(G)JR dynamical parton distributions: PDF4LHC discussion group

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Following the guidelines of the meeting:

The dynamical parametrization

Small-x region

Input data: is GJR a global fit?

The strangeness asymmetry

The W/lepton asymmetry data

Treatment of QCD parameters

Treatment of heavy quarks

The dynamical parametrization

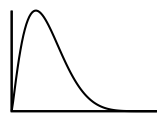
Since we are free to (and have to) select an input scale for the RGE:

At low-enough Q^2 only "valence" partons would be "resolved"
$\Rightarrow$ structure at higher Q^2 appears radiatively (i.e. due to QCD dynamics)

DYNAMICAL:

$Q_0^2 < 1\,\mathrm{GeV}^2$ optimally **determined**

a > 0 *"valence-like"*



"STANDARD":

$Q_0^2 = 2\,\mathrm{GeV}^2$ arbitrarily **fixed**

Unrestricted parameters

$$xf(x,Q_0^2) = N x^{\mathbf{a}}(1-x)^b(1+A\sqrt{x}+Bx)$$

Positive definite input distributions

QCD **predictions** for $x \lesssim 10^{-2}$

More restrictive, **less uncertainties**

Arbitrary fine tunning ($g < 0$!)

Extrapolations to unmeasured region

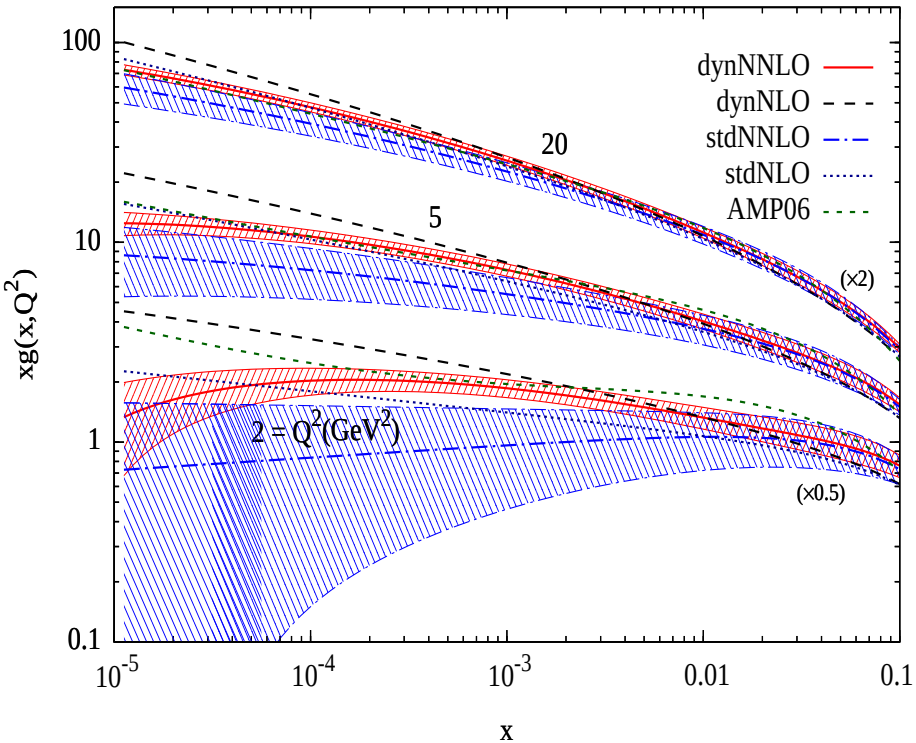
Less restrictive, *marginally* smaller χ^2

Physical motivation for the **CC of the DGLAP $\neq$ NP structure** of the nucleon

There are *no extra theoretical assumptions* involved in the dynamical approach with respect to the "standard" one

Small-x region

Extraordinarily important due to the strong rise of gluon and sea distributions



This rise is a *prediction* of the dynamical approach [GRV92] wich was **confirmed only later** at HERA [H1, ZEUS 93]

Q_0^2 also play another role: "standard" gluons fall below dynamical ones

Excellent agreement with data:

dyn: $\chi^2_{\rm DIS} = 0.90$

std: $\chi^2_{\rm DIS} = 0.87$

$\Rightarrow$ Fine tunning marginal

Our dynamical (and "standard") results for $F_L(x,Q^2)$ are *stable and positive*: observed [M(R)ST(W)] instabilities are an *unphysical artefact* of negative gluons

In summary: *the dynamical approach does not have any disadvantage with respect to the "standard" one, while its predictive power is an important and desirable feature*

Input data: is GJR a global fit?

There are claims that CTEQ, MSTW and NNPDF are the only "truly global" fits:

	What data they have?	What goes into GJR?
DIS NC (HERA + FT)	✓	✓
DIS CC	✓	×
Drell-Yan muon pair	✓	✓
W/Z hadroproduction	✓	×
Tevatron jet production	✓	✓

The *most important* data set is *by far* DIS NC: *valence, sea* and *gluon*

Drell-Yan muon pair production is *instrumental* in fixing $\bar{d} - \bar{u}$ (or $\bar{d}/\bar{u}$)

Tevatron jet production helps to constrain the large-x gluon

Global analysis means all PDFs constrained in the relevant regions: GJR *does it!*

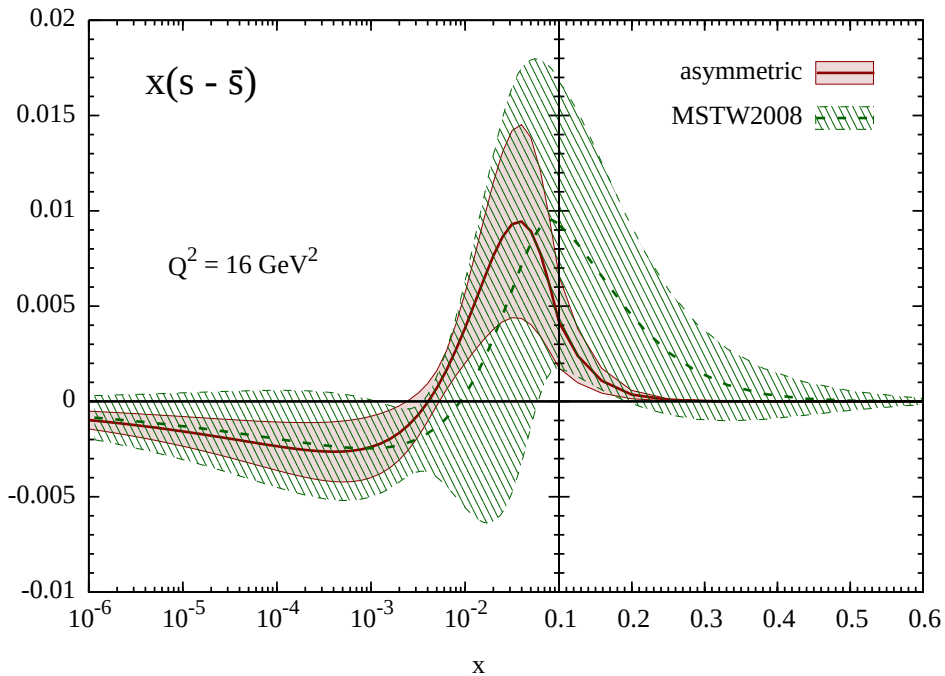
Both, CC DIS and W/Z hadroproduction data provide only *additional* (redundant?) information to the data that we include

At NNLO the Tevatron jet data cannot be consistently included (choice)

The strangeness asymmetry

DIS CC are only supplementary (and far less relevant) to DIS NC and DY, except for they fix the strange asymmetry $(s-\bar{s})(x,Q^2)$

We have also studied this (using dimuon production data) and found that [PJD 10]:



GJR PDFs are *completely compatible* with CC DIS data

A marginal improvement in χ^2 ($65 \rightarrow 60$ for 90 points) is achieved by introducing $s \neq \bar{s}$

The impact on non-strange PDFs is negligible

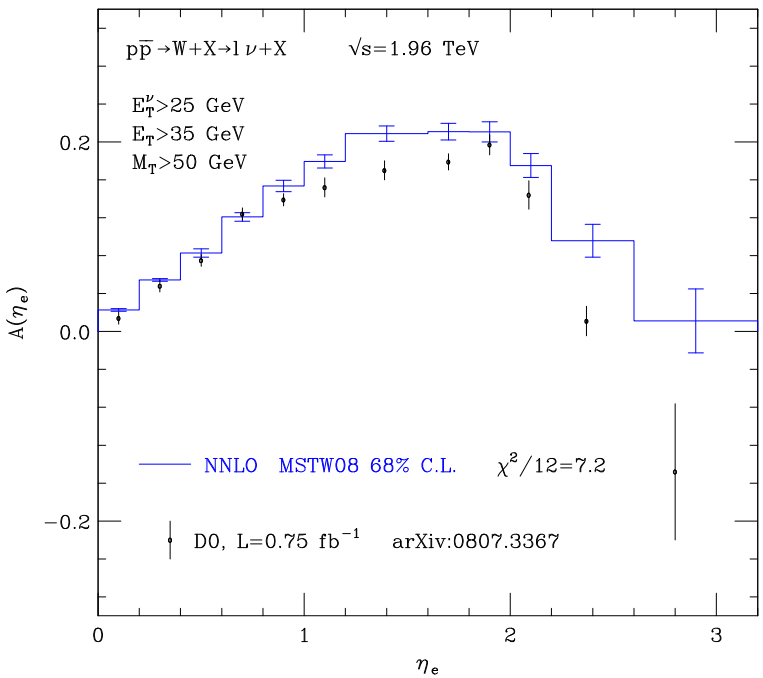
Furthermore, it is *irrelevant* for most applications (depend on $s+\bar{s}$), i.e. for LHC

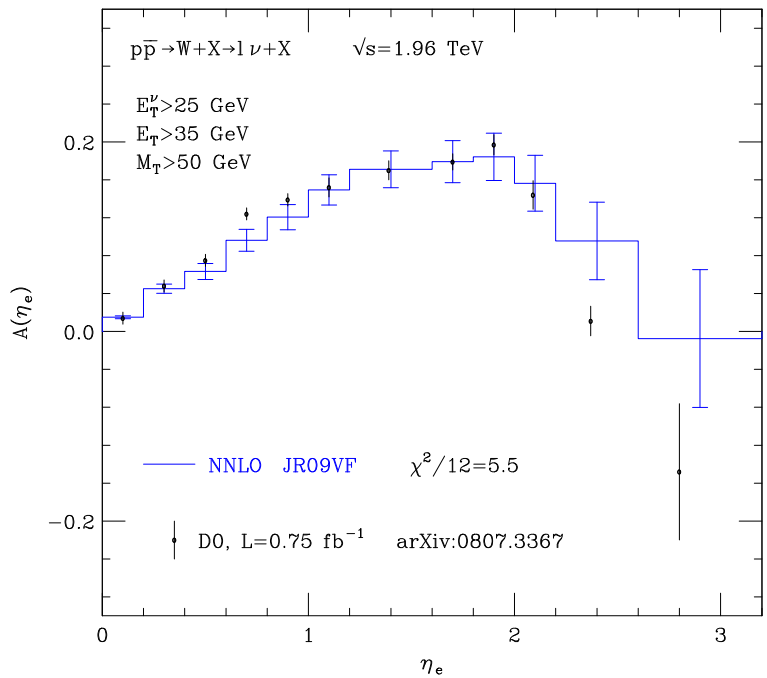
For especially sensitive experiments (e.g. NuTeV anomaly) the results are available (and can be combined with GJR)

The W/lepton asymmetry data

W-asymmetry data (mainly sensitive to d/u at medium-x) are supplementary to fixed-target NC DIS data (F_2^p/F_2^n ratios)

Besides, there are experimental (CDF/D0) tensions and the most recent data are poorly described, e.g. by the MSTW PDFS [Catani,Ferrera,Grazzini 10]





In fact the best description of the D0 data is achieved with our JR09 PDFs!

(By the way, we do not include nuclear corrections to the deuterium data)

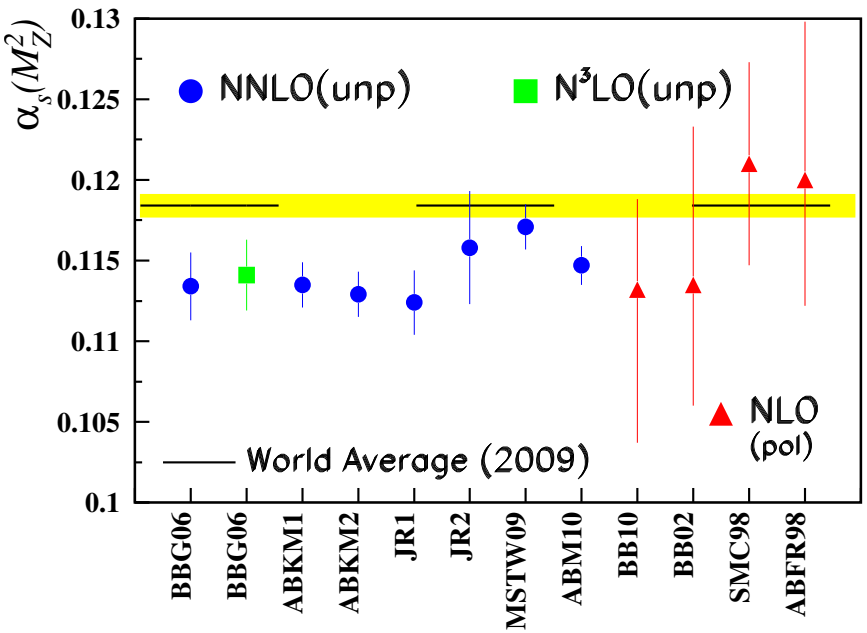
Treatment of QCD parameters

$\alpha_s(\mu^2)$ and HQ masses are *parameters* which *depend on the theoretical input* (order, scheme, scales, etc.)

It is desirable that their values come out of the global fits

A *perfectly valid* choice is *not* to force the PDFs to accomodate to particular (arbitrary) values

DIS data generally prefer lower values than LEP or hadron colliders:



[Blümlein 10]

These differences should be interpreted as *uncertainties* and *not* be "removed" by convention (what sense makes to fix it to a value "between CTEQ and MSTW"??)

Treatment of heavy quarks

For details see the plenary talk on heavy quarks, which conclusions are:

The current theoretical status on HQ contributions is (and will be for a while) NLO, any NNLO is an approximation (thus model dependent)

The **FFNS is a stable and reliable framework** for the treatment of HQ contributions (there is no need to resum *supposedly* "large logarithms")

The **VFNS is** not valid for global analyses but **sufficiently accurate for LHC and Tevatron** energies (the input distributions must be generated in the FFNS)

Other "popular" choices (which we do *not recommend*) are the GM-VFNS's (model/process dependence)

Schemes choices are a source of theoretical uncertainties in the predictions for high-energy colliders which cannot (and should not) be hidden "by convention"

(will we not lose something if every group switches to the GM-VFNS?)

Summary and conclusions ...

The dynamical approach does *not have any disadvantage* with respect to the "standard" one, while its *predictive power* is an *important and desirable* feature

GJR is a global fit: data differences (supplements) with respect to CTEQ, MSTW or NNPDF are of *minor importance* (and not all necessarily provide adequate information)

Uncertainties in the values of theoretical parameters and due to the treatment of heavy quarks are *real* and should not (and cannot) be hidden "by convention"

... and some questions for reflection:

If all groups agree to use the same data, the same parameter values and use the same theoretical treatments, would the eventual "agreement" provide us a with a better understanding of nature? Why then to have several groups at all?

Is it pure coincidence that the "PDF4LHC recommendations" favor the PDFs produced by people involved in the decision process?