



$H \rightarrow ZZ^{(*)} \rightarrow 4l$ Analysis

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Samples:

- **Data (p2425):**

Period D - J

Integrated Luminosity of 3.2 fb^{-1}

GRL: All_Good/data15_13TeV.periodAllYear_DetStatus-v73-pro19-08_DQDefects-00-01-02_PHYS_StandardGRL_All_Good_25ns.xml

- **Luminosity calculation and pileup reweighting:**

ilumicalc_histograms_None_276262-284484.root



■ MC (p2425):

Signal: mc15a 341505 , 321518 (ggF, VBF Powheg/Pythia8)
341964 (WH, Powheg/Pythia8)
341947 (ZH, Powheg/Pythia8)
342561 (ttH, Powheg/Pythia8)

Z+jets: mc15a 341103-341106 (Sherpa - filtered)
361372-361419 (Sherpa)

WZ: mc15a 361601 (Powheg/Pythia8)

qq → ZZ: mc15b 361603, 342556, 343232 (Powheg/Pythia8)

gg → ZZ: mc15a 343212, 343213 (Powheg/Pythia8)

tt̄: mc15b 410000 (Powheg/Pythia)

VVV + tt̄: mc15a 361625, 361626, 361621, 361623 (Powheg/Pythia8)
410069, 410070 (MadGraph/Pythia8)

Results of the event selection ($118 \text{ GeV} < m_{4l} < 129 \text{ GeV}$):

Results of the event selection:

H4l Analyse - 3.21 fb^{-1} : 118-129 GeV									
	4μ		$2e2\mu$		$2\mu 2e$		$4e$		Total
Data	1.00 ±	1.00	1.00 ±	1.00	2.00 ±	1.41	0.00 ±	0.00	4.00 ± 2.00
Signal	1.67 ±	0.02	1.06 ±	0.02	0.97 ±	0.02	0.88 ±	0.02	4.58 ± 0.03
ZZ	0.64 ±	0.01	0.44 ±	0.01	0.34 ±	0.01	0.32 ±	0.01	1.74 ± 0.02
Z+jets, tt, tt+V, VV, WZ	0.08 ±	0.01	0.07 ±	0.01	0.09 ±	0.01	0.10 ±	0.02	0.34 ± 0.02
Total MC	2.39 ±	0.04	1.57 ±	0.04	1.40 ±	0.04	1.30 ±	0.05	6.66 ± 0.07

Results of the event selection from ATLAS-CONF-2015-059:

H4l Analyse - 3.21 fb^{-1} : 118-129 GeV									
	4μ		$2e2\mu$		$2\mu 2e$		$4e$		Total
Data	1.00 ±	1.00	1.00 ±	1.00	2.00 ±	1.41	0.00 ±	0.00	4.00 ± 2.00
Signal	1.67 ±	0.20	1.06 ±	0.13	0.96 ±	0.15	0.88 ±	0.13	4.57 ± 0.54
ZZ	0.64 ±	0.06	0.44 ±	0.04	0.34 ±	0.05	0.32 ±	0.05	1.74 ± 0.19
Z+jets, tt, tt+V, VV, WZ	0.08 ±	0.03	0.07 ±	0.03	0.09 ±	0.02	0.09 ±	0.02	0.33 ± 0.06
Total MC	2.39 ±	0.21	1.57 ±	0.14	1.39 ±	0.16	1.29 ±	0.14	6.64 ± 0.58



Irreducible Background (ZZ^*):

- Estimated with MC simulation
- mc15b for $qq \rightarrow ZZ$
- $qq \rightarrow ZZ^*$: NNLO QCD and NLO EW corrections
- $gg \rightarrow ZZ^*$: NLO QCD corrections
- shape is smoothed with kernel estimation (RooKeysPDF)



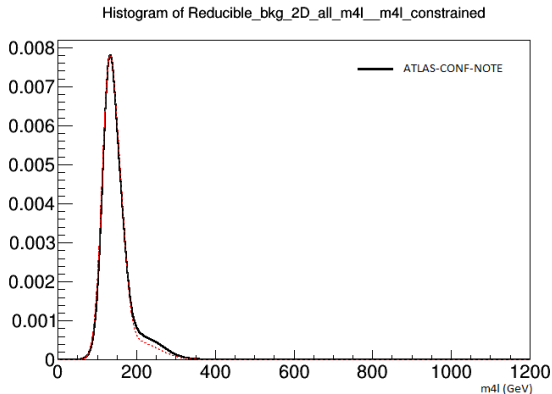
Reducible Background (Z+jets, $t\bar{t}$, WZ, $t\bar{t}$ + Z, VVV):

- WZ, $t\bar{t}$ + Z, VVV estimated with MC simulation
- Z+jets, $t\bar{t}$: data-driven methods
- Final background estimation in full mass range (from ATLAS-CONF-2015-059):

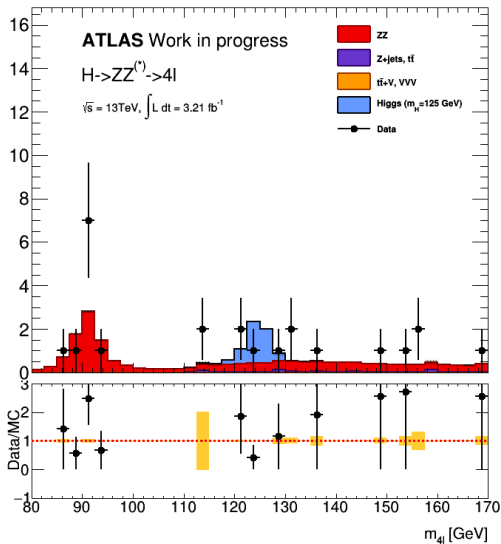
Final state	Background component	Estimate in full mass range
$\ell\ell + \mu\mu$	Z + jets	$0.65 \pm 0.18(\text{stat}) \pm 0.12(\text{syst})$
	$t\bar{t}$	$0.23 \pm 0.02(\text{stat}) \pm 0.16(\text{syst})$
	WZ	0.08 ± 0.02
$\ell\ell + ee$	Z + jets, $t\bar{t}$ and WZ	$1.19 \pm 0.10(\text{stat}) \pm 0.27(\text{syst})$

- use the shape from simulation, combining all final states (because of statistics)
 - smoothed with kernel estimation (RooKeysPDF)
 - same shape for all channels
- determine the fraction of reducible Background in a certain m_{4l} - mass range

Smoothed curve of the reducible Background:



Mass spectrum for m_{4l} :





Plans:

- Smooth the shape for the ZZ^* and Z+jets, $t\bar{t}$ Background
- Include all uncertainties
- Prepare the DPG-Talk :)