Plans of the PDF studies
for precision EW measurements at the HL/HE LHC

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PDF uncertainties in EW precision measurements

· the PDF uncertainties are one of the dominant modelling systematics
   in the measurements of MW and $\sin^2\theta_W$ (EWPO=EW precision observables)

· Two different contributions from the HL/HE runs to reduce these uncertinties

Direct

New measurements of the EWPO in different acceptance/energy conditions
   → combination with current results

Indirect

New measurements   →   new/stronger constraints on PDFs   →
   → reanalysis of LHC Run I and II data   → reduction of the current PDF error

Direct approach

· we compute the observables relevant for EWPO determination

(e.g. MT and pt_lep distributions in CC-DY for MW,

AFB for $\sin^2\theta_W$)

in the HL/HE setups

using different PDF sets available today (NNPDF3.0, 3.1, PDF4LHC15)

· via template fit, we estimate the PDF uncertainty on the EWPO in those setups
cfr. Bozzi, Citelli, AV, arXiv:1501.05587

· we compute the correlation w.r.t. PDF variations

between the EWPO extracted in the different setups (LHC Run I-II-III, HL, HE)

· we combine the EWPO results including this correlation cfr. Bozzi, Citelli, Vesterinen, AV, arXiv:1508.06954

and assess the level of improvement after HL, HE

Contribution for the YR

comparing different PDF sets

→ estimate of EWPO values and associated PDF uncertainties measured at HL , HE

→ combination of EWPO accounting for the PDF correlations

Indirect approach

· we compute in the HL/HE setups DY observables in extended kinematical ranges

including regions currently statistically limited

absent from PDF fits

· via reweighing we estimate the potential impact of these new precise data
on the current PDF parameterisations cfr. NNPDF, arXiv:1012.0836

→ we assign a weight w_i to each PDF replica, depending on its compatibility
with the new data

→ we apply these weights in a reanalysis of the current Run I-II results for the EWPO

· we quantify the impact on EWPO of new measurements currently not accessible

$$\langle O \rangle_{PDF}^{today} = \frac{1}{N_{rep}} \sum_{i=1}^{N_{rep}} O_i \qquad \rightarrow \qquad \langle O \rangle_{PDF}^{new\,data} = \frac{1}{N_{rep}} \sum_{i=1}^{N_{rep}} w_i \, O_i$$

Contribution for the YR

→ estimate of EWPO values and associated PDF uncertainties
under different assumptions for the potential PDF improvement given by new data

→ discussion of the role of the new observables

Understanding the sources of uncertainties

- we call DY observables (all the bins of) all the available kinematical distributions
     in Run II/ HL/ HE setups

- we compute two sets of correlation functions w.r.t. PDF variations
     1) between different observables
     2) between one observable and the parton-parton luminosities

- we identify two groups of DY observables: sensitive and insensitive to EWPO

- we look for combinations of observables that preserve the sensitivity to the EWPO
  and
  reduce the dependence on the PDF uncertainty

Contribution to the YR

- four summary plots
  collecting the results in the "direct" and "indirect" approaches for MW and $\sin^2\theta_W$
- in either case we consider different setups (Run II, HL, HE) and different PDF sets

an example of the format could be
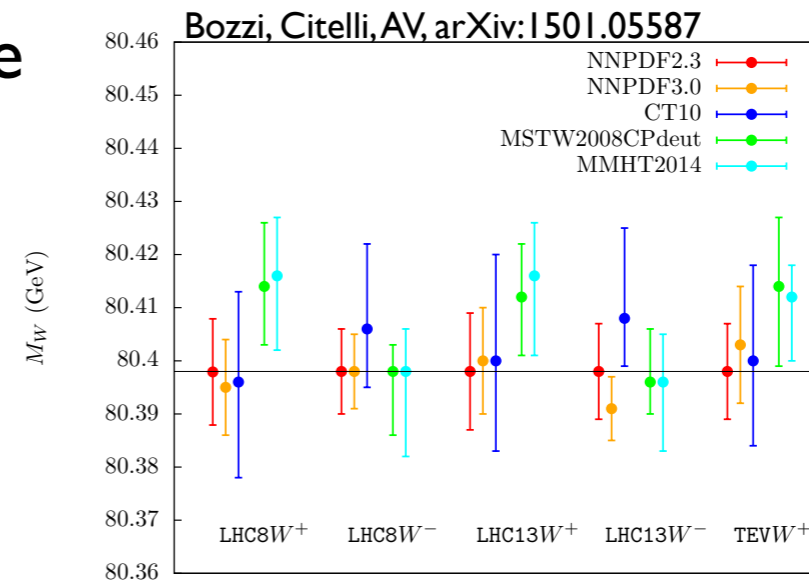
- brief description of the approaches adopted in the analysis (3 pages including the plots)