Measurements of the top quark mass using the ATLAS and CMS detectors at the LHC

DIS2015 Sven Menke, MPP München 29 Apr 2015, SMU
on behalf of the ATLAS and CMS collaborations

- Introduction
  - ATLAS & CMS @ LHC
  - Top Quark Mass
- Template/Ideogram based measurements (MC mass)
  - Lepton+Jets
  - Di-Lepton
  - Full-Hadronic
- Measurements of the pole mass
  - Di-Lepton
  - $t\bar{t} + 1$jet
- Conclusions

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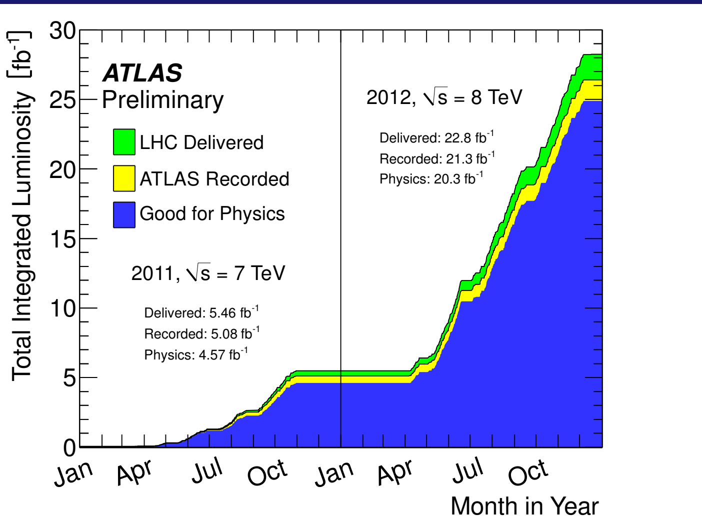
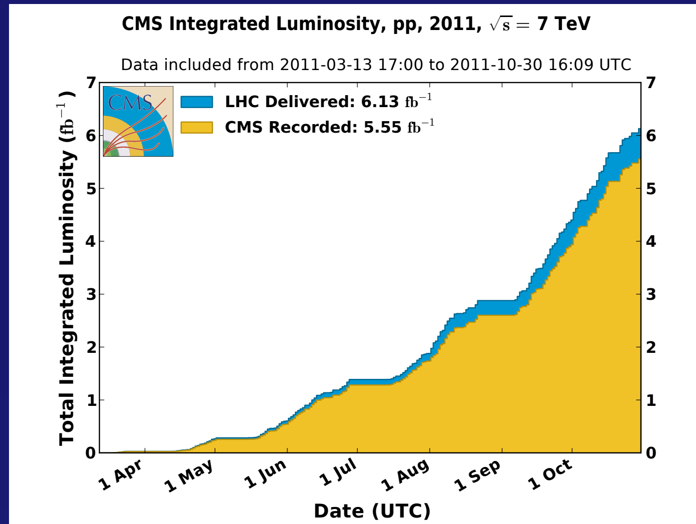
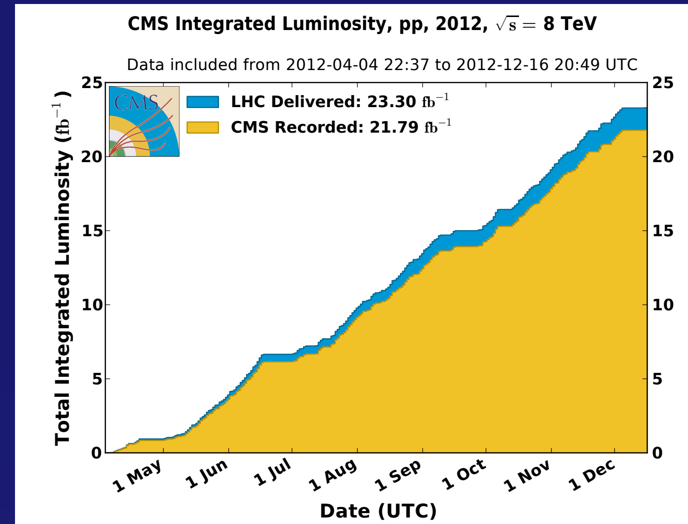
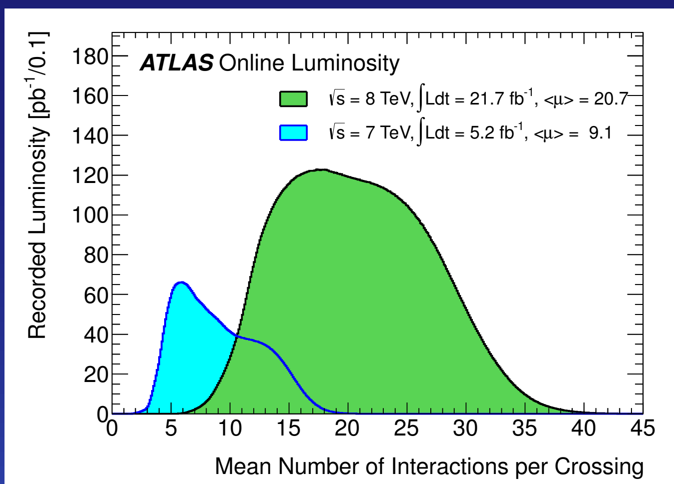
Introduction ► ATLAS and CMS @ the LHC



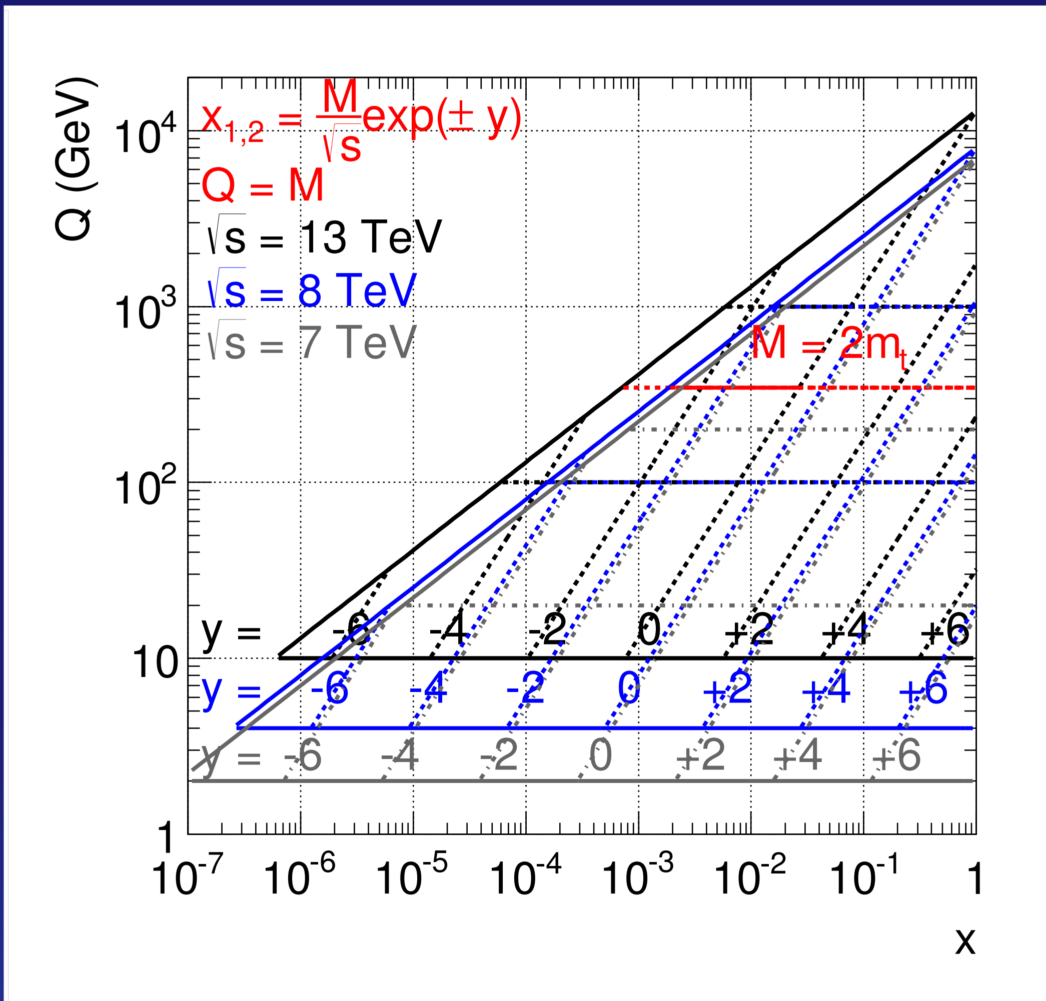


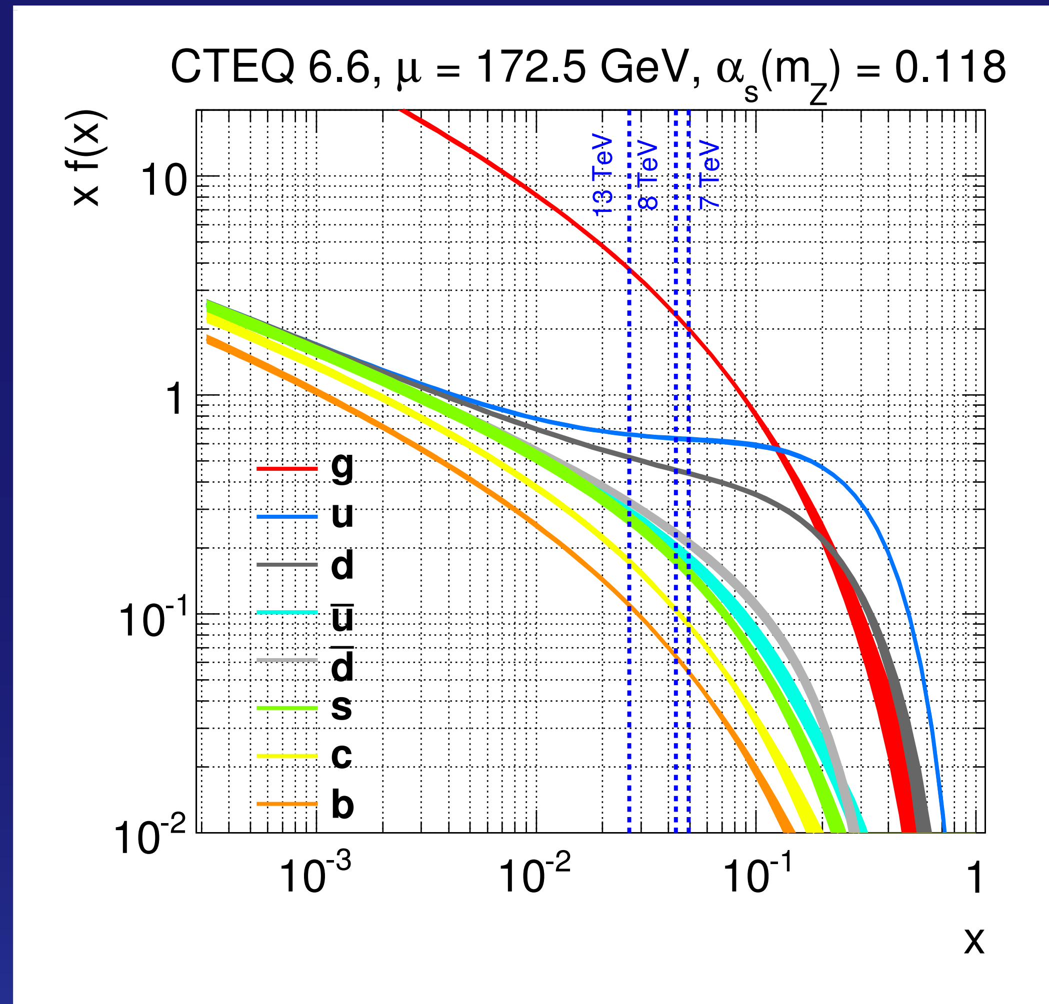




- LHC: pp Collisions @$\sqrt{s} = 7\&8$ TeV since March 2010
- 2011 recorded integrated luminosity @$\sqrt{s} = 7\,\mathrm{TeV}$: $L = 5.08\,\mathrm{fb}^{-1}$ (ATLAS), and $L = 5.55\,\mathrm{fb}^{-1}$ (CMS), with $\langle\mu\rangle \simeq 9$
- 2012 recorded integrated luminosity @$\sqrt{s} = 8\,\mathrm{TeV}$: $L = 21.3\,\mathrm{fb}^{-1}$ (ATLAS), and $L = 21.8\,\mathrm{fb}^{-1}$ (CMS), with $\langle\mu\rangle \simeq 21$

Kinematics at the LHC ► $t\bar{t}$ production

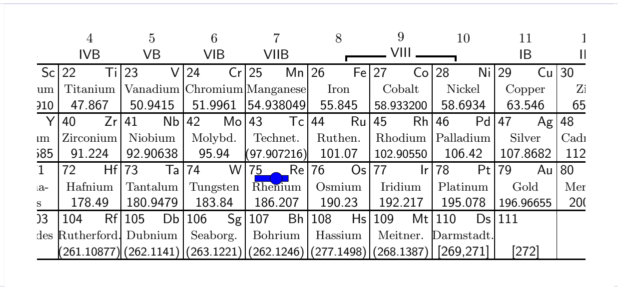




- Q vs. $x_{1,2}$ for the LHC at 7, 8, and 13 TeV (left)
- red curve shows top-pair production as example
- QCD measurements constrain α_s and PDF's – here CTEQ 6.6 (right)

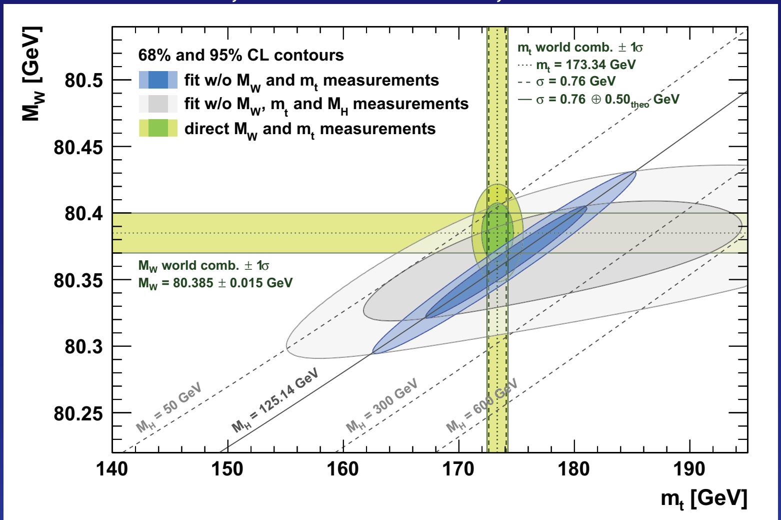
Importance of the top quark mass

- The top quark is by far the heaviest known fermion
- And the heaviest known particle – outperforming the Higgs by $\sim 40\%$ and the E.W. gauge bosons by $\sim 100\%$
  - Compared to the periodic table of elements a single top quark is as heavy as a Rhenium atom – heavier than Tungsten and not far from Gold ...



4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB
22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546
40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybd. 95.94	43 Tc Technet. (97.907216)	44 Ru Ruthen. 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682
72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.078	79 Au Gold 196.96655
104 Rf Rutherford. (261.10877)	105 Db Dubnium (262.1141)	106 Sg Seaborg. (263.1221)	107 Bh Bohrium (262.1246)	108 Hs Hassium (277.1498)	109 Mt Meitner. (268.1387)	110 Ds Darmstadt. [269,271]	111 [272]

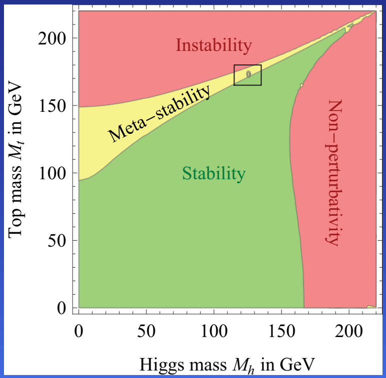
GFitter, M. Baak et al., arxiv:1407.3792

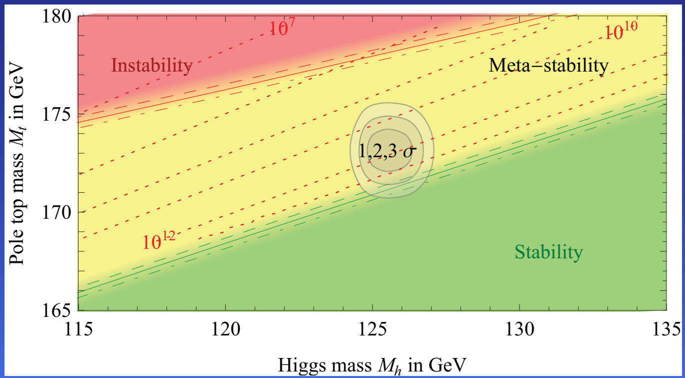


- m_{top} provides together with m_{W} and m_{Higgs} over-constraints to SM fits
- Direct measurements can be compared with indirect fit results to probe the validity of the SM

G. Degrassi et al., arxiv:1205.6497v2

- m_{top} and m_{Higgs} determine the SM vacuum stability





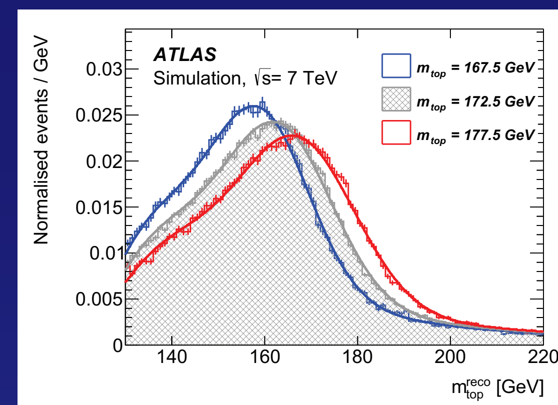
Pole mass vs. MC mass

- Different mass definitions need to be distinguished for the top quark
  - The MC mass (the parameter put into a MC generator program)
  - The pole mass (the parameter that enters the top propagator)
  - The mass in a low-scale short-distance scheme
- S. Moch et al., arxiv:1405.4781 interpret A.H. Hoang and I.W. Stewart, Nucl.Phys.Proc.Suppl. 185 (2008) 220-226 as The uncertainty on the translation from the MC mass definition to a theoretically well defined short distance mass definition at a low scale is currently estimated to be of the order of 1 GeV
  - The conversion from a short-distance mass to pole mass depends on the perturbative order and the used scale
  - The related uncertainty has not been fully worked out
- Most methods relying on kinematic fits to the distribution of top decay products (leptons, jets) measure the MC mass
- Cross-section based methods measure a theoretically well defined mass (e.g. pole mass)

Template/Ideogram based measurements

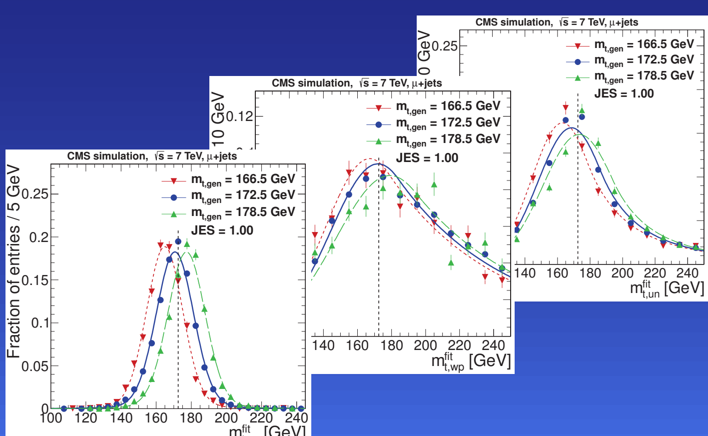
- Typical analysis in the case of MC mass
  - Reconstruct top candidates in data and MC ► often with kinematic fit
  - Perform Likelihood fit in one (m_{top}) or more (JES, bJES, f_{bkgd}) parameters
  - Likelihood is based on Templates (ATLAS+CMS) or Ideograms (CMS)
- Templates (ATLAS+CMS)
  - Templates are PDFs constructed from full MC simulations in the reconstructed quantities ($m_{\mathrm{top}}^{\mathrm{reco}}$, ...)
  - For a variety of generated top quark masses ($m_{\mathrm{top}}^{\mathrm{gen}}$ and optionally other quantities (JES, bJES))
  - Separately for signal ($t\bar{t}$) and background
  - Templates are parameterized and the parameters fitted linearly to varied quantities ($m_{\mathrm{top}}^{\mathrm{gen}}$, ...)
  - Likelihood uses the fitted Template functions

ATLAS, arxiv:1503.05427

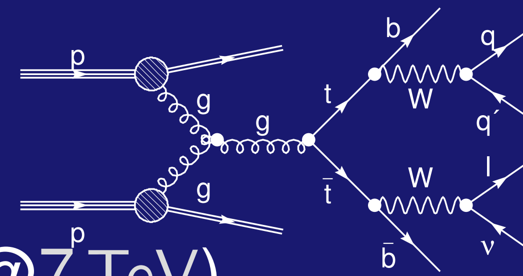


- Ideograms (CMS)
  - Extension of Templates
  - PDFs are constructed like above but not only separately for signal and background but also for different signal categories
  - Several permutations of the same event are allowed (weighted with $P_{\mathrm{g.o.f}}$) instead of just one
  - PDFs are parameterized and the parameters fitted linearly to varied quantities ($m_{\mathrm{top}}^{\mathrm{gen}}$, ...) as above
  - Likelihood uses the Ideograms (the weighted PDF for each permutation and category) with fitted parameterized PDFs

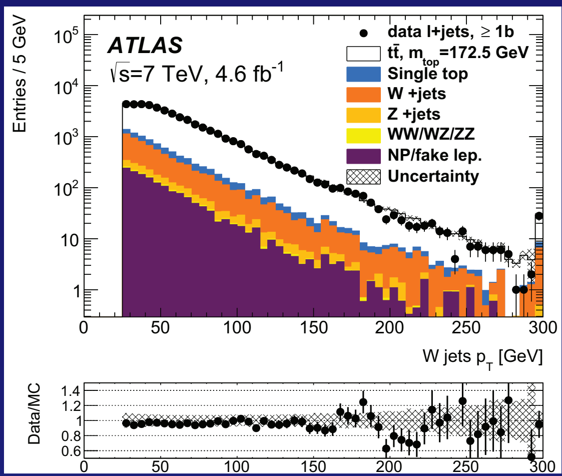
CMS, arxiv:1209.2319v2



- The Lepton+Jets channel gives the most precise result for m_{top}

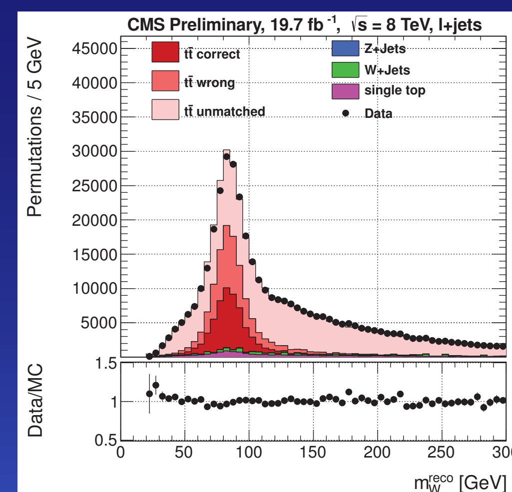


arxiv:1503.05427



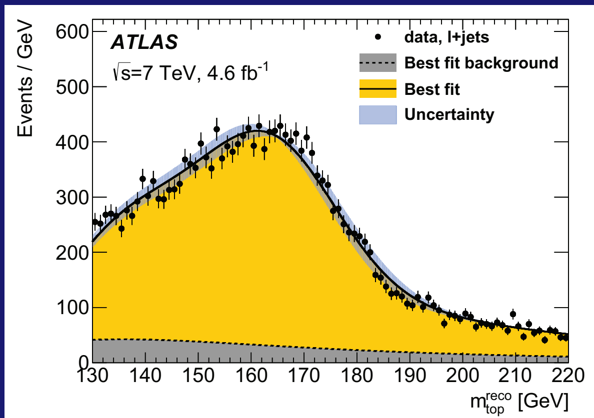
- Event selection (ATLAS@7 TeV)
  - One isolated electron (muon) with $|\eta| < 2.47(2.5)$, $|\eta_e| > 1.52 \vee |\eta_e| < 1.37$, $p_\perp > 25$ GeV (20 GeV)
  - Large missing transverse momentum: $E_\perp^{\mathrm{miss}} > 30$ GeV (20 GeV)
  - Large transverse mass of the leptonic W: $m_\perp^W > 30$ GeV ($E_\perp^{\mathrm{miss}} + m_\perp^W > 60$ GeV)
  - At least 4 AntiKt jets with $R = 0.4$, $|\eta| < 2.5$ and $p_\perp > 25$ GeV; at least one of them b-tagged

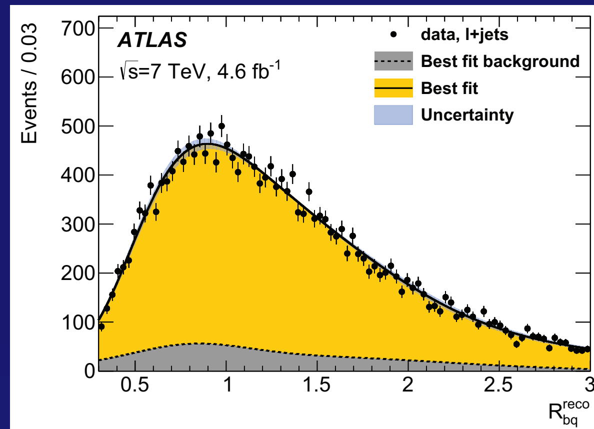
PAS-TOP-14-001

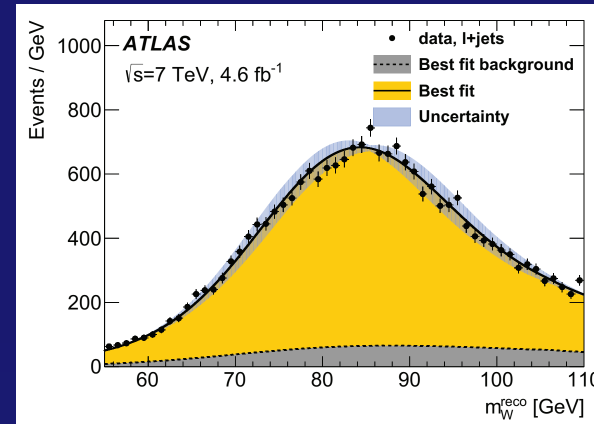


- Event selection (CMS@8 TeV)
  - One isolated electron or muon with $|\eta| < 2.1$, $p_\perp > 33$ GeV
  - At least 4 AntiKt jets with $R = 0.5$, $|\eta| < 2.4$ and $p_\perp > 30$ GeV; exactly two of them b-tagged
- Both use kinematic fits to constrain the masses/widths of W's and the decay of 2 heavy particles of equal mass
- Keeping the best permutation only (ATLAS) or all (CMS) with a g.o.f. probability weight

arxiv:1503.05427



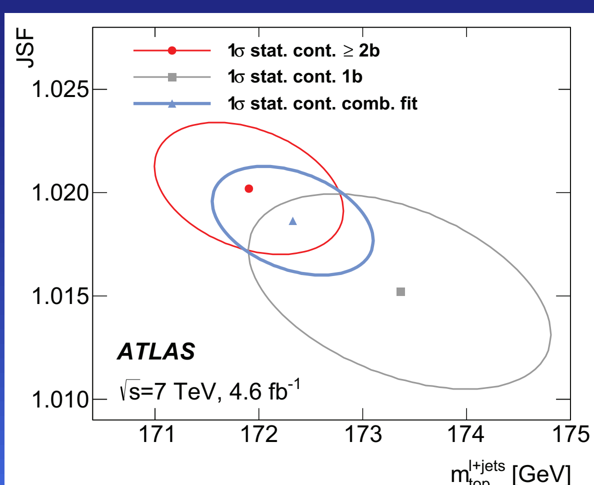


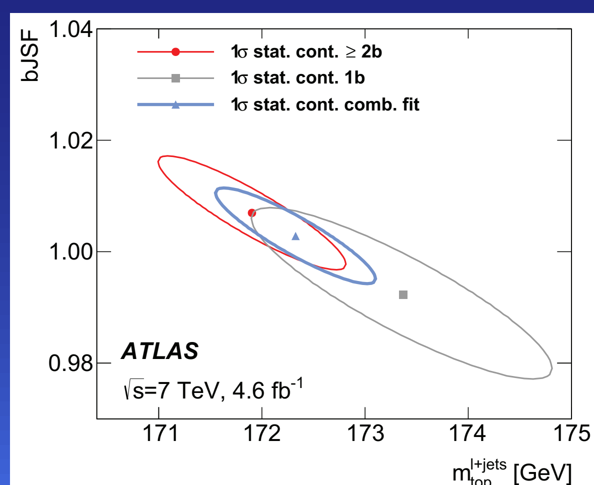


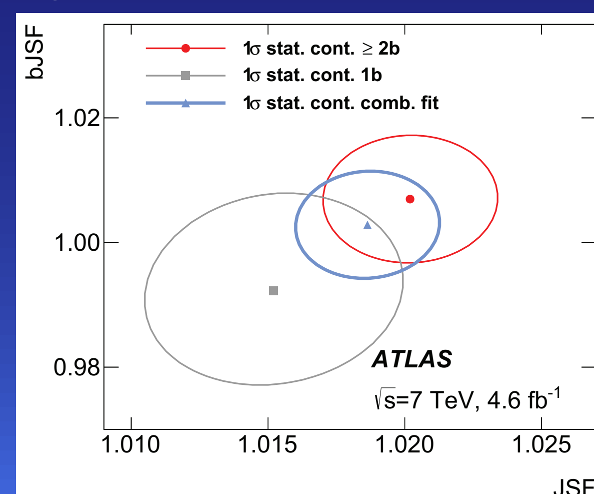
► Template fit (ATLAS@7 TeV)

- Simultaneously in three observables
- m_{top}^{reco} – top-mass after kinematic fit ► sensitive to m_{top}, JSF, bJSF
- R_{bq}^{reco} – ratio of transverse momenta of b-tagged over light jets before kinematic fit ► sensitive to bJSF
- m_{W}^{reco} – hadronic W mass before kinematic fit ► sensitive to JSF

$$m_{top} = 172.33 \pm 0.75_{stat} \pm 1.02_{sys} (0.58_{JES} \oplus 0.50_{bTag} \oplus 0.32_{ISR/FSR} \oplus \ldots) \text{ GeV}$$

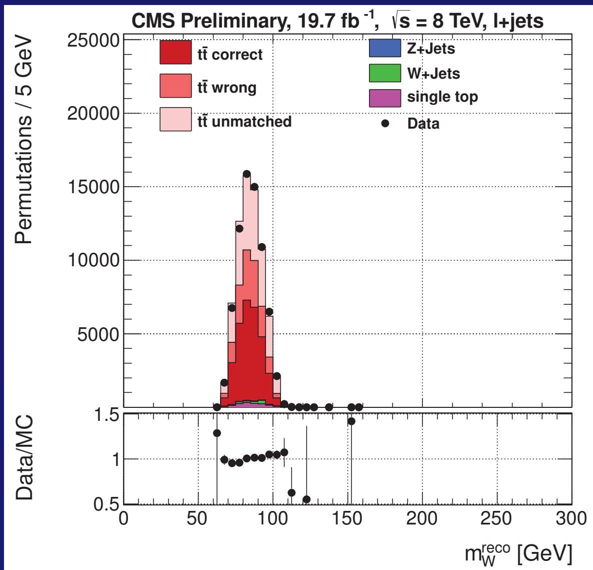


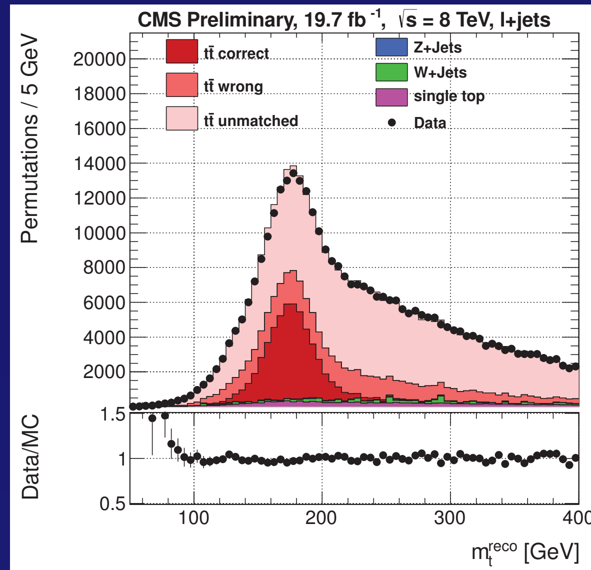


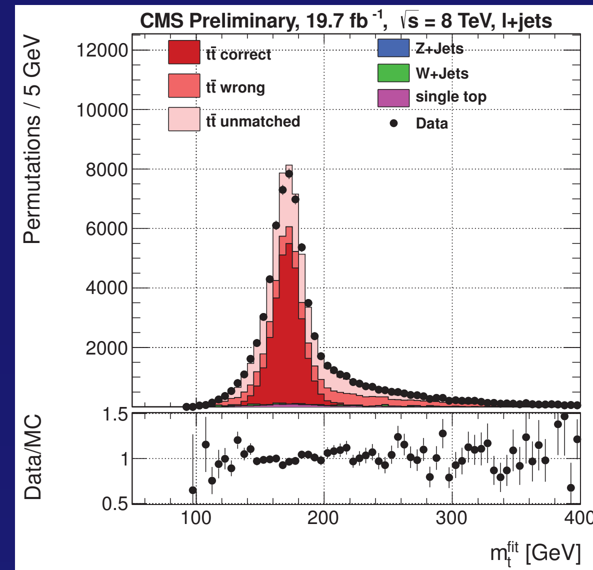


Template/Ideogram based measurements ► Lepton+Jets

PAS-TOP-14-001

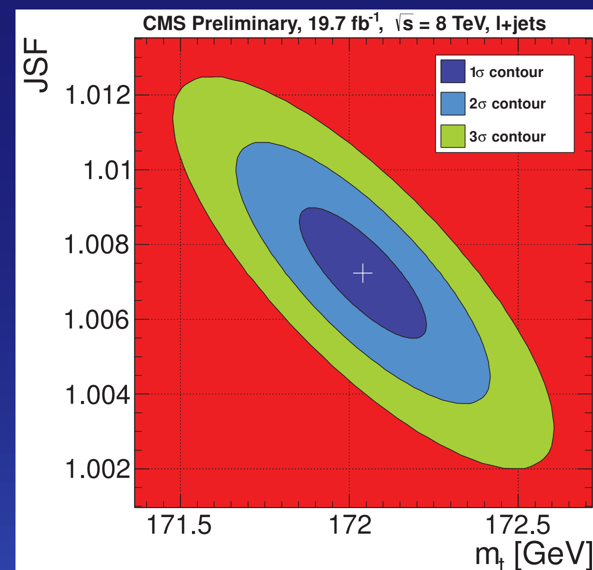


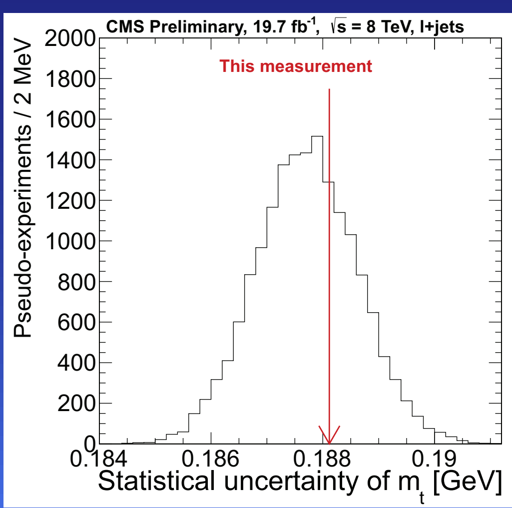




► Ideogram fit (CMS@8 TeV)

- Simultaneously in two observables
- m_t^{fit} – top-mass after kinematic fit and g.o.f. weighting ► sensitive to m_{top}, JSF
- m_W^{reco} – hadronic W mass before kinematic fit but weighted with g.o.f. ► sensitive to JSF

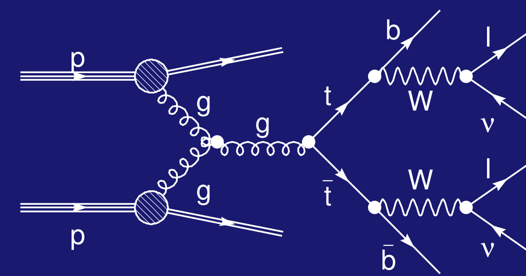




$$m_{top} = 172.04 \pm 0.19_{stat} \pm 0.75_{sys}$$

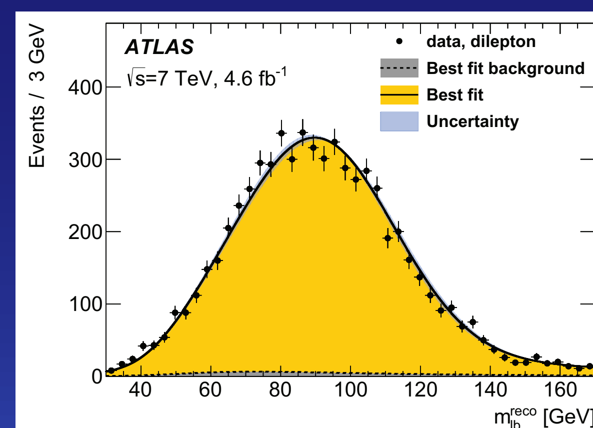
$$(0.41_{\text{Flavor JSF}} \oplus 0.27_{\text{PileUp}} \oplus 0.26_{\text{JER}} \oplus \ldots)\ \text{GeV}$$

- The Di-Lepton channel provides the cleanest sample of $t\bar{t}$ events



- Event selection (ATLAS@7 TeV)
  - Exactly two isolated oppositely charged leptons
  - Large missing transverse momentum for ee and $\mu\mu$: $E_{\perp}^{\text{miss}} > 60$ GeV
  - Invariant mass for same-flavor leptons: $m_{ee,\mu\mu} > 15\,\text{GeV} \wedge |m_{ee,\mu\mu} - 91\,\text{GeV}| > 10$ GeV
  - Hard objects transverse momentum sum in $e\mu$: $H_{\perp} > 130$ GeV
  - At least 2 AntiKt jets with $R = 0.4$, $|\eta| < 2.5$ and $p_{\perp} > 25$ GeV; exactly one or two of them b-tagged; for one b-tag add the one with highest MV1 weight

arxiv:1503.05427



- Template fit (ATLAS@7 TeV)
  - Construct $m_{\ell b}$ the inv. mass of the lepton and b-jet
  - Take the permutation with lowest average $m_{\ell b}$
  - Restrict to $30\,\text{GeV} < m_{\ell b}^{\text{reco}} < 170$ GeV
  - Fit to signal and background templates with m_{top} and bkgd. fraction as free parameters

$$m_{\text{top}} = 173.79 \pm 0.54_{\text{stat}} \pm 1.30_{\text{sys}} \\ (0.75_{\text{JES}} \oplus 0.68_{\text{bJES}} \oplus 0.53_{\text{Hadro.}} \oplus \ldots)\ \text{GeV}$$

- Combined fit with Lepton+Jets channel (correlation only -7%):

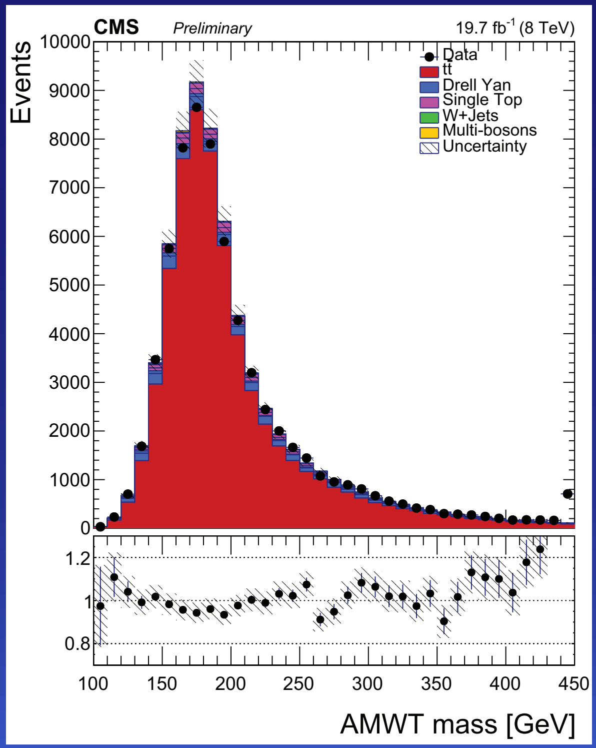
$$m_{\text{top}} = 172.99 \pm 0.48_{\text{stat}} \pm 0.78_{\text{sys}} (0.41_{\text{JES}} \oplus 0.34_{\text{bJES}} \oplus 0.34_{\text{Hadro.}} \oplus \ldots)\ \text{GeV}$$

Template/Ideogram based measurements ► Di-Lepton

► Event selection (CMS@8 TeV)

- Exactly two isolated oppositely charged leptons with $p_\perp > 20$ GeV and $|\eta| < 2.4$ for muons < 2.5 for electrons
- Large missing transverse momentum for ee and $\mu\mu$: $E_\perp^{\mathrm{miss}} > 40$ GeV
- Invariant mass for same-flavor leptons: $m_{ee,\mu\mu} > 15\ \mathrm{GeV} \wedge |m_{ee,\mu\mu} - 91\ \mathrm{GeV}| > 15$ GeV
- Data driven correction factors for DY background between 1.11 and 1.33 with $\sim 30\%$ uncertainty
- At least 2 AntiKt jets with $R = 0.5$, $|\eta| < 2.4$ and $p_\perp > 30$ GeV; at least one of them b-tagged; keep the two b-tagged jets with largest $p_\perp$ or supplement with the leading un-tagged jet

PAS-TOP-14-010



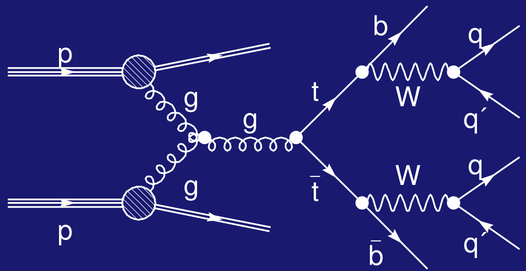
► Template fit (CMS@8 TeV)

- Construct top-mass estimator m_{peak} from 500 randomized re-reconstructions per event as the top mass with highest LO matrix weight for all kinematical allowed solutions (AMWT)
- Keep those in the range $100\ \mathrm{GeV} < m_{\mathrm{peak}} < 400$ GeV
- Fit to signal and background templates at 7 fixed $m_{\mathrm{top}}^{\mathrm{MC}}$ points
- Quadratic fit to the 7 $-\log\mathcal{L}$ values leads to m_{top} at minimum after un-blinding
- Correct for small method bias of -0.06 ± 0.03 GeV

$$m_{\mathrm{top}} = 172.47 \pm 0.17_{\mathrm{stat}} \pm 1.40_{\mathrm{sys}}$$
$$(0.87_{\mu_{R,F}} \oplus 0.67_{\text{b-frag}} \oplus 0.61_{\mathrm{JES}} \oplus \ldots)\ \mathrm{GeV}$$

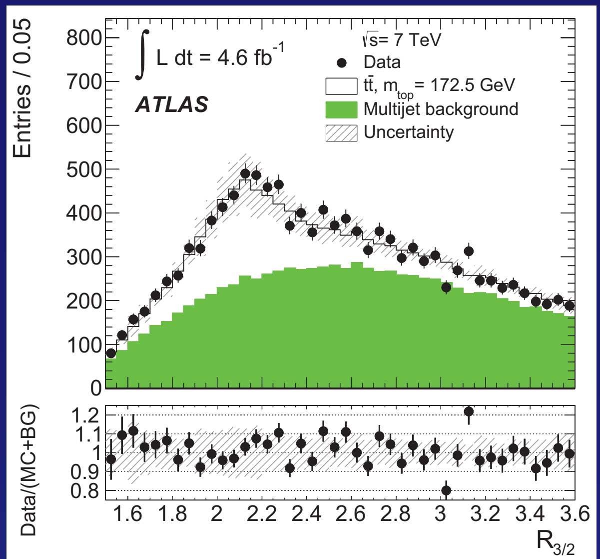
► Alternative blinded template fit (CMS@8 TeV)

- using $m_{\ell b}$ as estimator in $e\mu$ events (PAS-TOP-14-014): $m_{\mathrm{top}} = 172.2 \pm 1.3$ GeV



- The Full-Hadronic channel provides a fully reconstructed final state of $t\bar{t}$ events but suffers from large QCD multijet background

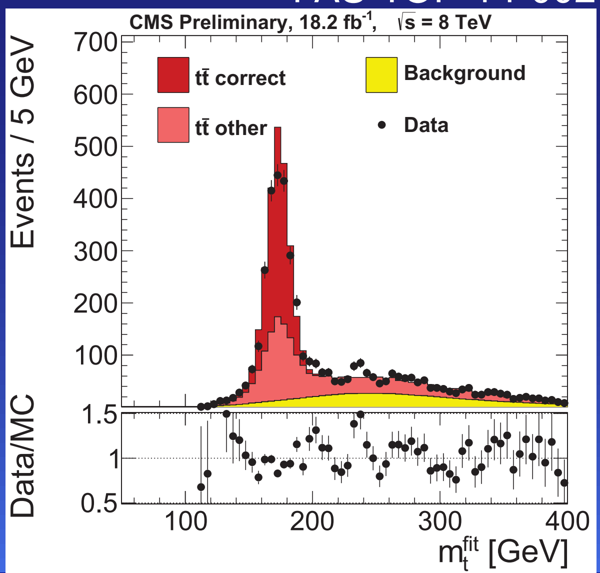
arxiv:1409.0832



► Event selection (ATLAS@7 TeV)

- No isolated high $p_\perp$ electrons or muons
- At least 5 central AntiKt jets with $R = 0.4$ and $p_\perp > 55$ GeV
- At least one more central jet with $p_\perp > 30$ GeV
- JVF > 0.75 for all jets
- No significant $E_\perp^{\text{miss}}$
- Exactly 2 b-tagged jets among the leading 4
- Reject events not compatible with kinematic fit to $t\bar{t}$ hypothesis

PAS-TOP-14-002



► Event selection (CMS@8 TeV)

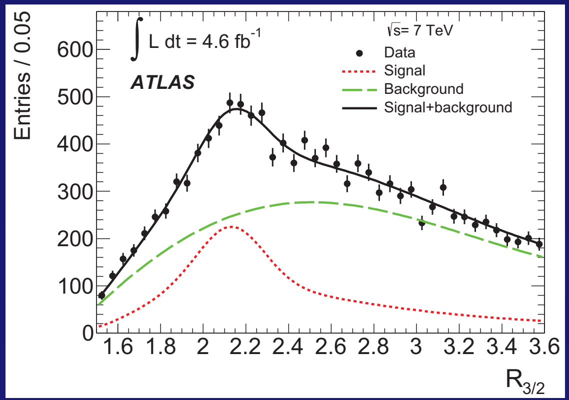
- At least 4 central AntiKt jets with $R = 0.5$ and $p_\perp > 60$ GeV
- Two more central jets with $p_\perp > 30$ GeV
- Exactly 2 b-tagged jets among the leading 6
- Reject events not compatible with kinematic fit to $t\bar{t}$ hypothesis $p_{\text{g.o.f.}} > 0.1$
- Large distance of the b-tagged jets $\Delta R_{b\bar{b}} > 2.0$

► Data-driven QCD multijet bkgd. estimates (ATLAS & CMS)

Template/Ideogram based measurements ► Full-Hadronic

► Template fit to $R_{3/2} \equiv m_{jjj}/m_{jj}$ (ATLAS@7 TeV)

arxiv:1409.0832



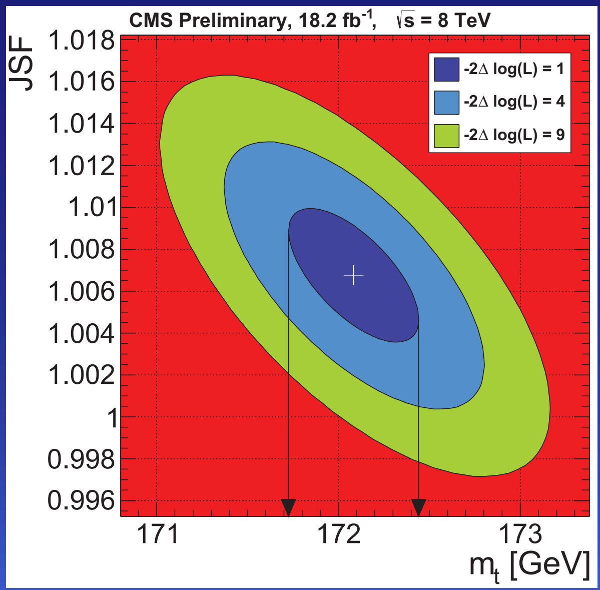
- Both $R_{3/2}$ of each event used (60% correlated) ► accounted for in stat. error
- Fit to linearly parameterized templates of signal MC
- Parameterized background from "ABCDEF" method binned in 2 bins of 6th jet $p_\perp$ and # of b-tags (0,1,2) ► region F is signal region; bkgd. in F from ratios of other regions
- Tests with 5000 pseudo-experiments lead to small correction of bias -0.23 ± 0.14 GeV

$$m_{top} = 175.1 \pm 1.4_{stat} \pm 1.2_{sys} (0.62_{bJES} \oplus 0.51_{JES} \oplus 0.50_{Hadro.} \oplus \ldots) \text{ GeV}$$

PAS-TOP-14-002

► Ideogram fit to m_t^{fit} (CMS@8 TeV)

- m_t^{fit} after and m_W^{reco} before kinematic fit used as input to Ideogram fit
- Multijet background is estimated from event mixing with randomized jet content
- m_t, JSF and f_{sig} and $f_{correct}$ are fitted for all permutations
- Calibration by 10 000 pseudo-experiments correct small bias in m_t and JSF

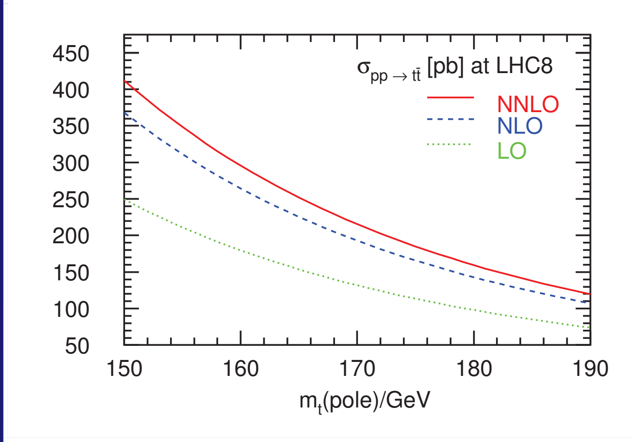


$$m_{top} = 172.08 \pm 0.36_{stat} \pm 0.83_{sys} (0.36_{Flavor\ JSF} \oplus 0.31_{PileUp} \oplus 0.28_{JES} \oplus \ldots) \text{ GeV}$$

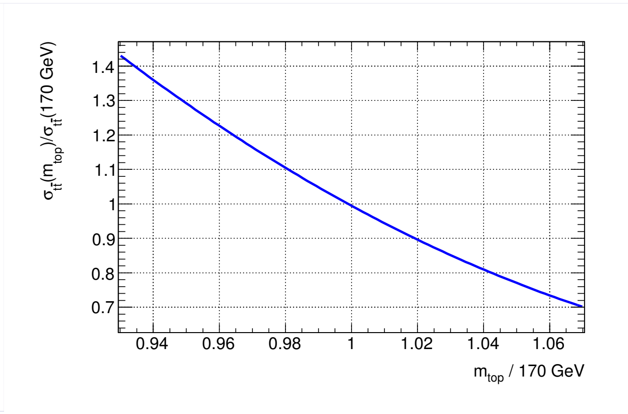
Pole mass measurements

- Opposite approach than for Template/Ideogram methods
  - Instead of fitting to MC distributions “folded” with the detector response unfold the data to hadron/parton level
  - Compare to QCD predictions with $m_{\text{top}}^{\text{pole}}$ as parameter
  - Pro: Better defined mass
  - Caveat: Larger uncertainties on both theory and experiment
- Example: Cross section as function of $m_{\text{top}}^{\text{pole}}$ in LO, NLO and NNLO
  - Large dependency on order: $\sigma_{\text{NNLO}}/\sigma_{\text{NLO}} \simeq 10\%$
  - Relative uncertainty stable: $\Delta\sigma_{t\bar{t}}/\sigma_{t\bar{t}} \simeq 5\% \to \Delta m_{\text{top}}/m_{\text{top}} \simeq 1\%$
- Experimental challenges:
  - Unfolding is more difficult than folding
  - Cross sections need absolute normalization
- New observables help
  - Use shapes of differential cross-sections instead of total cross sections
  - For example $\mathcal{R}(m_{\text{top}}^{\text{pole}}, \rho_s) = \frac{1}{\sigma_{t\bar{t}+1\text{jet}}} \frac{d\sigma_{t\bar{t}+1\text{jet}}}{d\rho_s}(m_{\text{top}}^{\text{pole}}, \rho_s)$, with $\rho_s = \frac{2m_0}{\sqrt{s_{t\bar{t}j}}}$ (S. Alioli et al., Eur.Phys.J. C73 (2013) 2438)

S. Alekhin, J. Bluemlein, S. Moch
Phys.Rev. D89 (2014) 5, 054028

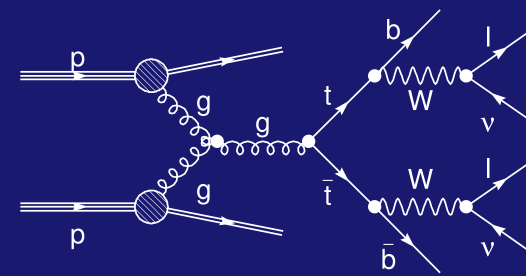


LO shape – NNLO identical



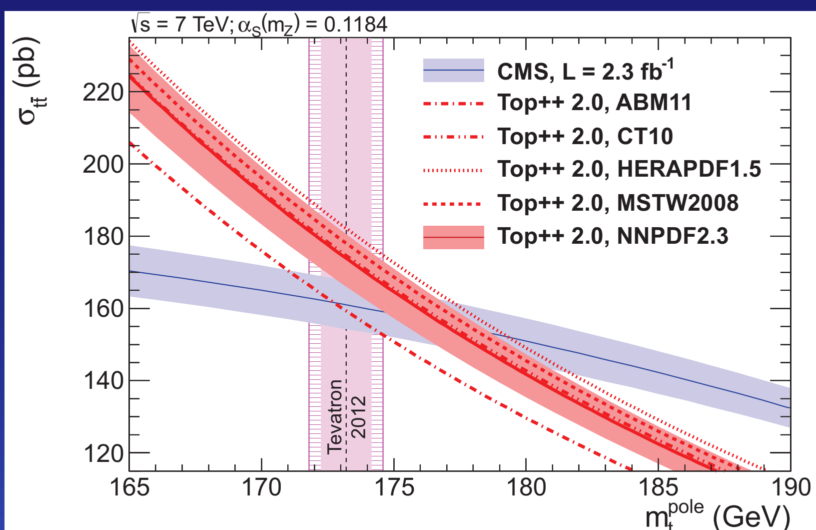
Pole mass measurements ► Di-Lepton

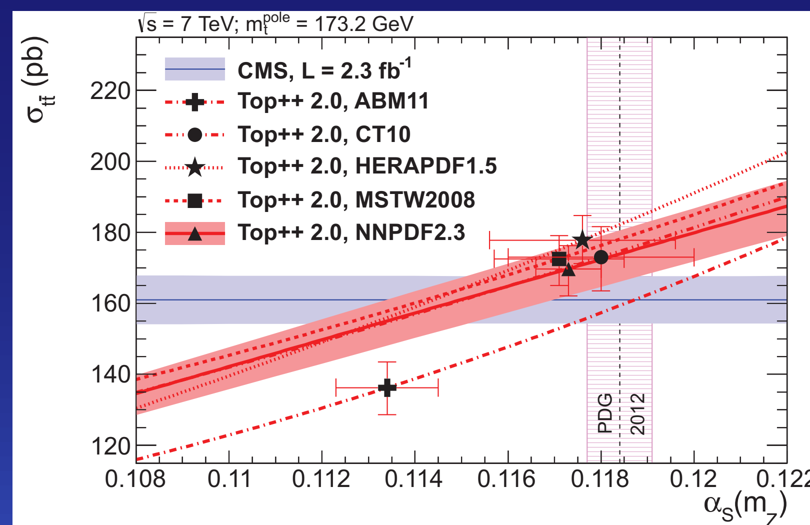
- m_{top}^{pole} from total $t\bar{t}$ cross-section in the di-Lepton channel measured by CMS@7 TeV (see talk by J.G. Garcia)



- Original measurement of cross-section (CMS, arxiv:1208.6682) assumed $m_{top} = 172.5\,\text{GeV}$ and $\alpha_s(m_Z) = 0.118$
  - $\sigma_{t\bar{t}} = 161.9 \pm 6.7\,\text{pb}$
  - Analysis was turned around to measure m_{top}^{pole} or α_s (fixing the other parameter) from predicted $\sigma_{t\bar{t}}$ in NNLO+NNLL with different NNLO PDF sets

CMS, Phys.Lett.B 728 (2014) 496



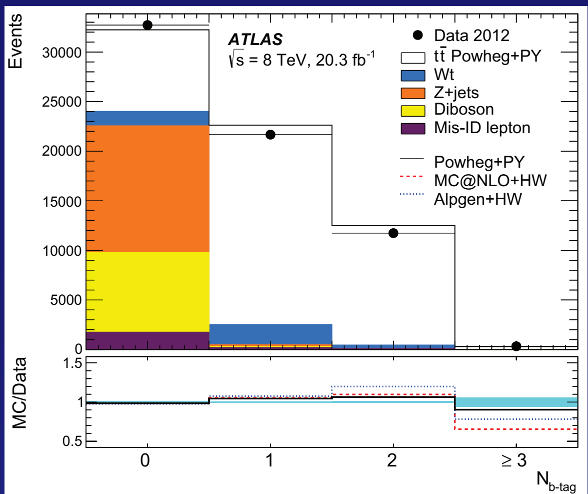


$$m_{top}^{pole} = 176.7^{+3.0}_{-2.8}\left(^{+2.1}_{-2.0}\,_{\text{meas. xsec}} \oplus\ ^{+1.5}_{-1.3}\,_{\text{PDF}} \oplus 0.9_{\mu_{R,F}} \oplus 0.9_{E_{\text{LHC}}} \oplus \ldots\right)\,\text{GeV}$$

Pole mass measurements ► Di-Lepton

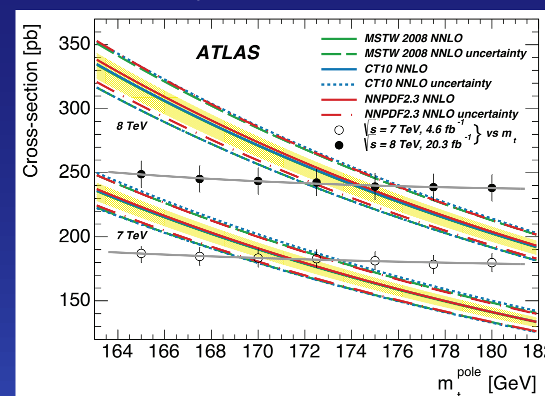
- $m_{\text{top}}^{\text{pole}}$ from total $t\bar{t}$ cross-section in the di-Lepton channel measured by ATLAS@7 and 8 TeV

Eur.Phys.J. C74 (2014) 3109



- Measurement of cross-section with oppositely charged di-lepton ($e\mu$) final states with exactly 1 or 2 b-tagged jets (see talk by S. Protopopescu)
  - The two b-tag bins constrain b-tagging efficiency
  - Results contain small dependency on assumed $m_{\text{top}} = 172.5$ GeV in MC through Wt bckgd. MC and reconstruction efficiencies
  - $\sigma_{t\bar{t}}(7\text{ TeV}) = 182.9 \pm 7.1$ pb
  - $\sigma_{t\bar{t}}(8\text{ TeV}) = 242.4 \pm 10.3$ pb

Eur.Phys.J. C74 (2014) 3109



- Extraction of pole mass
  - Bayesian likelihood approach
  - Theoretical errors from several PDF+α_s sets and QCD scale dominate
    - ► Large correlation leads to almost identical error for combination

$$m_{\text{top},7\text{ TeV}}^{\text{pole}} = 171.4 \pm 0.6_{\text{stat}} \pm 2.5_{\text{sys+theo}} (1.8_{\text{PDF}+\alpha_s} \oplus {}^{+0.9}_{-1.2}{}_{\mu_{R,F}} \oplus 0.8_{\text{analysis}} \oplus \ldots)\text{ GeV}$$

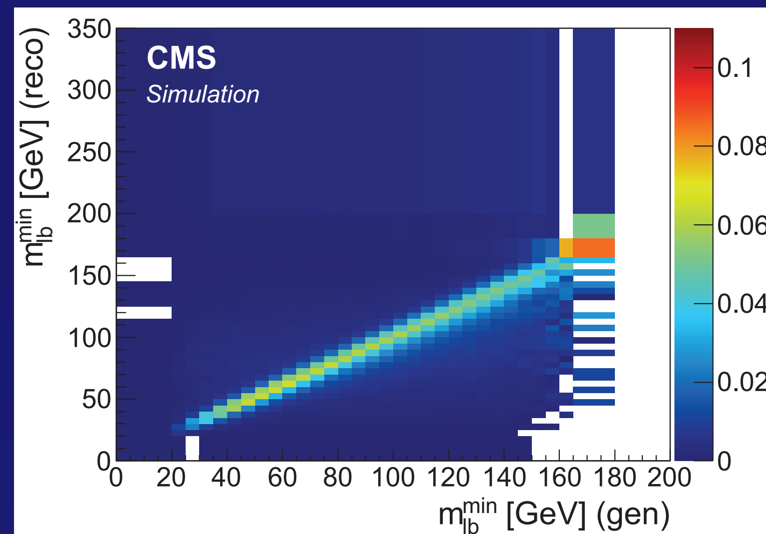
$$m_{\text{top},8\text{ TeV}}^{\text{pole}} = 174.1 \pm 0.3_{\text{stat}} \pm 2.6_{\text{sys+theo}} (1.7_{\text{PDF}+\alpha_s} \oplus {}^{+0.9}_{-1.3}{}_{\mu_{R,F}} \oplus 1.2_{\text{lumi}} \oplus \ldots)\text{ GeV}$$

Pole mass measurements ► Di-Lepton

► CMS@8 TeV

- Take permutation that minimizes $m_{\ell b}$ from both leptons and leading b-tagged jet
- Construct detector response matrix to map generated $m_{\ell b}^{gen}$ to reconstructed $m_{\ell b}^{reco}$
- Fold MCFM-based prediction of differential cross-section σ_{pred} with response matrix
- Fit folded MCFM $m_{\ell b}$ distributions with different m_{top} to shape of data

PAS-TOP-14-014



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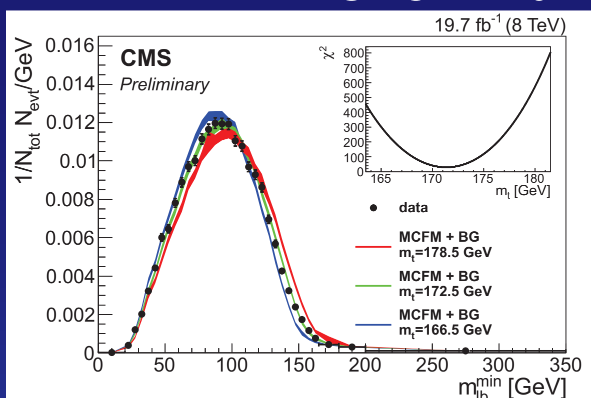

► From folded MCFM@NLO:

$$m_{top} = 171.4 \pm 0.4_{stat} \pm 1.0_{sys}$$
$$(0.5_{\mu_{R,F}} \oplus 0.43_{JES} \oplus 0.43_{b\ frag} \oplus \ldots)\ \text{GeV}$$

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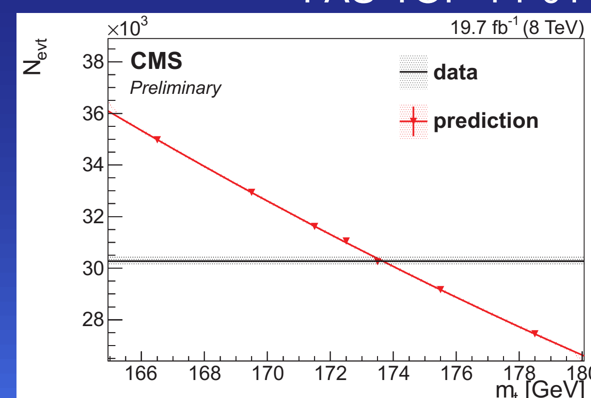


► From total cross-section compared to NNLO calculation: $m_{top} = 173.7 \pm 0.3_{stat} \pm 3.4_{sys}$

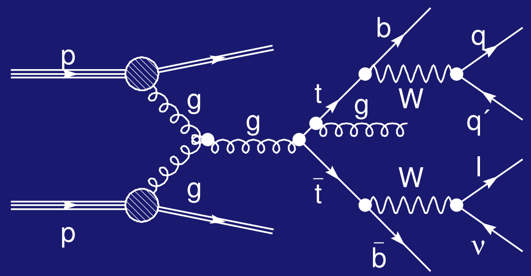
$$(1.3_{lumi} \oplus 1.2_{bkgd} \oplus 1.1_{ME} \oplus \ldots)\ \text{GeV}$$

- with detector effects modeled by MadGraph+Pythia+Geant4

- $m_{\rm top}^{\rm pole}$ from differential cross section observable in $t\bar{t} + 1$jet:

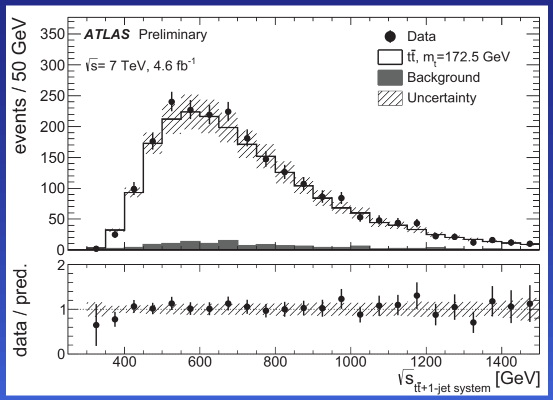
$$\mathcal{R}(m_{\rm top}^{\rm pole}, \rho_s) = \frac{1}{\sigma_{t\bar{t}+1\rm jet}} \frac{d\sigma_{t\bar{t}+1\rm jet}}{d\rho_s}(m_{\rm top}^{\rm pole}, \rho_s),$$

with $\rho_s = \frac{2m_0}{\sqrt{s_{t\bar{t}j}}}$ by ATLAS@7 TeV



- Event selection
  - First select $t\bar{t}$ candidates in the lepton+jets channel
  - One central high $p_\perp > 25$ GeV isolated electron or muon
  - Large transverse missing momentum and lepton+neutrino mass: $E_\perp^{\rm miss} > 30$ GeV, $m_\perp^{\rm W} > 30$ GeV
  - At least 5 central AntiKt jets with $R = 0.4$, $p_\perp > 25$ GeV and JVF > 0.75
  - 2 of them b-tagged
  - Test light jet pairs for consistency with W ($0.9 < \alpha \equiv m_{\rm W}^{\rm ref}/m_{jj} < 1.25$) and correct with α
  - Constrain mass of leptonic W and keep the permutation minimizing the mass difference between had. and lep. top quark and requiring $m_t^{\rm lep} > 0.9 m_t^{\rm had}$
  - Leading unused jet (the additional one) needs to satisfy $p_\perp > 50$ GeV and $|\eta| < 2.5$

ATLAS-CONF-2014-053

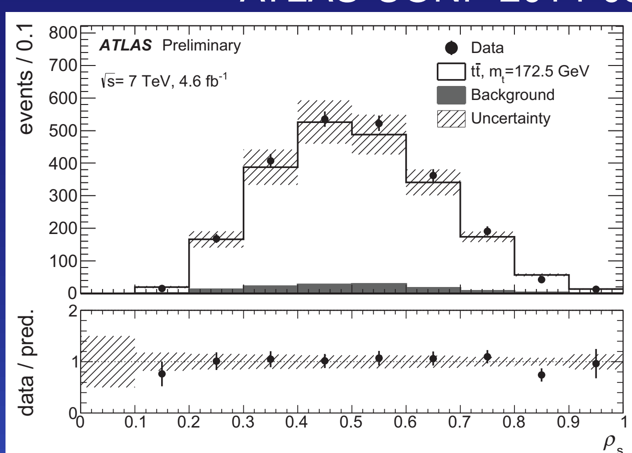


Pole mass measurements ► $t\bar{t} + 1\,\mathrm{jet}$

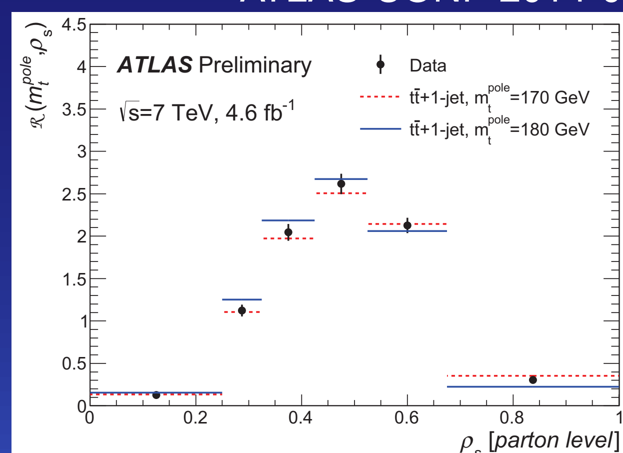
► Unfolding of distribution in ρ_s

- Unfolding by SVD with response matrix from Powheg+Pythia+Geant4 to parton level with on-shell top quarks
- Apply second (small) correction step to move to parton level equivalent to NLO+PS calculation
- $m_{\mathrm{top}}^{\mathrm{pole}}$ extracted from χ^2-fit to theory with regularized covariance matrix in unfolded $0.25 < \rho_s < 1$
- Most sensitive bin is $0.675 < \rho_s < 1$ (zoom on the right)
- Validation with Powheg+Pythia+Geant4 MC samples with MC masses from 167.5 to $180\ \mathrm{GeV}$ but unfolded with default matrix (@$172.5\ \mathrm{GeV}$)
  ► consistent results with input masses within statistical errors

ATLAS-CONF-2014-053



ATLAS-CONF-2014-053



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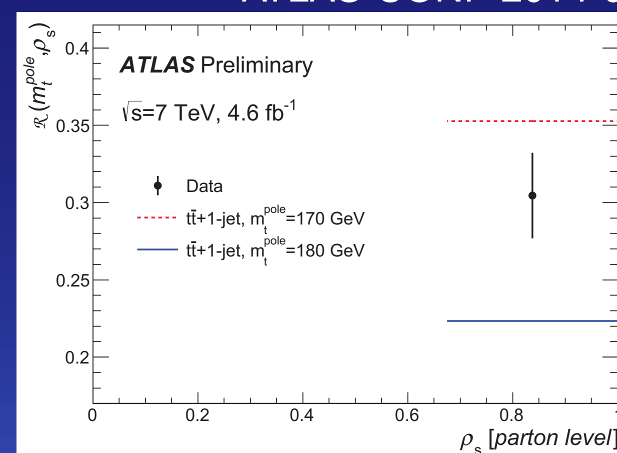
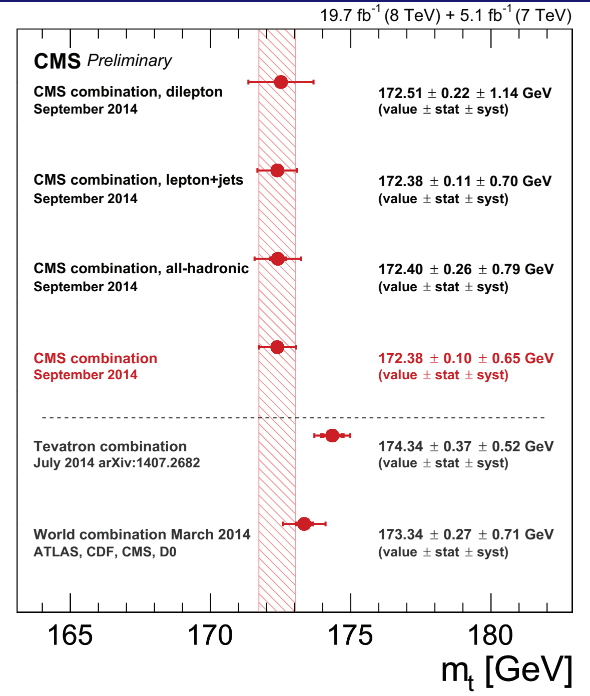


$$m_{\mathrm{top}}^{\mathrm{pole}} = 173.7 \pm 1.5_{\mathrm{stat}}\, {}^{+1.0}_{-0.5}{}_{\mathrm{theo}} \pm 1.4_{\mathrm{sys}} (0.9_{\mathrm{JES+bJES}} \oplus 0.7_{\mathrm{ISR/FSR}} \oplus 0.5_{\mathrm{PDF}} \oplus \ldots)\ \mathrm{GeV}$$

Conclusions

- Top quark mass measurements are performed in high precision at LHC
  - Template/Ideogram methods fitting to MC mass provide smallest uncertainties
  - Calculations of pole mass form inclusive cross-section measurements
  - Folding/Unfolding methods to pole-mass sensitive distributions are improving in precision
  - So far no inconsistencies between the measurement schemes discovered
- CMS summary of Run1 results: $m_{top} = 172.38 \pm 0.10_{stat} \pm 0.65_{sys}$ GeV
- Preliminary ATLAS summary of 7 TeV Run1 results: $m_{top} = 172.99 \pm 0.48_{stat} \pm 0.78_{sys}$ GeV
- March 2014 Tevatron+LHC summary: $m_{top} = 173.34 \pm 0.27_{stat} \pm 0.71_{sys}$ GeV
- We look forward to complete the Run1 analyses and to more results from Run2@13 TeV!

PAS-TOP-14-015



ATLAS public plots