

# The Top Quark Charge Asymmetry using 4.7/fb at $\sqrt{s} = 7$ TeV with the ATLAS Detector

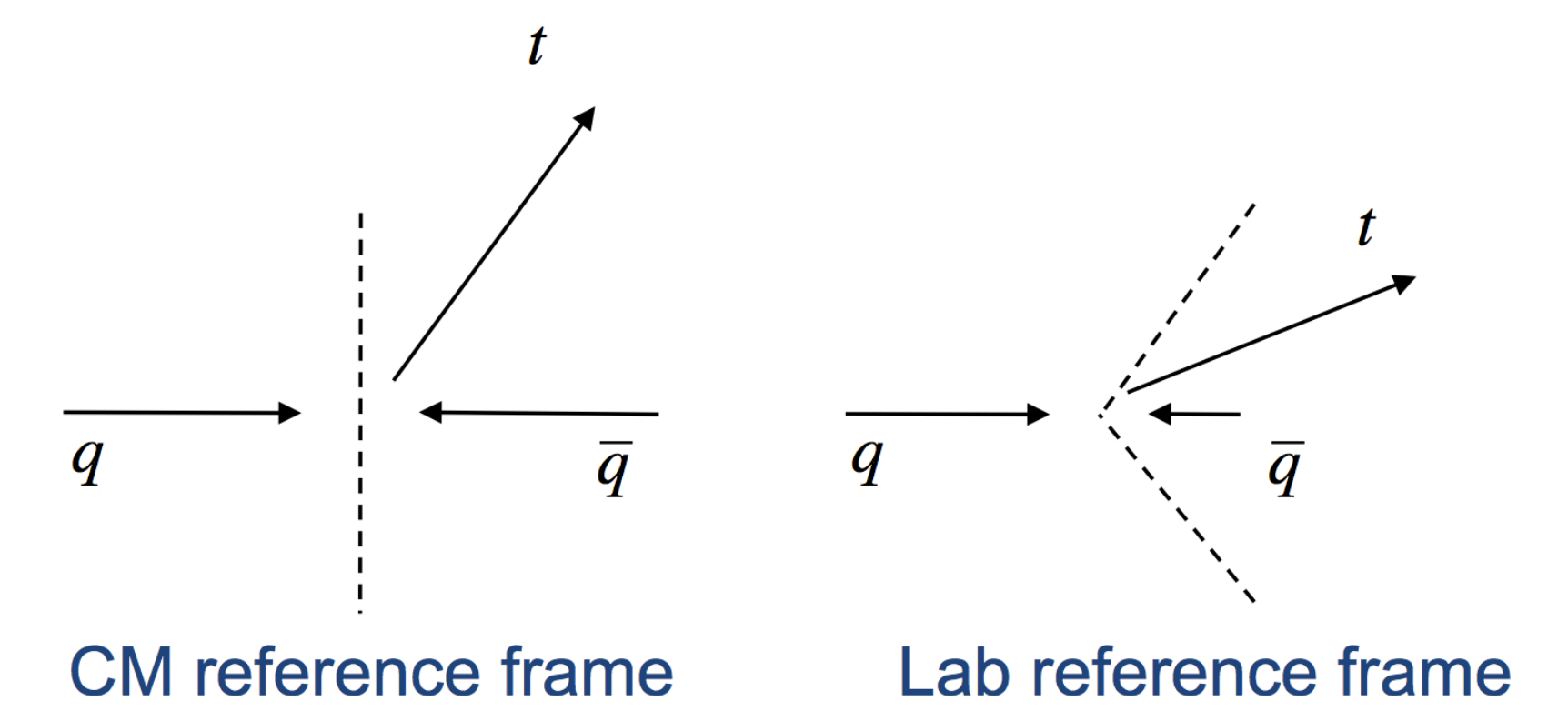
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## Introduction

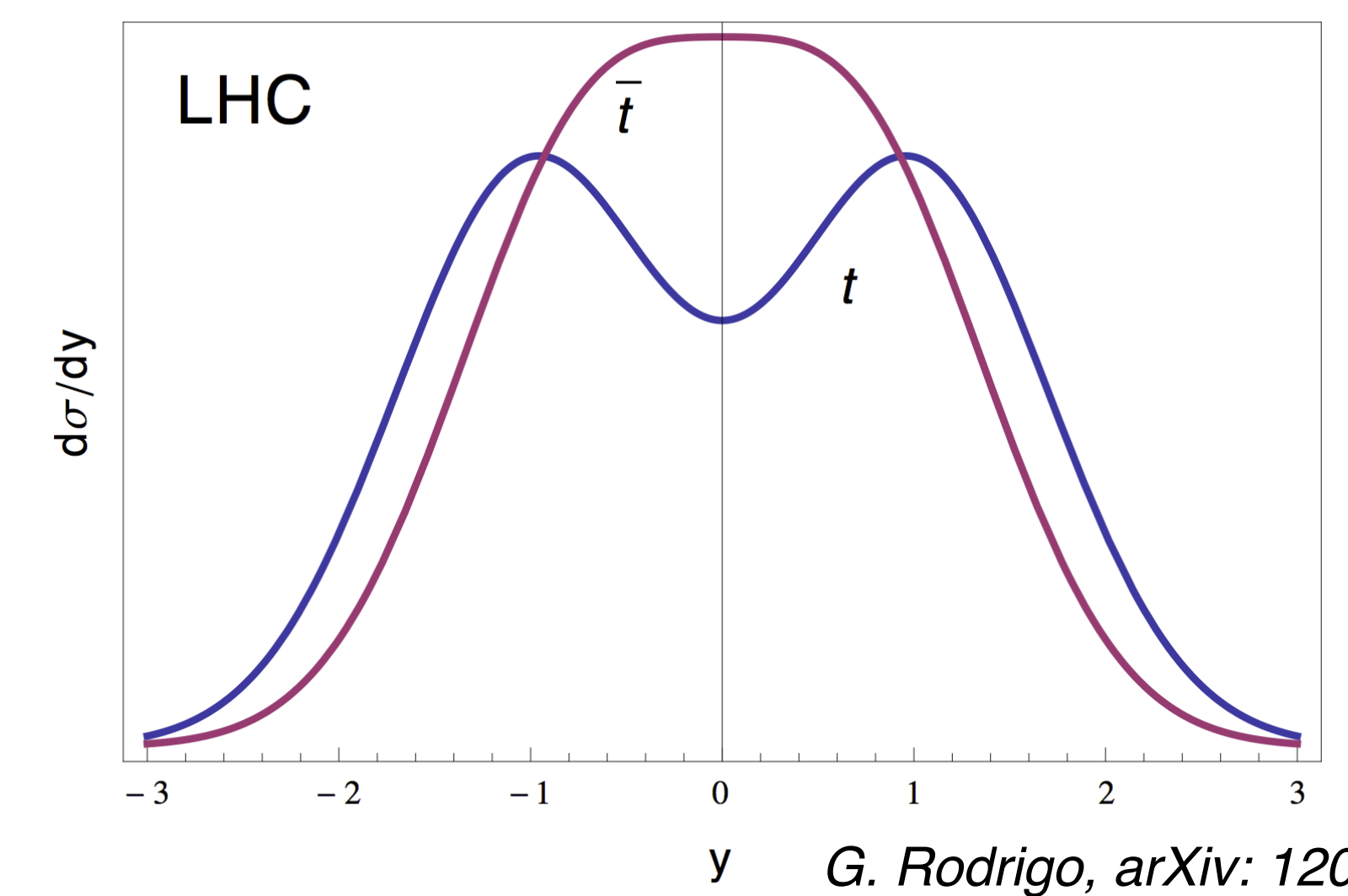
The charge asymmetry, defined as

$$A_C = \frac{N(\Delta|y| > 0) - N(\Delta|y| < 0)}{N(\Delta|y| > 0) + N(\Delta|y| < 0)}$$

where  $\Delta|y| \equiv |y_t| - |y_{\bar{t}}|$ ,



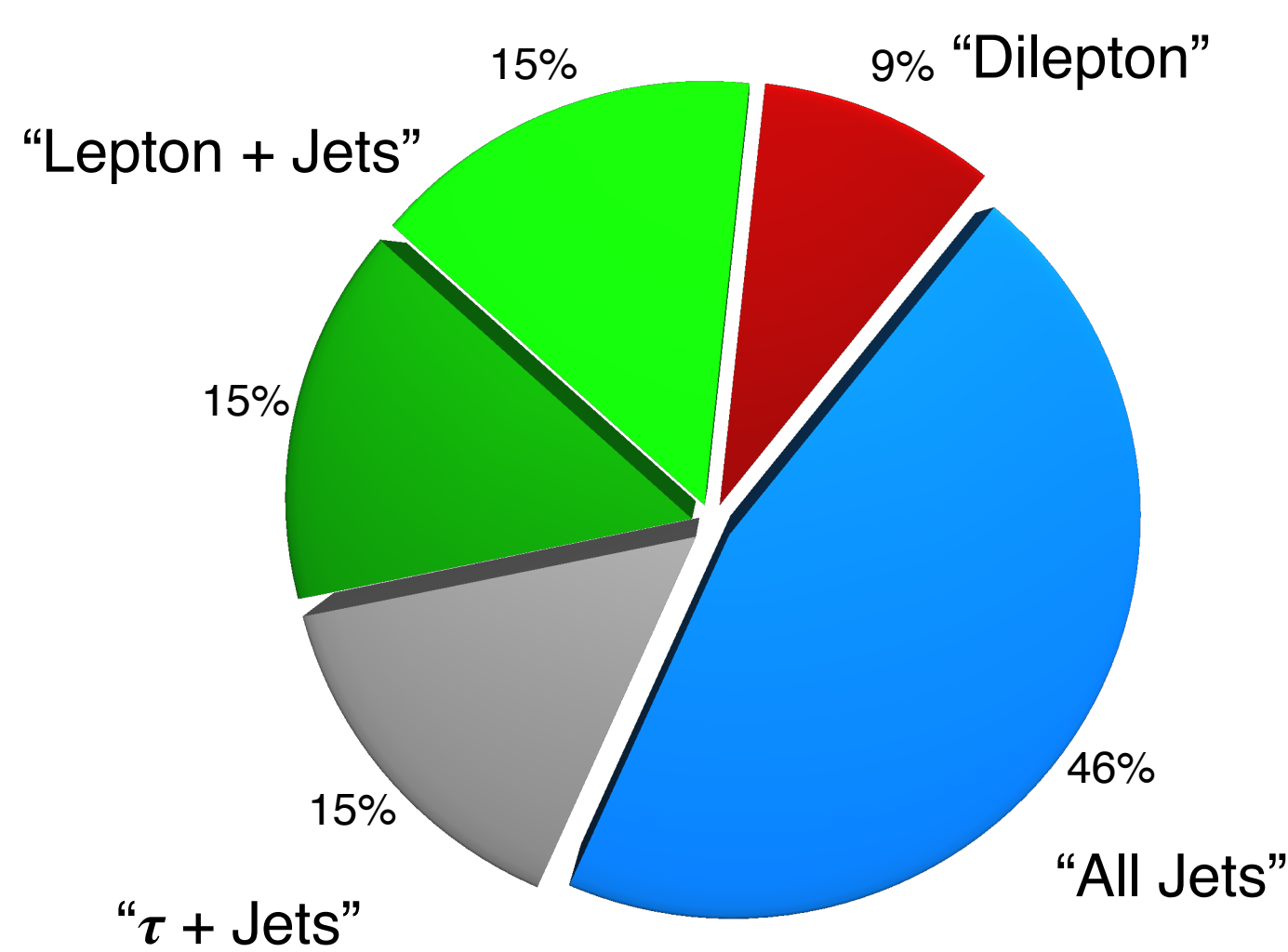
At the LHC, the rapidity distribution of the top quark is broader than the antitop quark.



Additionally, a similar measurement at the Tevatron observed an excess compared to the Standard Model value, further motivating this measurement at the LHC.

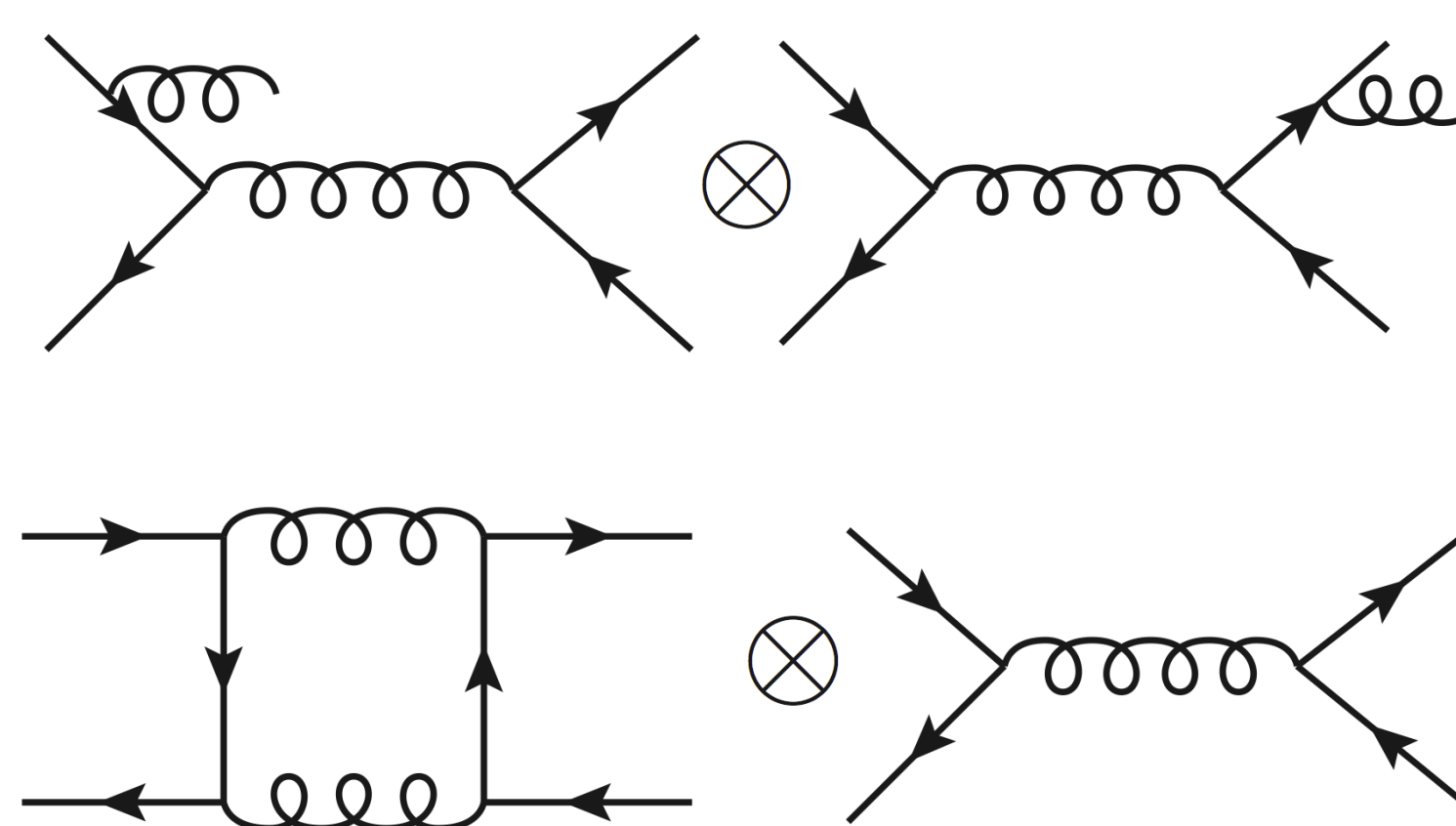
In the Standard Model of particle physics, the top quark is the heaviest fundamental particle with a mass of 173 GeV.

The top quark decays before hadronization and almost exclusively to a  $W$  boson and  $b$ -quark.



Lepton charge is needed to distinguish between top and antitop quarks. Thus, only the dilepton (where the asymmetry can be measured directly with the leptons or top-antitop system) and lepton+jets channels are used for this measurement.

is generated through interference at NLO between ISR/FSR and Born/Box diagrams.



At the LHC, new particles can enhance the charge asymmetry (axigluons,  $Z'$ ,  $W'$ , etc.) through interference with Standard Model diagrams.

## Event Selection

### Lepton+Jets

- One isolated lepton
- $e$ :  $E_T > 25$  GeV &  $\mu$ :  $p_T > 20$  GeV
- At least 4 jets with  $p_T > 25$  GeV
- At least 1  $b$ -tagged jet with  $p_T > 25$  GeV

### Dilepton:

- Two oppositely charged leptons
- $ee$  and  $\mu\mu$  channel:
  - $|m_{\ell\ell} - m_Z| > 10$  GeV &  $MET \geq 60$  GeV
- $e\mu$  channel:
  - $H_T \geq 130$  GeV
- At least 2 jets with  $p_T > 25$  GeV

## Reconstruction

A kinematic likelihood method is applied [1]. The four-momenta of the jets, lepton, and missing transverse energy are inputs of the likelihood. The top and  $W$  masses and widths are constraints on the likelihood.

The top-antitop system is under-constrained due to the two neutrinos. The kinematics of the event are determined by computing a probability distribution using the leading-order matrix element. The top and  $W$  masses and widths are constraints used in solving the kinematics.

## Unfolding

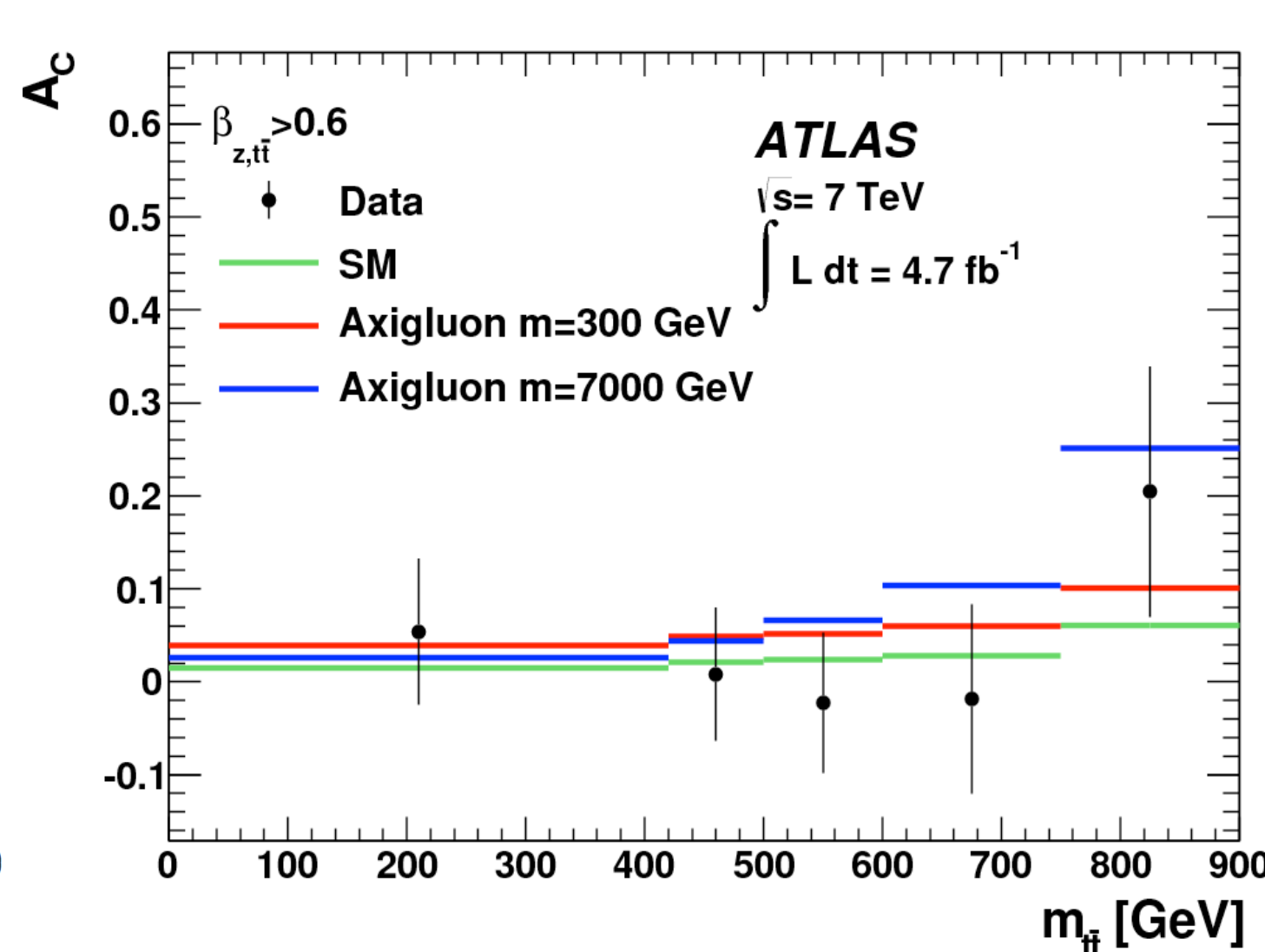
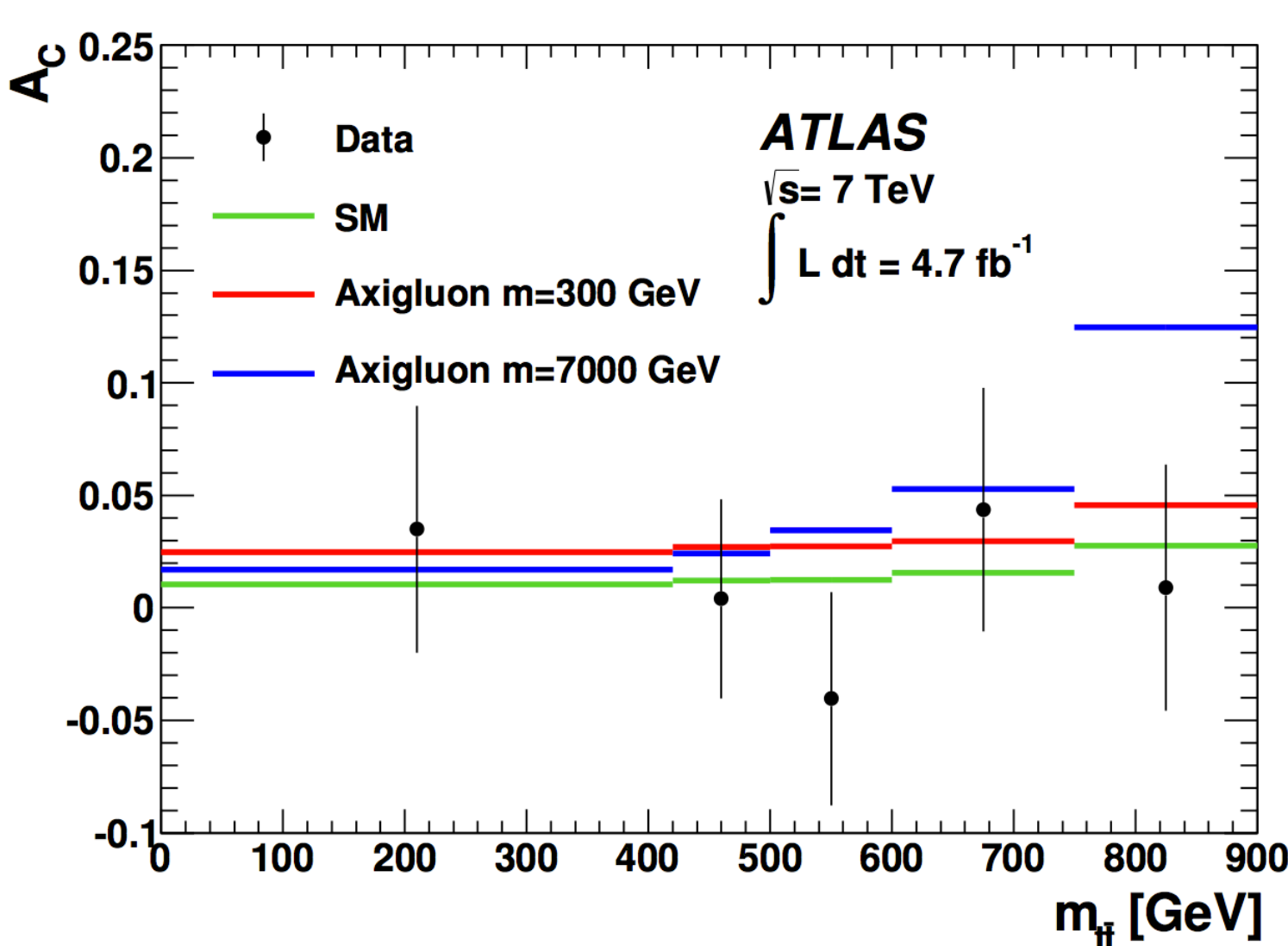
Fully Bayesian Unfolding (FBU) [2] is applied to the reconstructed distribution. This method estimates the posterior probability for the parton-level distribution given a distribution in data.

Estimate the parton-level asymmetry by applying a correction to the reconstructed asymmetry, after background subtraction. The correction is based on performing Monte Carlo simulations with various generated asymmetries.

## Lepton+Jets Results

The charge asymmetry is reported for inclusive and differential measurements. Results are consistent with the Standard Model.

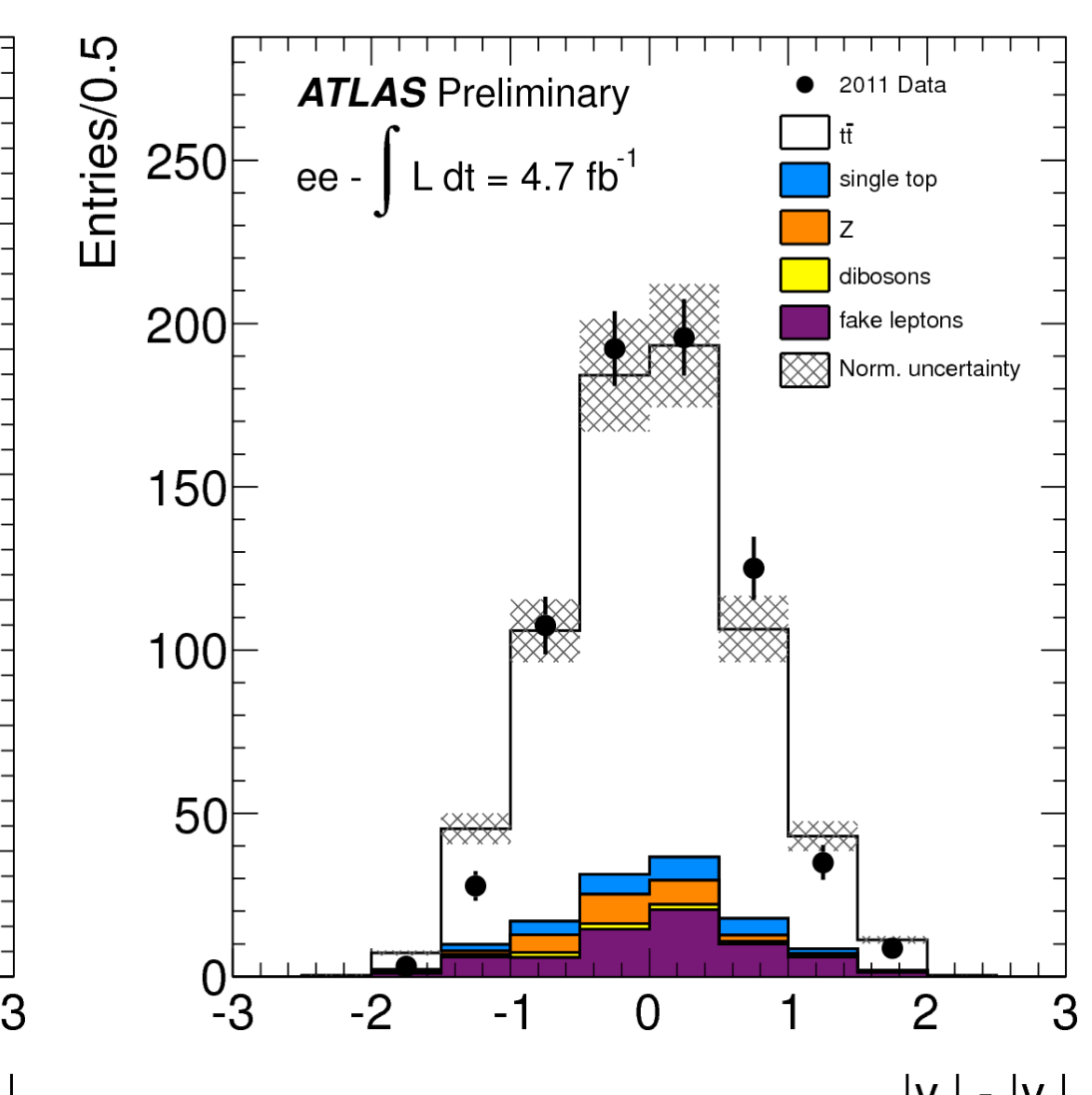
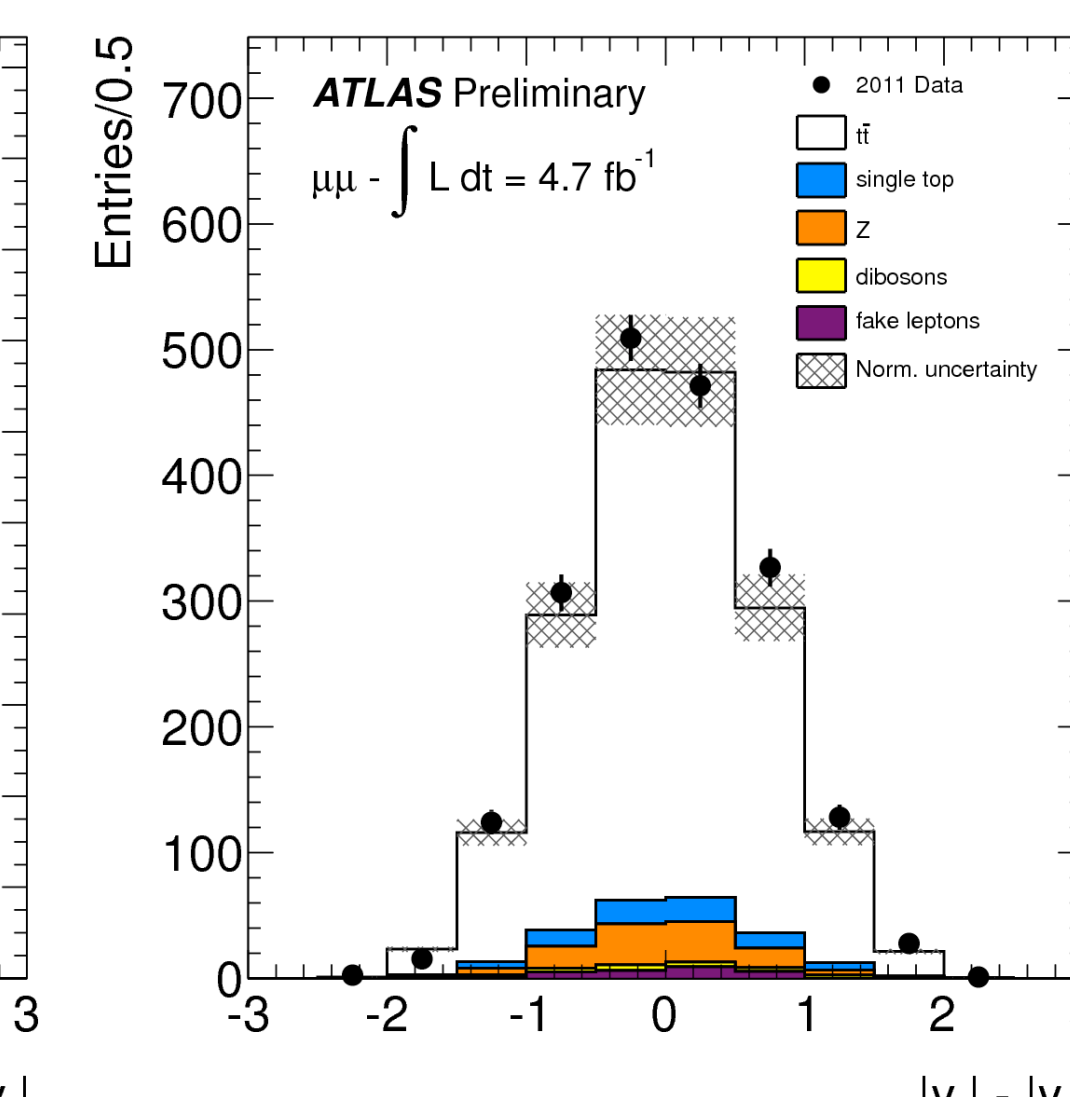
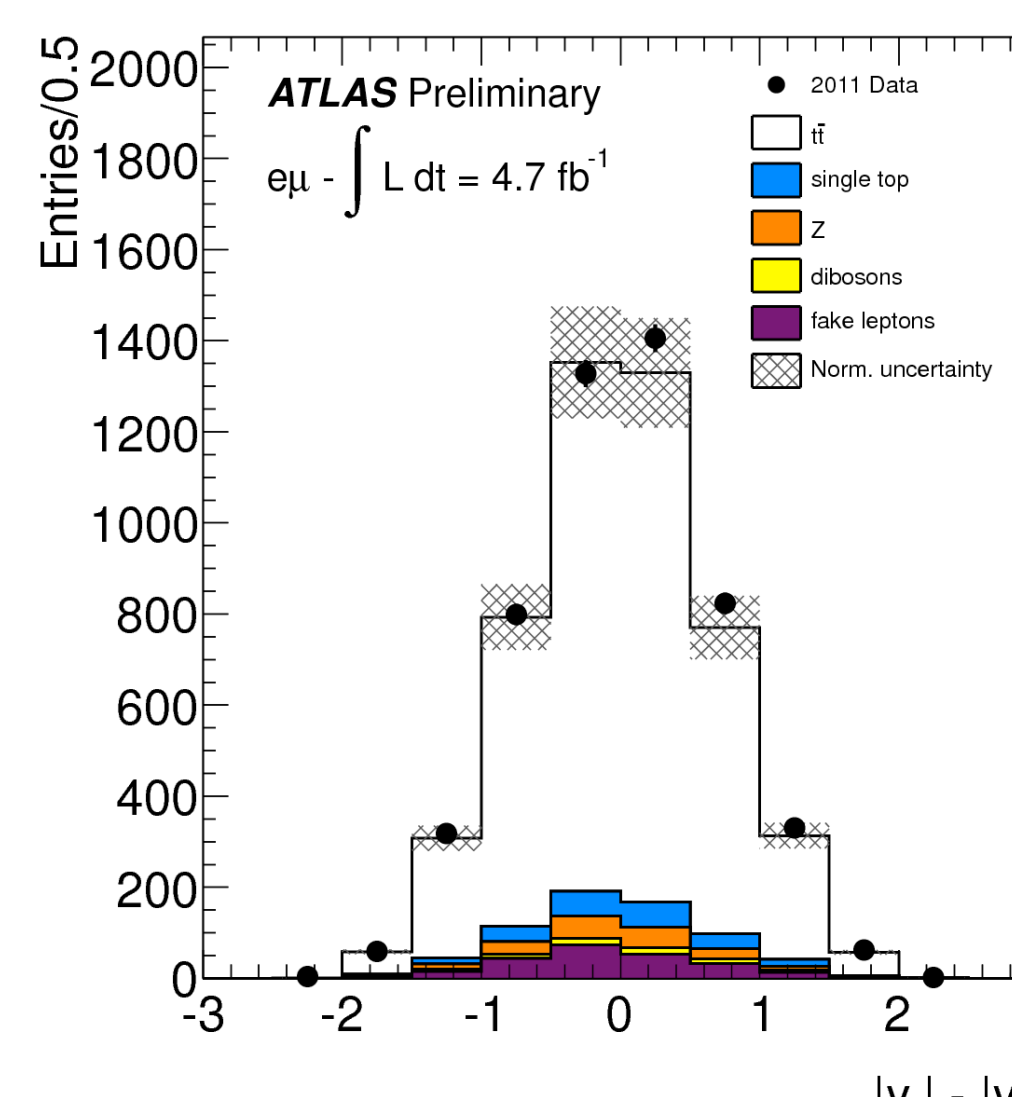
Unfolded $A_C$ [3]	Theory (NLO) [4]
$0.006 \pm 0.010$ (stat.+syst.) (Inclusive)	0.0123(5)
$0.018 \pm 0.022$ (stat.+syst.) ( $m_{t\bar{t}} > 600$ GeV)	0.0175(5)



## Dilepton Results

Results, consistent with the Standard Model, are reported for the full top-antitop-based asymmetry and the lepton-based asymmetry.

Unfolded $A_C$ [5]	Theory (NLO) [5]
$0.023 \pm 0.012$ (stat.) $\pm 0.008$ (syst.) (lepton)	$0.004 \pm 0.001$
$0.057 \pm 0.024$ (stat.) $\pm 0.015$ (syst.) (top)	$0.006 \pm 0.002$



[1] J. Erdmann, et al., Nucl.Instrum.Meth. A748, 18 (2014)  
[2] G. Choudalakis, arXiv: 1201.4612

[3] G. Aad et al. (ATLAS Collaboration), JHEP 1402, 107 (2014)  
[4] W. Bernreuther and Z.-G. Si, Phys. Rev. D 86 (2012) 034026

[5] ATLAS-CONF-2012-057