Charge asymmetry in top quark pair production in the di-lepton channel at the ATLAS experiment
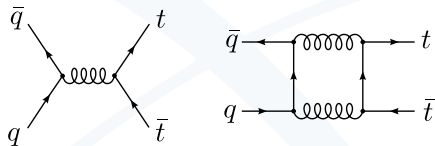
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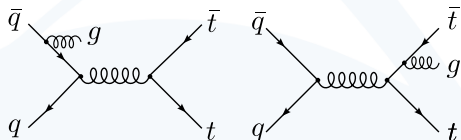on behalf of the ATLAS Collaboration

Physical introduction

- one of possible tests of QCD
- asymmetry from NLO $q\bar{q}$, gq
- at LHC $A_C^{t\bar{t}}$ measured by $\Delta|y|$
- $A_C^{t\bar{t}} \sim 0.5\%$ (MC@NLO)
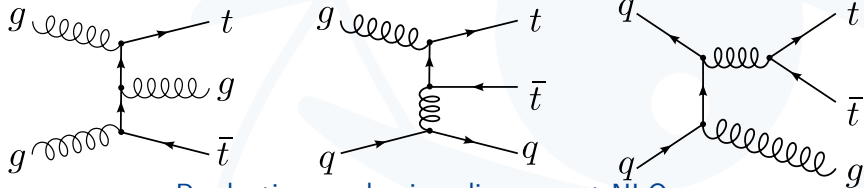
$$A_C^{t\bar{t}} = \frac{N(\Delta|y| > 0) - N(\Delta|y| < 0)}{N(\Delta|y| > 0) + N(\Delta|y| < 0)}$$

Box vs. Born interference

ISR vs. FSR interference

Production mechanism diagrams at NLO.

Data and Monte-Carlo

- Data: pp-collisions LHC 2011 $\sqrt{s} = 7$ TeV, $\mathscr{L} = 4.7$ fb^{-1} recorded by ATLAS
- Monte-Carlo: signal (MC@NLO) and background (expect W+jets)

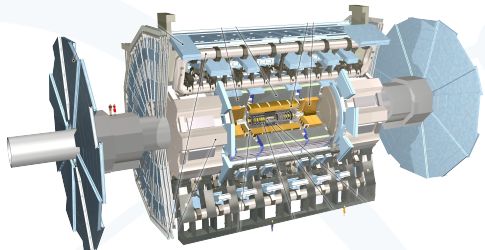Table: Expected and observed number of events.

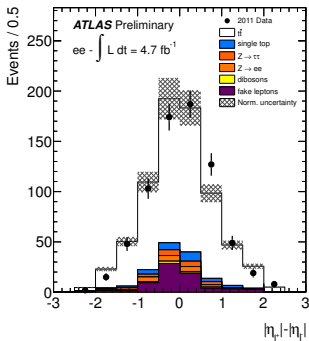| Channel	ee	$e\mu$	$\mu\mu$
$t\bar{t}$	590 ± 60	4400 ± 500	1640 ± 170
$Z \to ee/\mu\mu$	19 ± 7	-	83 ± 29
$Z \to \tau\tau$	19 ± 7	180 ± 60	67 ± 23
Single top	30 ± 2	230 ± 20	82 ± 7
Dibosons	9 ± 1	70 ± 4	23 ± 2
Multijets/ W+jets	70 ± 36	250 ± 130	32 ± 17
Total	740 ± 70	5100 ± 500	1930 ± 170
Data	732	5305	2010

Reconstruction

- **Reconstruction objects:** two leptons, two jets and missing E_T
- **Reconstruction method** based on computation of weights from LO matrix element of $gg \to t\bar{t}$
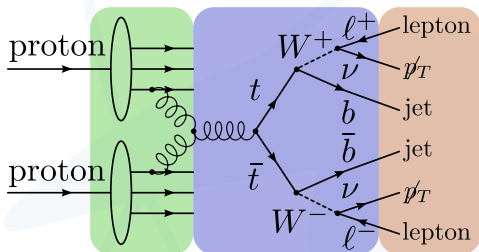
$$w \equiv \frac{(2\pi)^4}{\varepsilon_1 \varepsilon_2 s} d\varepsilon_1 d\varepsilon_2 f_{\text{PDF}}(\varepsilon_1) f_{\text{PDF}}(\varepsilon_1) |\mathcal{M}(y)|^2 W(x,y) d\Phi_n \ ,$$
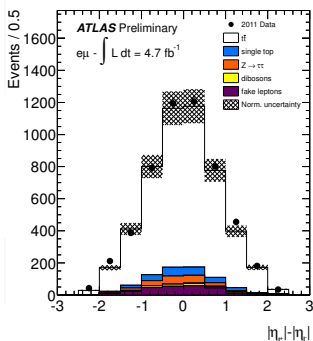
Results - lepton charge asymmetry

ee - channel $\qquad$ $e\mu$ - channel $\qquad$ $\mu\mu$ - channel

$$\mathbf{A}_{\mathbf{C}}^{\ell^+\ell^-} = 0.091 \qquad \mathbf{A}_{\mathbf{C}}^{\ell^+\ell^-} = 0.018 \qquad \mathbf{A}_{\mathbf{C}}^{\ell^+\ell^-} = 0.026$$

$$\pm 0.041 \text{ (stat.)} \qquad \pm 0.014 \text{ (stat.)} \qquad \pm 0.023 \text{ (stat.)}$$
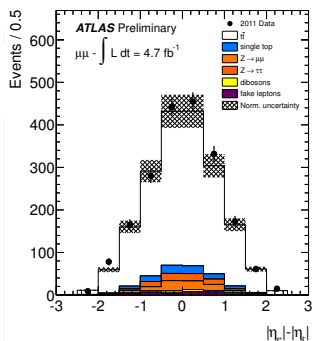
$$\pm 0.029 \text{ (syst.)} \qquad \pm 0.009 \text{ (syst.)} \qquad \pm 0.009 \text{ (syst.)}$$

Results - $t\bar{t}$ charge asymmetry

ee - channel
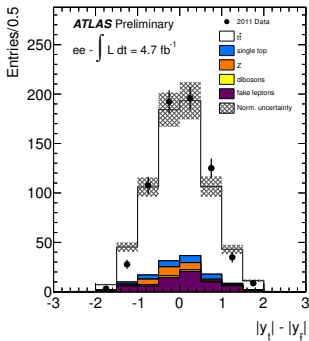
$e\mu$ - channel

$\mu\mu$ - channel

$\mathbf{A_C^{t\bar{t}}}$ = 0.079
$\pm$ 0.087 (stat.)
$\pm$ 0.028 (syst.)
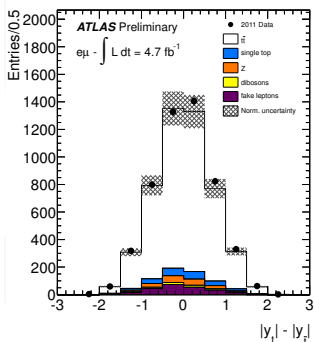
$\mathbf{A_C^{t\bar{t}}}$ = 0.078
$\pm$ 0.029 (stat.)
$\pm$ 0.017 (syst.)
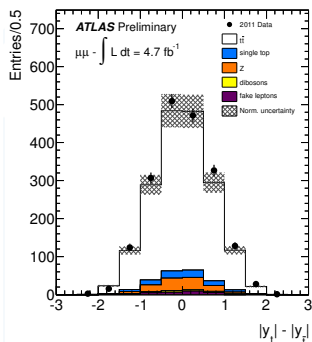
$\mathbf{A_C^{t\bar{t}}}$ = 0.000
$\pm$ 0.046 (stat.)
$\pm$ 0.021 (syst.)

Summary

- These results are the first measurement of top charge asymmetry in dilepton channel on ATLAS.
- Lepton charge asymmetry, all channels combined by BLUE:
  $$\mathbf{A}_C^{\ell^+\ell^-} = 0.023 \pm 0.012 \text{ (stat.) } \pm 0.008 \text{ (syst.) .}$$
- Top charge asymmetry, all channels combined by BLUE:
  $$\mathbf{A}_C^{t\bar{t}} = 0.057 \pm 0.024 \text{ (stat.) } \pm 0.015 \text{ (syst.) .}$$
- Top charge asymmetry, lepton+jet and dilepton combined by BLUE:
  $$\mathbf{A}_C^{t\bar{t}} = 0.029 \pm 0.018 \text{ (stat.) } \pm 0.014 \text{ (syst.)}$$
- Current results are compatible with the Standard Model predictions.

Thank you for your attention.
Comments during poster
session.