Towards NNPDFpol2.0

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31st International Workshop on Deep Inelastic Scattering and Related Subjects (DIS2024)

Overview

1. FONLL for polarised DIS [EPJC84.189]

2. Towards NNPDFpol2.0

3. Summary

FONLL for polarised DIS [EPJC84.189]

How to treat charm in polarised PDFs? [EPJC84.189]

FH, Magni, Nocera, Rabemananjara, Rojo, Schaus & Stegeman

Treatment of heavy quarks in present polPDFs: ZM-VFNS $\Rightarrow m_c = \infty$ or $m_c = 0$

With FONLL we account for charm mass effects [NPB834.116]:

$$g_1^{\text{FONLL}} = g_1^{\text{FFNS3c}} + g_1^{\text{FFNS4}} - g_1^{\text{double}-\text{counting}}$$

where

- ▶ g^{FFNS3c} retains all mass effects at a finite order $\Rightarrow Q^2 \approx m_c^2$ ✓
- ▶ g^{FFNS4} resums all collinear logs, but has no power-like terms $\Rightarrow Q^2 \gg m_c^2$ ✓
- ▶ $g^{\text{double}-\text{counting}}$ is the overlap between FFNS3c and FFNS4

The `pineline` framework [CPC297.109061]

Straight to the fit.

https://nnpdf.github.io/pineline

EKO
Evolution Kernel Operators
[EPJC82.976]

← NNLO splitting functions ✓
← NNLO matching conditions ✓
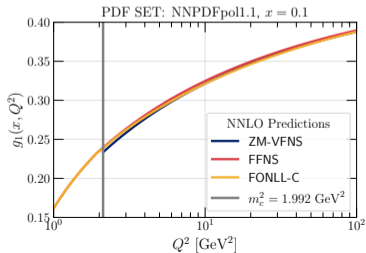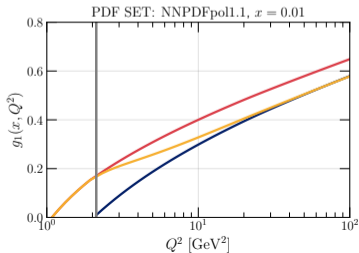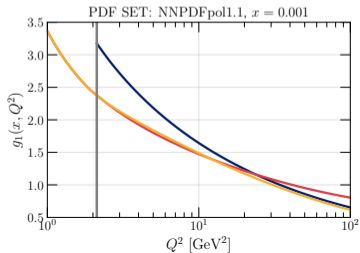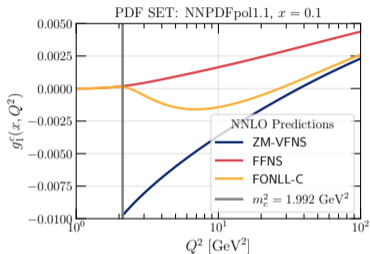→ NNLO massless coefficient functions ✓
→ NNLO massive coefficient functions ✓

Yadism
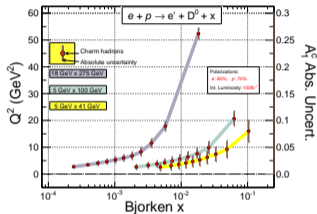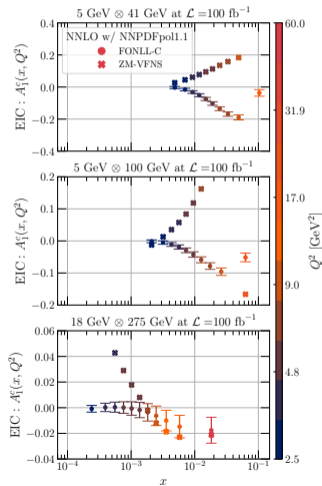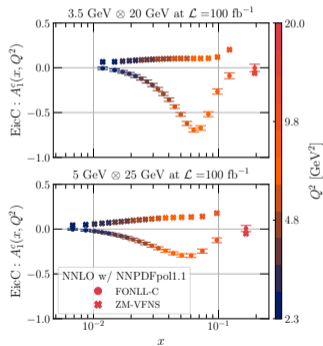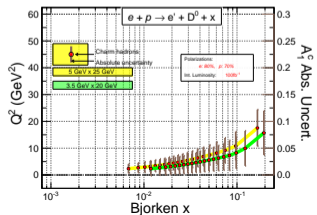Yet Another DIS Module
[2401.15187]

Structure functions

Predictions for single spin asymetries at EIC and EicC

Anderle, Dong, FH et al. & Anderle, Guo, FH et al.

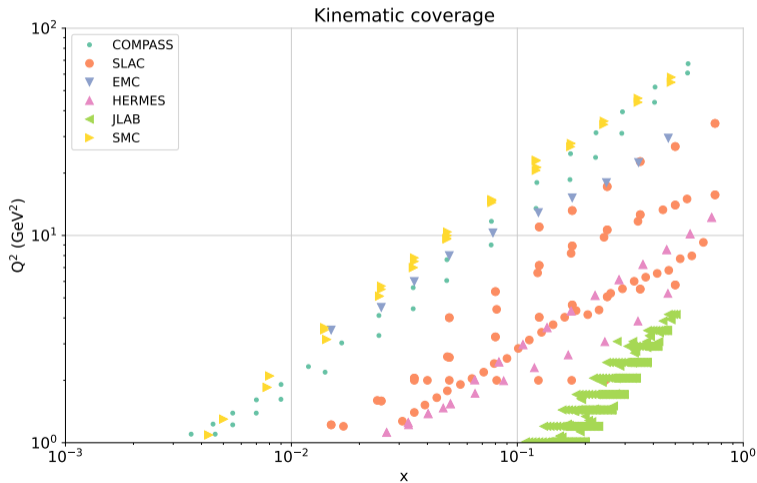← EIC [PRD104.114039]

EicC [PRD109.034021] →

Towards NNPDFpol2.0

NNPDFpol2.0 - PRELIMINARY

- ▶ we can already do a DIS-only PDF fit $\rightarrow \Delta g, \Delta S, \Delta T_3, \Delta T_8$
- ▶ use NNPDF4.0 technology [EPJC82.428][EPJC81.958]
- ▶ use `pineline` technology [CPC297.109061]

- ▶ impose positivity $|\Delta f| < f$ at $5\,\mathrm{GeV}^2$ [2308.00025]
- ▶ impose sum rules for ΔT_3 and ΔT_8 (baryon decays)
- ▶ impose finite first moment for Δg and ΔS at $1\,\mathrm{GeV}^2$

PRELIMINARY!

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Data - PRELIMINARY

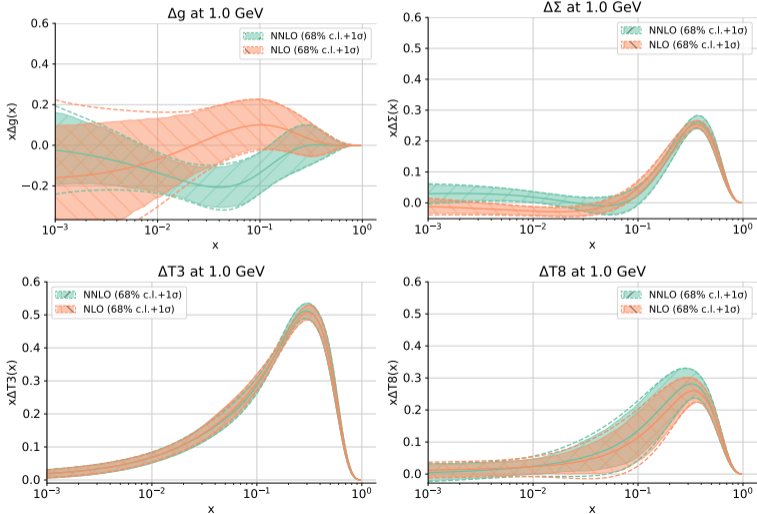

Kinematic coverage

g_1 COMPASS, SLAC, HERMES, JLab, SMC

A_1 SLAC, JLab, SMC

$W^2 \geq 4\,\mathrm{GeV}^2$
$Q^2 \geq 1\,\mathrm{GeV}^2$

NLO vs. NNLO - PRELIMINARY

Comparison to others - PRELIMINARY

Summary

Summary

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- we can work at NNLO for DIS
- measurements at the EIC will be able to resolve mass effects

TODO for NNPDFpol2.0:

- add more data, i.e. hadronic data: $W^{\pm}$ production, pion production, jet production
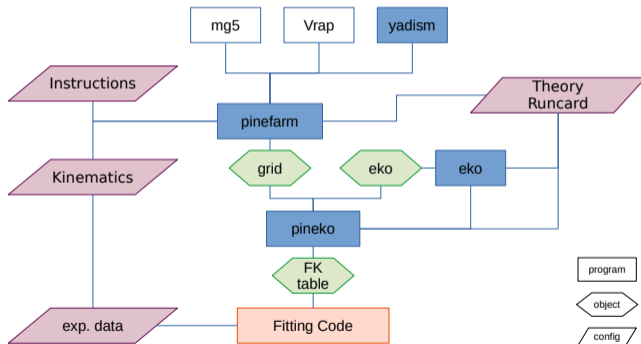- add missing higher order uncertainty (MHOU) [2401.10319]

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Danke! Thanks! Kiitos!

Backup slides

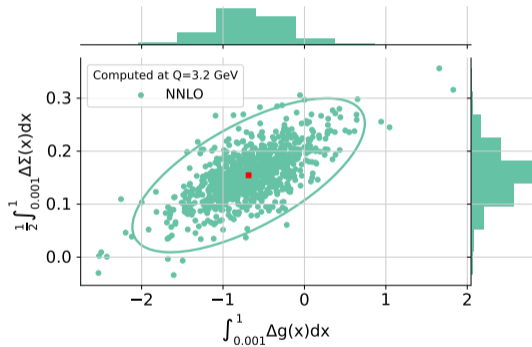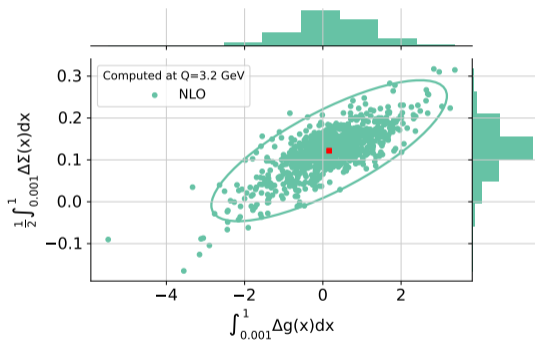# New Theory Prediction ~~Pipeline~~ Pineline
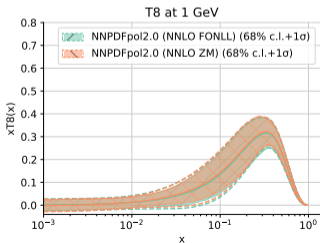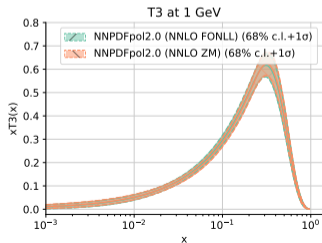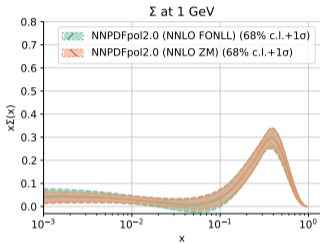
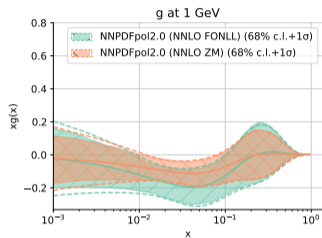Produce FastKernel (FK) tables!

The workhorse in the background: PineAPPL

Spin momentum

FONLL vs. ZM-VFNS - PRELIMINARY

FONLL: NLO vs. NNLO