Type II Seesaw: Background Estimates

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Outline

- Two frameworks in place for the analysis; one is based in CPPM and the other utilizes the central ATLAS ntuples.
- New signal estimates
- Background estimates using ATLAS MC
- Some distributions
- Plans for next week

Re-calculated fiducial cross-sections

There were some issues with the cross-sections pointed out. An inclusive sample was made and the fiducial signal cross-sections were re-estimated.

Final State	200 (fb^{-1})	300 (fb^{-1})	400 (fb^{-1})
$2\ell^{ss}$	2.808	0.625	0.193
3ℓ	1.256	0.292	0.095

Fiducial cross-section is defined as $\sigma_{fid} = A * \times \sigma_{th} \times BR$. where Acceptance, A, is the ratio of the total $2\ell^{ss}/3\ell$ that pass the p_T and η cuts to the total number of $2\ell^{ss}/3\ell$ final state events. The cut-flow is included in the back up.

Selection cuts for 3ℓ

- 3ℓ with total charge $= \pm 1$
- b-jet veto
- Events with at least two-jets
- $E_T^{miss} > 30 GeV$
- $M_{\ell\ell}^{ss} > 50 GeV$
- Z-mass veto ($\pm 10 GeV$) for opposite-sign, same-flavour fermions

Background yields

Most of the backgrounds are included with the above mentioned selections. These are normalized to 100 fb^{-1}.
The total background estimate is **4170±173**.

	3l	3l-totalCharge	3l-nJets	3l-nBjets	3l-Mll-ss	3l-MET	3l-Mll-Zveto
$t\bar{t}+H$	298 ± 10.4	293 ± 10.3	280 ± 10.2	40.7 ± 4.59	24.7 ± 3.76	22.5 ± 3.45	17.9 ± 3.16
$t\bar{t}+W$	349 ± 6.19	338 ± 6.09	286 ± 5.66	36.4 ± 2.06	26.2 ± 1.76	22.8 ± 1.62	19.9 ± 1.52
$t\bar{t}+Z$	897 ± 2.75	890 ± 2.74	848 ± 2.69	112 ± 0.873	89.7 ± 0.784	77.2 ± 0.728	20.1 ± 0.373
Z + jets	1.16e+05 ± 4.28e+03	1.15e+05 ± 4.26e+03	1.44e+04 ± 1.19e+03	1.09e+04 ± 1.06e+03	4.87e+03 ± 729	2.19e+03 ± 367	472 ± 145
$t\bar{t}$ (MC)	4.04e+04 ± 333	4e+04 ± 332	2.04e+04 ± 237	6.42e+03 ± 135	3.27e+03 ± 96.7	2.9e+03 ± 90.8	2.59e+03 ± 85.8
Single top	3.09e+03 ± 52.1	3.06e+03 ± 51.8	894 ± 28.1	384 ± 18.5	228 ± 14.3	195 ± 13.2	176 ± 12.6
Four Top	14.3 ± 0.74	14 ± 0.734	14 ± 0.734	0.192 ± 0.0898	0.169 ± 0.0882	0.169 ± 0.0882	0.169 ± 0.0882
$t\bar{t}+WW$	17.2 ± 1.67	17 ± 1.66	16.4 ± 1.62	1.99 ± 0.616	1.91 ± 0.612	1.9 ± 0.612	1.66 ± 0.58
Diboson	5.3e+04 ± 324	5.27e+04 ± 323	9.94e+03 ± 145	8.67e+03 ± 130	6.07e+03 ± 102	4.29e+03 ± 76.1	879 ± 37.2
Total	2.14e+05 ± 4.31e+03	2.13e+05 ± 4.29e+03	4.71e+04 ± 1.23e+03	2.65e+04 ± 1.08e+03	1.46e+04 ± 743	9.7e+03 ± 386	4.17e+03 ± 173

Signal yields can be found here.

Plots and checks

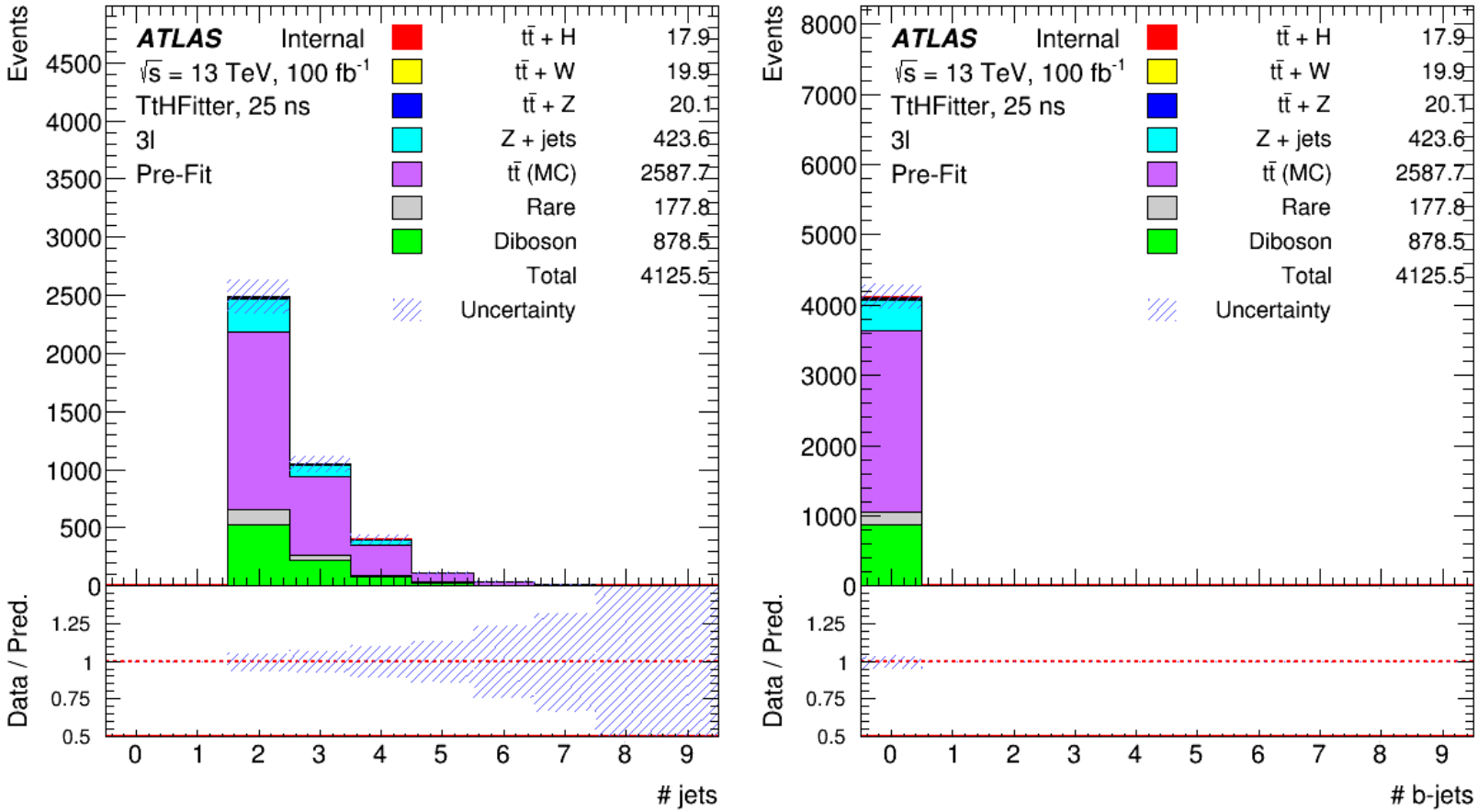
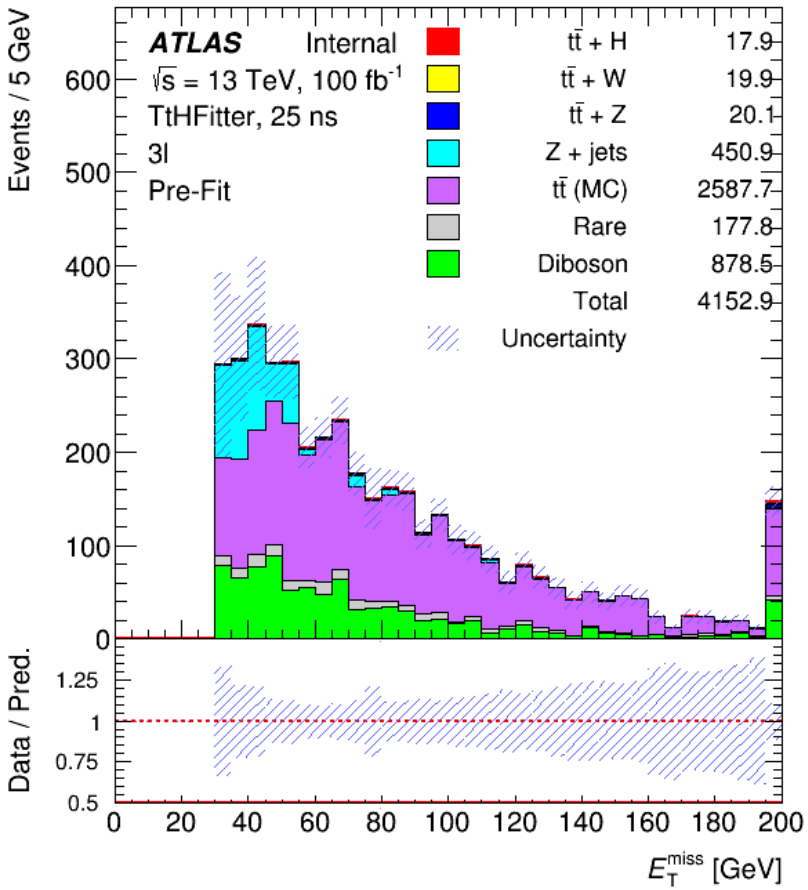


Figure: Number of jets (left) and number of b-jets (right)



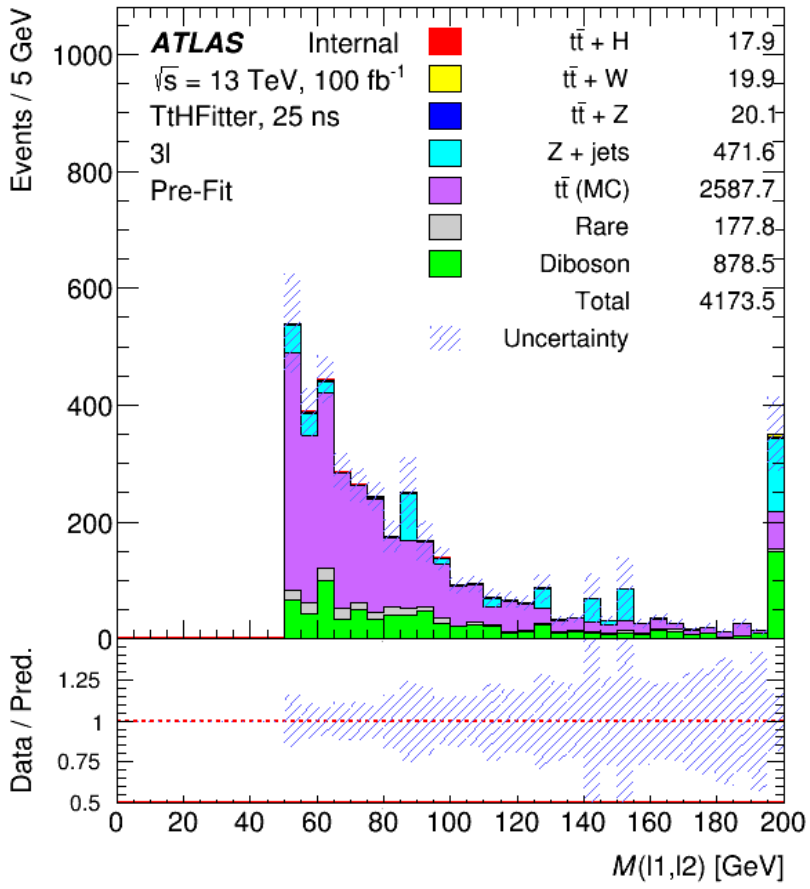


Figure: Missing E_T (left) and $M_{\ell\ell}$ of same sign leptons (right)

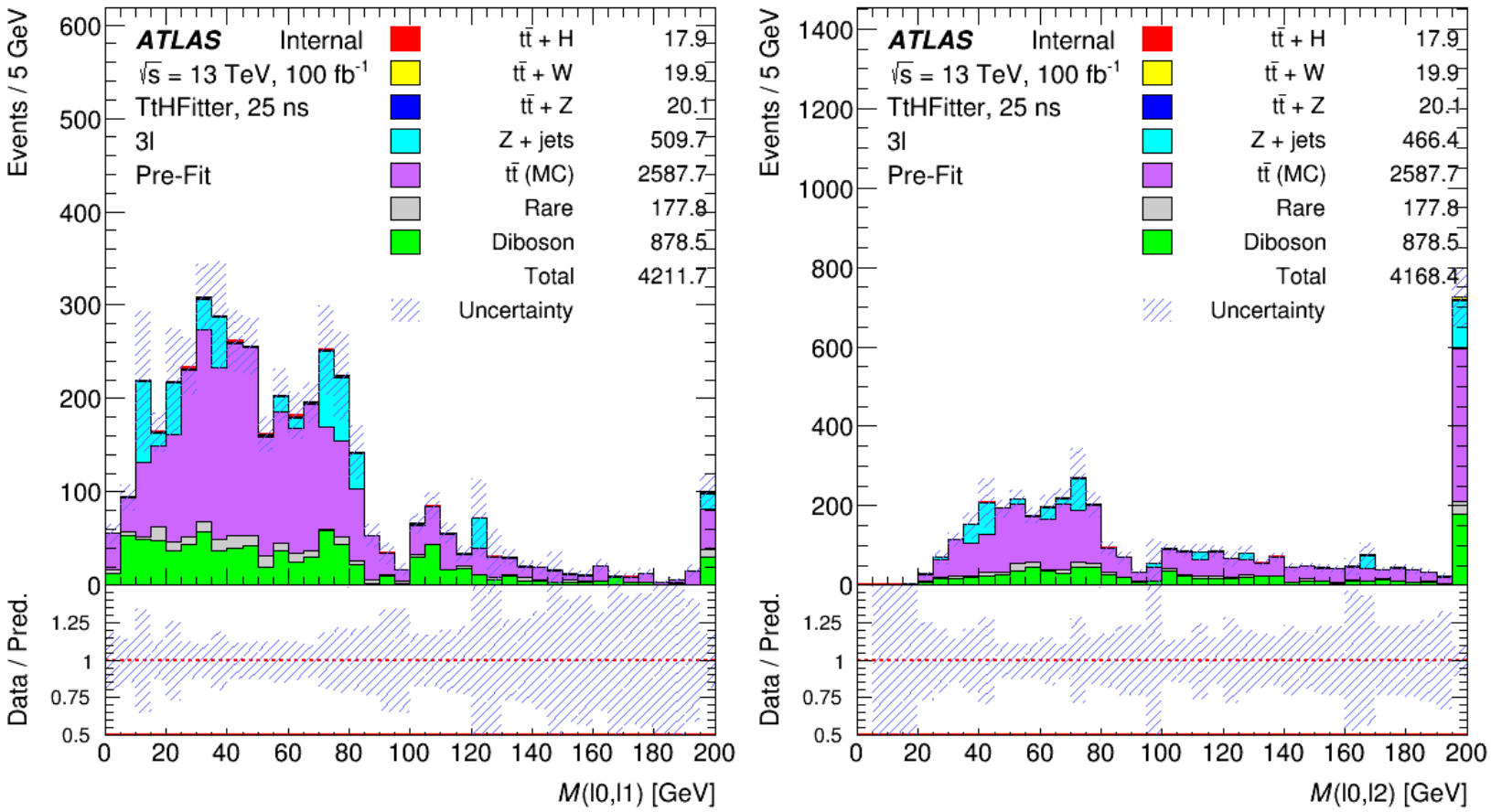
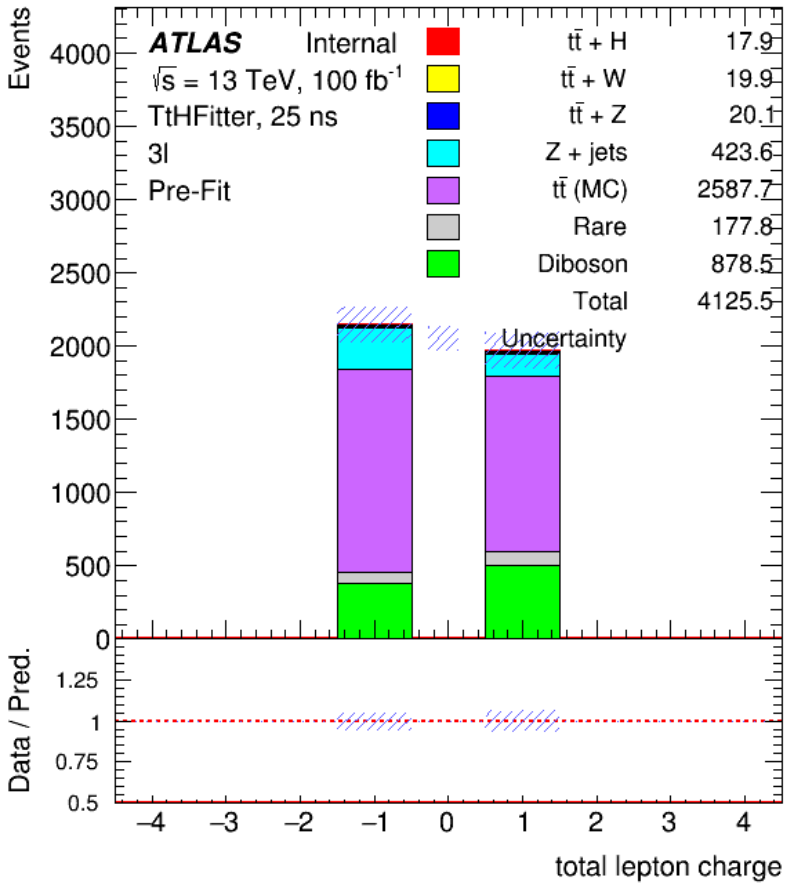
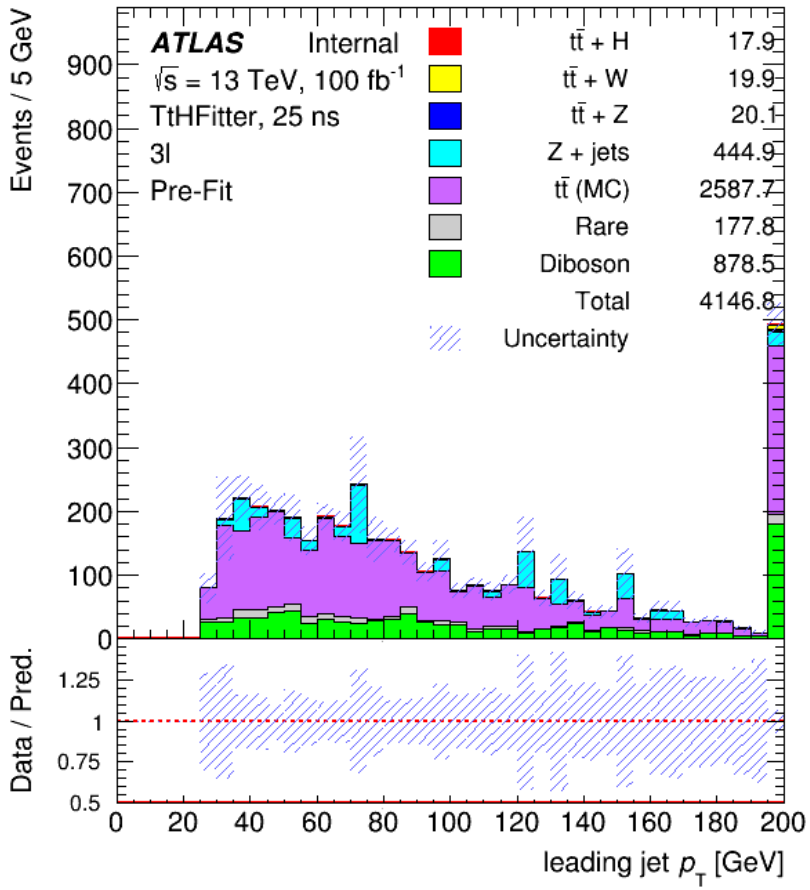


Figure: $M_{\ell\ell}$ for opposite-charge pairs


ATLAS Internal
√s = 13 TeV, 100 fb-1
TtHFitter, 25 ns
3l
Pre-Fit
tt̄ + H 17.9
tt̄ + W 19.9
tt̄ + Z 20.1
Z + jets 423.6
tt̄ (MC) 2587.7
Rare 177.8
Diboson 878.5
Total 4125.5
Uncertainty
Events
Data / Pred.
total lepton charge


ATLAS Internal
√s = 13 TeV, 100 fb-1
TtHFitter, 25 ns
3l
Pre-Fit
tt̄ + H 17.9
tt̄ + W 19.9
tt̄ + Z 20.1
Z + jets 444.9
tt̄ (MC) 2587.7
Rare 177.8
Diboson 878.5
Total 4146.8
Uncertainty
Events / 5 GeV
Data / Pred.
leading jet p_T [GeV]

Selection cuts for $2\ell^{ss}$

- 2ℓ with total charge of ± 2
- Number of jets at least 4
- b-jet veto.

More cuts are being tried– similar to the ones used in the 3ℓ case.

Background yields

Most of the backgrounds are included with the above mentioned selections. Further cuts need to be applied. These are normalized to 100 fb^{-1}.

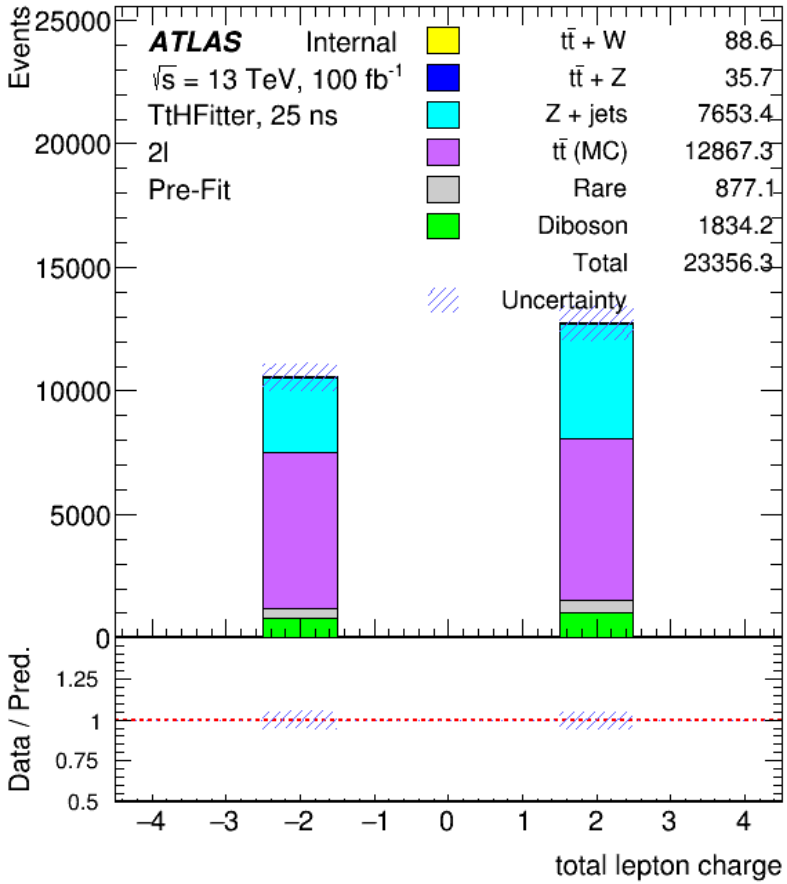
	2l
$t\bar{t} + W$	88.6 ± 3.35
$t\bar{t} + Z$	35.7 ± 2.58
Z + jets	7.75e+03 ± 878
$t\bar{t}(MC)$	1.29e+04 ± 192
Single top	873 ± 28.4
Four Top	0.939 ± 0.203
$t\bar{t} + WW$	3.48 ± 0.838
Diboson	1.83e+03 ± 79.8
Total	2.35e+04 ± 903

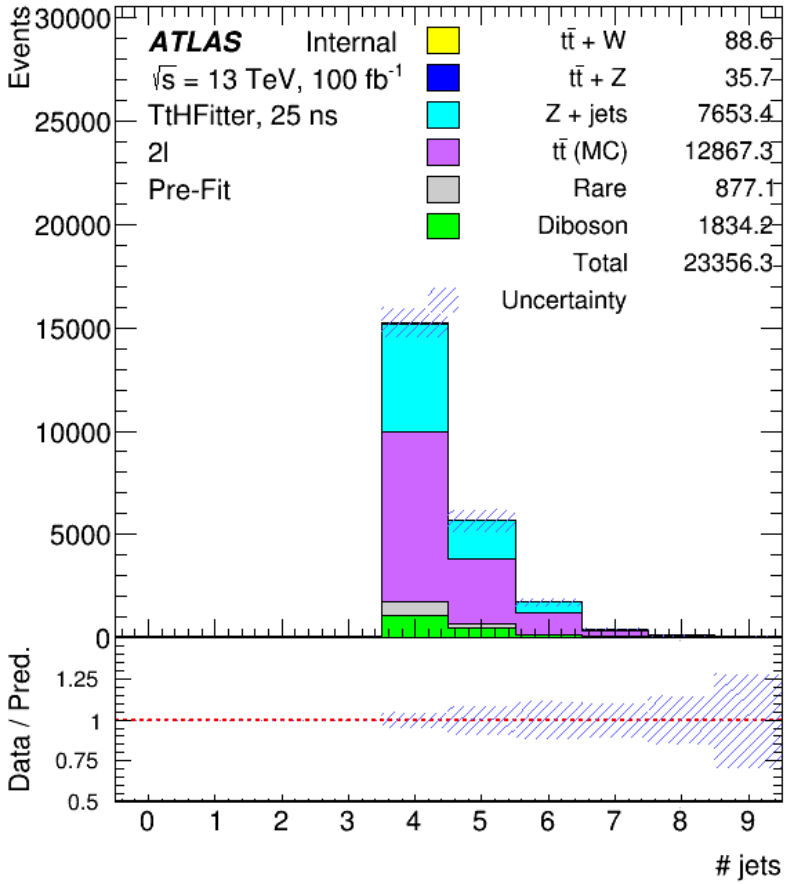
Table 1: Yields of the analysis

Signal yields can be found here.

Checks

More plots to be included after further cuts are applied.





Next week

- Framework to perform studies on reconstructed objects is ready.
- Background estimates with the available background samples $\Rightarrow ttHbb, ttZ, ttW, WZ$.
- Significance studies with the pheno samples.

ATLAS simulation of the signal is in progress. Once these have enough events, significance studies on these will be performed.

Backup

Signal Cut-flow

Sheet1

3l-inclusive	430	429	412	BR
	1265	1262	1312	
	1233	1252	1250	
	448	423	446	
Total	3376	3366	3420	
sigma(theory)(fb)	64.573	13.341	3.998	
sig X BR	2.1452287085	0.4432115002	0.1328205965	

2lss-inclusive	1505	1460	1561	BR
	2953	3001	2906	
	1490	1534	1459	
Total	5948	5995	5926	
sigma(theory)(fb)	64.573	13.341	3.998	
sig X BR	3.8029054378	0.7856931139	0.2354546938	

3l-fid	254	285	287
	750	829	942
	717	822	885
	257	282	333
Total	1978	2218	2447
Acceptance	0.5859004739	0.6589423648	0.715497076
sig fid	1.256890517	0.292050834	0.0950327484

2lss-fid	1124	1184	1263
	2163	2370	2397
	1105	1218	1205
Total	4392	4772	4865
Acceptance	0.738399462	0.7959966639	0.820958488
sig fid	2.8080633293	0.6254090975	0.1932985294