Work Report

Valerio Bertone

CERN

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Nature of the Problem

- Goal:
  - constraining **Parton Distribution Functions** (PDFs) using collider observables with the highest accuracy possible.
- Problem:
  - presently, (N)NLO calculations for such observables are too **time-consuming** to be directly employed in a PDF fit.
- Solution adopted:
  - representing cross sections in a **PDF-independent** way by means of **interpolation grids**:

$$f_i(x,Q^2) = \sum_{\alpha=0}^{N_x}\sum_{\beta=0}^{N_Q} I_\alpha^{(k)}(x) I_\beta^{(k')}(Q^2) f_i(x_\alpha, Q_\beta^2)$$

  - For a **Monte Carlo** program that computes a DIS process:

$$d\sigma = \sum_{m=1}^{N} w_m \left[\alpha_s^p(Q_m^2) f(x_m, Q_m^2)\right] \quad \Rightarrow \quad d\sigma = \sum_{\alpha=0}^{N_x}\sum_{\beta=0}^{N_Q} W_{\alpha,\beta} \left[\alpha_s^p(Q_\beta^2) f(x_\alpha, Q_\beta^2)\right]$$

$$W_{\alpha,\beta} \equiv \sum_{m=1}^{N} w_m I_\alpha^{(k)}(x_m) I_\beta^{(k')}(Q_m^2)$$

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Precomputed and stored

Application

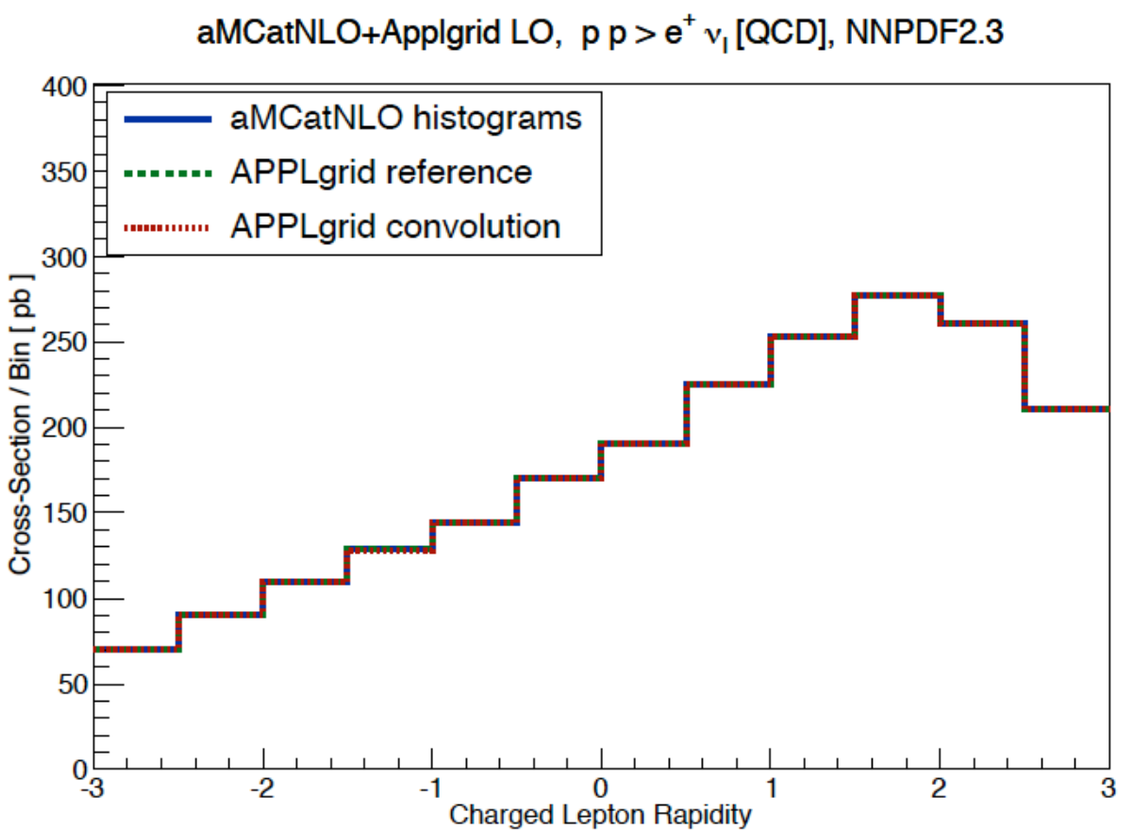
Interfacing aMC@NLO to APPLgrid

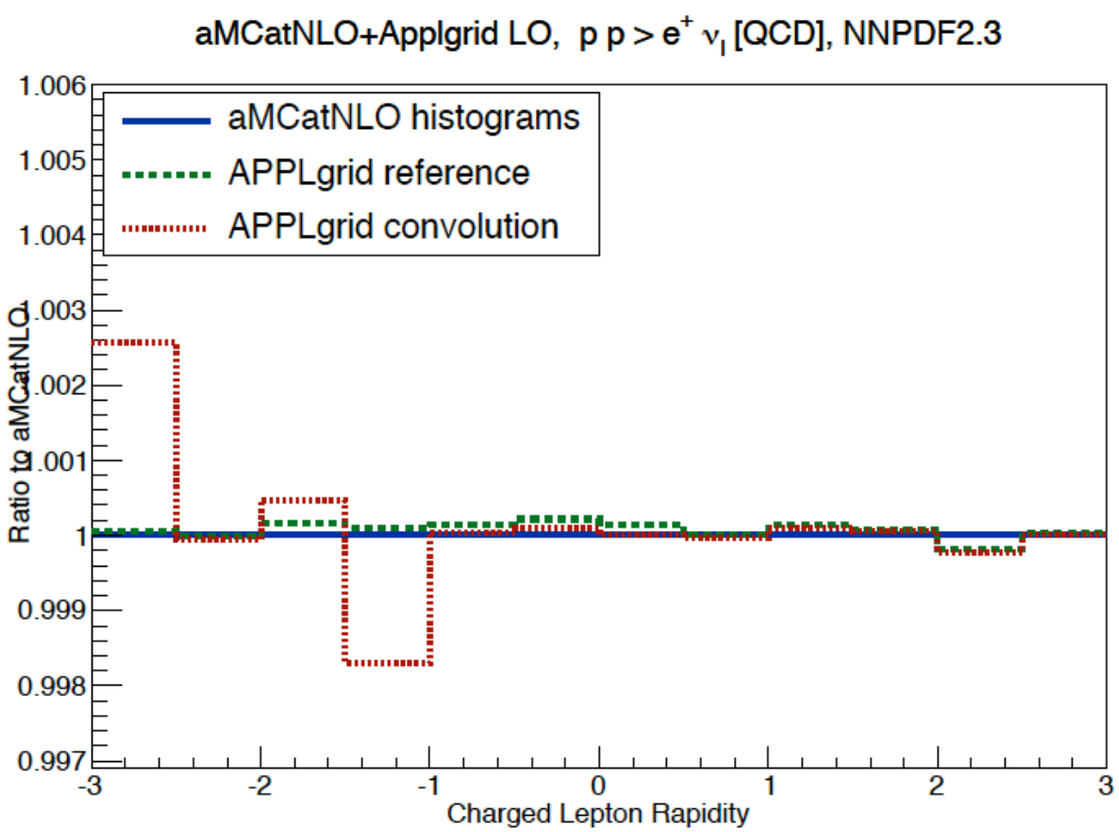
- APPLgrid [arXiv:0911.2985]:
  - is a public code that implements the PDF-independent parametrization of cross sections in a general and flexible way,
  - is presently interfaced to codes, like **MCFM** and **NLOjet++**, that provide **NLO computations**.
- aMC@NLO e.g. [arXiv:1110.4738]:
  - provides a **fully exclusive** description, including hadronization effects, accurate up to **NLO+LL** (parton shower) in a completely **automated** fashion for large number of processes.
- Importance of interfacing aMC@NLO to APPLgrid:
  - **increasing the number of processes** for which a fast NLO interface is available and thus can be used to constrain PDFs,
  - perform for the **first time** a PDF fit accurate at NLO+LL specific for **MC generators**.

Application

Interfacing aMC@NLO to APPLgrid: Status

- First step:
  - interface for the LO (Born) and NLO computations:





  - perfect accuracy at Born level.

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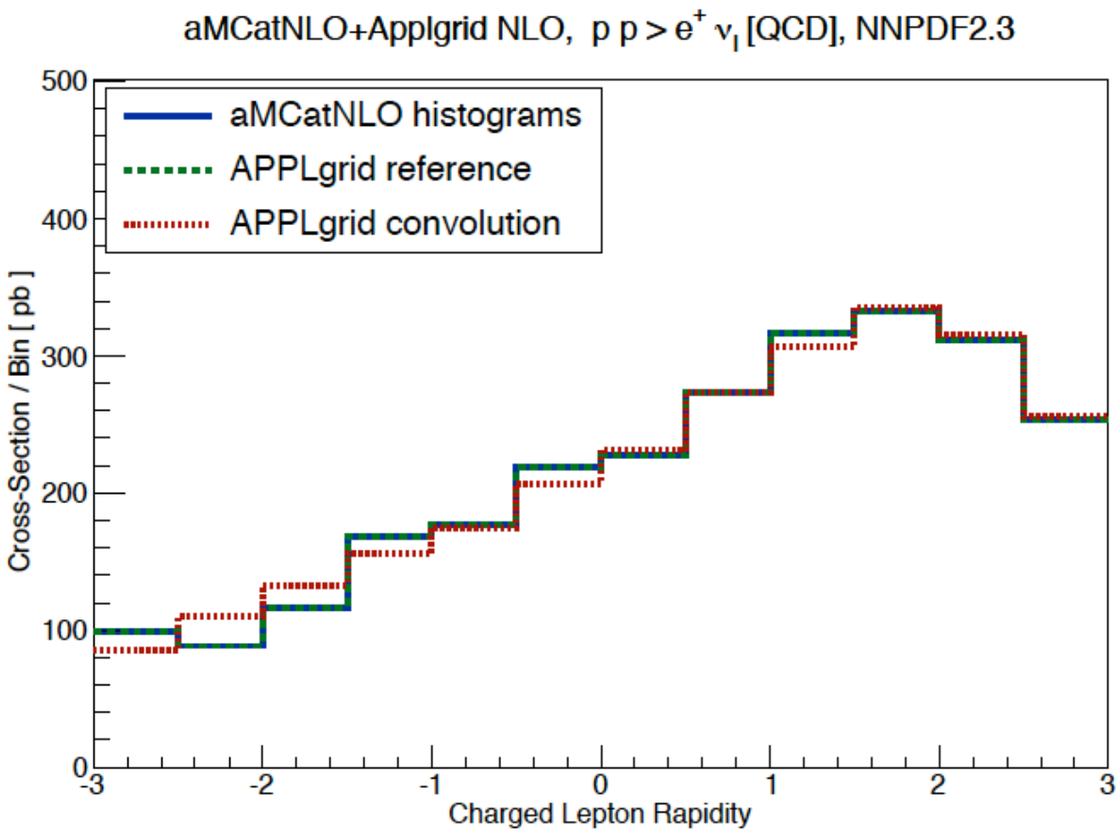

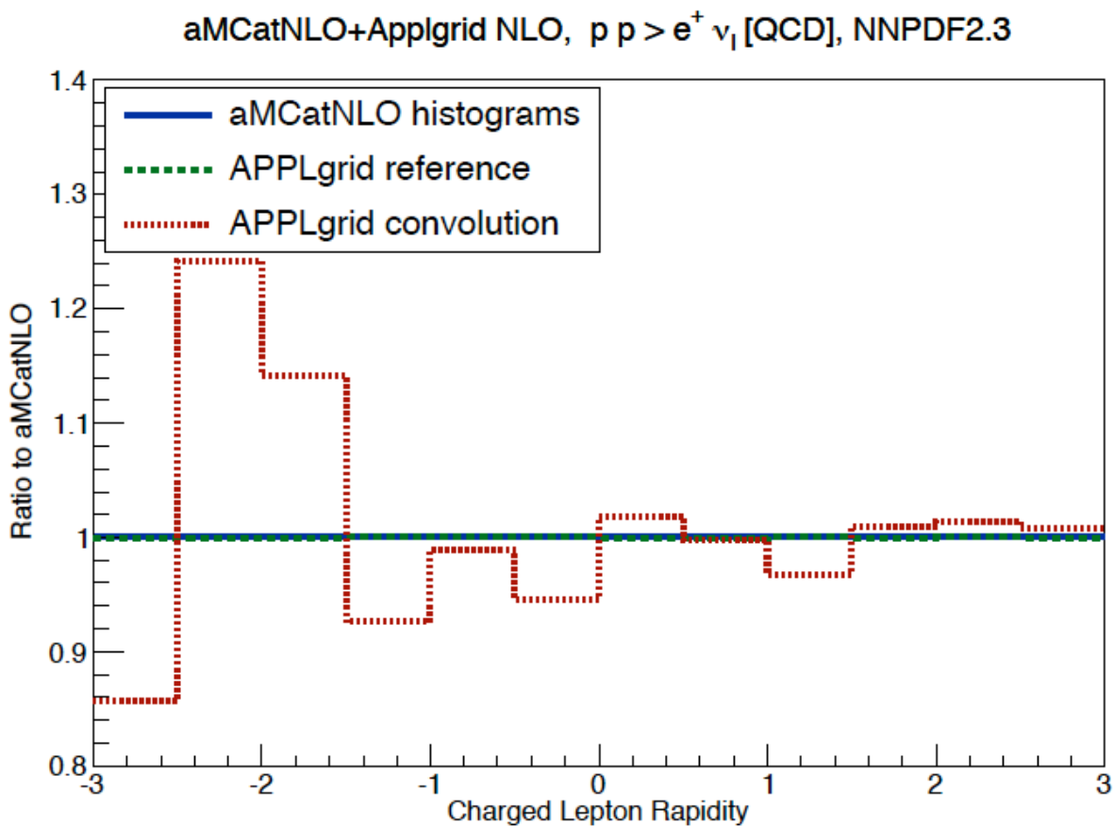

  - unsatisfactory discrepancy at NLO (~20%): **working on this**.

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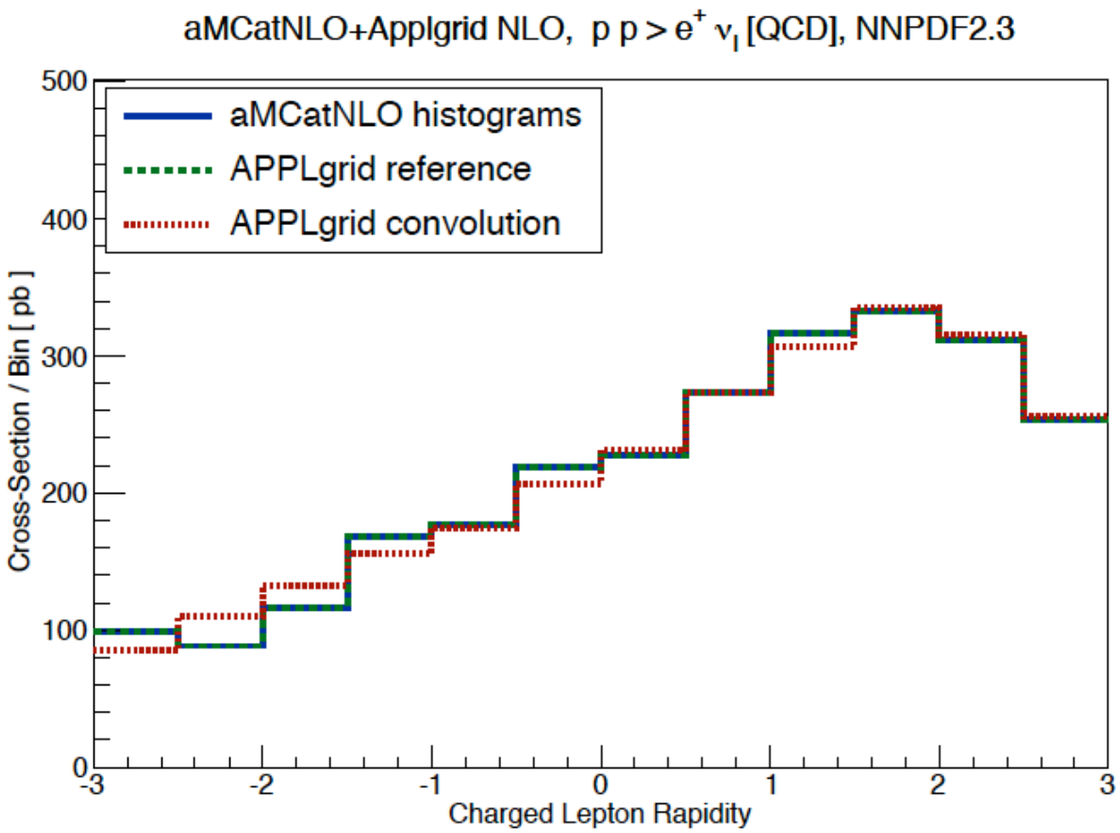

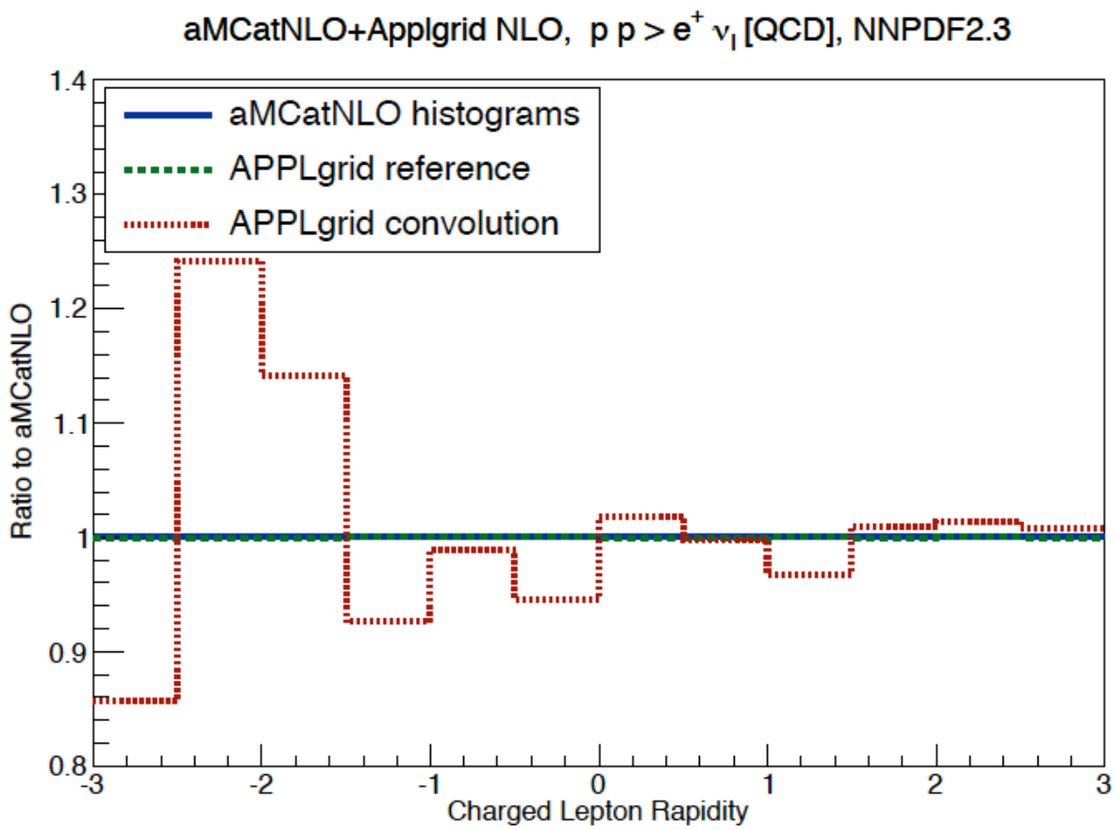

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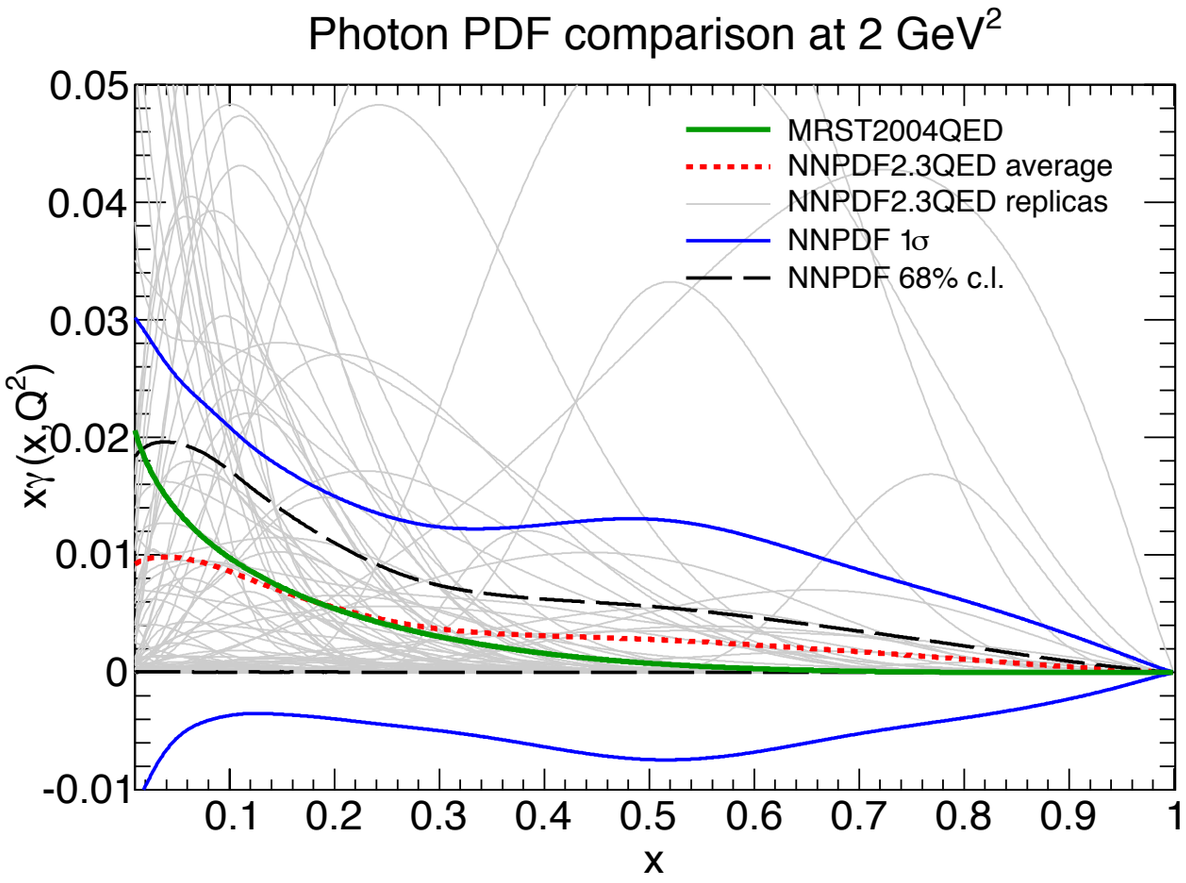
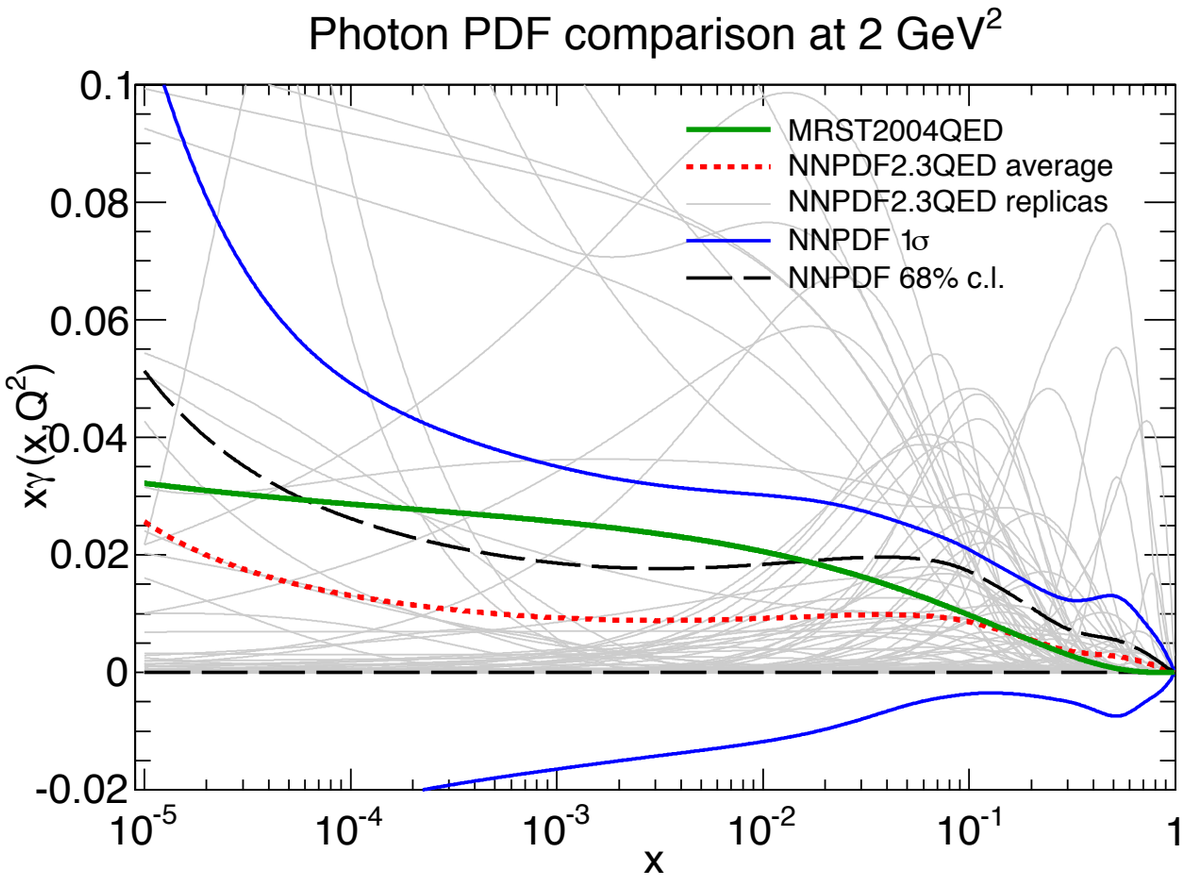
- Next step:
  - interface of the NLO+PS computation,
  - no definitive strategy yet.

NNPDF

PDFs with QED Corrections: NNPDF2.3 QED

- Photon PDF extracted from LHC and DIS data [arXiv:1308.0598]:
  - based on the NNPDF2.3 set [arXiv:1207.1303],
  - QED corrections to the PDF evolution and inclusion of photon-initiated diagrams,
  - first real fit of the photon PDF.

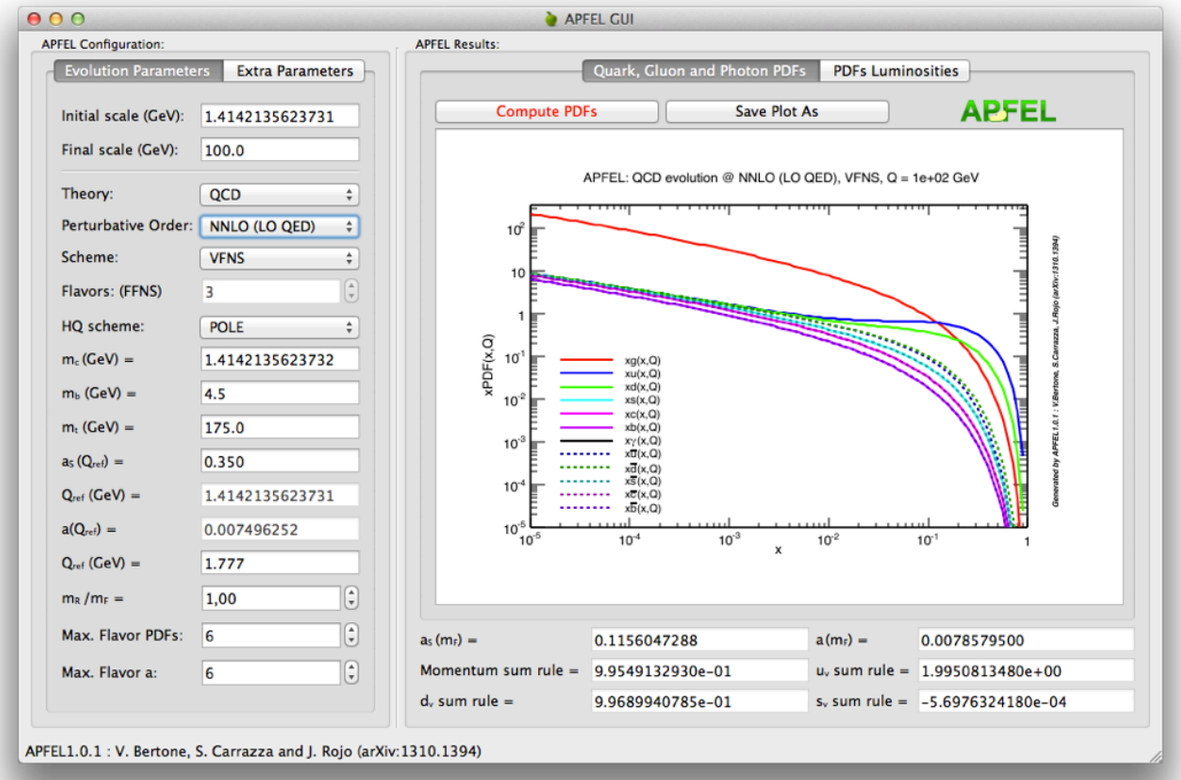




APFEL

A PDF Evolution Library

- Original idea [arXiv:1310.1394]:
  - PDF evolution up to NNLO in QCD including **QED corrections**.
- Future developments:
  - a **graphical interface** for PDF and parton luminosity plots (already present in the version1.0.1),
  - inclusion of a code that computes all the **DIS observables** (NC and CC) up to NNLO and using different mass schemes.



http://apfel.hepforge.org/