Study of additional b-jets in top pair events using ATLAS data

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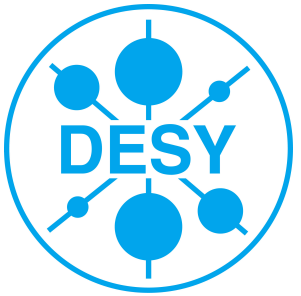
13/06/2017



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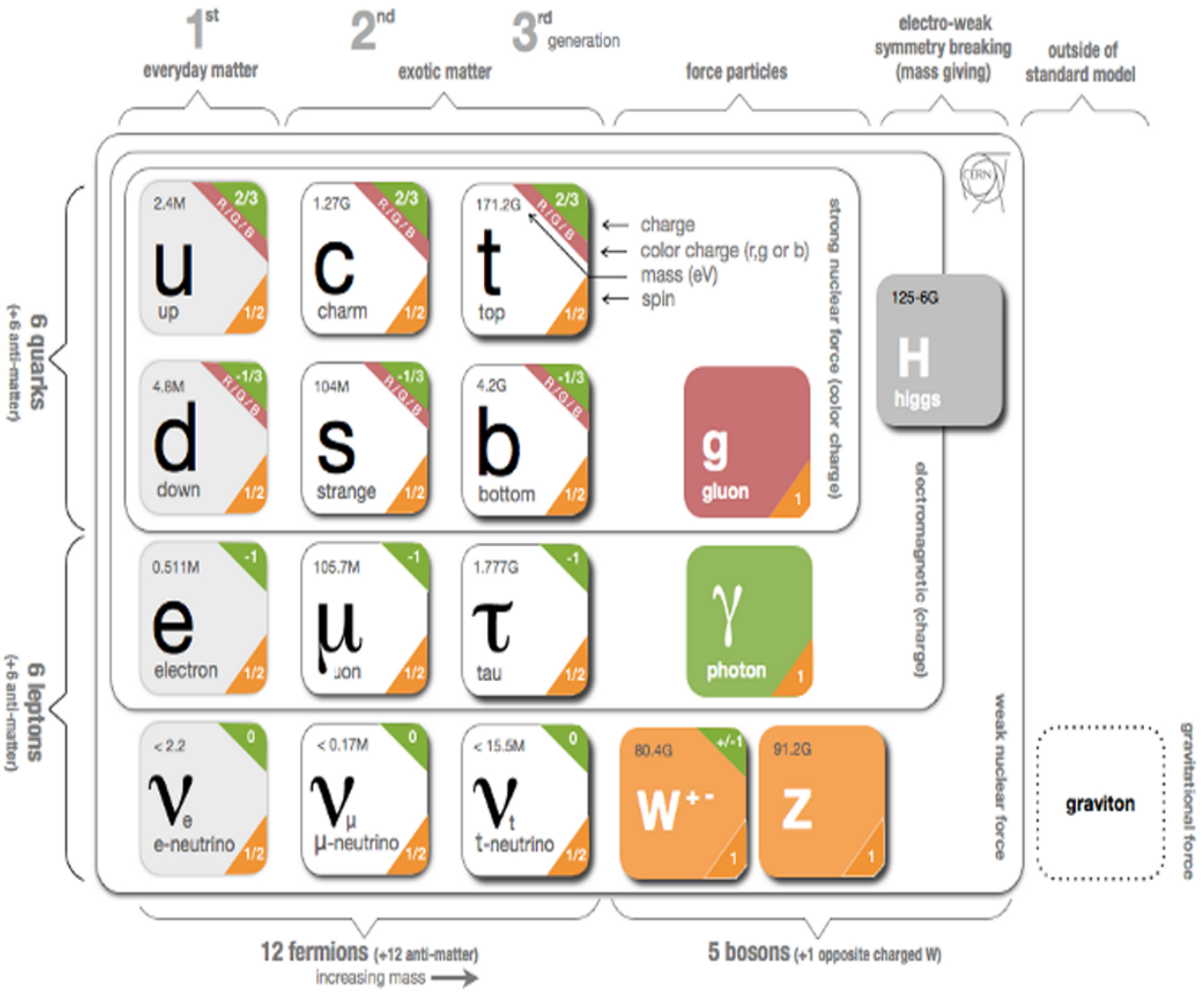
Standard model

Fermions:
matter, 3 families

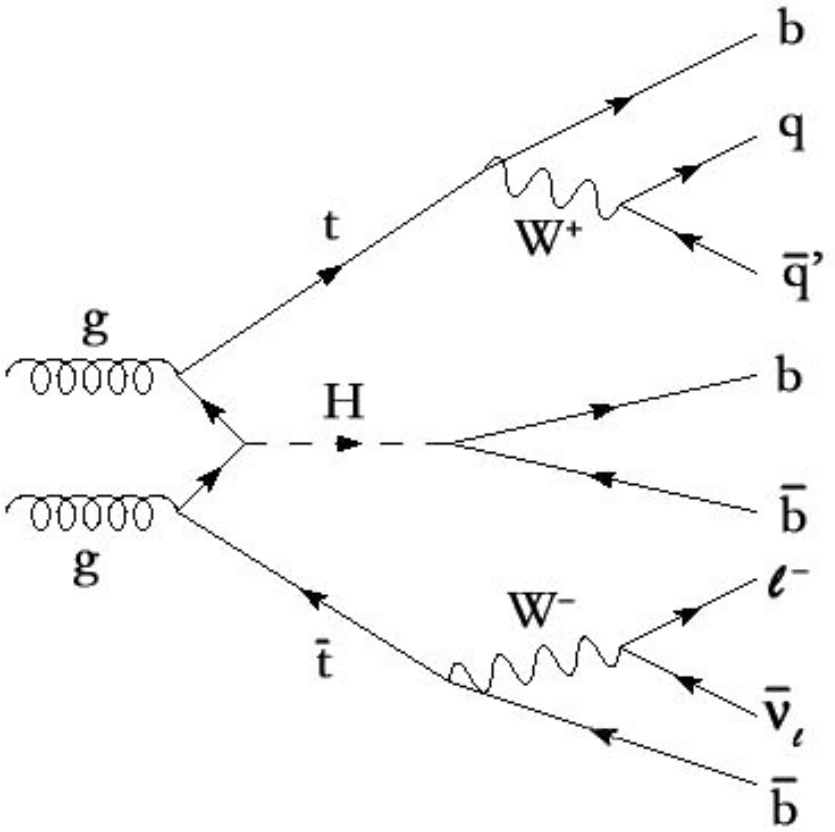
Bosons:
force mediator, strong, em, weak

Higgs:
mass generation



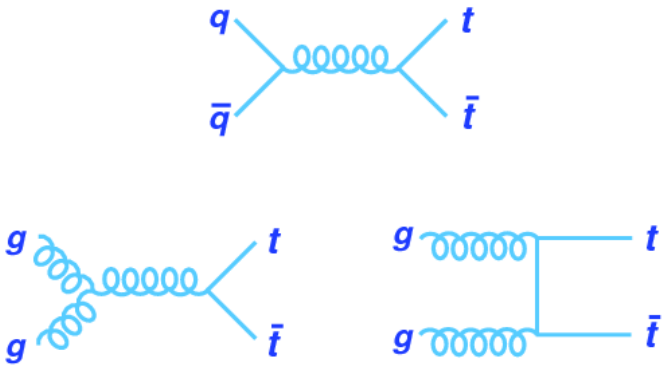
Top quark

- Heaviest particle
- Short lifetime: decay before hadronisation
- Tests for QCD predictions
- Searches for physics BSM
- Associated production with Higgs:
    - Only coupling not directly observed in SM

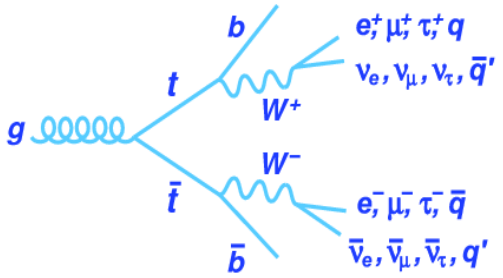


$t\bar{t}$ events (1/2)

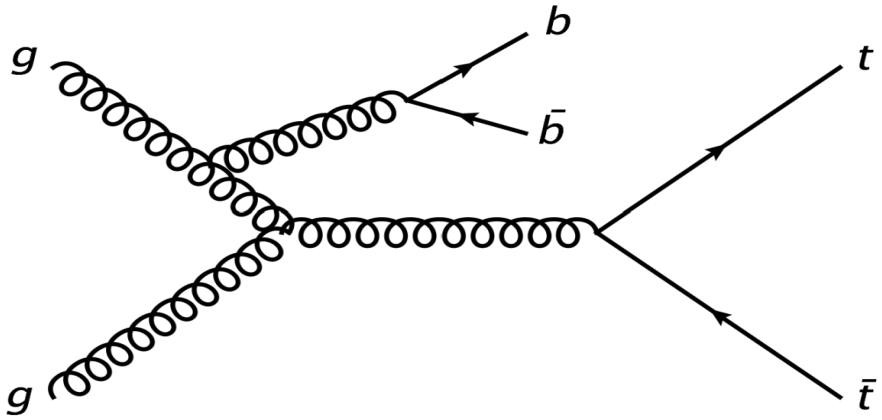
- Production modes:



- Decay channels:



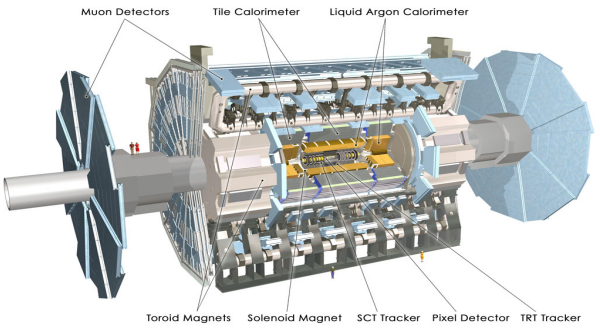
- Radiations of additional partons:

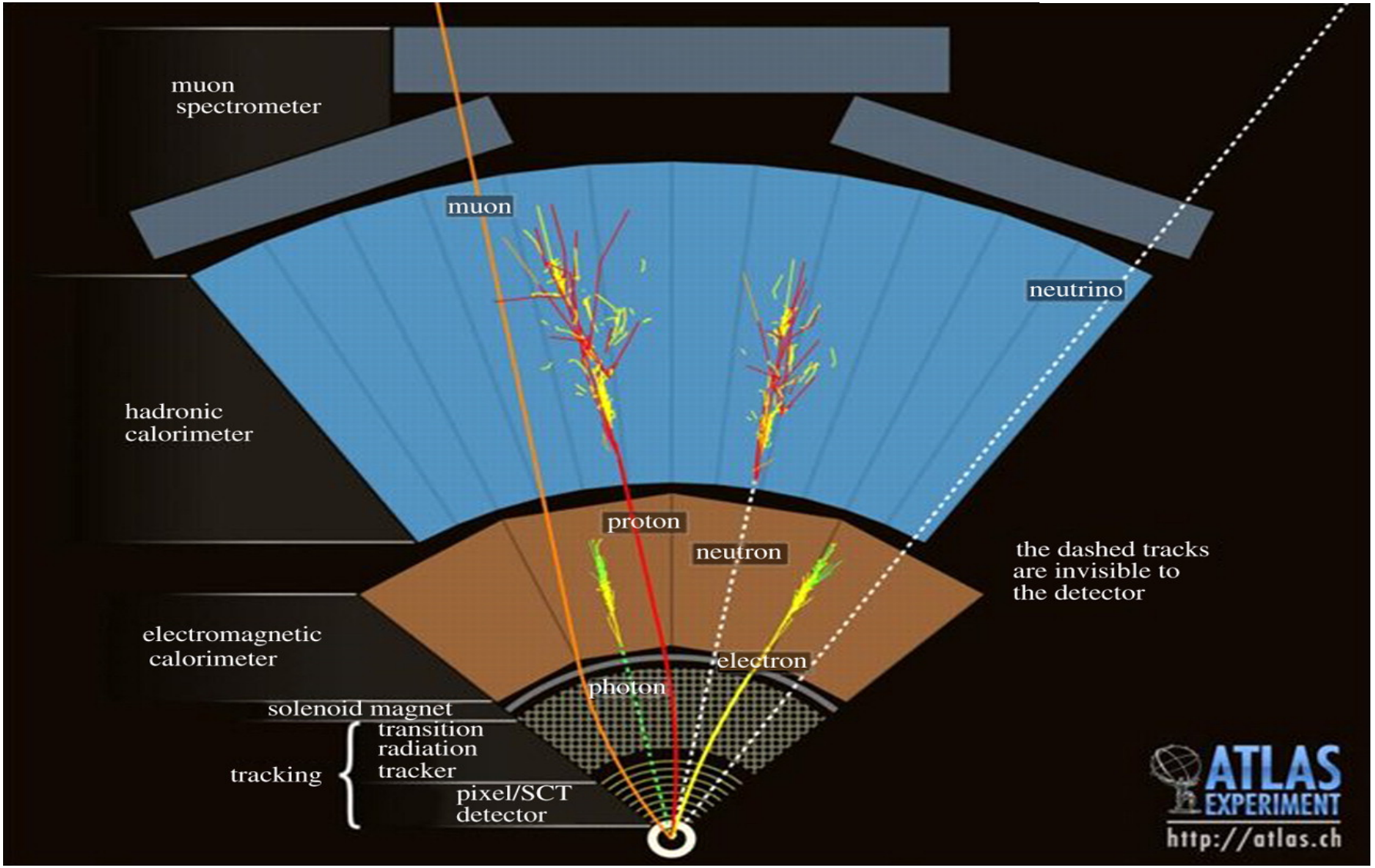


Major background for $t\bar{t}H$

Uncertainty in total cross section

Object reconstruction





Jets: bundles of hadronic particles

Object selection

- Atlas data taken 2015/6: $\mathcal{L}$ = 36fb^{-1} at ECM = 13 TeV
- $t\bar{t} \rightarrow b\bar{b} + W^+W^- \rightarrow b\bar{b} + \ell\bar{\ell}$ (+ $\nu\bar{\nu}$)
- eμ channel only is studied
- Requirements:
  - One electron with p_T > 25GeV, $|\eta|$<2.47 && not in [1.37,1.52] (region between endcaps and barrel)
  - One μ with p_T > 25GeV, $|\eta|$<2.5
  - Two b-jets from top with p_T > 25GeV, $|\eta|$<2.5
  - One additional b-jet
- b-jets are tagged with an efficiency of 77% (multivariate method)

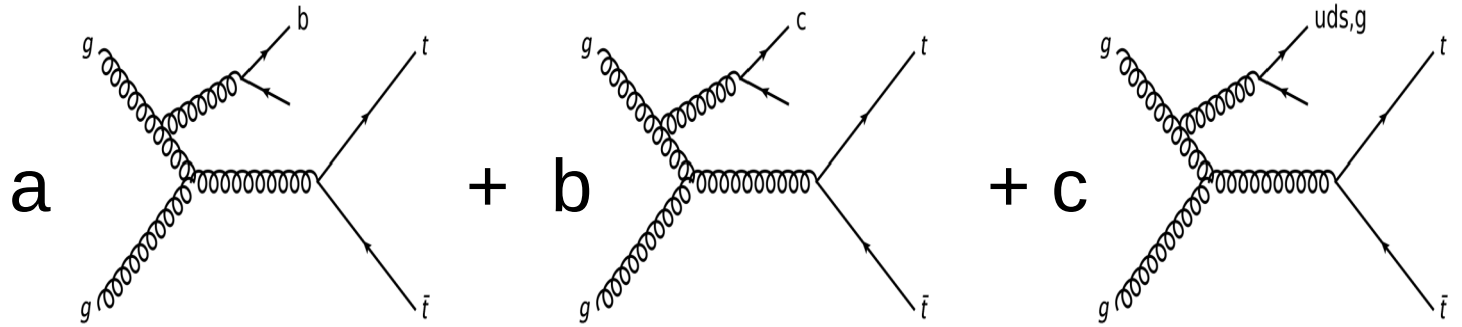
  → very clean $t\bar{t}$ sample (~ 5% background)
- MC events generated with POWHEG+PYTHIA8 (NLO+PS)

Correction factors for detector and generator

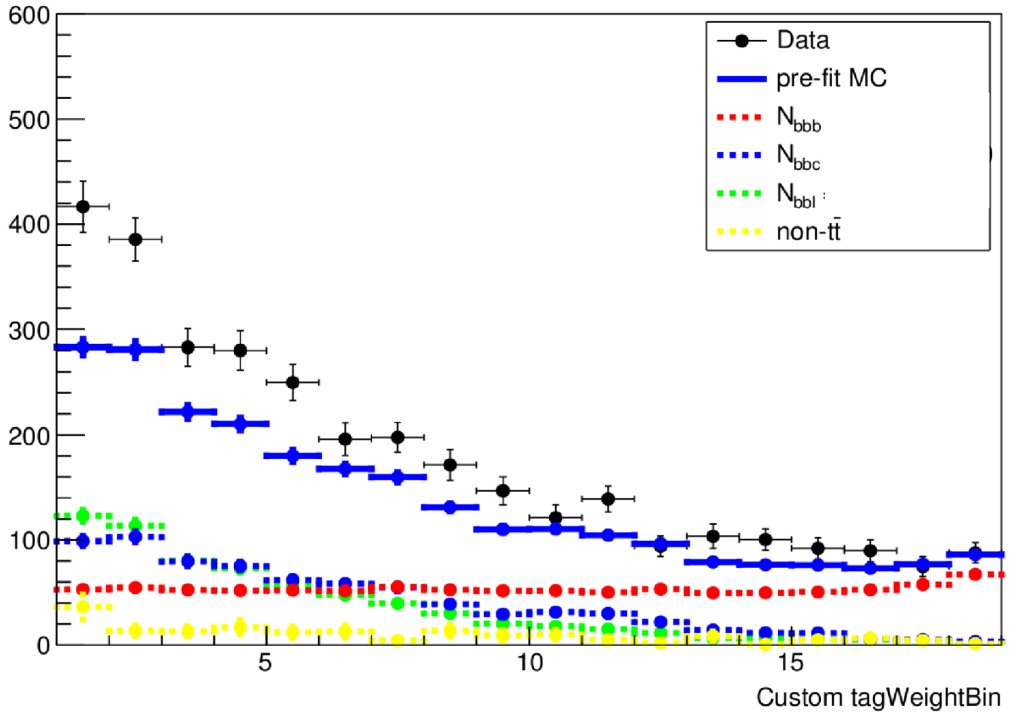
- Corrections for efficiency differences between data and MC on detector level are already applied
- MC generator: fractions of b, c, and light jets are not well modeled

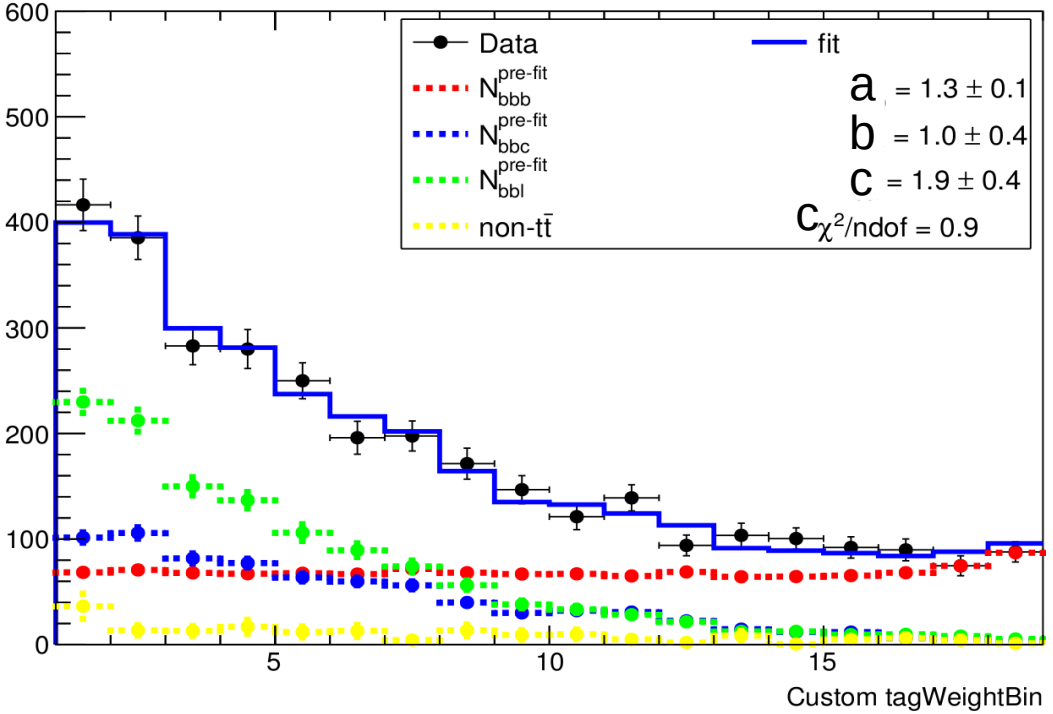
  → Scale factors for these production fractions are applied using a fit with simulated templates

Fitting



Fitting observable: b-ness of the third jet (least b-like jet)
No flavor violation but all jets are not always detected





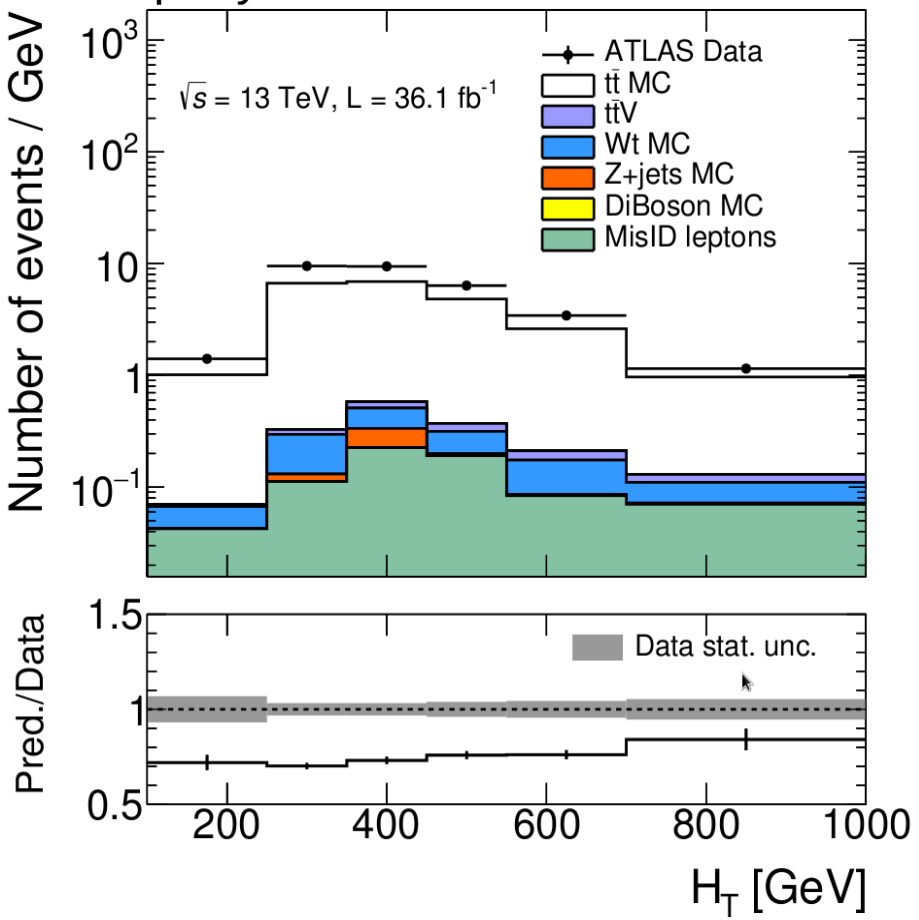
lowest b-ness

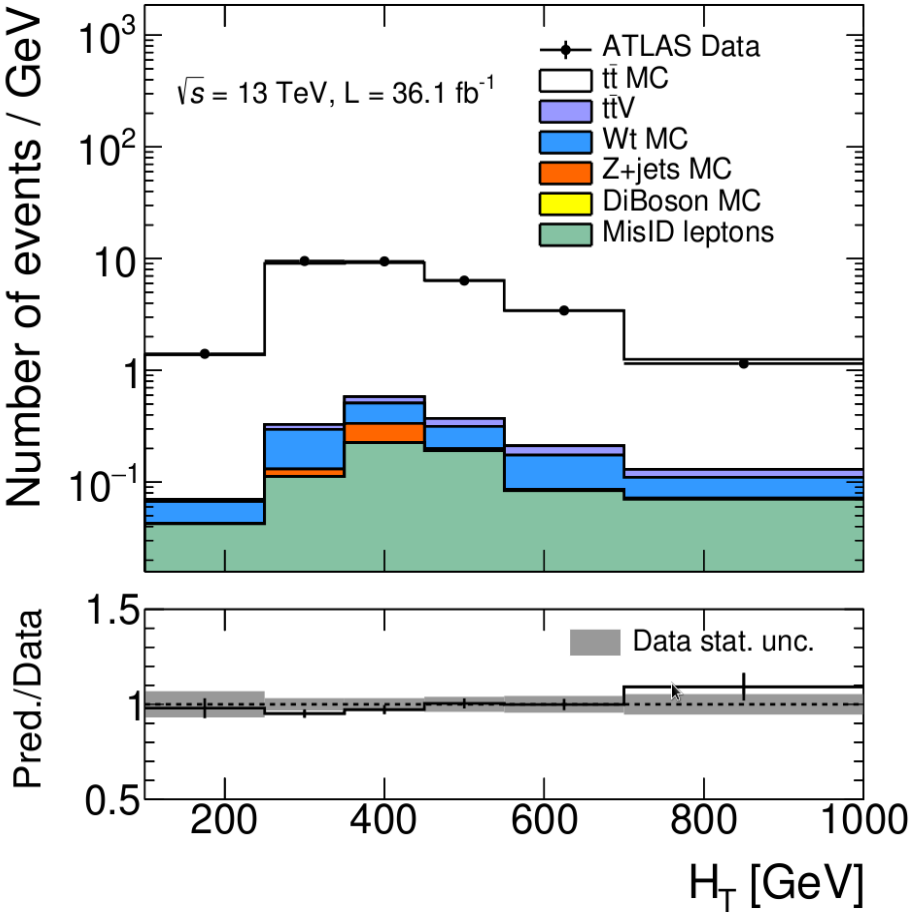
Highest b-ness

Results (1/2)

Control plots before and after applying the data driven correction factors a,b,c on the $t\bar{t}$ Monte Carlo

Property of the full $t\bar{t}$ event:

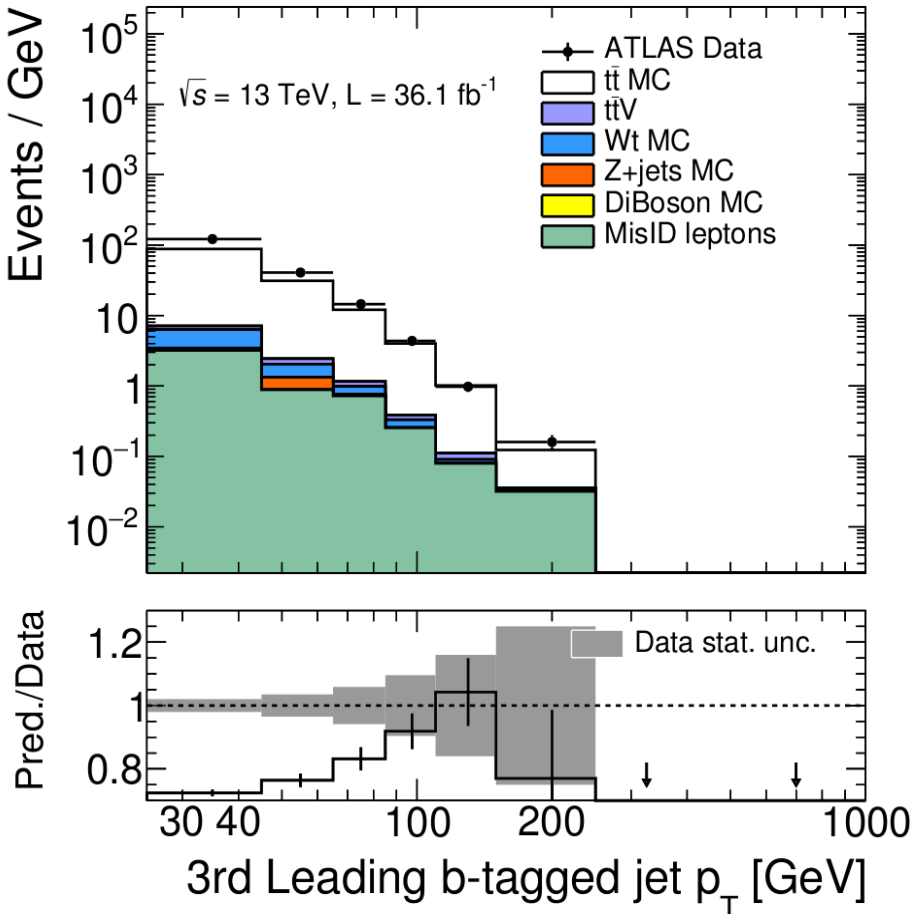


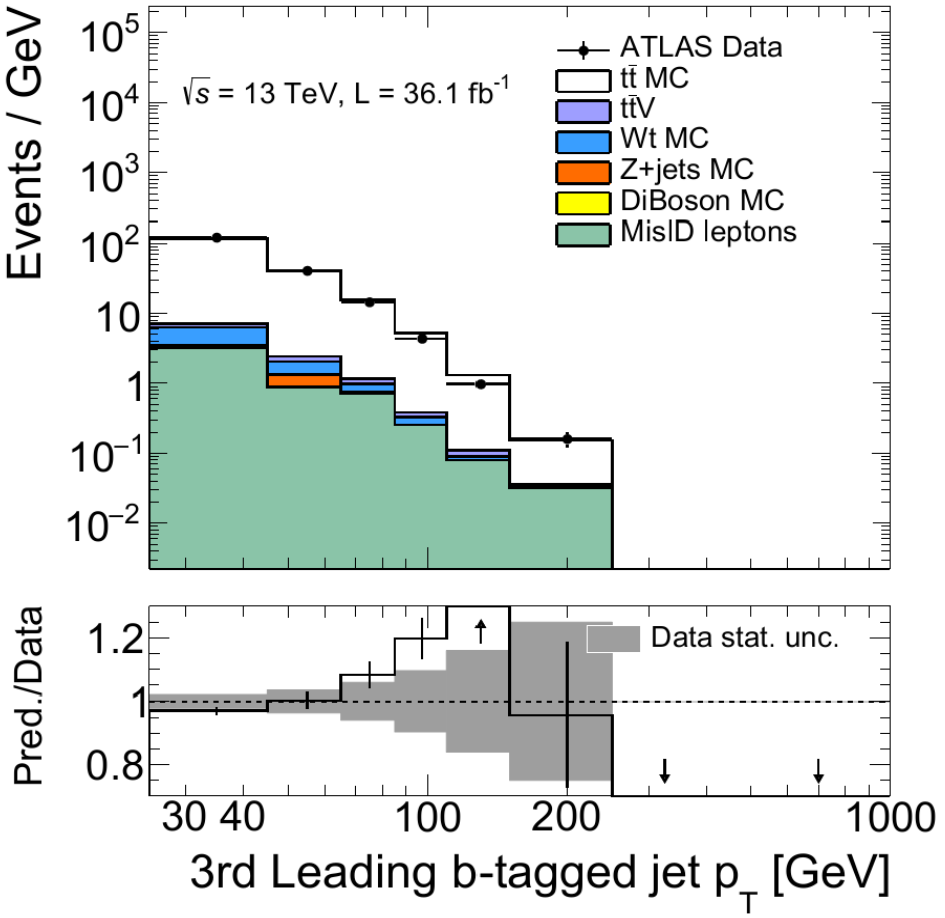


HT is the total transverse momentum of leptons and jets

Results (2/2)

Property of the additional jet (one of the most important observable to measure):





Leading additional jet pt

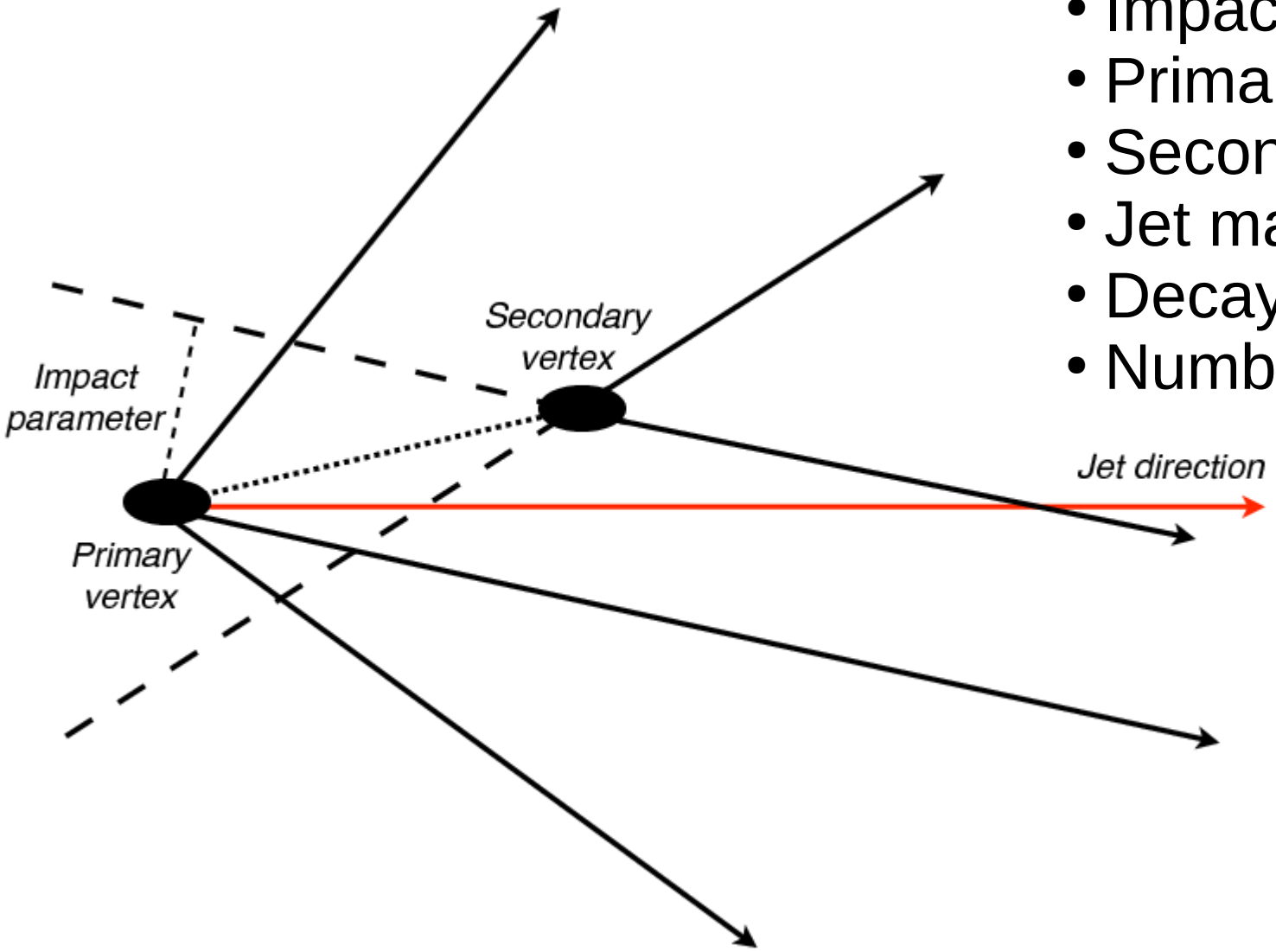
Fair but not perfect agreement: resolution effect ? mismodeling ?

Conclusion

- Fit to improve the data MC agreement applying correction factors to MC
- Better agreement between MC simulations and data with scale factors
- Fair agreement between data and MC inside statistics
- Next step:
  more qualitative statement of compatibility,
  understanding of systematic uncertainties in the fit procedure

Thank you for your attention !

b-tagging



- Impact parameter
- Primary vertex
- Secondary vertex
- Jet mass
- Decay length
- Number of tracks