8 and 13 TeV Powheg-ew predictions
status report

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LHC EW precision subroup meeting
Feb 26, 2021

Nominal Setup (reminder)

- Observable: Born level $A_4(m, y)$
- (LO, NLO, NLO+HO) EW Powheg + NLO QCD
  generated with Powheg Z(_ew) + Pythia8
- $\sin^2\theta^{\ell}_{\text{eff}}$: 0.23150($\pm$0.00050)
- NNPDF31_nnlo_hessian_pdfas
- 6 equal $y_{\ell\ell}$ bins with width of 0.4
- 7 $m_{\ell\ell}$ bins: **52**,66,76,86,96,106,116,150

- 08 and 13 TeV
- Muon and electron channels
- NLO QCD and LO, NLO, or NLO-HO EW corrections
- Total of about 5B 8TeV and 10B 13 TeV events in two channels

Samples

v04
- LO and NLO EW

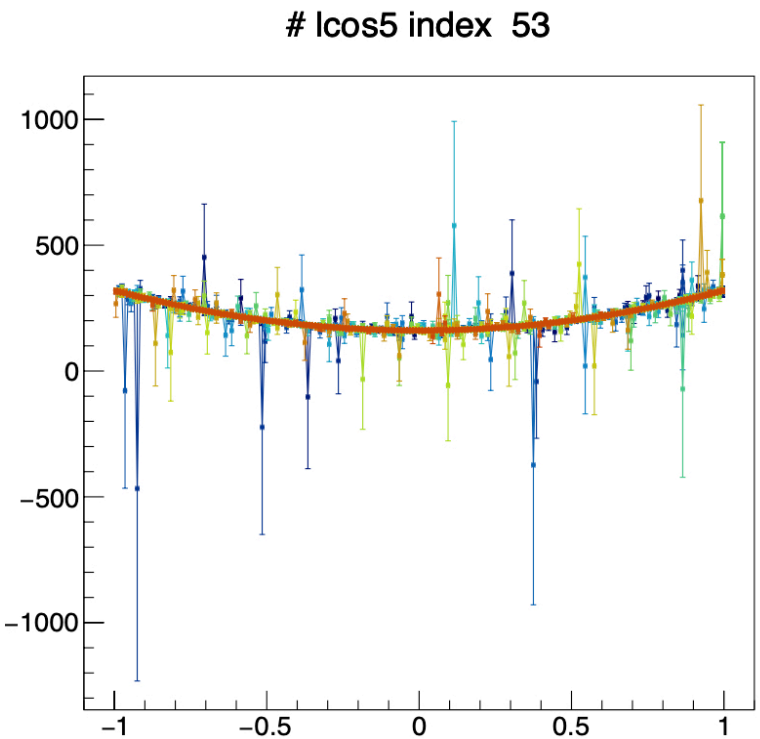
v05
- fine-tune EW input settings to match with Fulvio and Elzbieta
- add nlo+ho predictions
- increased precision

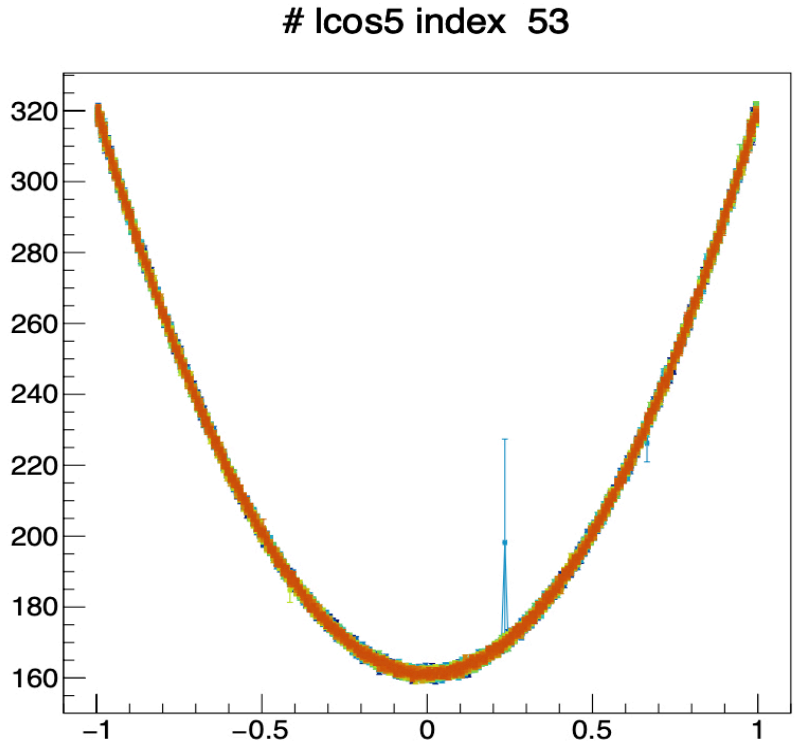
v10
- fix a problem in my setup of random seeds
  – may account for part or full "residual uncertainty" observed before
- use *manyseeds* (100) to remove uncertainty from grid calculation
- svn revision (3828) with increased numerical precision for QCD radiation calculation in certain phase-space regions to improve stability
- enable negative weights

– today will only show half stats (5B events) for 13 TeV and only LO and NLO+HO results (i.e. no NLO)

Difference between LO and NLO+HO distributions

- POWHEG makes a set of 70 distributions during gridpack calculation which can be used for validation before launching event production
- Example dist. before (left) and after (right) increasing numerical precision

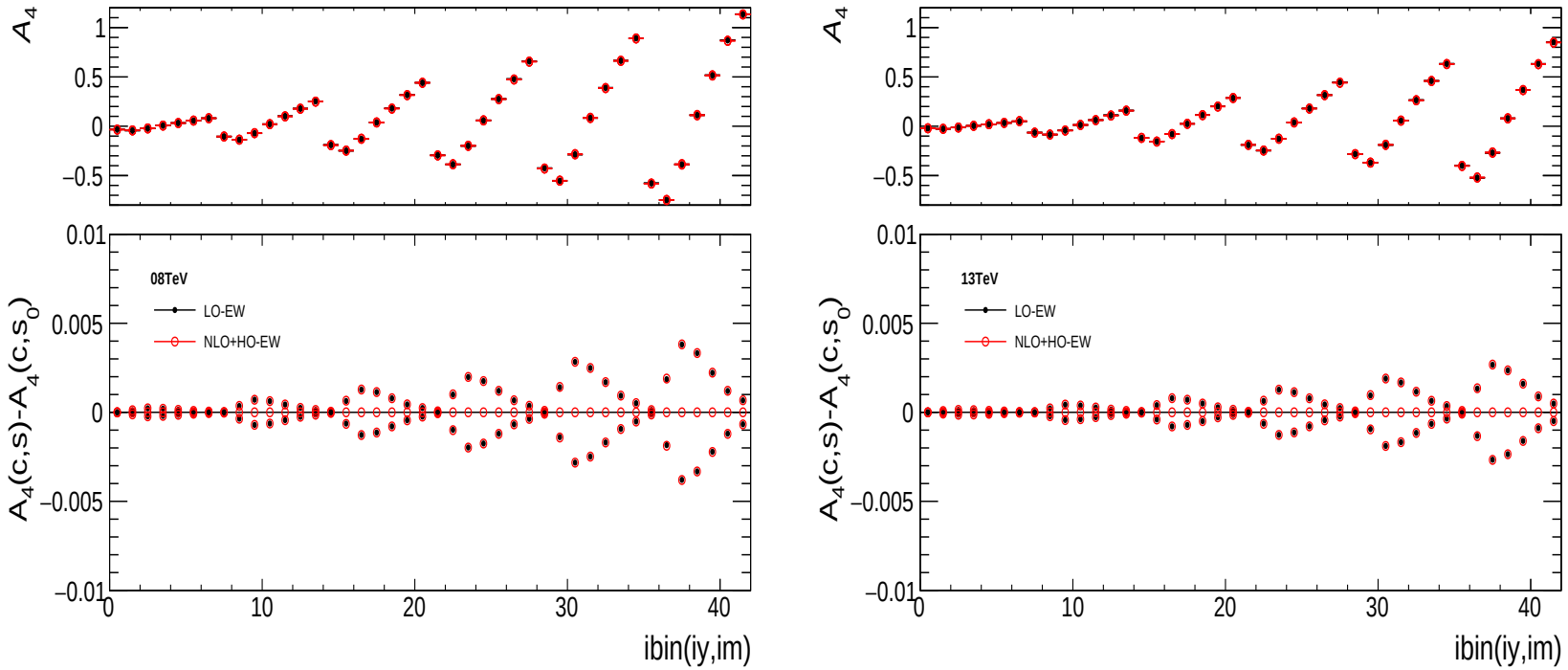




- Distributions from 100 calculations are displayed with different colors

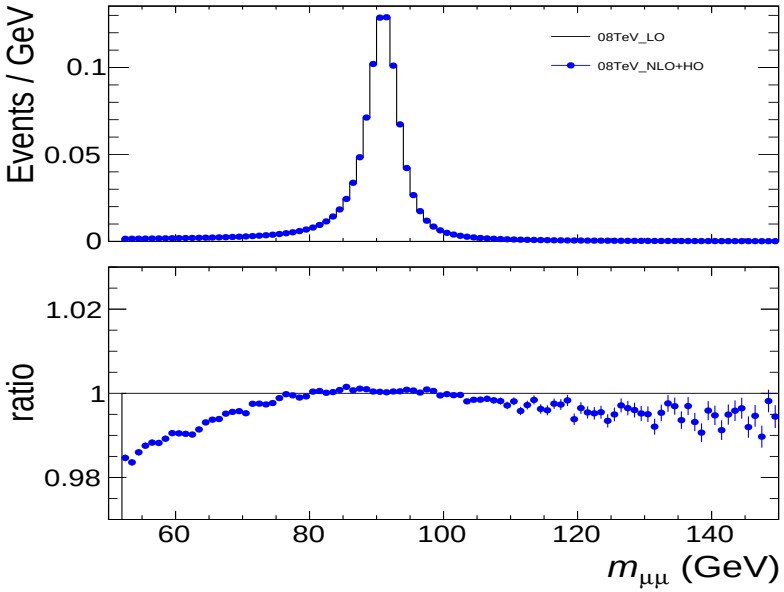
A_4 variations with $\sin^2\theta^\ell_{\rm eff}$

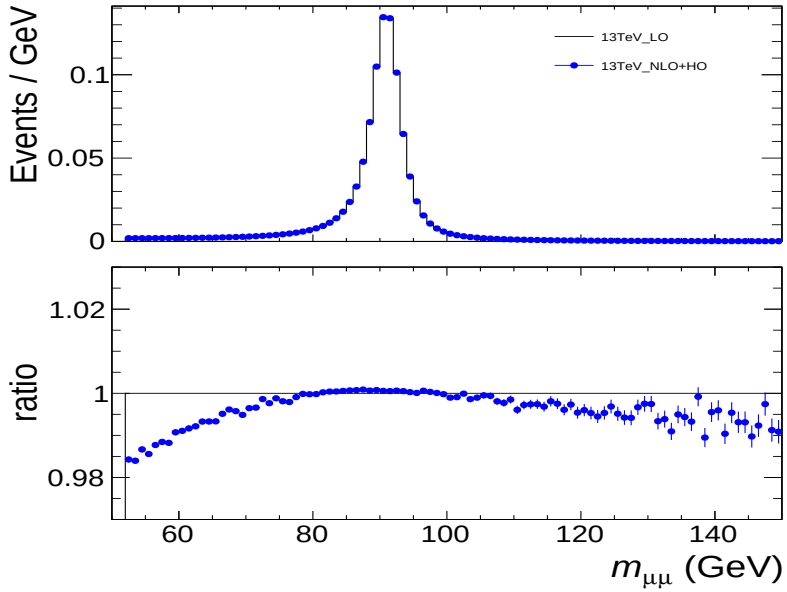
- changes in predictions for different $\sin^2\theta^\ell_{\rm eff}$ inputs are evaluated with Powheg reweighting

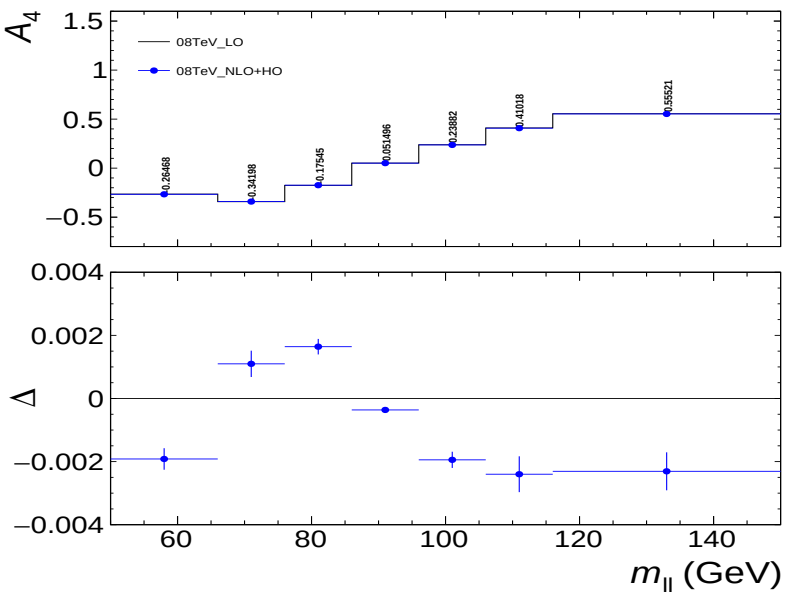


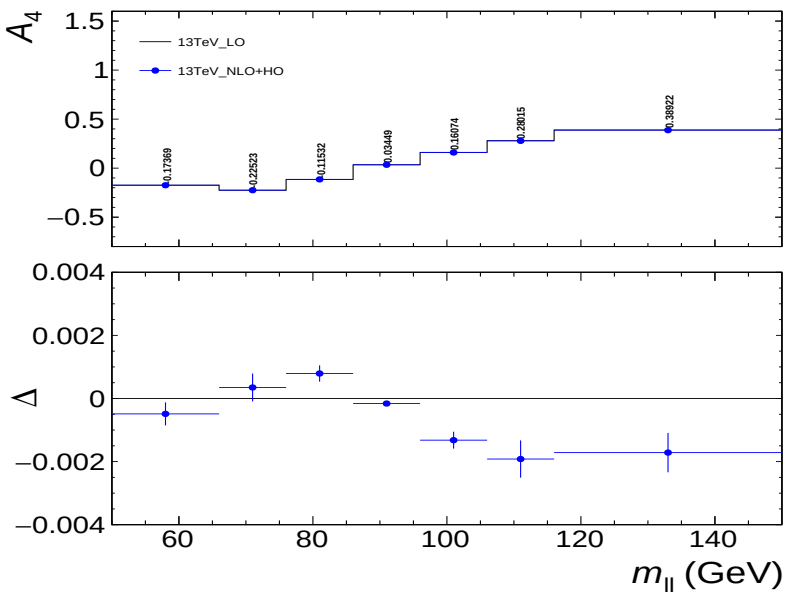
- In $\sin^2\theta^\ell_{\rm eff}$ input scheme, δA_4 variations are identical for LO- and NLO+HO configurations

Difference between LO and NLO+HO distributions

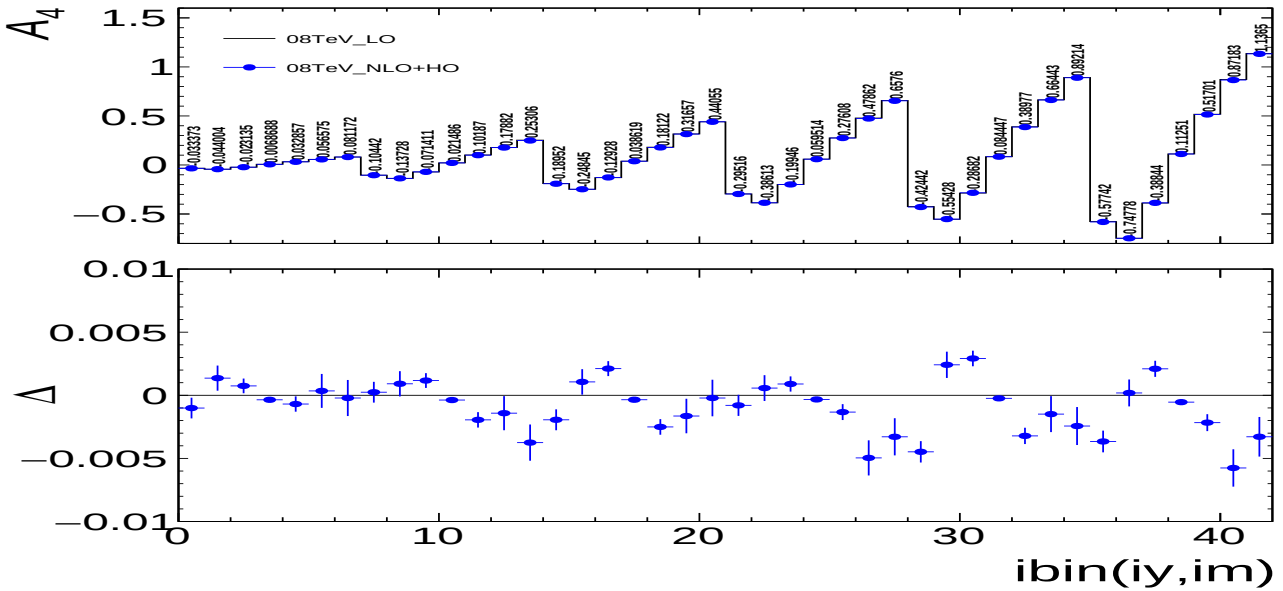


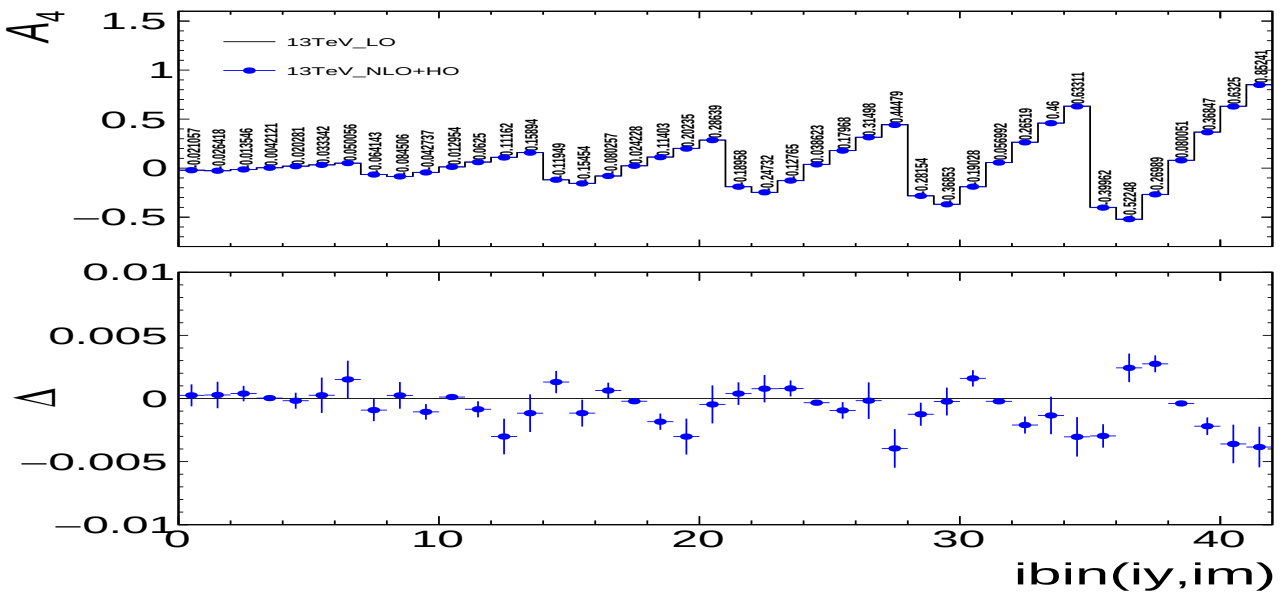






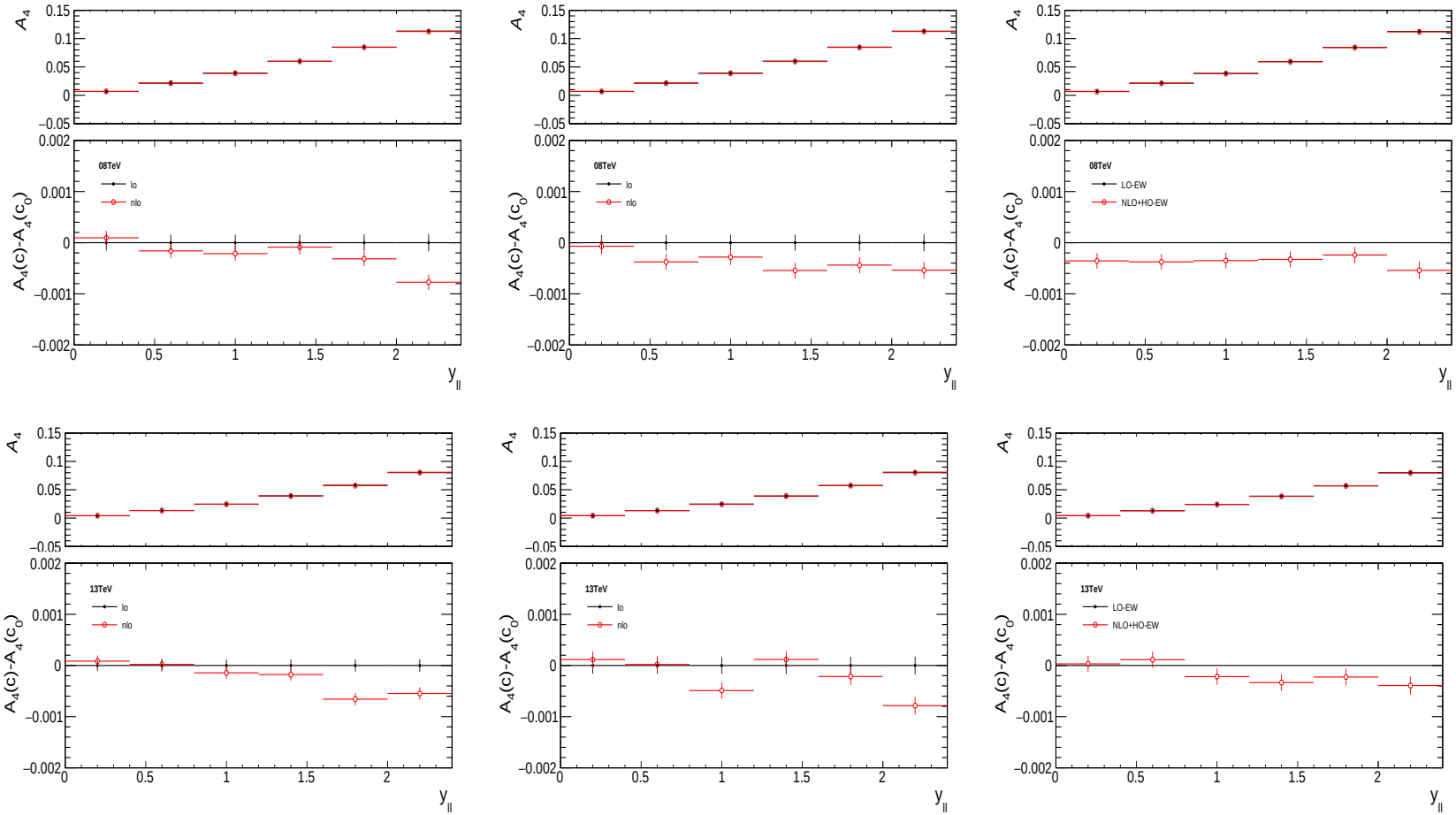
Difference between LO and NLO+HO distributions





Z-peak A4 predictions

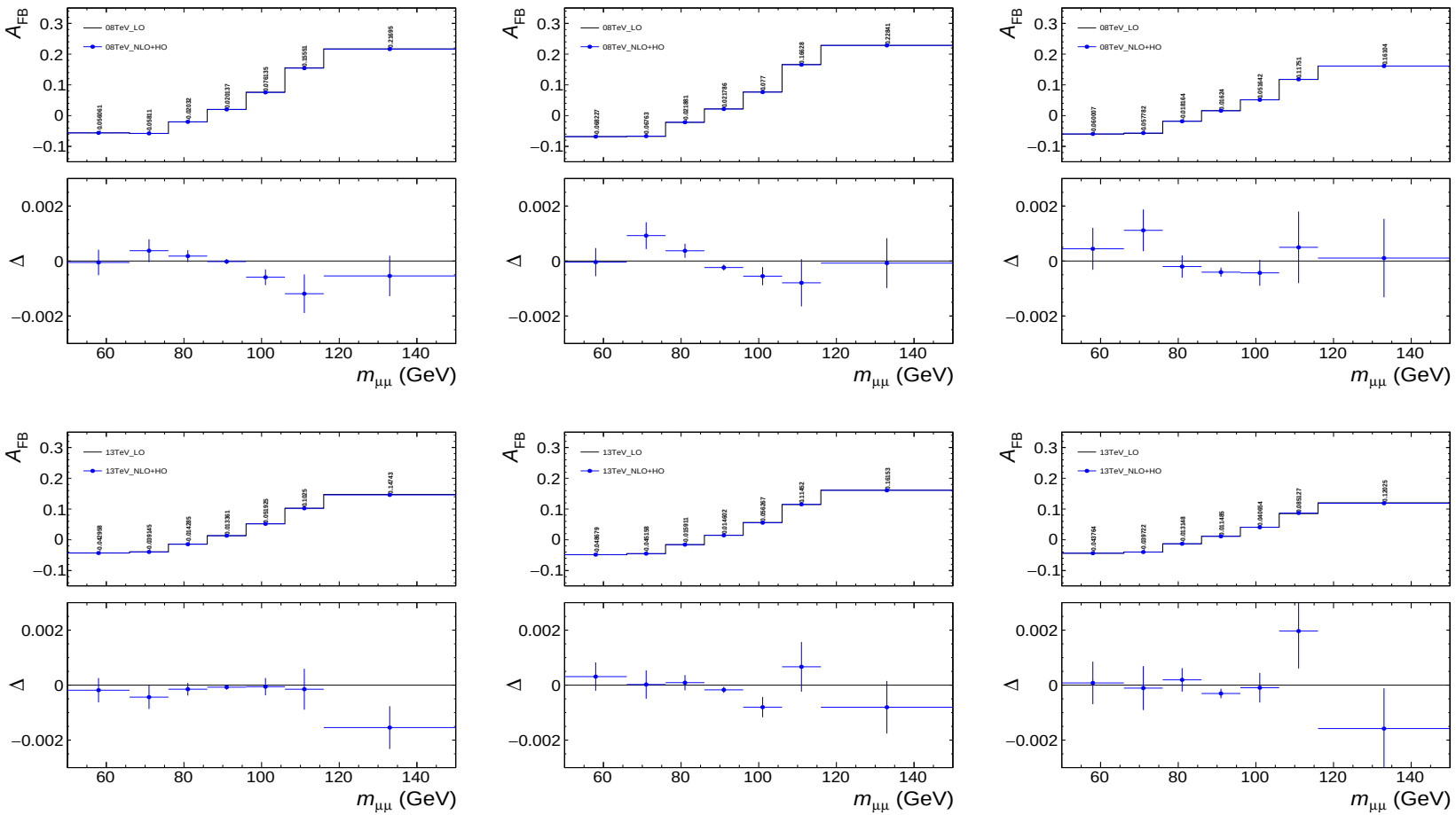
- $A_4(y)$ in Z peak (81,101) region



- v04 (left), v05 (middle), v10 (right) at 08TeV (top) and 13TeV (bottom)

AFB(m)

- $A_{\mathrm{FB}}(m)$ in last 3 y bins:
  - 1.2-1.6 (left), 1.6-2.0 (middle), 2.0-2.4 (right)
  - 08 TeV (top) and 13 TeV (bottom)



Effective shift in WMA between LO and NLO+HO

- To estimate effective shift between LO and NLO+HO configurations for resulting $\sin^2\theta^\ell_{\rm eff}$, fit weighted $A_{\rm FB}(y,m)$ distribution of NLO+HO configuration with LO EW templates.

- All predictions are in $\sin^2\theta^\ell_{\rm eff}$-input scheme

- Here using variables at "pseudo-detector" level
  – i.e. after efficiency-based selection and momentum smearing

- $\delta\sin^2\theta^\ell_{\rm eff}$ in units of 10^{-5}:

	8 TeV	13 TeV
v04:	$+07 \pm 3$	$+17 \pm 2$
v05:	$+15 \pm 3$	-01 ± 4
v10:	$+12 \pm 3$	$+13 \pm 4$

- Stable variations achieved in v10
  – consistent with observed smoother differences for A4
  – consistent results for ee and uu (not shown here)

Status and next

- Good stat. precision of Powheg-EW predictions achieved
- First reliable estimate of effective shift in $\sin^2\theta^{\ell}_{\text{eff}}$ between Powheg LO and NLO+HO: ≈ 0.00012
- Next: analyze full stats of 13 TeV and add NLO
- Next: continue pseudo-data studies
  - Add forward electron channel
  - Differences between our central off-peak predictions need to be understood
  - Studies of PDF uncertainties (?)
  - Studies of QCD uncertainties (?)