m_W in the HL/HE-LHC era

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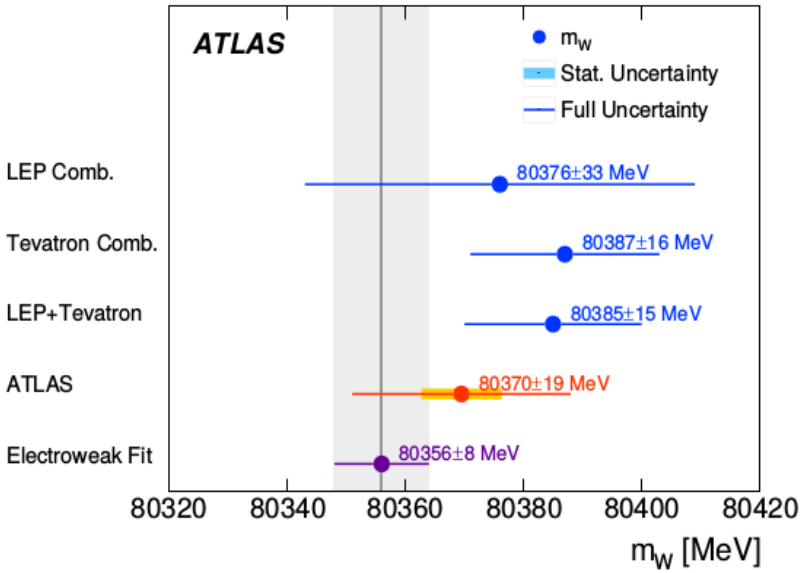
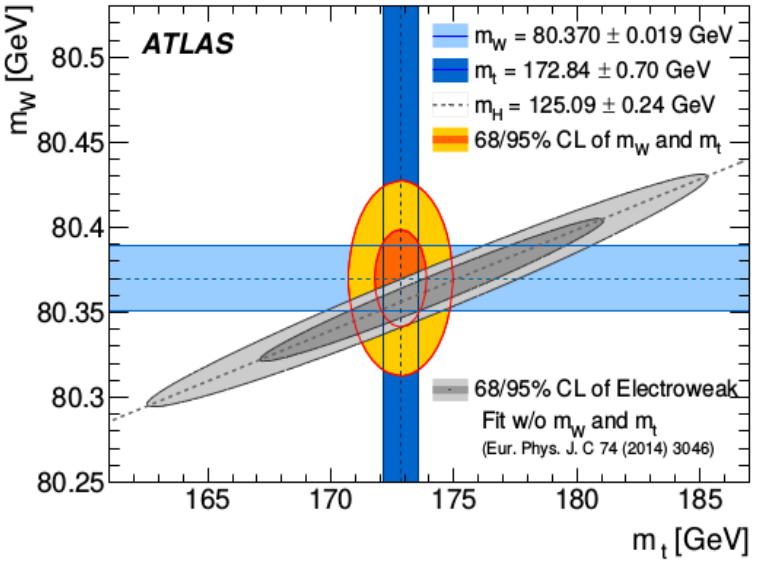
- m_W is a key parameter of the standard model, and we need to invest effort in its measurement with the objective of reaching $dm_W \sim 5$ MeV (or thereabout), i.e. below the precision of the indirect determination

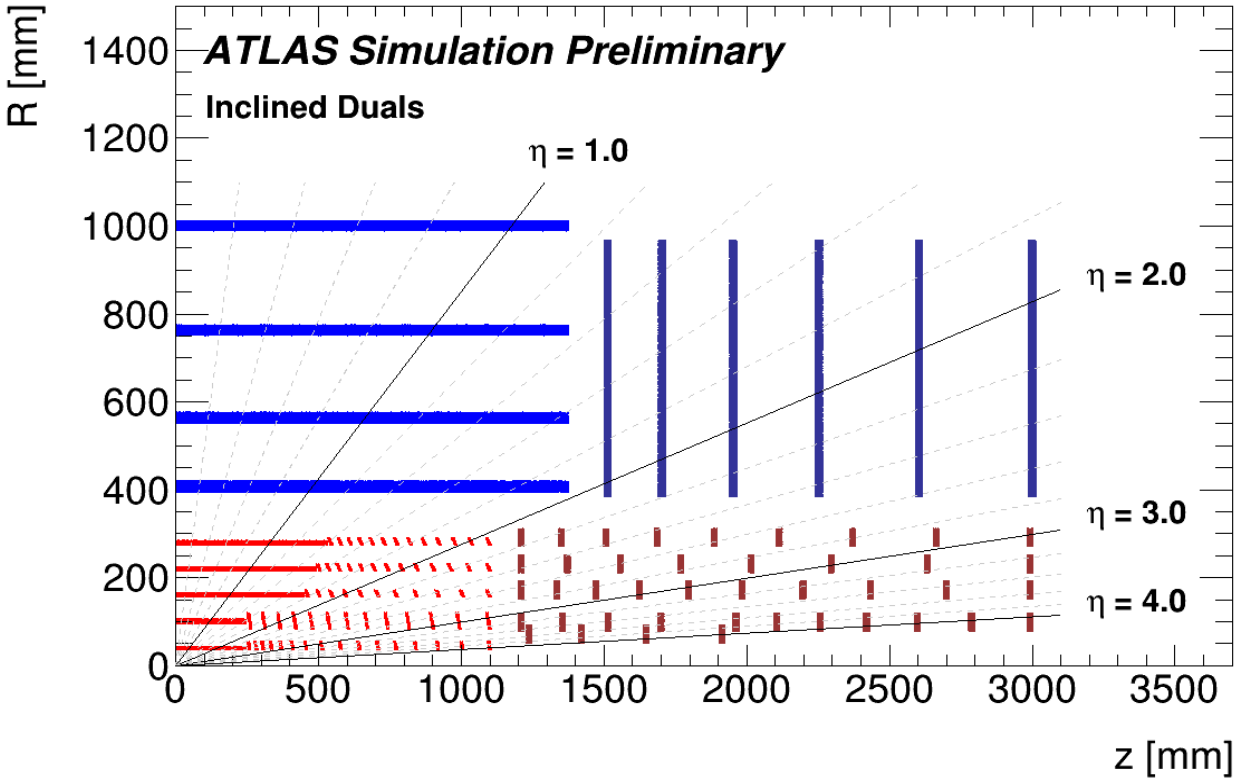




- NB : hand-waving world-averages start appearing, with values $\delta m_W \sim 11 – 13$ MeV, depending on the assumed correlation between the TeVatron and ATLAS measurements

The upgraded tracker

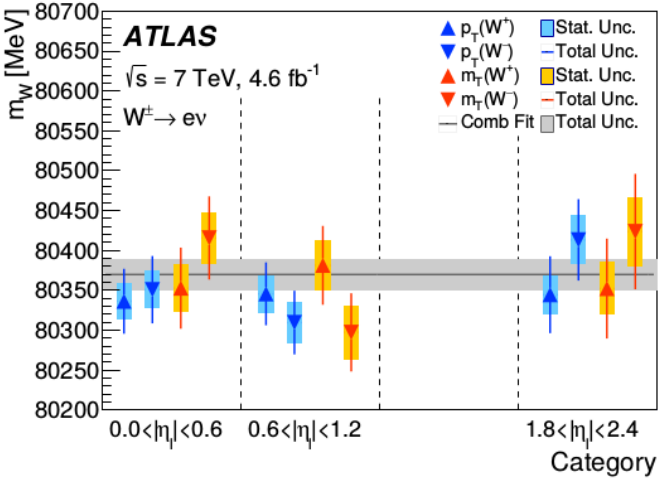
- ITK layout :

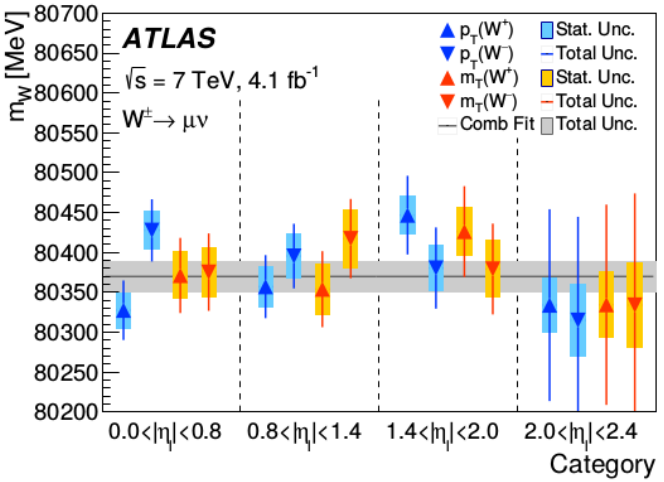


- With proper trigger, allows to record single-electron events ($W \rightarrow e\nu$) up to $|\eta|$~4
  - Muon trigger still stops at $|\eta|$~2.7

De/correlation of PDF uncertainties

- Pseudo-rapidity bins of the ATLAS measurement:





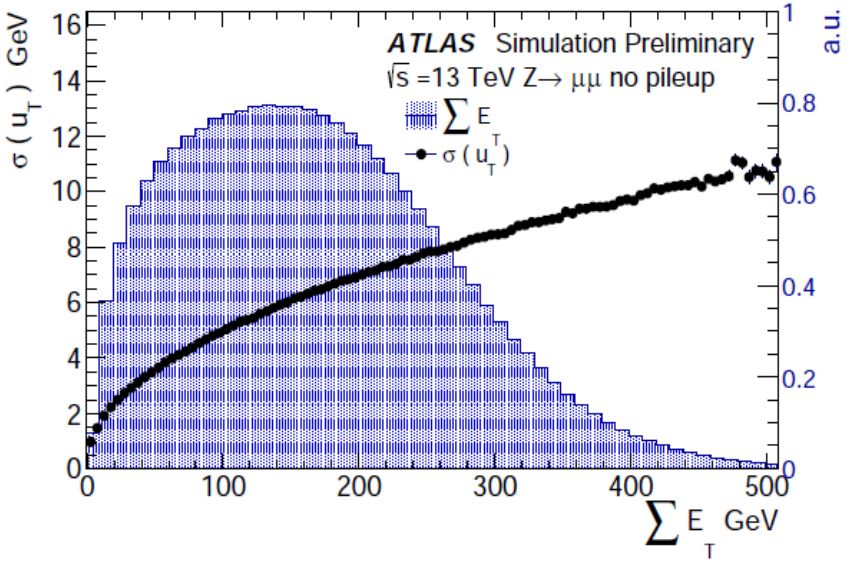
PDF uncertainty:
- in each bin : 20-30 MeV
- combined : ~8-9 MeV

- Tevatron : extending the lepton pseudorapidity range from ~1 to ~2 is expected to divide the PDF uncertainty by ~2
- LHCb study (arXiv:1508.06954) : finds ~30% reduction of PDF uncertainty from combining the General Purpose Detectors with LHCb
- What do we gain from the extended pseudorapidity range in ATLAS?

Potential of low pile-up samples

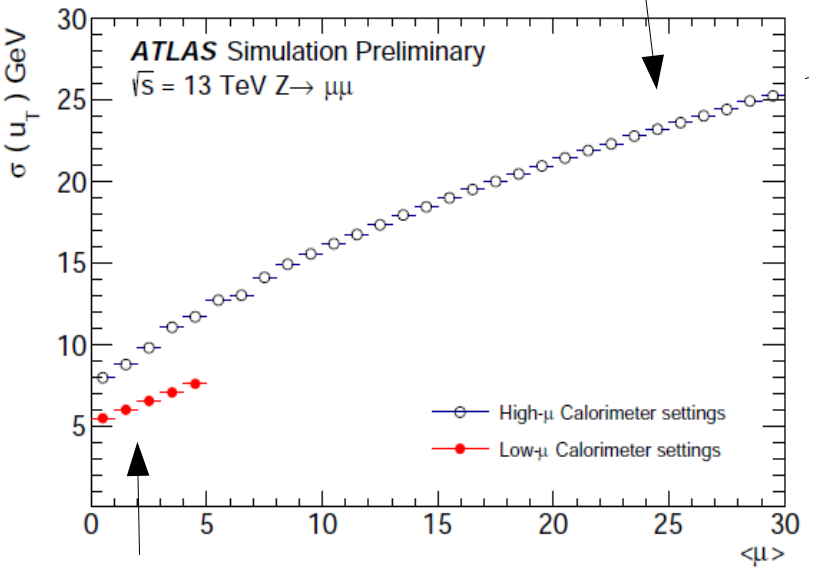
HL-LHC

- Recoil resolution (enters MET, mT):



2017

2016



2017 low-μ runs

- In 2017, ATLAS took ~270 pb^{-1} at 5 TeV and ~155 pb^{-1} at 13 TeV, μ~2.
  - 1.3M + 1.7M clean, well measured candidates
  - Statistical sensitivity : ~13 MeV from each sample, and for each distribution (pT, mT) – correlations to be evaluated

Proposal

- Event generatior + smearing at 13 and 27 TeV
  - μ~2
  - 10M events at each energy and for each lepton flavour (e, μ)
  - Include PDF uncertainty variations
- Estimate potential of ~1-2 weeks of low pile-up data at each energy
  - ~200 pb^{-1} ; ~2M candidates at 13 TeV; ~4M at 27 TeV
  - If interesting, could of course ask for a bit more (and/or at different energies)
- Evaluate the gain of
  - The additional η range ($|\eta|<2.5 \rightarrow |\eta|<4$) at 13 TeV (accessible in the electron channel)
  - The jump in center-of-mass energy

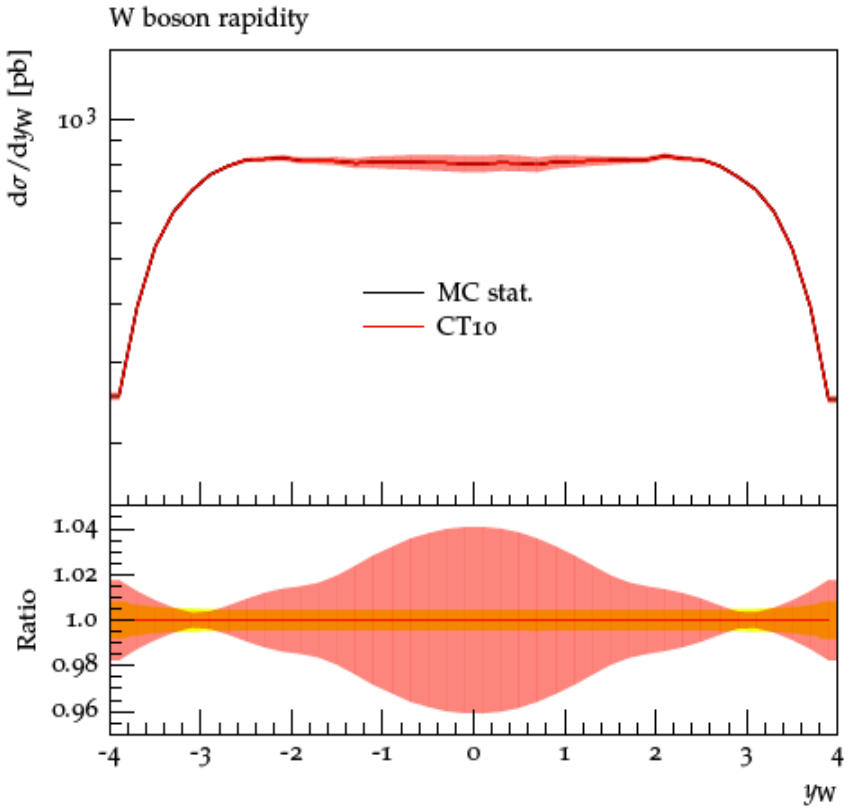
  via decorrelation of PDF uncertainties.
- Depending on results, motivates work to bring other sources of uncertainty (QCDxEW corrections, pTW/pTZ...) on par.

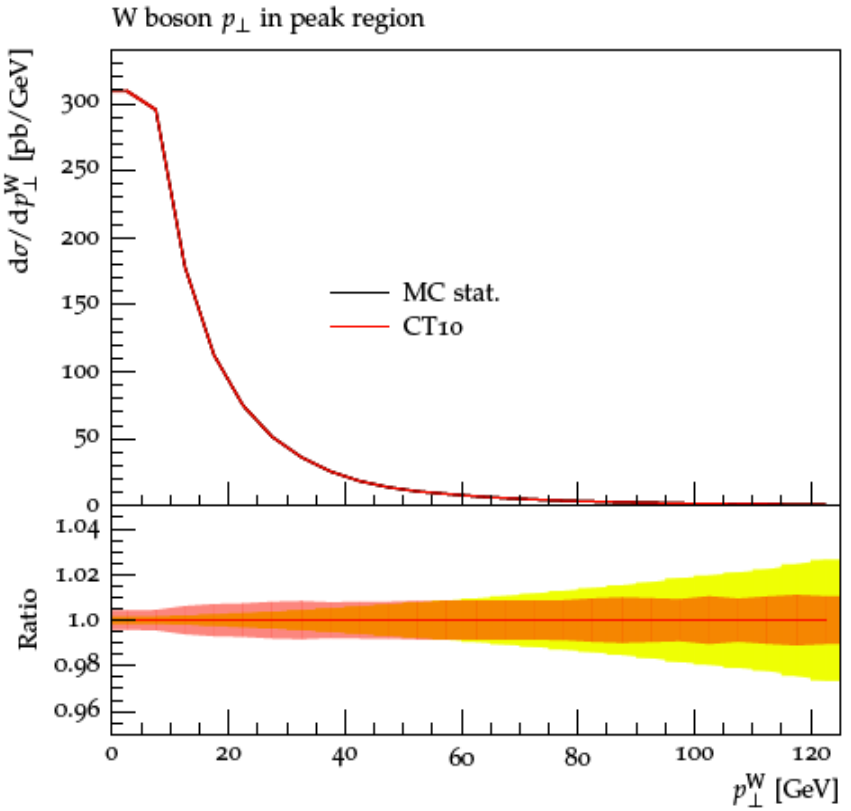
Status

- Event generation : Powheg + Photos; internal PDF variations

13TeV | CT10 uncertainties

- First look at PDF weights:



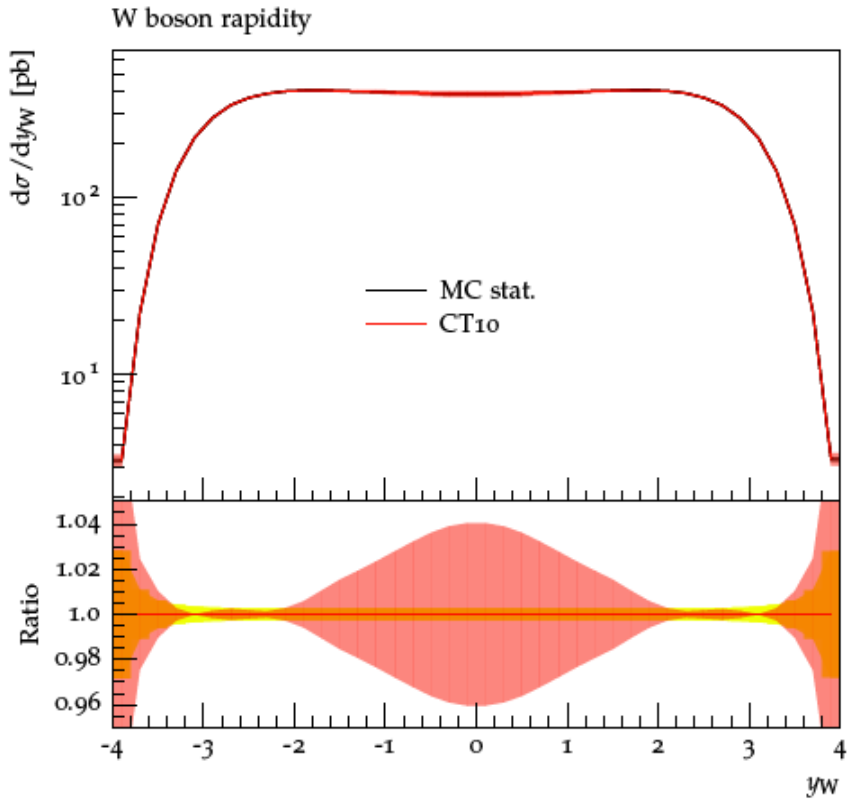


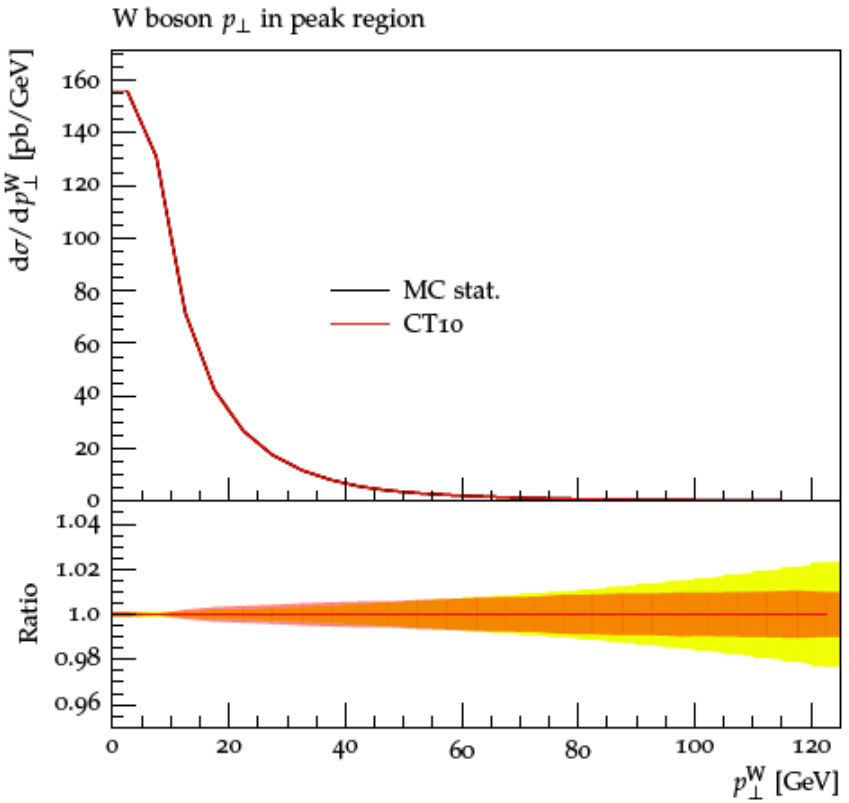
Status

- Event generation : Powheg + Photos; internal PDF variations

5TeV | CT10 uncertainties

- First look at PDF weights:

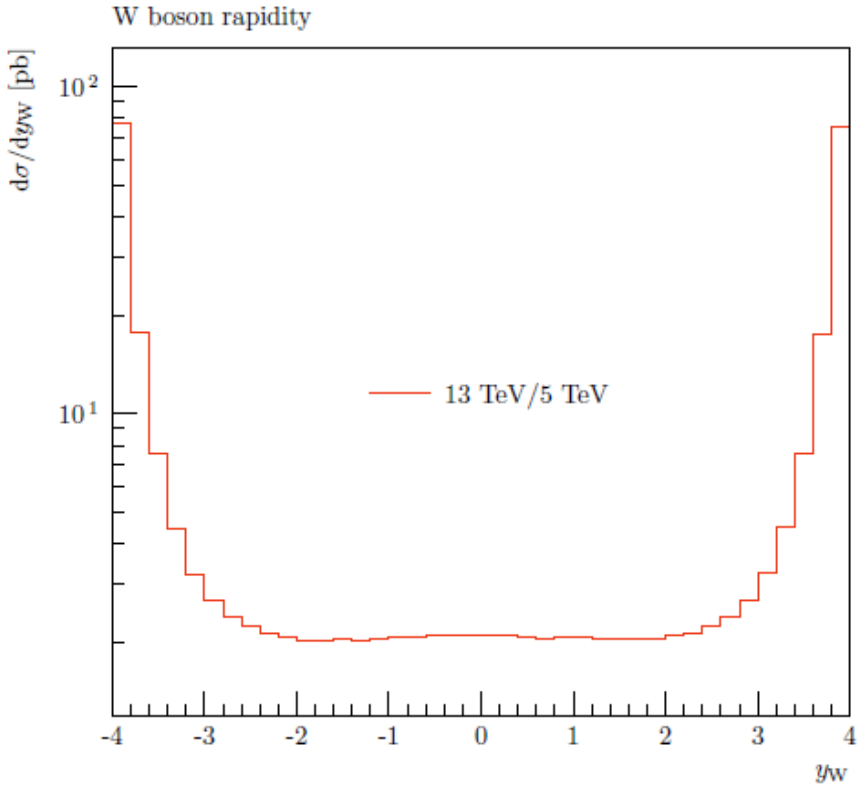


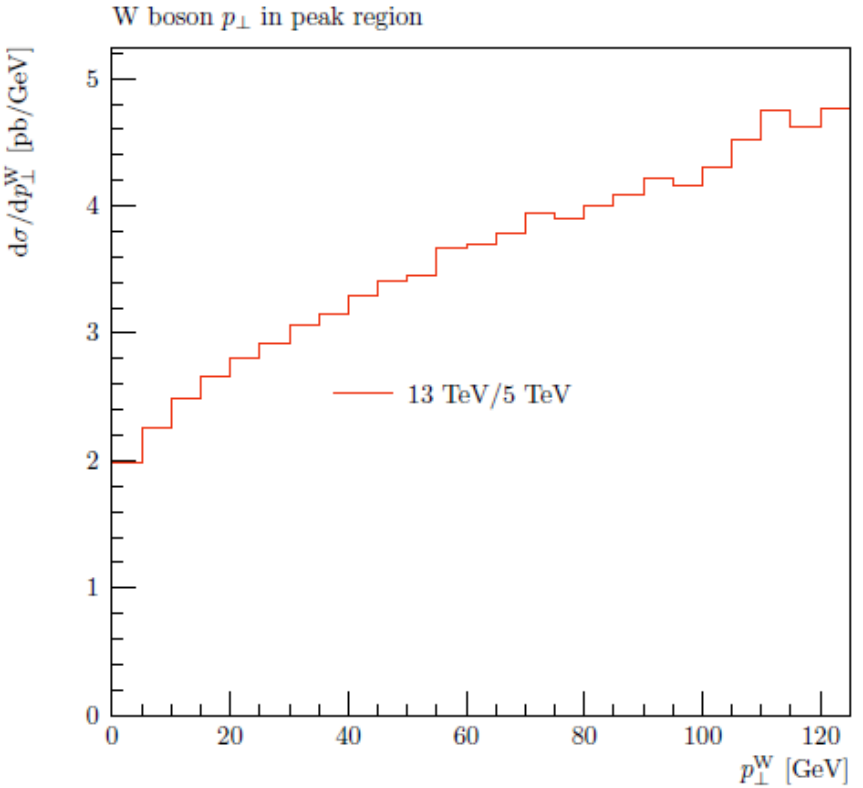


Status

- Event generation : Powheg + Photos; internal PDF variations

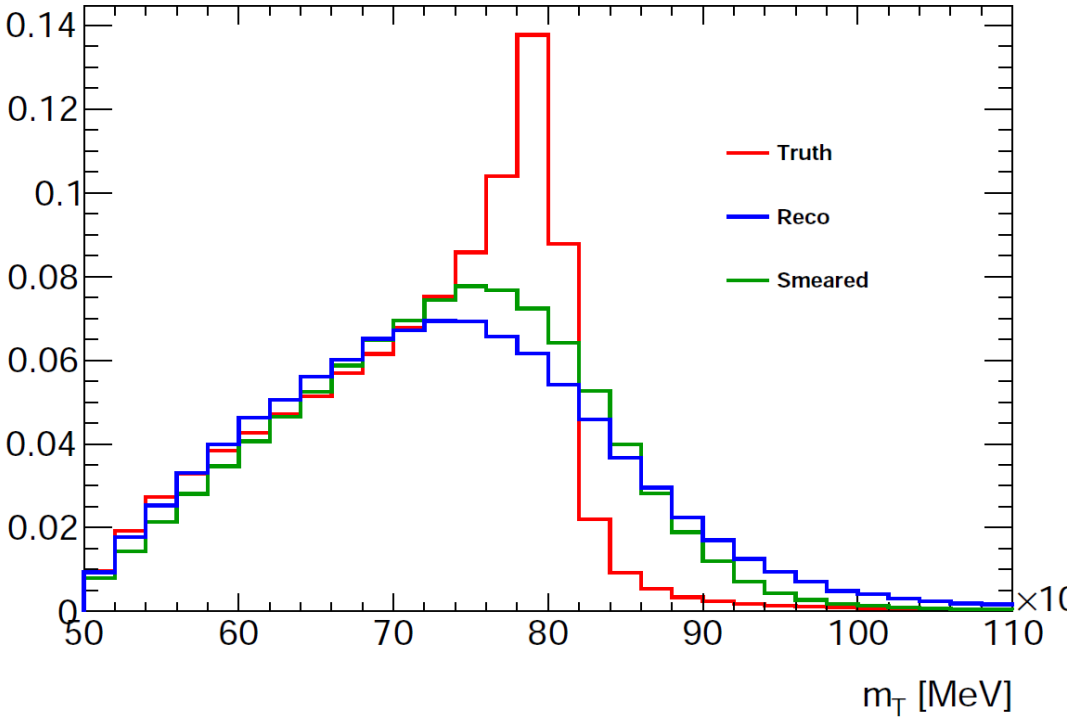
13TeV/5TeV | Central values





Status

- Smearing :
  - Recoil : at μ~2, $u_T^{smeared} \sim u_T^{true} \oplus$ ~6 GeV (depending on bosn p_T and SumET)
  - Leptons : standard resolution parametrizations, reproducing expected ATLAS performance
    - Electrons: $\sigma/E \sim a/E^{1/2} \oplus b/E \oplus c$ (a ~ 12%, b ~ 100-200 MeV, c ~ 0.7%)
    - Muons: $\sigma/p_T \sim r_0/p_T \oplus r_1 \oplus r_2 * p_T$ (r_1 ~ 2%)



Being improved, but already allows uncertainty estimates with <10% accuracy

Outline of contribution

- 2-3 pages of text:
  - Event selection; expected statistics; categories ($|\eta|_l$ bins, etc); statistical precision of mW fit
  - PDF uncertainties and uncertainty correlations in the various configurations
- Figures : example pTl and mT distributions
- Tables:
  - PDF uncertainties :

	CT14	MMHT2014	...
(1) 7 TeV, $\|\eta\|<2.5$			
(2) 13 TeV, $\|\eta\|<2.5$			
(3) 13 TeV, $\|\eta\|<4.0$			
(4) 27 TeV, $\|\eta\|<4.0$			

  - PDF correlations for the four configurations
  - Cumulative PDF uncertainties (1) → (1)+(2) → (1)+(2)+(3) → (1)+(2)+(3)+(4)