VVV Update

Jenny Holzbauer and Mandy Rominsky
Aug. 2, 2013
EW Working Session during Snowmass

What has Changed?

- We have moved from Madgraph 10 to 11
  - "Fix CRITICAL bug (returning wrong cross-section) for processes with more than one W decaying leptonically. For such processes the lepton cuts were also used on the neutrino particle reducing the cross-section. This bug was present only for group_subprocesses=True (the default)"
- We reoptimized the selection because of this new MC
  - Now include a MET cut, with a looser invariant mass of the leptons cut
  - Now include a pt > 25 GeV cut on the leptons (for realism)

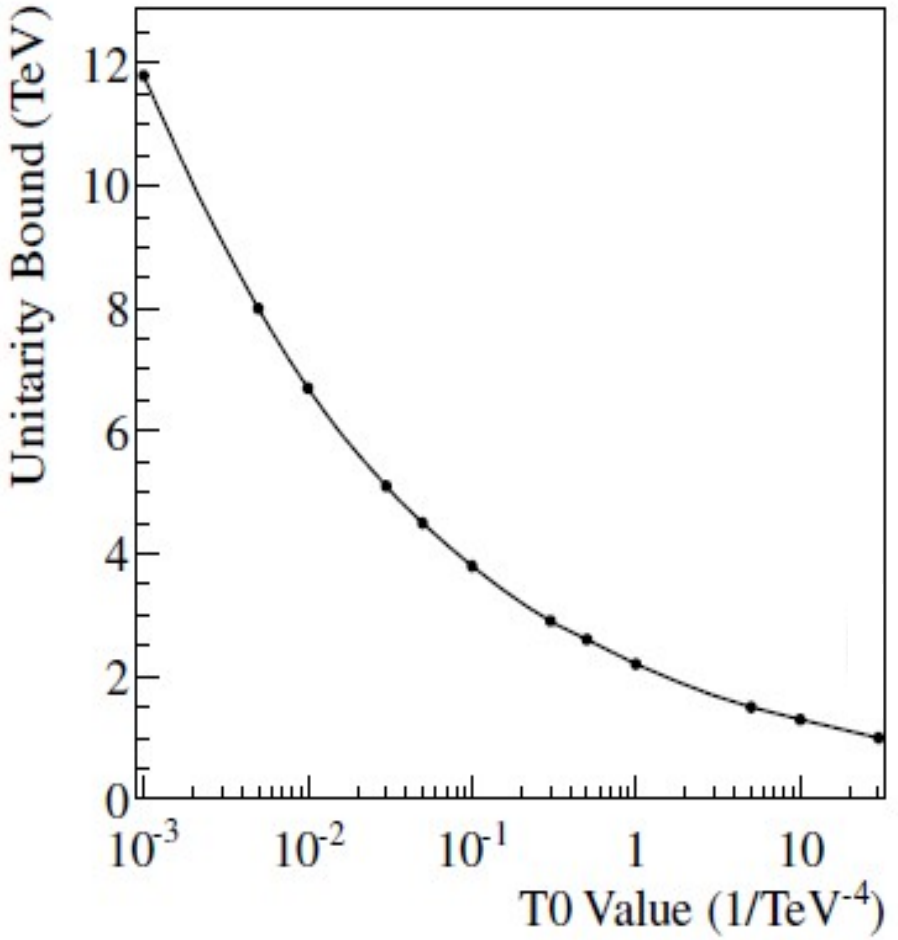
- At least three leptons where leptons must have $p_T(l) > 25$ GeV
- No two leptons may have the same flavor and opposite charge
- $M(alllep) > 400$ GeV
- $E_{\mathrm{T}}^{\mathrm{miss}} > 150$ GeV

New Cross-section Scan, dim8

Coupling SM Cross Section (pb)	WWW 0.000603400	WWZ 0.000124200	WZZ 0.000009634	ZZZ 0.000000972
sm/sm	1.0	1.0	1.0	1.0
fs0/sm	1.0	1.0	1.0	1.0
fs1/sm	1.0	1.0	1.0	1.0
fm0/sm	1.46	1.09	1.05	1.02
fm1/sm	1.17	1.02	1.04	1.03
fm2/sm	1.0	1.05	1.0	1.02
fm3/sm	1.0	1.01	1.00	1.01
ft0/sm	18.31	396	3.38	2.90
ft1/sm	15.15	2.10	2.83	2.90
ft2/sm	4.48	1.32	1.35	1.54
ft8/sm	1.0	1.0	1.0	1.31
ft9/sm	1.0	1.0	1.0	1.08

Table 5: Dimension 8 operators and their comparison to SM values for a 14 TeVproton proton collider. This is for a coupling strength of 10^{-4} TeV.

Unitarity Bound for dim8



Distribution Example for WWW

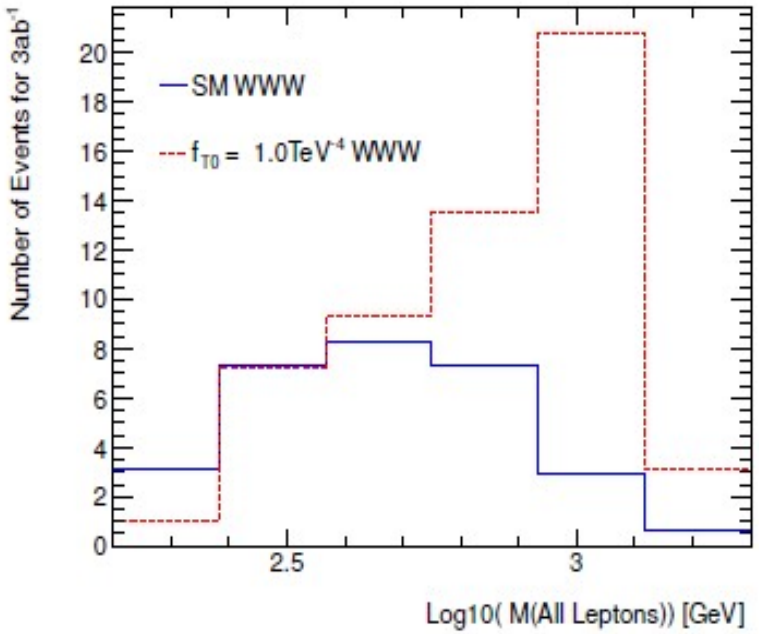
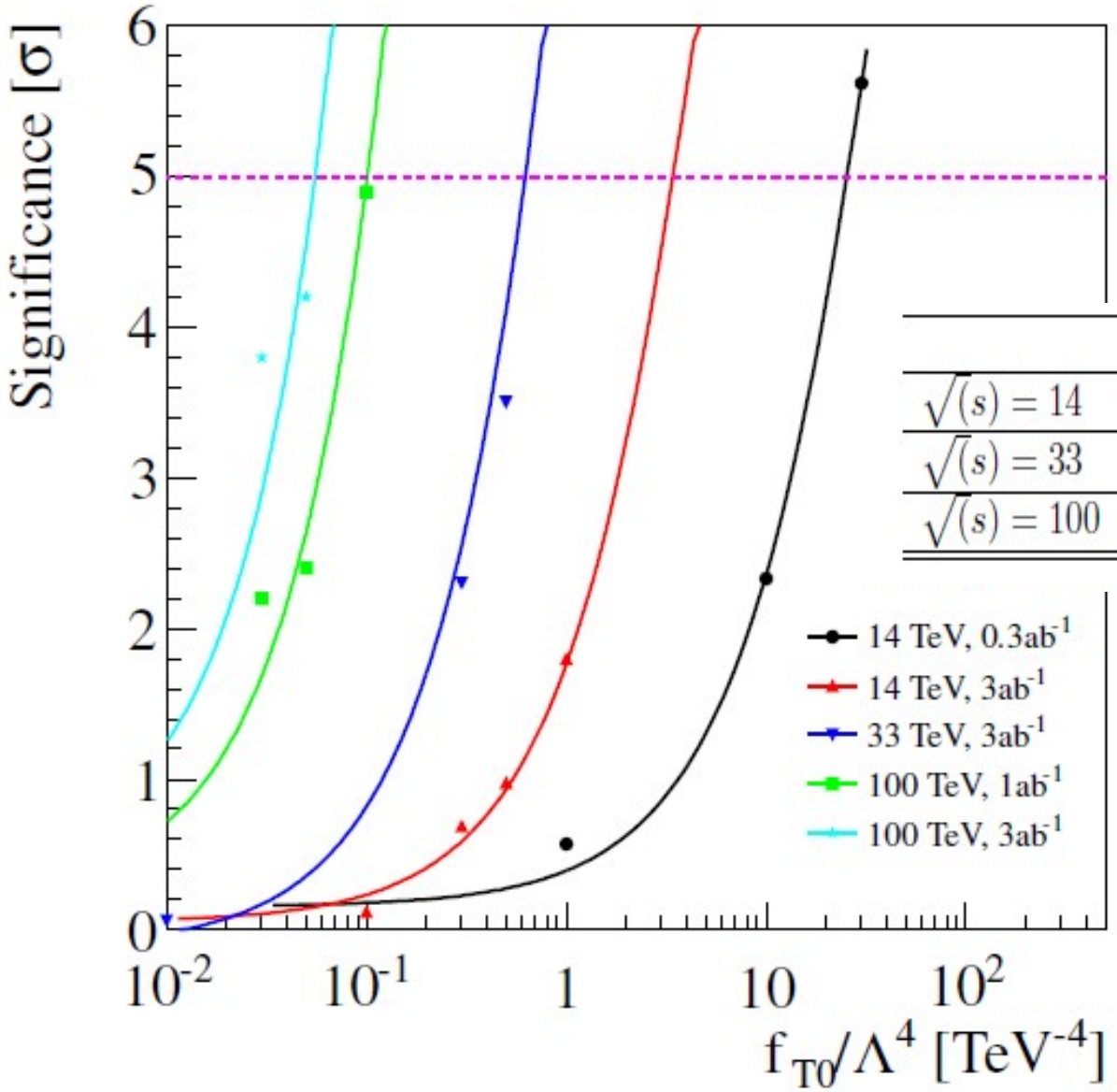


Figure 9: WWW invariant mass of all of the leptons for the WWW SM and WWW with f_{T0} of 1 TeV^{-4}. This distribution was made without the lepton invariant mass selection.

Results for Dim 8 WWW



5 sigma values

	300 fb^{-1}	1000 fb^{-1}	3000 fb^{-1}
$\sqrt{(s)} = 14$	25 TeV^{-4}	-	3 TeV^{-4}
$\sqrt{(s)} = 33$	-	-	0.8 TeV^{-4}
$\sqrt{(s)} = 100$	-	0.5 TeV^{-4}	0.1 TeV^{-4}

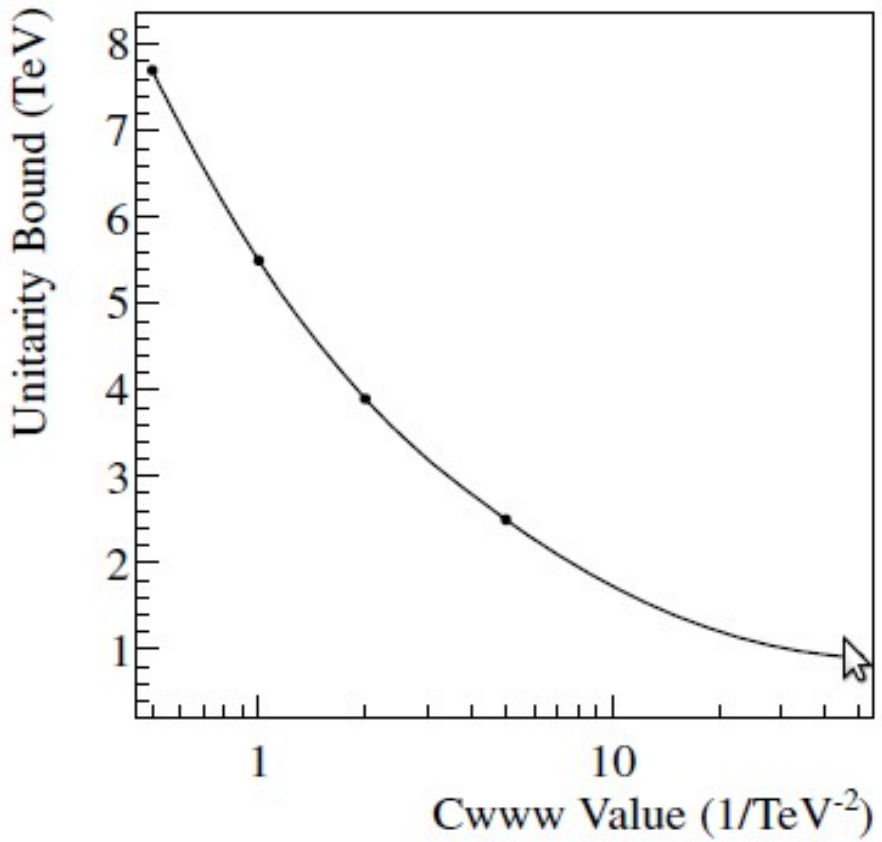
Dim6 Cross-section Scan

Coupling SM Cross Section (pb)	WWW 0.000603400	WWZ 0.000124200	WZZ 0.000009634	ZZZ 0.000000972
sm/sm	1.0	1.0	1.0	1.0
Cwww/sm	1.4	1.2	1.4	1.0
Cw/sm	1.1	1.1	1.2	1.1
Cb/sm	1.0	1.0	1.0	1.0

Table 9: Dimension 6 operators and their comparison to SM values for a 14 TeVproton proton collider. This is for a coupling strength of 5^{-2} TeV.

- For simplicity, we keep the same cuts as for the dim8 study
  - We have to reject the same SM and ttbar

Dim6 Unitarity Bound



Dim6 Example Plot

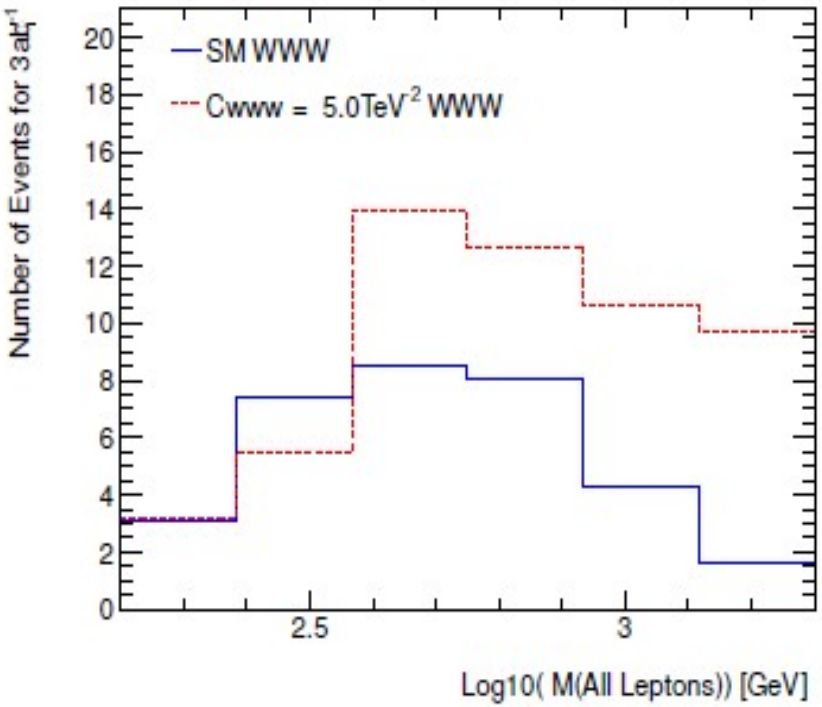
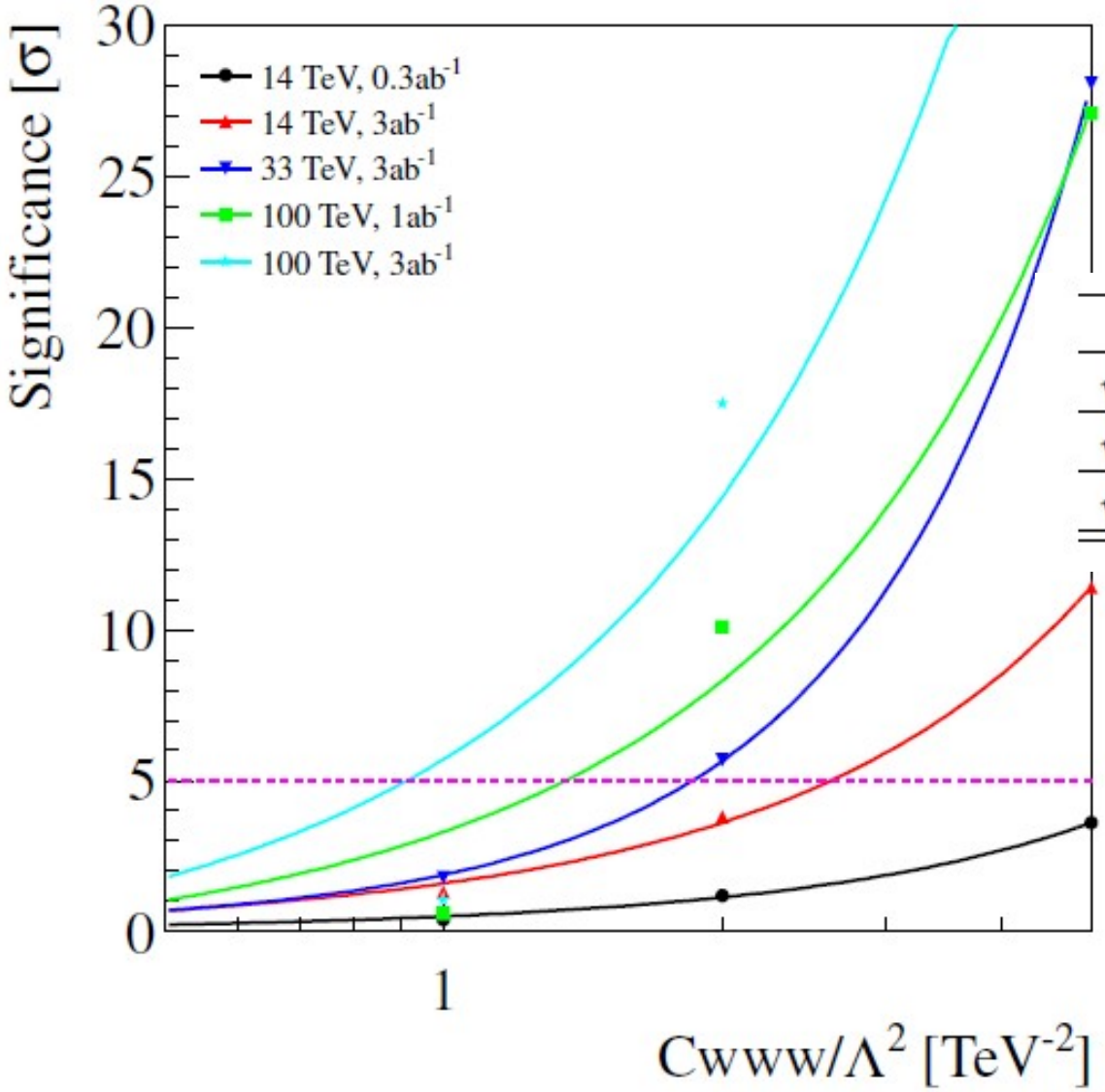


Figure 14: Invariant mass for WWW at 33 TeV with the SM (blue) and $Cwww$ at 2 TeV^{-2} (red).

Results for Dim6 WWW



5 sigma values

	300 fb^{-1}	1000 fb^{-1}	3000 fb^{-1}
$\sqrt{(s)} = 14$	8 TeV^{-2}	-	2.5 TeV^{-2}
$\sqrt{(s)} = 33$	-	-	2.0 TeV^{-2}
$\sqrt{(s)} = 100$	-	1.5 TeV^{-2}	1.0 TeV^{-2}

Summary and To Do List

- Redone nearly all studies, give 5 sigma values again below
- Still need to finish cross-section scan of e+e- colliders
- Still need to do pileup cross-check (did this before with other Madgraph version and without MET cut)

dim8

	$300\,\mathrm{fb}^{-1}$	$1000\,\mathrm{fb}^{-1}$	$3000\,\mathrm{fb}^{-1}$
$\sqrt{(s)} = 14$	$25\ \mathrm{TeV}^{-4}$	-	$3\ \mathrm{TeV}^{-4}$
$\sqrt{(s)} = 33$	-	-	$0.8\ \mathrm{TeV}^{-4}$
$\sqrt{(s)} = 100$	-	$0.5\ \mathrm{TeV}^{-4}$	$0.1\ \mathrm{TeV}^{-4}$

dim6

	$300\,\mathrm{fb}^{-1}$	$1000\,\mathrm{fb}^{-1}$	$3000\,\mathrm{fb}^{-1}$
$\sqrt{(s)} = 14$	$8\ \mathrm{TeV}^{-2}$	-	$2.5\ \mathrm{TeV}^{-2}$
$\sqrt{(s)} = 33$	-	-	$2.0\ \mathrm{TeV}^{-2}$
$\sqrt{(s)} = 100$	-	$1.5\ \mathrm{TeV}^{-2}$	$1.0\ \mathrm{TeV}^{-2}$