Prospects for Top Physics at the start-up LHC

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DESY

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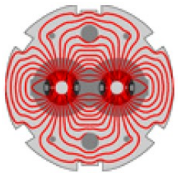
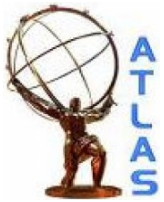
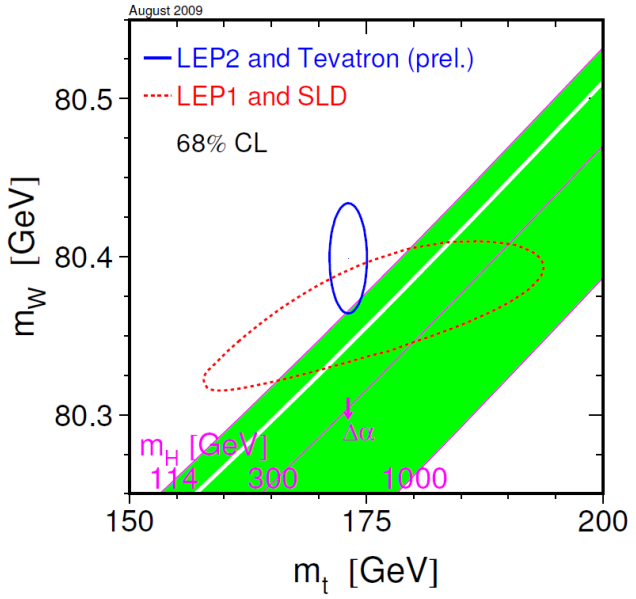




Motivation for Top Physics at the LHC

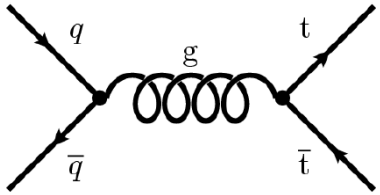
- Precision measurement of Standard Model (SM) parameters
  - Top-pair cross-section measurements first stepping stone to new physics
    - Many models of beyond SM physics have same signatures
  - Single-top cross-section measurement gives direct handle on V_{tb}
    - Cross-section is proportional to V_{tb}^2
  - Mass measurement gives handle on SM Higgs mass
    - Via radiative correction in m_W term

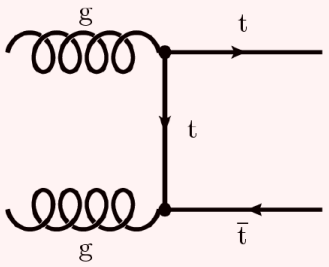
- General interest
  - Top is a major background for new physics
  - New physics might manifest itself in top
  - Top topologies can be used to understand your detector

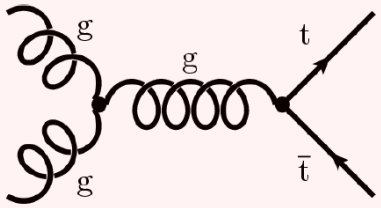


Top-Quark Production at the LHC

- Top-pair production via strong interaction
  - Cross-section: ~ **850 pb at 14 TeV**, ~ **400 pb at 10 TeV**
  - Rate: **1 Hz at 10^{33} $cm^{-2}s^{-1}$** (nominal low luminosity)

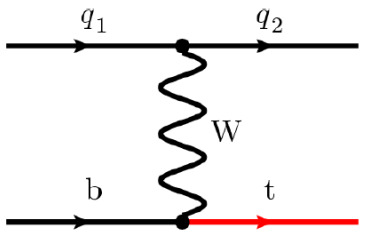




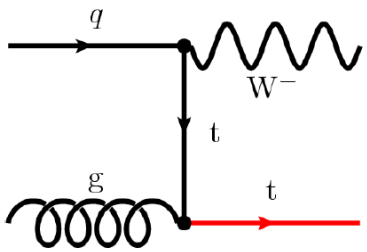


90% at the 14 TeV LHC

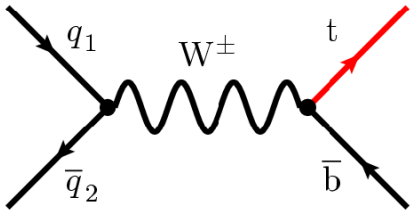
- Single-top production via electro-weak interaction
  - Cross-section: ~ **320 pb at 14 TeV** (t-channel ~250 pb, W+t-channel ~ 60 pb, s-channel ~ 10 pb)
  - Direct **sensitivity on V_{tb}**



t-channel



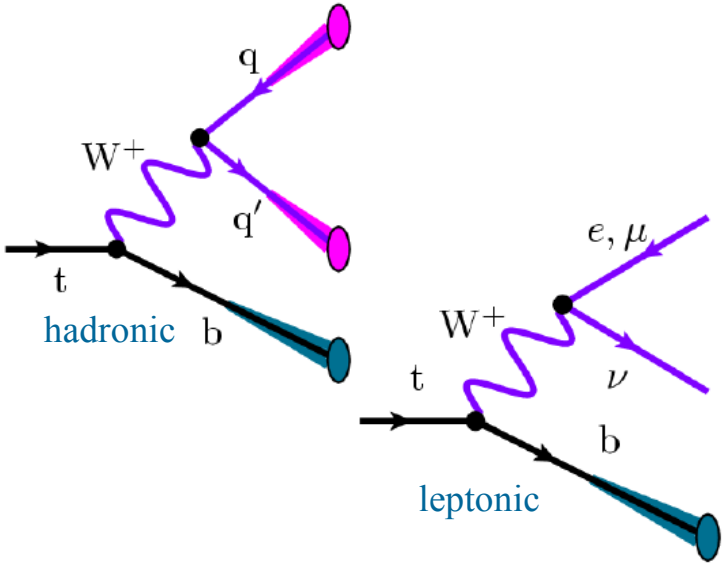
W+t-channel



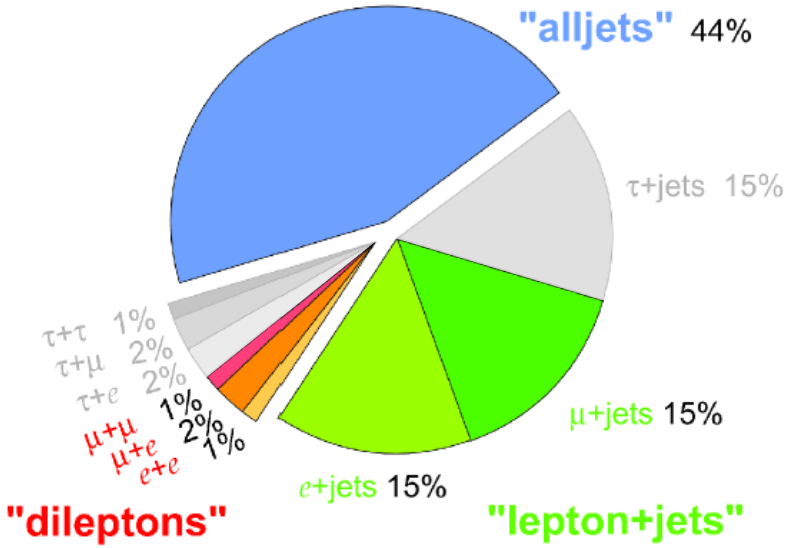
s-channel

Top Reconstruction

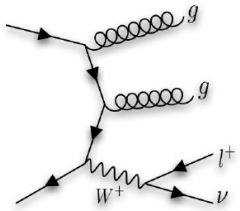
- Top decay modes

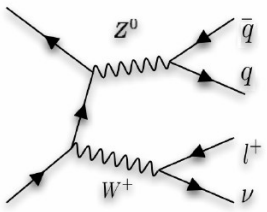


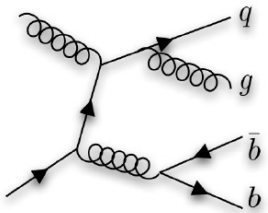
- Top-pair topologies



- Main top-pair backgrounds
  - W,Z + jets (W,Z + heavy flavour)
  - Dibosons
  - QCD multijets
  - Single top
- Main single-top backgrounds
  - Mostly top-pairs
  - W,Z + jets (W,Z + heavy flavour)
  - QCD multijets

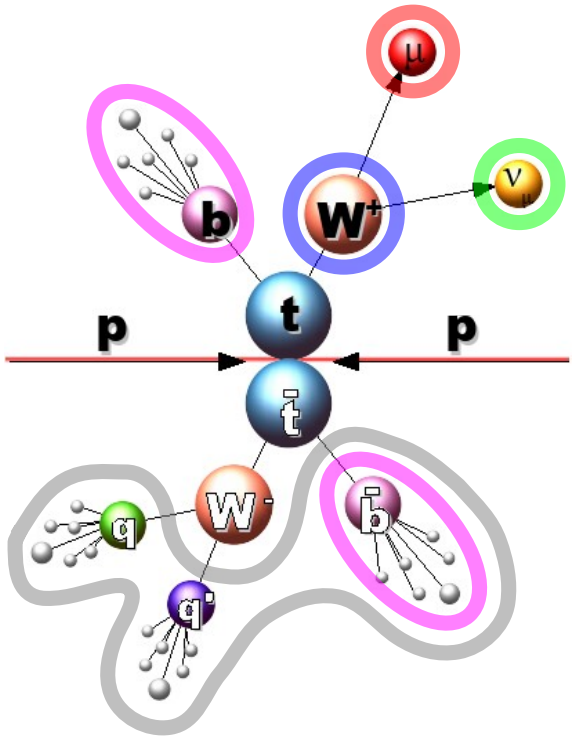


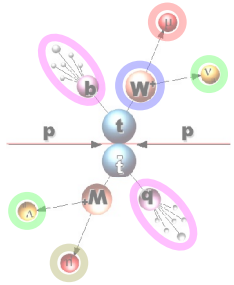




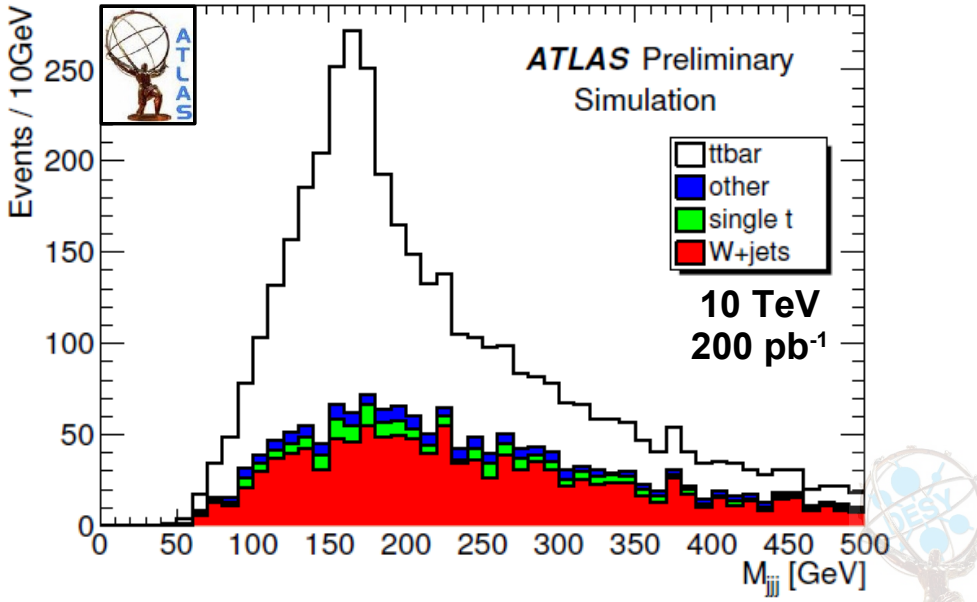
Top Reconstruction

- General approach
  - Trigger on **isolated, high p_T lepton**
  - Add **missing E_T** and/or m_T^W
  - Purify sample via
    - **Second lepton**
      - Tagged **b-jets**
      - **Hadronic top decay** (N_{jets}, m_{jj}, m_{jjj})





- **Day 1 top-pair events** selection (10 TeV, 200 pb^{-1})
  - 1 isol. electron/muon, $p_T > 20$ GeV
  - $E_T^{miss} > 20$ GeV
  - ≥ 4 jets with $p_T > 20$ GeV, ≥ 3 jets with $p_T > 40$ GeV
  - t_{had} = 3 jets maximising p_T^{top}
  - W_{had} = 2 jets maximising p_T^W (in jjj rest frame)
  - Loose m_W constraint ($|m_{jj}-m_W| < 10$ GeV)
  - **No b-tagging required**
  - **S/B = ~ 2, ε_{sel} = ~ 10 %**



Top for Calibration – b-tagging efficiency

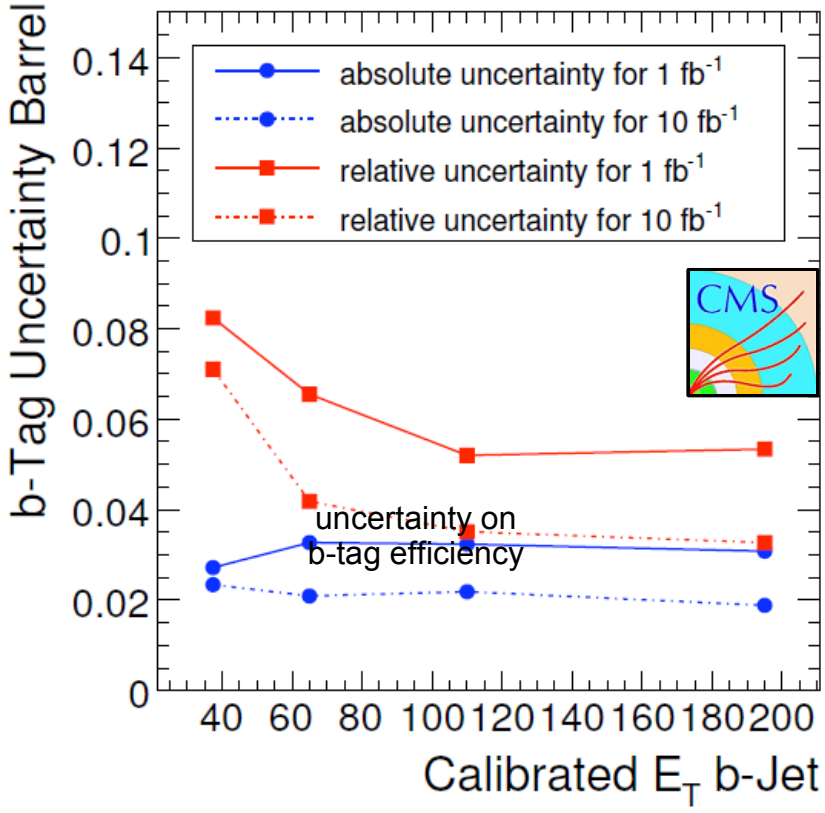
- CMS (14 TeV, 1 fb^{-1})
  - Using [**semi-] leptonic** channel
    - 2 [1] lepton(s), 2 [4] jets, E_T^{miss}, [1 b-tag]
  - Select b-enriched jet sample by
    - Event-by-event kinematic fit to match jets to partons, imposing m_W and m_t constraints
    - Likelihood ratio from fit and other variables
  - Get **ε_b as function of E_T^{jet} and η_{jet}**

$$\Delta\varepsilon_b = \frac{x_{tag} - \varepsilon_0(1 - x_b)}{x_b}$$

x_{tag}: fraction of tagged jets; ε_0: mistag rate for non-b jets; x_b: b-purity

$$\left(\Delta\varepsilon_b/\varepsilon_b\right)^{barrel} \sim \pm 6\%$$

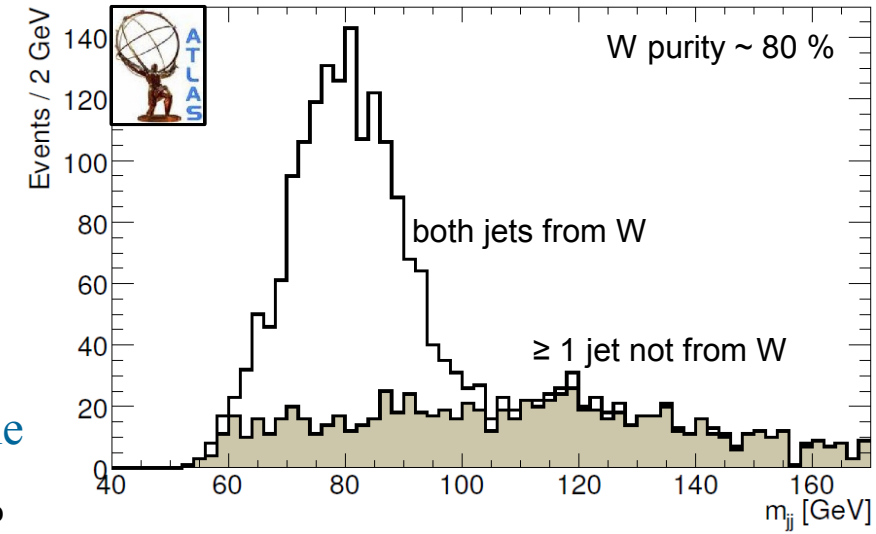
$$\left(\Delta\varepsilon_b/\varepsilon_b\right)^{end\text{-}cap} \sim \pm 10\%$$

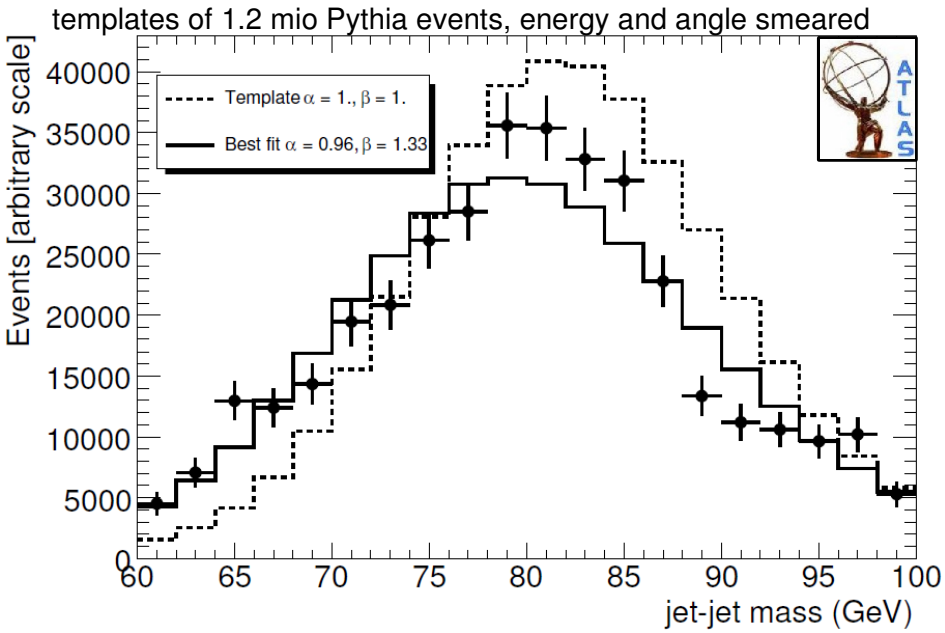


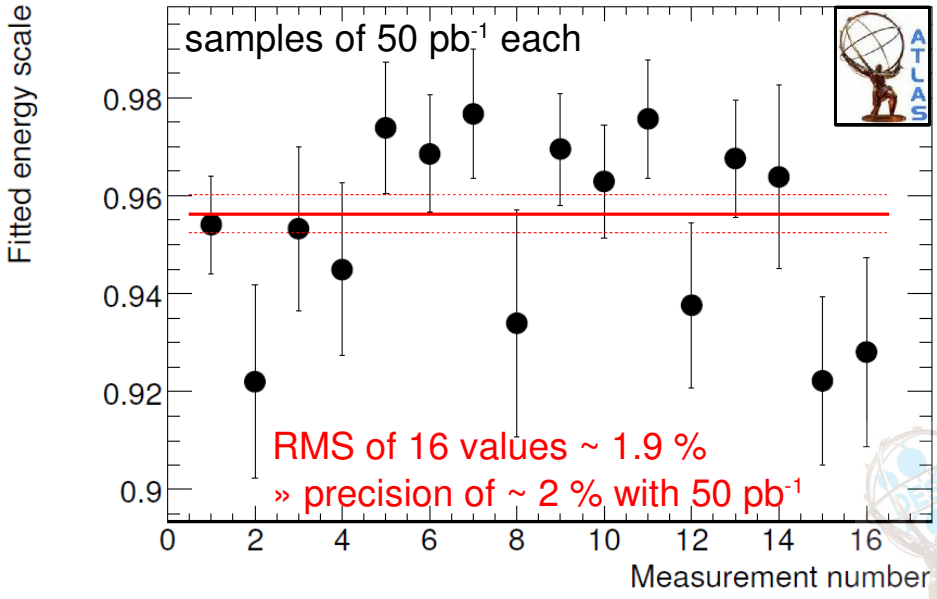
- ATLAS study at 14 TeV with 100 pb^{-1} using semi-leptonic channel, fitting $N_{b\text{-}tag}$ distribution to simultaneously get ε_b, ε_c and σ_{ttbar} suggests $\left(\Delta\varepsilon_b/\varepsilon_b\right)^{l+jets} = \left(\pm 2.7_{(stat)} \pm 3.4_{(syst)}\right)\%$

Top for Calibration – light jet energy scale (JES)

- ATLAS (14 TeV, 1 fb^{-1})
  - Semi-leptonic channel
    - 1 isol. lepton pT > 20 GeV, 4 jets p_T > 40 GeV, E_T^{miss} > 20 GeV, **2 b-tags**, 150 GeV < m_t < 200 GeV
  - Fit m_{jj} distribution to smeared templates of different energy scale α / resolution β
  - Compute each χ2 and find minimum in (α, β) plane
  - Estimated uncertainty on JES $(\Delta JES / JES)_{temp} = 1\,\%$



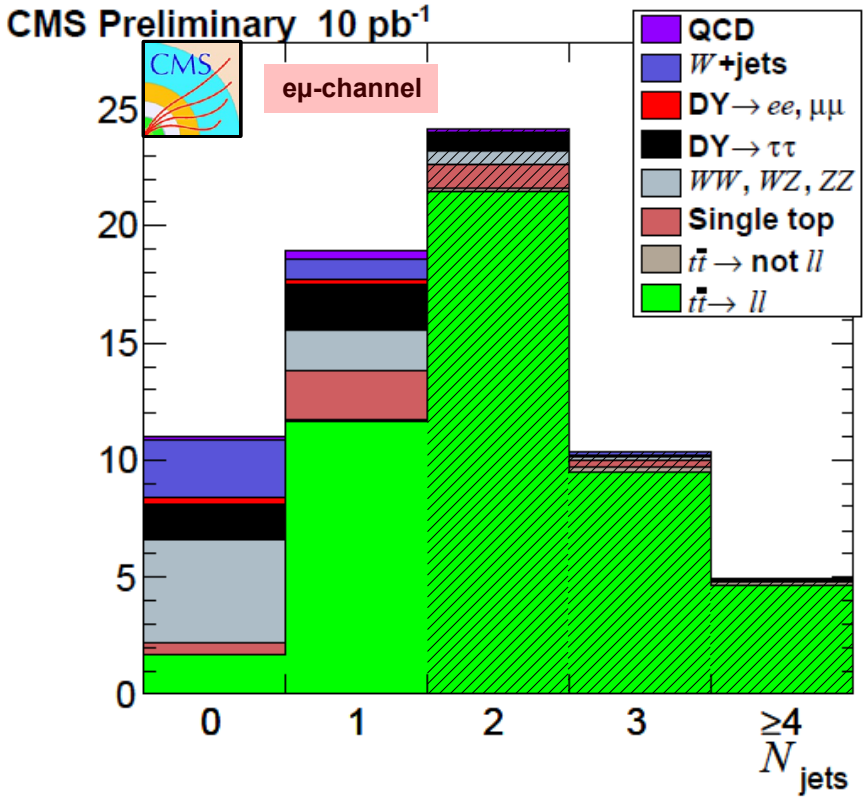




Top Cross-section – top-pair production

- CMS (10 TeV, 10 pb^{-1})
  - Di-leptonic channel (eμ-channel)
    - 2 isol. leptons of **opposite charge** $p_T > 20$ GeV, 2 jets $p_T > 30$ GeV, ($E_T^{miss} > 20/30$ GeV for eμ/ee+μμ)
    - Z-boson veto in ee and μμ channels ($|m_{jj}-m_Z| < 15$ GeV)
  - **Counting experiment approach**
  - Combined uncertainty for ee+eμ+μμ

    $(\Delta\sigma/\sigma)^{\text{di-lep}} = \left(\pm 15_{(\text{stat})} \pm 10_{(\text{syst})} \pm 10_{(\text{lumi})}\right)\%$
  - First data approach using only the cleaner eμ-channel $(\Delta\sigma/\sigma)^{(e\mu)} = \left(\pm 18_{(\text{stat})} \pm 10_{(\text{syst})} \pm 10_{(\text{lumi})}\right)\%$



- D0 at 1.96 TeV with 1 fb^{-1} $(\Delta\sigma_{t\bar{t}}/\sigma_{t\bar{t}})^{\text{di-lep}} \sim {}^{+20}_{-17}\%$
- ATLAS study at 10 TeV with 200 pb^{-1} leptonic channel with a counting/likelihood method, estimating a combined uncertainty for ee+eμ+μμ of $\Delta\sigma/\sigma = \left({}^{+4.1}_{-4.0(\text{stat})} {}^{+9.6}_{-8.7(\text{syst})} {}^{+26.2}_{-17.4(\text{lumi})}\right)\%$

Top Cross-section – top-pair production

- ATLAS (10 TeV, 200 pb^{-1})
  - Semi-leptonic channel (muon+jets)
    - 1 isol. lepton $p_T > 20$ GeV, ≥ 4 jets $p_T > 20$ GeV, ≥ 3 jets $p_T > 40$ GeV, $E_T^{miss} > 20$ GeV,

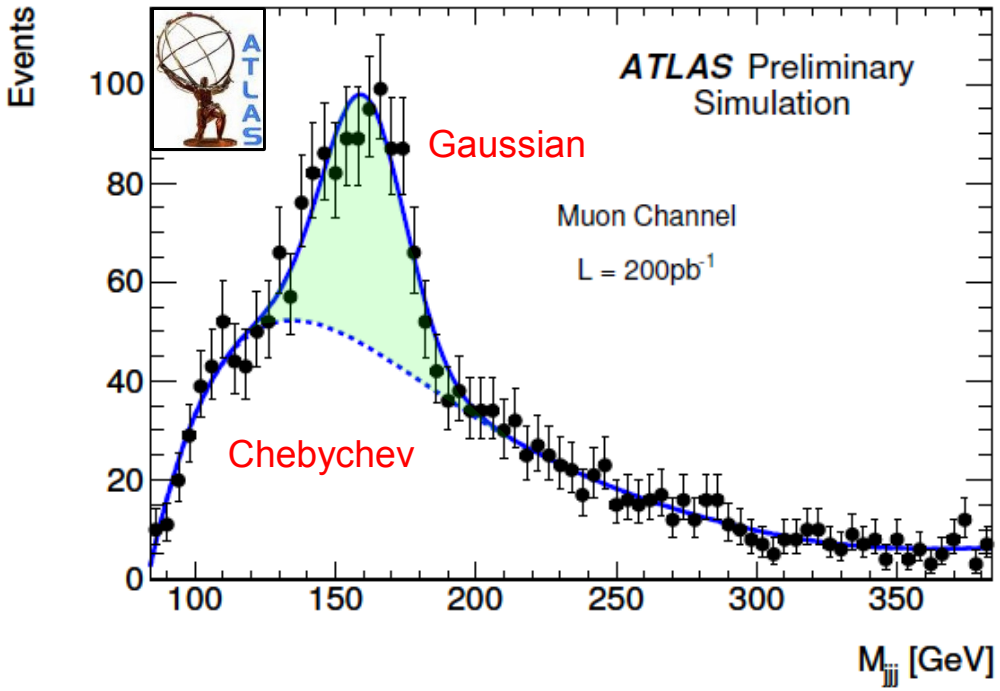
      (two jets of had. top should fulfil $|m_{jj}-m_W| < 10$ GeV)
  - Cut-and-Count method

$$\sigma_{count} = \frac{N_{obs} - N_{bkg}}{L_{int} \cdot \varepsilon_{tot}}$$

$$\left(\frac{\Delta\sigma}{\sigma}\right)^{(\mu+jets)}_{count} = \left(\pm 3_{(stat)}\, ^{+12}_{-15(syst)} \pm 22_{(lumi)}\right)\%$$

  - Likelihood fit method

$$\left(\frac{\Delta\sigma}{\sigma}\right)^{(\mu+jets)}_{fit} = \left(\pm 15_{(stat)}\, ^{+6}_{-15(syst)} \pm 20_{(lumi)}\right)\%$$



- CDF at 1.96 TeV with 2.8 fb^{-1} $\Delta\sigma_{t\bar{t}}/\sigma_{t\bar{t}} \sim 9\%$
- CMS study at 10 TeV with 20 pb^{-1} using semi-leptonic muon channel with a template method fitting m_{jjj}, estimating an uncertainty $\left(\Delta\sigma/\sigma\right)_{M3'fit} = \left(\pm 12_{(stat)} \pm 25_{(syst)} \pm 10_{(lumi)}\right)\%$

Top Cross-section – single-top production

- CMS (10 TeV, 200 pb^{-1})
  - T-channel (muon)
    - 1 isol. muon $p_T > 20$ GeV, veto on electrons $p_T > 20$ GeV, 2 jets $p_T > 30$ GeV, 1 b-jet, $M_T > 50$ GeV

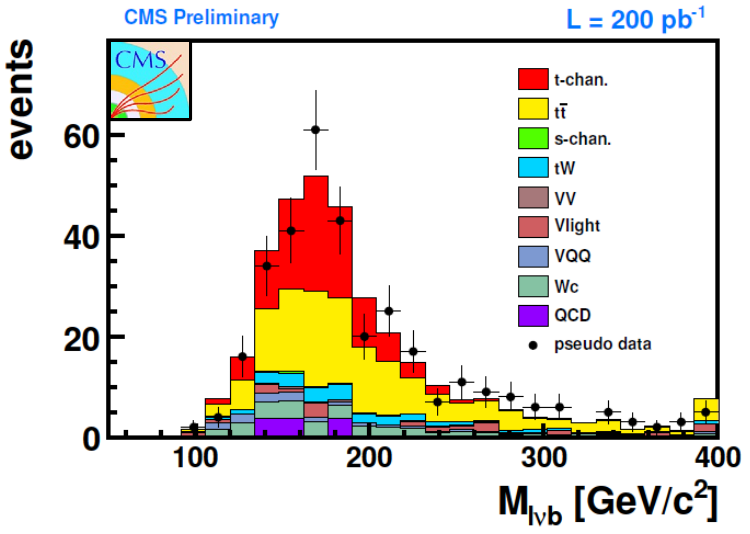
$$M_T = \sqrt{(p_{T,\mu} + p_{T,\nu})^2 - (p_{x,\mu} + p_{x,\nu})^2 - (p_{y,\mu} + p_{y,\nu})^2}$$

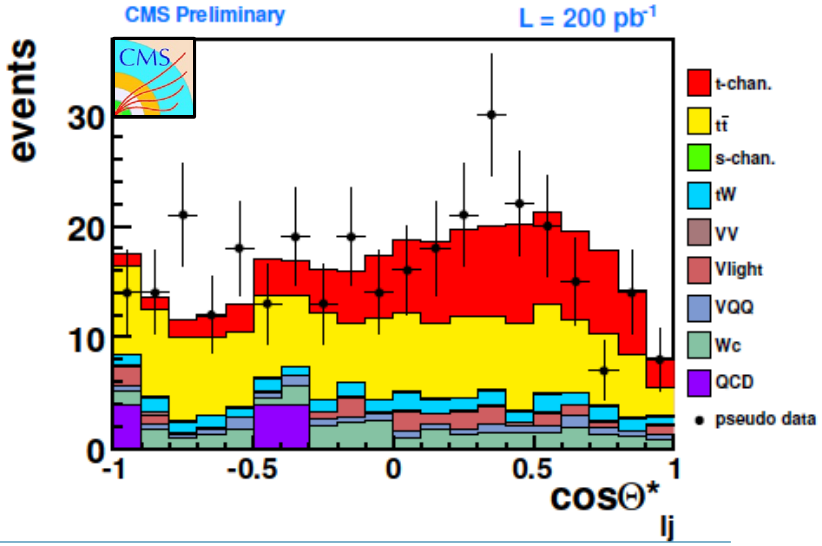
  - Top (M_{lvb}) is reconstructed using b-tagged jet and by fixing $M_T = m_W$
  - Cross-section is determined from binned likelihood fit to $\cos\theta^*_{ij}$-distribution

$$(\Delta\sigma/\sigma)_{\text{t-chan}} = (\pm 35_{(\text{stat})} \pm 14_{(\text{syst})} \pm 10_{(\text{lumi})})\,\%$$

  - At 14 TeV, 10 fb^{-1}

$$(\Delta\sigma/\sigma)^{14\,TeV,\,10\,fb^{-1}}_{\text{t-chan}} = (\pm 2.7_{(\text{stat})} \pm 8_{(\text{syst})})\,\%$$





- Similar ATLAS study at 14 TeV with 1 fb^{-1} in W+t channel with a MVA/BDT method, estimating an uncertainty of $(\Delta\sigma/\sigma)_{\text{Wt-chan}} = \pm 34_{(\text{stat+syst})}\,\%$
- Considering all channels » $\Delta|V_{tb}|/|V_{tb}| \sim 14\%$

- CDF at 1.96 TeV with 2.8 fb^{-1} $\Delta|V_{tb}|/|V_{tb}| \sim 12\%$

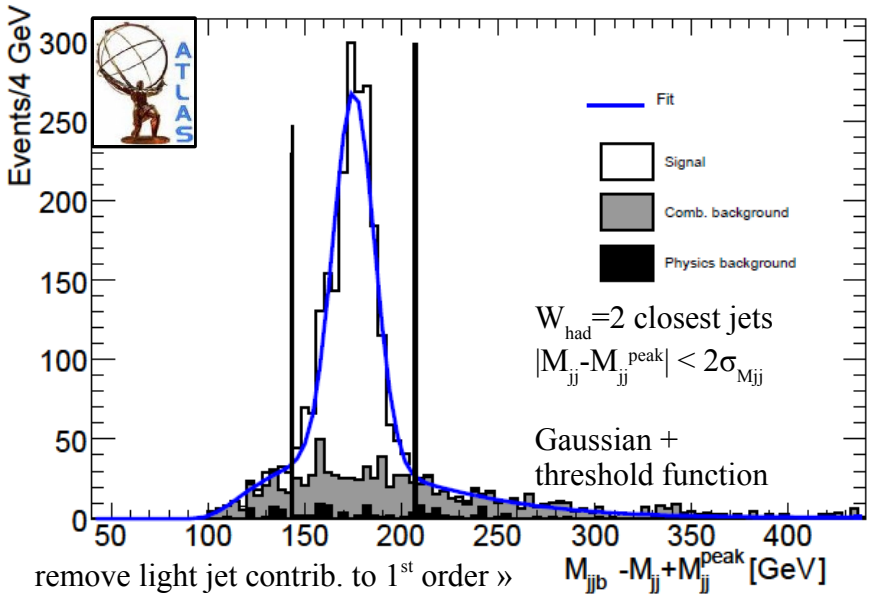
Top Mass

- ATLAS (14 TeV, 1 fb^{-1})
  - Lepton+jets channel
    - 1 isol. lepton $p_T > 20$ GeV, 4 jets $p_T > 40$ GeV, $E_T^{miss} > 20$ GeV, **2 b-tags**

      W_{had} via geometric (2 closest jets) or χ^2-method, $t_{had} = W_{had}$ + closest (b-)jet
  - Sample purity increased by add. cuts
    - $m_{inv}(W_{had}, b_{W\text{-}lep}) > 200$ GeV
    - $m_{inv}(l, b_{W\text{-}lep}) < 160$ GeV
  - m_t from functional fit

$$\Delta m_{top} = \left(\leq 0.4\,(\text{stat}) \pm 3.5\,(\text{syst})\right)\text{GeV}\,,\ \Delta\,\text{JES}\,(\text{b-jet}) = 5\,\%$$
$$\Delta m_{top} = \left(\leq 0.4\,(\text{stat}) \pm 1\,(\text{syst})\right)\text{GeV}\,,\ \Delta\,\text{JES}\,(\text{b-jet}) = 1\,\%$$

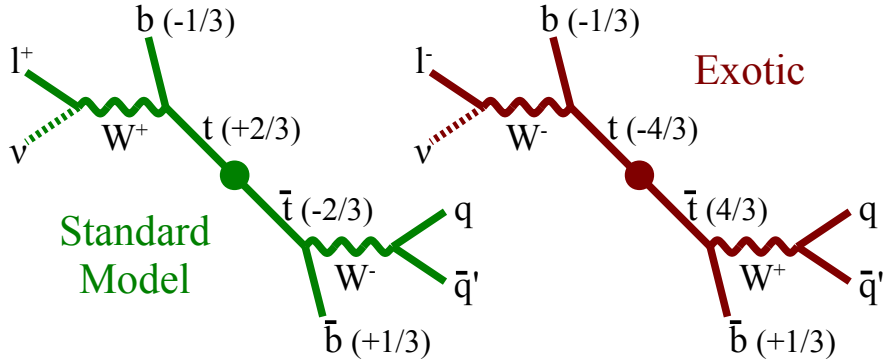
  - Main uncertainty from JES and JES(b)

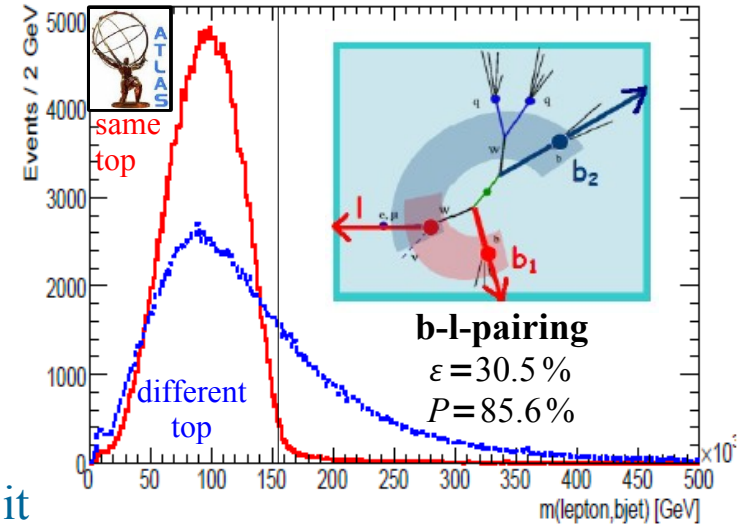


- CMS study at 10 TeV with 1 fb^{-1} using fully-leptonic, writing event kinematics as a forth order polynomial containing m_t, weighted by SM expectation for p^{ν} spectrum $\Delta m_{top}^{dilepton} = \left(\pm 1.5\,(\text{stat}) \pm 4.2\,(\text{syst})\right)\text{GeV}$
- Combined Tevatron $\Delta m_{top} = \left(\pm 0.6\,(\text{stat}) \pm 1.1\,(\text{syst})\right)\text{GeV}$

Top Charge

- ATLAS (14 TeV, 1 fb^{-1})
  - Real top **(2/3)** or exotic object **(4/3)** at 173 GeV?



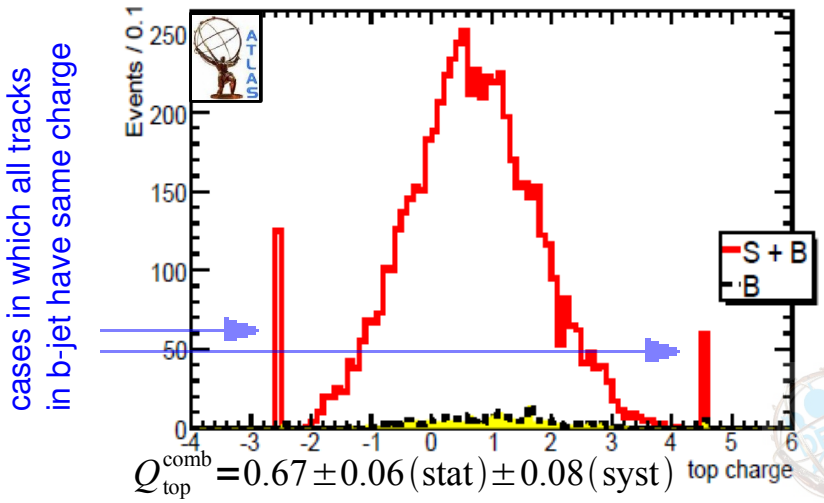


  - Important to get **b-l-pairing** right
  - Charge weight technique
    - correlates b charge and charges of tracks belonging to it

$$Q_{\text{bjet}} = \frac{\sum_i q_i |\vec{j}_i \cdot \vec{p}_i|^\kappa}{\sum_i |\vec{j}_i \cdot \vec{p}_i|^\kappa}, (\kappa = 0.5)$$

$$Q_{\text{b}} = -1/3 = C_{\text{b}} \cdot Q_{\text{comb}} = C_{\text{b}} \cdot Q(l) \cdot Q_{bjet}^{(l)}$$
$$Q_{\text{top}} = Q_{\text{lep}} + Q_{\text{bjet}} \cdot C_{\text{b}}$$

    - Discrimination between SM and exotic scenarios with well above 5σ is likely



Conclusion / Summary

- Already at 10 TeV the LHC will be a top factory
- ATLAS and CMS have shown similar projections in top quark physics
  - big efford on selection robustness and strategies for (first) data
    (data-driven techniques to measure efficiencies and background contributions)

- Wide range of studies have been performed at both experiments for 14 TeV running
  - Light jet energy scale to O(1 %) with 100 pb^{-1}
  - b-tagging efficiency uncertainty to $\leq$ 10 % with O(100 pb^{-1})
  - Good top charge discrimination with 1 fb^{-1}

- Recent 10 TeV studies promise interesting/important results
  already in first year of data taking - O(100 pb^{-1})
  - Rediscovery of the top quark
  - first $\sigma_{t\bar{t}}$ measurements already at O(10 pb^{-1})

References

- ATLAS

A1 • "Prospects for measuring top pair production in the dilepton channel with early ATLAS data at sqrt(s)=10 TeV", ATL-PHYS-PUB-2009-086

A2 • "Prospects for the top pair pair production cross-section at sqrt(s)=10 TeV in the single lepton channel in ATLAS", ATL-PHYS-PUB-2009-087

A3 • "Expected performance of the ATLAS experiment : detector, trigger and physics", CERN-OPEN-2008-020

A4 • "Prospects for associated single top quark production cross-section measurements in the dilepton decay mode with ATLAS", ATL-PHYS-PUB-2009-001

- CMS

C1 • "Expectations for observation of top quark pair production in the dilepton final state with early data at 10 TeV", CMS-PAS-TOP-09-002

C2 • "Prospects for the first Measurement of the ttbar Cross Section in the Muon-plus-Jets Channel at sqrt{s} = 10 TeV with the CMS Detector", CMS-PAS-TOP-09-003

C3 • "Expectation for a measurement of the t-tbar production cross section in the muon+jets final state using a multivariate technique", CMS-PAS-TOP-09-010

C4 • "Prospects for the measurement of the single-top t-channel cross section in the muon channel with 200 pb^{-1} at 10 TeV", CMS-PAS-TOP-09-005

C5 • "CMS physics : Technical Design Report", CERN-LHCC-2006-001 & CERN-LHCC-2006-021

References

- Tevatron

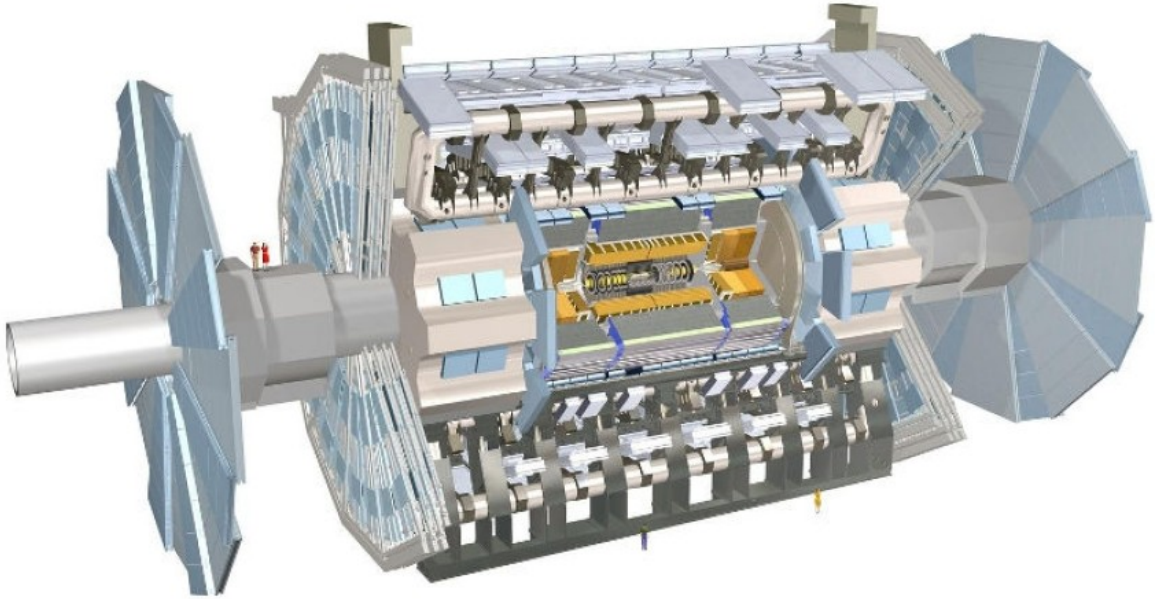
T1 • "Measurement of the production cross section and top quark mass extraction using dilepton events in collisions ", Physics Letters B, Volume 679, Issue 3, 24 August 2009, Pages 177-185

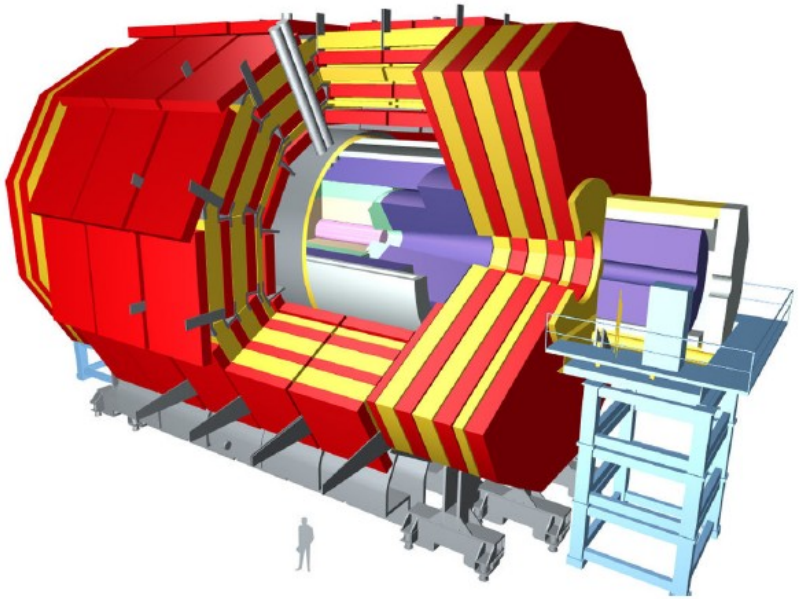
T2 • "Combination of CDF top quark pair production cross section measurements with 2.8 fb-1", CDF-9448 (2008), and references therein.

T3 • "Combination of CDF and DØ Results on the Mass of the Top Quark", arXiv:0903.2503 (2009).

Backup Slides

ATLAS and CMS





ATLAS

- Pixel/Semiconductor Tracker (10-20 μm in r-φ)
- E-CAL (liquid argon, longitudinal segmentation)
- H-CAL calorimeter (scintillating tiles)
- Muon system (DTs and cathode stripes, standalone & combined μ tracking)
- TRT allows for e-π-separation ($|\eta| \leq 2.0$)

CMS

- Central silicon detector (~ 10 μm in r-φ)
- E-CAL calorimeter (lead tungstate crystal)
- H-CAL calorimeter (scintillating tiles)
- Muon system (DTs and cathode stripes, 4 barrel stations)

Jets	$\|\eta_{jets}\| \leq 5.0$ (≤ 2.5 for b-tag or mass resolution)
Electrons	$\|\eta_{electron}\| \leq 2.5$ (Inner Detector match)
Muons	$\|\eta_{muon}\| \leq 2.5$ (Inner Detector match)
Tracks	$\|\eta_{tracks}\| \leq 2.5$, $p_T \sim 20$ GeV

Top Physics Overview

- ATLAS (14 TeV, 1 fb^{-1})

Observables	Expected Precision
Top quark charge (2/3 versus -4/3)	$\geq 5\sigma$
Spin Correlations:	
A	50%
A_D	34%
W-boson Polarisation:	
F_0	5%
F_L	12%
F_R	0.03
Angular Asymmetries:	
A_{FB}	19%
A_+	11%
A_-	4%
Anomalous Couplings:	
V_R	0.15
g_L	0.07
g_R	0.15
Top quark FCNC decays (95% C.L.):	
$Br(t \rightarrow q\gamma)$	10^{-3}
$Br(t \rightarrow qZ)$	10^{-3}
$Br(t \rightarrow qg)$	10^{-2}
$t\bar{t}$ Resonances (discovery):	
$\sigma \times Br$ ($m_{t\bar{t}}$=700GeV)	$\geq$ 11 pb

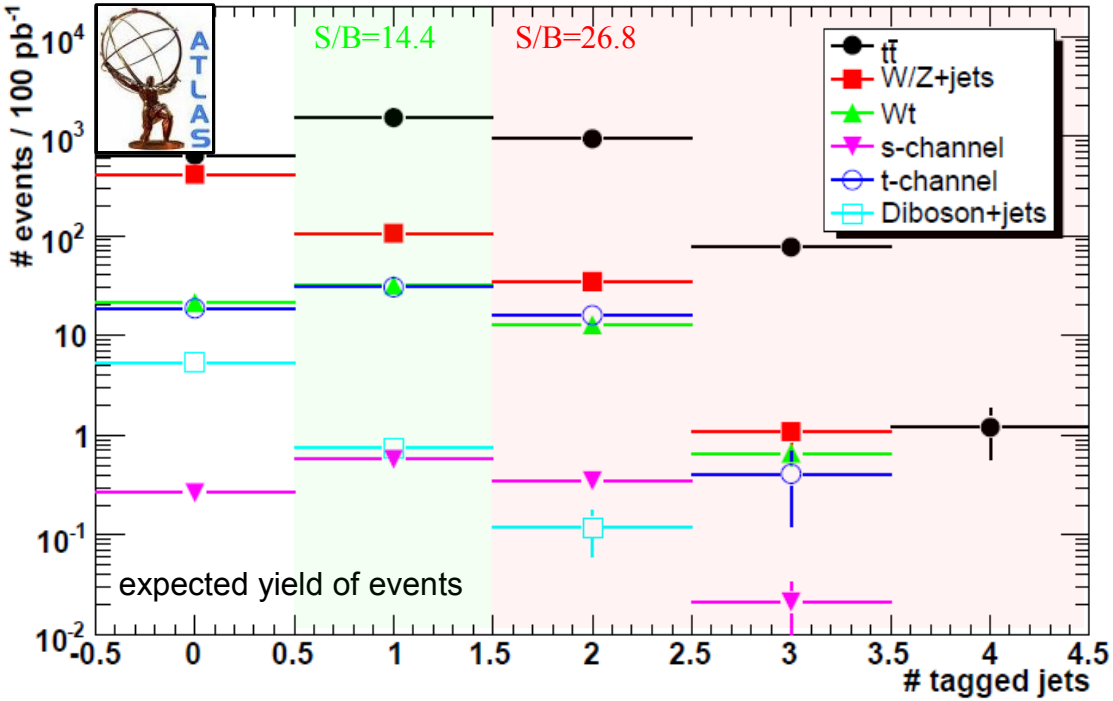
Top for Calibration (b-tagging efficiency)

- ATLAS (14 TeV, 100 pb^{-1})

  - Using **leptonic and semi-leptonic** channels
    - Lepton p_T > 20 GeV, jet p_T > 30 GeV,
      20/30 GeV range cuts on reconst. W/t mass
  - **Count events** with 0 to 3 b-tags
  - Get **ε_b, ε_c and σ_{ttbar} from fit to N_{tag} dist.**

$$\left(\Delta\varepsilon_b/\varepsilon_b\right)^{\text{l+jets}} = \left(\pm 2.7_{(\text{stat})} \pm 3.4_{(\text{syst})}\right)\%$$

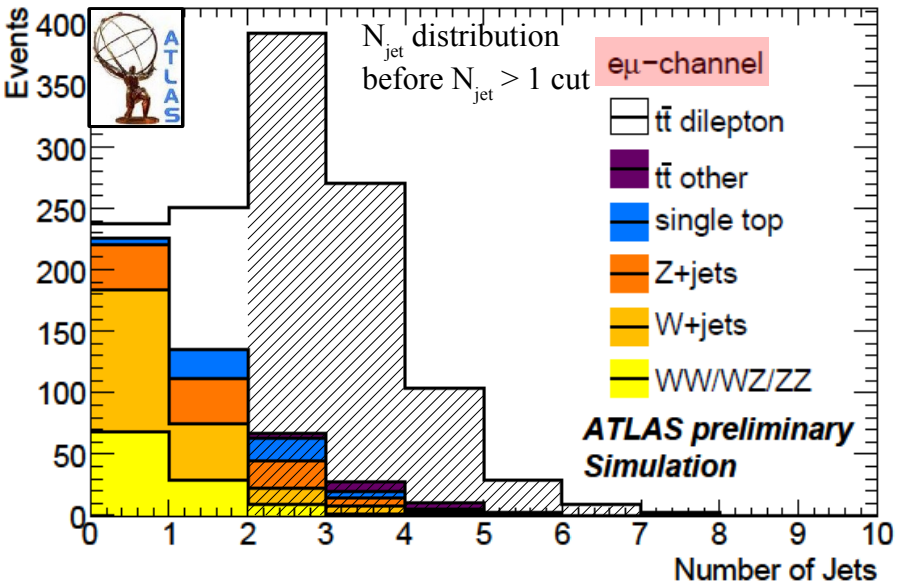
$$\left(\Delta\varepsilon_b/\varepsilon_b\right)^{\text{di-lep}} = \left(\pm 4.2_{(\text{stat})} \pm 3.5_{(\text{syst})}\right)\%$$



Top Cross-section – top-pair production, dilepton channel

- ATLAS (10 TeV, 200 pb^{-1})
  - 2 isol. leptons of **opposite charge** $p_T > 20$ GeV, 2 jets $p_T > 20$ GeV, $E_T^{miss} > 20$ GeV
  - **Counting/likelihood method**

    $l = l(\sigma_{sig}, L, \alpha_j)$
  - $(S/B)_{e\mu} = 5.5$, $\varepsilon_{sel} = 26.5$ %



$\Delta\sigma/\sigma$ (%)	ee channel	$\mu\mu$ channel	$e\mu$ channel	combined
Stat only	-7.5 / 7.8	-6.0 / 6.2	-4.0 / 4.1	-3.1 / 3.1
Luminosity	-17.3 / 26.3	-17.4 / 26.2	-17.4 / 26.2	-17.4 / 26.2
Electron Efficiency	-4.5 / 5.0	0.0 / 0.0	-2.2 / 2.4	-1.9 / 1.9
Muon Efficiency	0.0 / 0.0	-4.6 / 5.2	-2.1 / 2.2	-2.2 / 2.3
Lepton Energy Scale	-0.3 / 1.6	-2.4 / 2.0	-0.5 / 0.5	-0.8 / 0.8
Jet Energy Scale	-3.4 / 3.2	-3.0 / 4.5	-2.5 / 2.5	-2.8 / 3.0
PDF	-2.1 / 2.3	-1.4 / 1.6	-1.6 / 1.8	-1.7 / 1.8
ISR FSR	-4.0 / 4.2	-3.6 / 3.7	-3.5 / 3.5	-3.6 / 3.7
Signal Generator	-4.7 / 5.4	-4.6 / 5.4	-4.7 / 5.3	-4.7 / 5.3
Cross-Sections	-0.3 / 0.3	-0.3 / 0.3	-0.3 / 0.3	-0.3 / 0.3
Drell Yan	-1.4 / 1.3	-2.2 / 2.2	-0.5 / 0.5	-0.8 / 0.9
Fake Rate	-9.7 / 9.5	-1.1 / 1.1	-6.2 / 6.2	-4.0 / 4.0
All syst but Luminosity	-12.7 / 13.9	-8.9 / 10.2	-9.4 / 10.2	-8.7 / 9.6
All systematics	-21.0 / 30.3	-19.3 / 28.3	-19.5 / 28.5	-19.3 / 28.1
Stat + Syst	-22.3 / 31.3	-20.2 / 29.0	-19.9 / 28.8	-19.5 / 28.3

- Combined uncertainty for ee+eμ+μμ

$$\Delta\sigma/\sigma = \left(^{+4.1}_{-4.0(\mathrm{stat})}\ ^{+9.6}_{-8.7(\mathrm{syst})}\ ^{+26.2}_{-17.4(\mathrm{lumi})}\right)\%$$

Top Cross-section – top-pair production, single lepton μ-channel

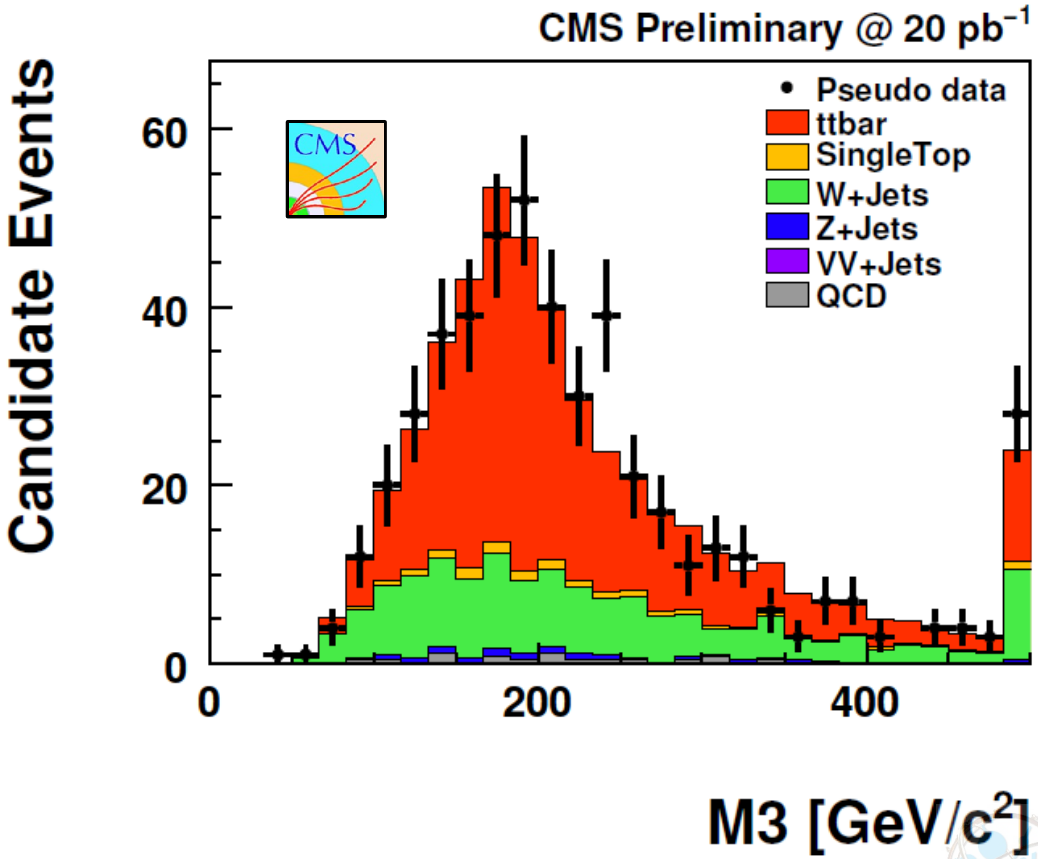
- CMS (10 TeV, 20 pb^{-1})
  - Semi-leptonic channel (muon+jets)
    - 1 isol. lepton $p_T > 20$ GeV, 4 jets $p_T > 30$ GeV, no E_T^{miss} requirement
  - **Template fit of M3'** (M3 with minimal χ^2)

$$\chi^2 = \frac{(m_{j_1 j_2} - m_W)^2}{\sigma_{jj}^2} + \frac{(m_{j_1 j_2 j_3} - m_t)^2}{\sigma_{jjj}^2} + \frac{(m_{\mu\nu j_4} - m_t)^2}{\sigma_{\mu\nu j}^2}$$

and **multivariate method using BDTs**

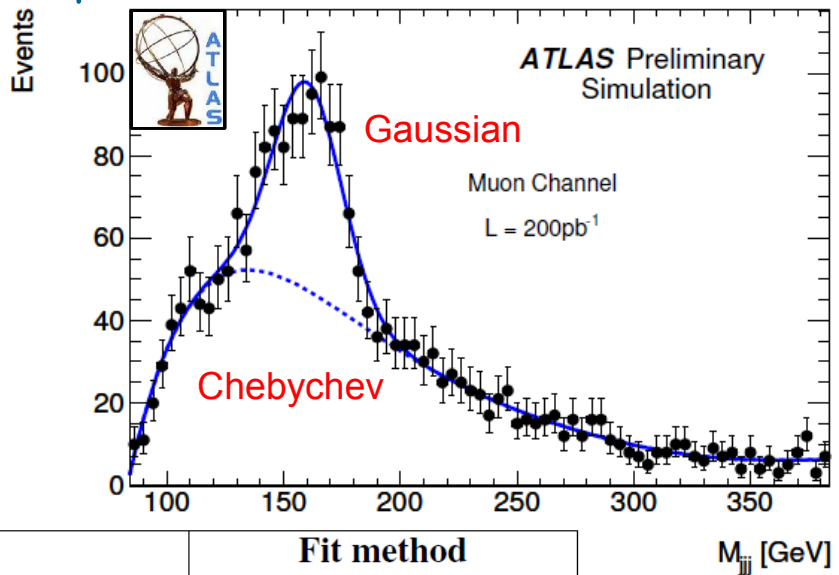
$$\left(\frac{\Delta\sigma}{\sigma}\right)_{\text{M3'fit}} = \left(\pm 12_{(\text{stat})} \pm 19_{(\text{syst})} \pm 10_{(\text{lumi})}\right)\%$$

$$\left(\frac{\Delta\sigma}{\sigma}\right)_{\text{BDT}} = \left(\pm 9_{(\text{stat})} \pm 22_{(\text{syst})} \pm 10_{(\text{lumi})}\right)\%$$



Top Cross-section - top-pair production, single lepton μ-channel

- ATLAS (10 TeV, 200 pb^{-1}) A2
  - 1 isolated lepton, $p_T > 20$ GeV
  - ≥ 4 jets, $p_T > 20$ GeV
  - ≥ 3 jets, $p_T > 40$ GeV
  - MET > 20 GeV
  - Likelihood fit (and counting method)



	Cut and Count method				Fit method	
Source	*e*-analysis		*μ*-analysis		*e*-analysis	*μ*-analysis
	default (%)	**+M_W-cut** (%)	**default** (%)	**+M_W-cut** (%)	**+M_W-cut** (%)	**+M_W-cut** (%)
Stat.	± 2.5	± 3.4	±2.3	±3.1	± 14.1	± 15.2
Lepton ID eff.	±1.0	**±1.0**	±1.0	**±1.0**	**± 1.0**	**± 1.0**
Lepton trig. eff.	±1.0	**±1.0**	±1.0	**±1.0**	**± 1.0**	**± 1.0**
50% W+jets	±25.1	±17.4	±28.1	±19.8	± 3.3	± 5.6
20% W+jets	±10.0	**±7.0**	±11.2	**±7.9**	**± 1.5**	**± 2.6**
JES (10%,-10%)	+24.8-23.4	+15.9-19.1	+20.5-22.3	+11.9-17.9	-14.4	-15.4
JES (5%,-5%)	+12.3-11.9	**+8.6-9.3**	+10.4-10.9	**+6.1-8.4**	**-3.7**	**-3.9**
PDFs	±1.6	**± 1.9**	±1.2	**± 1.4**	**± 1.9**	**± 1.4**
ISR/FSR	+9.1-9.1	**+7.6-8.2**	+8.2-8.2	**+5.2-8.3**	**-12.9**	**-12.9**
Signal MC	±3.3	**±4.4**	±0.3	**±2.8**	**± 4.5**	**± 1.4**
Back. Uncertainty	±0.6	**±0.4**	±0.5	**±0.4**	-	-
Fitting Model	-	-	-	-	**± 3.3**	**± 4.7**
10% Lumi.	±11.6	±11.2	±11.4	±11.1	±10	±10
20% Lumi.	±23.2	**±22.3**	±22.8	**±22.2**	**±20**	**± 20**
Tot. without Lumi.	+18.8-18.5	**+14.4-15.2**	+17.5-17.7	**+11.9-14.7**	**+6.4 -14.9**	**+6.0 - 14.8**

Top Cross-section – single-top production

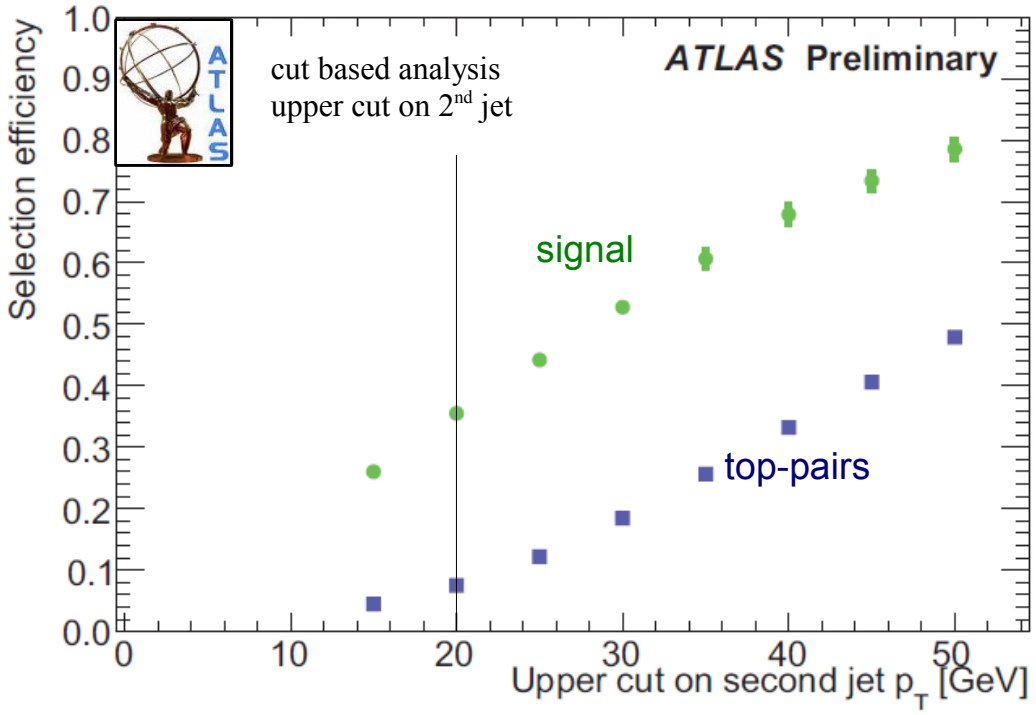
- ATLAS (14 TeV, 1 fb^{-1})
  - **Wt-dilepton-channel**
    - 2 isol. leptons pT > 30 GeV, 1 jet p_T > 15 GeV and ≤ 1 jet p_T < 20 GeV*, E_T^{miss} > 20/30 GeV
  - **Cut-based** (* only here) **and BDT analysis**

$$\left(\Delta\sigma/\sigma\right)^{\text{cuts}}_{\text{Wt-chan}} = \pm 50_{(\text{stat+syst})}\,\%$$
$$\left(\Delta\sigma/\sigma\right)^{\text{BDT}}_{\text{Wt-chan}} = \pm 34_{(\text{stat+syst})}\,\%$$

  - All channels

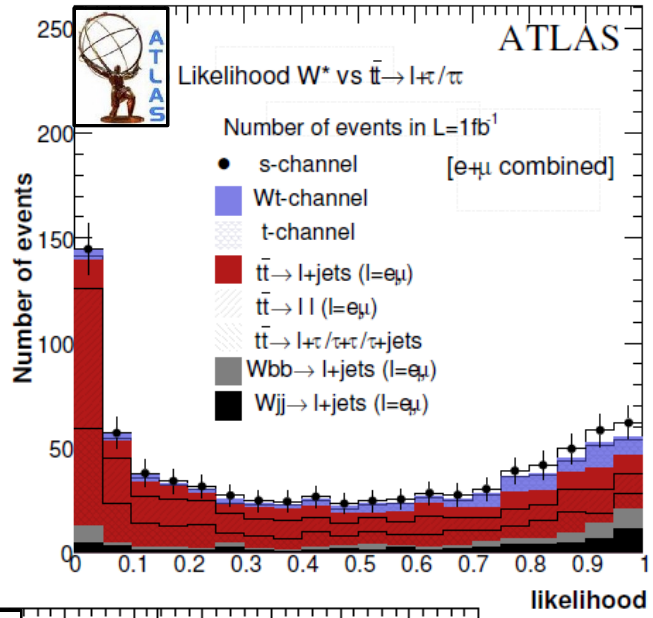
$$\left(\Delta\sigma/\sigma\right)^{\text{BDT}}_{\text{t-chan}} = \left(\pm 5.7_{(\text{stat})} \pm 22_{(\text{syst})}\right)\%$$
$$\left(\Delta\sigma/\sigma\right)^{\text{BDT}}_{\text{Wt-chan, 1l}} = \left(\pm 21_{(\text{stat})} \pm 48_{(\text{syst})}\right)\%$$
$$\left(\Delta\sigma/\sigma\right)^{\text{BDT}}_{\text{s-chan}} = \left(\pm 64_{(\text{stat})} \pm 95_{(\text{syst})}\right)\%$$

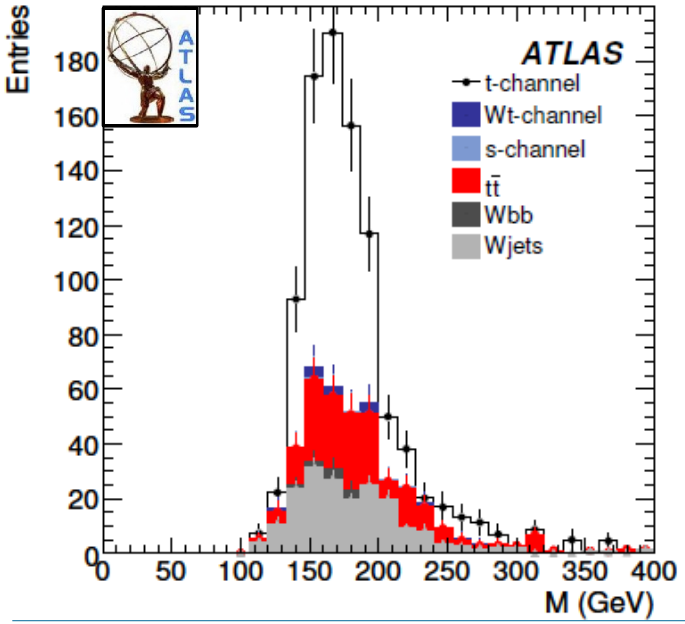
$$\frac{\Delta|V_{tb}|}{|V_{tb}|} = \left(\pm 11_{(\text{stat+syst})} \pm 4_{(\text{theo})}\right)\% = 12\,\%$$



Top Cross-section - single-top production

- ATLAS (14 TeV, 1 fb^{-1}) A3 A4





Wt-dilepton-channel

Source of uncertainty	Analysis for 1 fb^{-1} Variation	$\Delta\sigma/\sigma$	Analysis for 10 fb^{-1} Variation	$\Delta\sigma/\sigma$
Data Statistics		15%		5%
Monte Carlo Statistics		20%		
Luminosity	5%	26%	3%	15%
JES	5%	26%	1%	4%
Background Cross Sections	7.9%	22%	3%	8%
Total		50%		19%

s-channel

Source of uncertainty	Analysis for 1 fb^{-1} Variation	$\Delta\sigma/\sigma$	Analysis for 10 fb^{-1} Variation	$\Delta\sigma/\sigma$
Data Statistics		64%		20%
MC Statistics		29%		
Luminosity	5%	31%	3%	18%
b-tagging	5%	44%	3%	25%
JES	5%	25%	1%	5%
Lepton ID	1%	6%	1%	6%
Bkg x-section	10.3%	47%	3%	16%
ISR/FSR	9%	52%	3%	17%
PDF	2%	16%	2%	16%
b-fragmentation	3.6%	19%	3.6%	19%
Total Systematics		95%		48%

t-channel

Source	Analysis of 1 fb^{-1} Variation	Cut-based	BDT	Analysis of 10 fb^{-1} Variation	Cut-based	BDT
Data Statistics		5.0%	5.7 %		1.6%	1.8 %
MC Statistics		6.5 %	7.9%		2.0 %	2.5%
Luminosity	5%	18.3 %	8.8%	3%	10.9 %	5.2%
b-tagging	5%	18.1 %	6.6%	3%	10.9%	3.9%
JES	5%	21.6%	9.9%	1%	4.4 %	2.0%
Lepton ID	0.4%	1.5 %	0.7%	0.2%	0.6 %	0.3%
Trigger	1.0%	1.7 %	1.7%	1.0%	3.6 %	1.7%
Bkg x-section		22.9%	8.2%		6.9 %	2.5%
ISR/FSR	+7.2 -10.6%	9.8 %	9.4%	+2.2 -3.2%	2.7 %	2.5%
PDF	+1.38 -1.07%	12.3 %	3.2%	+1.38 -1.07%	12.3 %	3.2%
MC Model	4.2%	4.2 %	4.2%	4.2%	4.2 %	4.2%
Total		45%	22%		22%	10%

Top Mass

- CMS (10 TeV, 1 fb^{-1})
  - Fully-leptonic channel
    - six unknown kin. quantities (neutrino momenta)
    - using m_W constraints and $m_{t1}=m_{t2}$
  - Obtain forth order polynomial containing m_t as parameter
  - All m_t combinations per event are weighted by SM expectation of the p^{ν} spectrum » best kept
  - Fit Gaussian to signal
  - Systematics due to constraints above and detector effects

$$\Delta m_{\text{top}}^{\text{dilepton}} = \left(\pm 1.5\,(\text{stat}) \pm 4.2\,(\text{syst})\right)\text{GeV}$$