ttbar cross sections at the LHC

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On behalf of ATLAS and CMS
For HCP2011 at Paris
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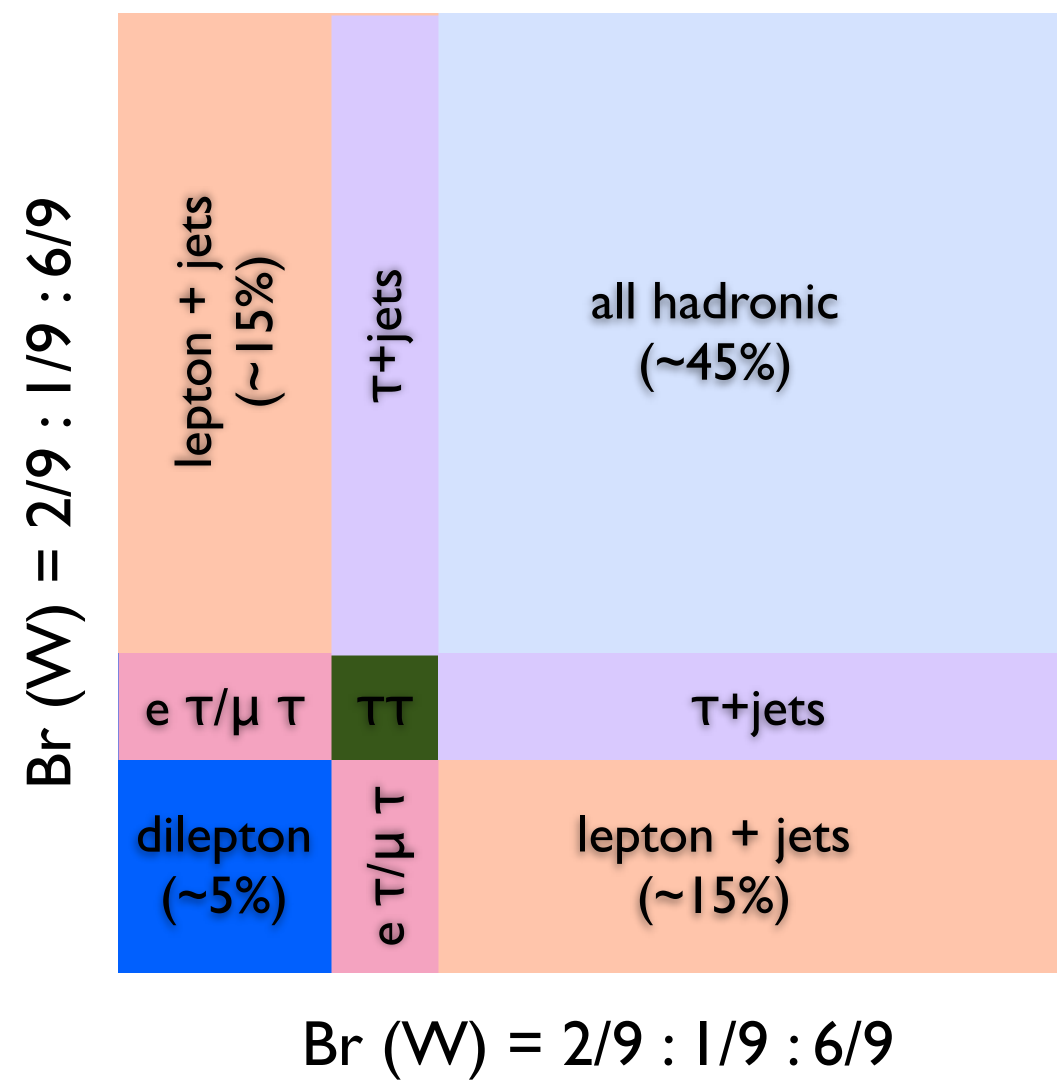
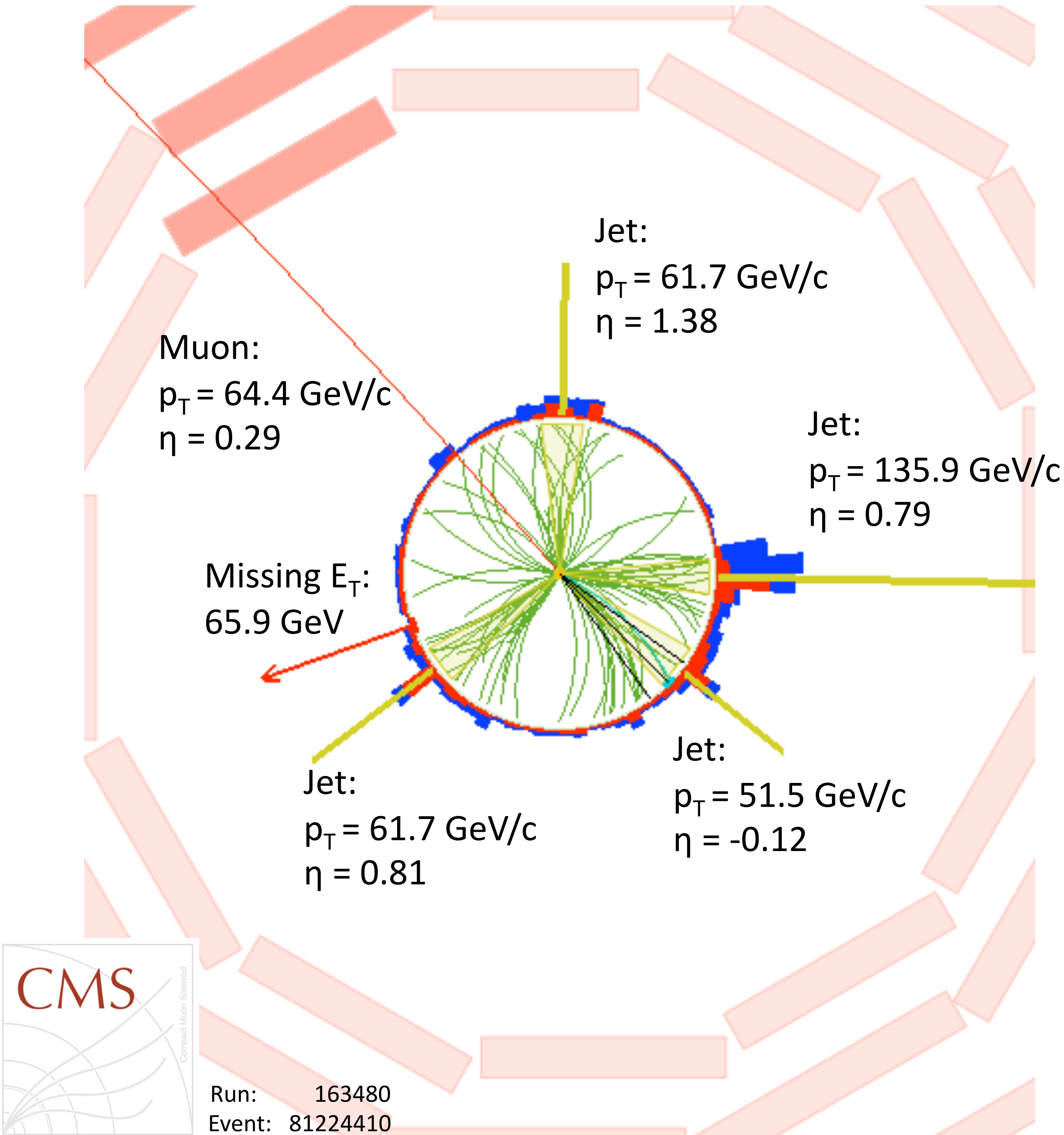
Introduction

- Motivation
  - Test of Perturbative QCD through precision measurement
  - Main background for new physics - possible deviation due to new physics
- Agree well with prediction so far last year 2010.

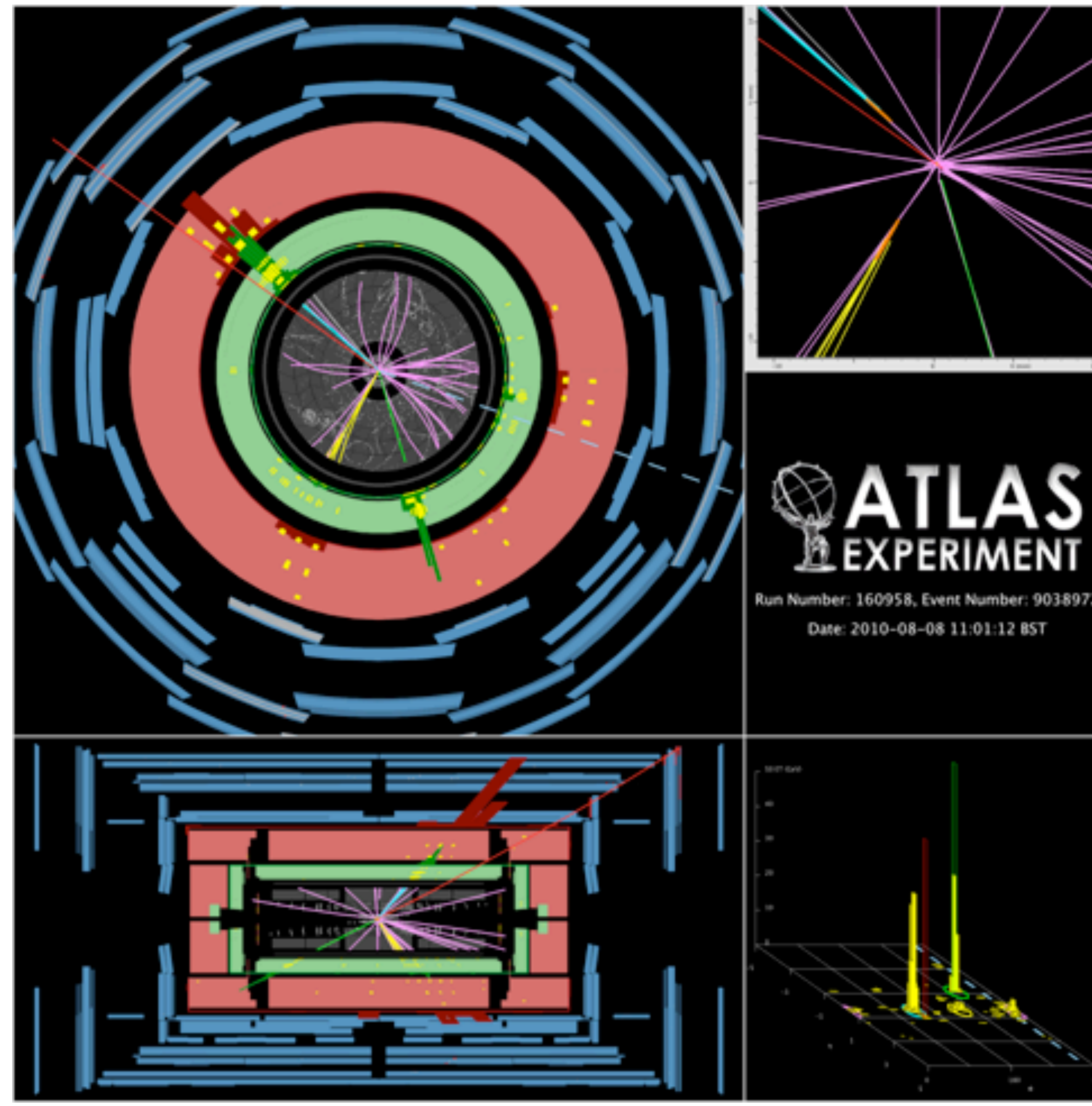
- Focus on 2011 analyses
  - cross section in dilepton decay mode
  - cross section in l+tau decay mode
  - cross section in l+jets decay mode
  - cross section in hadronic decay mode
  - multi-jet distribution in l+jets
  - charge asymmetry



ttbar events



muon+jets event



electron+muon event

ttbar MC samples

- CMS
  - MadGraph with matrix elements up to three additional partons
  - ME are matched with Pythia for Parton showering (PS)
  - TAUOLA for tau decay
  - Top mass 172.5 GeV
  - NLO 157.5 pb using MCFM

- ATLAS
  - MC@NLO interfaced with HERWIG (PS) and JIMMY (UE)
  - TAUOLA for tau decay
  - Top mass 172.5 GeV
  - Approximate NNLO 164.6 pb

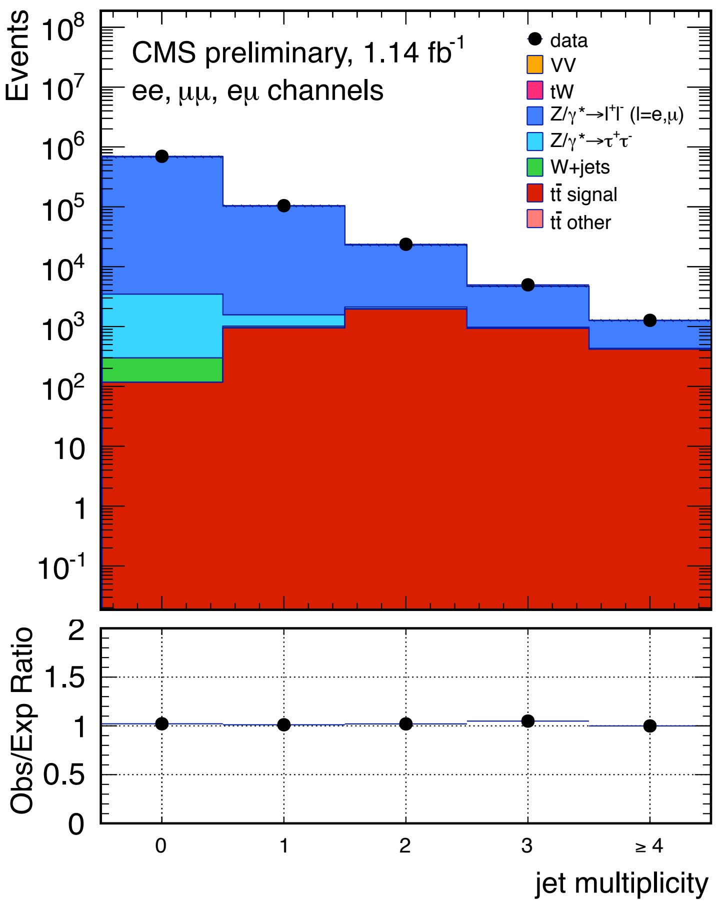
Physics Objects

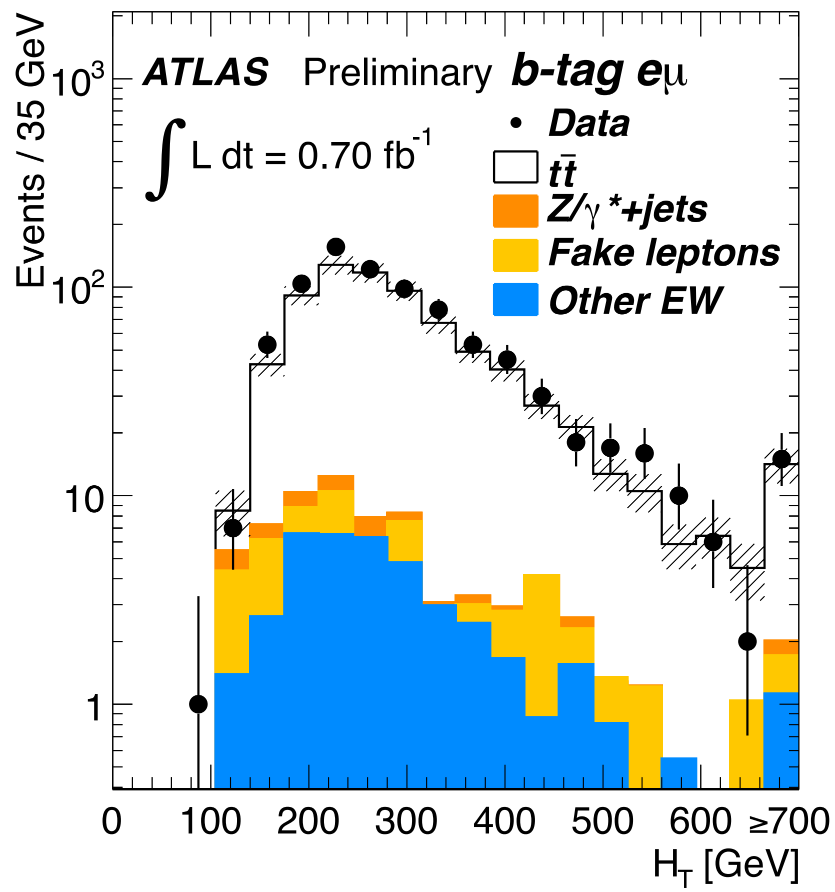
	CMS	ATLAS
Muons	$\lvert\eta\rvert < 2.4$ (2.1) Particle-based isolation	$\lvert\eta\rvert < 2.5$, dR(mu, jet) > 0.4 energy/track isolation
Electrons	$\lvert\eta\rvert < 2.5$, (veto $1.44 < \lvert\eta\rvert < 1.57$) Particle-based isolation	$\lvert\eta\rvert < 2.5$, veto $1.37 < \lvert\eta\rvert < 1.52$ energy sum for isolation
Taus	Hadron plus strips algorithm	Boosted Decision Tree
Jets	Particle-flow* jets Anti-Kt with dR=0.5 $p_T > 30$ GeV	Calo-jets Anti-Kt with 0.4 dR(e, jet) > 0.4, $p_T > 20$ GeV
MET	Vector sum of all particles	Vector sum of energy

*Combines all information from all sub-detectors and reconstruct all particles: charged hadrons, photons, neutral hadrons, muons and electrons which are used for jet and MET reconstruction as well as for isolation requirement.

Dilepton decay

- Two opposite sign isolated leptons p_T > 25/20 GeV (ATLAS/CMS)
- M_{ll} >15/12 GeV & $|M_{ll}$ - 91| > 10/15 GeV for ee/μμ (ATLAS/CMS)
- At least two jets p_T > 25/30 GeV (ATLAS/CMS)
- MET > 60 or 40 (b-tag) /30 GeV for ee/μμ (ATLAS/CMS)
- H_T > 130 or 140 (b-tag) GeV for eμ (ATLAS)
- One b-tagging (CMS:track counting, ATLAS:likelihood ratio)

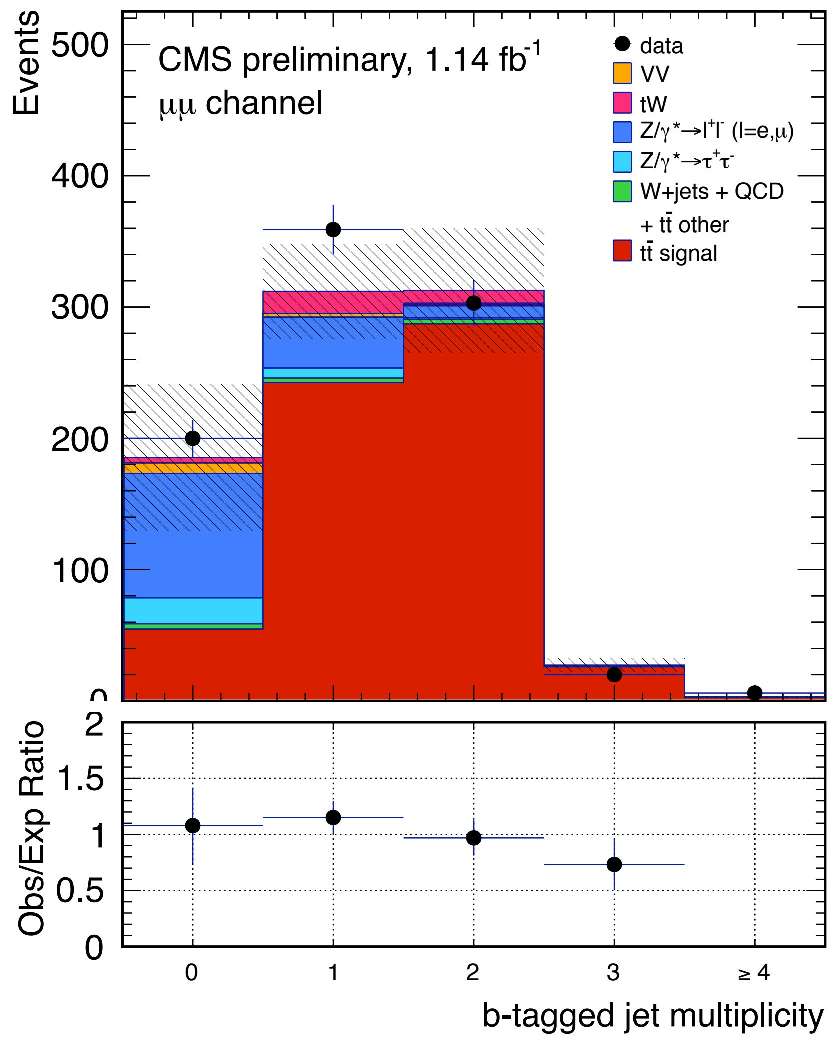




- Lepton efficiency
  - Data-driven way
  - Using Z candidate
- Background estimation
  - Z window for Drell-yan
  - Matrix method for QCD and W+jets

Dilepton (CMS)

(TOP-11-005, 1.1fb^{-1})



- Counting method
- BLUE (Best Linear Unbiased Estimator) method for combination of three decay modes

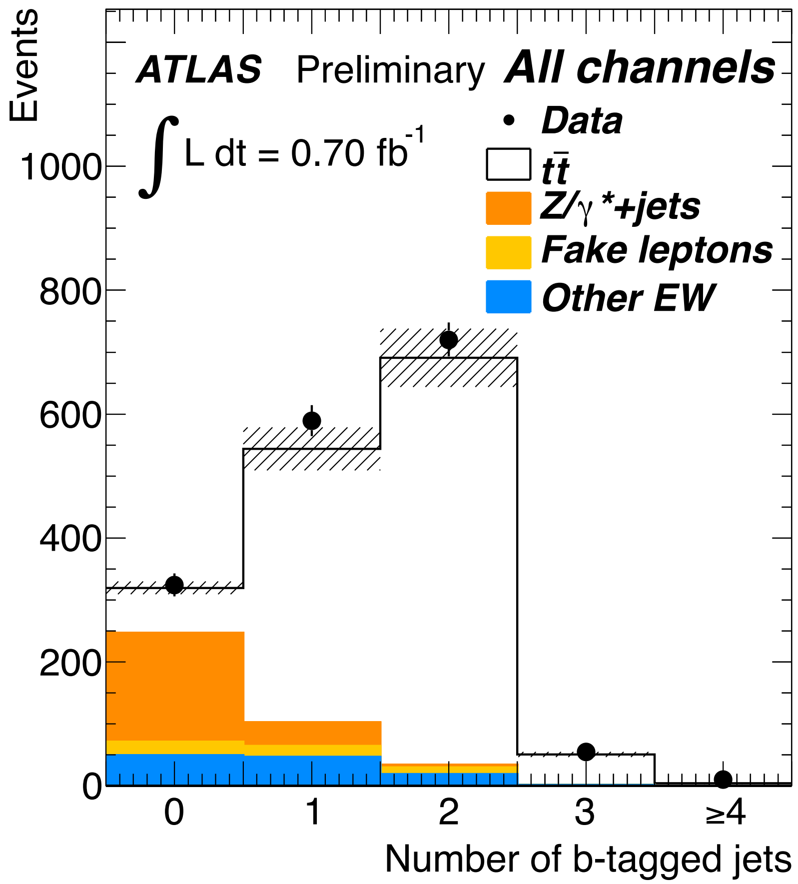
Source	Cont. to the $\sigma_{t\bar{t}}$(pb)	Cont. to the $\sigma_{t\bar{t}}$(%)
VV	0.4	0.2
Single top - tW	2.7	1.6
Drell-Yan $\tau\tau$	1.1	0.6
Drell-Yan ee, $\mu\mu$	0.8	0.5
QCD/W+jets leptons	1.2	0.7
Lepton efficiencies	3.7	2.2
Lepton selection model	6.8	4.0
Jet and $\not{E}_T$ energy scale	3.2	1.9
B-tagging	8.5	5.0
Pile-up	8.5	5.0
Branching ratio	2.9	1.7
Decay model	3.4	2.0
Event Q^2 scale	3.0	1.8
Top quark mass	2.8	1.6
Jet and $\not{E}_T$ model	1.3	0.8
Shower model	1.2	0.7
Total Systematic	16.3	9.6
Luminosity	7.6	4.5
Statistics	3.9	2.3

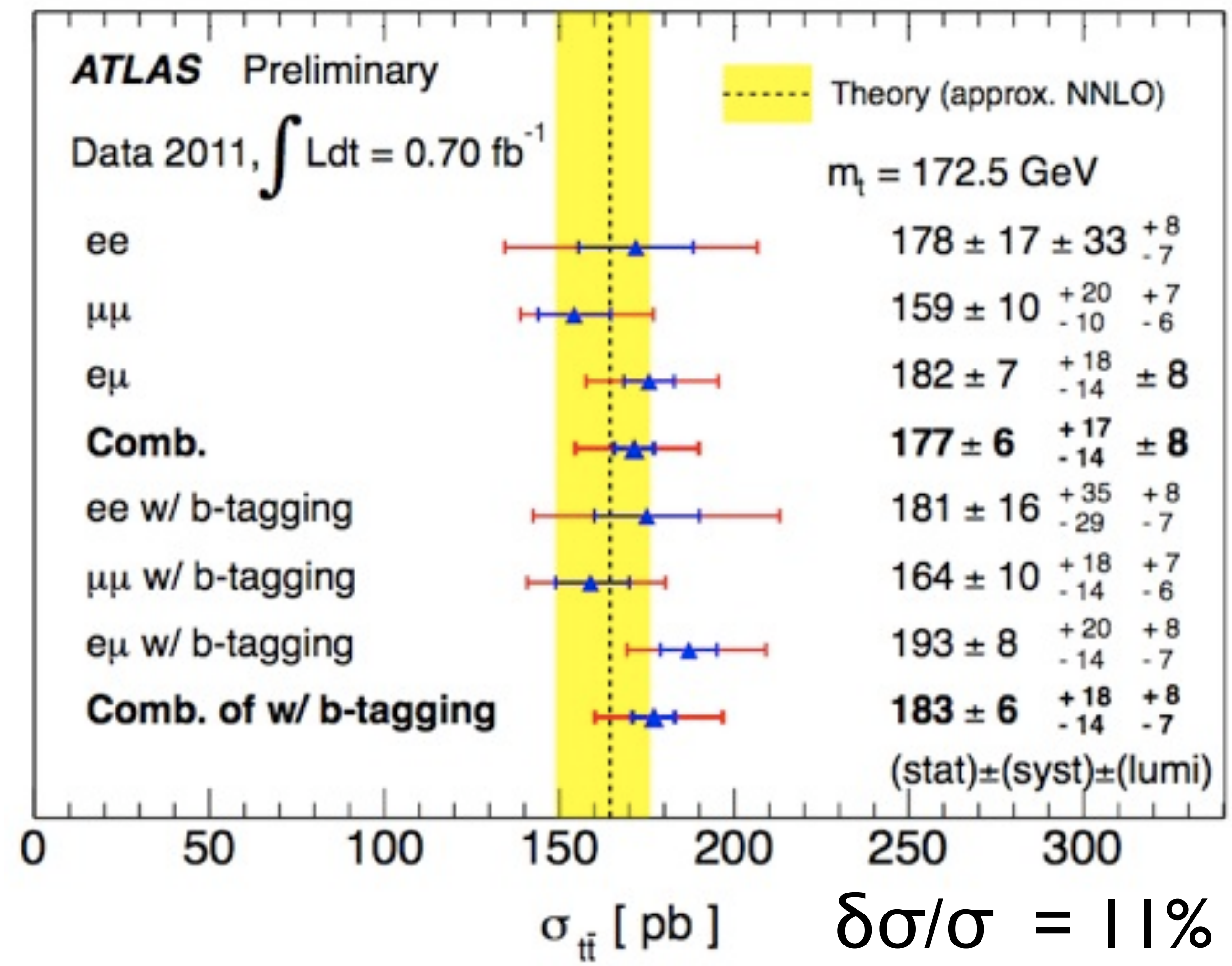
σ=169.9±3.9(stat.)±16.3(syst.)±7.6(lumi.)pb   δσ/σ = 10.8%

2010 data
σ =168 ± 18(stat.) ± 14(syst.) ± 7(lumi.)pb with 36 pb^{-1} : J. High Energy Phys. 07 (2011) 049
σ = 194 ± 72(stat.) ± 24(syst.) ± 21(lumi.) pb. with 3 pb^{-1} : Phys. Lett. B 695 (2011) 424-443

Dilepton (ATLAS)

(ATLAS-CONF-2011-100, 0.7fb^{-1})





$\delta\sigma/\sigma$ = 11%

$$\sigma_{t\bar{t}} = 177 \pm 6(\text{stat.})^{+17}_{-14}(\text{syst.}) \pm 8(\text{lum.})\ \text{pb}.$$

with b-tag

$$\sigma_{t\bar{t}} = 183 \pm 6(\text{stat.})^{+18}_{-14}(\text{syst.})^{+8}_{-7}(\text{lum.})\ \text{pb}.$$

- Analysis with/without b-tagging.
- Likelihood fitting
- Main systematic uncertainty
  - Jet energy scale
  - b-tagging efficiency

2010 data →

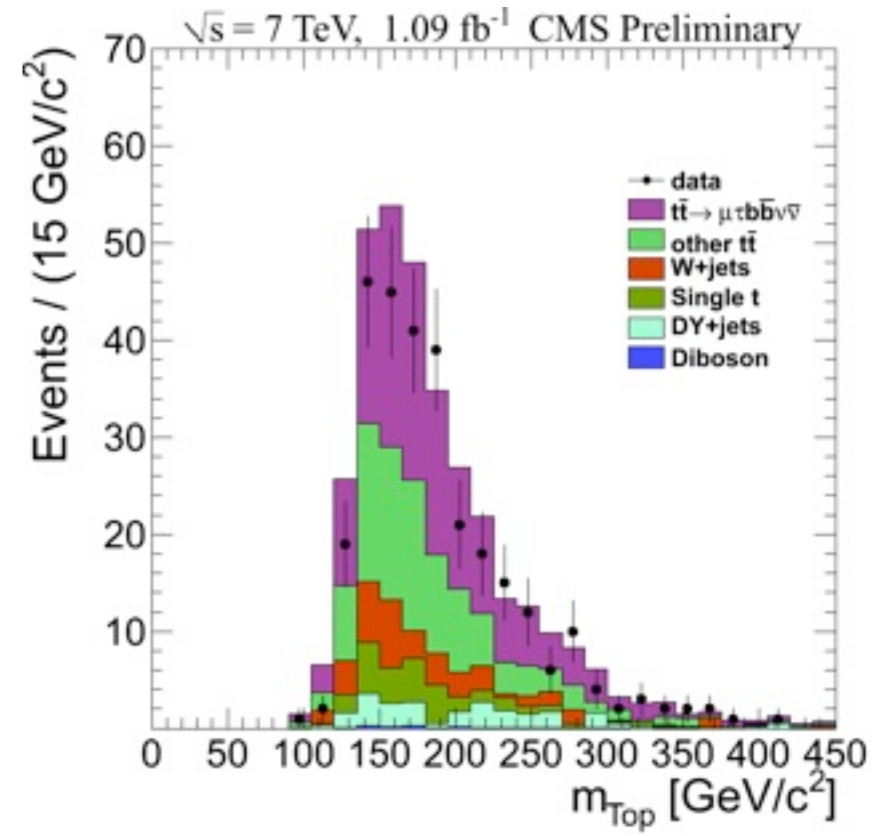
$$\sigma_{t\bar{t}} = 188 \pm 26(\text{stat.})^{+20}_{-16}(\text{syst.})^{+9}_{-7}(\text{lum.})\ \text{pb}$$

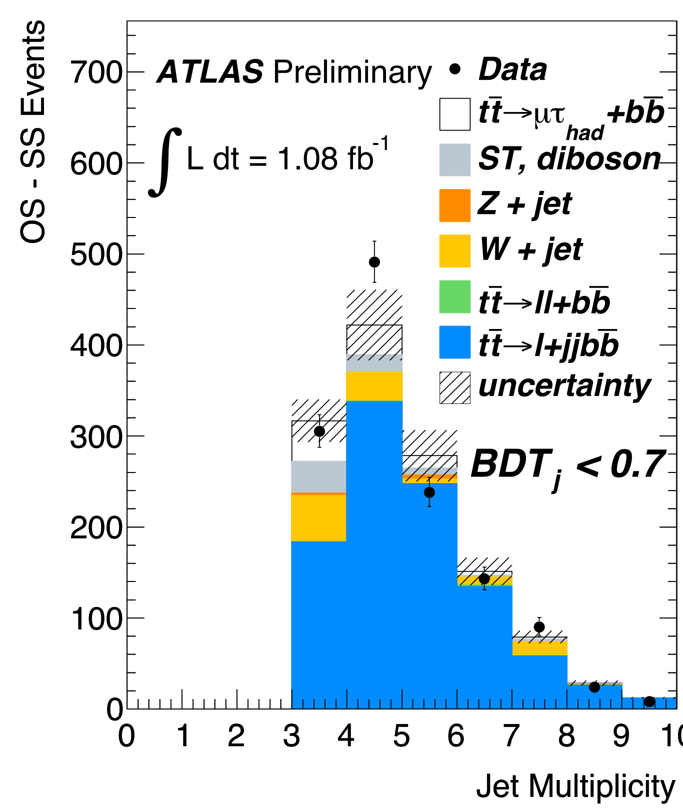
$$\sigma_{t\bar{t}} = 145 \pm 31\ ^{+42}_{-27}\ \text{pb}$$

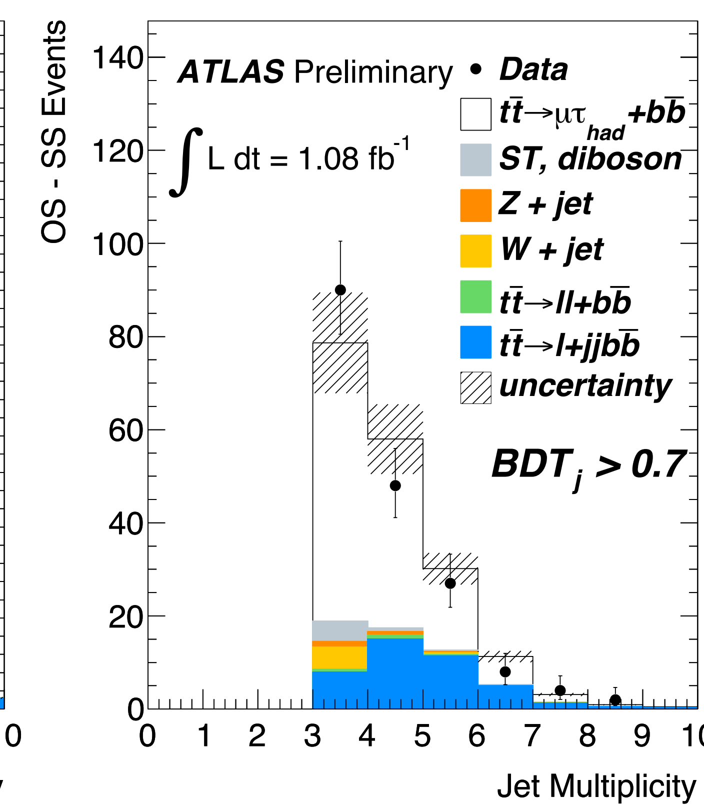
- Phys. Lett. B arXiv:1108.369
- EPJC 71 (2011) 1577

μ+tau decay mode

- H^+ (<top mass) can contribute.
- Tau identification
  - CMS - Hadrons plus strips (HPS) combining charged hadrons and EM particles in strips in calorimeter to take into account π^0
  - ATLAS - multivariate discriminate using Boosted Decision Tree identifying two tau candidates: τ_1 (1 track) and τ_3 (3 tracks)
- Event selection
  - Only one isolated muon p_T > 20/25 GeV (CMS/ATLAS)
  - At least two jets
  - MET > 40/30 GeV (CMS/ATLAS)
  - H_T > 200 GeV (ATLAS)
  - One b-tagging
  - At least one tau jet
  - Opposite sign of muon and tau jet



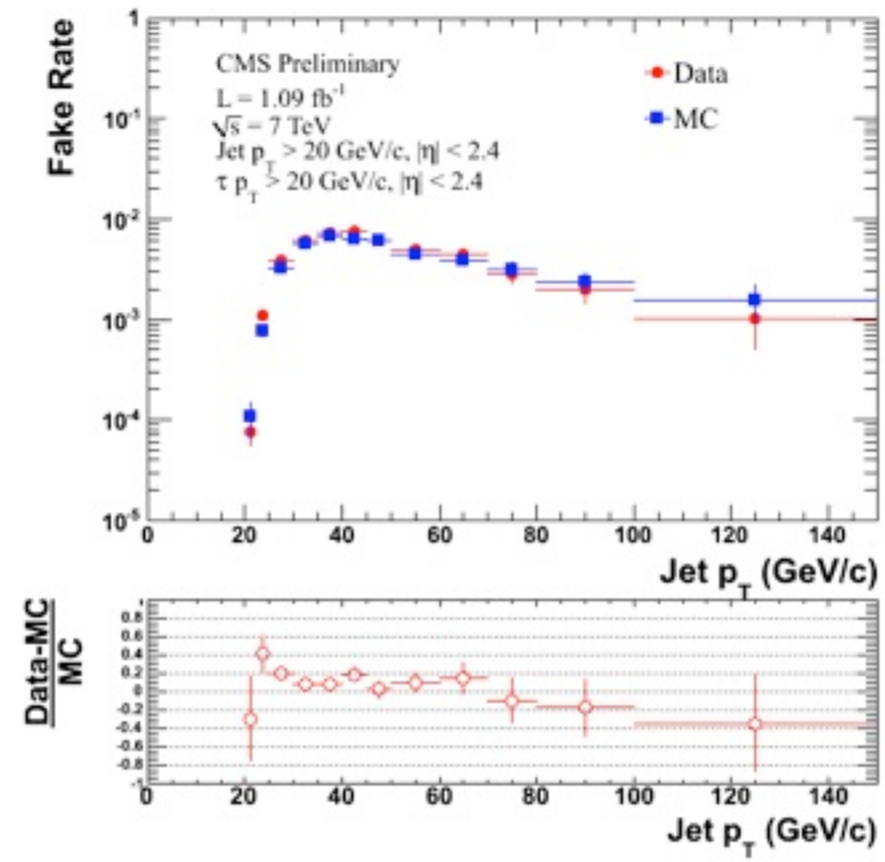




μ+tau (CMS)

(TOP-11-006 with 1.1 fb^{-1})

- Counting method
- Data-driven background estimation
  - The jet → tau fake rate is from enriched QCD (gluon jet) and W+jets (quark jet) data sample separately
  - Take average over two estimates
- Main systematic uncertainty
  - tau fake background estimation
  - tau id
  - b-tagging



	Uncertainties [%]
τ fake background	13.0
τ jet identification	7.3
b-jet tagging & jet→b mis-id	5.5
jet energy scale, jet energy resolution, E_T^{miss}	4.4
theoretical uncertainty on signal efficiency	4.0
pileup modeling	3.1
lepton selection	2.1
cross-section of MC backgrounds	1.6
luminosity	6.0

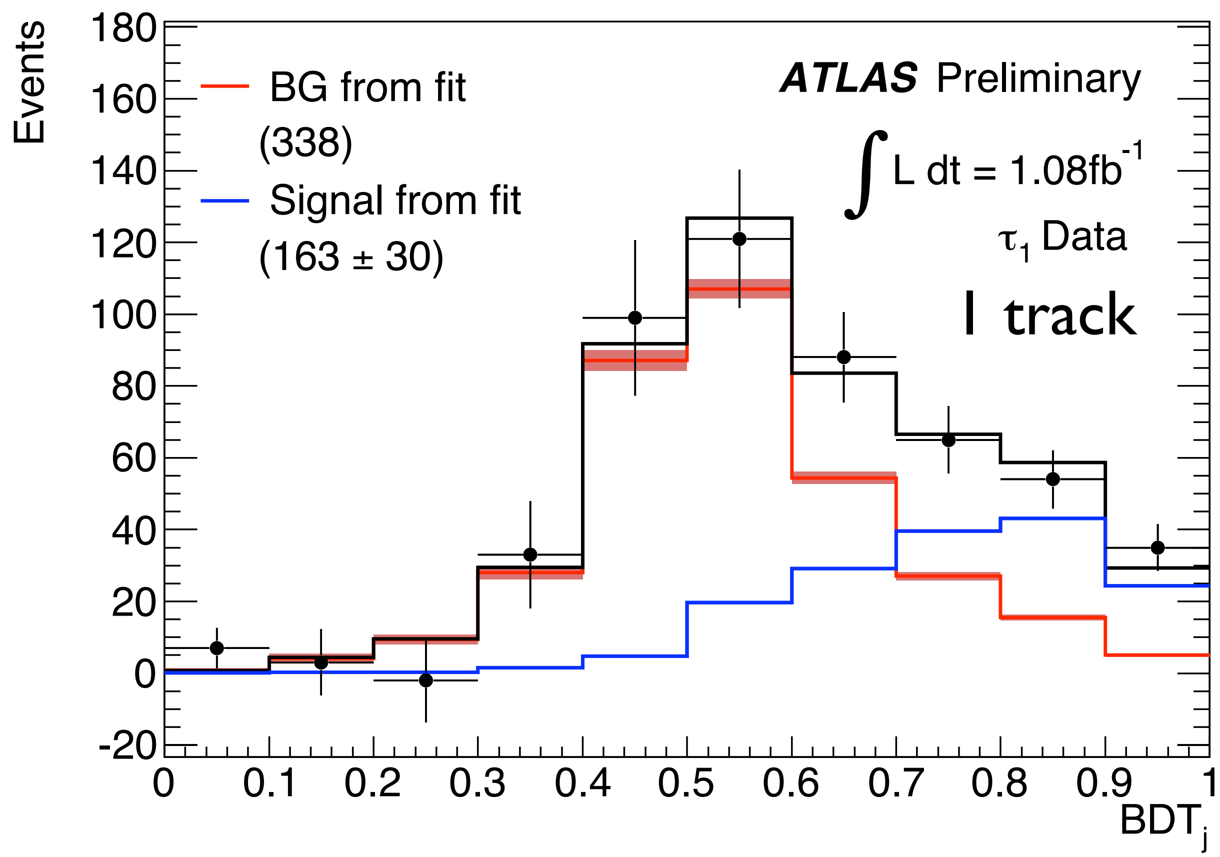
$\delta\sigma/\sigma = 24\%$

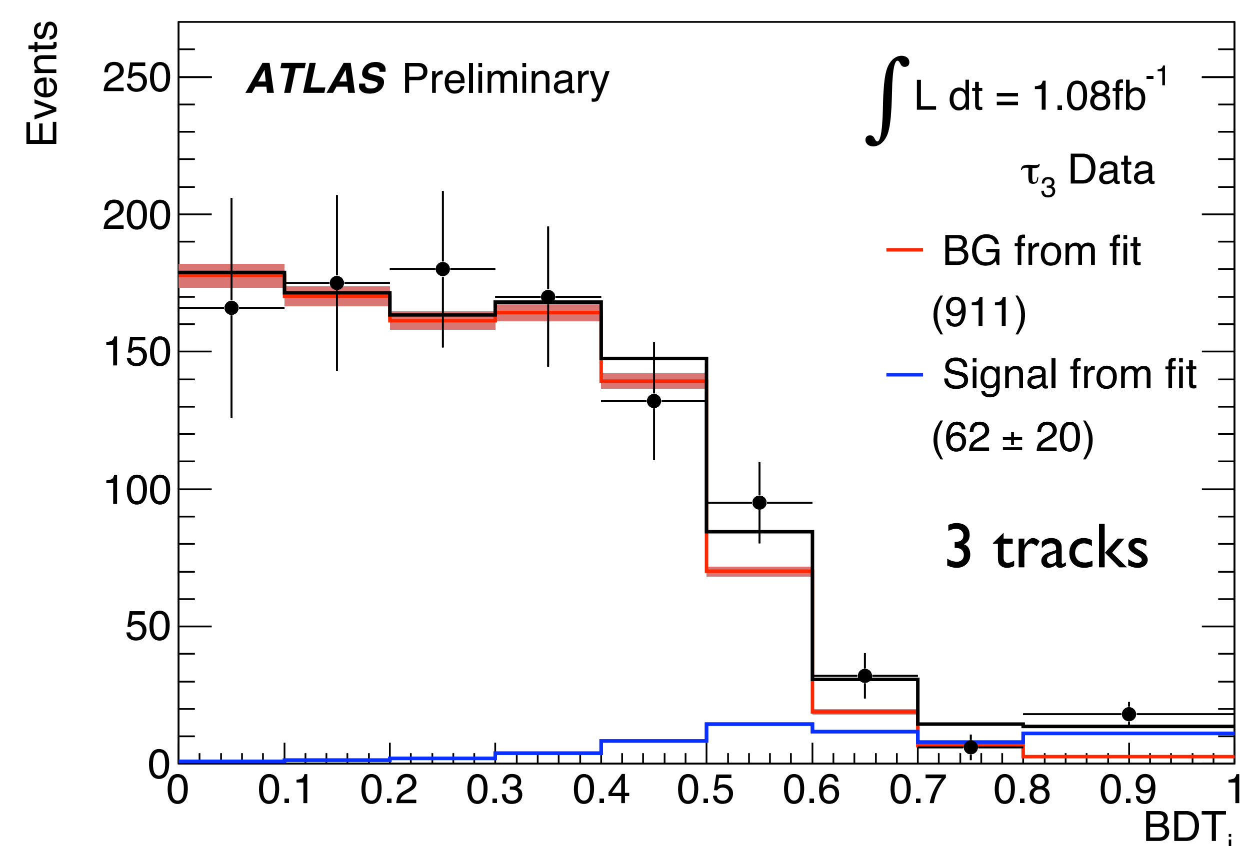
σ=148.7±23.6(stat.)±26.0(syst.)±8.9(lumi.)pb

μ+tau (ATLAS)

(ATLAS-CONF-2010-119 with 1.1 fb^{-1})

- Fitting to Boosted Decision Tree (BDT) distribution
- Opposite sign minus same sign BDT → reduce gluon contribution from QCD and W+jets





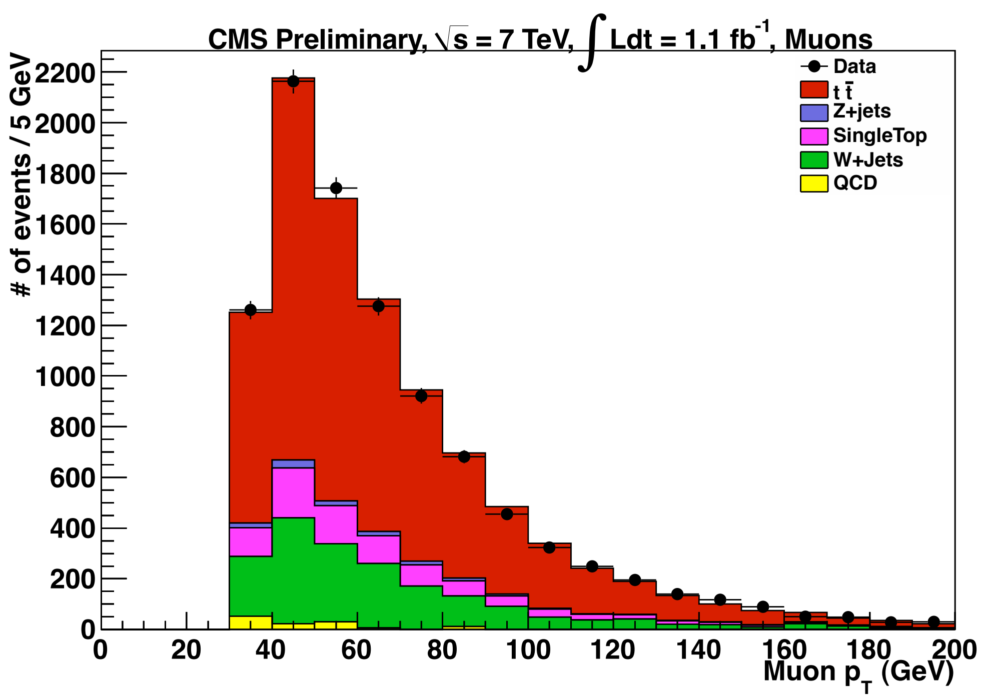
$$\sigma_{t\bar{t}} = 142 \pm 21 \text{ (stat.)} \pm^{20}_{16} \text{ (syst.)} \pm 5 \text{ (lumi.)} \quad \text{pb}$$

$\delta\sigma/\sigma = 21\%$

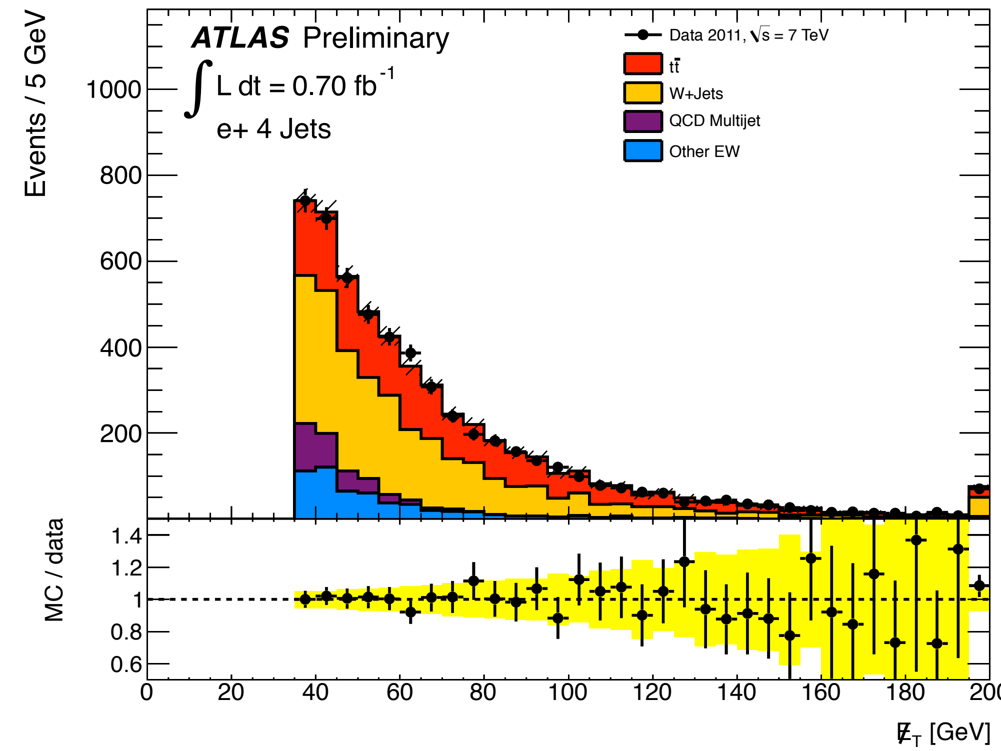
l+jets

CMS

- Event selection
  - Only one isolated lepton : p_T > 45/35 GeV (e/μ)
  - MET > 20/30 GeV (e/μ)
  - b-tagging (secondary vertex algorithm)
- QCD shape is from non-isolated data



$$m_T(W) = \sqrt{2p_T^\ell p_T^\nu(1 - \cos(\phi^\ell - \phi^\nu))}$$



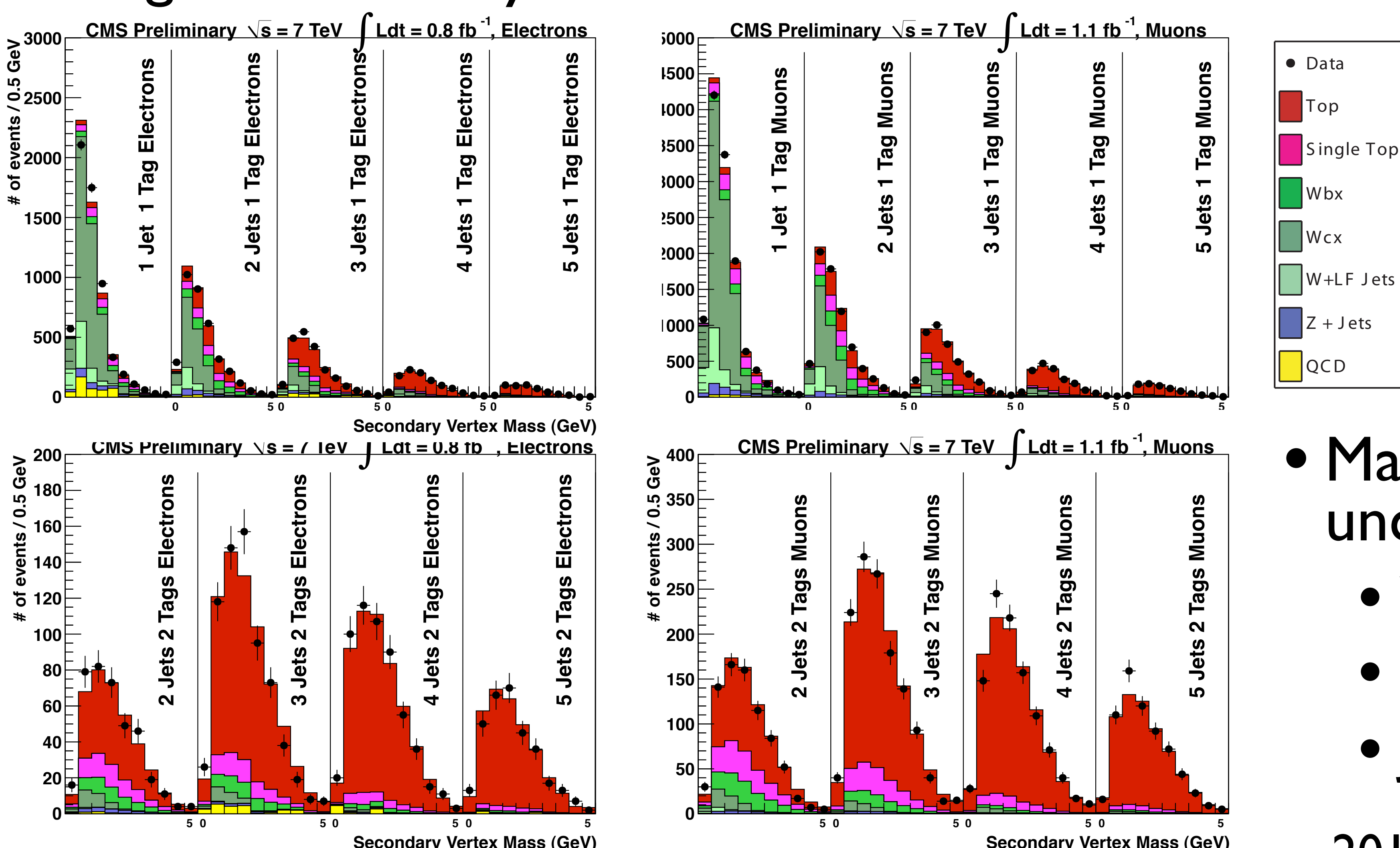
ATLAS

- Event selection
  - Only one isolated lepton : p_T > 25/20 GeV (e/μ)
  - MET > 35/25 GeV (e/μ)
  - $M_T(W)$ > 25 (e)
  - $M_T(W)$+MET> 60 GeV (μ)
- QCD shape is from data with Matrix method.

l+jets (CMS)

(TOP-11-003 with 0.8(e)/1.1(μ) fb^{-1})

- Binned profile likelihood fitting
- Fitting to secondary vertex mass distribution in 1 b-tag and 2 b-tag jet bins



- Main systematic uncertainties included in fit
  - W + jets Q^2
  - b-tagging efficiency
  - JES

2011 result $\delta\sigma/\sigma = 8.7\%$

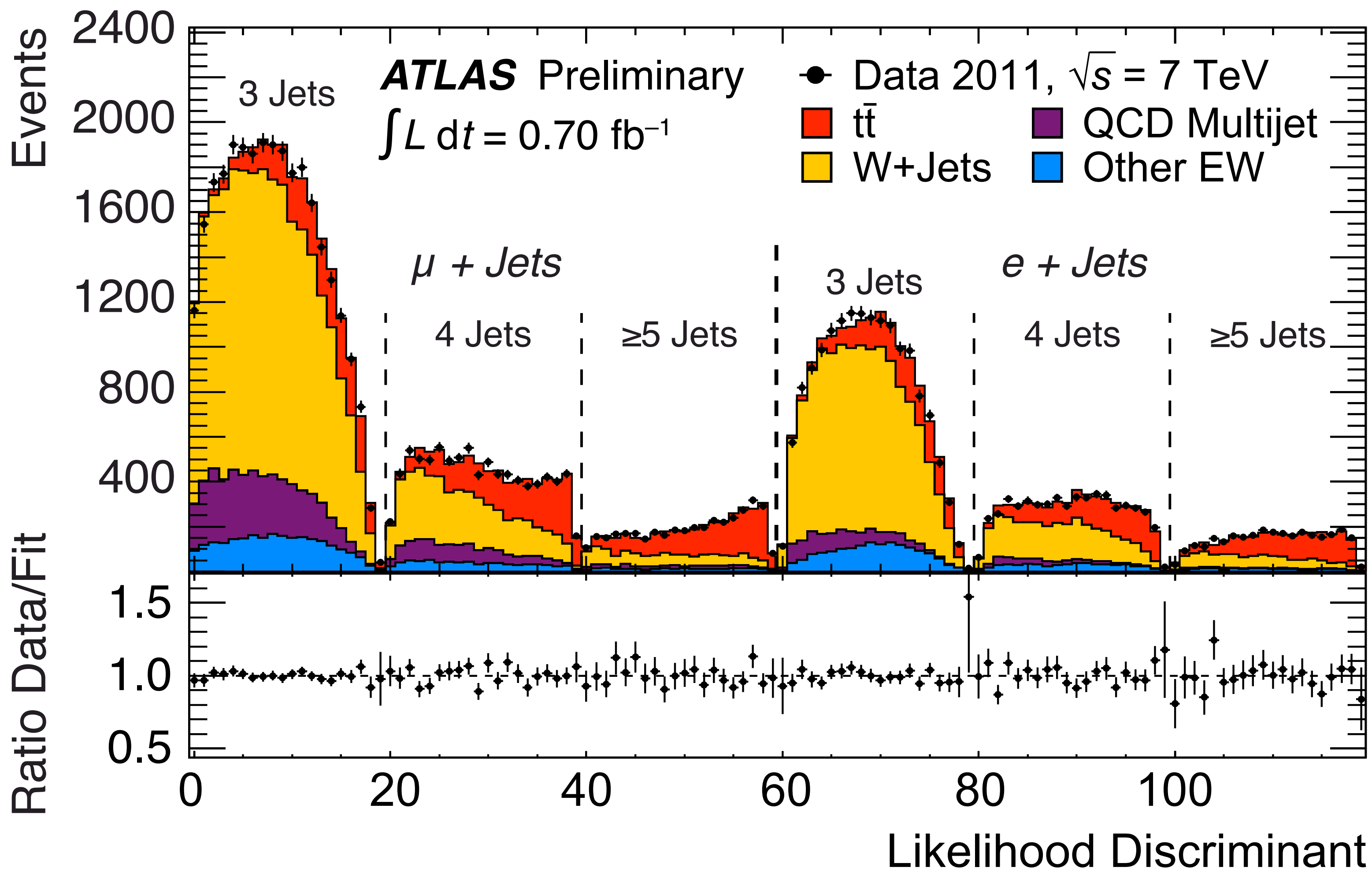
σ(mu)=163.2±3.4(stat.)±12.7(syst.)±7.3(lumi.)pb
σ(e)=163.0±4.4(stat.)±12.7(syst.)±7.3(lumi.) pb
σ(comb.)=164.4±2.8(stat.)±11.9(syst.)±7.4(lumi.) pb

2010 data

w/o b-tagging : Eur. Phys. J. C 71 (2011) 1721
w b-tagging : arXiv:1108.3773

l+jets (ATLAS)

(ATLAS-CONF-2011-121, 0.7 fb^{-1})



- Main systematic uncertainties
  - Signal MC generator
  - JES
  - ISR+FSR

Likelihood Discriminant : lepton eta, highest jet pt, event aplanarity, HT

$$\mathcal{L}(\vec{\beta},\vec{\delta}) = \prod_{k=1}^{120} \mathcal{P}(\mu_k, n_k) \times \prod_j \mathcal{G}(\beta_j, \Delta_j) \times \prod_i \mathcal{G}(\delta_i, 1)$$

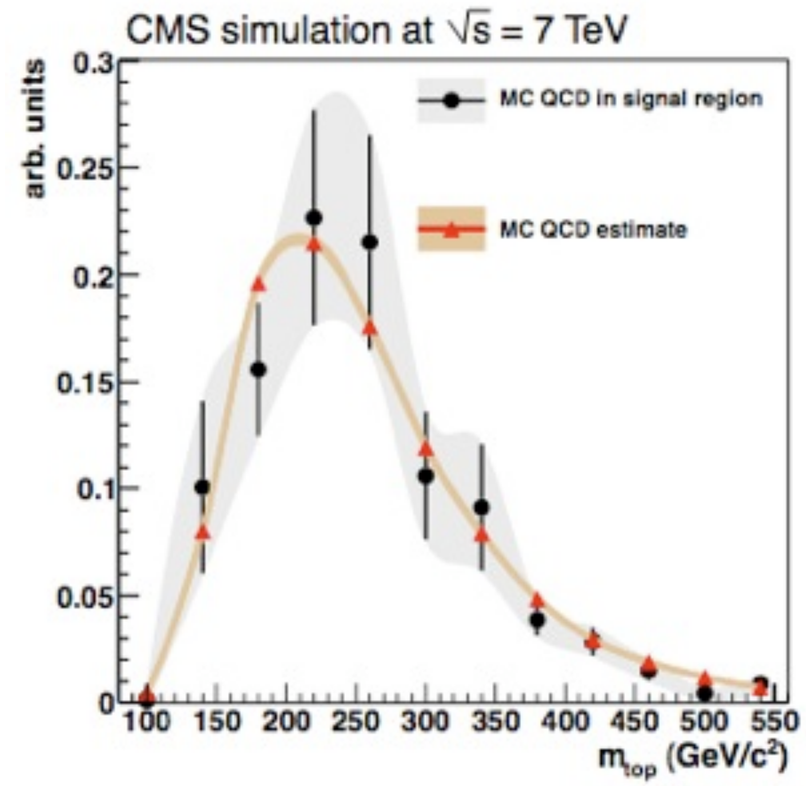
β=free parameter, δ=nuisance parameter

σ(comb.)=179.0±3.9(stat.)±9.0(syst.)±6.6(lumi.) pb

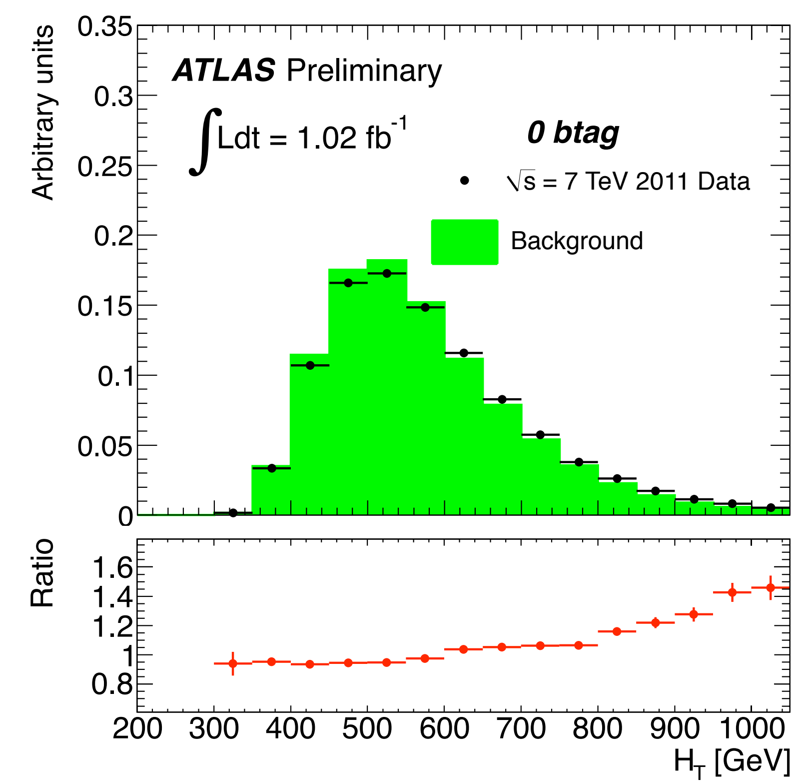
δσ/σ = 6.6%

Hadronic decay

- Branching ratio is large ~ 45 %
  - suffer from large multi jet background
- Event selection
  - 6 jets are required
  - at least two b-tagged jets
    - Simple secondary vertex with high purity (CMS) / JetFitterCombNN (ATLAS)
  - MET significance : $MET/\sqrt{H_T} < 3$ (ATLAS)
  - dR(b, bbar) > 1.2 (ATLAS)
    - to remove gluon splitting

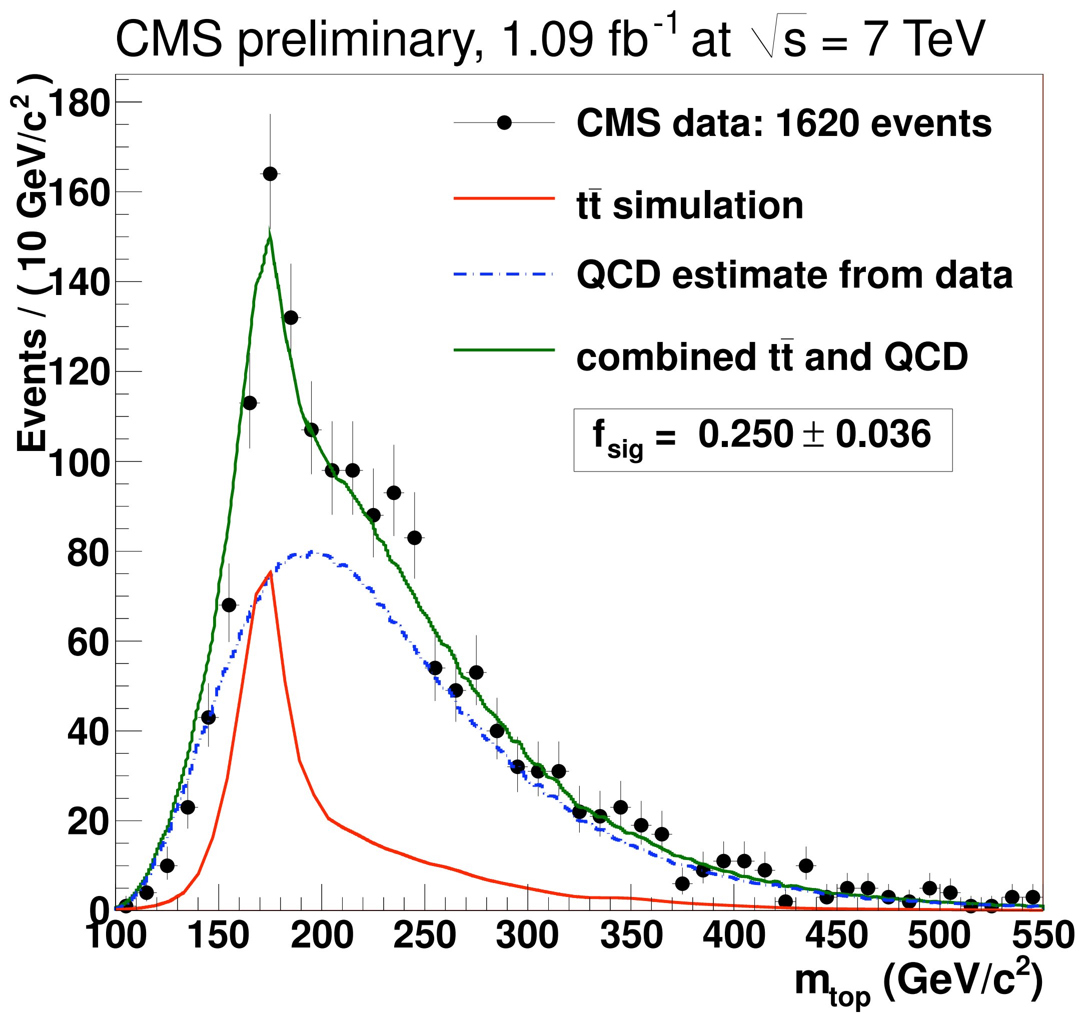


- QCD contribution from data
  - CMS : scale factor from non b-tagged jet sample (more than 6 jets) to b-tagged jets as a function of p_T and η.
  - ATLAS : Event mixing technique - model higher jet multiplicity using lower jet-multiplicity multi-jet sample.



Hadronic decay (CMS)

(TOP-11-007 with $1.1 fb^{-1}$)



Source	Relative Uncertainty (%)
B-Tagging	15.7
Jet Energy Scale	13.5
Background	12.2
Q^2 Scale	8.7
Tune	8.1
ISR/FSR	5.6
Top Quark Mass	5.3
Parton Shower Matching	5.2
Jet Energy Resolution	4.8
Trigger	4.5
Pile-Up	0.6
Systematic	29.1
Statistical	14.3
Luminosity	6.0
Total Uncertainty	33.0

- Unbinned maximum likelihood fit to extract number of signal.

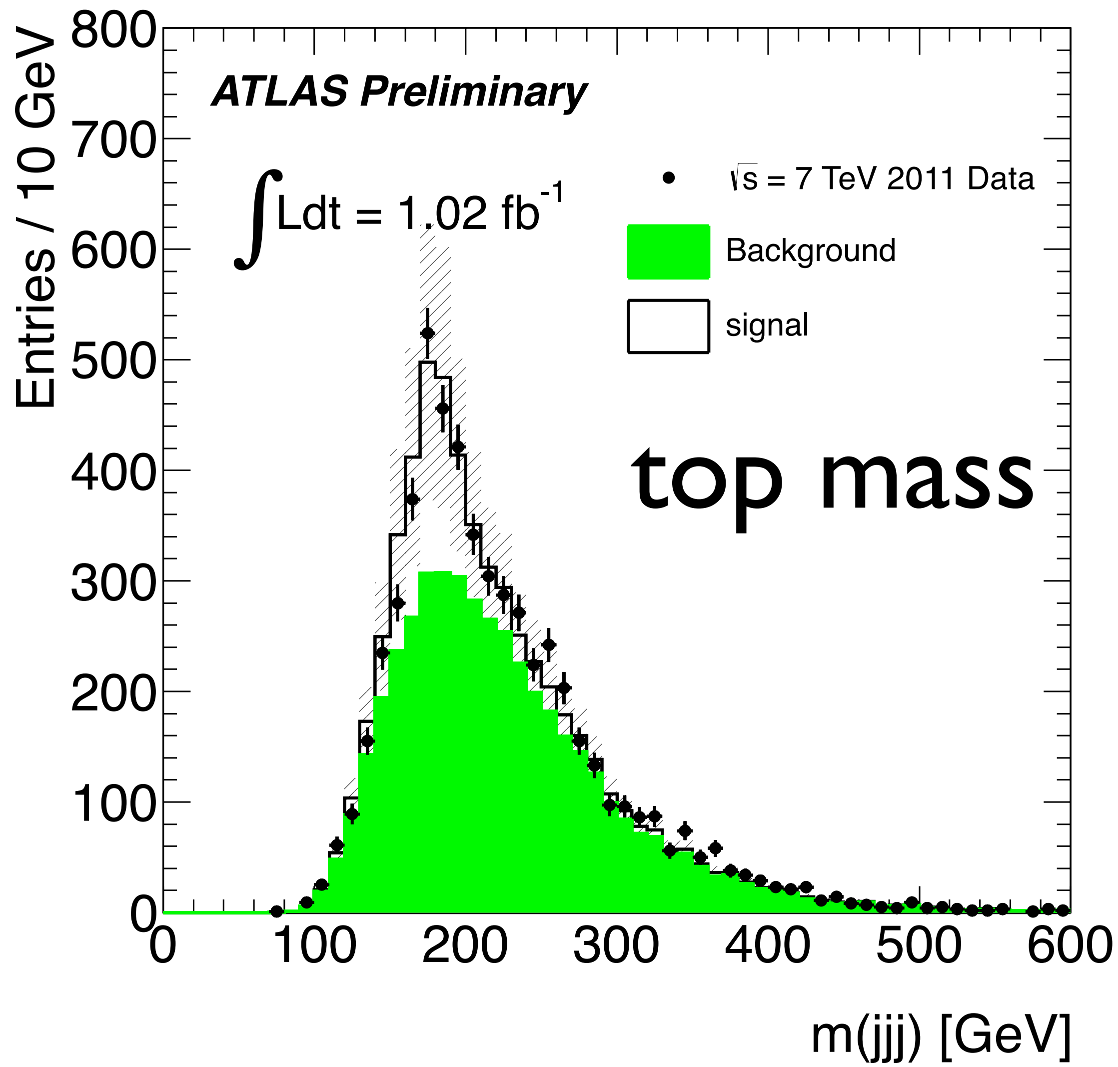
$\delta\sigma/\sigma = 33\ \%$

σ=136±20(stat.)±40(syst.)±8(lumi.)pb

- Uncertainty mainly from
  - b-tagging
  - jet energy scale
  - background estimation.

Hadronic decay (ATLAS)

(ATLAS-CONF-2010-140 with 1.02 fb^{-1})



Source of uncertainty	Event Mixing (%)	ABCD (%)
Jet energy scale	24.2	13.7
Jet reconstruction efficiency	0.1	0.3
Jet energy resolution	13.5	6.8
Multi-jet trigger	10.0	10.0
LAr readout problem	0.6	0.3
b-tagging	23.0	30.0
Generator (PS., Hadronisation)	5.4	13.0
ISR, FSR	23.4	10.0
PDF	8.6	8.6
Luminosity	3.7	3.7
Multi-jet modelling	12.1	30.0
Total	46.7	49.9

↑ cross check : ABCD method

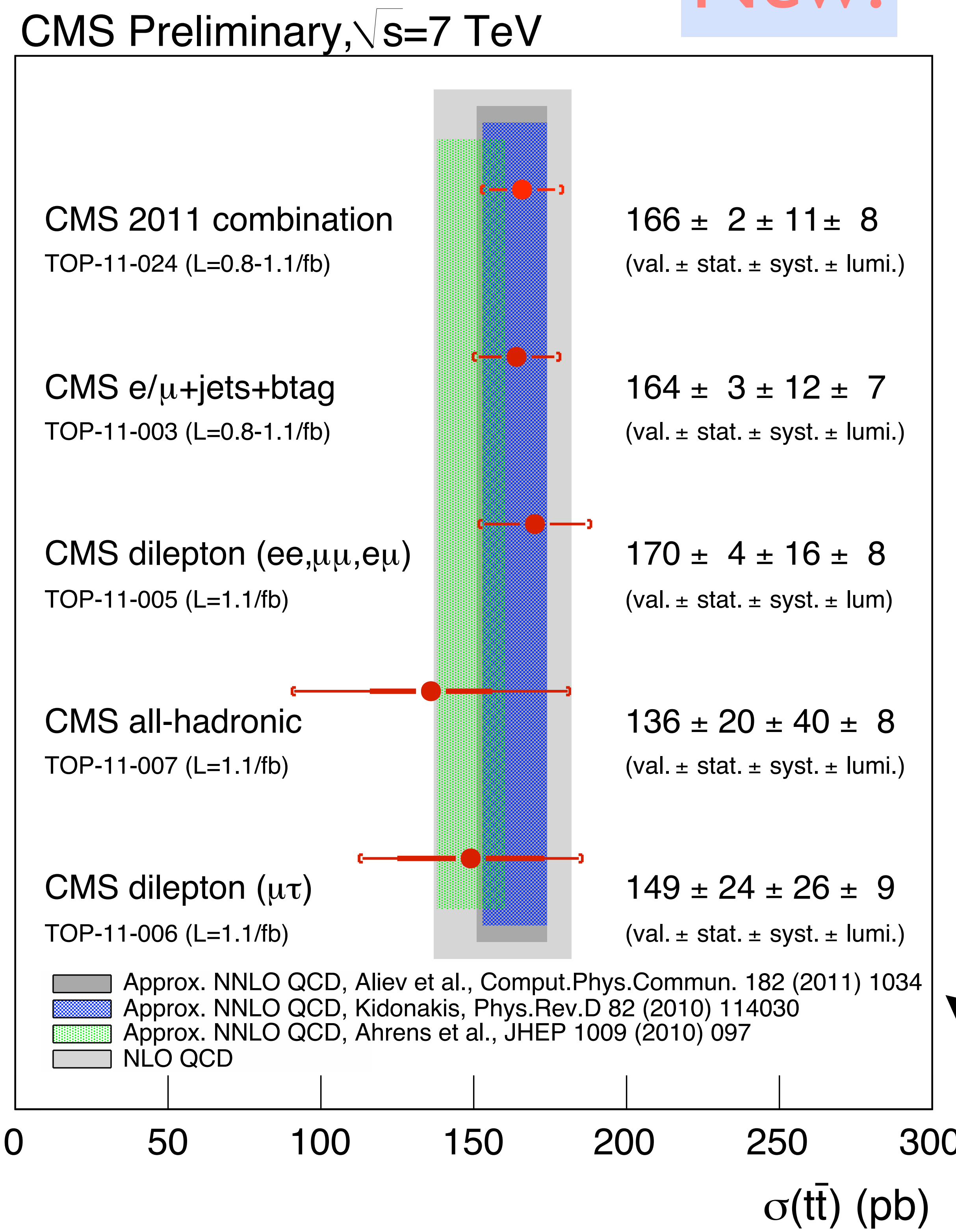
- Uncertainty mainly from
  - jet energy scale
  - b-tagging
  - ISR, FSR

- The number of signal is extracted from the fitting to mass χ^2

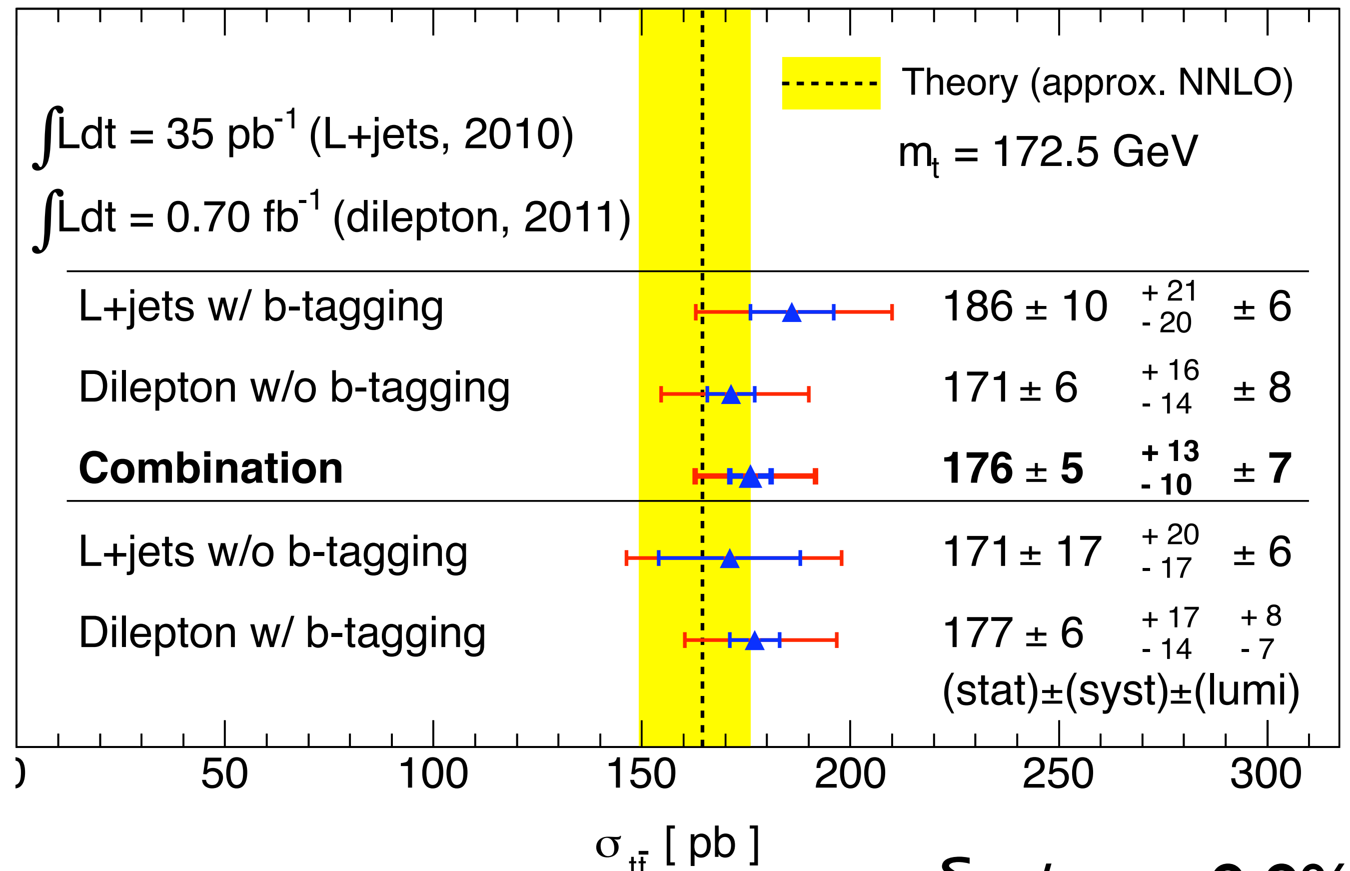
$\sigma = 167 \pm 18(\text{stat.}) \pm 78(\text{syst.}) \pm 6(\text{lumi.})\,\text{pb}$ $\quad \delta\sigma/\sigma = 48\%$

Combined cross section

(CMS-TOP-11-024) New!



(ATLAS-CONF-2011-108)



$\delta\sigma/\sigma = 8.8\%$

$$176 \pm 5(\text{stat.}) \pm {}^{13}_{10}(\text{syst.}) \pm 7(\text{lumi})$$

$\delta\sigma/\sigma = 8\%$

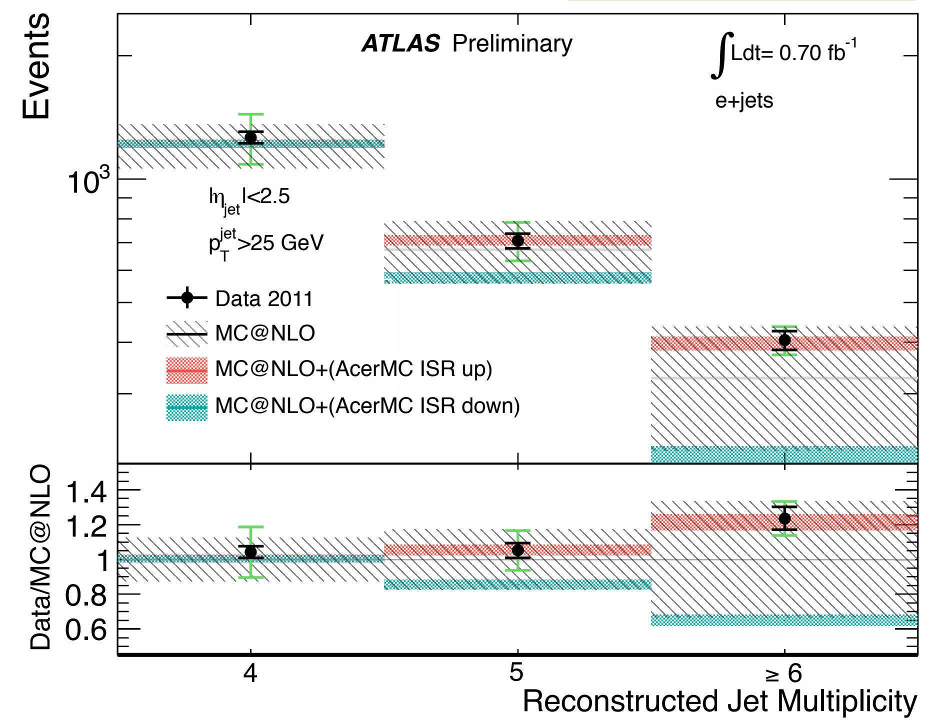
$$\sigma_{t\bar{t}} = 165.8 \pm 2.2(\text{stat.}) \pm 10.6(\text{syst}) \pm 7.8(\text{lumi.})\ \text{pb}$$

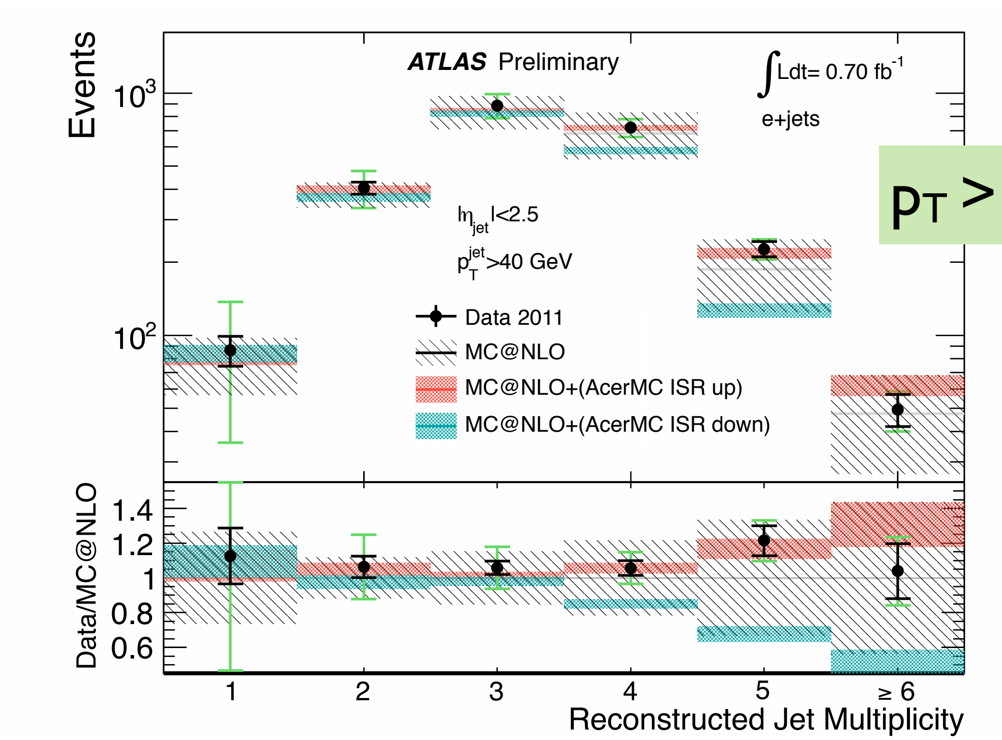
Jet multiplicity in ttbar (ATLAS)

(ATLAS-CONF-2011-142 with 0.7 fb^{-1})

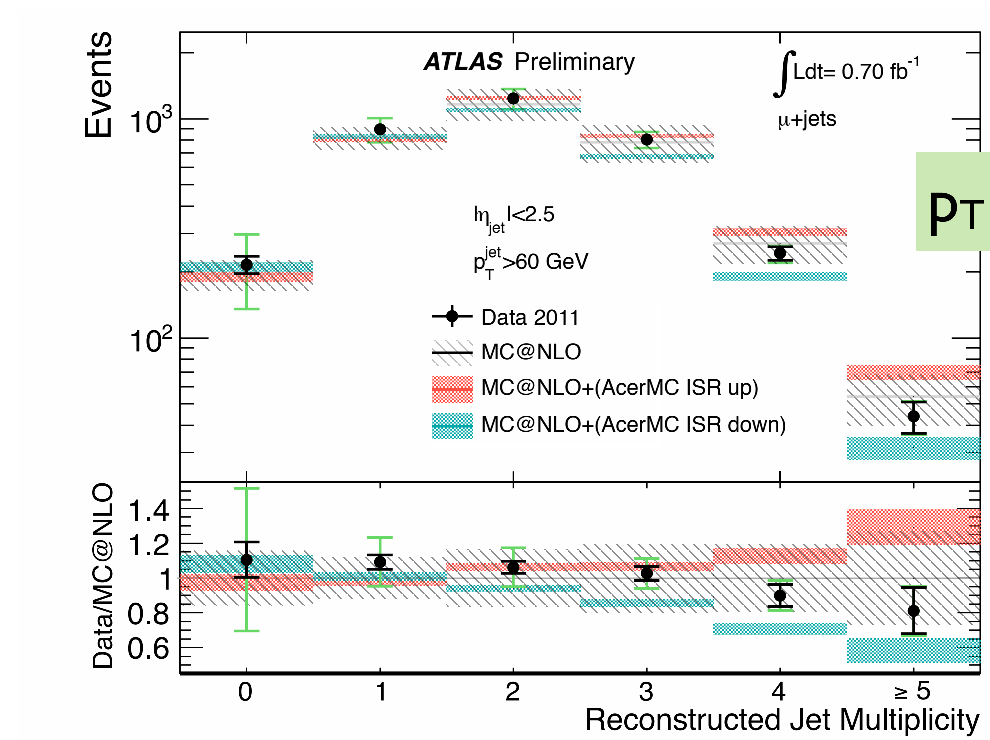
p_T > 25 GeV

- Jet multiplicity with additional jets as a function of the jet pT.
- Useful to constrain initial state radiation.
- Performed in l+jets channel only
- Event selection following l+jets cross section analysis with at least 4 jets and one b-tagging (SV0 algorithm)
- The background-subtracted reconstructed jet multiplicity compared with MC ISR variations.





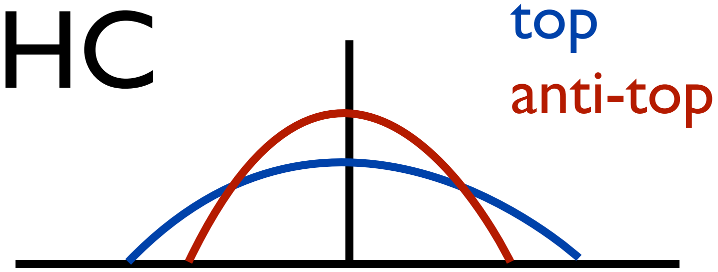
p_T > 40 GeV



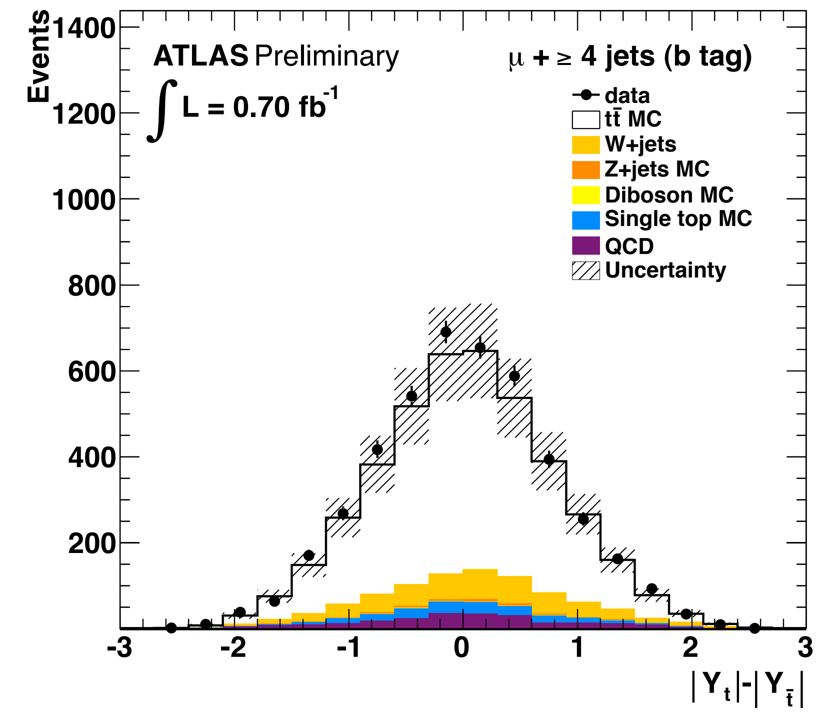
p_T > 60 GeV

Charge Asymmetry

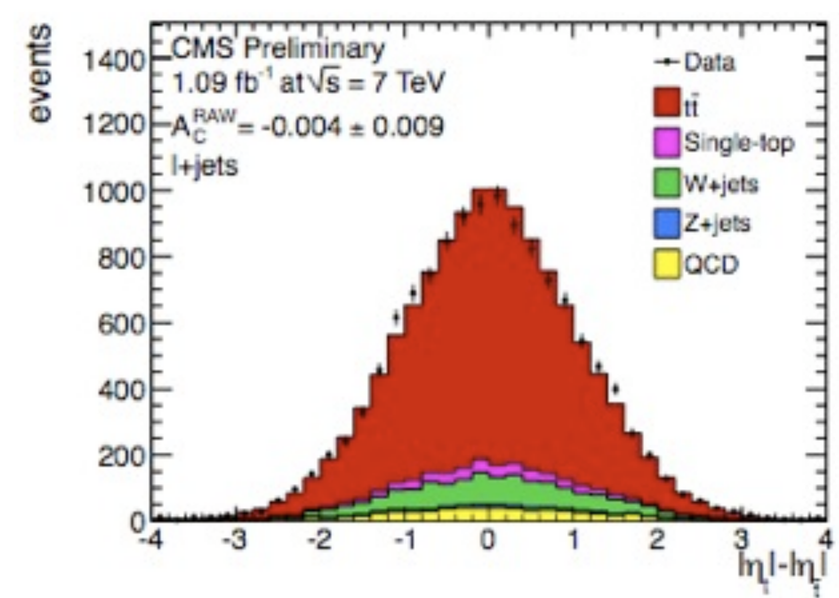
- CDF has already observed 3.4 sigma deviation with respect to SM above 450 GeV.
- Could be explained by possible new exchange particles in t-channel from various theory paper.
- Charge asymmetry is sensitive to this additional production mode.
- Variables LHC



  - CMS $$\Delta|\eta| = |\eta_t| - |\eta_{\bar{t}}|$$ $$\Delta y^2 = (y_t - y_{\bar{t}}) \times (y_t + y_{\bar{t}})$$
  - ATLAS $$\Delta|y| = |y_t| - |y_{\bar{t}}|$$
- Event selection follows l+jets analysis requiring 4 jets and one b-tag.



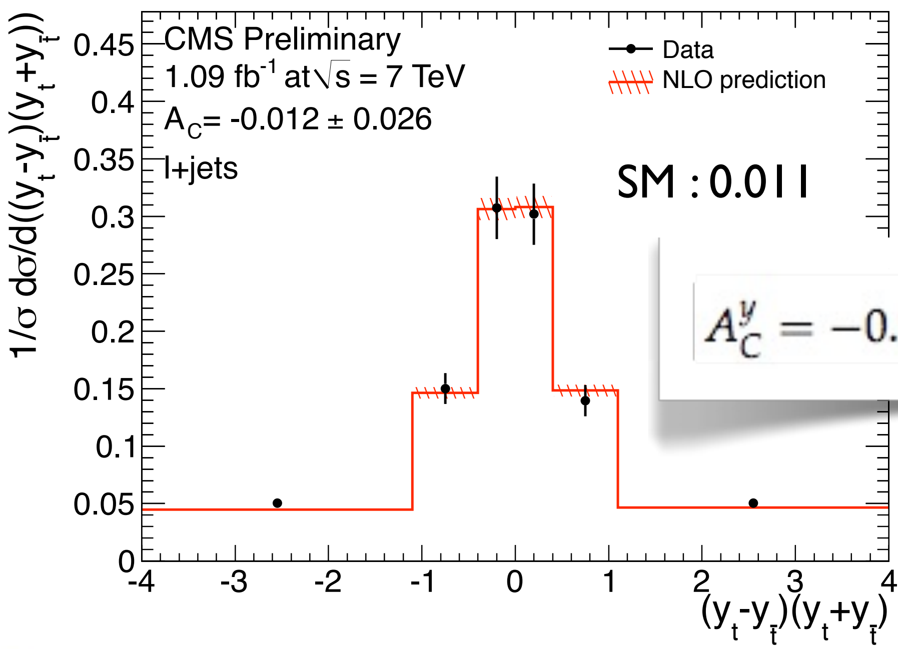
$$A_C = \frac{N(\Delta|Y| > 0) - N(\Delta|Y| < 0)}{N(\Delta|Y| > 0) + N(\Delta|Y| < 0)}$$



CMS-PAS-TOP-10-010 with 36 pb^{-1}

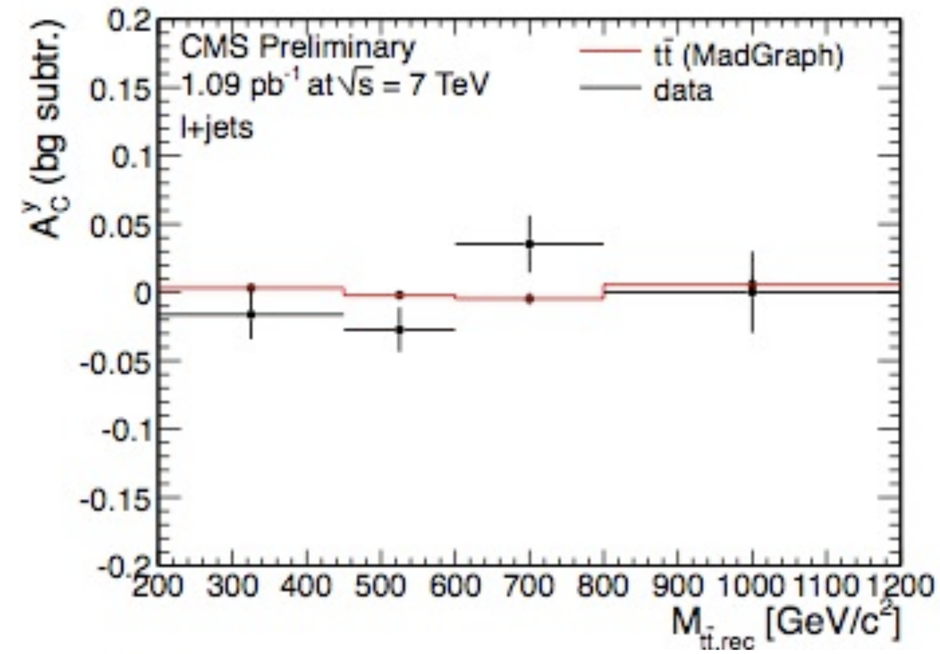
Charge Asymmetry (CMS)

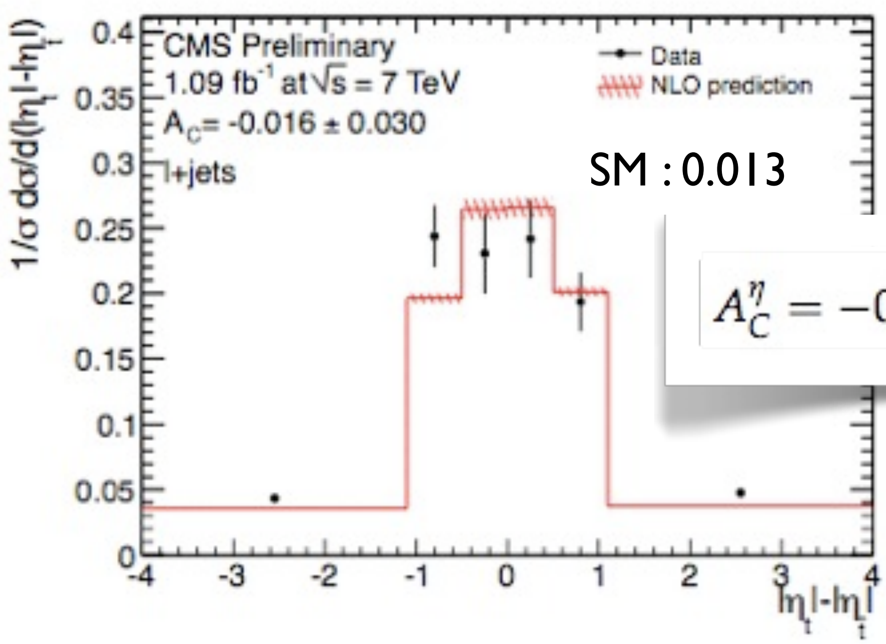
(TOP-11-014 with 1.1 fb^{-1})



SM : 0.011

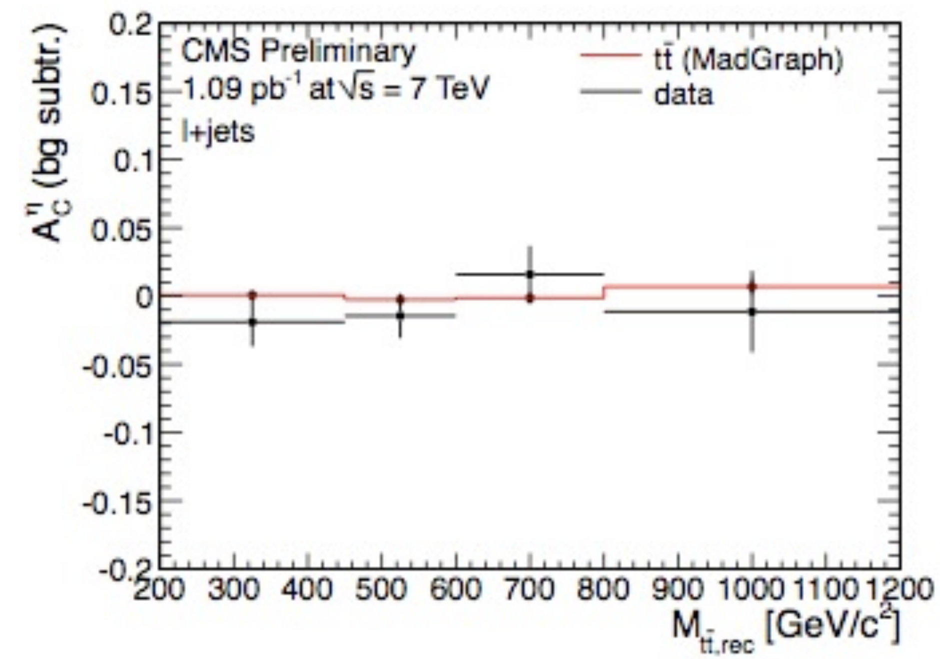
$$A_C^y = -0.013 \pm 0.026\ (\text{stat.})^{+0.026}_{-0.021}(\text{syst.})$$





SM : 0.013

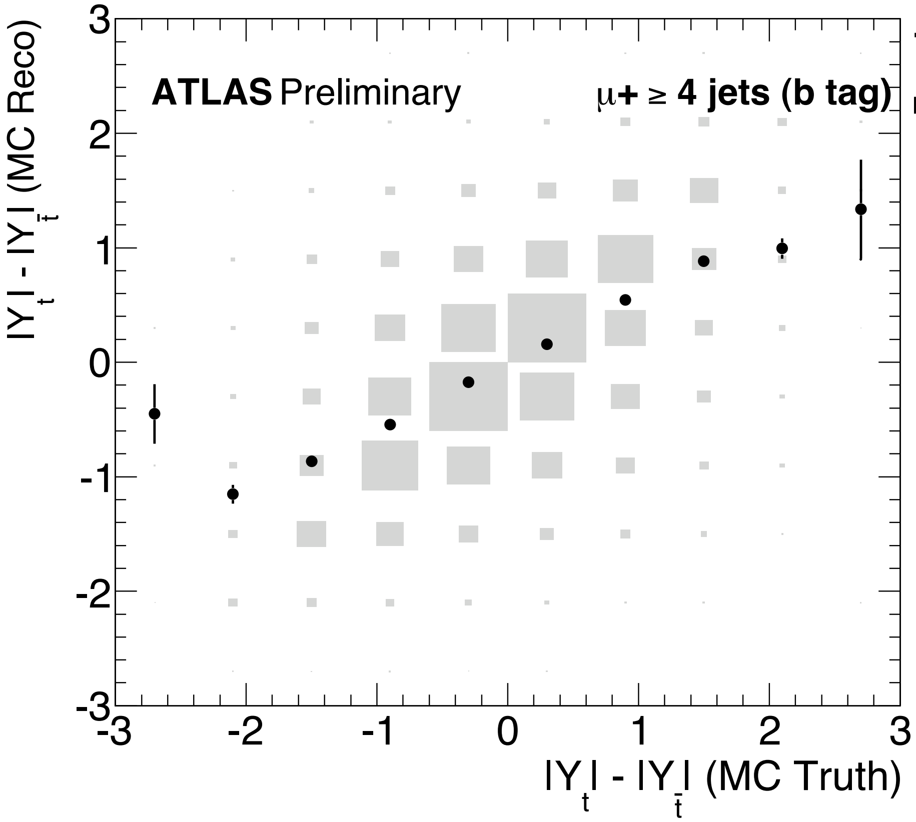
$$A_C^\eta = -0.016 \pm 0.030\ (\text{stat.})^{+0.010}_{-0.019}(\text{syst.})$$

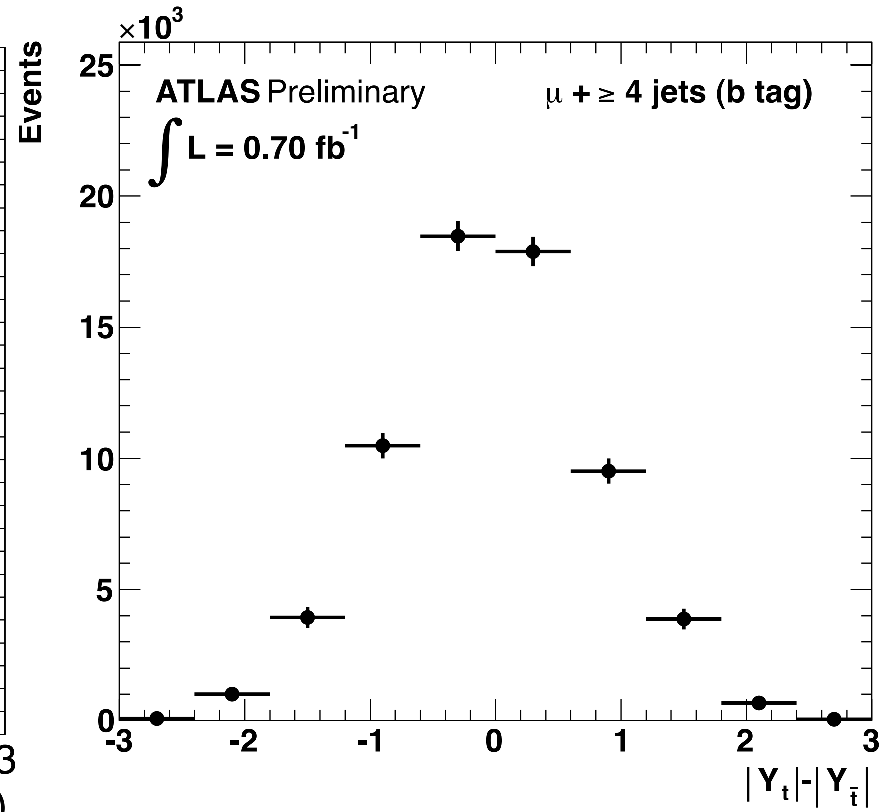


- Regularized unfolding
- Consistent with SM prediction
- No deviation was found above 450 GeV.
- Need unfolding with M_{ttbar}

Charge Asymmetry (ATLAS)

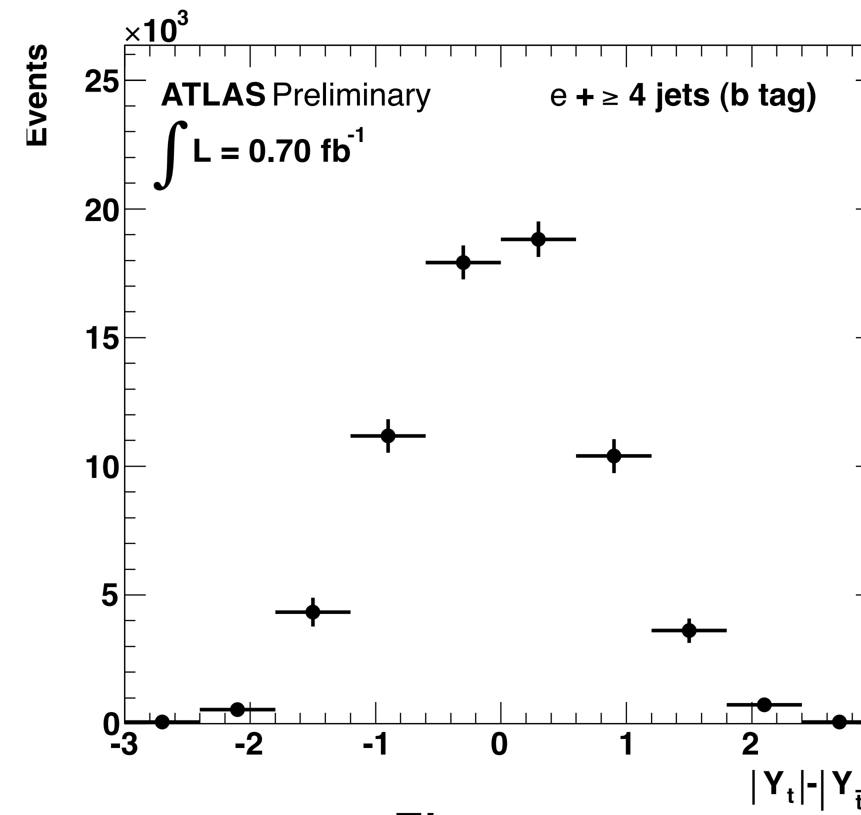
(ATLAS-CONF-2010-119 with 0.7 fb^{-1})





Muon

$$A_C = -0.028 \pm 0.019\,(\text{stat.}) \pm 0.022\,(\text{syst.})$$



Electron

$$A_C = -0.009 \pm 0.023\,(\text{stat.}) \pm 0.032\,(\text{syst.})$$

- Matrix method for QCD estimation
- Bayesian Unfolding

Combined

A_c = 0.006 MC@NLO

$$A_C = -0.024 \pm 0.016\,(\text{stat.}) \pm 0.023\,(\text{syst.})$$

Conclusion

- CMS and ATLAS have produced precise measurements in the dilepton and l+jets channels
- These measurements are already systematically limited, starting to constrain theory
- First measurements in fully hadronic decays and decays with tau
- Covering most of all possible decay modes
- Measurement of charge asymmetry, as yet consistent with SM.

- Improve pileup modeling and b-tagging to reduce systematic uncertainty.

- Differential cross section measurement coming soon!

Dilepton

(TOP-11-005)

Source	ee	$\mu\mu$	$e\mu$
Dilepton $t\bar{t}$	$427.5 \pm 19.7 \pm 44.5$	$559.3 \pm 22.9 \pm 56.3$	$1487.2 \pm 37.3 \pm 139.2$
VV	$2.6 \pm 1.6 \pm 0.8$	$3.4 \pm 1.9 \pm 1.1$	$6.9 \pm 2.6 \pm 2.2$
Single top - tW	$22.9 \pm 4.8 \pm 7.3$	$28.9 \pm 5.4 \pm 9.2$	$73.4 \pm 8.6 \pm 23.3$
Drell-Yan $\tau\tau$	$6.9 \pm 2.6 \pm 2.2$	$8.8 \pm 3.0 \pm 2.9$	$27.3 \pm 5.2 \pm 8.8$
Drell-Yan ee, $\mu\mu$	$38.2 \pm 4.3 \pm 19.1$	$50.5 \pm 5.1 \pm 25.2$	-
QCD/W+jets	2.9 ± 4.3(tot.)	7.6 ± 4.7(tot.)	30.0 ± 12.0(tot.)
Total background	73.6 ± 22.2(tot.)	99.1 ± 28.6(tot.)	137.6 ± 29.6(tot.)
Data	589	688	1742
Cross section, pb	$189.9 \pm 8.9 \pm 21.4 \pm 8.5$	$165.8 \pm 7.4 \pm 18.5 \pm 7.5$	$169.9 \pm 4.4 \pm 16.2 \pm 7.6$

(ATLAS-CONF-2011-100)

	ee	$\mu\mu$	$e\mu$	b-tag ee	b-tag $\mu\mu$	b-tag $e\mu$
$Z/\gamma^*(\rightarrow ee/\mu\mu)$+jets	$3.8^{+2.5}_{-1.2}$	14.8 ± 4.7	-	$9.3^{+3.7}_{-1.9}$	$19.1^{+2.4}_{-1.6}$	-
$Z/\gamma^*(\rightarrow \tau\tau)$+jets	5.2 ± 2.6	11.2 ± 4.8	43 ± 16	$1.6^{+1.1}_{-0.9}$	$7.0^{+2.8}_{-3.2}$	$9.1^{+3.6}_{-3.7}$
Fake leptons	3.1 ± 2.2	$0.3^{+0.6}_{-0.3}$	44 ± 24	4.9 ± 3.1	1.0 ± 0.8	19 ± 12
Single top quarks	6.6 ± 1.2	16.2 ± 2.0	40.9 ± 5.6	$6.8^{+1.3}_{-1.2}$	$15.4^{+2.5}_{-2.4}$	$30.8^{+4.9}_{-4.5}$
Diboson	5.6 ± 1.0	8.2 ± 1.2	30.9 ± 4.6	2.1 ± 0.8	$2.7^{+0.9}_{-0.6}$	$8.7^{+1.5}_{-1.3}$
Total bkg.	$24.3^{+5.4}_{-4.7}$	50.8 ± 8.4	158 ± 34	$24.7^{+5.2}_{-4.0}$	$45.2^{+4.6}_{-4.4}$	68 ± 14
Predicted $t\bar{t}$	130 ± 16	243^{+22}_{-27}	728 ± 59	161 ± 21	304^{+29}_{-37}	644^{+60}_{-74}
Total	154 ± 17	294^{+23}_{-28}	886 ± 68	186 ± 21	349^{+30}_{-37}	712^{+61}_{-75}
Observed	165	287	962	202	349	823

l+jets

(ATLAS-CONF-2011-121)

Uncertainty	up (pb)	down (pb)	up (%)	down (%)
Statistical	3.9	−3.9	2.2	−2.2
Detector simulation				
Jets	3.2	−4.3	1.8	−2.4
Muon	4.1	−4.1	2.3	−2.3
Electron	2.7	−3.0	1.5	−1.7
$E_{\mathrm{T}}^{\mathrm{miss}}$	2.0	−1.6	1.1	−0.9
Signal model				
Generator*)	5.4	−5.4	3.0	−3.0
Hadronization*)	0.9	−0.9	0.5	−0.5
ISR/FSR	3.0	−2.3	1.7	−1.3
PDF*)	1.8	−1.8	1.0	−1.0
Background model				
QCD shape*)	0.7	−0.7	0.4	−0.4
W shape*)	0.9	−0.9	0.5	−0.5
Monte Carlo statistics*)	3.2	−3.2	1.8	−1.8
Systematic	9.0	−9.0	5.0	−5.0
Stat. & Syst.	9.8	−9.8	5.4	−5.4
Luminosity	6.6	−6.6	3.7	−3.7
Total	11.8	−11.8	6.6	−6.6

(TOP-11-003)

Source	Muon Analysis	Electron Analysis	Combined Analysis
Quantity	Uncertainty (%)		
Lepton ID/reco/trigger	3.4	3	3.4
$\not\!\!E_{\mathrm{T}}$ resolution due to unclustered energy	< 1	< 1	< 1
$t\bar{t}$+jets Q^2 scale	2	2	2
ISR/FSR	2	2	2
ME to PS matching	2	2	2
Pile-up	2.5	2.6	2.6
PDF	3.4	3.4	3.4
Profile Likelihood Parameter	Uncertainty (%)		
Jet energy scale and resolution	4.2	4.2	3.1
b-tag efficiency	3.3	3.4	2.4
W+jets Q^2 scale	0.9	0.8	0.7
Combined	7.8	7.8	7.3

μ+tau

(ATLAS-CONF-2010-119)

Systematic source	τ_1		τ_3	
	$\Delta\mathcal{A}/\mathcal{A}$ by -1σ	$\Delta\mathcal{A}/\mathcal{A}$ by $+1\sigma$	$\Delta\mathcal{A}/\mathcal{A}$ by -1σ	$\Delta\mathcal{A}/\mathcal{A}$ by $+1\sigma$
Muon p_T smearing (ID)	+0.7%	+0.6%	+0.4%	+0.9%
Muon p_T smearing (MS)	+0.3%	+0.6%	+0.0%	+1.3%
Muon SF (id/Trigger)	+0.6%	+0.4%	+0.4%	+0.4%
Jet energy scale	−2.2%	+2.5%	−3.4%	+1.7%
Jet ident. efficiency	−0.5%	+0.5%	−0.4%	+0.4%
ISR/FSR	−8.2%	+0.0%	−9.1%	+3.6%
Generator	−3.4%	+3.6%	−3.4%	+3.6%
b−tag SF	−8.4%	+7.9%	−7.6%	+7.1%
TauID	−5.8%	+9.5%	−7.8%	+8.8%
Total	−14%	+11%	−14%	+12%

(TOP-11-006)

Source	Events (± stat. ± syst.)
$t\bar{t} \to WbWb \to \mu\nu b\ \tau\nu b$	$152.7 \pm 2.8 \pm 16.6$
τ fakes	$163.0 \pm 9.7 \pm 17.3$
other $t\bar{t}$	$12.7 \pm 0.8 \pm 2.6$
$Z/\gamma^* \to ee, \mu\mu$	$0.7 \pm 0.5 \pm 0.5$
$Z/\gamma^* \to \tau\tau$	$30.9 \pm 3.6 \pm 5.8$
Single top	$13.8 \pm 0.7 \pm 2.0$
VV	$2.4 \pm 0.2 \pm 0.3$
Total expected	$376.4 \pm 10.8 \pm 29.7$
Data	361

Charge Asymmetry

(TOP-11-014)

Observable	Raw A_C	BG-subtracted A_C	Unfolded (and corrected) A_C
$\Delta\|\eta\|$	-0.004 ± 0.009	-0.009 ± 0.010	$-0.016 \pm 0.030^{+0.010}_{-0.019}$
$\Delta(y^2)$	-0.004 ± 0.009	-0.007 ± 0.010	$-0.013 \pm 0.026^{+0.026}_{-0.021}$

(ATLAS-CONF-2010-119)

Asymmetry	detector unfolded	detector and acceptance unfolded
A_C (muon pretag)	-0.020 ± 0.026 (stat.) ± 0.062 (syst.)	-0.016 ± 0.028 (stat.) ± 0.064 (syst.)
A_C (muon b-tag)	-0.030 ± 0.021 (stat.) ± 0.020 (syst.)	-0.028 ± 0.019 (stat.) ± 0.022 (syst.)
A_C (electron pretag)	-0.017 ± 0.031 (stat.) ± 0.067 (syst.)	-0.023 ± 0.034 (stat.) ± 0.065 (syst.)
A_C (electron b-tag)	-0.012 ± 0.026 (stat.) ± 0.030 (syst.)	-0.009 ± 0.023 (stat.) ± 0.032 (syst.)