Imperial College London

First Look at Limits

P. Dunne

Updates on progress since last week

- Chayanit has producing 2D trigger weights binned in met and jet 2 pt to cross check
  - I need to remake light trees with these weights and have a look at control plots
- Cross-checked top control region with Higgs to tau tau
  - They get a scale factor of 0.9-1.1, we get 0.78 after applying top reweighting
  - Needs further study

Limits introduction

- Most systematics now implemented:
- lumi, lepton efficiency, JES, JER, UES, PU weight, V+jets and top data and MC stat., Z mumu→nunu extrapolation, other backgrounds MC stat, VBF signal theory uncertainties.
- Still missing:
  - ggH theory uncertainties, WGamma cross section uncertainty, error on QCD contribution.
- Also currently ignoring QCD
- Datacard maker written
  - Takes ~10 minutes to remake datacards with new selection if selection accessible with already made light trees

First try at limits

- Haven't fixed on QCD estimation method yet:
  - Pick region where QCD small/negligible
  - metsig>4, $min\Delta\phi(alljets, metnomu) > 1.5$
- Rates:

Process	ggH	qqH	zvv	wmu	wel	wtau	top	wg	vv	total bkg
Rate	146	930	1065	670	467	1207	76	84	41	3610

- Expected Limit: 0.9102
  - Prompt expected was 0.49
- Wtau is dominant background

Uncertainty Impact Check - Impacts above 0.5%

Nuisance	% change from removal	% change from addition
lumi_8TeV:	-0.9%	0.0%
CMS_eff_e:	-0.9%	3.5%
CMS_eff_m:	-0.9%	13.3%
CMS_scale_j:	-28.1%	487.0%
CMS_res_j:	-2.6%	121.2%
CMS_scale_met:	-0.9%	13.3%
CMS_VBFHinv_puweight:	-0.9%	48.6%
CMS_VBFHinv_zvv_norm:	-0.9%	23.8%
CMS_VBFHinv_zvv_stat:	-2.6%	86.0%
CMS_VBFHinv_wmu_norm:	-0.9%	3.5%
CMS_VBFHinv_wmu_stat:	-0.9%	3.5%
CMS_VBFHinv_wel_norm:	-0.9%	3.5%
CMS_VBFHinv_wel_stat:	-0.9%	7.9%
CMS_VBFHinv_tau_eff:	-0.9%	74.9%
CMS_VBFHinv_wtau_norm:	-3.4%	175.9%
CMS_VBFHinv_wtau_stat:	-5.2%	234.0%
CMS_VBFHinv_zvv_extrapfacunc:	-8.6%	188.2%
pdf_qqbar:	-0.9%	0.0%

Scanned through variables

- Showed yesterday effectof adding CJV and mjj 1000 cut:
  - Expected limit went to 0.5371
- Have now also scanned through mjj, met significance and jetmetdphi cut
- Best working point is metsig$>$ 4, mjj$>$ 1000, jetmetdphi$>$ 2.5
  - Expected limit: 0.2764

Process	ggH	qqH	zvv	wmu	wel	wtau	top	wg	vv	total
Rate	21.5	316.0	143.8	71.9	47.7	10.2	4.4	3.6	5.4	287

- Weights for V+jets regions decrease further needs investigating
  - wenu: 0.32, wmunu: 0.38, wtau: 0 (this really needs looking at), top: 0.55
  - Should try removing CJV from wtau control region as was done for prompt
- Limits ignoring systematics are 10.2%, was 16.6% for prompt
- 19 events in Z control region, was 12 for prompt

Uncertainty Impact Check- some low impact not listed

Nuisance	% change from removal	% change from addition
CMS_eff_m:	-0.7%	3.8%
CMS_scale_j:	-2.8%	3.8%
CMS_res_j:	0.0%	0.0%
CMS_scale_met:	0.0%	0.4%
CMS_VBFHinv_puweight:	-4.3%	29.6%
CMS_VBFHinv_zvv_norm:	-2.8%	27.7%
CMS_VBFHinv_zvv_stat:	-15.6%	84.1%
CMS_VBFHinv_wmu_norm:	-0.7%	4.7%
CMS_VBFHinv_wmu_stat:	-0.7%	3.8%
CMS_VBFHinv_wel_norm:	-0.7%	4.7%
CMS_VBFHinv_wel_stat:	-1.4%	6.7%
CMS_VBFHinv_tau_eff:	0.0%	0.0%
CMS_VBFHinv_wtau_norm:	0.0%	18.1%
CMS_VBFHinv_wtau_stat:	0.0%	17.1%
CMS_VBFHinv_zvv_extrapfacunc:	-9.2%	63.1%
CMS_VBFHinv_top_norm:	0.0%	0.0%
CMS_VBFHinv_top_stat:	0.0%	0.9%

Conclusions

- Expected limit now better than prompt, but things to check
  - V+jets weights
- Next steps: BDT, systematically optimise cut based
- More work to be done on trigger weights and top control region

Backup

Scanned through variables

- Add CJV
  - Expected limit: 0.7090

Process	ggH	qqH	zvv	wmu	wel	wtau	top	wg	vv	total
Rate	115	880	909	510	342	886	41	67	29	2783

- Add CJV and mjj$>$ 1000
  - Expected limit: 0.5371

Process	ggH	qqH	zvv	wmu	wel	wtau	top	wg	vv	total
Rate	68	668	457	291	192	285	17	32	15	1288

Uncertainty Impact Check - cjv mjj1000

Nuisance	% change from removal	% change from addition
lumi_8TeV:	-0.7%	0.5%
CMS_eff_m:	-0.7%	8.0%
CMS_scale_j:	-23.3%	289.8%
CMS_res_j:	-0.7%	30.1%
CMS_VBFHinv_puweight:	-0.7%	23.0%
CMS_VBFHinv_zvv_norm:	-0.7%	22.1%
CMS_VBFHinv_zvv_stat:	-5.1%	85.4%
CMS_VBFHinv_wmu_norm:	-0.7%	5.0%
CMS_VBFHinv_wmu_stat:	-0.7%	5.0%
CMS_VBFHinv_wel_norm:	-0.7%	5.0%
CMS_VBFHinv_wel_stat:	-0.7%	8.0%
CMS_VBFHinv_wtau_norm:	-2.2%	116.0%
CMS_VBFHinv_wtau_stat:	-2.9%	144.1%
CMS_VBFHinv_zvv_extrapfacunc:	-9.5%	120.1%
CMS_VBFHinv_top_stat:	-0.4%	2.0%
pdf_qqbar:	-0.4%	0.0%