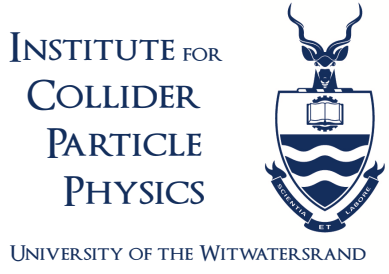
Weekly report

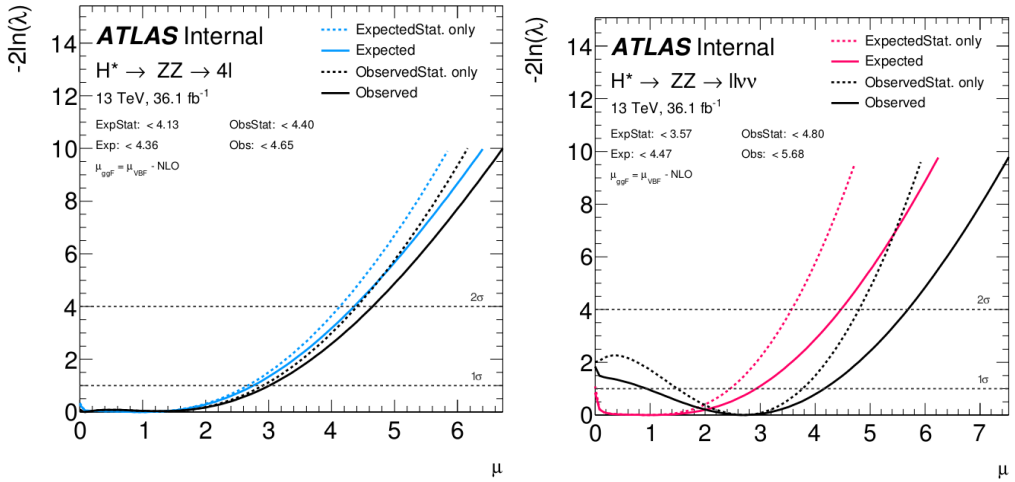
Abdualazem Fadol

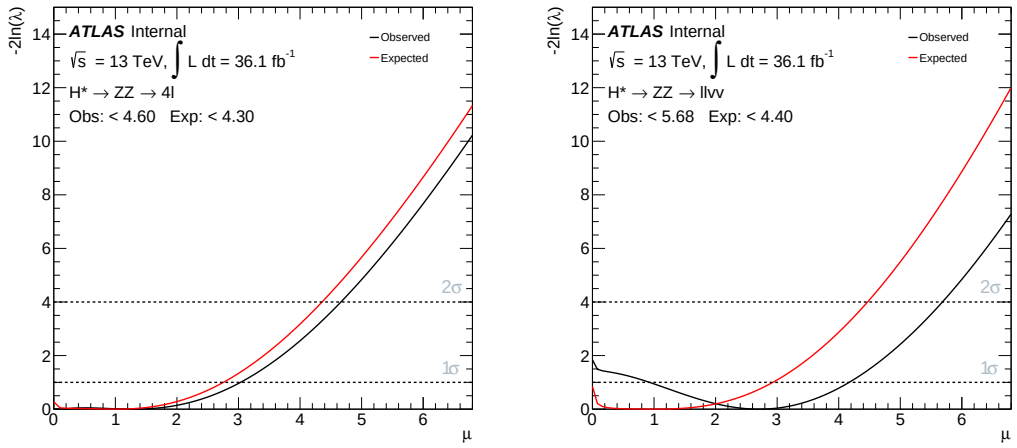
January 25, 2021



Off-shell couplings: 4ℓ and $2\ell2\nu$ combination

Cross check the 36.1 fb^{-1} results





- They are perfectly match, I think my results are more accurate.
- The results are presented in this note.

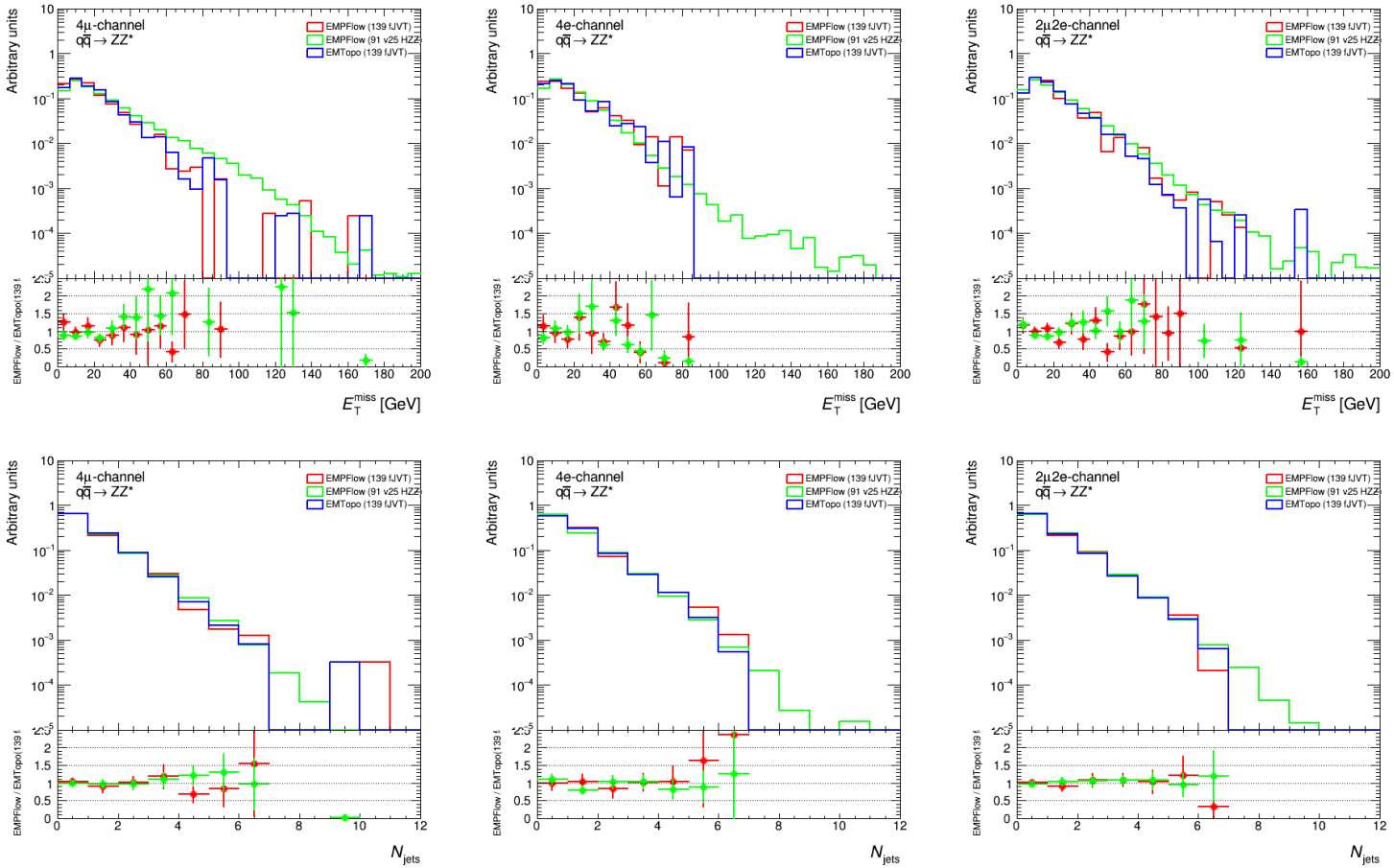
Off-shell couplings: 4ℓ and $2\ell2\nu$ combination

Combination strategy

- Will be using the workspaceCombiner framework.
- First reproduce the combination of the 36.1 fb^{-1} results.
- Just to make sure everything is set right, then go ahead with the task.
- I already started working on the code.
- But there's lots of things need to be prepared.
- We will be working on preliminary results for full Run-II data.

$4\ell + E_{\mathrm{T}}^{\mathrm{miss}}$ analysis

Sample production checks: $q\bar{q} \to ZZ^*$



- ☐ Compare EMPFlow and EMTopo (139 v25 fJVT) to official EMPFlow (91 v25)
- ☐ JVT cut and bug fix are applied everything else is the same.

$4\ell + E_{\mathrm{T}}^{\mathrm{miss}}$ analysis

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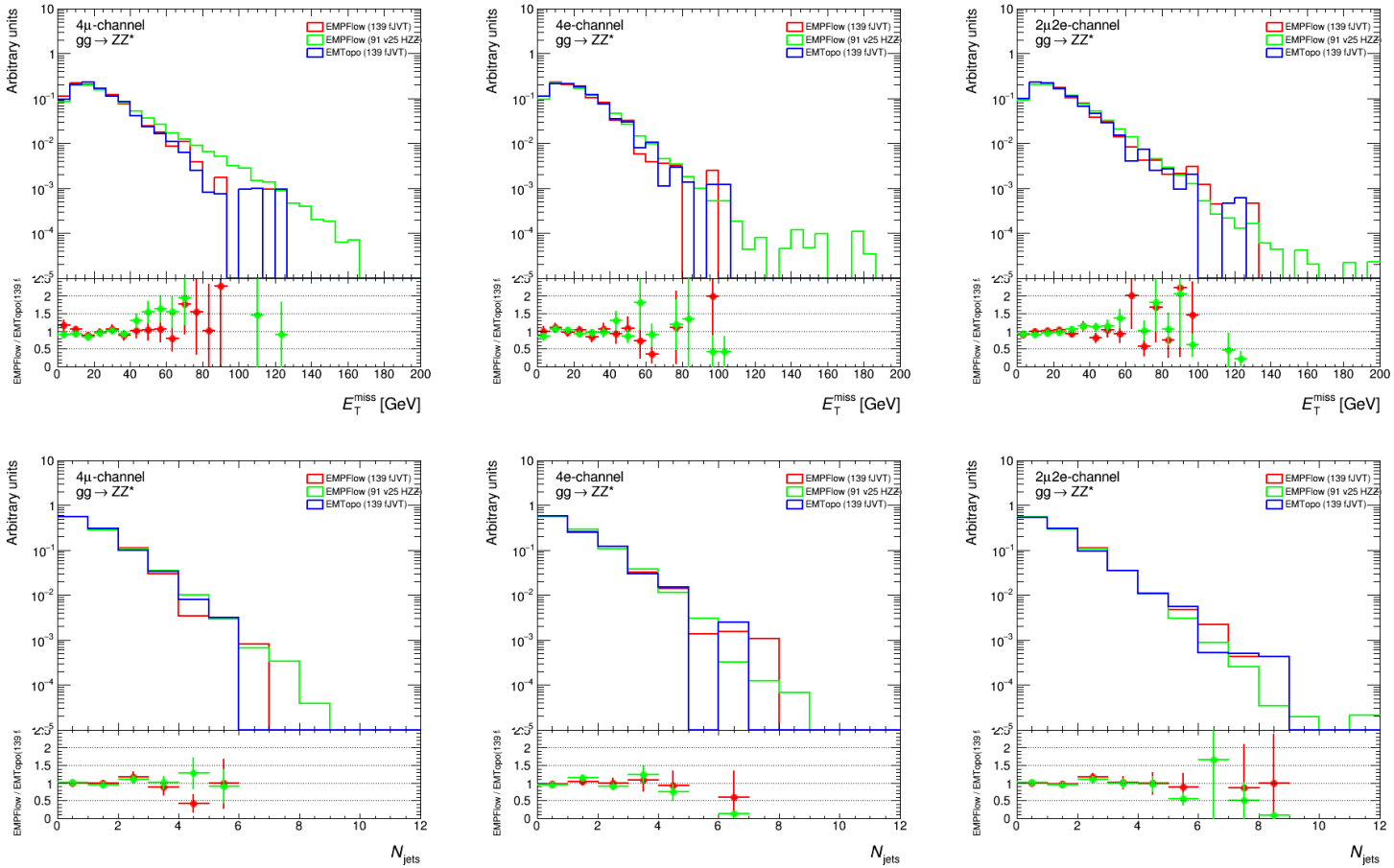

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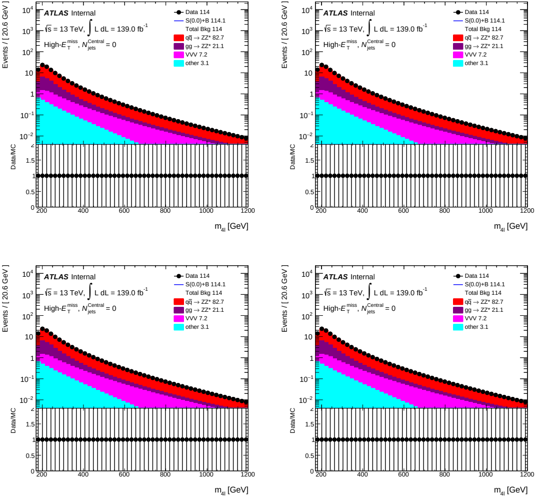
$4\ell + E_{\mathrm{T}}^{\mathrm{miss}}$ analysis

Samples are failing on the grid

- Some samples are heavily failing on the grid, and it's totally random.
- Which means that a failed sample will succeed is submitted again.
- Finished: https://bigpanda.cern.ch/task/23874508/
- Broken: https://bigpanda.cern.ch/task/23874503/
- Failed: https://bigpanda.cern.ch/task/23874273/

$4\ell + E_{\mathrm{T}}^{\mathrm{miss}}$ analysis

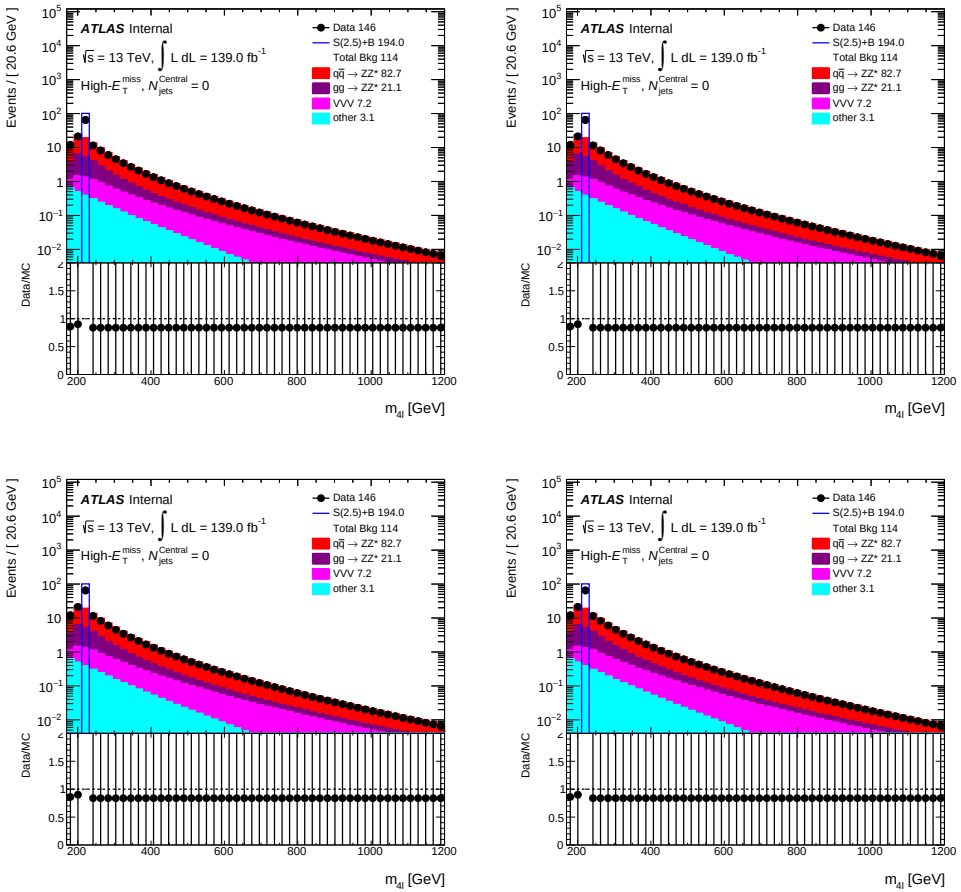
The fit with the new background model: For $(m_R, m_H) = (390, 220)$ GeV with $\mu_{\mathrm{RSH}} = 0$



- ☐ The fit is shown after the background only to Asimov data.

$4\ell + E_{\mathrm{T}}^{\mathrm{miss}}$ analysis

The fit with the new background model: For $(m_R, m_H) = (390, 220)$ GeV with $\mu_{\mathrm{RSH}} = 1$



- The fit is shown after signal plus background to Asimov data.
- The signal scaled by 2.5

DiHiggs to 4ℓ analysis
Version 3 samples

- Still have issues to get the samples running on the grid.
- I should fix that soon and then get back into the analysis.

Summary

- ☐ Did a quick check for new samples with >p4191, they look fine.
- ☐ Now I'm submitting jobs, but some samples fail randomly.
- ☐ Checked the workspace with the new background model.
- ☐ After background only fit to Asimov data, the fit looks good.
- ☐ Injecting the signal ($\mu = 1$) makes the MC to be pushed up, slide 5.

To do . . .

- ☐ Adding all the systematic and then try to check the Ranking, pull etc.
- ☐ Looking into the AZH signal parametrisation.
- ☐ Note: working on the samples and event selection soon should finish.

Thank you!

Additional slides
Event selection

Event Selection	
Quadruplet Selection	- Require at least one quadruplet of leptons consisting of two pairs of same-flavour opposite-charge leptons fulfilling the following requirements: - p_T thresholds for three leading leptons in the quadruplet: 20, 15 and 10 GeV - Maximum one calo-tagged or stand-alone muon or silicon-associated forward per quadruplet - Leading di-lepton mass requirement: $50 < m_{12} < 106$ GeV - Sub-leading di-lepton mass requirement: $m_{\text{threshold}} < m_{34} < 115$ GeV - $\Delta R(\ell, \ell') > 0.10$ for all leptons in the quadruplet - Remove quadruplet if alternative same-flavour opposite-charge di-lepton gives $m_{\ell\ell} < 5$ GeV - Keep all quadruplets passing the above selection
Isolation	- Contribution from the other leptons of the quadruplet is subtracted - FixedCutPFlowLoose WP for all leptons
Impact Parameter Significance	- Apply impact parameter significance cut to all leptons of the quadruplet - For electrons: $d_0/\sigma_{d_0} < 5$ - For muons: $d_0/\sigma_{d_0} < 3$
Best Quadruplet	- If more than one quadruplet has been selected, choose the quadruplet with highest Higgs decay ME according to channel: 4μ, $2e2\mu$, $2\mu2e$ and $4e$
Vertex Selection	- Require a common vertex for the leptons: - $\chi^2/\text{ndof} < 5$ for 4μ and < 9 for others decay channels

Additional slides
Nuisance parameters

Normalisation	Shape
Electrons	
	EG_RESOLUTION_ALL
EL_EFF_ID_CorrUncertaintyNP[0-15]	EG_SCALE_ALLCORR
EL_EFF_ID_SIMPLIFIED_UncorrUncertaintyNP[0-17]	EG_SCALE_E4SCINTILLATOR
EL_EFF_Iso_TOTAL_1NPCOR_PLUS_UNCOR	EG_SCALE_LARCALIB_EXTRA2015PRE
EL_EFF_Reco_TOTAL_1NPCOR_PLUS_UNCOR	EG_SCALE_LARTEMPERATURE_EXTRA2015PRE
	EG_SCALE_LARTEMPERATURE_EXTRA2016PRE
Muons	
MUON_EFF_ISO_STAT	
MUON_EFF_ISO_SYS	MUON_ID
MUON_EFF_RECO_STAT	MUON_MS
MUON_EFF_RECO_STAT_LOWPT	MUON_SAGITTA_RESBIAS
MUON_EFF_RECO_SYS	MUON_SAGITTA_RHO
MUON_EFF_RECO_SYS_LOWPT	MUON_SCALE
MUON_EFF_TTVA_STAT	
MUON_EFF_TTVA_SYS	
Jets	
	JET_BJES_Response
	JET_EffectiveNP_[1-7]
	JET_EffectiveNP_8restTerm
	JET_EtaIntercalibration_Modelling
	JET_EtaIntercalibration_NonClosure_highE
	JET_EtaIntercalibration_NonClosure_negEta
	JET_EtaIntercalibration_NonClosure_posEta
	JET_EtaIntercalibration_TotalStat
	JET_Flavor_Composition
	JET_Flavor_Response
	JET_JER_DataVsMC
	JET_JER_EffectiveNP_[1-6]
	JET_JER_EffectiveNP_7restTerm
	JET_Pileup_OffsetMu
	JET_Pileup_OffsetNPV
	JET_Pileup_PtTerm
	JET_Pileup_RhoTopology
	JET_PunchThrough_MC16
	JET_SingleParticle_HighPt
Missing transverse energy	
	MET_SoftTrk_ResoPara
	MET_SoftTrk_ResoPerp
	MET_SoftTrk_Scale
Other	
HOEW_QCD_syst	
HOEW_syst	
HOQCD_scale_syst	
PRW_DATASF	

Additional slides
Cutflow table

	$qqZZ^*$	$ggZZ^*$	$qqZZ^*$ EW	$t\bar{t}V$	VVV	$Z+jets$	WZ	$t\bar{t}$	Expected
4ℓ	2516.52±4.50	348.96±0.71	32.85±0.28	8.60±0.05	19.04±0.11	10.35±8.28	5.12±0.34	2.68±0.20	2944.13±14.48
b-veto	2451.45±4.47	341.64±0.70	30.67±0.27	2.14±0.02	18.48±0.11	10.35±8.28	4.96±0.33	1.77±0.15	2861.46±14.34
$N_{\text{Jets}}^{\text{central}} = 0$	1625.63±3.87	212.93±0.56	3.10±0.11	0.41±0.01	9.40±0.07	9.69±8.27	2.85±0.26	0.78±0.08	1864.79±13.23
$p_{\text{T}}^{4\ell} > 30$ & $\text{metSig} > 2.0$	82.73±0.94	21.12±0.18	0.51±0.03	0.33±0.01	7.22±0.07	0.32±0.32	1.69±0.19	0.53±0.07	114.44±1.80
$p_{\text{T}}^{4\ell} > 15$ & $\text{metSig} > 1.5$	258.04±1.74	58.30±0.29	0.99±0.04	0.37±0.01	8.17±0.07	1.82±1.54	2.13±0.21	0.65±0.07	330.47±3.99
$N_{\text{Jets}}^{\text{central}} \geq 1$	825.82±2.24	128.71±0.43	27.56±0.25	1.73±0.02	9.08±0.08	0.66±0.35	2.11±0.21	0.99±0.12	996.67±3.71
$p_{\text{T}}^{4\ell} > 10$ & $\text{metSig} > 3.5$	10.46±0.23	2.25±0.06	0.30±0.02	0.93±0.02	4.68±0.06	0.01±0.01	0.76±0.13	0.63±0.11	20.02±0.63
$p_{\text{T}}^{4\ell} > 0$ & $\text{metSig} > 2.5$	51.55±0.66	10.66±0.13	1.35±0.05	1.25±0.02	6.19±0.07	0.01±0.01	1.09±0.15	0.75±0.11	72.83±1.19

- The ZZ^* estimated to be 97% of the total background.
- 85% from $qqZZ$, 11% from $ggZZ$, and 1% from $qqZZ(EW)$.
- The rest of backgrounds combined are $\sim$ 3%.