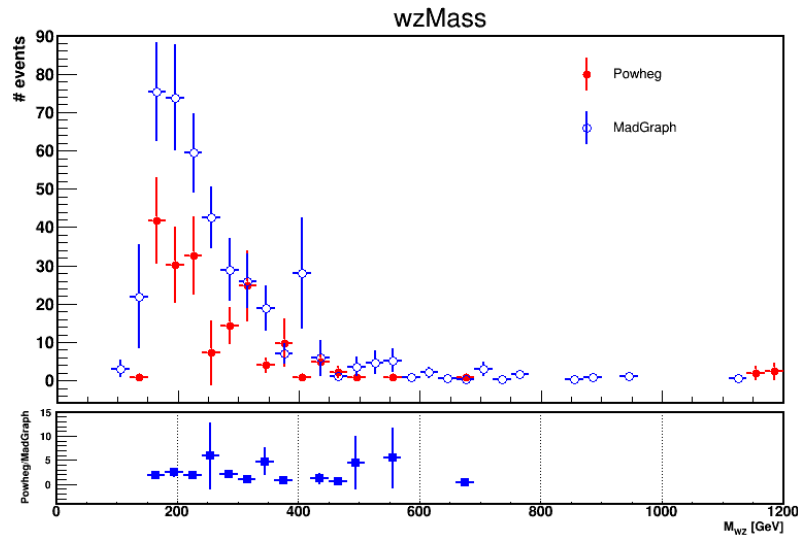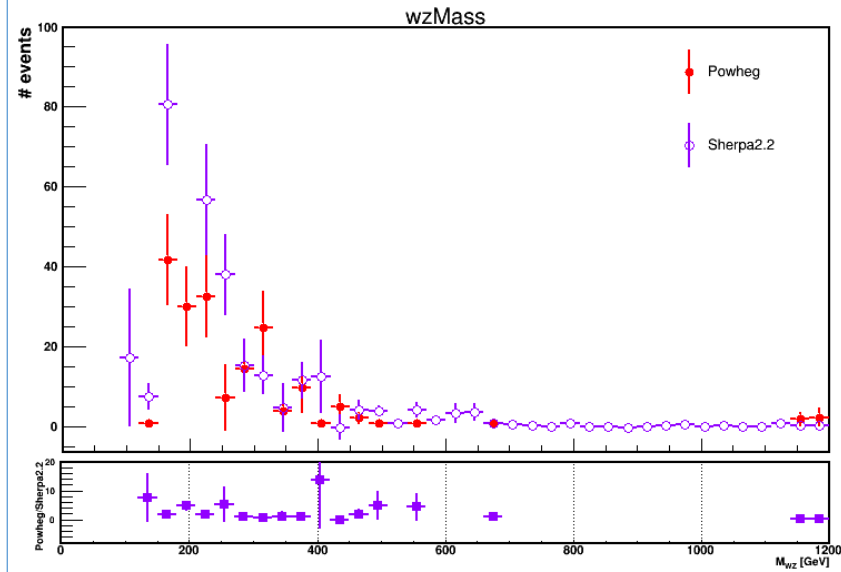
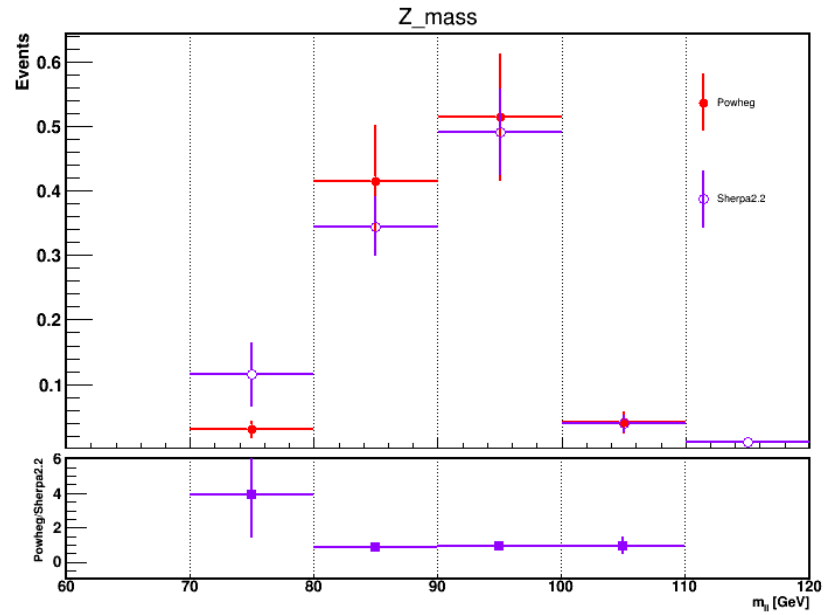Powheg / Sherpa2.2

Powheg / Sherpa2.1

- PowHeg seems to have less events at high WZ mass compared to the other generators

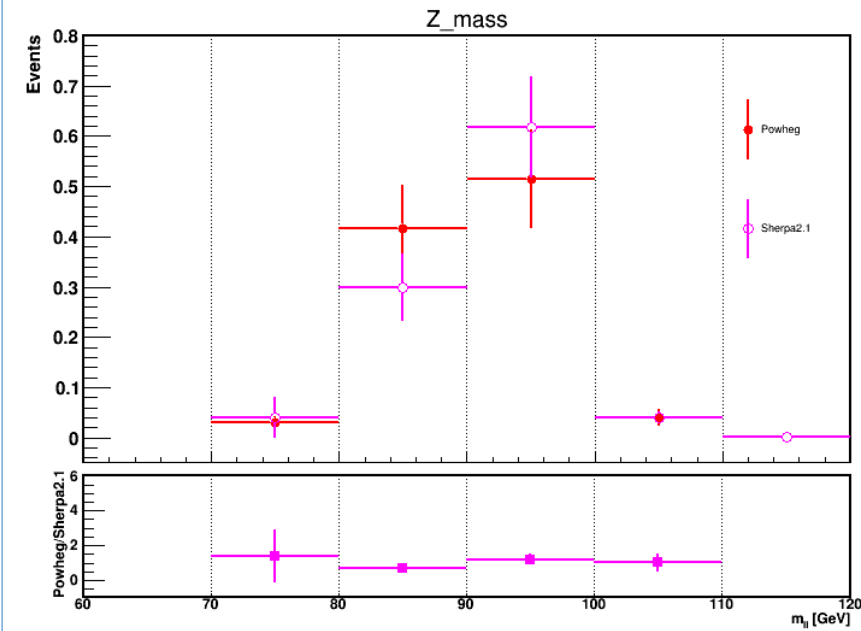# Zjets Shape comparison (normalized to unit) : Z Mass

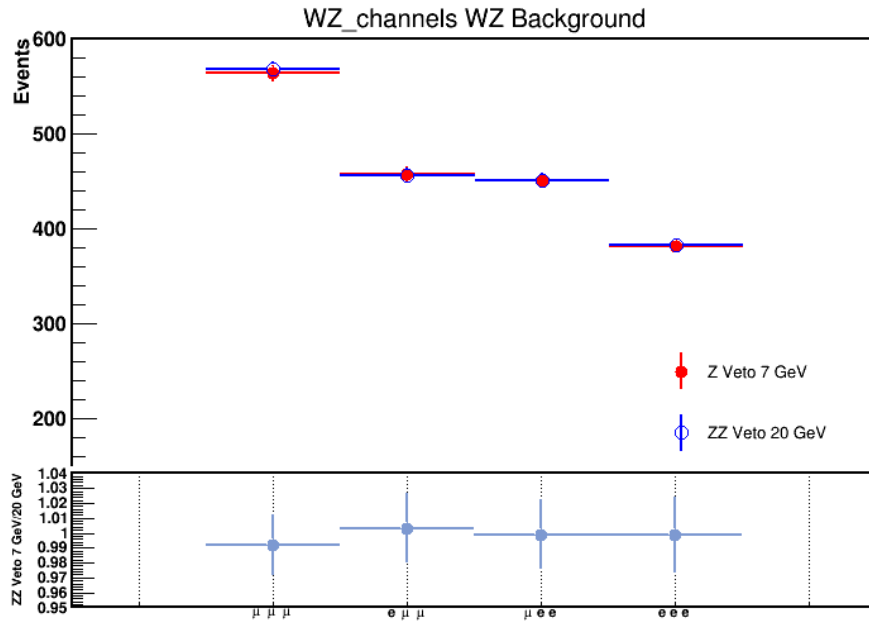Powheg / MadGraph

Powheg / Sherpa2.2

Powheg / Sherpa2.1

- The difference in Z-mass shape will be taken as a generator systematic in the simultaneous fit

ZZ Veto Comparison :

WZ_channels WZ Background

WZ_channels ZZ Background

WZ					
Veto	μμμ	eμμ	μee	eee	Total
20 GeV	568.27	456.34	451.18	382.61	1858.4
7 GeV	563.67	457.78	450.71	382.17	1854.33
Ratio %	0.81	-0.31	0.1	0.115	0.22
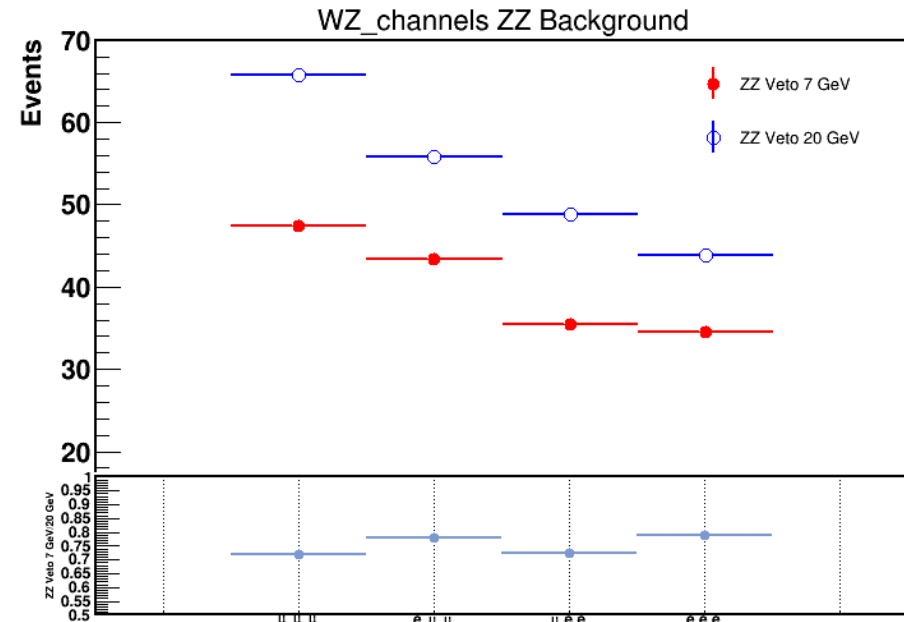
ZZ					
Veto	μμμ	eμμ	μee	eee	Total
20 GeV	65.75	55.77	48.88	43.83	214.77
7 GeV	47.42	43.35	35.45	34.49	160.71
Ratio %	28	22	27	21	25

ZZ Veto Comparison :

WZ_channels VVV Background

WZ_channels top Background
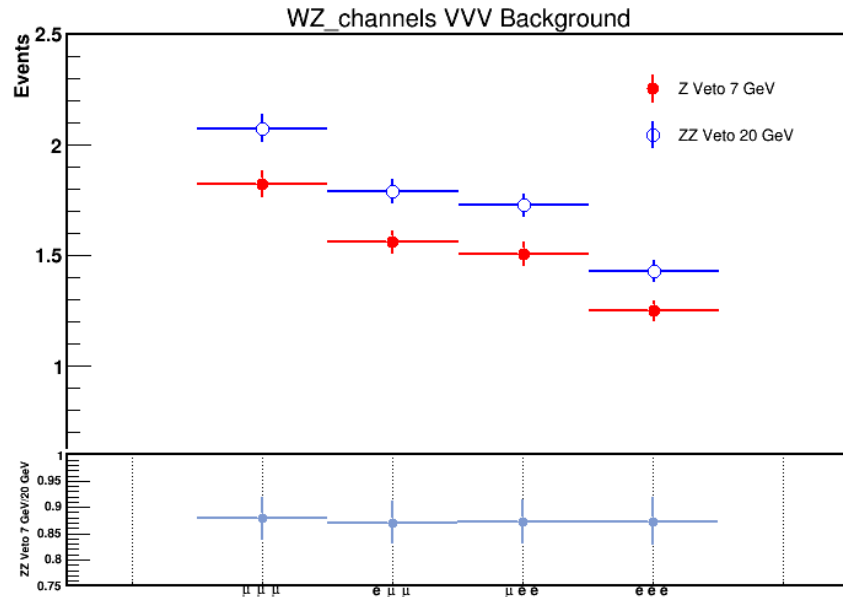
Tribosons					
Veto	μμμ	eμμ	μee	eee	Total
20 GeV	2.07	1.79	1.72	1.43	7.01
7 GeV	1.8	1.56	1.50	1.25	6.11
Ratio%	13	12.8	12.8	12.87	12.83
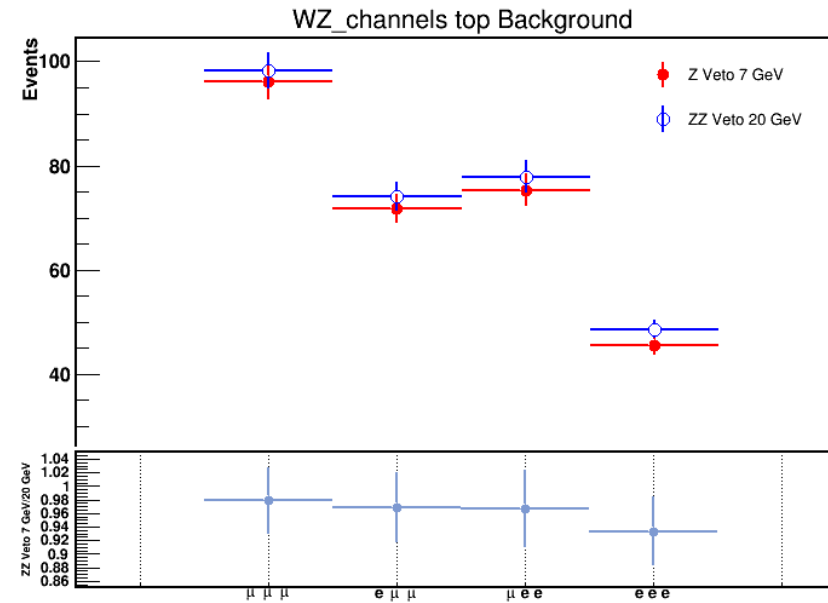
top					
Veto	μμμ	eμμ	μee	eee	Total
20 GeV	98.28	74.13	77.89	48.67	298.97
7 GeV	96.20	71.81	75.31	45.44	288.76
Ratio %	2.11	3.13	3.32	6.6	3.41

ZZ Veto Comparison :

WZ_channels Z+Jet Backgroud

WZ_channels Z+gamma Background
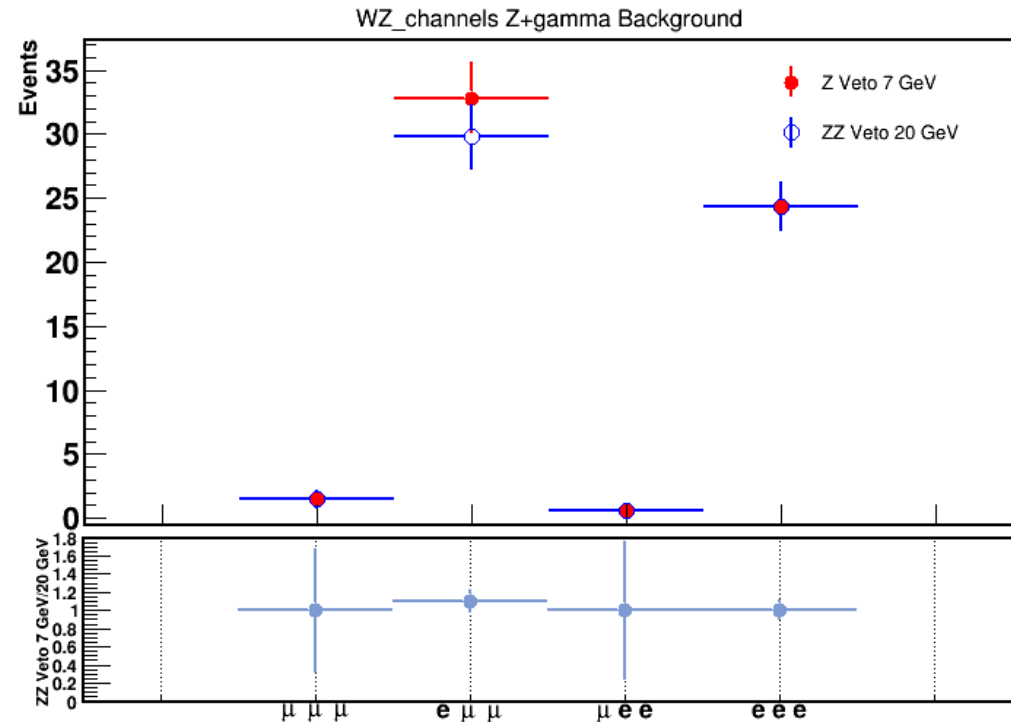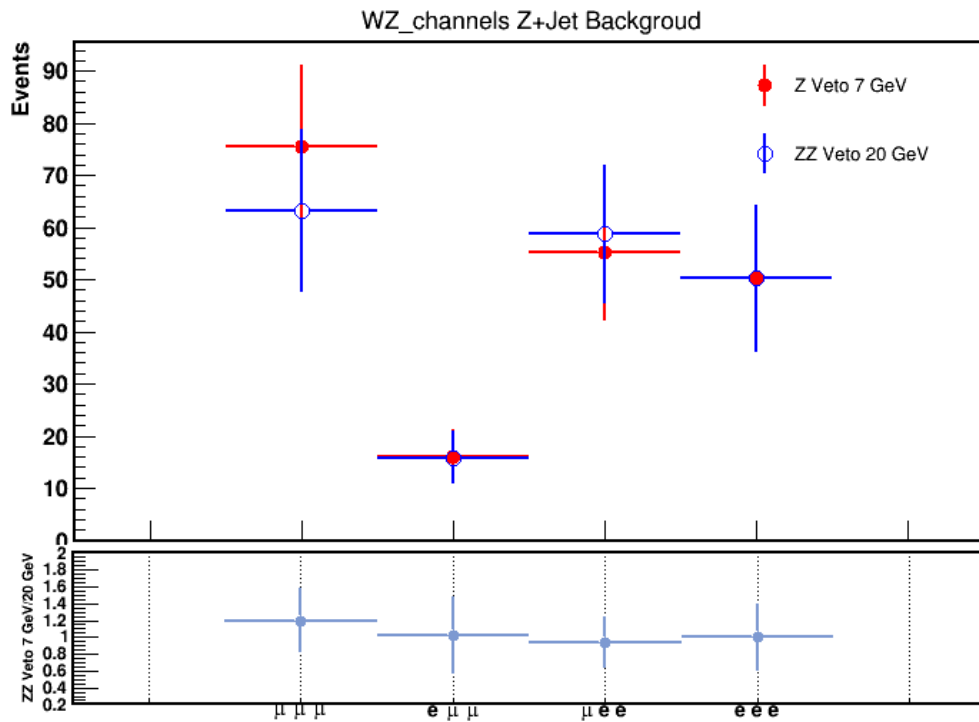
Z+Jet					
Veto	μμμ	eμμ	μee	eee	Total
20 GeV	63.12	15.78	58.75	50.16	187.81
7 GeV	75.61	16.05	55.25	50.21	197.12
Ratio %	-20	-1.71	5.95	-0.1	-4.95

Z+gamma					
Veto	μμμ	eμμ	μee	eee	Total
20 GeV	1.46	29.79	0.53	24.35	56.13
7 GeV	1.46	32.80	0.53	24.35	59.14
Ratio %	0	-10.10	0	0	-5.1

Summary

- By looking at the HVT signal at the lepton pre-selection level less than 1% gain by adding MET .

- Using the single lepton triggers for HVT signals, we have an efficiency of ~99 % . Not evident gain in signal HVT or WZ SM by adding MET triggers to our final selection.

- Small gain in trigger efficiency was seen in data by adding MET triggers to the nominal selection.

- A comparison between the normalisation and the shape information between four Z+jets generators was performed.

- The difference in Z-mass shape will be taken as a generator systematic in the simultaneous fit.

- Decreasing the ZZ veto pt lepton cut from 20 GeV to 7 GeV, reduces the ZZ background by more than 25%. While the dominant background WZ SM is not affected by this cut.

- Will run on data 2015-2016 with 7 GeV cut.