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The latest results on top quark pair cross-section measurement

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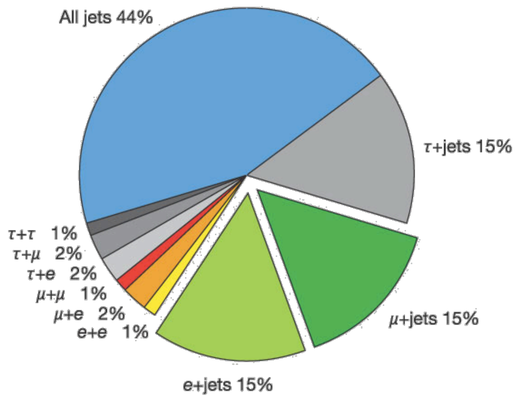
Top quark

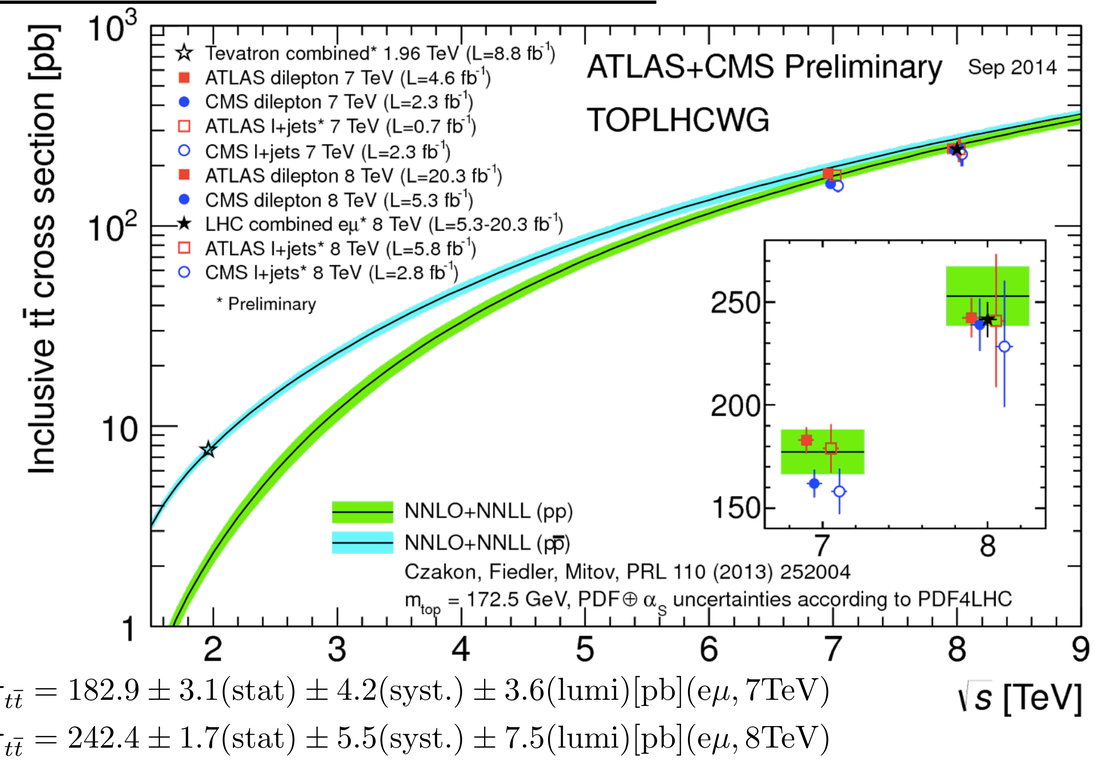
Top quark is the heaviest elementary particle (173 GeV) in the Standard Model (SM). Since its mass is close to the electro-weak symmetry breaking scale, the top-quark production cross-section is sensitive to various new physics models. Additionally, since the top-antitop pairs are produced via the strong interaction, the measurement of the pair-production cross-section is useful to test perturbative QCD (pQCD) .

Top quark decays into a b-quark and a W-boson with a branching fraction of about 100%. Therefore, the final state of the top quark pair is categorized by the decays of two W-bosons.

Top quark pair decay modes



Inclusive cross-section measurement



$\sigma_{t\bar{t}} = 182.9 \pm 3.1(\text{stat}) \pm 4.2(\text{syst.}) \pm 3.6(\text{lumi})[\text{pb}](e\mu, 7\text{TeV})$

$\sigma_{t\bar{t}} = 242.4 \pm 1.7(\text{stat}) \pm 5.5(\text{syst.}) \pm 7.5(\text{lumi})[\text{pb}](e\mu, 8\text{TeV})$

The experimental uncertainty is small enough to provide the input to the pQCD calculations.

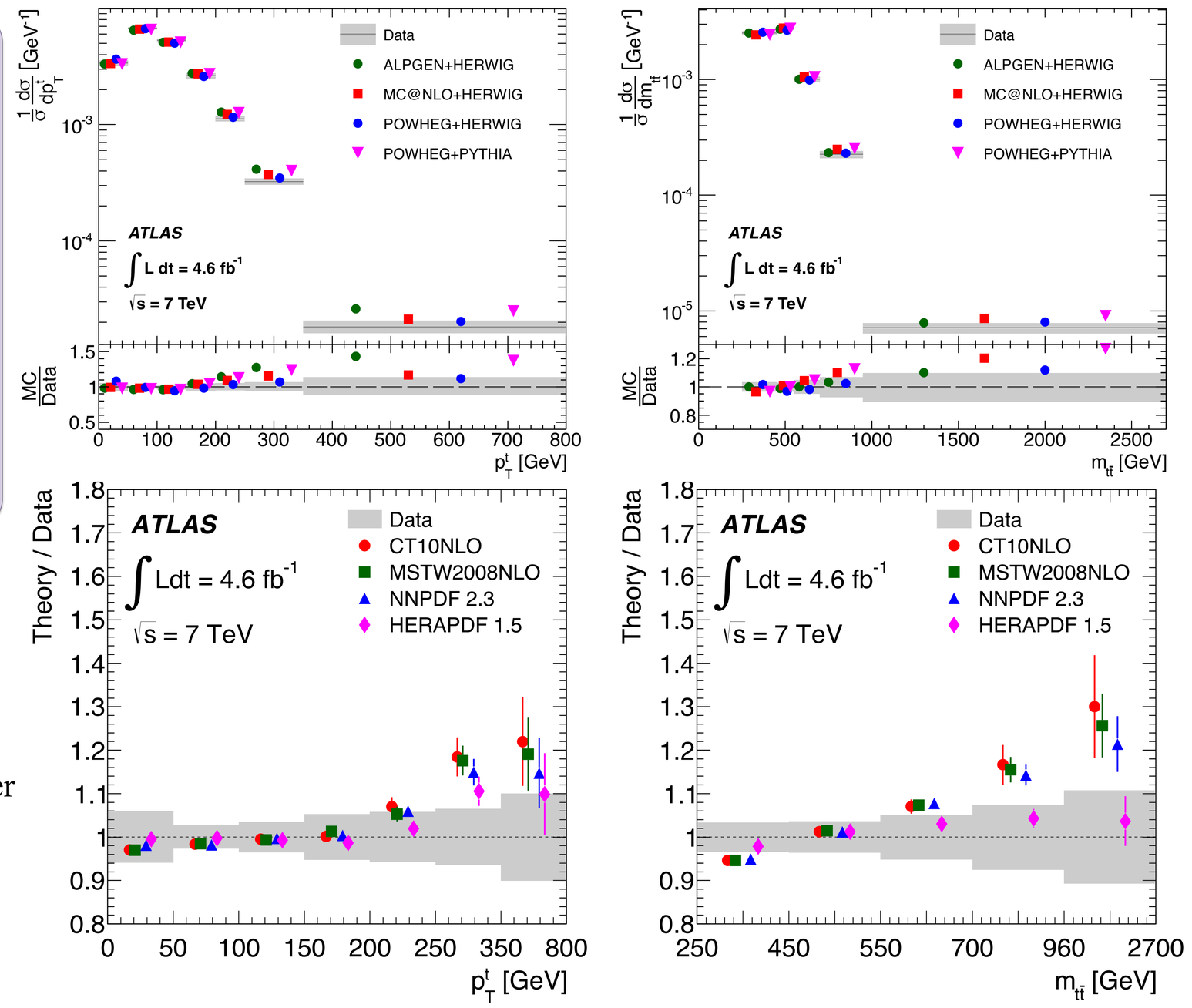
Differential cross-section measurement using lepton + jets events at 7 TeV

Phys. Rev. D 90, 072004

Analysis method

The top-quark pair is reconstructed with a kinematic likelihood fit. Top quark decay in a leading-order representation is assumed in the likelihood fit. Reconstructed variables are unfolded to correct for the detector response. e+jets and μ+jets channels are individually unfolded and combined. The normalized cross-section is obtained by dividing by the measured total cross-section in order to reduce systematic uncertainties.

The results are compared to the predictions of Monte Carlo MC generators and next-to-leading-order (NLO) QCD calculations.
MC predictions agree with the data within the uncertainties in a wide kinematic region.
However, the measured cross-sections are smaller than the predictions in high p_T^t and m_{tt} regions.
The distributions show some preference for HERAPDF1.5 when used in conjunction with a fixed-order NLO QCD calculation.

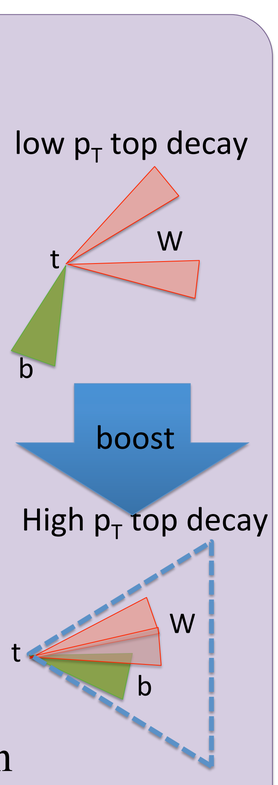


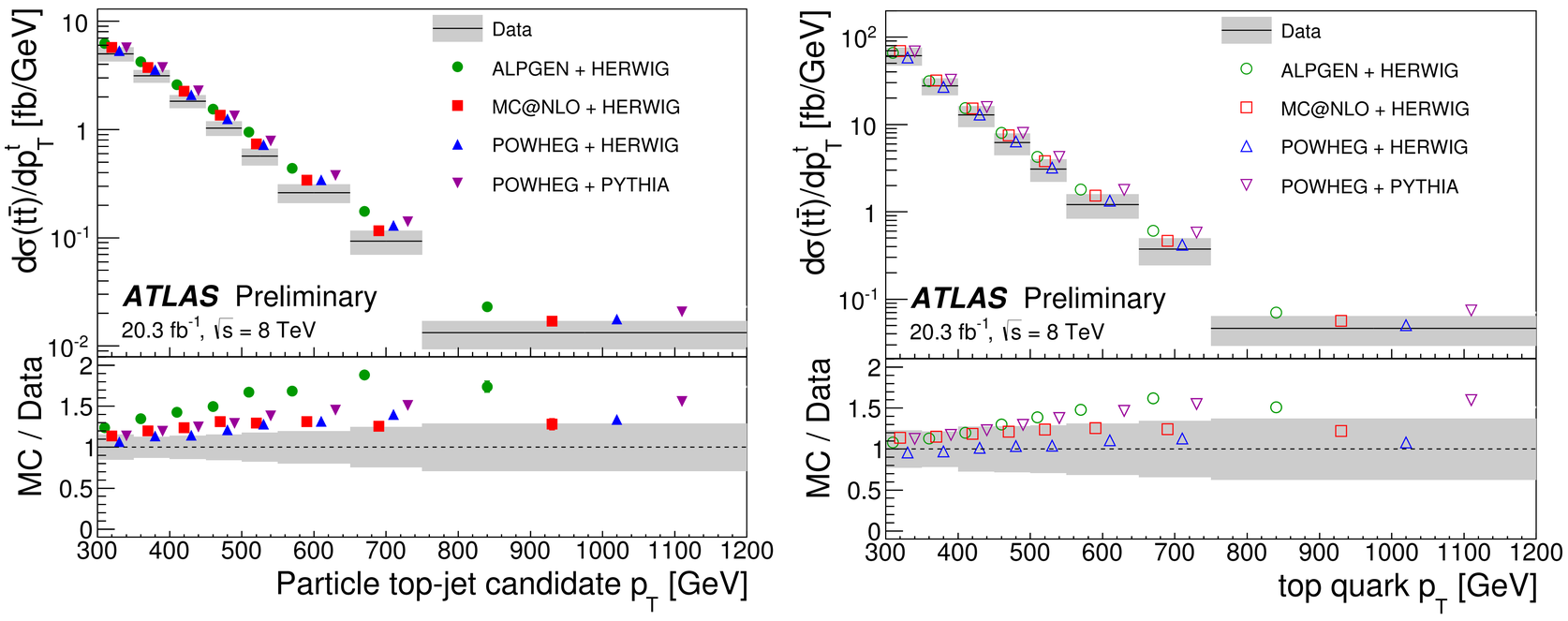
Differential cross-section measurement for boosted top quark using lepton + jets events at 8 TeV

ATLAS-CONF-2014-057

Analysis method

The differential cross-section for p_T of the top quark is measured for the hadronically decaying top quark with $p_T > 300$ GeV.
The jets from high-p_T top quarks are collimated and therefore treated as a single jet with large radius.
The p_T distribution of the large-radius jet is unfolded to correct for the detector response. Both of the parton level and particle level cross-sections are measured.





The measured cross-section is generally smaller than the prediction of NLO and LO + parton shower MC generators after normalization to NNLO+NNLL QCD calculations of the inclusive cross-section. The discrepancy is between the measurements and the predictions ranges from 30% to 70% in the highest-p_T bin, depending on MC generators employed in the predictions.