Measurement of the leptonic t̄t charge asymmetry in the dilepton channel with the DØ detector

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Figure 1 : NLO QCD interferences responsible for the top charge asymmetry.

1. Theory and measurements

✗ In the standard model charge asymmetry is a QCD NLO effect coming from the interferences of ISR/FSR and born/box diagram (see Fig. 1).

✗ The top charge asymmetry is transfered to leptons in the decay $t \rightarrow Wb \rightarrow l\nu b$.

✗ Observables :

$$A^{ll} = \frac{N(\Delta\eta > 0) - N(\Delta\eta < 0)}{N(\Delta\eta > 0) + N(\Delta\eta < 0)} \qquad A^{l}_{FB} = \frac{N(q \times \eta_l > 0) - N(q \times \eta_l < 0)}{N(q \times \eta_l > 0) + N(q \times \eta_l < 0)}$$

$\Delta\eta = \eta_{l+} - \eta_{l-}$ η_l is the lepton pseudorapidity and q is the lepton electric charge.

✗ The asymmetry could be enhanced by BSM processes (axigluons, Z' ...).

✗ Previous results at the Tevatron from both CDF and D0 show deviations from the predictions. ATLAS and CMS results at 7 TeV show an agreement with the predictions but the asymmetry at the LHC is smaller.
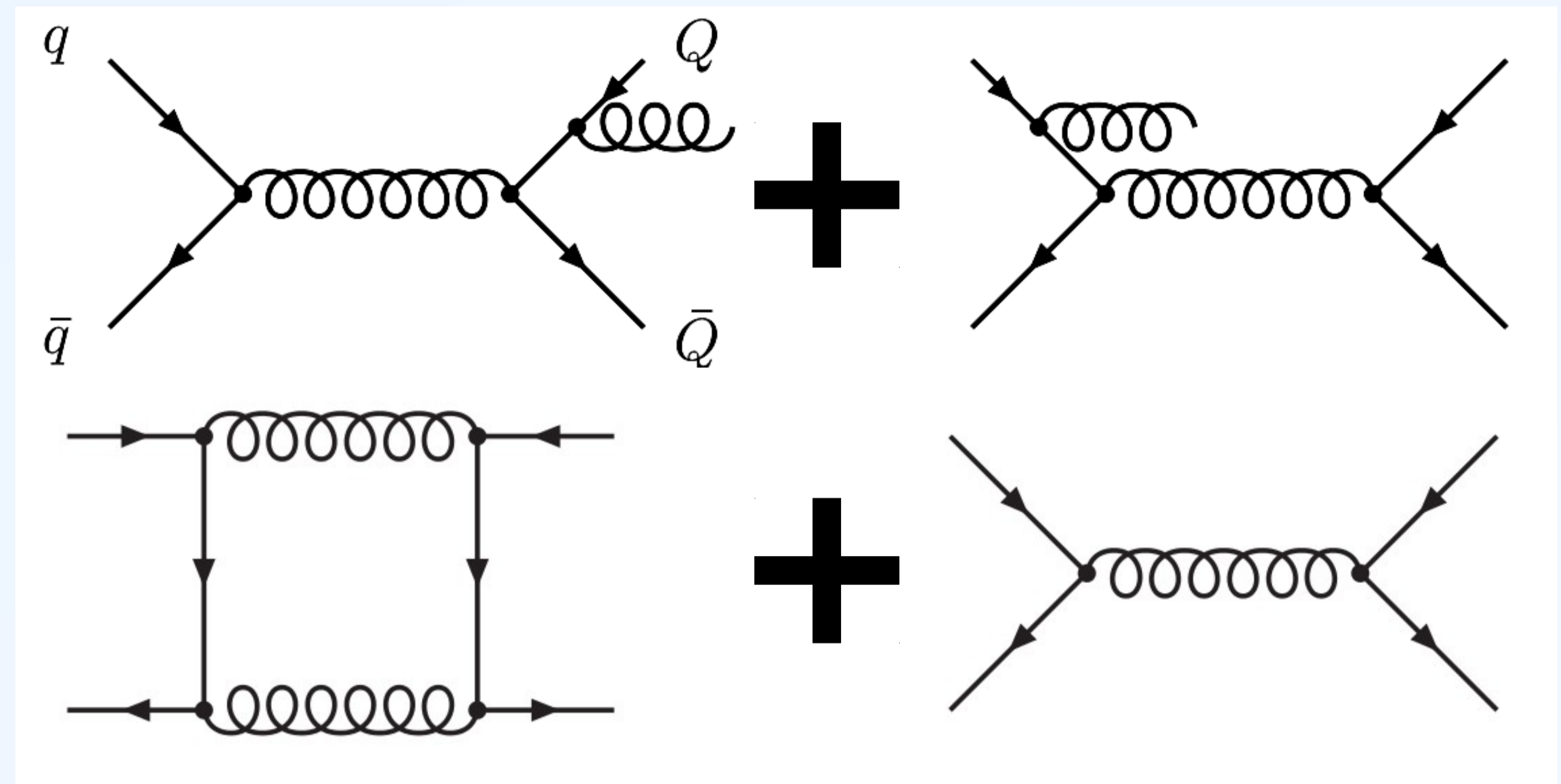
	ee	eµ 2 jets	eµ 1 jet	µµ
t̄t	127.8 ± 1.4	314.7 ± 1.1	61.7 ± 0.5	97.7 ± 0.6
background	24.3 ± 0.7	33.9 ± 4.0	15 ± 1.8	19.4 ± 0.7
Total predicted	152.1 ± 1.6	348.6 ± 4.1	76.7 ± 1.9	117.1 ± 0.9
Total observed	147	343	78	114

Table 1 : event yields after the selection (statistical uncertainty only).

Figure 2 : q x η and Δη distributions after the event selection.

3. Measurement method

✗ Within the fiducial region (visible phase space): the estimated backgrounds are subtracted from data in each bin of the distributions in Fig. 2. A bin-by-bin correction is then applied to account for the reconstruction efficiency and selection acceptance (see Fig. 3). This leads to the so-called « corrected » (or partonic) asymmetry.

✗ The corrected asymmetries are extrapolated to the full phase space using MC@NLO partonic informations. The corresponding « extrapolated » asymmetries can be compared to the NLO predictions based on the SM.

Figure 5 : Tevatron measurements summary.

2. Event selection (see Fig. 2.)

Full DØ data sample : 9.7 fb⁻¹ (see Table 1)

✗ Two oppositely charged leptons (electron or muon) with p_T > 15 GeV.

✗ Two or more jets with p_T > 20 GeV + exactly 1 jet in eµ channel.

✗ Final selection :
- one b-tagged jet (multivariate discriminant) ;
- topological requirement : (ee) MET significance > 2.5, (eµ 2 jets) H_T > 108 GeV, (eµ 1 jet) H_T > 85 GeV, (µµ) MET significance > 3.5 ;
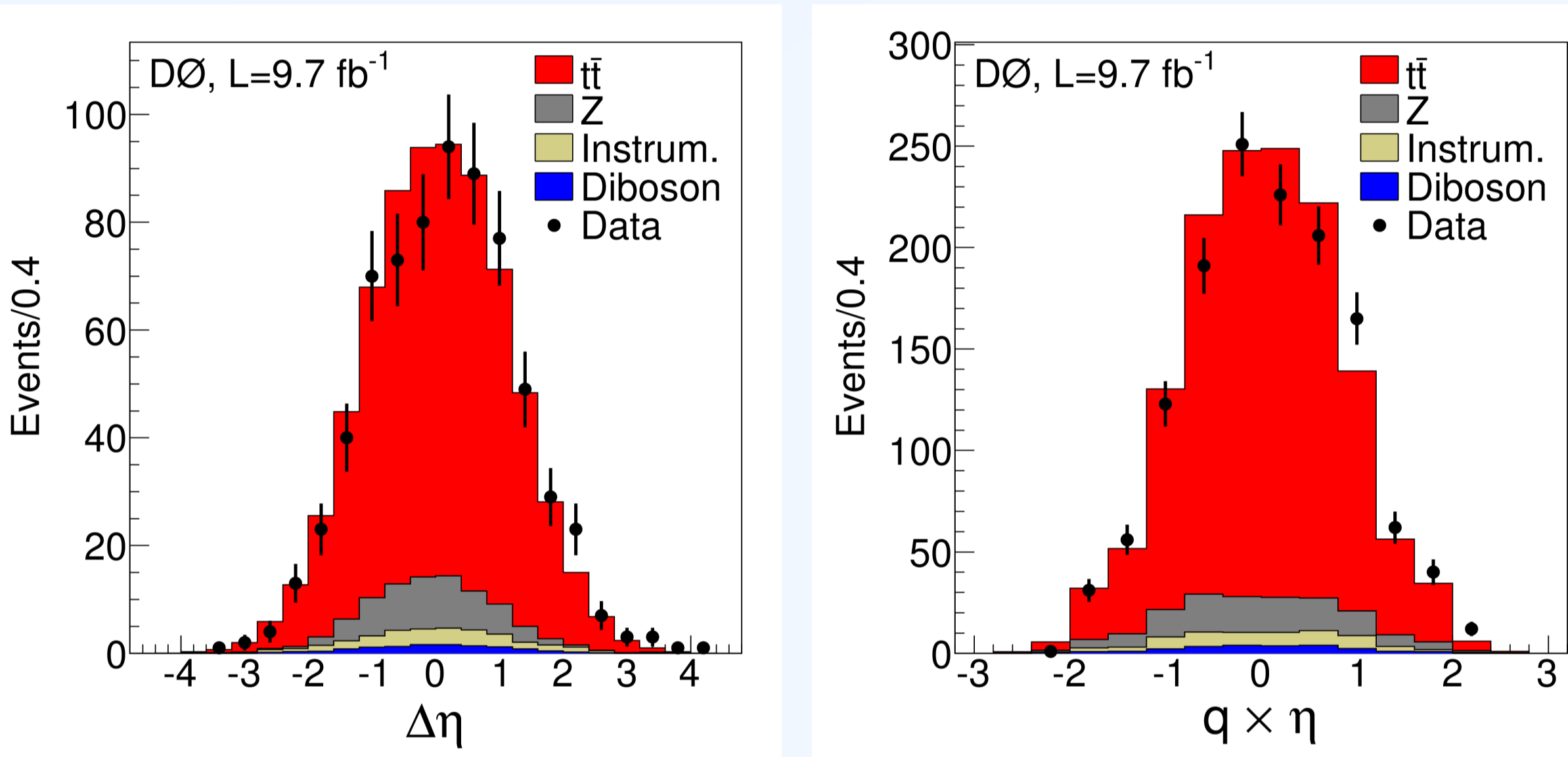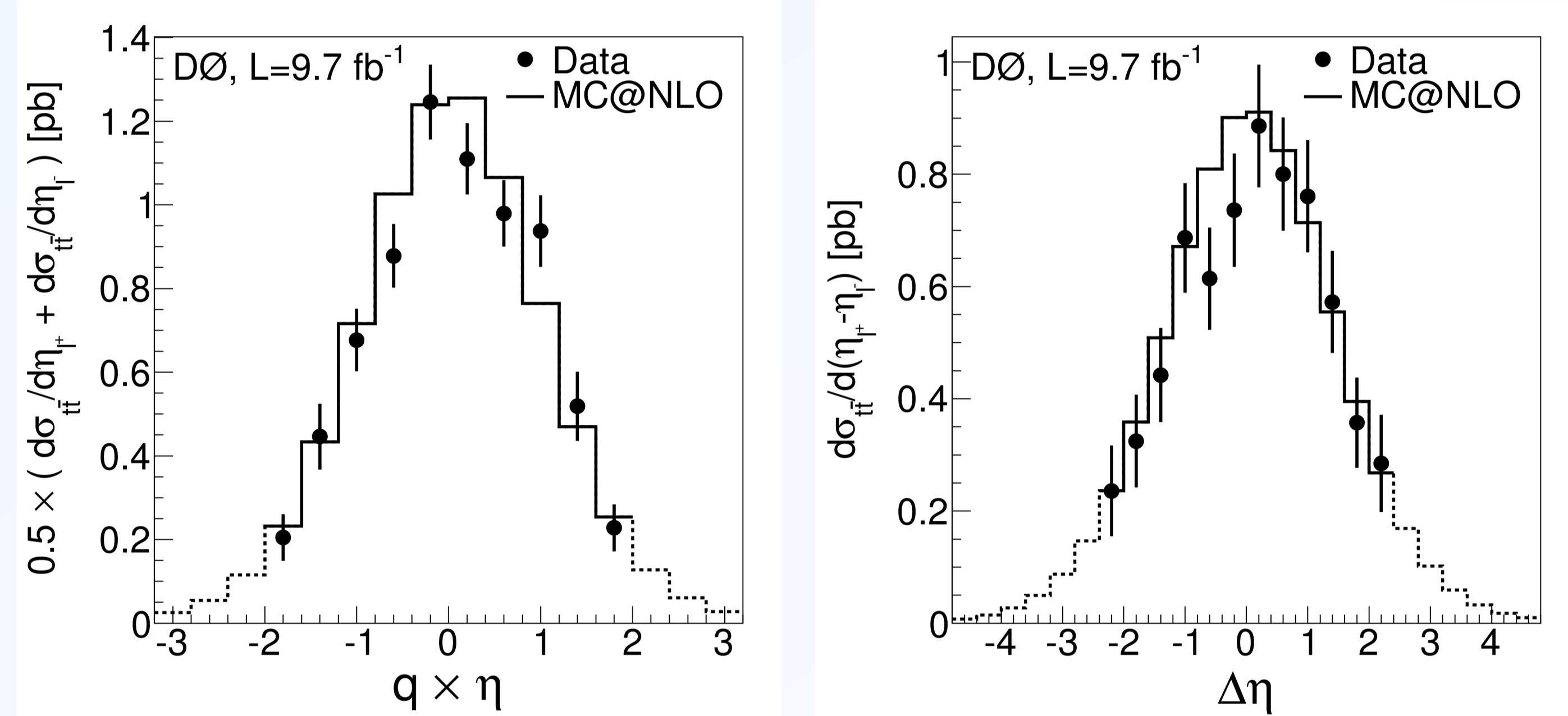- definition of the fiducial region : $|\eta_l|$ < 2 and $|\Delta\eta|$ < 2.4.

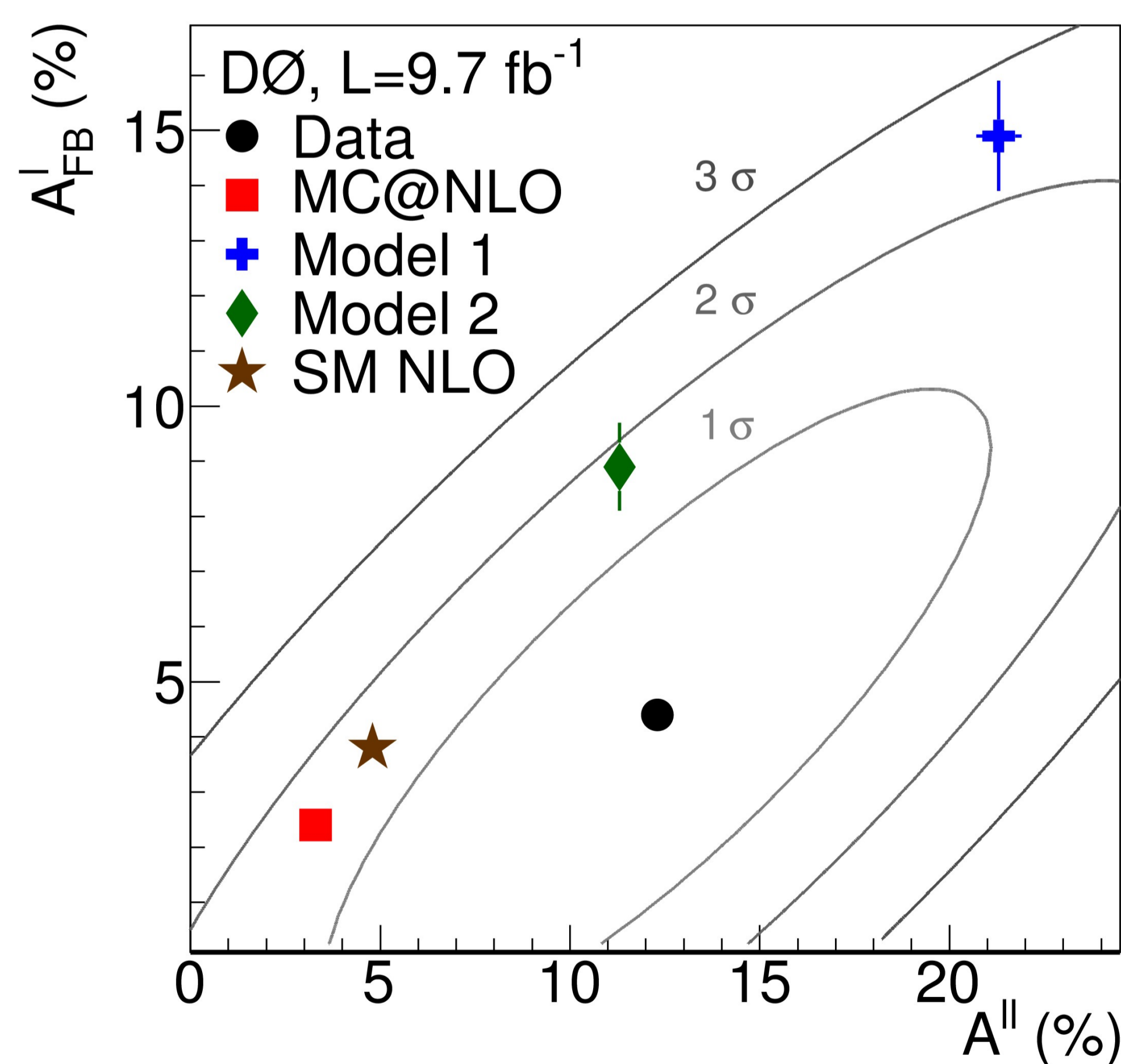Figure 3 : q x η and Δη distributions at the partonic level.

Figure 4 : Extrapolated A^l_{FB} versus A^{ll}.

4. Systematics

✗ Instrumental background.
✗ Parton shower/hadronization.
✗ Z background asymmetry.
✗ Background normalization.

5. Results

✗ Measured asymmetries (see Table 2 and Fig. 4) are in agreement with the predictions based on the SM.

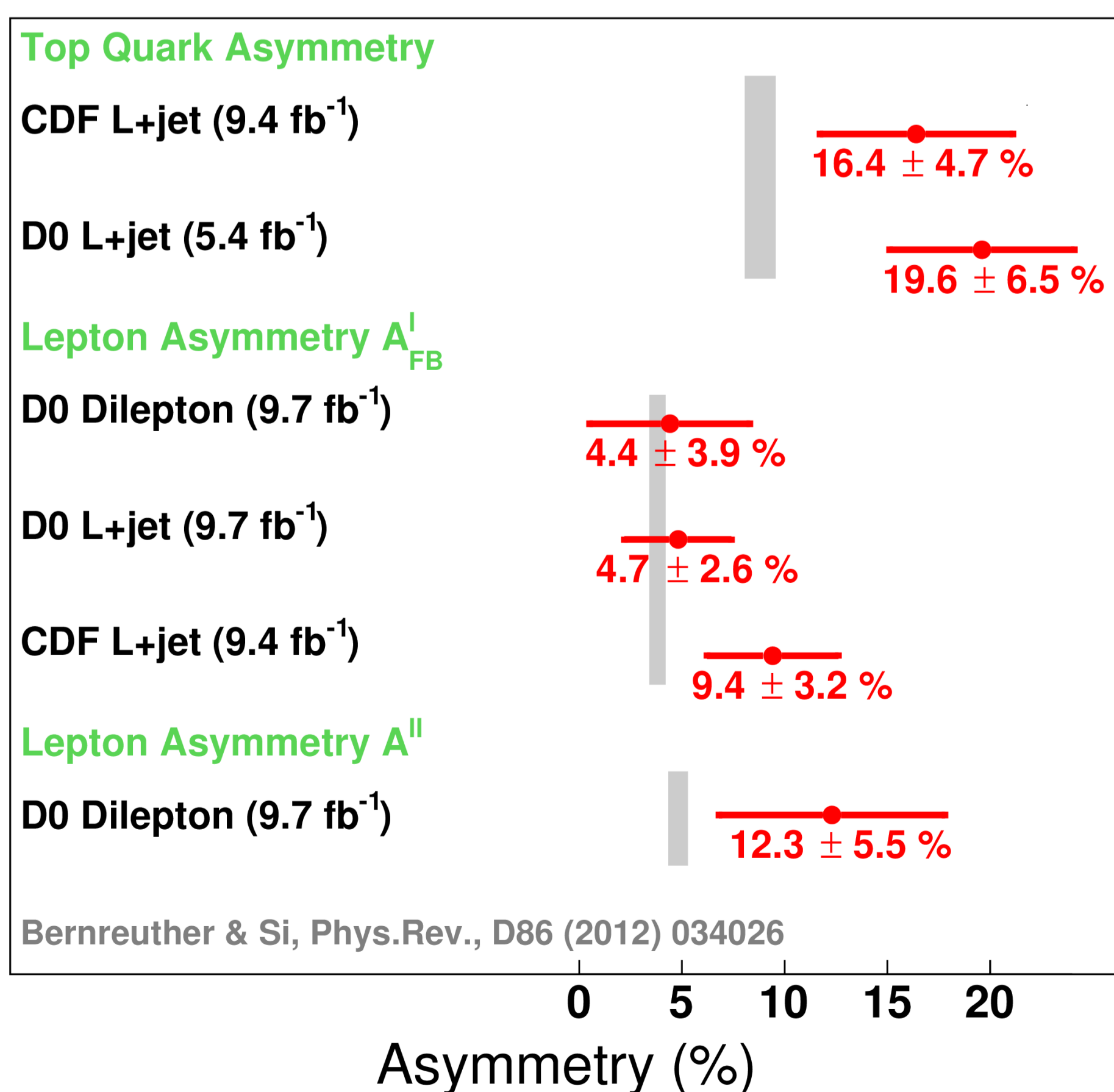✗ Figure 5 shows the summary of the Tevatron measurements.

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	Corrected	Extrapolated	Predictions[1]
A^l_{FB} (%)	4.1 ± 3.5 ± 1.0	4.4 ± 3.7 ± 1.1	3.8 ± 0.3
A^{ll} (%)	10.5 ± 4.7 ± 1.1	12.3 ± 5.3 ± 1.5	4.8 ± 0.4
A^l_{FB}/A^{ll}		0.36 ± 0.20	0.79 ± 0.10

Table 2 : Results : XX ± XX (stat) ± XX (syst).

[1] : W. Bernreuther and Z.-G. Si, Phys. Rev. D 86, 034026 (2012)