More Operators for Tribosons: Significance

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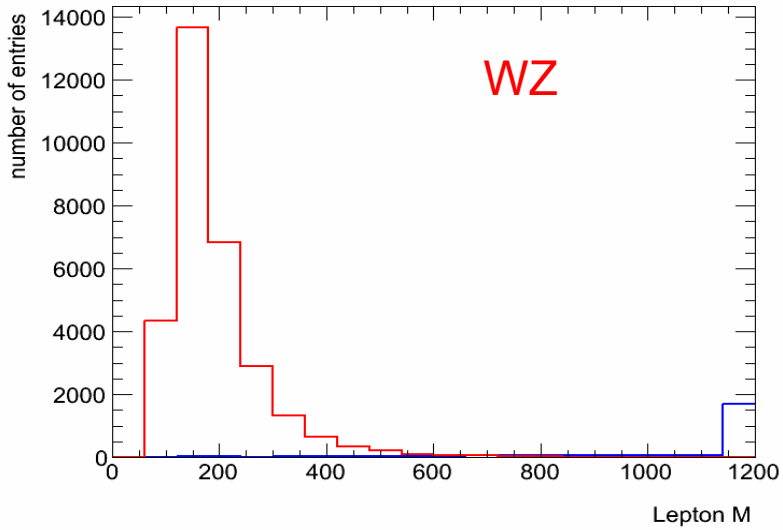
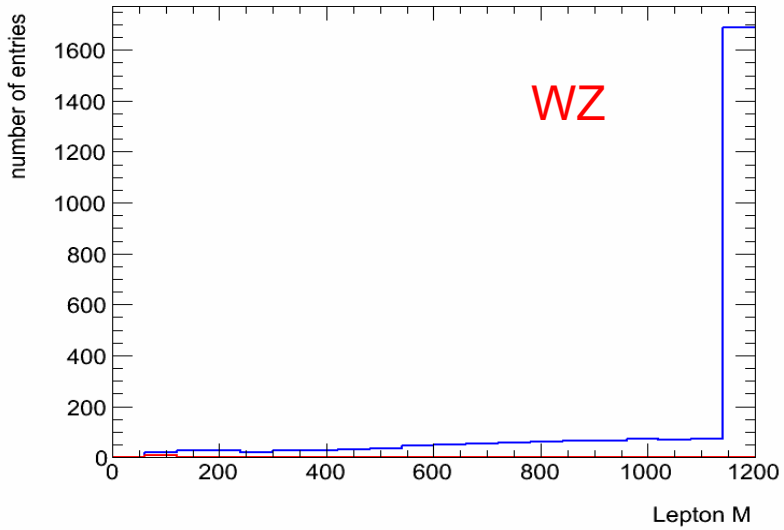
Note

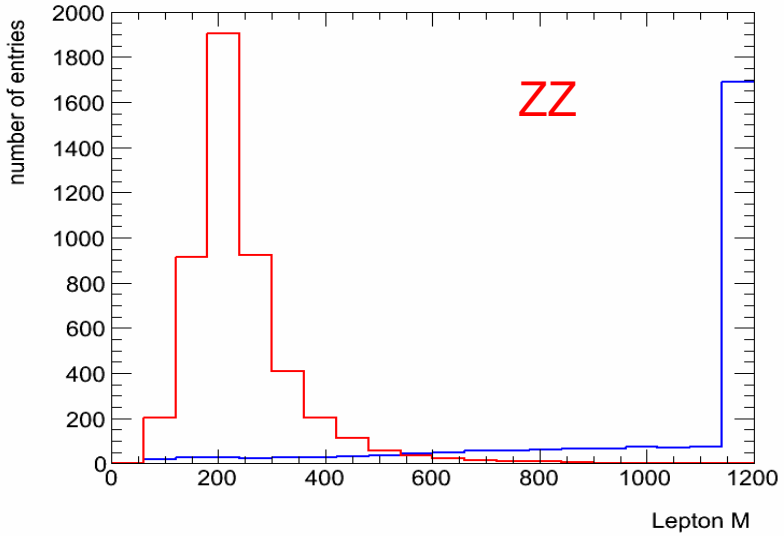
- These slides contain a bug fix that affected the last (overflow) bin of previous talks
  - The bug added both overflow bins into the second plotted distribution, which is usually the red aQGC. The extra events were a low contribution SM, typically, so this was not a particularly strong effect in most plots
  - Have also used fewer bins/shorter range for these plots, plan to add log scale soon
- Please use plots from this talk forward
- Talk also contains updated version of significance calculator

Backgrounds Before

- WWW 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

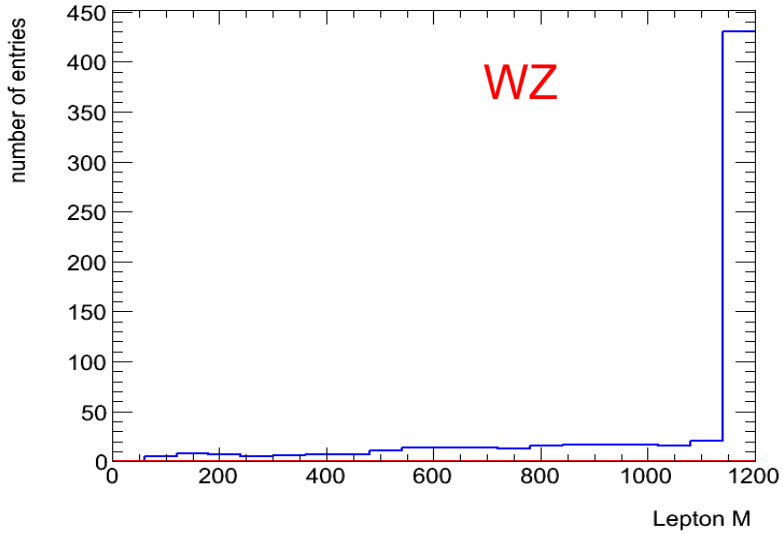


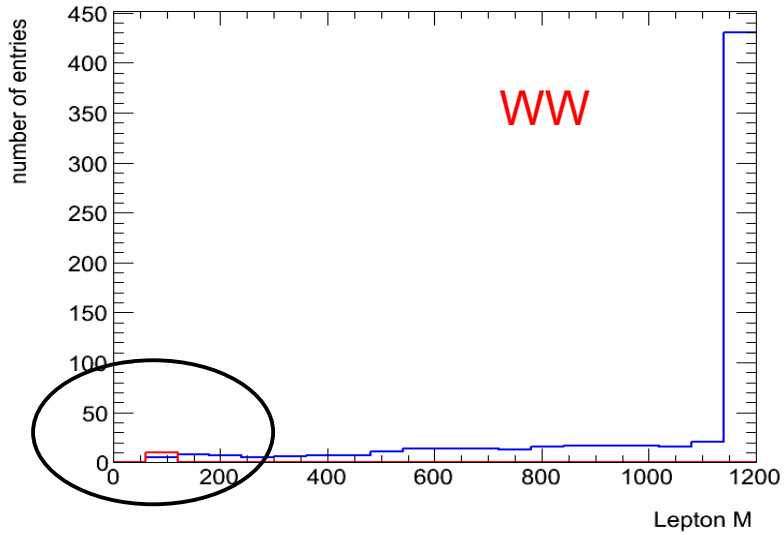


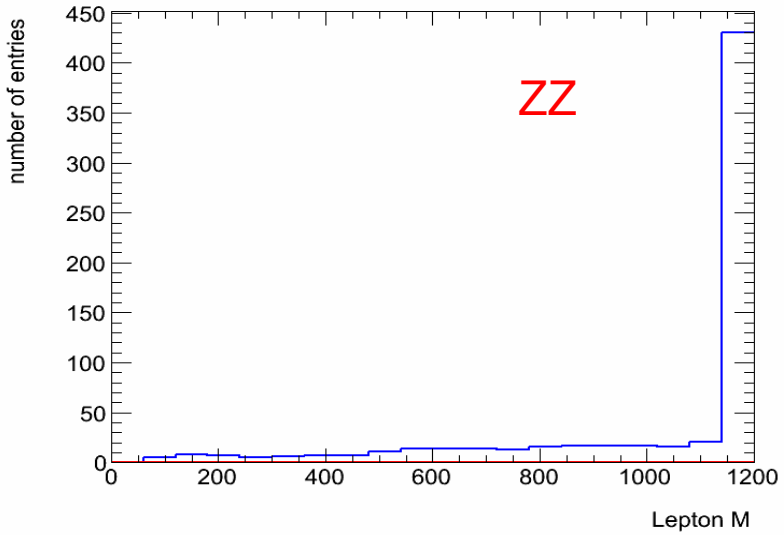


Backgrounds After

- Not allowing two leptons with same flavor + opposite charge
- Plots have nlepton >= 3, red is SM diboson, blue is FT0 for WWW
- About 75% signal reduction, but ~all diboson bkgd removed

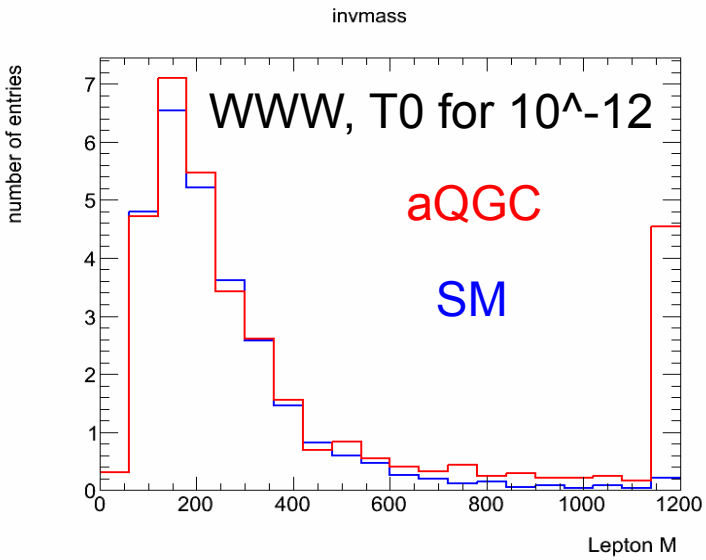






Significance

- Not allowing two leptons with same flavor + opposite charge removes ~all dibosons
  - So can run significance estimate with only SM and aQCD (first pass)
  - 10^-11 way over 5 sigma, 10^-12 around 3-5 sigma at 14 TeV, 300fb-1



WWW, T0 for 10^-12

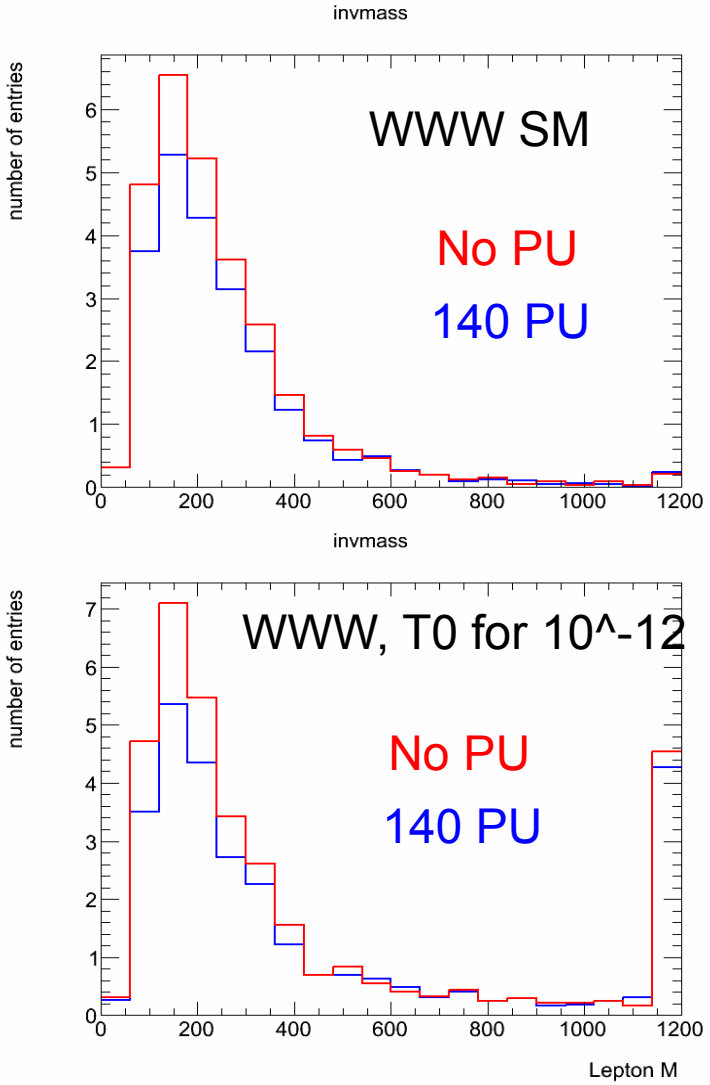
Rough estimate of Significance = Sqrt(-2 logLikelihood Ratio):
NSigma: 4.66981 p-val: 1.5074e-06

Frequentist significance: MCerr = 0 NToyMC= 10000000:
Data LLR -10.9036
NSigma: 4.68497 pval = 1.4e-06

Frequentist significance MCErr= 1 NToyMC= 10000000:
Data LLR -10.9036
NSigma: 3.2898 pval = 0.0005013

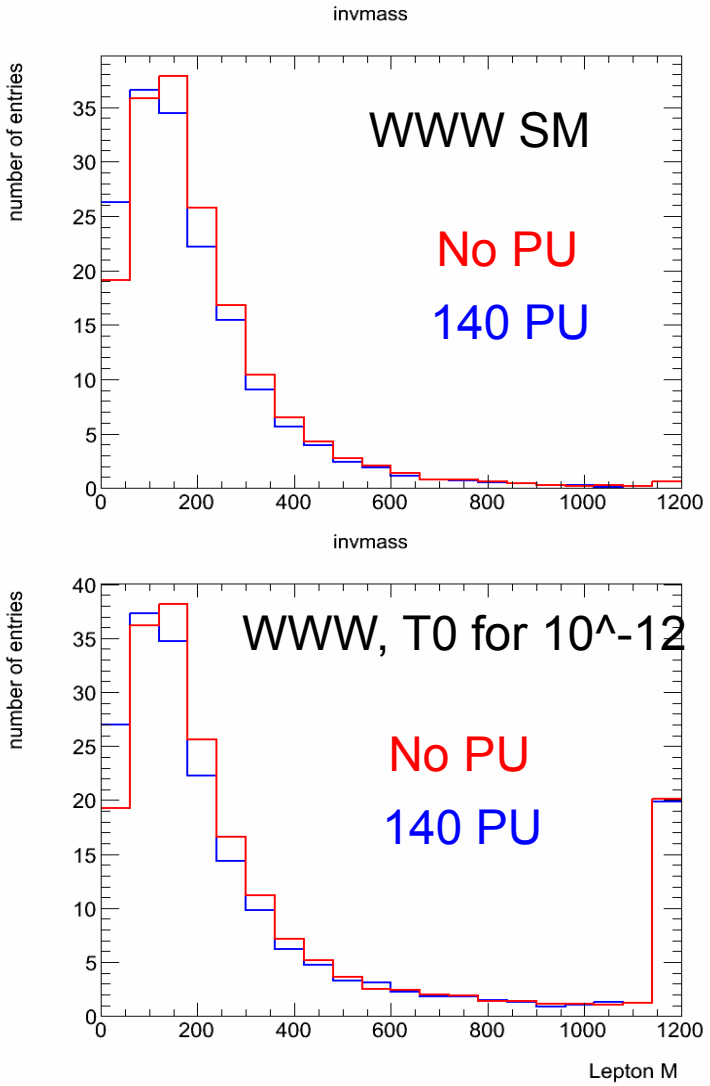
Pileup

- Is push of events towards higher energies with the 140 PU scenario for 14 TeV
- These plots include >=3 lepton number cut and lepton charge, flavor selection



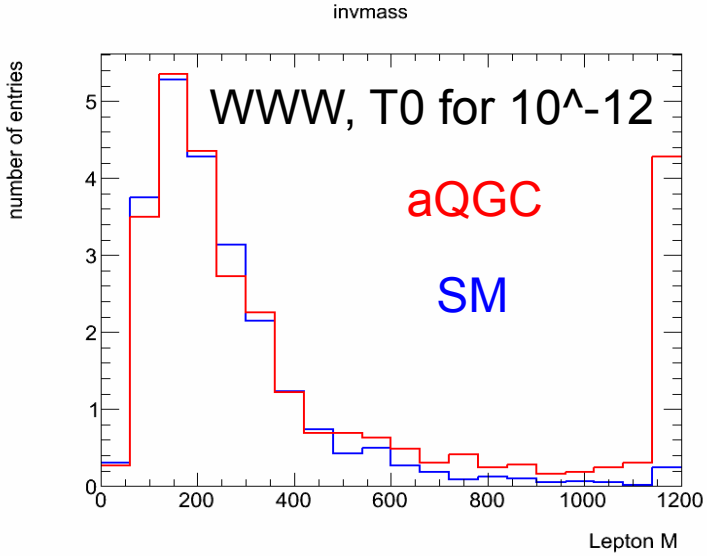
Pileup, Fewer Cuts

- Is push of events towards higher energies with the 140 PU scenario for 14 TeV
- These plots include no explicit special requirements (but of course invariant mass not sensible if there aren't leptons, so some implicit cuts)



Significance with pileup

- Same settings as slide 2 but now with pileup
- Small impact on significance



WWW, T0 for 10^-12

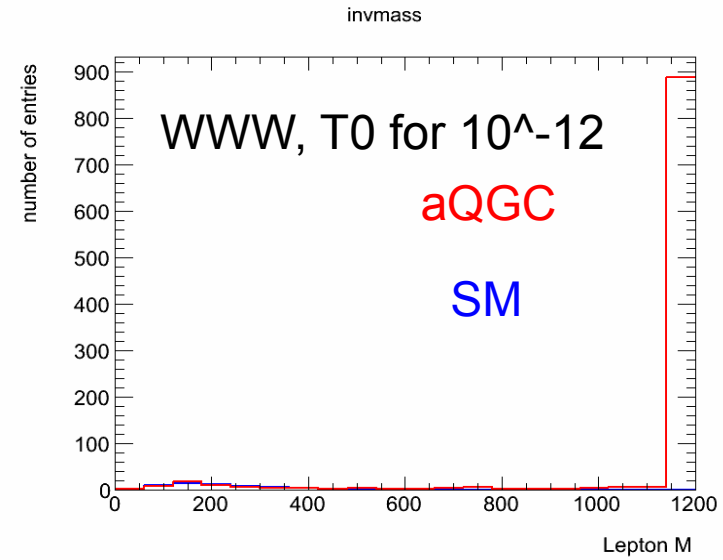
Rough estimate of Signifiance = Sqrt(-2 logLikelihood Ratio):
NSigma: 4.4555 p-val: 4.18487e-06

Frequentist significance: MCerr = 0 NToyMC= 10000000:
Data LLR -9.92575
NSigma: 4.49985 pval = 3.4e-06

Frequentist significance MCErr= 1 NToyMC= 10000000:
Data LLR -9.92575
NSigma: 3.12524 pval = 0.0008883

33 TeV

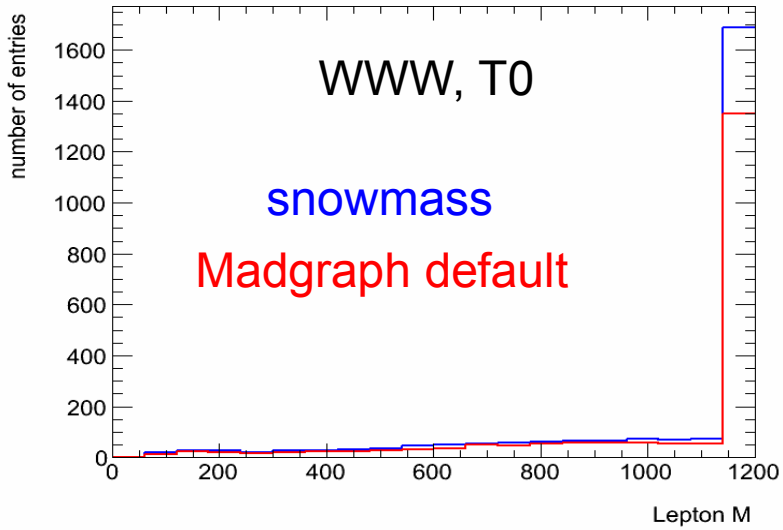
- Looks like 10^-12 is higher than needed, can run with 10^-13
  - 10^-13 scans are nearly done, may take another step down as well
  - Plan to finish this scan and significances for tomorrow

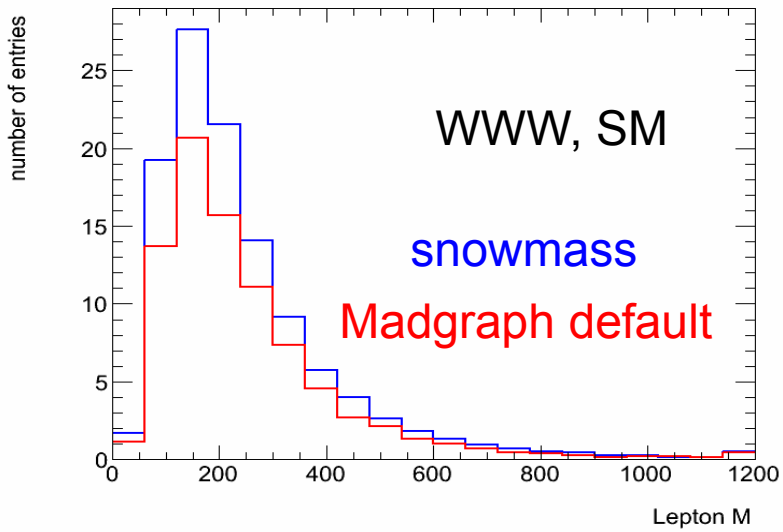


Back up

Snowmass Delphes, No Pileup

- 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





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