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Update on the studies of the Photon-induced contributions and AFB predictions

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Status at the July meeting

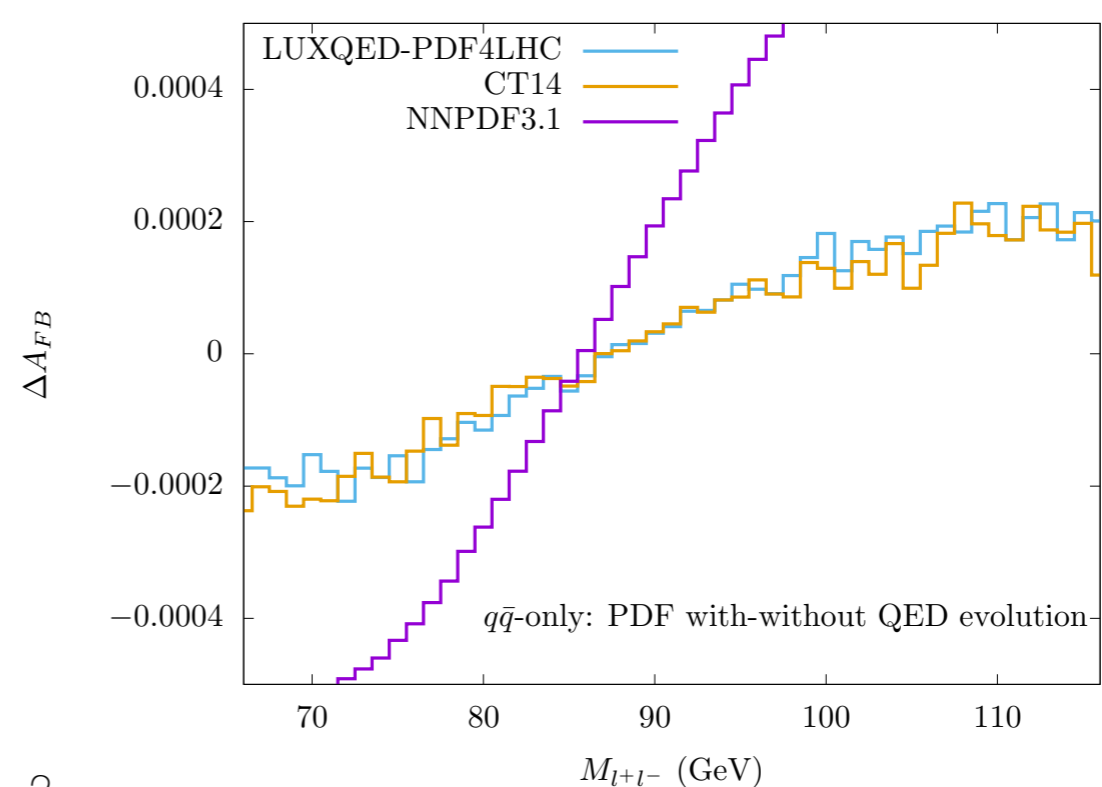
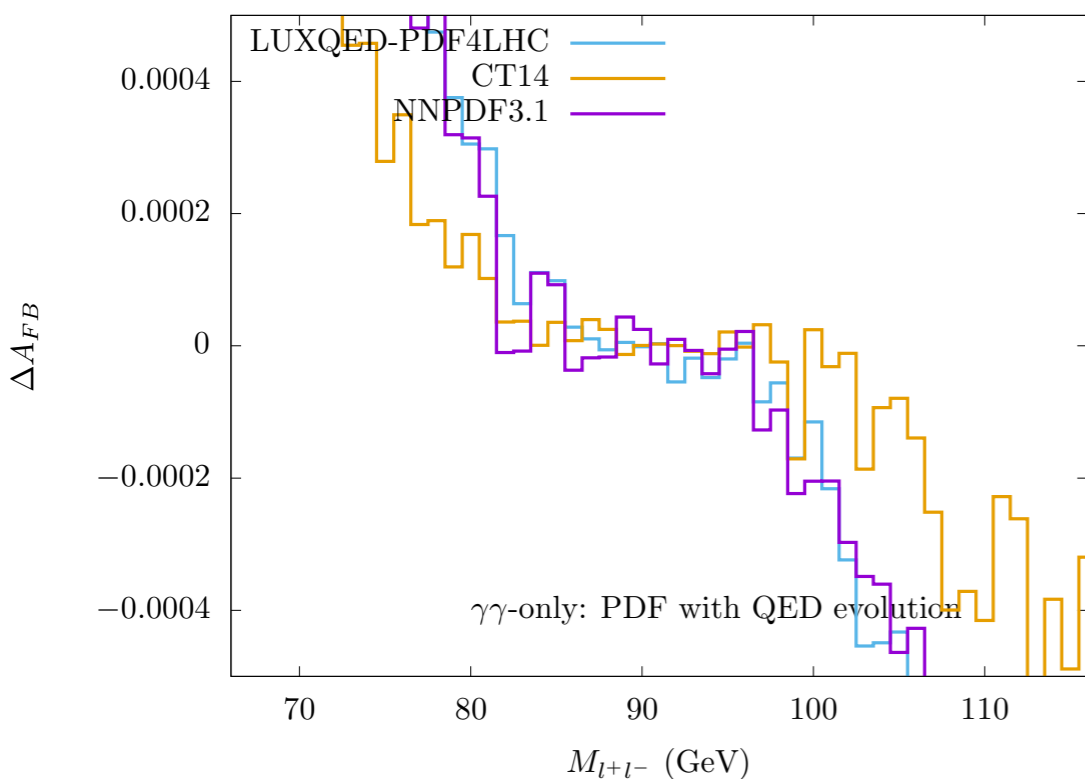
Photon-induced processes are a natural ingredient of EW processes at hadron colliders
(cancellation of QED IS mass singularities, contribution of photon density in the proton)

The NNPDF3.1_as_0118_nlo_luxqed PDF set induces a very large distortion of the AFB distribution, compared to its pure QCD counterpart

This feature is not visible with other PDF sets that include QED DGLAP evolution:
comparison against CT14QED (dynamically generated photon), PDF4LHC15-LUXQED

First attempts to breakdown the problem:

- 1) evaluation of only the $\gamma\gamma$ contribution \rightarrow similar AFB behaviour with different PDF sets
- 2) comparison of qqbar contribution QCD+QED vs QCD quarks
 \rightarrow differences between NNPDF3.1 and the other sets



New recent inputs from PDF collaborations

MMHT

two new PDF sets, including

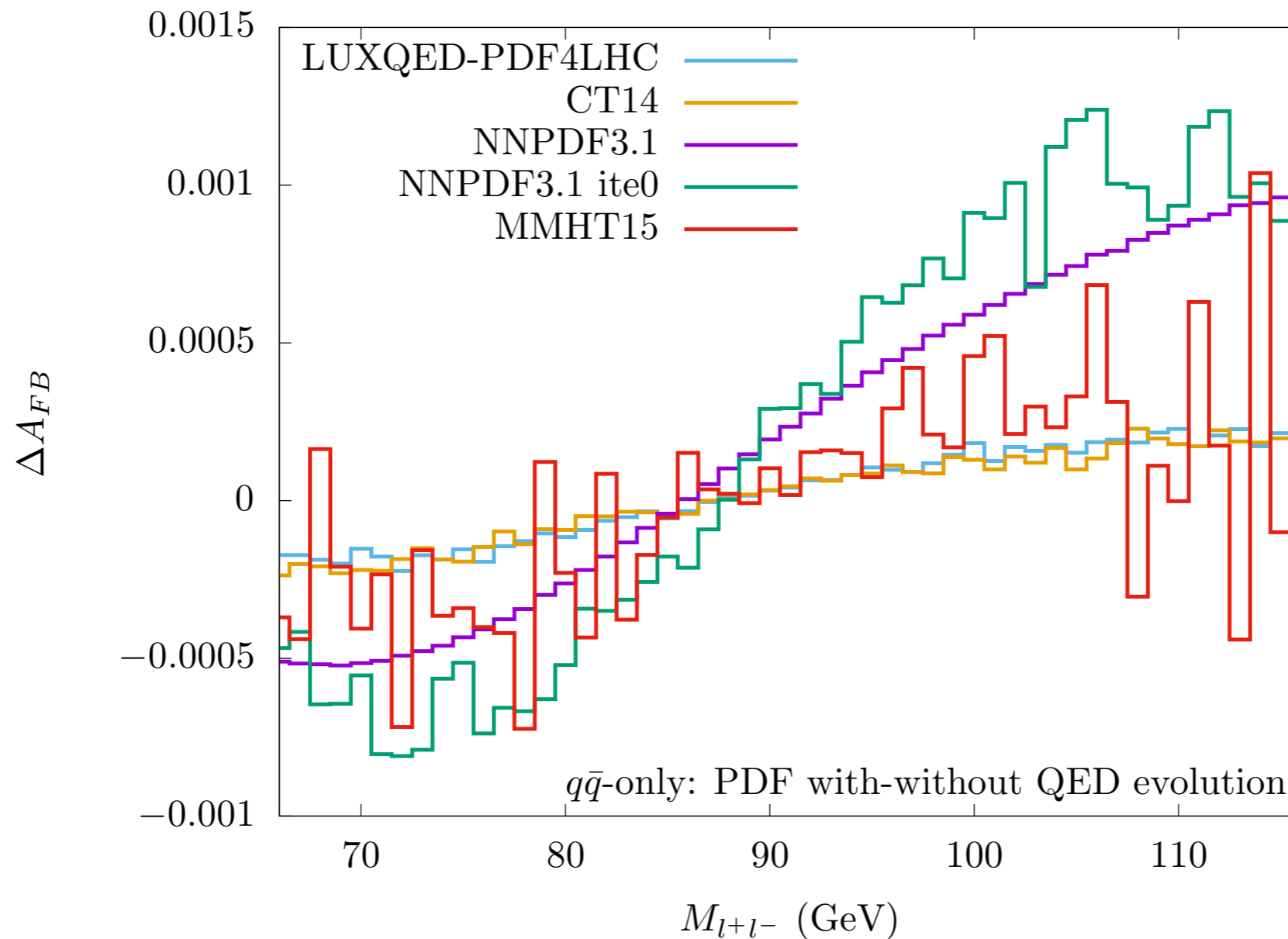
- an implementation of the LUX-QED solution for the photon density (+quarks and gluons)
MMHT2015_nloqed (with further breakdown into elastic and inelastic components)
- only quarks and gluons evolving with only the QCD kernels
MMHT2015_nloqcd

NNPDF

auxiliary PDF set corresponding to the first stage of the procedure used to include the photon density (LUX-QED solution) in the global NNPDF fit

- ite0 quarks and gluons coincide with those of the “purely QCD” set
the photon $\gamma_0(x,Q)$ is computed from the quarks (LUX-QED)
sum rules are restored
→ very similar to the PDF4LHC15_LUXQED combination

New recent inputs from PDF collaborations: qqbar contributions only



the NNPDF3.1 intermediate set is still showing a different behaviour compared to the other sets

the trend of the MMHT15 set is closer to the older sets, but much higher statistics is needed

very demanding simulations!

Comments on the PDF uncertainty

Important difference between
the PDF uncertainty on AFB and the PDF uncertainty on $\sin^2\theta_{\text{eff}}$

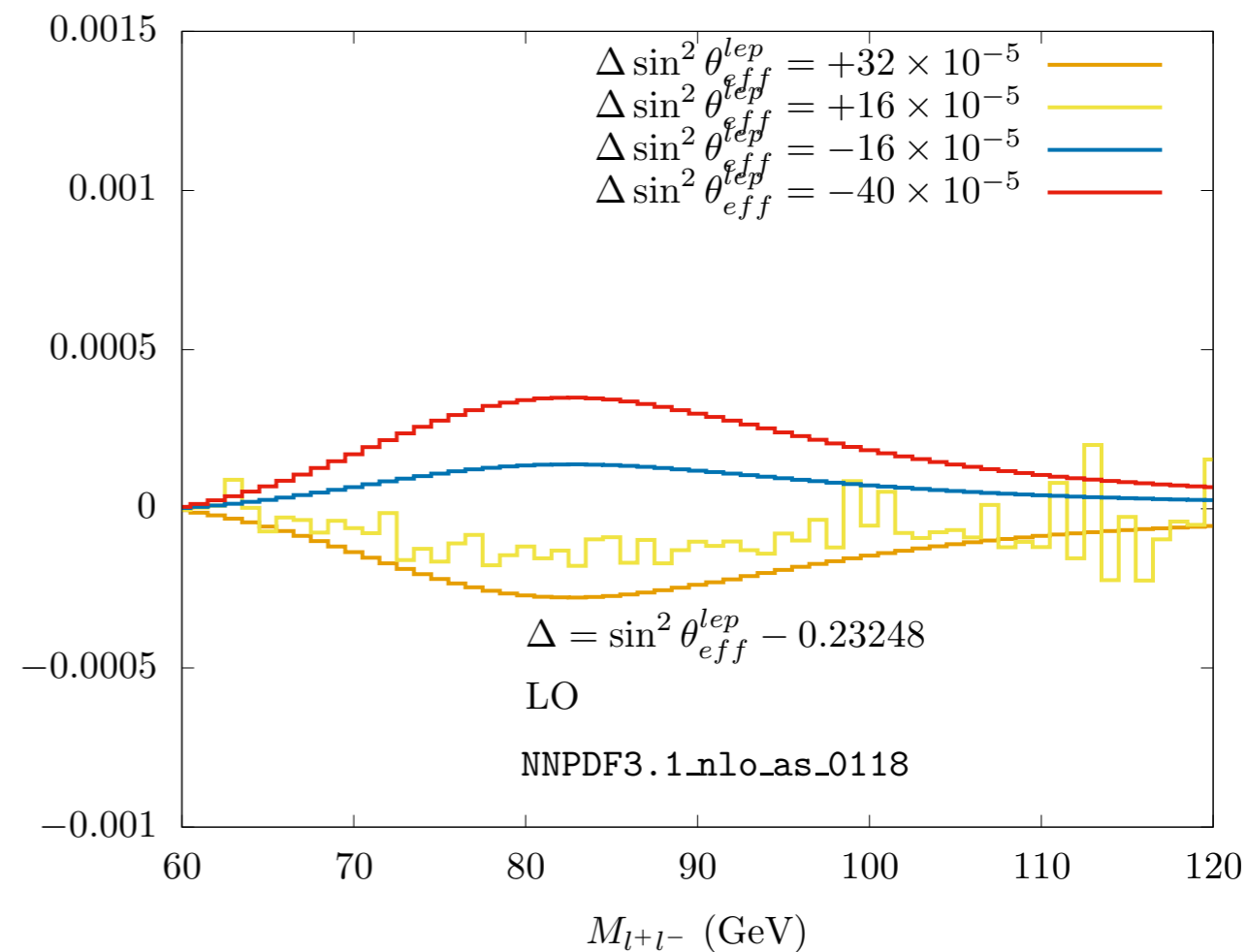
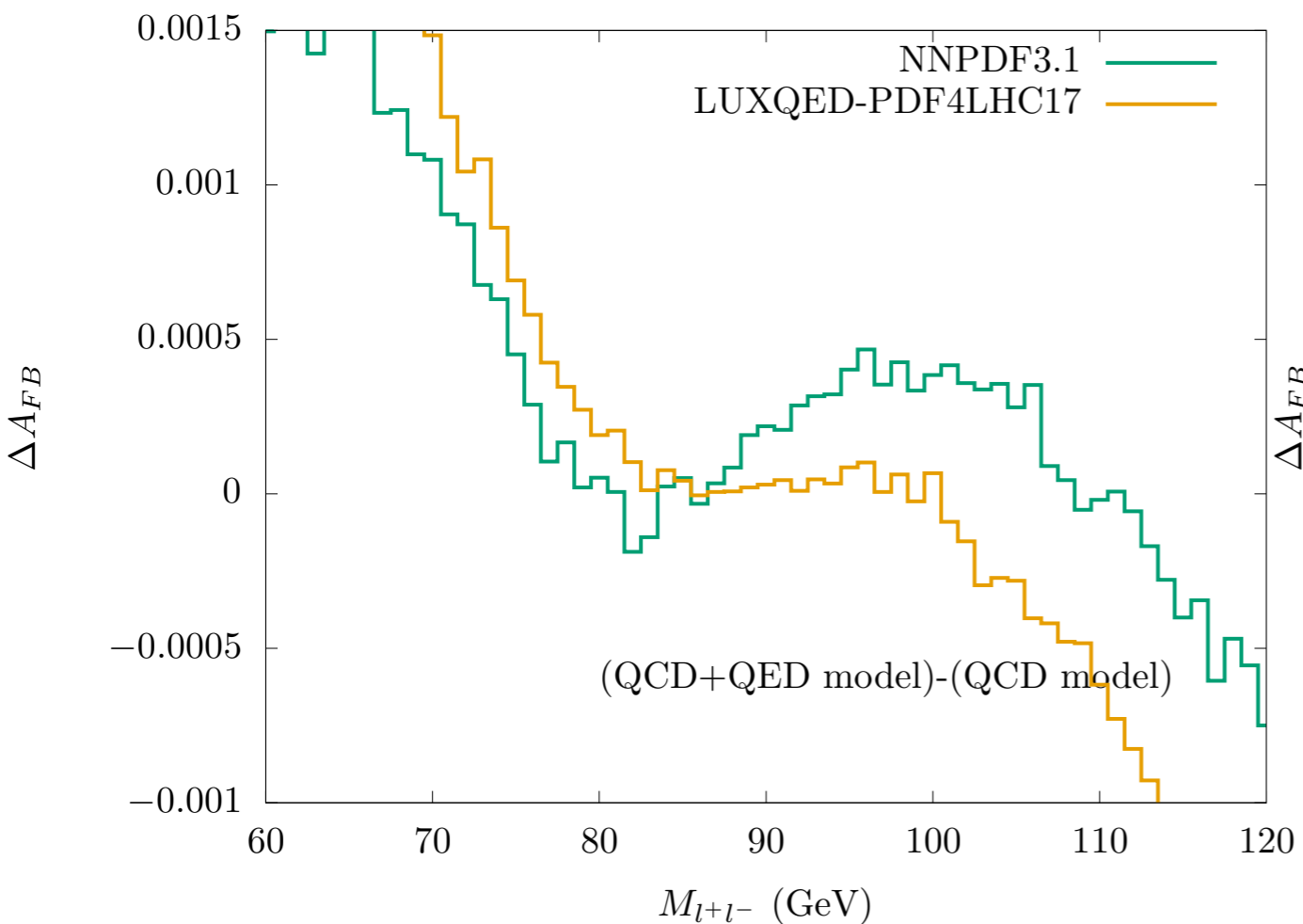
The recipe to compute the PDF uncertainty holds for the individual bins of a kinematic distribution

The envelope drawn to include the individual uncertainty intervals in a single band largely overestimates the actual uncertainty on the $\sin^2\theta_{\text{eff}}$ determination because it neglects the correlations w.r.t. PDF variations of the AFB distribution

The relevance of the photon induced “anomalous” behaviour can be assessed only by:

- 0) preparing templates in the QCD-only model
- 1) estimating the impact of the replica of a QCD-only PDF set on the $\sin^2\theta_{\text{eff}}$ determination
- 2) estimating the impact of the central replica of a QCD+QED PDF set on $\sin^2\theta_{\text{eff}}$
- 3) comparing the offset caused by the photon-induced processes with the QCD-only uncertainty

Comments on the PDF uncertainty



Different distortion of the AFB distribution under

- inclusion of photon-induced contributions
- variation of the $\sin^2 \theta_{eff}$ value

→ non-trivial outcome of the fit

In progress: preparation of a toy template fit,

to assess the relevance of the photon-induced effects on the $\sin^2 \theta_{eff}$ determination