$t\bar{t}H$ DILEPTONIC PRODUCTION @ ATLAS

$\sqrt{s} = 8$ TeV

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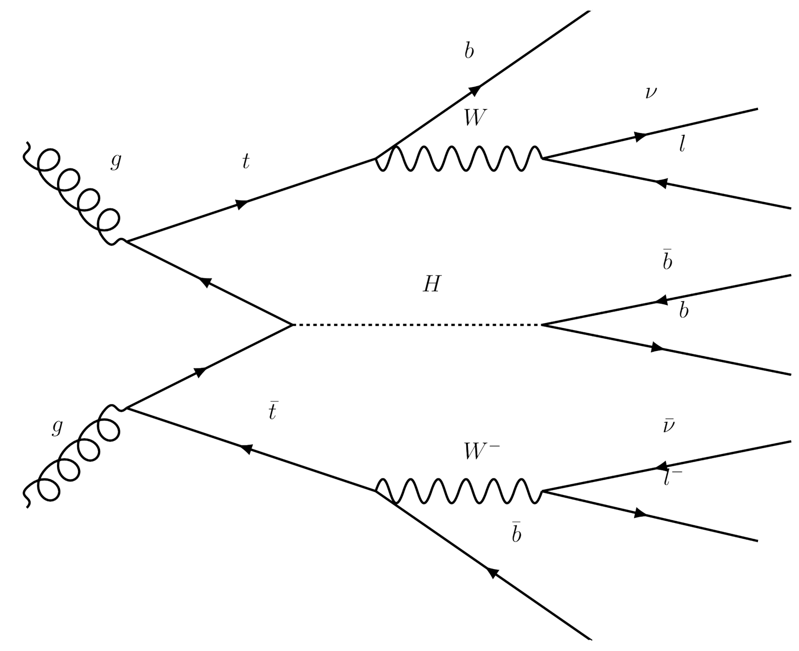
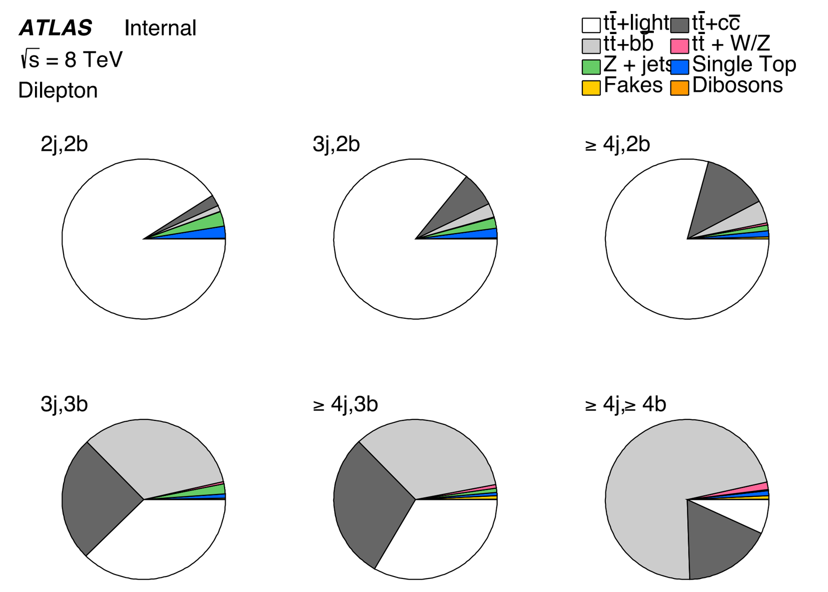
OBJECTIVE

Search of the ttH dileptonic production and determination of a 95% CL upper limit on its cross-section using $L_{int} = 20.3\ fb^{-1}$ of *pp* collision data at $\sqrt{s}$=8TeV, collected with ATLAS experiment.





EVENT SELECTION

- Exactly 2 opposite charged leptons (e or μ) [1]
  - leading $l^{\pm}$ with $p_T > 25$ GeV & $|\eta| < 2.5$
  - subleading $l^{\pm}$ with $p_T > 15$ GeV
- $N_{jets} \geq 2$ and $N_{b\text{-}jets} \geq 2$
- For eμ events: $H_T > 130$ GeV
- For ee & μμ events:
  - $M_{ll} > 15$ GeV & $|M_{ll} - m_Z| \geq 8$ GeV (with $m_Z = 91$ GeV)
- For ee & μμ events:
  - $M_{ll} > 60$ GeV for events with exactly 2 b-jets

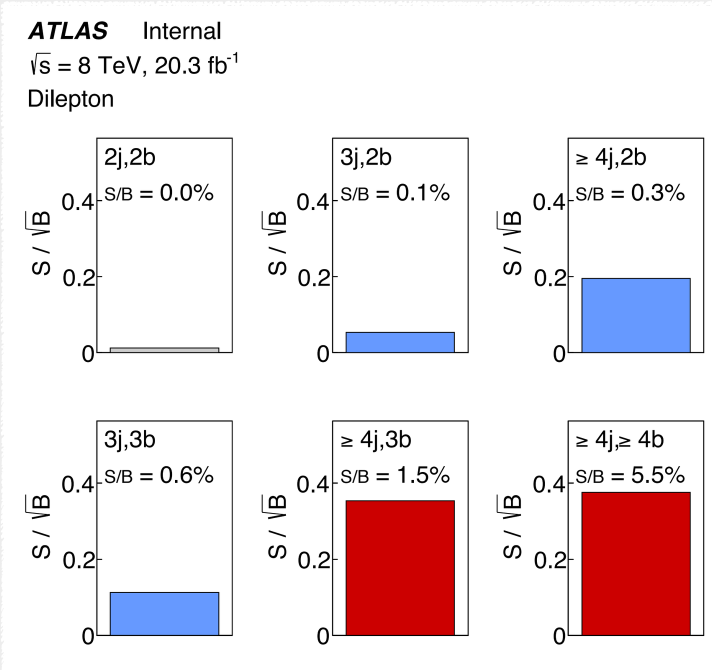
B-tag Information

- 70% b-tagging efficiency
- 1% of light-jets mistag rate
- Jet flavour separation
- Use *T.R.F.* to minimise stat. errors.

ANALYSIS METHOD

Divide the events according to jet and b-tag multiplicity in order to improve sensitivity and maximise statistical power.

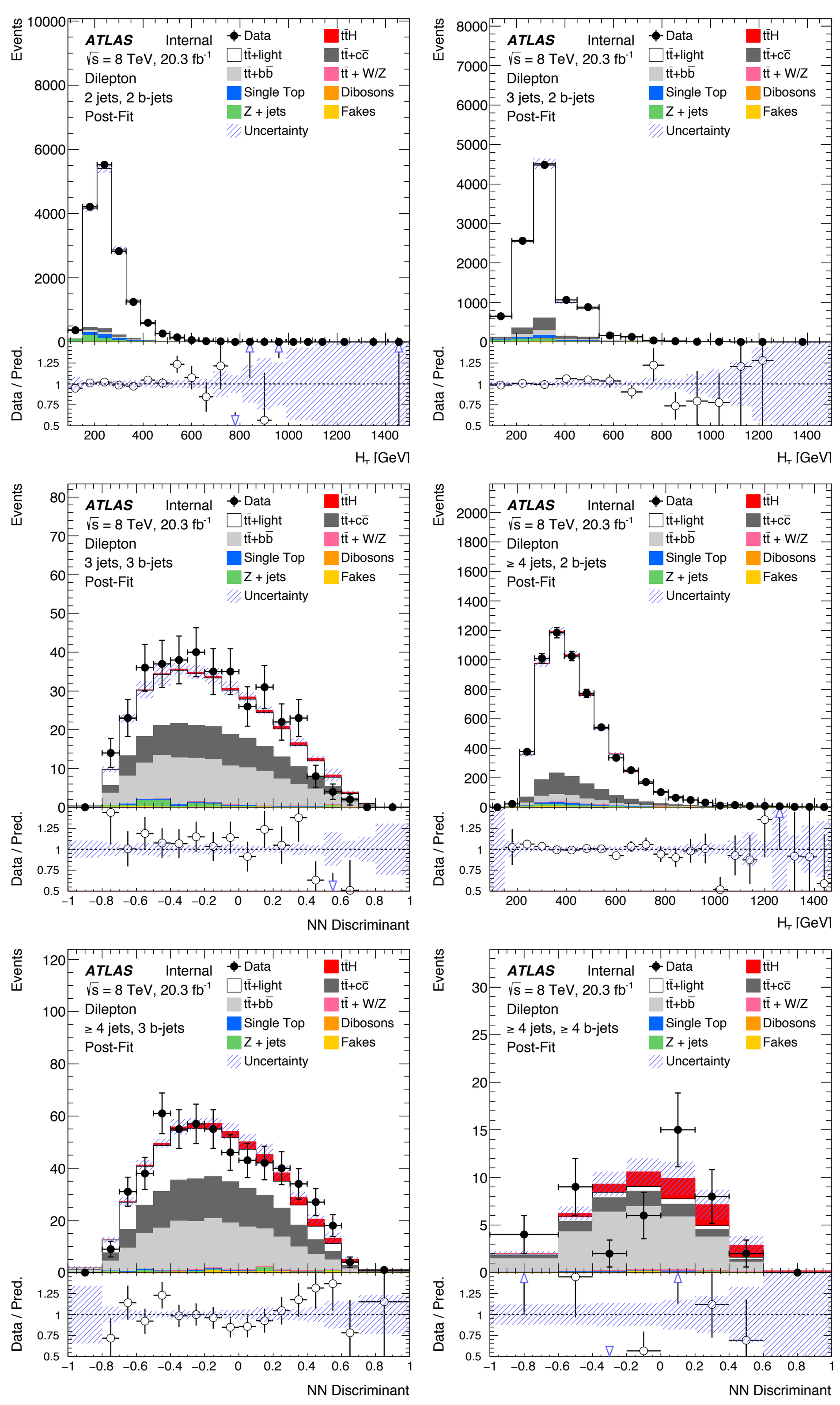
	2 b	3 b	>= 4 b
2 jets	H_T		
3 jets	H_T	NN	
>=4 j	H_T	NN	NN



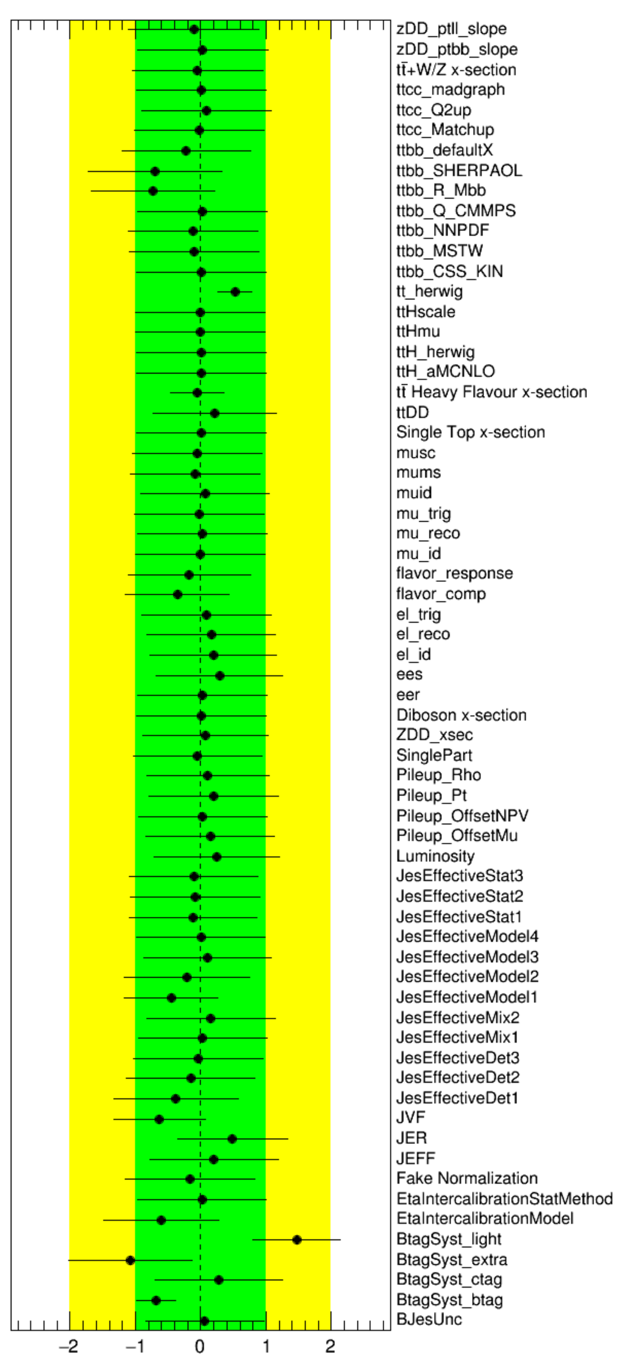
Choose suitable discriminant variable in each channel:
VALIDATION: H_T
CONTROL REGION: H_T
SIGNAL REGION: Neural Network [2]

RESULTS

Perform hypothesis testing including constraining of systematic uncertainties [3]



S+B hypothesis 95% CL limit σ/σ_{SM}	obs.	-2σ	-1σ	exp.	-1σ	-2σ
	8.6	2.5	3.4	4.7	6.8	9.5



DATA DRIVEN BACKGROUNDS

✓ FAKE LEPTON ESTIMATION

Estimate the contribution of non-isolated leptons or misidentified photons or jets in the analysis.

CONTROL REGION Same Sign (SS) Exactly 2 same charge leptons

$$\text{Fakes}_{j\,b} = [N^{SS}_{data} - N^{SS}_{MC}]_{j\,\text{All btag Inc.}} \frac{N^{SS}_{MC\,j\,b}}{N^{SS}_{MC\,j\,\text{All btag Inc.}}}$$

✓ Z+JETS MODELLING [Only for ee & μμ events.]

Correctly estimate the Z+jets production, modelling it to data.

CONTROL REGION Z boson Mass Peak Events with $|M_{ll} - m_Z| \leq 8$ GeV

CROSS-SECTION NORMALISATION

$$\text{Scale Factor}_{j\,b} = \left.\frac{N^{CR}_{data} - N^{CR}_{other\ MC}}{N^{CR}_{Z+jets\ MC}}\right|_{j\,b}$$

TRANSVERSE MOMENTUM CORRECTIONS

Linear fits preformed on data/MC ratio of:
- Average Lepton $<p_T^{l1+l2}>$
- Average Jet $<p_T^{j1+j2}>$

Maintains the previous cross-section normalisation.

✓ $t\bar{t}$+JETS MODELLING

Estimate the $t\bar{t}$ production (including extra light, b or c jets) from eμ data, in low b-tag regions not included in the nominal analysis.

CONTROL REGION eμ events with exactly 0 and 1 b-jets

CROSS-SECTION NORMALISATION

Events in a jet bin $N_j = L\,\sigma_{t\bar{t}}\epsilon_j$

Direct k-factor to normalise MC to data: $k_{j\,b} = N^{D}_{j\,b}/N^{MC}_{j\,b}$
This cannot be directly use in SR.

Ratios of k_{jb} for consecutive b-tag regions are constant:

$$R_{[j\,b+1,\,j\,b]} = \frac{k_{j\,b+1}}{k_{j\,b}} = \frac{\epsilon^{D}_{b}\,(1-\epsilon^{MC}_{b})}{\epsilon^{MC}_{b}\,(1-\epsilon^{D}_{b})}$$

Thus, a scale factor can be applied, using only information from signal depleted bins (CR):

$$\text{Scale Factor}_{j\,b+1} = R_{[j\,b+1,\,j\,b]} \cdot k_{j\,b}$$

REFERENCES

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