More Operators for Tribosons: Cross-section Scans and Plots

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Overview

- Now using newest model files with NP=0 or 1
  - 14 TeV only for today, are running 33 and 100 TeV as well
  - Default Madgraph generator cuts, pt < 10 GeV, |eta| < 2.5
  - Coupling values 1e10-10, 1e10-11, 1e10-12
  - Includes electrons and muons
- Cross-checked with cross-sections shown earlier by Shih-Chieh for Muons with 10^-10 coupling values
- Have plots for 10^-12 using default Madgraph+pythia+Delphes
- Working on plots for 10^-11 using snowmass Delphes with pileup plus some additional backgrounds (diboson and ttbar)

Cross-sections and Ratio wrt SM for 10^-10 Couplings

Coupling	WWW	WWZ	WZZ	ZZZ
Sm Cross-section(pb)	0.000568000	0.000111800	0.000009634	0.000000972
sm/sm	1.00	1.00	1.00	1.00
fs0/sm	1.03	1.00	1.00	0.98
fs1/sm	1.01	1.00	1.00	0.98
fm0/sm	50.65	11.56	7.56	5.70
fm1/sm	17.92	3.68	3.55	2.74
fm2/sm	1.00	6.76	1.01	3.41
fm3/sm	1.00	2.44	1.00	1.78
ft0/sm	1804.58	326.57	232.82	203.96
ft1/sm	1469.37	122.81	179.99	203.96
ft2/sm	357.39	34.51	34.57	48.52
ft8/sm	1.00	1.00	1.00	10.33
ft9/sm	1.00	1.00	1.00	10.33

Cross-sections and Ratio wrt SM for 10^-11 Couplings

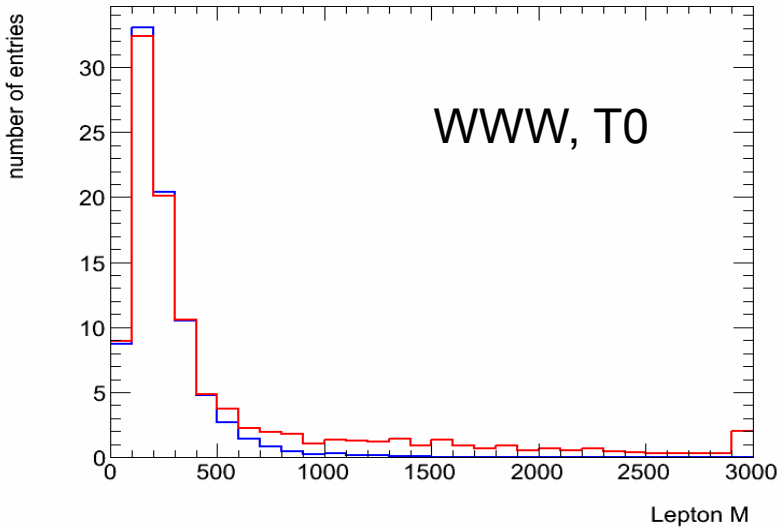
Coupling	WWW	WWZ	WZZ	ZZZ
Sm Cross-section(pb)	0.000568000	0.000111800	0.000009634	0.000000972
sm/sm	1.00	1.00	1.00	1.00
fs0/sm	1.00	1.00	1.00	1.00
fs1/sm	1.00	1.00	1.00	1.00
fm0/sm	1.49	1.09	1.05	1.02
fm1/sm	1.18	1.02	1.04	1.03
fm2/sm	1.00	1.05	1.00	1.02
fm3/sm	1.00	1.01	1.00	1.01
ft0/sm	19.10	4.23	3.38	2.90
ft1/sm	15.88	2.23	2.83	2.90
ft2/sm	4.61	1.33	1.35	1.54
ft8/sm	1.00	1.00	1.00	1.31
ft9/sm	1.00	1.00	1.00	1.08

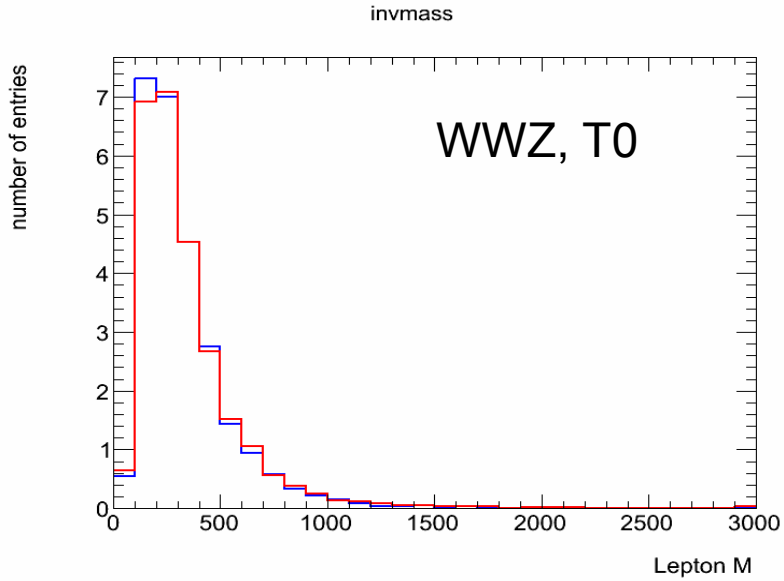
Cross-sections and Ratio wrt SM for 10^-12 Couplings

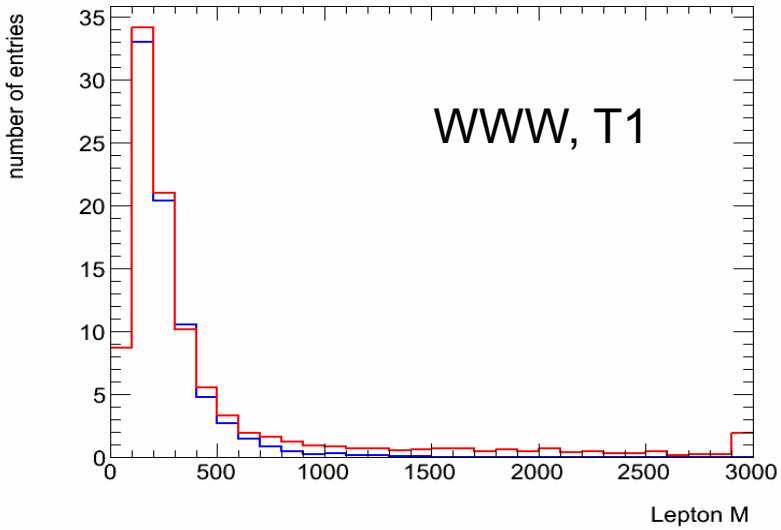
Coupling	WWW	WWZ	WZZ	ZZZ
Sm Cross-section(pb)	0.000568000	0.000111800	0.000009634	0.000000972
sm/sm	1.00	1.00	1.00	1.00
ft0/sm	1.19	1.03	1.03	1.03
ft1/sm	1.16	1.01	1.03	1.03
ft2/sm	1.05	1.00	1.01	1.02

Some Plots for T0, T1 = 10^-12

- Plots are for >=3 leptons, vs inv. mass of the leptons, 300fb-1, 14 TeV, default madgraph+pythia+delphes (nopileup)
- Some discrimination for WWW in tail but want more events, larger coupling

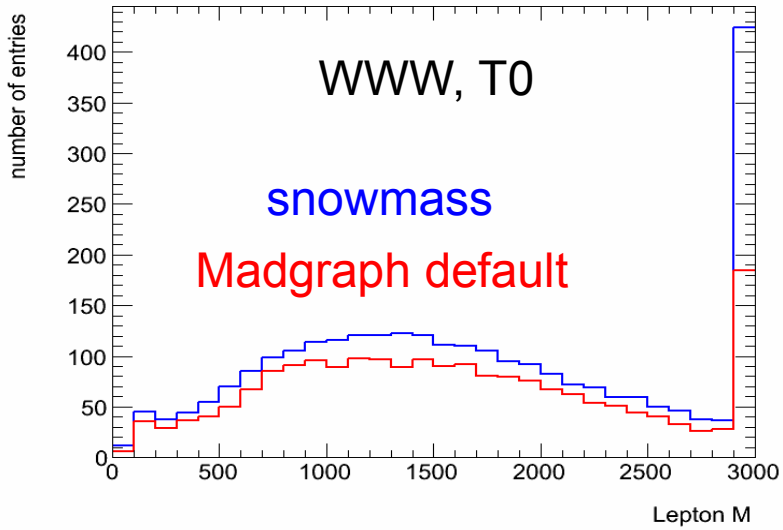


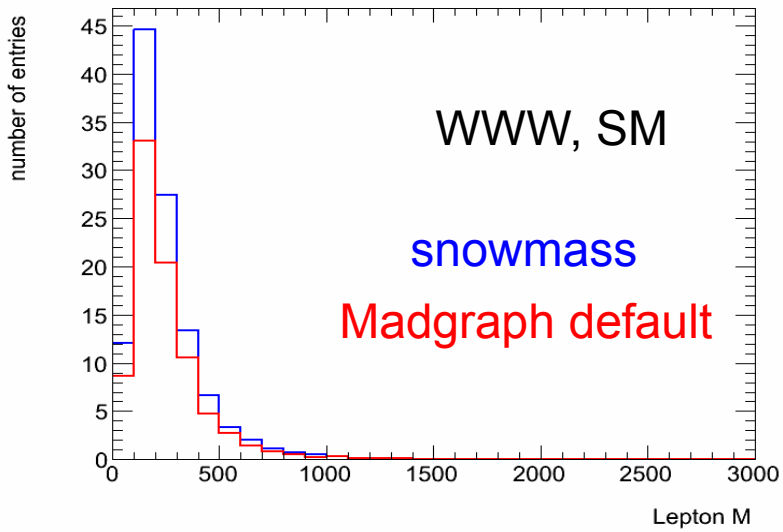




Snowmass Delphes

- I've done some runs with official snowmass delphes and smearing, following instructions from wiki
- Plot shows Madgraph Delphes and Snowmass Delphes for WWW FT0 = 10^-11 (top) and SM (bottom)
  - No pileup for this comparison
  - 10k madgraph, 50k snowmass but both reweighted to 14 TeV cross-sections
- Similar-ish shapes
- Snowmass version has more events retained after >= 3 lepton cut



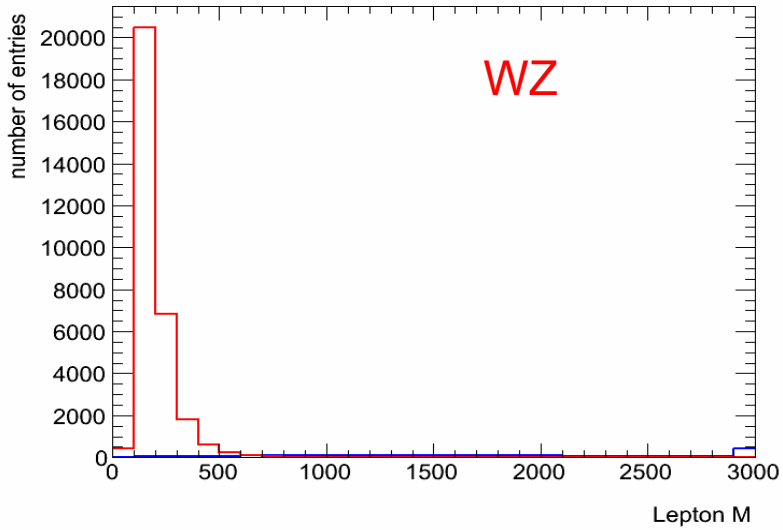


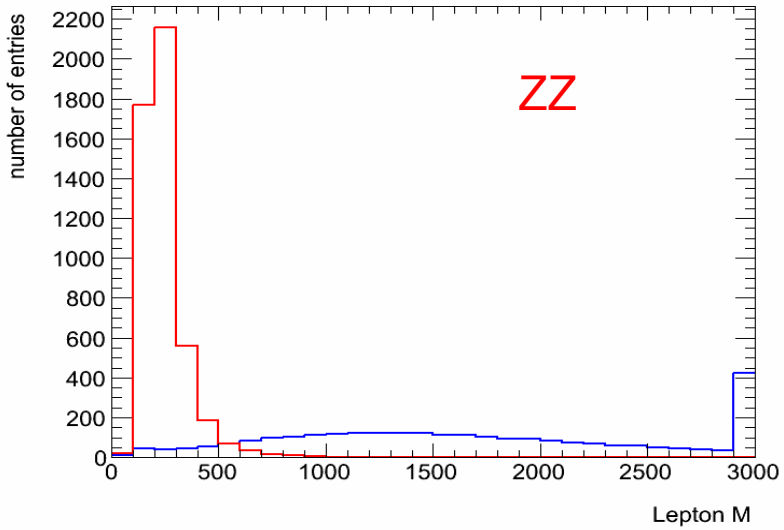
Snowmass Delphes with PU

- Running with pileup requires copying the appropriate machine pileup file to Minbias.pileup, which I forgot the first time...
- Runs with pileup, particularly runs with lots of lower energy events (SM like) take awhile, need to divide up into smaller jobs or add HT cut like for official samples
  - Doesn't run jobs on multiple cores by default like Madgraph does

Backgrounds

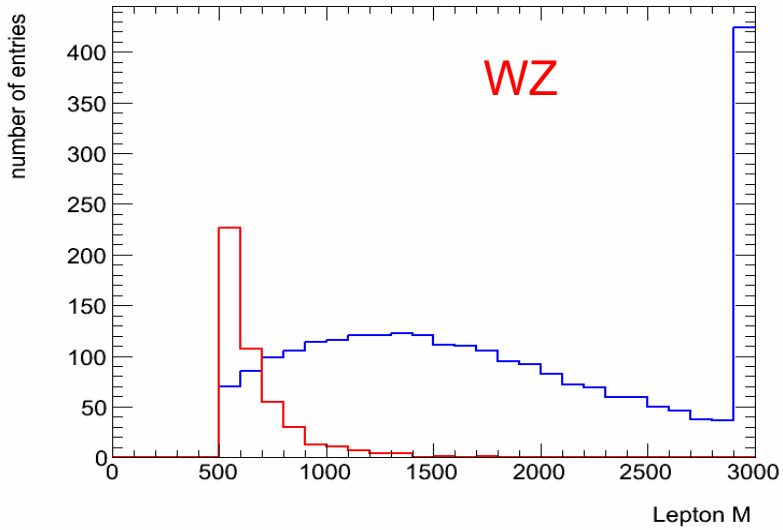
- WWW has only 3 leptons, fairly sensitive to backgrounds like SM WWW, WZ and ZZ
- Plots have nlepton >= 3, red is SM diboson, blue is FT0 for WWW
- No pileup but with snowmass Delphes
- May need to look > 500 GeV inv. mass

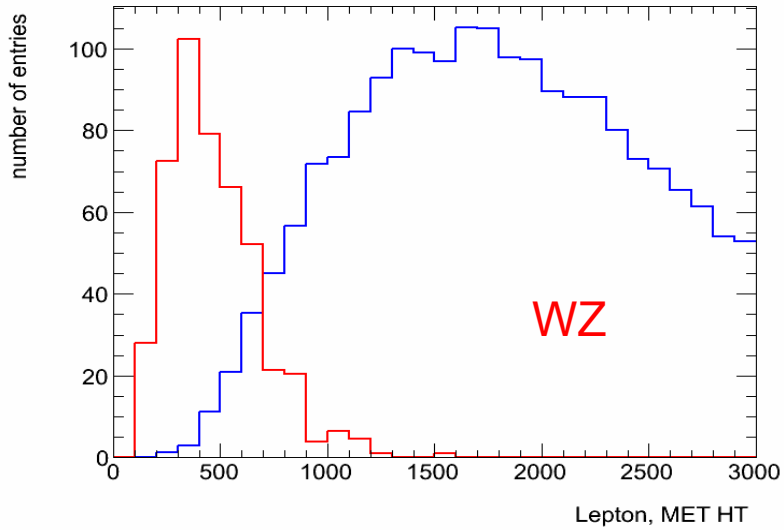


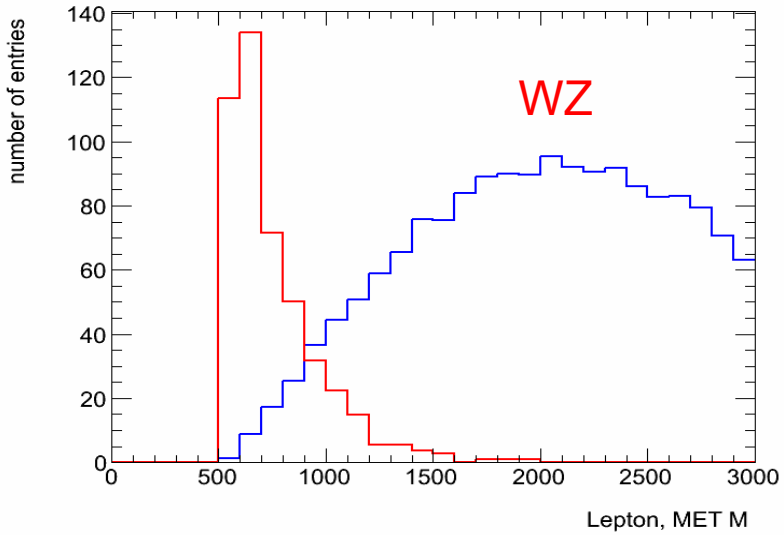


Backgrounds

- WZ plots now with 500 GeV invariant mass of leptons cut applied
- Plots have nlepton >= 3, red is SM diboson, blue is FT0 for WWW







To do

- Run cross-section scan for other machine energies
- Finish up case studies with backgrounds and pileup

Back up

Previous Cross-Section Scan

- We are planning a scan as well, to cross-check, include WZZ, and also check another coupling (1e-11) and all leptons

- Note that scan includes muons only, previous slide has both (and combinations)
- New aQGC/SM ratio for 1e-10: 6.7
- More motivation now to look at M0 in WWW, WWZ

VVV Cross-Section

photon/lepton (pT>10GeV, |eta|<2.5)

1.00E-10	WWW		WWZ		ZZZ	
SM	6.91E-05	ratio	1.40E-05	ratio	1.21E-07	ratio
fS0	7.15E-05	1.03	1.40E-05	1.00	-	
fS1	6.98E-05	1.01	1.40E-05	1.00	-	
fM0	0.00351	50.8	0.000161	11.5	6.82E-07	5.63
fM1	0.00123	17.8	5.18E-05	3.7	3.33E-07	2.75
fM2	-		0.0134	957.14	1.80E-06	14.79
fM3	-		3.44E-05	2.46	2.21E-07	1.83
fT8	-		-			
fT9	-		-		1.29E-06	10.66