



Measurement of the Charge Asymmetry in Top Quark Pair Production

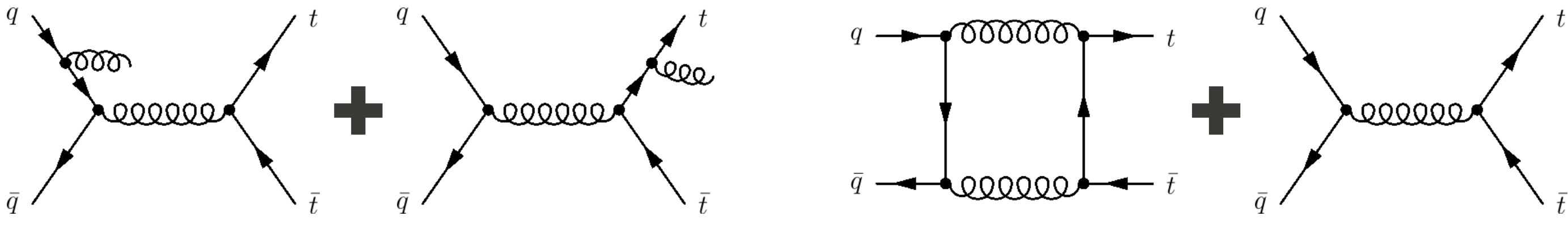
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on behalf of the CMS collaboration



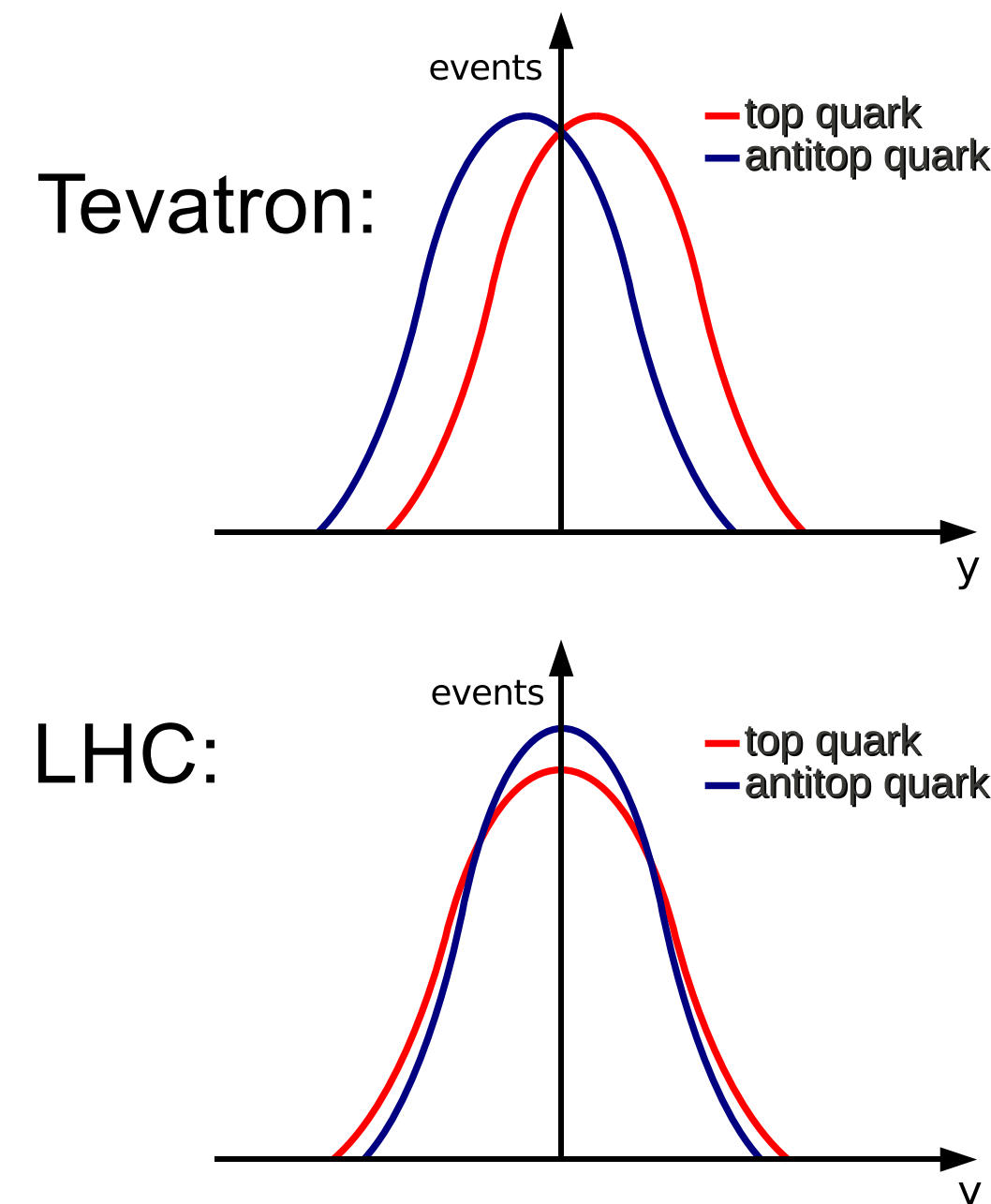
Top Quark Pair Charge Asymmetry

In the Standard Model:

- Interference of ISR and FSR and between box diagram and born diagram (NLO effect)



- Slight preference of top quarks to be emitted into direction of the initial quark and slight preference of antitop quarks to fly into the direction of the initial antiquark
- Excess of top quarks versus antitop quarks in certain kinematic regions, and vice versa



For LHC

Sensitive variables

$$\Delta(|\eta|) = |\eta_t| - |\eta_{\bar{t}}|$$

$$\Delta(y^2) = (y_t - y_{\bar{t}}) \cdot (y_t + y_{\bar{t}})$$

Charge asymmetry

$$A_C = \frac{N^+ - N^-}{N^+ + N^-}$$

SM prediction

$$A_C^{\eta} = 0.013 \pm 0.001$$

$$A_C^y = 0.011 \pm 0.001$$

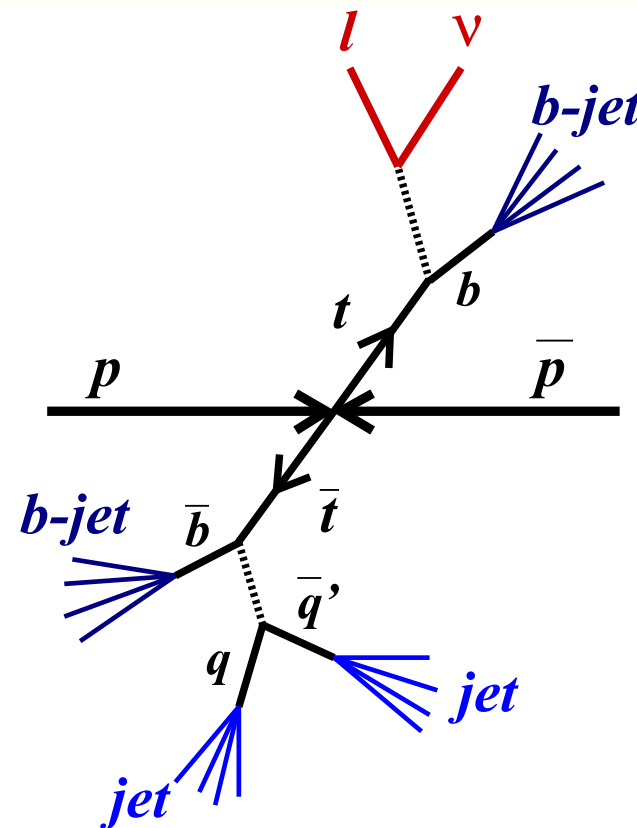
[Kühn, Rodrigo: arXiv:hep-ph/1109.6830]

Event Selection

Muon+jets and electron+jets channel

- One isolated charged lepton
- Second charged lepton veto
- At least four jets
- At least one of them b tagged

Used data: 1.09 fb⁻¹

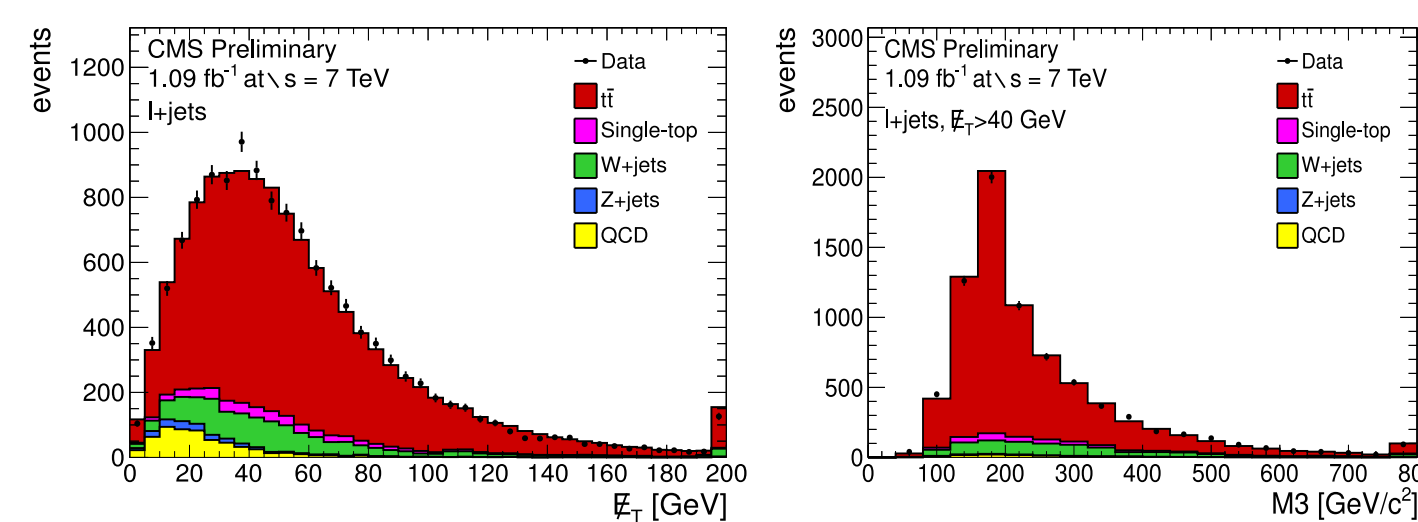


Background Estimation

- Fit MC templates in the missing transverse energy and the M3 distributions

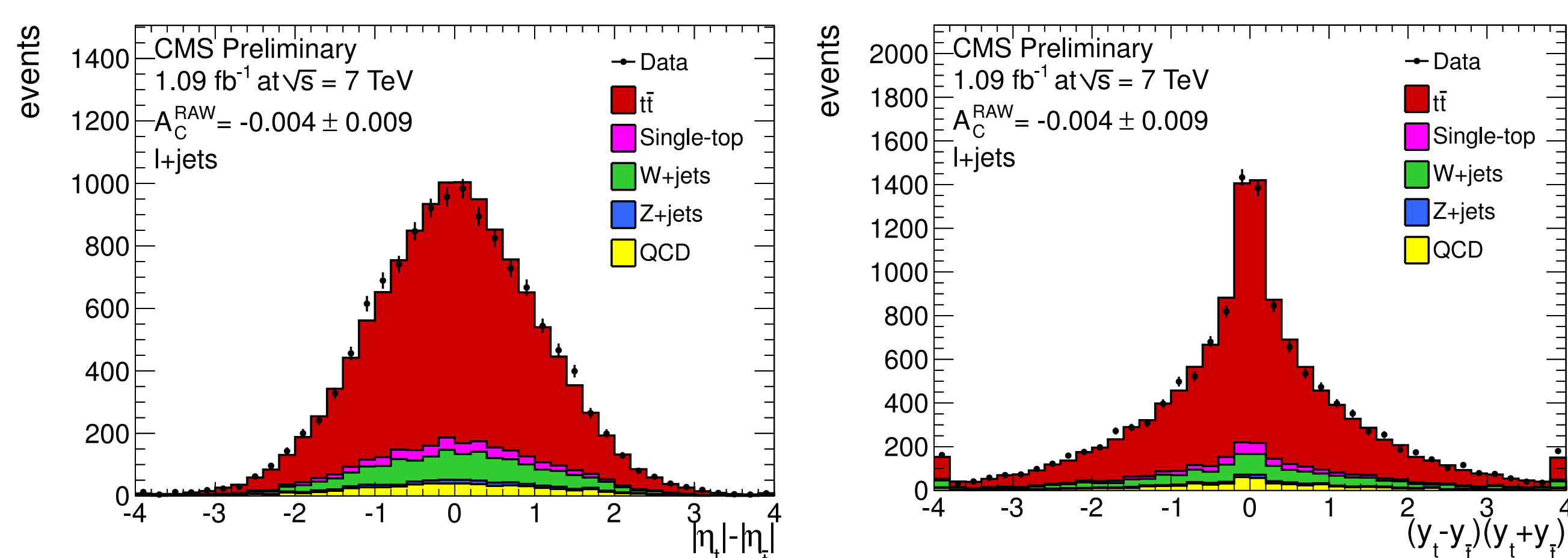
- M3 is the invariant mass of the three jets with the largest vectorially summed transverse momentum

- Signal purity is 80% in the combined lepton+jets channel



Reconstruction

- Reconstruct four-momenta of top and antitop quarks by assigning the selected physical objects, i.e. isolated lepton, jets and missing transverse energy, to the final state particles



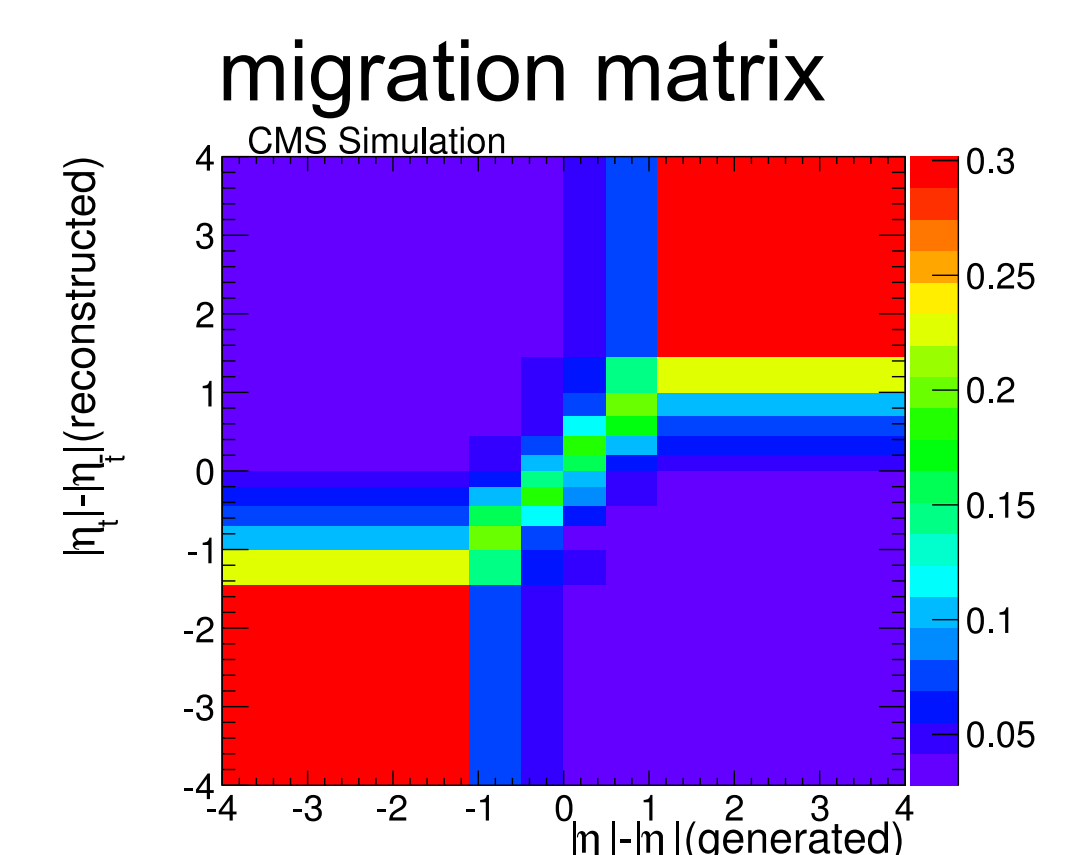
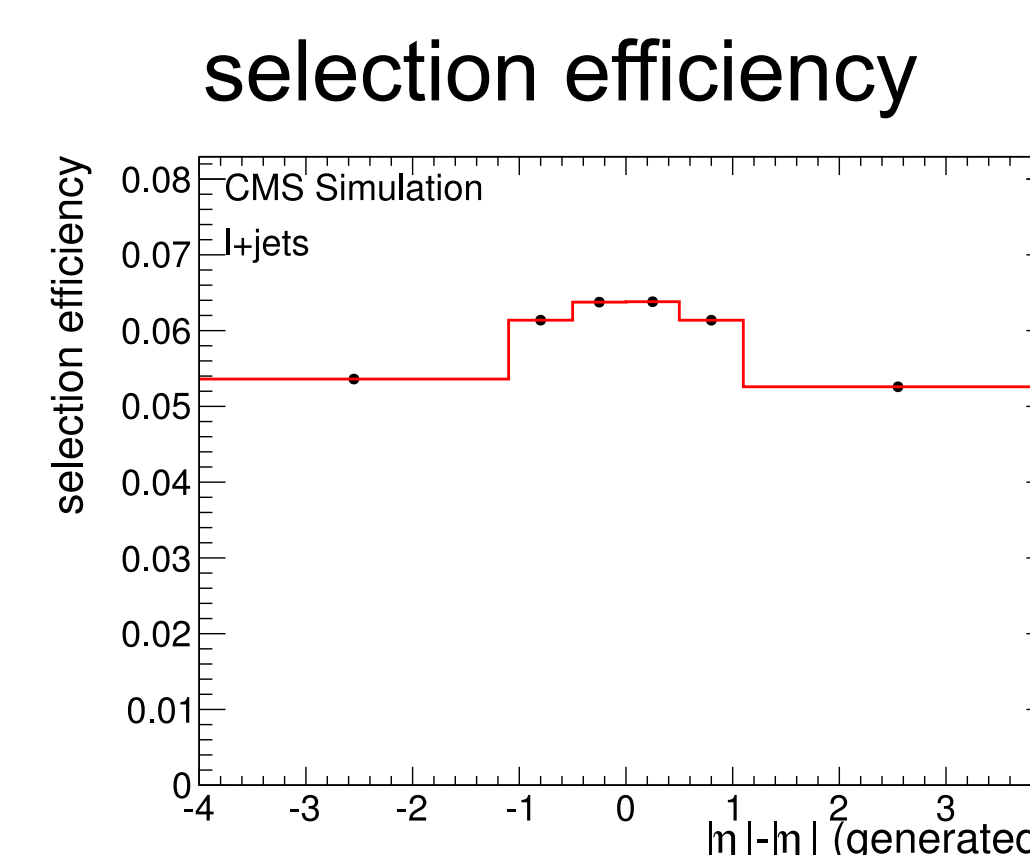
Unfolding

- Reconstructed distributions have to be corrected for

- Background processes
- Influences of non-flat selection efficiency
- Migration effects from reconstruction

- Regularized unfolding using a generalized matrix inversion method

- Consistency checks with pseudo experiments show very good agreement



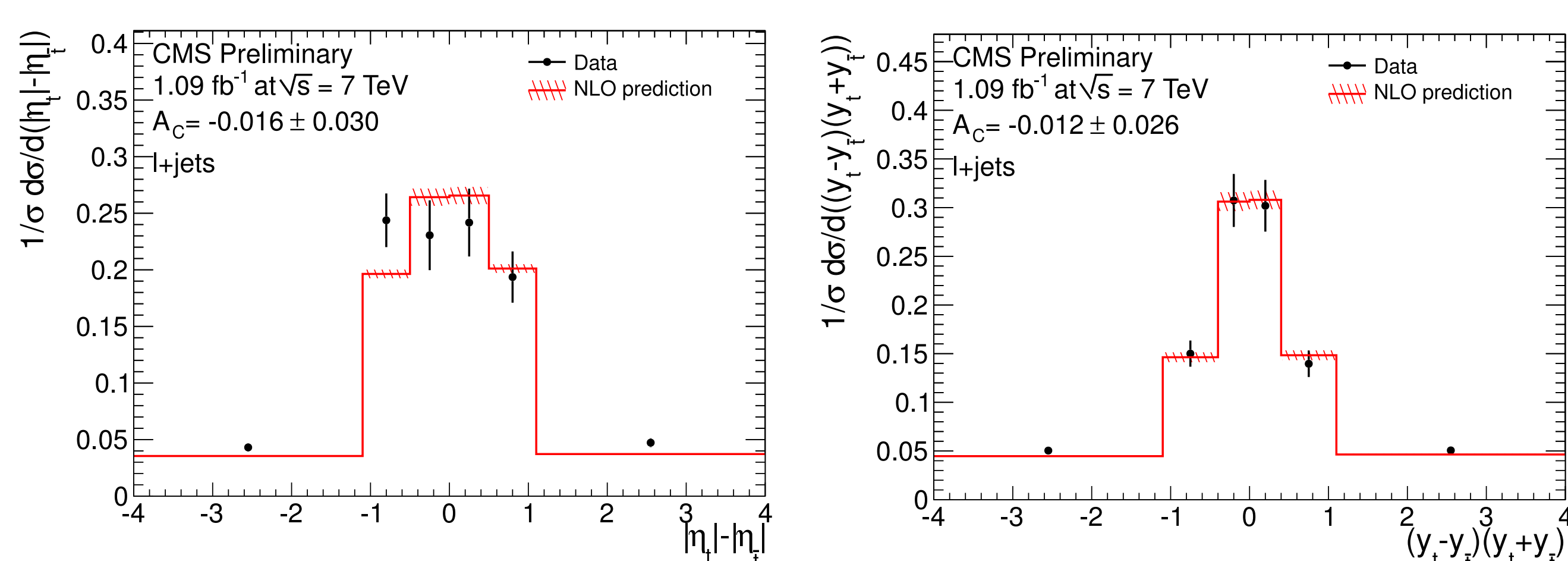
Systematic Uncertainties

- Perform pseudo experiments with systematically shifted distributions
- Unfold with standard templates

Source of Systematic	A_C^{η}		A_C^y	
	- Variation	+ Variation	- Variation	+ Variation
JES	-0.003	0.000	-0.007	0.000
JER	-0.002	0.000	-0.001	0.001
Q^2 scale	-0.014	0.000	-0.013	+0.003
ISR/FSR	-0.006	+0.003	0.000	+0.024
Matching threshold	-0.006	0.000	-0.013	+0.006
PDF	-0.001	+0.001	-0.001	+0.001
b tagging	-0.001	+0.003	0.000	0.001
Lepton ID/sel. efficiency	-0.002	+0.004	-0.002	0.003
QCD model	-0.008	+0.008	-0.006	+0.006
Pileup	-0.002	+0.002	0.000	0.000
Overall	-0.019	+0.010	-0.021	+0.026

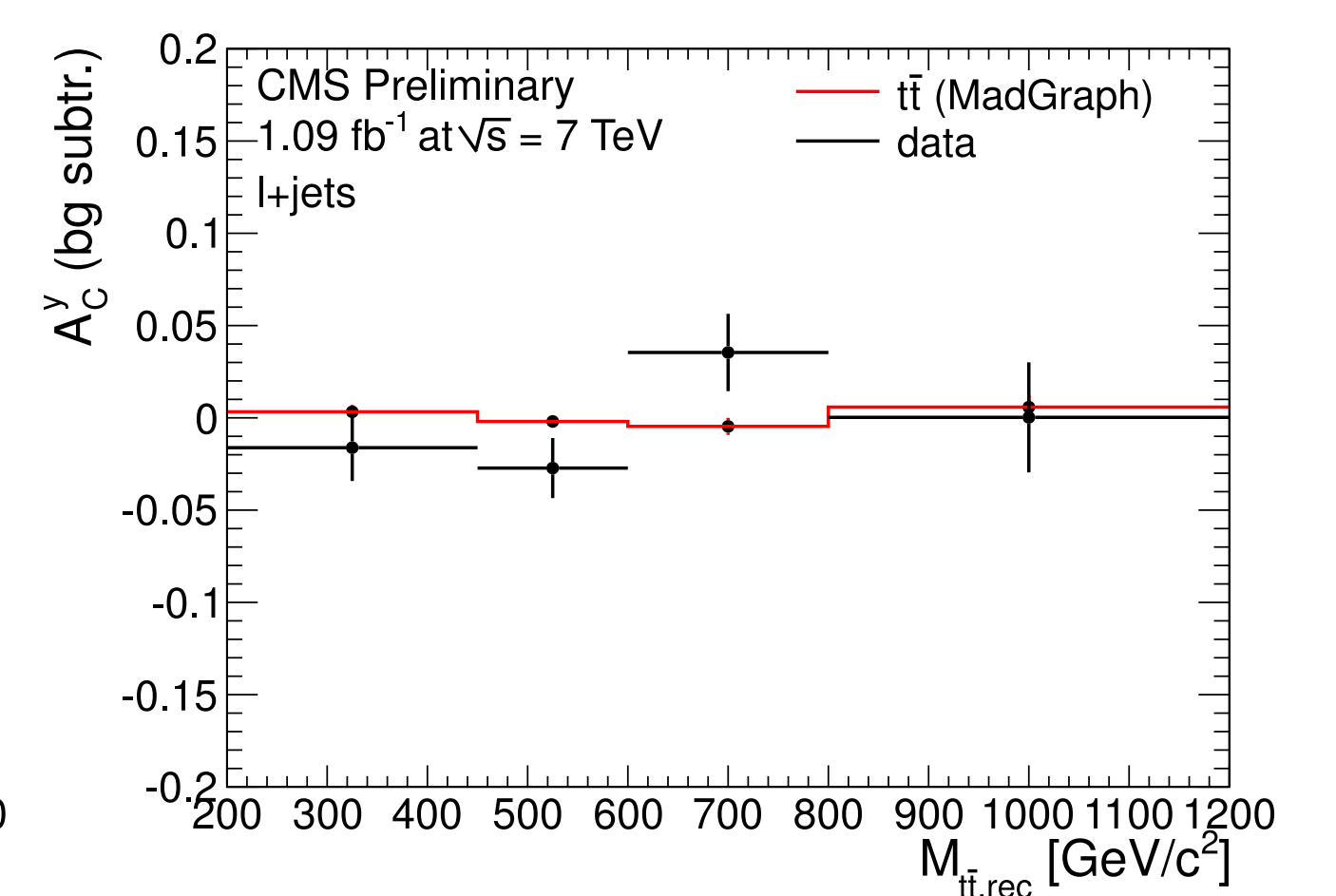
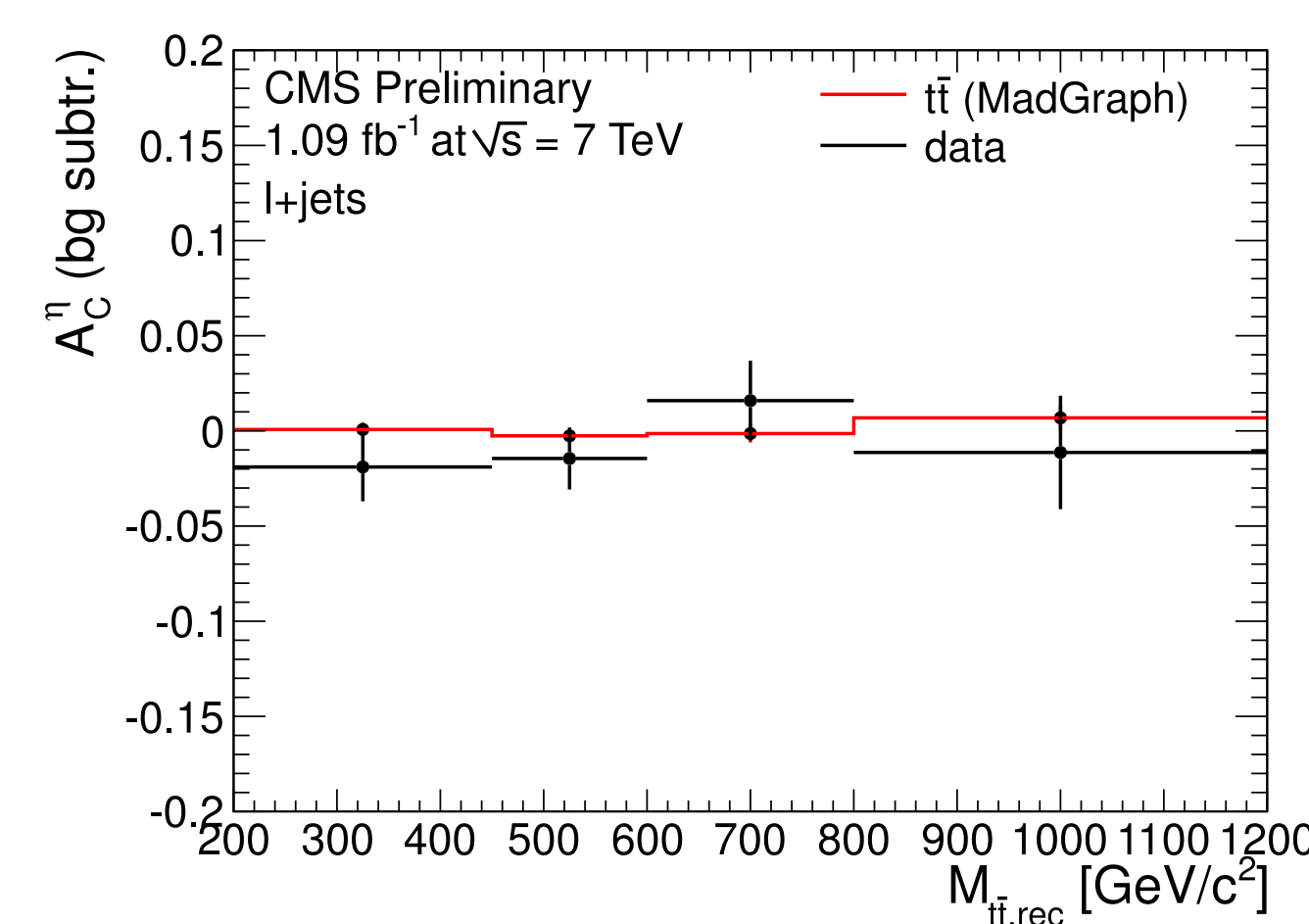
- Systematic uncertainties are of the same order as the statistical uncertainties

Results



$$A_C^{\eta} = -0.016 \pm 0.030 \text{ (stat.) } {}^{+0.010}_{-0.019} \text{ (syst.)}$$

$$A_C^y = -0.013 \pm 0.026 \text{ (stat.) } {}^{+0.026}_{-0.021} \text{ (syst.)}$$



- Results are in good agreement with the Standard Model predictions
- Background-subtracted asymmetries show no mass-dependence
- Published in Physics Analysis Summary CMS-PAS-11-014



[<http://cdsweb.cern.ch/record/1369205>]