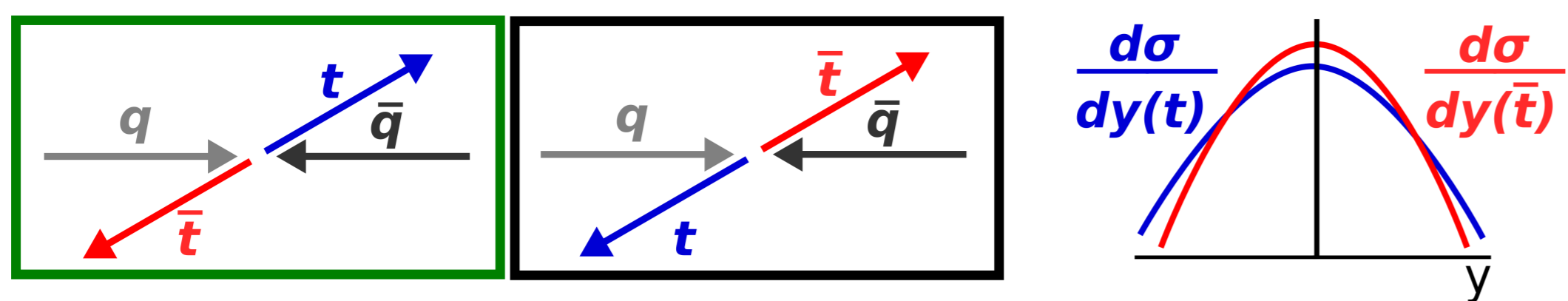


Charge asymmetry in dileptonic $t\bar{t}$ events @ LHC

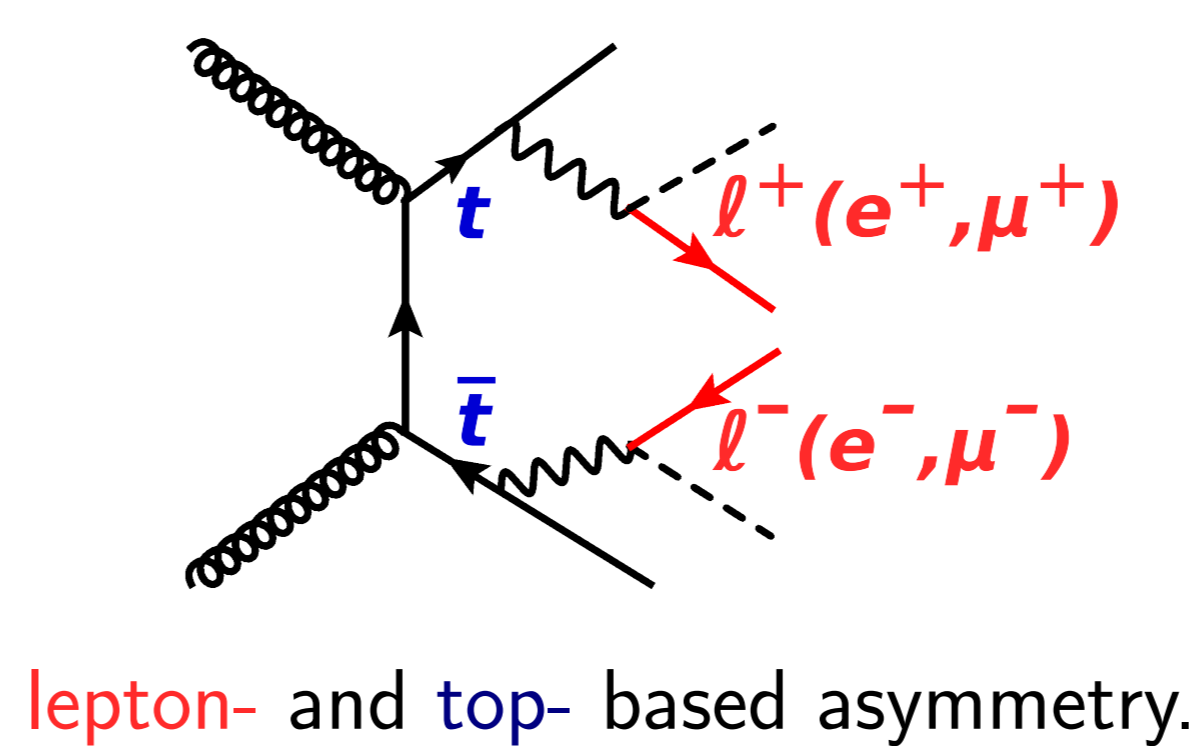
In the SM $t\bar{t}$ production, $q\bar{q}$ or qg initial states:

preferred: t emitted in the direction of q ,
suppressed: t emitted in the direction of \bar{q} .



⇒ @ LHC: $d\sigma/dy(t)$ is wider than $d\sigma/dy(\bar{t})$, where $y = \text{rapidity}$.

Dileptonic $t\bar{t}$:



Observables:

$$A_C^{\ell\ell} = \frac{N(\Delta|\eta| > 0) - N(\Delta|\eta| < 0)}{N(\Delta|\eta| > 0) + N(\Delta|\eta| < 0)},$$

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

where: N = number of events,
 $\Delta|\eta| = |\eta_{\ell^+}| - |\eta_{\ell^-}|$, $\eta = -\ln \tan(\theta/2)$,
 $\Delta|y| = |y_t| - |y_{\bar{t}}|$, $y = \frac{1}{2} \ln \frac{E+p_z}{E-p_z}$.

Event selection and $t\bar{t}$ reconstruction

Select events with dilepton $t\bar{t}$ signature:

- exactly 2 leptons of opposite charge,
- at least two jets,
- $ee/\mu\mu$: $|m_{ll} - m_Z| > 10$ GeV and $E_T^{\text{miss}} > 60$ GeV,
- $e\mu$: $H_T = \sum_{\text{jets, leptons}} p_T > 130$ GeV.

Backgrounds:

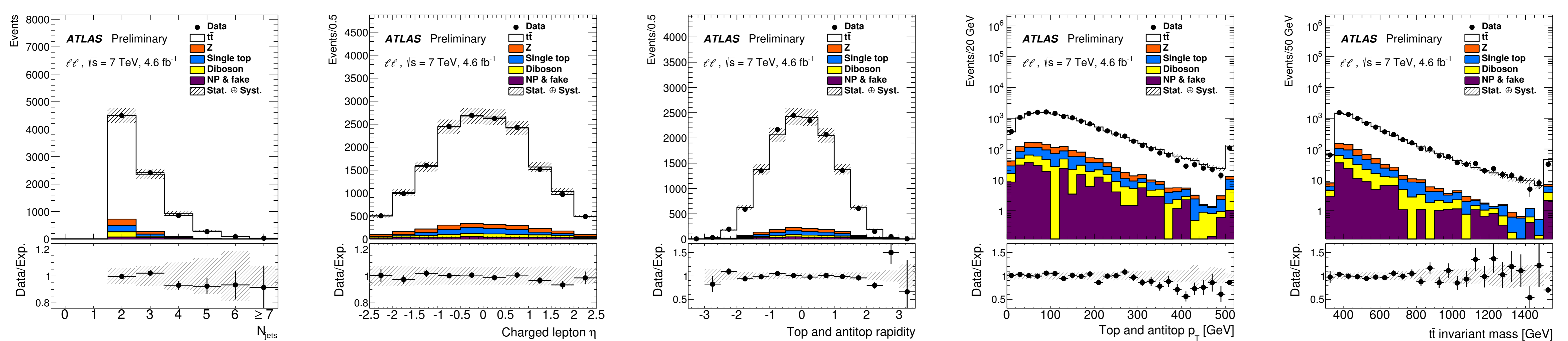
- Estimated from simulation except for:
- non-prompt or fake leptons: from data, using matrix method,
- $Z \rightarrow ee/\mu\mu$: normalized to data.

$A_C^{t\bar{t}}$ requires $t\bar{t}$ kinematics reconstruction.

Using neutrino weighting method:

- assumptions on ν and $\bar{\nu}$ η are made,
- kinematic equations are solved,
- solutions are assigned a weight, acc. to compatibility between the measured E_T^{miss} and $\nu, \bar{\nu}$ p_T .

After selection: sample of around 8000 events with signal/background ~ 6 .



Good agreement between data and MC simulation prediction.

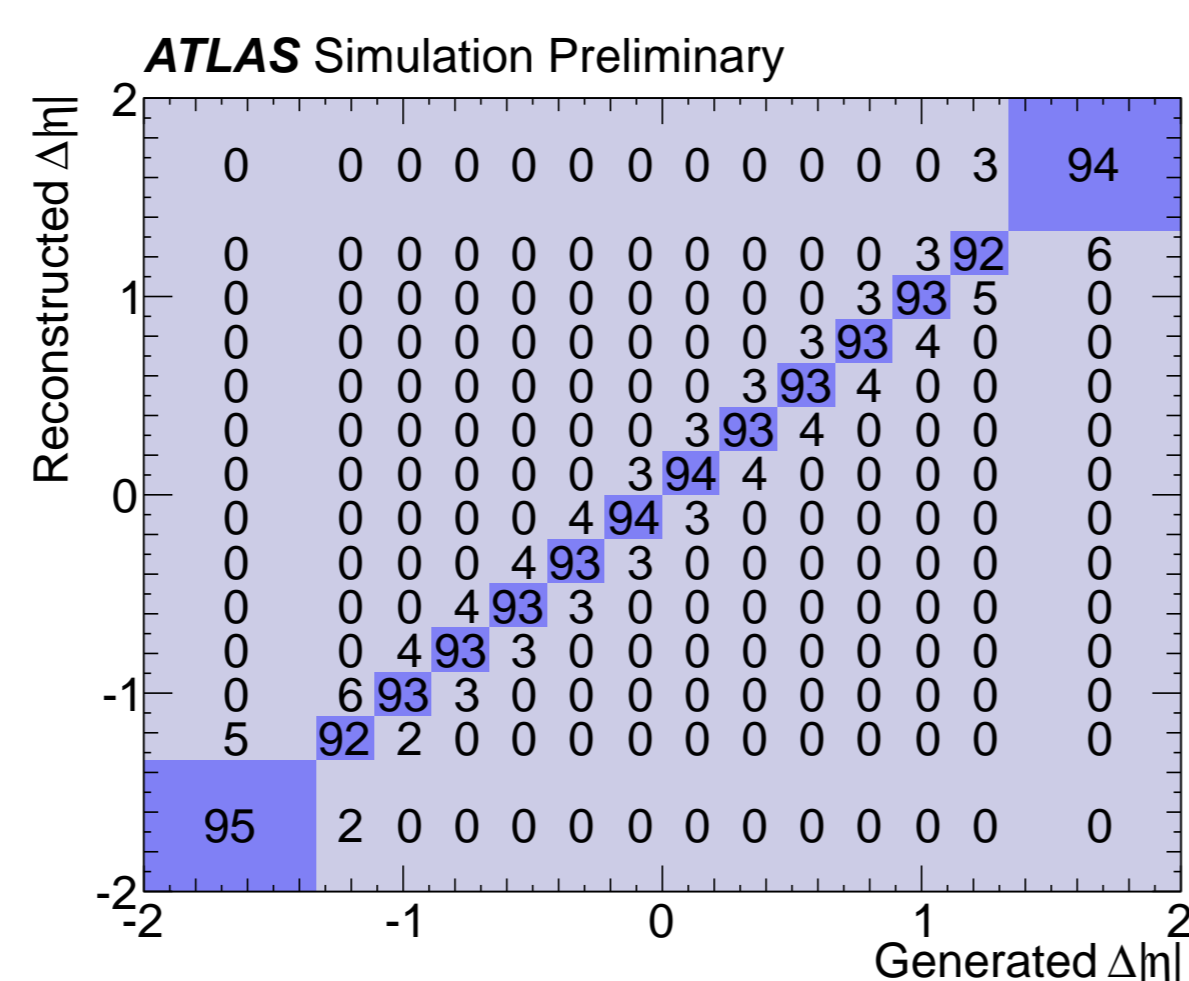
Corrections for detector and resolution effects

Lepton $\Delta|\eta|$ corrections:

Good resolution:

- only leptons, which are measured with high precision, are used,
- does not require $t\bar{t}$ reconstruction,
- $> 90\%$ events in diagonal bins of the migration matrix.

Correct for acceptance using bin-by-bin corrections method.

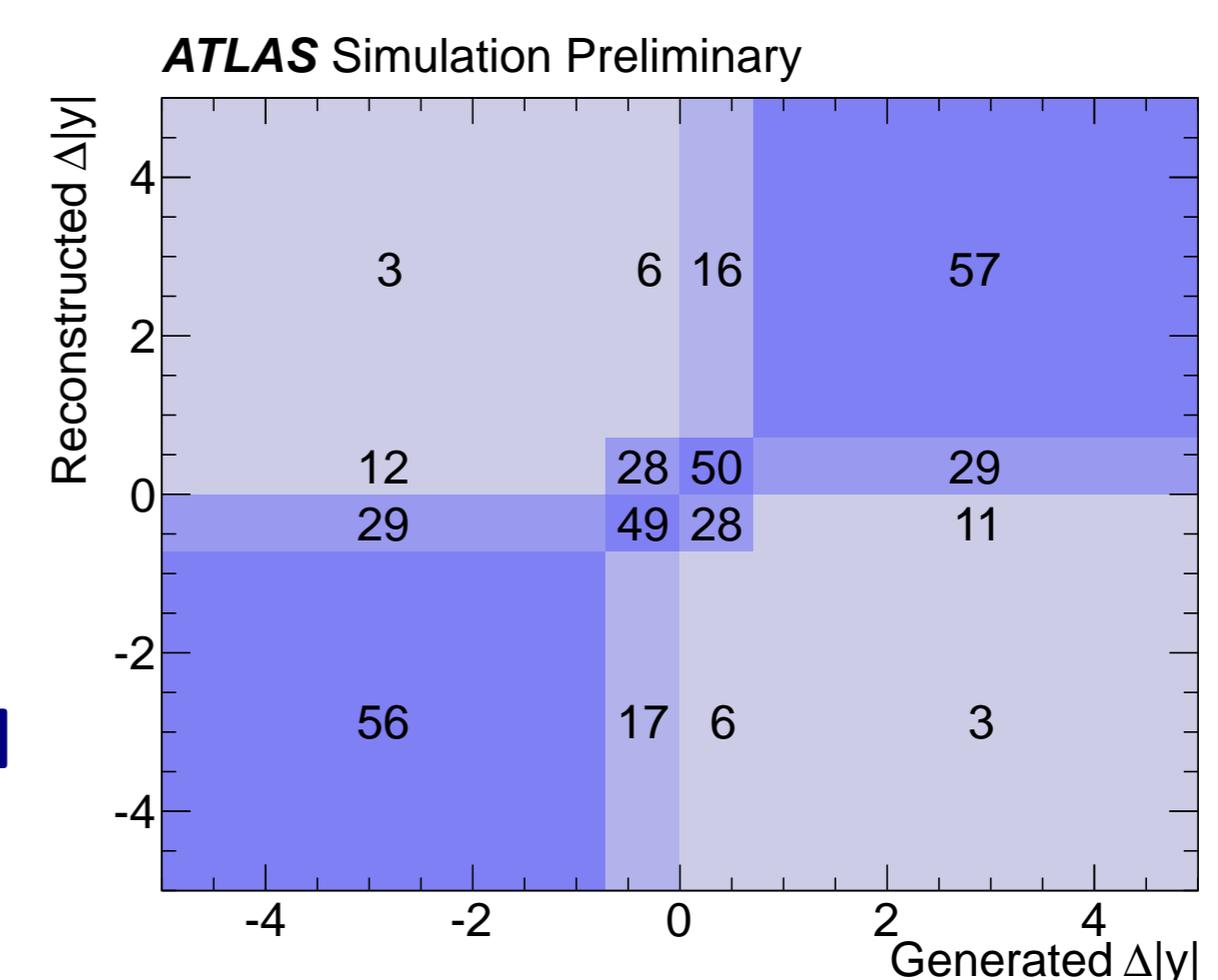


$t\bar{t}$ $\Delta|y|$ corrections:

Lower resolution:

- also jets and E_T^{miss} , measured with lower precision, are used,
- requires $t\bar{t}$ reconstruction,
- $\sim 50\%$ events in diagonal bins.

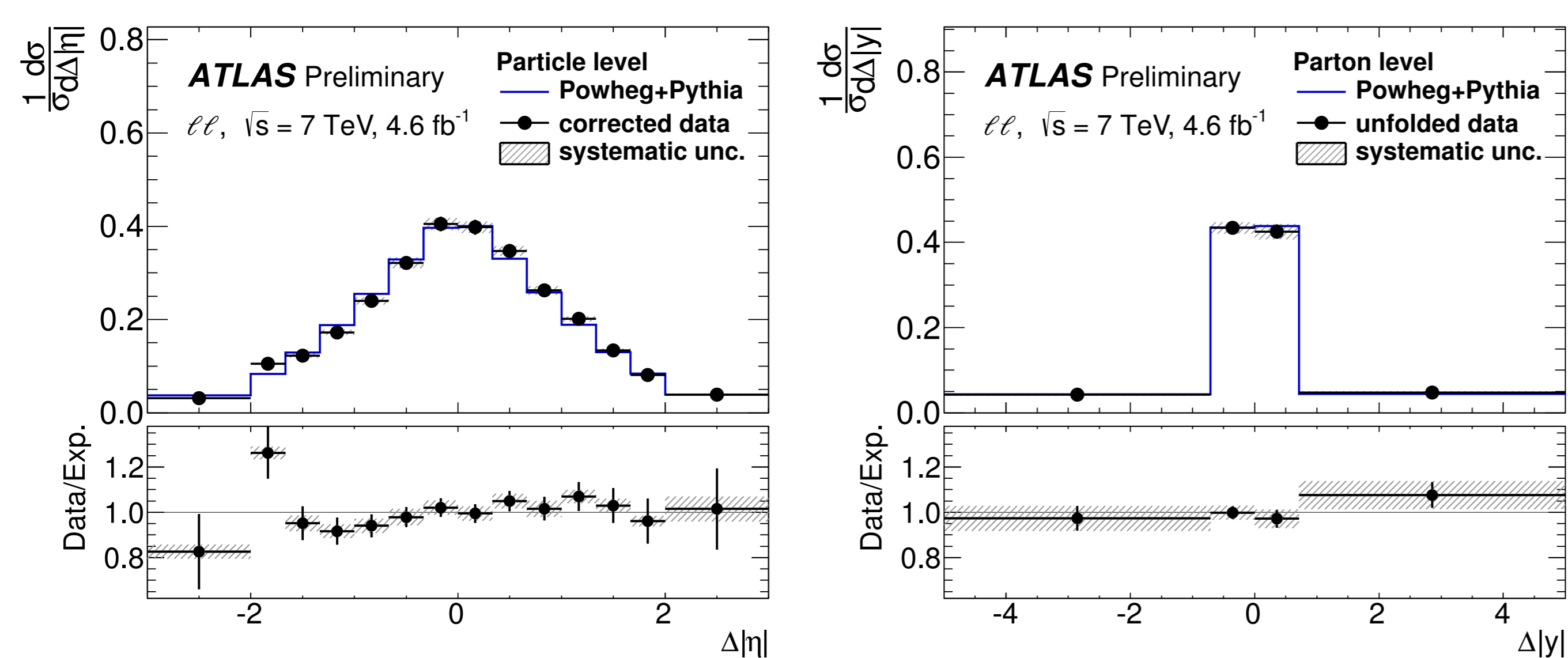
Correct for detector resolution and acceptance effects using Fully Bayesian Unfolding.



Results after corrections

Normalized differential cross-sections:

- for lepton $\Delta|\eta|$ and $t\bar{t}$ $\Delta|y|$.
- MC prediction: from (POWHEG-hvq + PYTHIA6).
- Good agreement between MC and measured distributions.



Measured inclusive asymmetry:

$$A_C^{\ell\ell} = 0.024 \pm 0.015 \text{ (stat.)} \pm 0.009 \text{ (syst.)}$$

$$A_C^{t\bar{t}} = 0.021 \pm 0.025 \text{ (stat.)} \pm 0.017 \text{ (syst.)}$$

In good agreement with SM NLO+EW QCD predictions¹.

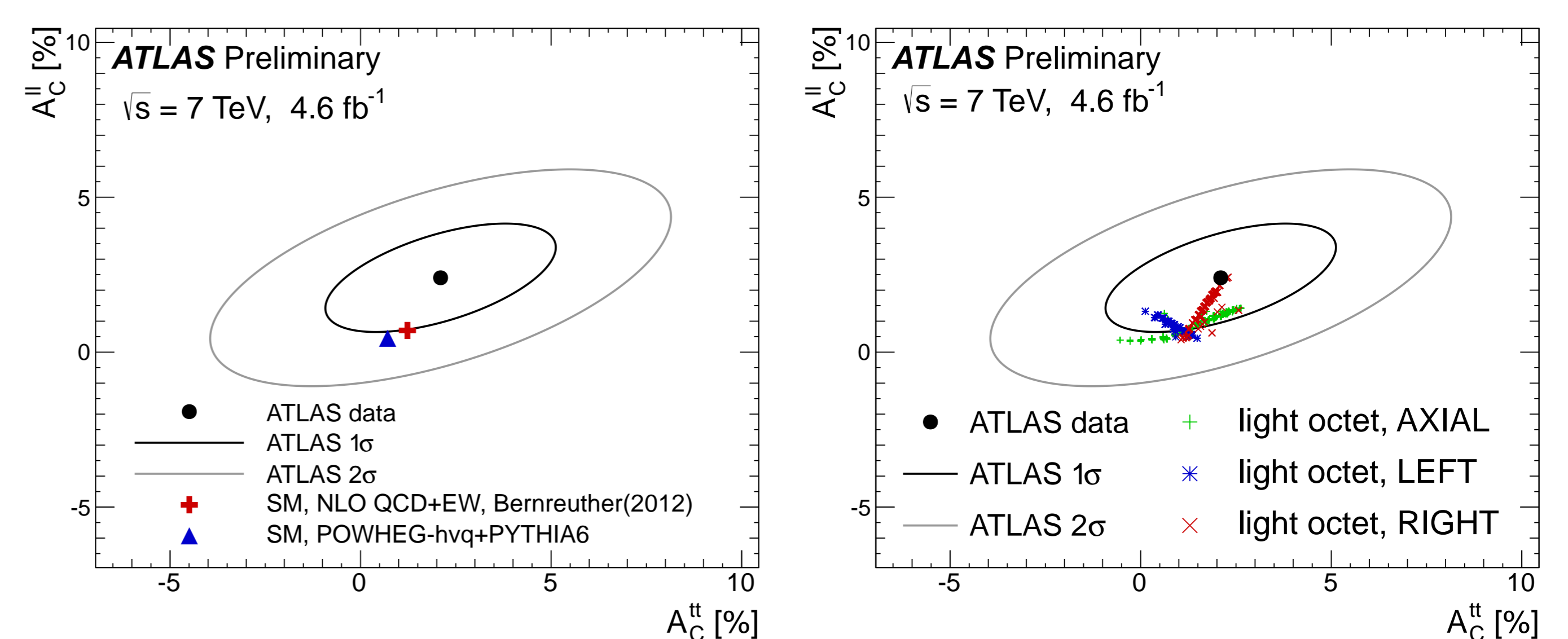
Systematic uncertainties dominant contributions:

- $A_C^{\ell\ell}$, lepton $\Delta|\eta|$: lepton reconstruction.
- $A_C^{t\bar{t}}$, $t\bar{t}$ $\Delta|y|$: detector modelling (lepton, jet reconstruction and E_T^{miss}) + NP & fake lepton backgrounds.

2D measurement and BSM interpretation:

SM and BSM predictions compared to $A_C^{\ell\ell}$ and $A_C^{t\bar{t}}$, with their correlation taken into account.

- SM prediction and 2D measurement: agreement within 1σ .
- BSM models² with new particle: color octet, with parameter ranges from fit, such that Tevatron and LHC measurements describe the data.
- Measurements include Tevatron forward-backward asymmetries and LHC $A_C^{t\bar{t}}$ from l +jets measurements.
- Models that satisfy the fit: in agreement with this measurement.



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

- $A_C^{\ell\ell} = 0.0070 \pm 0.0003$ (scale),
- $A_C^{t\bar{t}} = 0.0123 \pm 0.0005$ (scale).

2) BSM predictions from J. A. Aguilar-Saavedra, arXiv:1405.5826 (light octet mass $M = 250$ GeV).