Expected Yields for $H \to 4\ell$ at 13 TeV and $\mathcal{L} = 10\,\mathrm{fb}^{-1}$ with $m_{4\ell} = [115\text{-}130]$ *GeV* and for inclusive, 0-, 1-, 2-jet categories

Katharina Ecker

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MC Samples

Path to files:
/afs/cern.ch/atlas/groups/HSG2/H4l/run2/2015/MiniTrees/Prod_v03/mc/Nominal/

- mc15_13TeV.341505.PowhegPythia8EvtGen_CT10_AZNLOCTEQ6L1_ggH125_ZZ4lep_noTau.root
- mc15_13TeV.341518.PowhegPythia8EvtGen_CT10_AZNLOCTEQ6L1_VBFH125_ZZ4lep_noTau.root
- mc15_13TeV.341947.Pythia8EvtGen_A14NNPDF23LO_ZH125_ZZ4l.root
- mc15_13TeV.341964.Pythia8EvtGen_A14NNPDF23LO_WH125_ZZ4l.root
- mc15_13TeV.342561.aMcAtNloHerwigppEvtGen_UEEE5_CTEQ6L1_CT10ME_ttH125_4l.root

Luminosity and Selection

Selection

- Mass range: $m_{4\ell,\text{constrained}} = [115{,}130]$ GeV
- Jet selection: Minitree variable $n_{\text{jets}} = $ 0-,1-,2-jet and inclusive

Luminosity

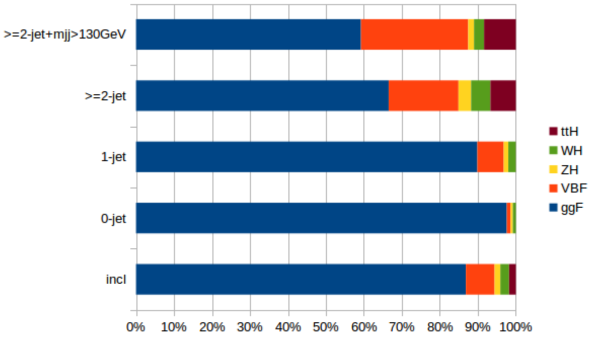
- $\mathcal{L} = 3.34257\,\text{fb}^{-1}$
- Note: Official ATLAS Luminosity $\mathcal{L} = 3.2\,\text{fb}^{-1}$ in publication https://cds.cern.ch/record/2108987/files/ATLAS-COM-CONF-2015-083.pdf
- For comparison: Internal common $H \to 4\ell$ note https://cds.cern.ch/record/2058249/files/ATL-COM-PHYS-2015-1277.pdf

https://atglance.web.cern.ch/atglance/confnote/detailAnalysis.php?readonly=true&id=8148

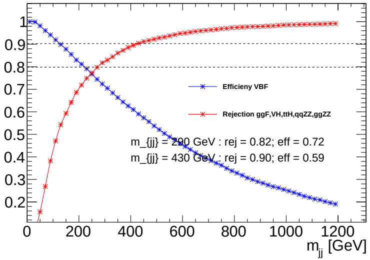
Expected Yields per decay channel for $\mathcal{L} = 10\,\text{fb}^{-1}$

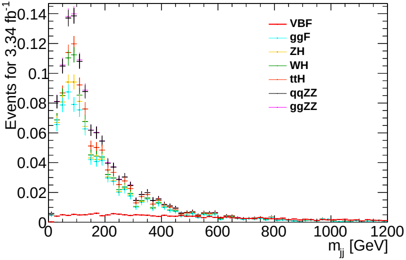
****Events weight all:****

	4mu	4e	2mu2e	2e2mu	all
1 - all	5.5532120494	3.1357608068	3.3040145756	3.6708580523	15.6645036604
2 - masscut	5.29718151	2.9022997275	3.1158061013	3.4280807881	14.7437749995
3 - 0-jet	2.1331071601	1.1671558112	1.2290512989	1.4434581774	5.9727395387
4 - 1-jet	1.7164158118	0.9851132512	1.0498209462	1.1236413897	4.8746922278
5 - >=2-jet	1.447969676	0.7499857894	0.8369308646	0.8612145744	3.8958944764



2-jet category: Optimization m_{jj} cut





Questions

- Analysis idea: Shape info in 0-jet category plus event yield infor of 2-jet category

⇒ Are expected number of events in 0-jet cat not too little for shape analysis?

⇒ Around 15% of SM 2-jet cat are VH+ttH production, still need to do optimization with m_{jj} cut to have pure VBF category (cut should not be too tight, as expected number of events are already very little)

- Note: Only cut on m_{jj} not on $\Delta\eta_{jj}$, which is also a typical VBF cat cut, because m_{jj} is not very BSM sensitive, whereas $\Delta\eta_{jj}$ is very sensitive to BSM contributions

Sources VBF cuts

1. ATLAS $H^{\pm} \to WZ$ (http://arxiv.org/pdf/1503.04233v2.pdf)
   $m_{jj} > 500\,GeV$ and $\Delta\eta_{jj} > 4$
2. ATLAS VBF Higgs to invisible
   (http://cds.cern.ch/record/2002121/files/ATLAS-CONF-2015-004.pdf)
   $m_{jj} > 1000\,GeV$ and $\Delta\eta_{jj} > 4$
3. ATLAS $H \to \gamma\gamma$ (http://arxiv.org/pdf/1408.7084v2.pdf)
   $\Delta\eta_{jj} > 2$ plus BDT
4. CMS $H \to \gamma\gamma$ (http://arxiv.org/pdf/1407.0558v2.pdf)
   $m_{jj} > 250\,GeV$
5. ATLAS $H \to 4\ell$ (http://arxiv.org/pdf/1408.5191v3.pdf)
   $m_{jj} > 130\,GeV$
6. CMS $H \to 4\ell$ (http://arxiv.org/pdf/1312.5353v3.pdf)
   Kinematic Discriminant with m_{jj} and $\Delta\eta_{jj}$ as input
   $p_{T,4\ell}$ used for 0,1 jet categories VH/VBF vs ggF
7. CMS $H \to WW$ (http://arxiv.org/pdf/1312.1129v2.pdf)
   $m_{jj} > 500\,GeV$ and $\Delta\eta_{jj} > 3.5$
8. Johanna thesis $H \to WW$
   $m_{jj} > 500\,GeV$ and $\Delta y_{jj} > 2.8$

Additional Material

Expected Yields per production mode for $\mathcal{L} = 10\,\text{fb}^{-1}$

****Events weight all:****

	ggF	VBF	ZH	WH	ttH	all
1 - all	13.4431	1.1673	0.2851	0.4092	0.3592	15.6645
2 - masscut	12.8022	1.1161	0.2224	0.3404	0.2624	14.7437
3 - 0-jet	5.8296	0.0617	0.0344	0.0468	3.8260E-005	5.9727
4 - 1-jet	4.3811	0.3388	0.0585	0.0956	0.0008	4.8746
5 - >=2-jet	2.5916	0.7156	0.1294	0.1978	0.2615	3.8958

Expected Yields per production mode for $\mathcal{L} = 3.343\,\text{fb}^{-1}$

****Events weight all:****

	ggF	VBF	ZH	WH	ttH	all
1 - all	4.49348	0.390204	0.0953222	0.13678	0.120096	5.23597
2 - masscut	4.27924	0.373086	0.0743579	0.113784	0.0877116	4.92821
3 - 0-jet	1.94861	0.0206356	0.0115272	0.0156727	1.27889e-05	1.99643
4 - 1-jet	1.46443	0.113247	0.0195667	0.0319827	0.000274895	1.6294
5 - >=2-jet	0.866286	0.239203	0.0432641	0.0661288	0.0874239	1.30223
fraction 0-jet:	45.5362 %	5.53107%	15.5023 %	13.7741 %	0.0145806%	40.5103 %
fraction 1-jet:	34.2216 %	30.354 %	26.3142 %	28.1081 %	0.313407 %	33.0627 %
fraction 2-jet:	20.2439 %	64.1147%	58.1836 %	58.1176 %	99.672 %	26.4241 %

Expected Yields per production mode for $\mathcal{L} = 5\,\mathrm{fb}^{-1}$

****Events weight all:****

	ggF	VBF	ZH	WH	ttH	all
1 - all	6.72	0.58	0.14	0.20	0.17	7.83
2 - masscut	6.40	0.55	0.11	0.17	0.13	7.37
3 - 0-jet	2.91	0.03	0.01	0.02	1.91E-005	2.98
4 - 1-jet	2.19	0.16	0.02	0.04	0.00	2.43
5 - $>=$2-jet	1.29	0.35	0.06	0.09	0.13	1.94