Status of 4Top analysis : 4top-¿at least 1τ

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Outline

1. Check on cross section

2. Data/MC comparison

Check on cross section

- $t\bar{t}$: 832 pb(NNLO+NNLL)
- *ttWJets* : 0.566 pb(NLO+NNLL), I used 0.611
- *ttZJets* : 0.863 pb(NLO+NNLL), I used 0.783
- *ttGJets* : 4.620 pb(LO), I used 3.788
- In general, I am not sure about the jet pt cut at generator level and whether there is a filter efficiency.
- In ATLAS, we have cross section, BR, k-factor, filter efficiency. Where can we get the job option of MC generation?
- We can begin from XSDB.
- Huiling, Fabio and Yu should update the corresponding column of cross section on twiki page to make sure we are using the same.

Data/MC comparison

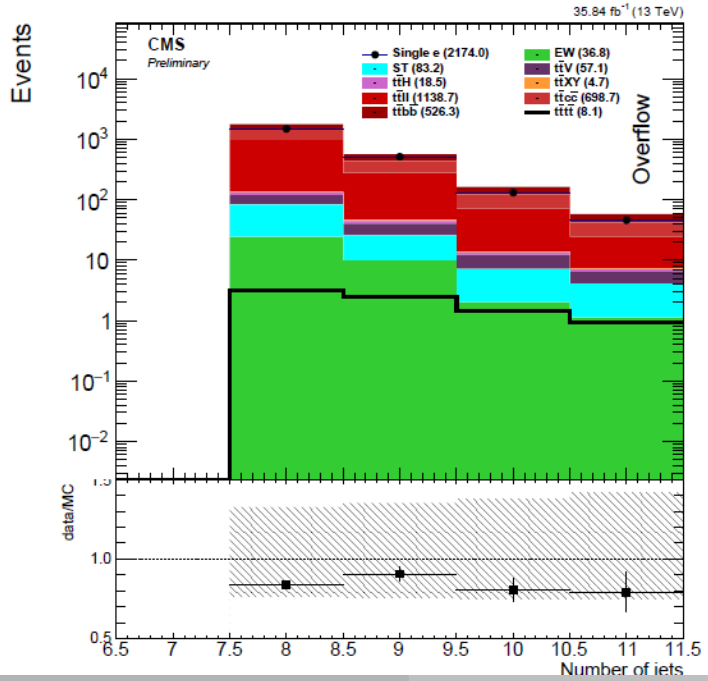
- I upload a directory with the cutflow of all the samples to CERN box (see README.txt there).

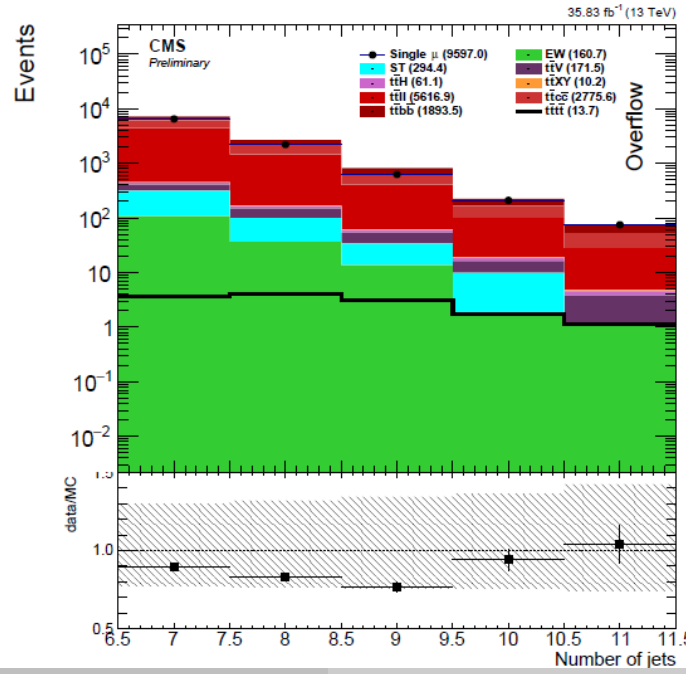
category	data	signal	$t\bar{t}$	SingleTop	TTX	SM Higgs	HH	total bkg	(data-bkg)/bkg
1Tau+0L	13942	9.474	6276.168	0.262	104.929	57.190	0.027	6438.577	1.165
1Tau+1L	2026	7.694	2329.306	0.651	65.438	35.281	0.003	2430.680	-0.166
1Tau+2L	78	1.843	62.112	0.555	19.325	6.488	0.002	88.482	-0.118
1Tau+3L	3	0.146	0.000	0.006	1.934	0.394	0.000	2.333	0.286
2Tau+0L	275	0.507	246.776	0.391	13.155	6.846	0.000	267.167	0.029
2Tau+1L	19	0.260	22.571	0.136	6.427	3.524	0.000	32.659	-0.418
2Tau+2L	1	0.031	0.271	0.004	0.729	0.354	0.000	1.358	-0.264

- I are not worried about $1Tau + 3L$, $2Tau + 1L$, $2Tau + 2L$ since the statistic in data is very low.
- In $1Tau + 0L$, QCD background is not included.
- The conssitency in $2Tau + 0L$ is quite good.
- The question is in $1Tau + 1L$, $1Tau + 2L$.
- Remember : I use Lumi=36.1(should be 35.9).

Discussion

- In 1Tau+1L,1Tau+2L, the dominant background is $t\bar{t}$(95% in 1Tau+1L and 70% in 1Tau+2L).
- In 4top$\rightarrow$ $1L, OS2L$ analysis, $t\bar{t}$ is also dominant.
- It is very possible that the MC modeling is not reliable in high jet multiplicity region e.g. PS modeling.
- The uncertainty includes ME, heavy flavour fraction reweighting, b-tagging, pile-up and PDF.

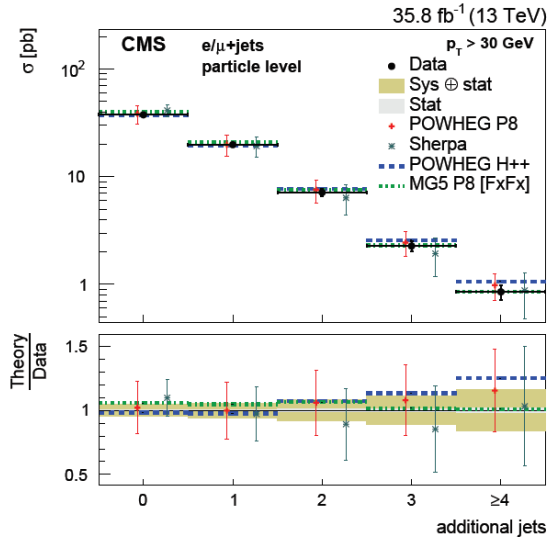




What is done in 1L&OS2L

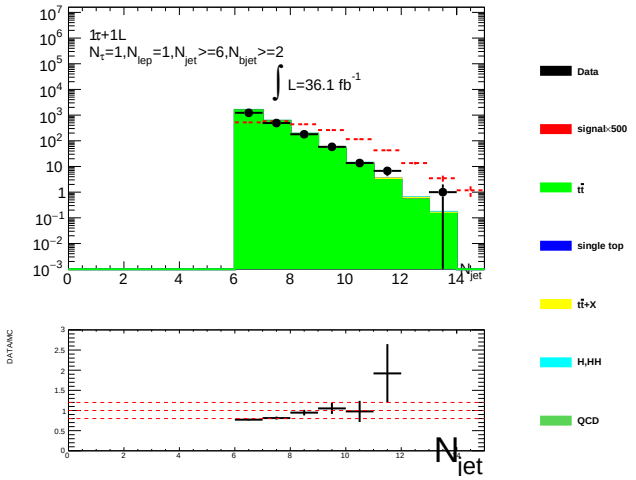
- They see data deficit in high jet multiplicity bins, especially in 8jet and 9jet bins. This is consistent with the measurement of $t\bar{t} + jets$ differential cross section. See AN-2017-003.
- They apply SF_8jet and SF_9jet to control normalization and let it flow in the fit.
- In principle, one can also introduce SF_7jet, but it will has strong anti-correlation with other normalization factors, so they do not add this.

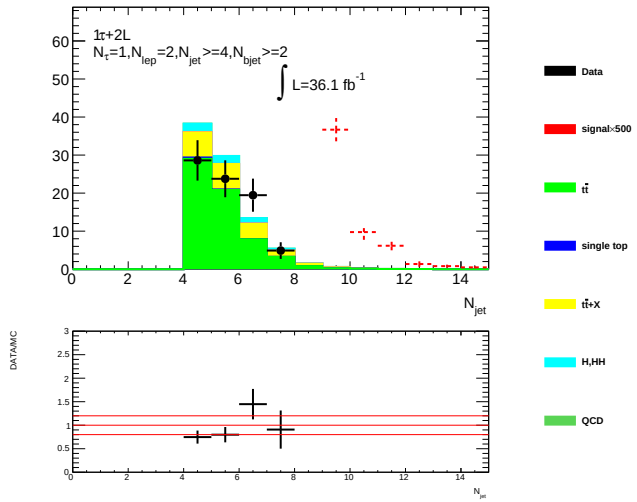
bin	normalisation correction factor
8 (scale_nj6_d8s)	0.87 ± 0.004
9 (scale_nj6_d9s)	0.78 ± 0.06
TOP-17-002	$\simeq 0.9 - 0.85 \pm 0.25(th)$



- The plot is from AN-17-003. The discrepancy is higher with higher jet pT cut.

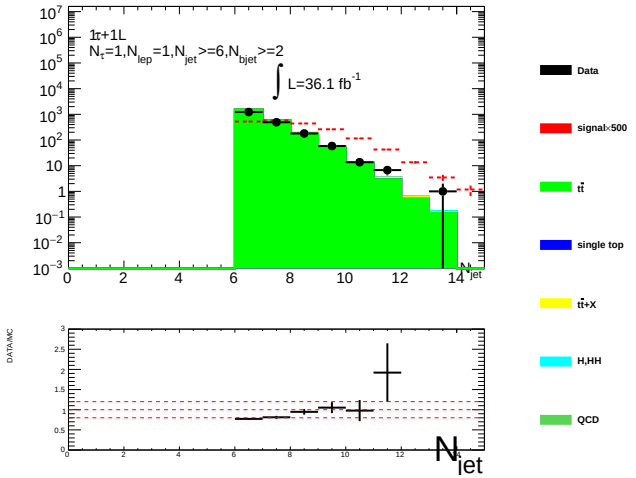
What is our case

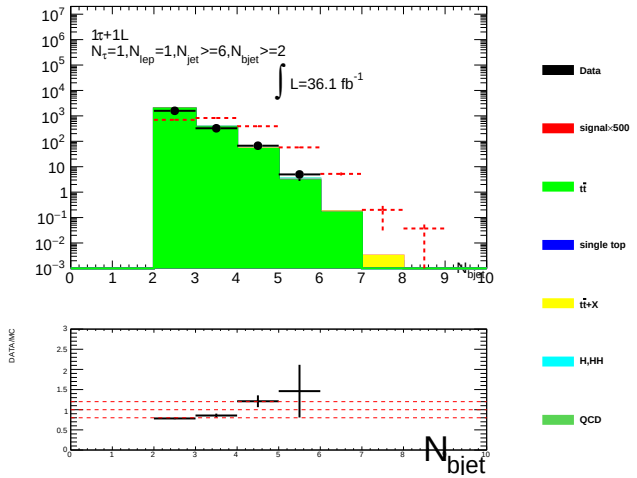


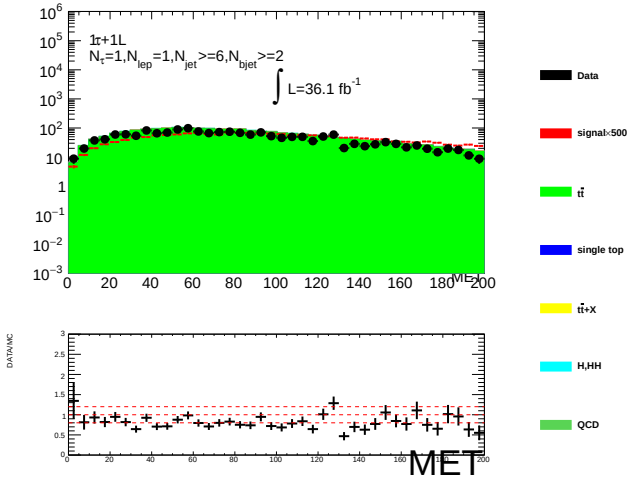


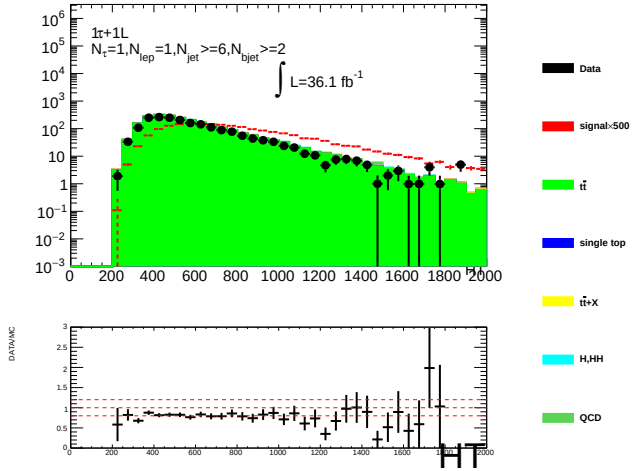
- 1Tau+1L : Our dominant background is actually $t\bar{t} + 4jets$. This already hits the region with large discrepancy.
- 1Tau+2L : Our dominant background is actually $t\bar{t} + 3(4)jets$. The jet multiplicity reweighting is needed.

Kinematics — 1Tau+1L

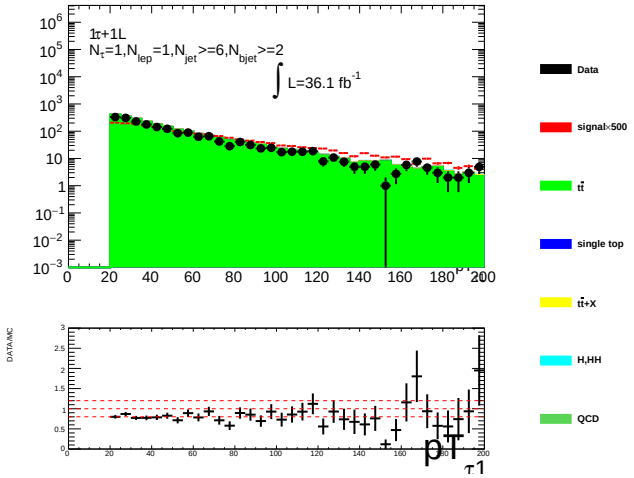


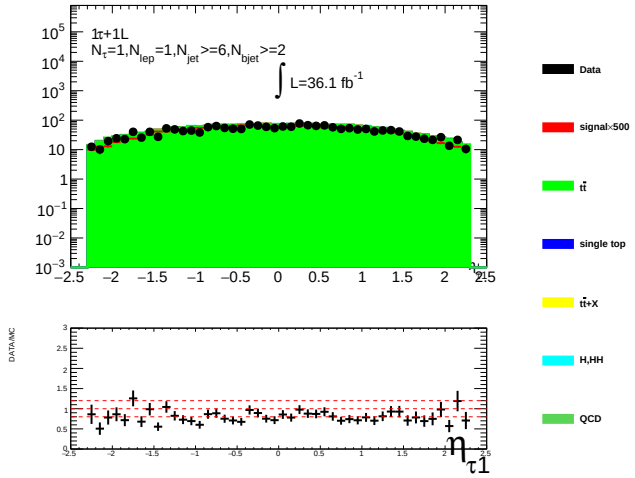






Kinematics — 1Tau+1L





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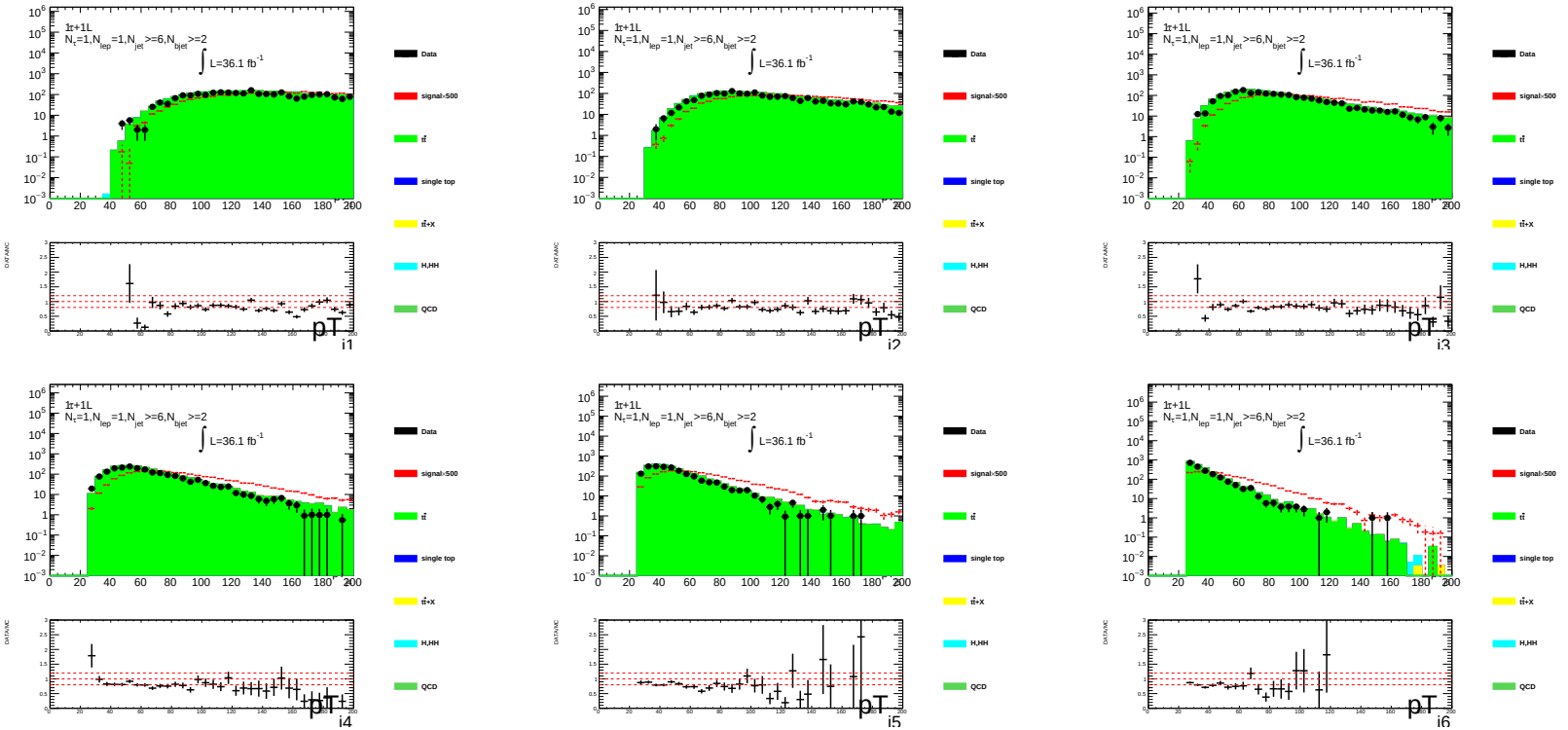
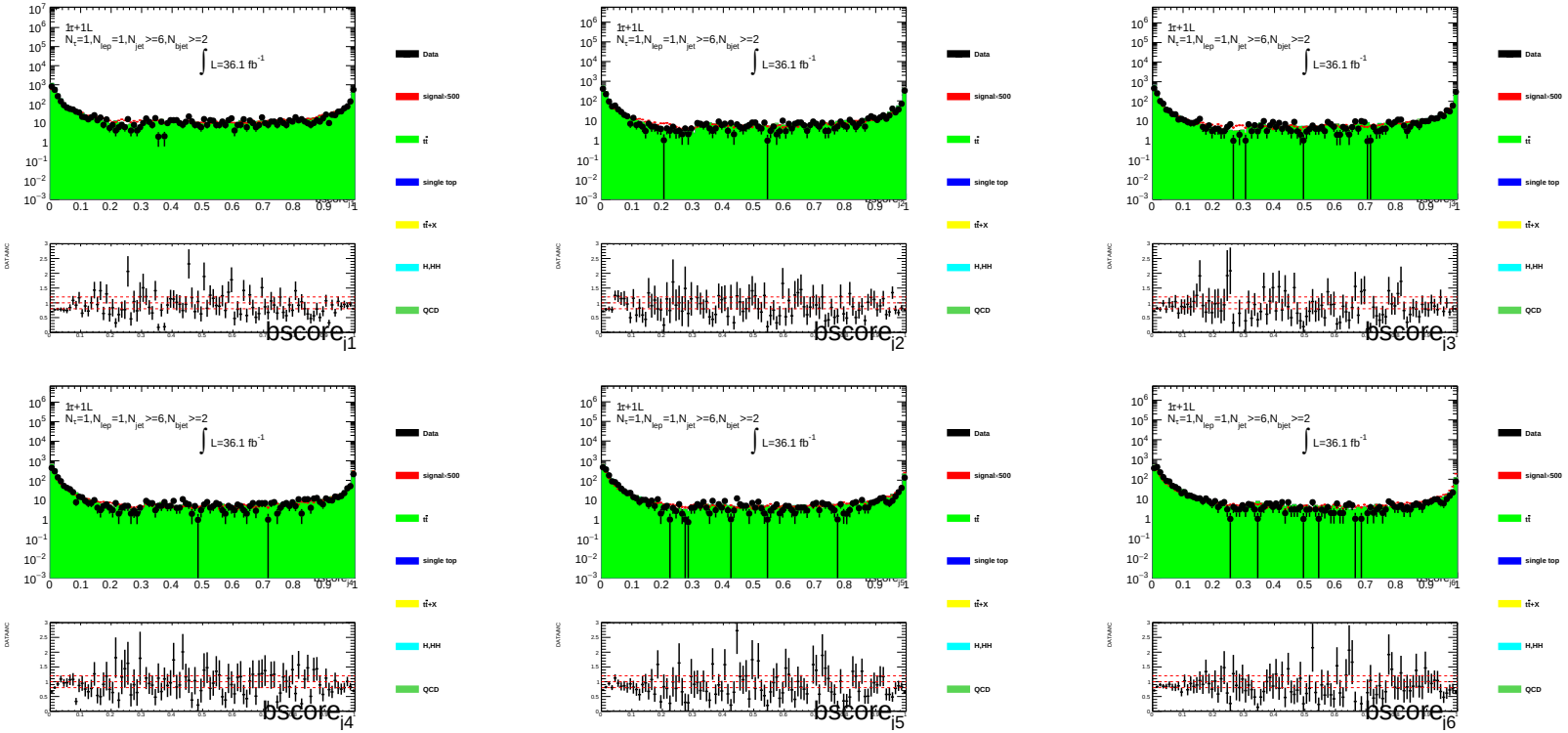


Kinematics — 1Tau+1L



- This is not clear. I should plot the maximum 4 bscores.

Scale factors — experimental

Event Level :

- prefireWeight
- PUWeight
- TriggerSF

Electron & Muon & Tau : only electron energy scale is available in ntuple.

- RECO/ID/ISO efficiency, energy scale/resolution

Jet : JES and JER are available in ntuple

- ID, b-tagging, energy scale/resolution

MET : available, two nuisance parameters.

Scale factors — theoretical

- $t\bar{t} + bb$ reweighting
- Jet multiplicity reweighting
- Top pt reweighting

Background estimation

- The default choice is : prompt(MC) + non-prompt(fake estimated by data-driven).
- We should think about the data-driven method even for $t\bar{t}$ background.