APFEL

Release 2.0.0

arXiv:1310.1394

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CERN

HERAFitter User's meeting

10.12.2013

In collaboration with Stefano Carrazza and Juan Rojo

Recap on APFEL

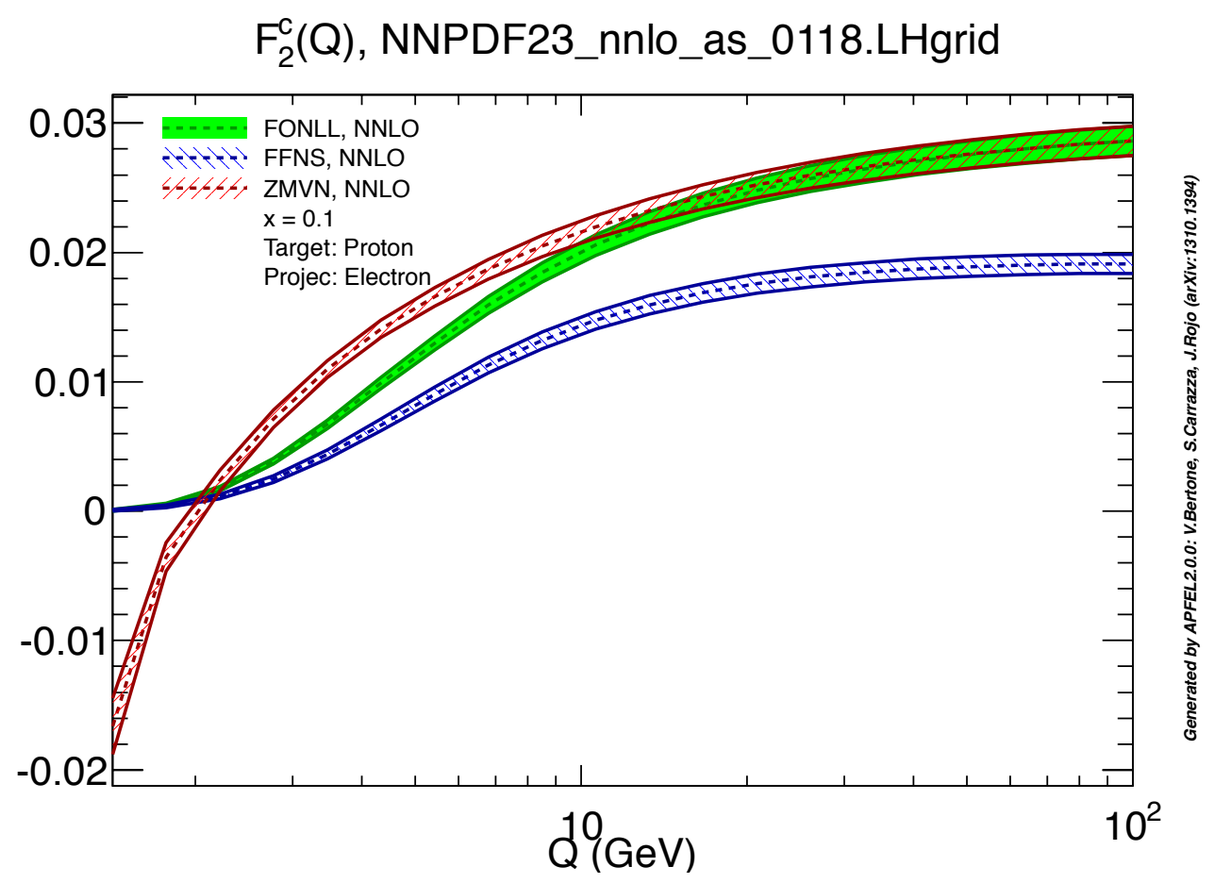
...up to Release 1.0.1

- APFEL is a **public** library for QCD+QED combined evolution:
  - up to NNLO in QCD and LO in QED,
  - FFNS and VFNS,
  - Pole and $\overline{\text{MS}}$ heavy quark masses,
  - interfaces to FORTRAN, C/C++ and Python,
  - interface to LHAPDF (input/output),
  - first version of the Graphical User Interface (GUI),
  - available from http://apfel.hepforge.org/.

APFEL 2.0.0: What's new?

Computation of DIS Observables

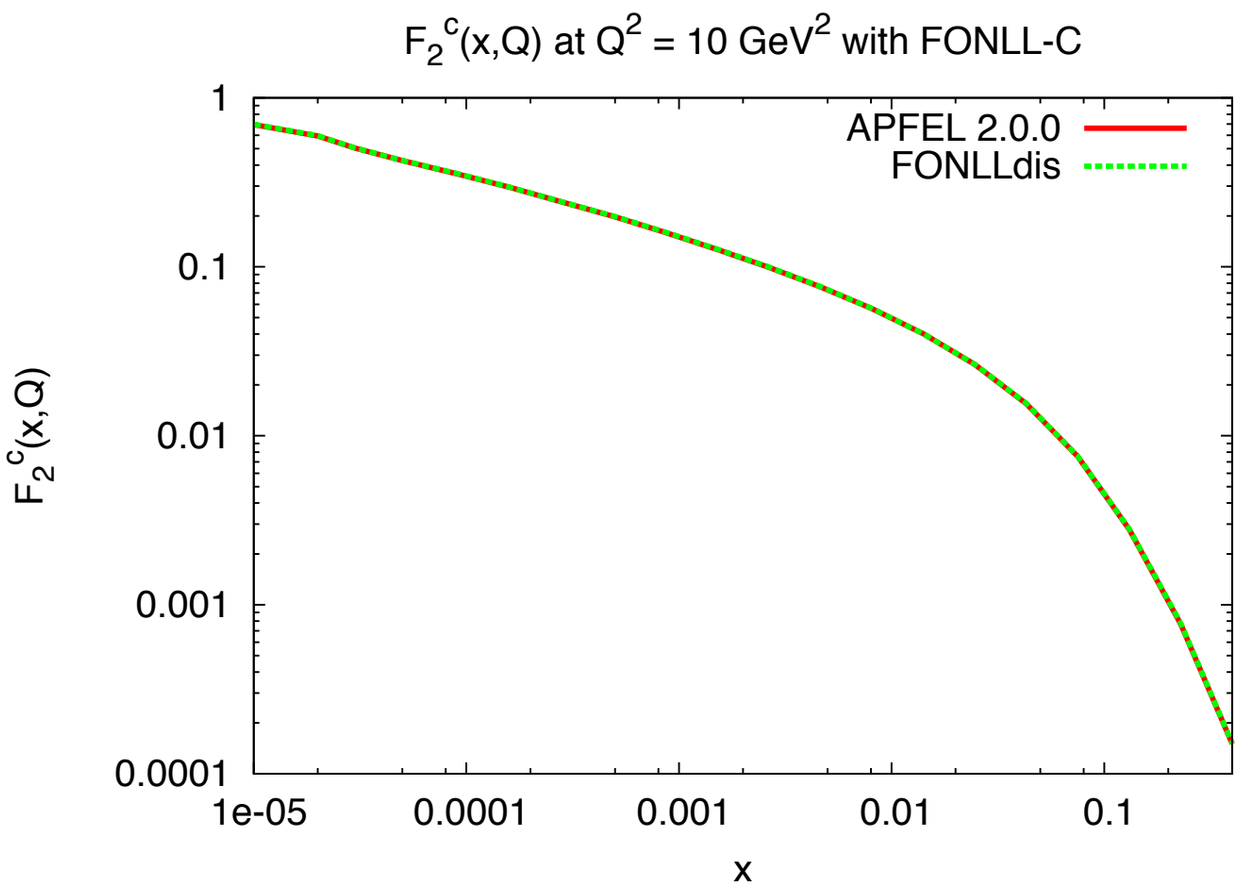
- New **DIS module** that provides:
  - all the **NC** and **CC** observables (F_2, F_L, F_3 and reduced cross sections),
  - up to order α_s^2 (when possible),
  - Schemes available: **FFNS**, **ZM-VFNS** and **FONLL** [arXiv:1001.2312],
  - inteface to the **APFEL evolution**.

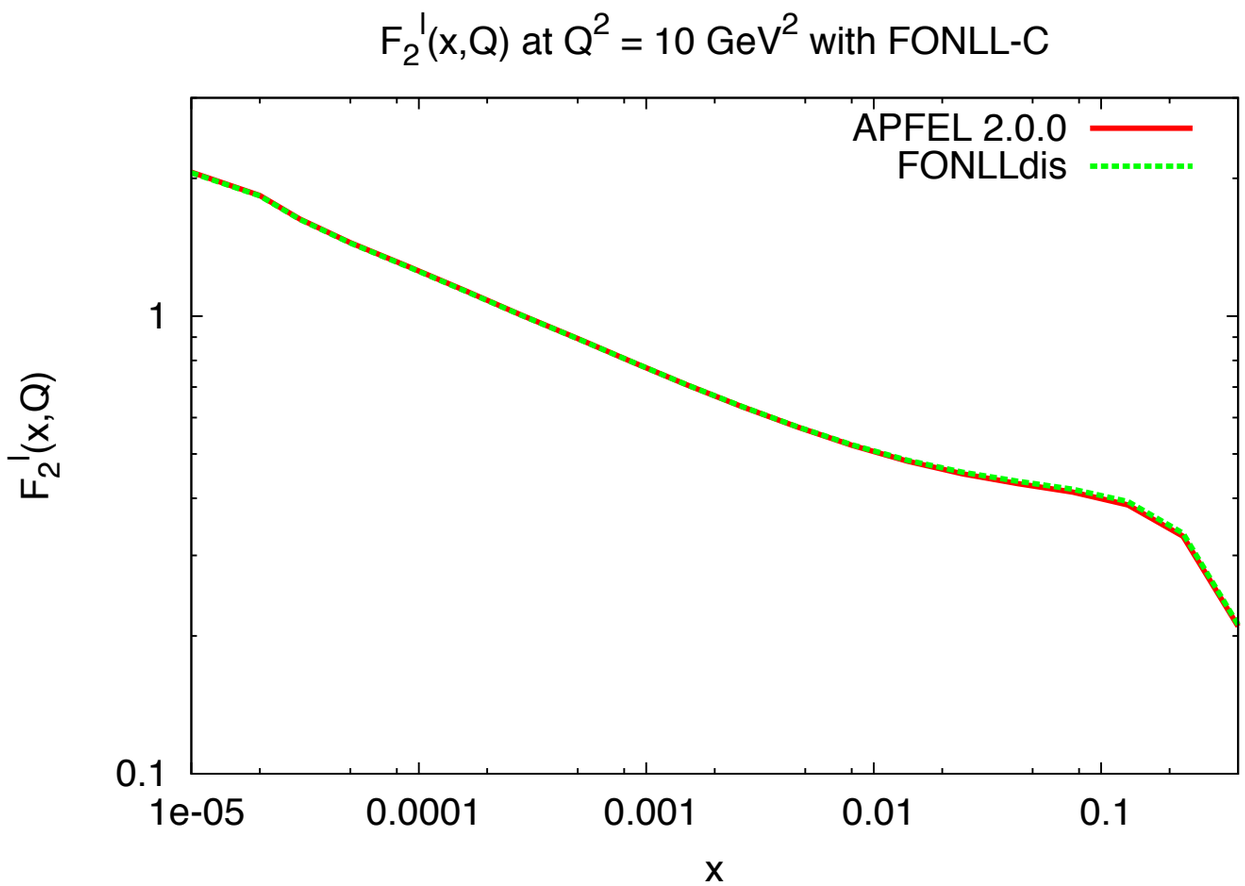


APFEL 2.0.0: What's new?

Computation of DIS Observables

- Benchmark of NC F_2 against FONLLdis [arXiv:1001.2312]:
  - APFEL is considerably **faster** than FONLLdis (~2s vs. ~80s per point).



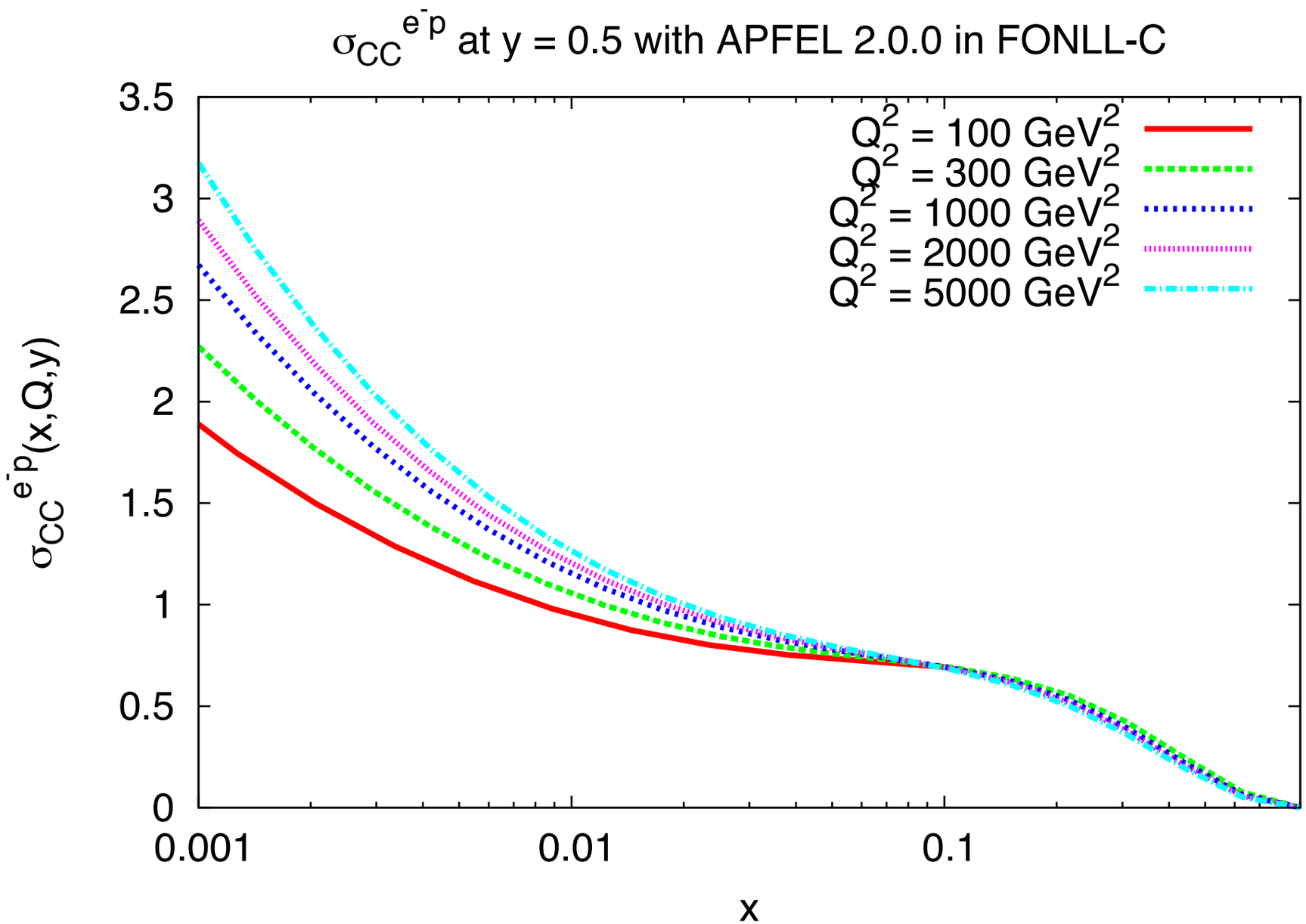


Very good accuracy!

APFEL 2.0.0: What's new?

Computation of DIS Observables

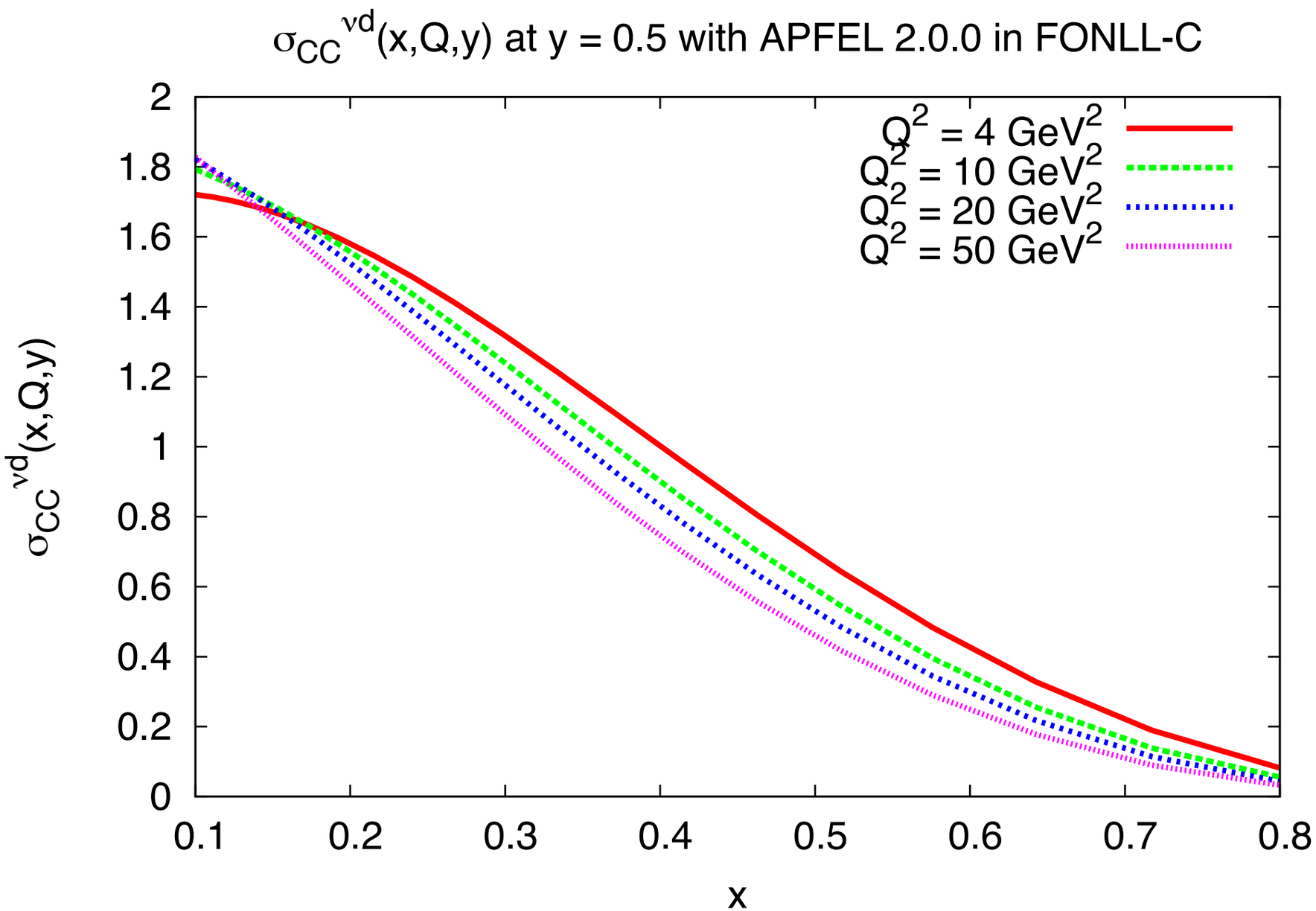
- CC reduced cross-sections:



APFEL 2.0.0: What's new?

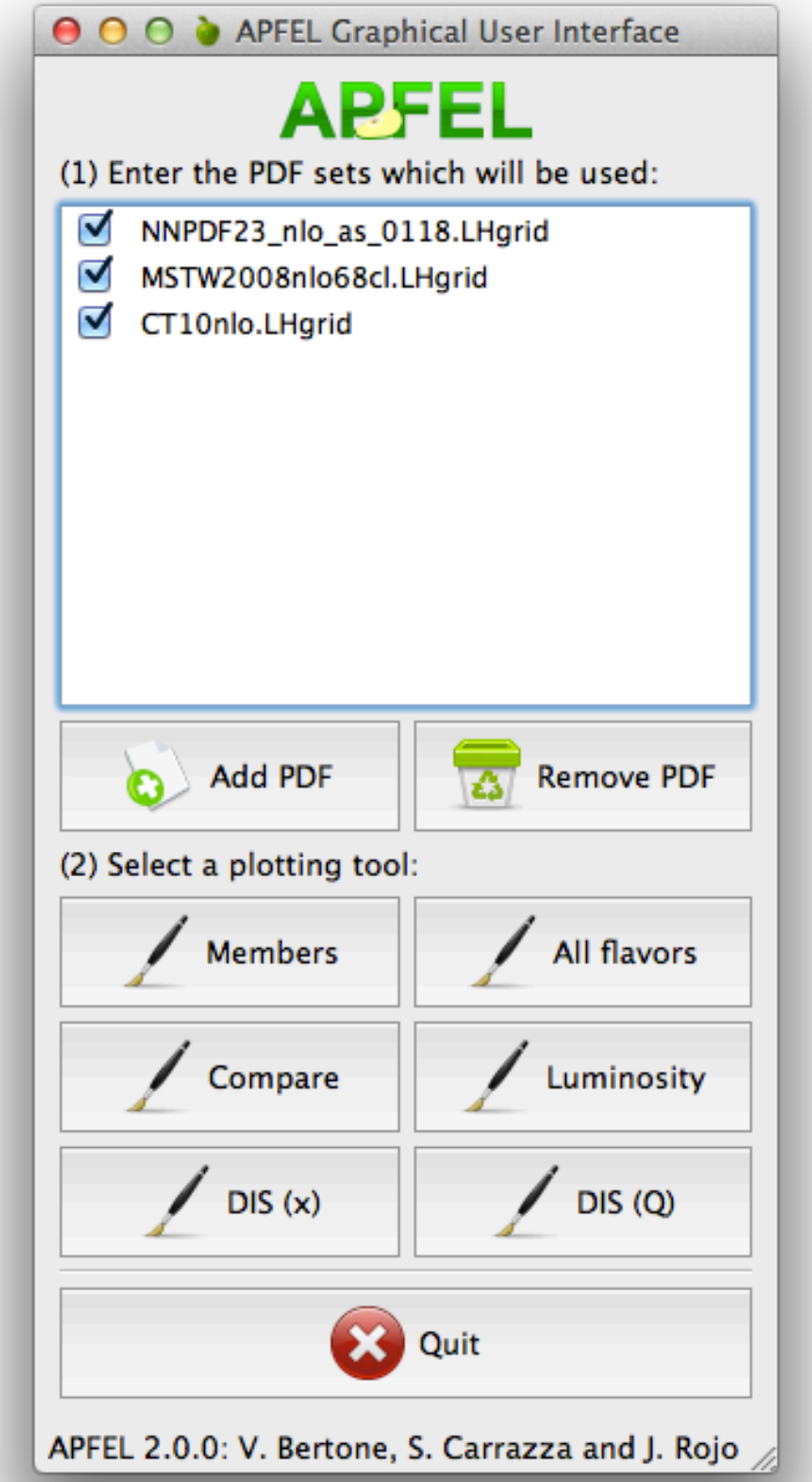
Computation of DIS Observables

- CC **neutrino** reduced cross-sections:



APFEL 2.0.0: What's new?

New Graphical User Interface



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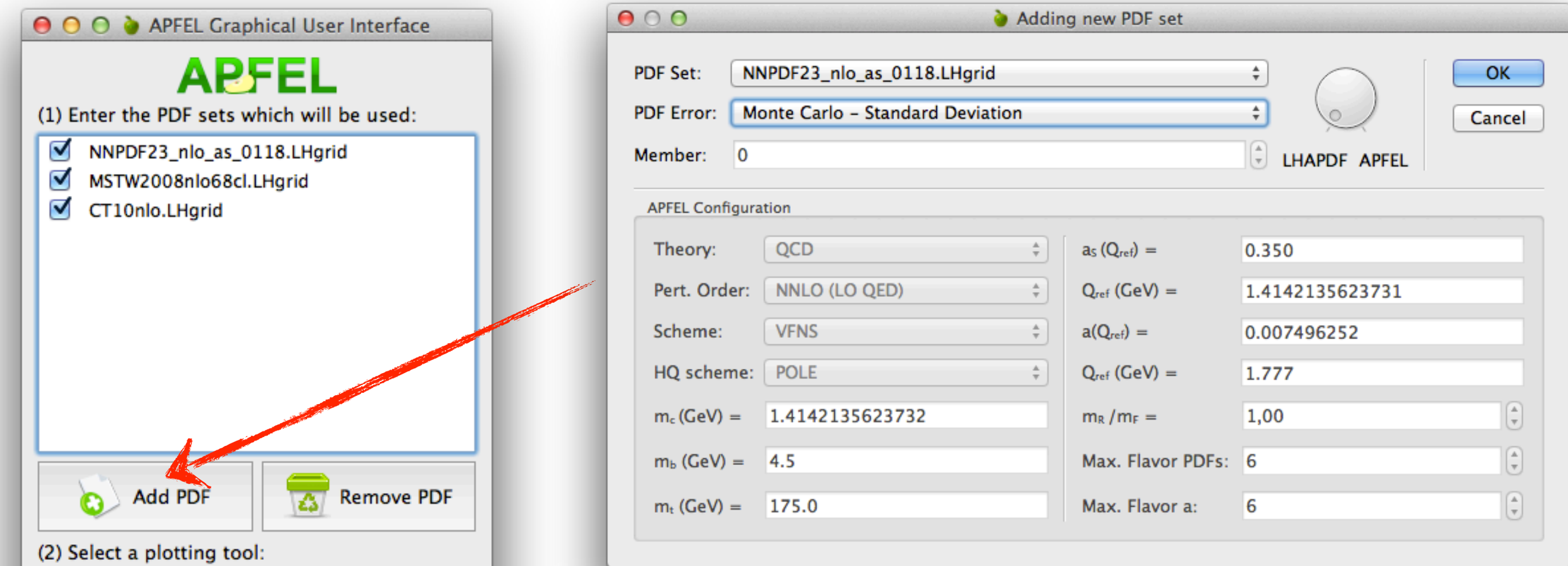
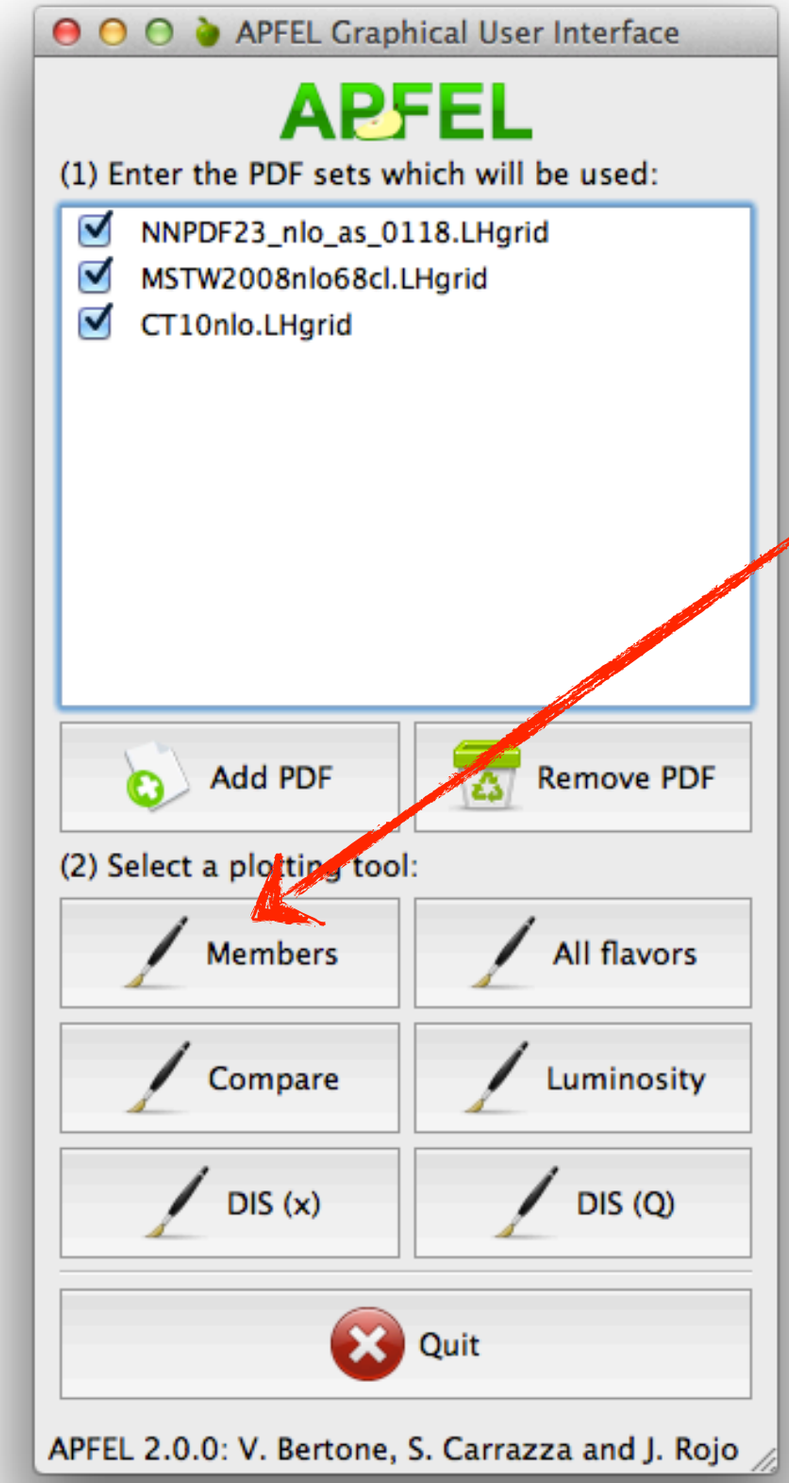
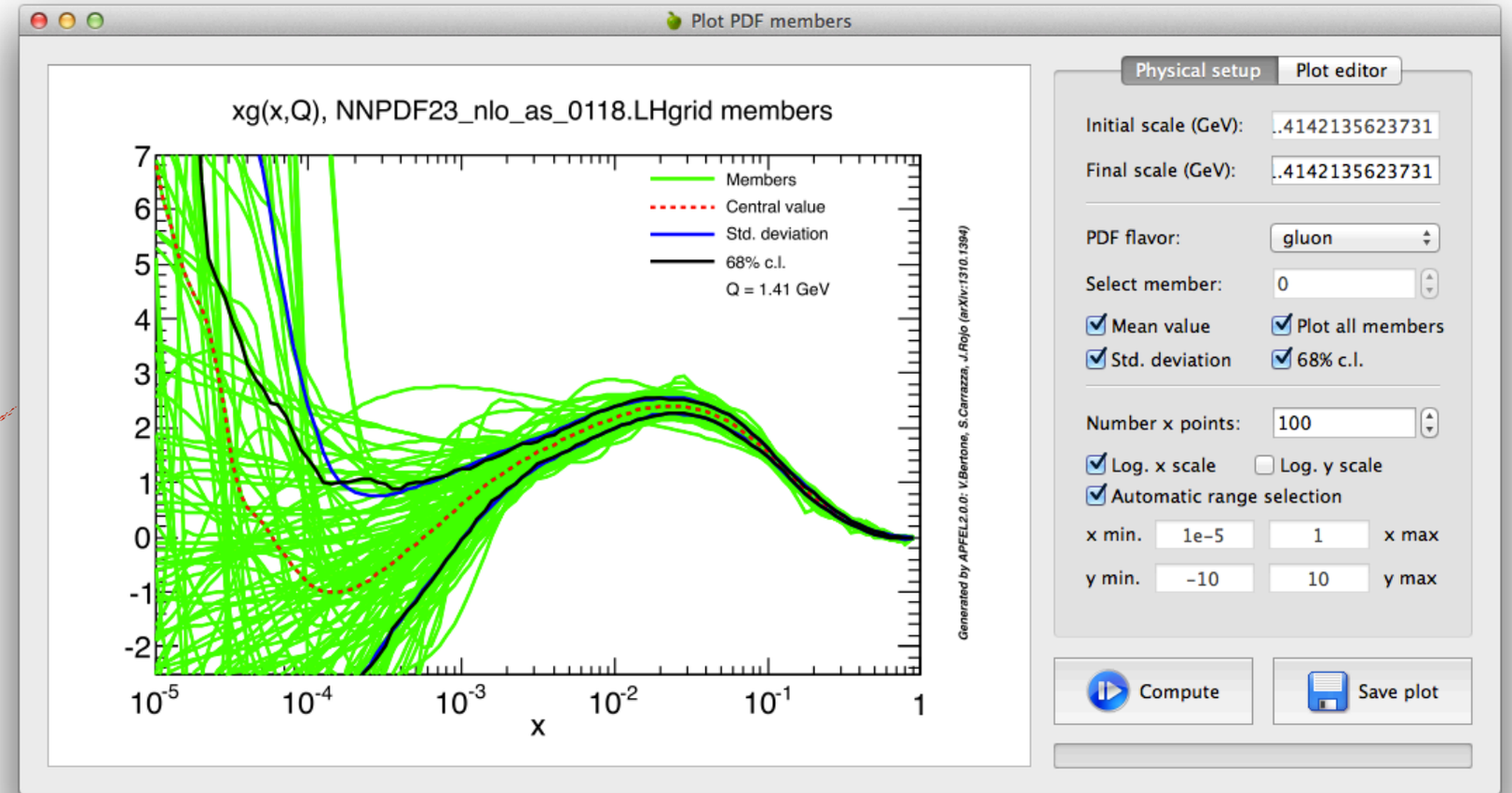


- Select a PDF set,
- select the error to plot,
- choose the evolution (APFEL or LHAPDF evolution).

APFEL 2.0.0: What's new?

New Graphical User Interface

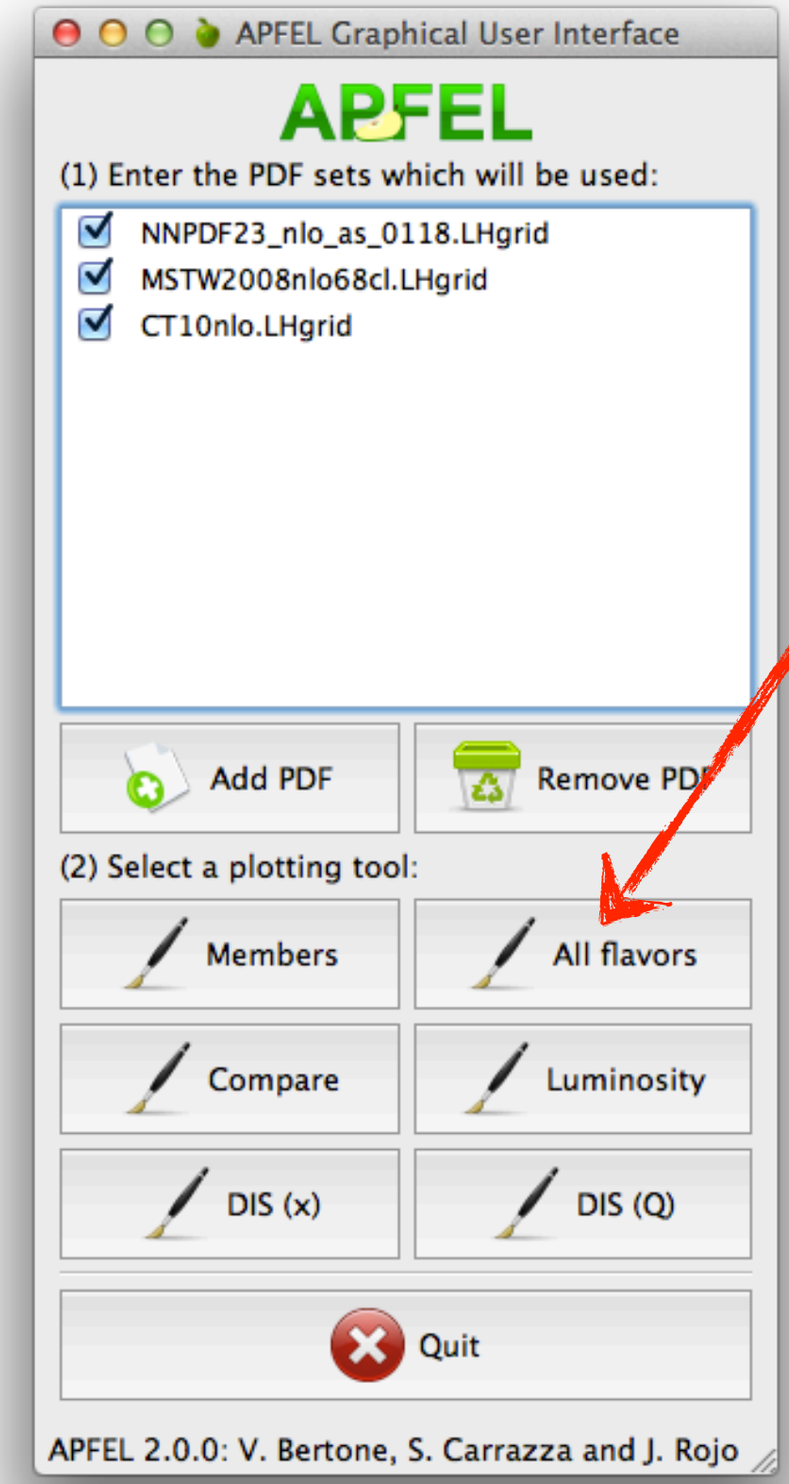


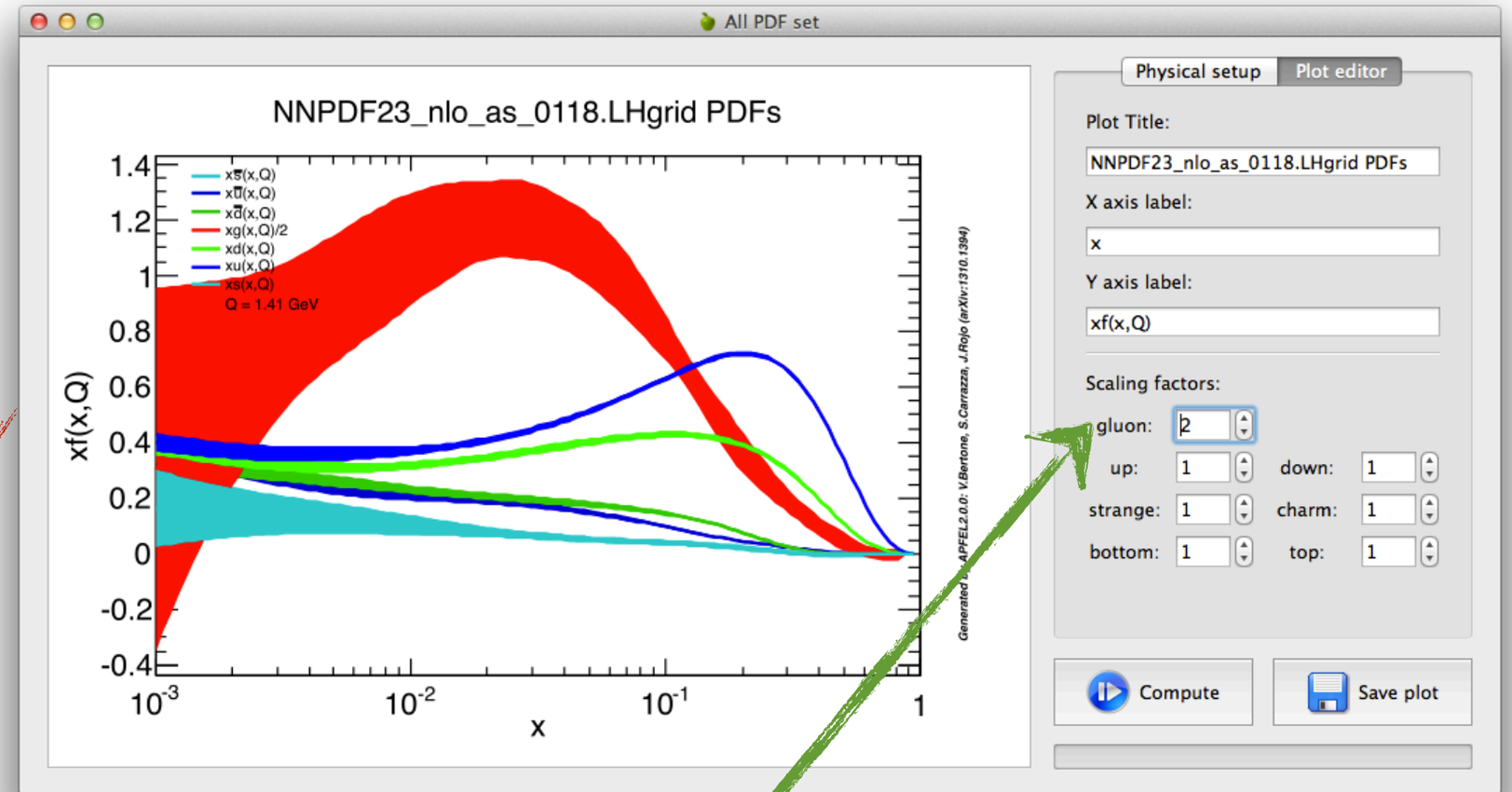


- Select initial/final scale,
- select PDF to plot and specific replica,
- select errors to display,
- ...

APFEL 2.0.0: What's new?

New Graphical User Interface

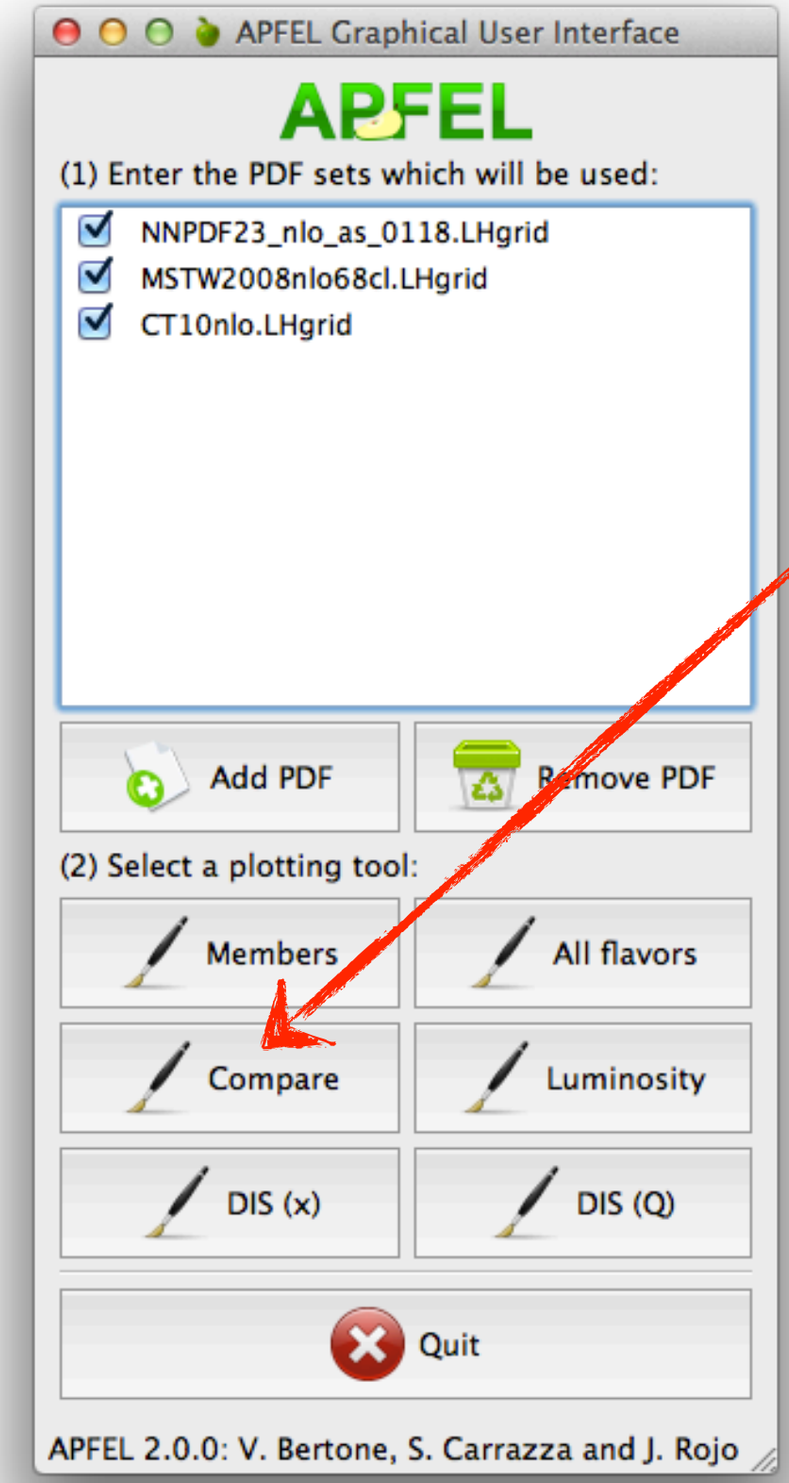


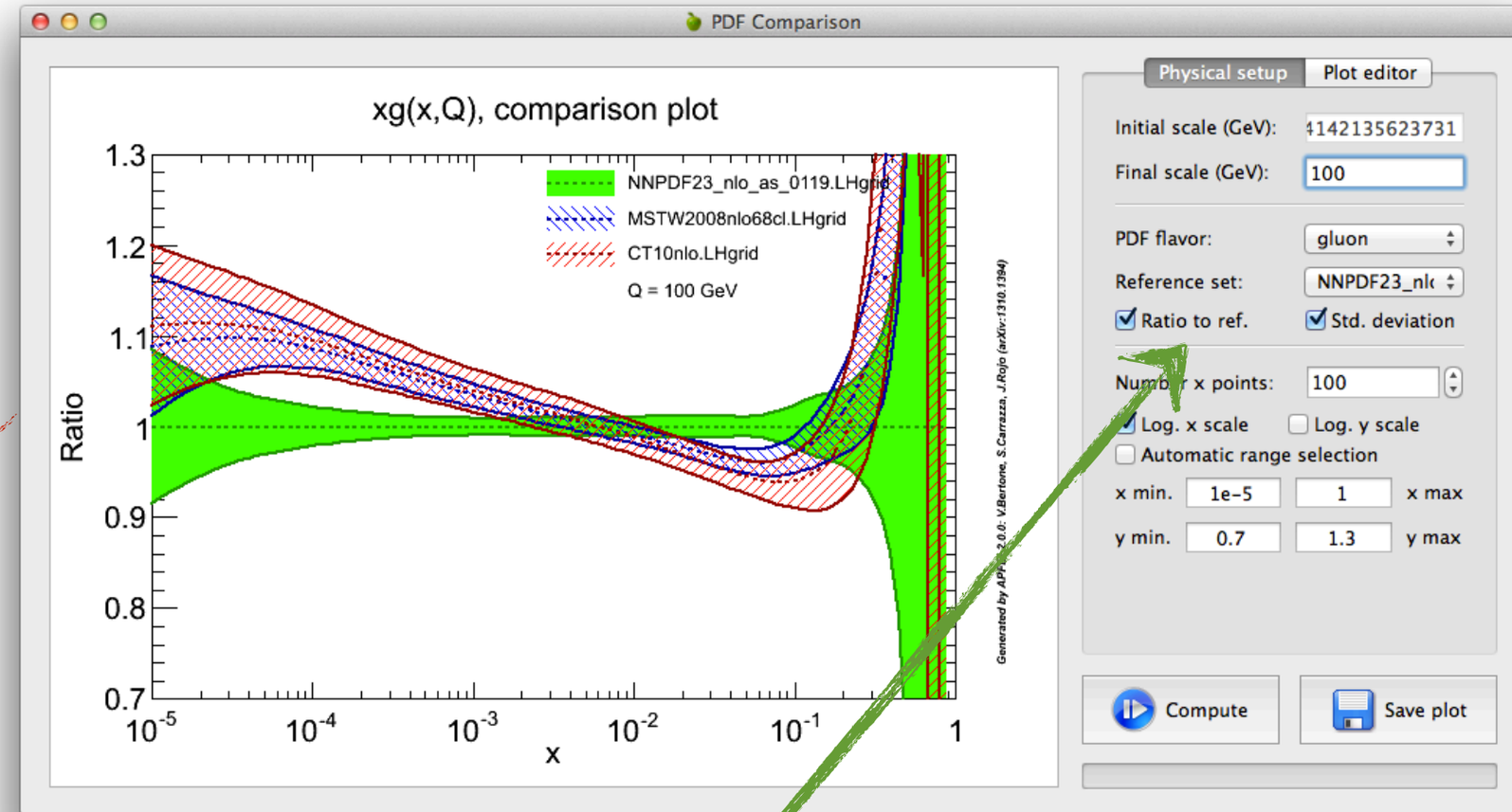


- Select scaling factors for any plotted PDF.

APFEL 2.0.0: What's new?

New Graphical User Interface

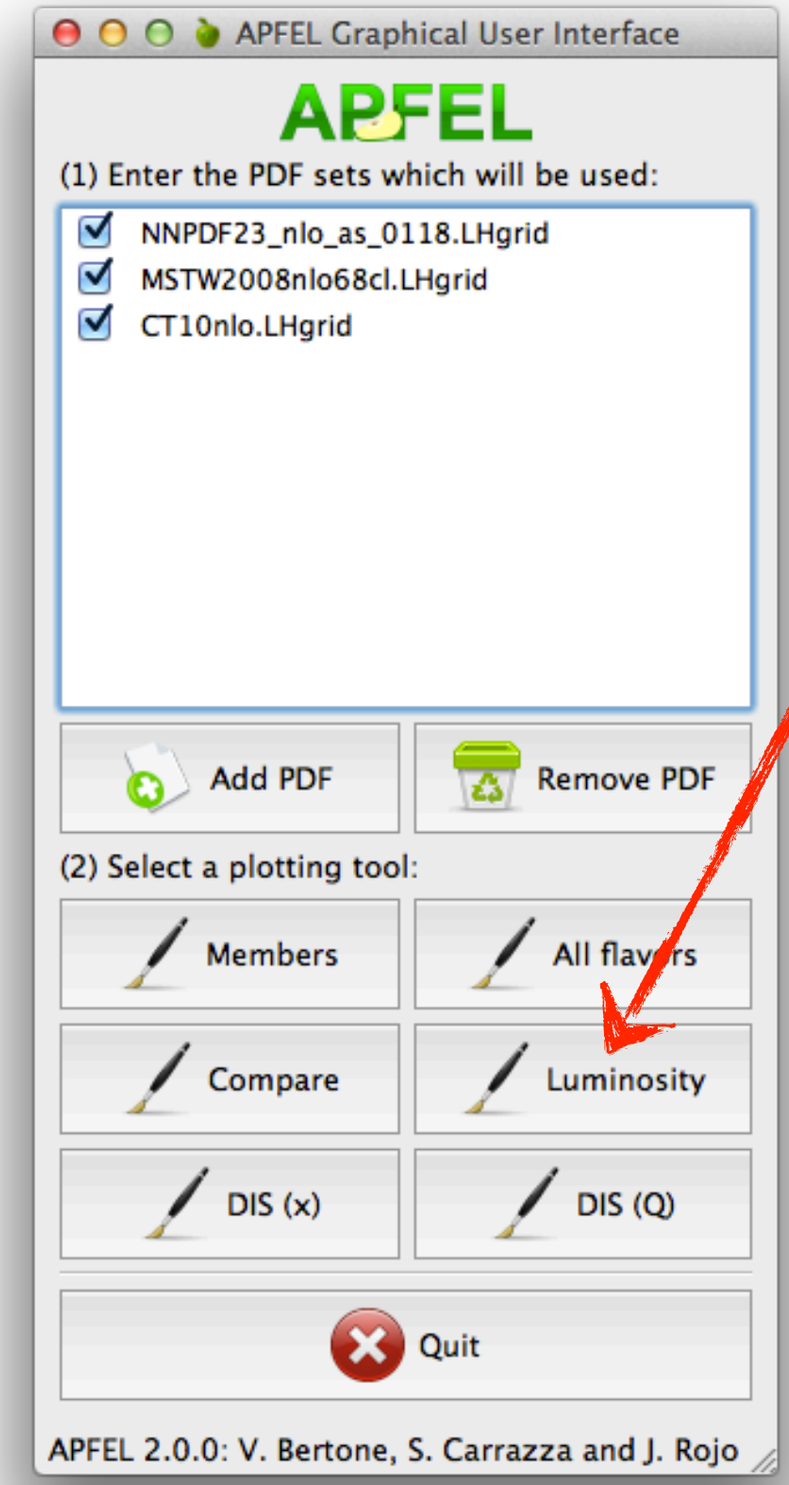


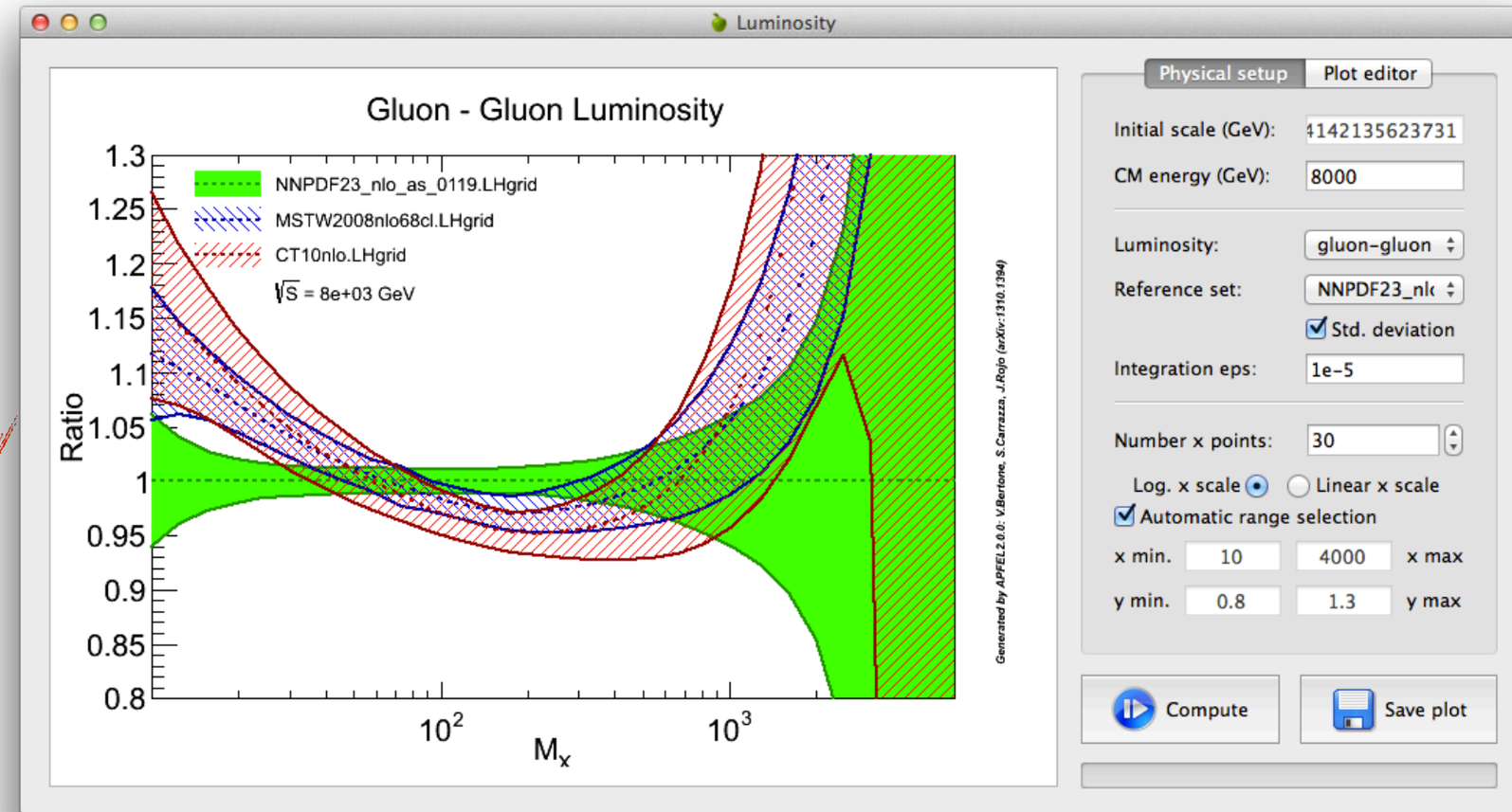


- Compare the selected PDF as ratios to the reference set.

APFEL 2.0.0: What's new?

New Graphical User Interface

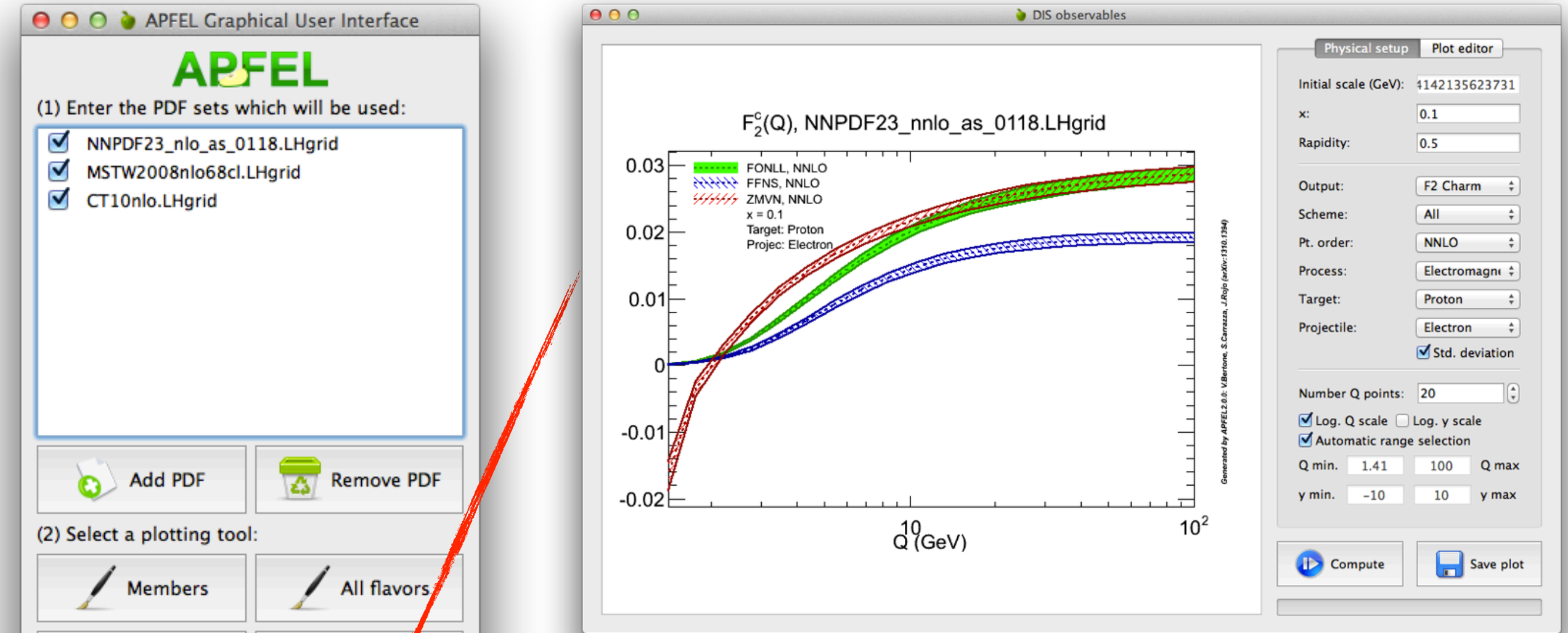




- Plot luminosities as ratios to a Refence set as a function of the invariant mass of the partonic system M_X for a given CME.

APFEL 2.0.0: What's new?

New Graphical User Interface



- Plot sructure functions or cross sections as a function of Q for a given value of x.

APFEL 2.0.0: What's new?

Interactive Console

- Once APFEL has been properly installed, the user will have at disposal the shell command `apfel` which gives access to an interactive console with all the APFEL functionalities.

```
bertone@MacBook-Pro-di-Valerio-Bertone.local: ~/apfel/trunk/src/DIS — Python — 105×44

Welcome to
    /_/_/   /_/_/_/  /_/_/_/  /_/_/_/  /
   /   /   /   /   /       /       /
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_____v 2.0.0 A PDF Evolution Library, arXiv:1310.1394
     Authors: V. Bertone, S. Carrazza, J. Rojo

 Type apfelhelp() for help

[apfel]: InitializeAPFEL()

 Welcome to
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_____v2.0.0 A PDF Evolution Library, arXiv:1310.1394
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 Report of the evolution parameters:

 QCD   evolution
 Evolution scheme = VFNS at N2LO
 Evolution range [     0.5000 :   400.0000 ] GeV
 Coupling reference values:
 - AlphaQCD(  1.4142 GeV) =   0.350000
 - AlphaQED(  1.7770 GeV) =   0.007496
 Pole  heavy quark thresholds:
 - mc =     1.4142 GeV
 - mb =     4.5000 GeV
 - mt =   175.0000 GeV

 Initialization done i  0.1890390000000002      s

[apfel]: EvolveAPFEL(2**0.5,100)
[apfel]: xPDF(0,0.00001)
220.1182241535072
[apfel]:
```

Initialization command

Evolve between $\sqrt{2}$ and 100 GeV

Get the gluon PDF at $x = 10^{-5}$

Conclusions and Outlook

- News of APFEL 2.0.0:
  - DIS module for the computation of structure functions and cross sections,
  - extended Graphical User Interface,
  - new interactive console.
- Outlook:
  - implementation of the $\overline{\text{MS}}$ masses for the DIS observables,
  - interface of APFEL to APPLgrid:
    - possibility to produce DIS APPLgrid grids,
    - inclusion of the PDF evolution in the pre-existing APPLgrid grids,
    - easy way to use the FONLL scheme in the HERAFitter framework.