



Centre of Excellence
in Quark Matter



NINPDF

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UNIVERSITY OF JYVÄSKYLÄ



Research Council
of Finland

HELSINKI INSTITUTE OF PHYSICS



Funded by
the European Union



erc

Towards NINPDFpol2.0

Felix Hekhorn

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]:

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

where

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

The pipeline framework [CPC297.109061]



<https://nnpdf.github.io/pipeline>

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

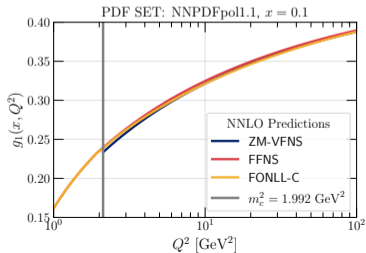
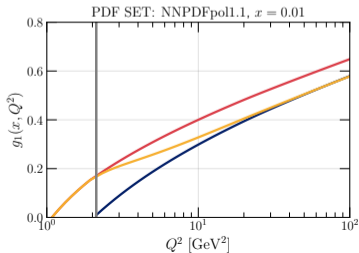
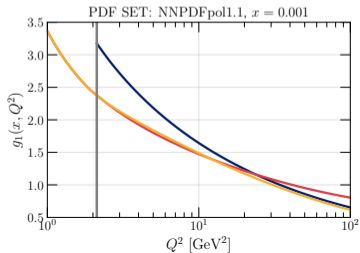
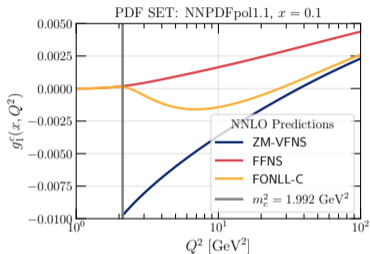
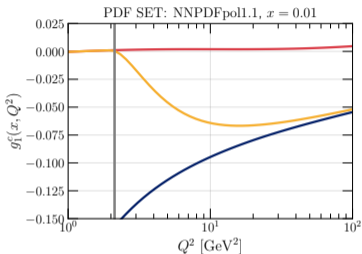
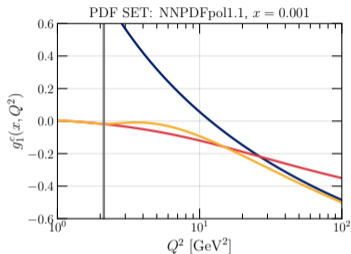
EKO
Evolution Kernel Operators

 [EPJC82.976]

 | **Yadism**
Yet Another DIS Module

 [2401.15187]

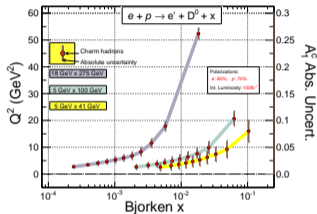
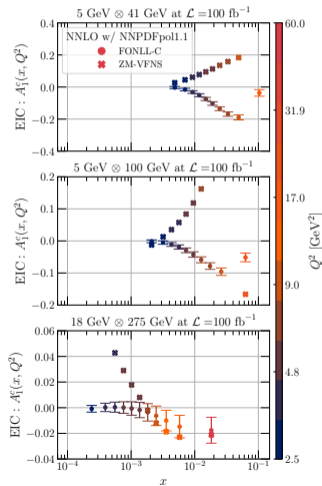
Structure functions



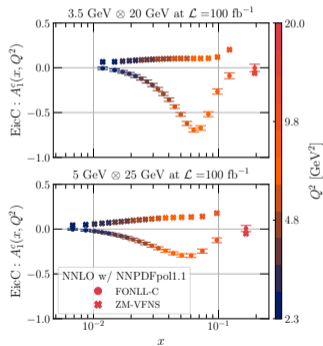
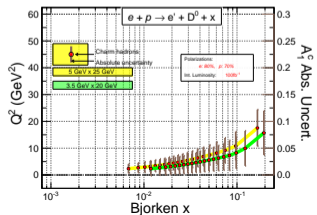
Predictions for single spin asymmetries at EIC and EicC

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

← EIC [PRD104.114039]



EicC [PRD109.034021] →



The background features a diagonal split between a teal upper-left section and a light gray lower-right section. The text is centered in the white area between these two colors.

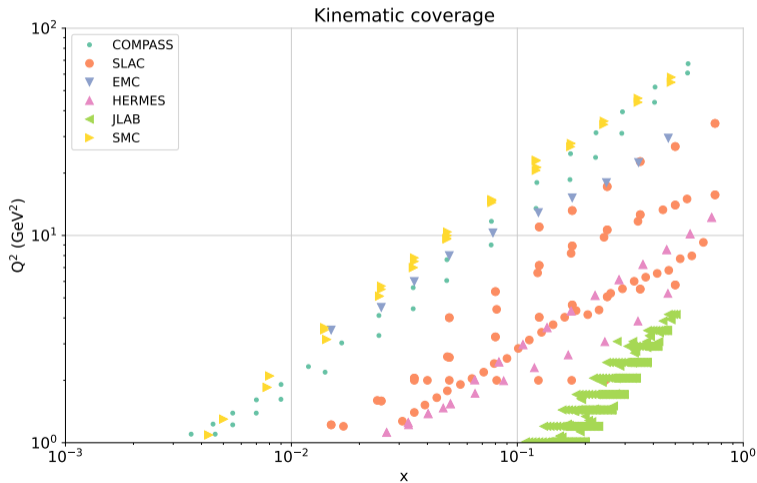
Towards NNPDFpol2.0

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 pipeline technology [CPC297.109061]
- ▶ impose positivity $|\Delta f| < f$ at 5 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 GeV^2

PRELIMINARY!

Data - PRELIMINARY



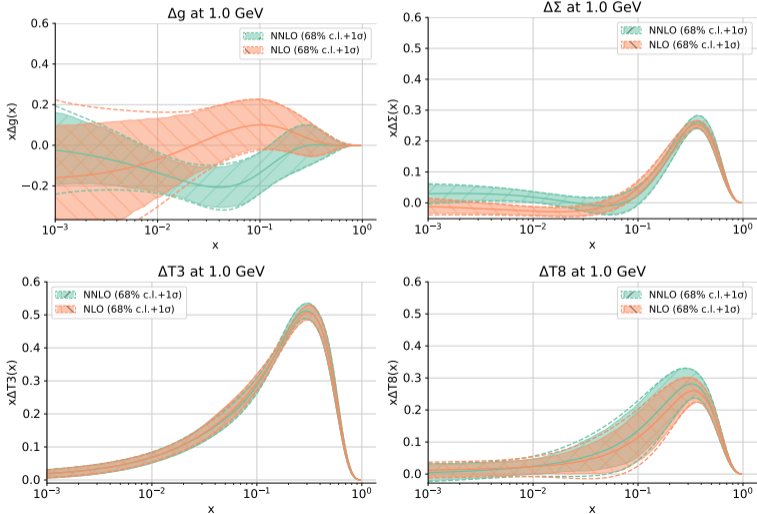
g_1 COMPASS, SLAC,
HERMES, JLab, SMC

A_1 SLAC, JLab, SMC

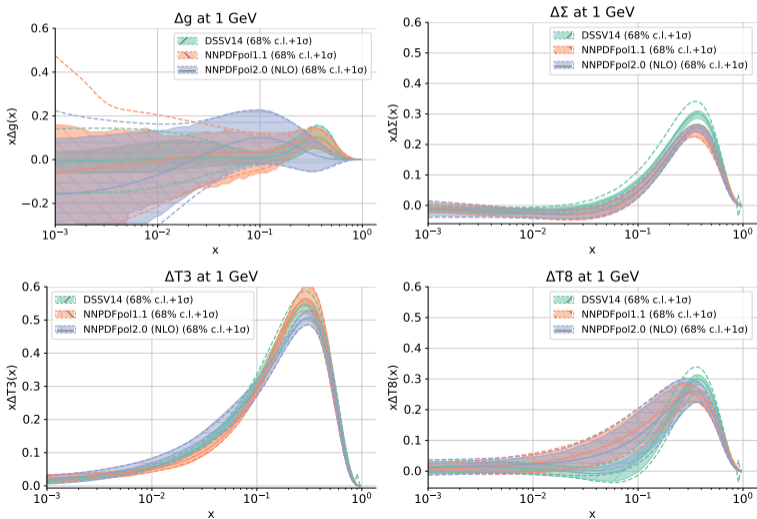
$$W^2 \geq 4 \text{ GeV}^2$$

$$Q^2 \geq 1 \text{ GeV}^2$$

NLO vs. NNLO - PRELIMINARY



Comparison to others - PRELIMINARY



The background consists of two large, overlapping geometric shapes. A teal-colored shape is in the upper-left corner, and a light gray shape is in the lower-left corner. The rest of the page is white. The word "Summary" is centered in the white area.

Summary

Summary

- ▶ we can apply the FONLL scheme for polarised PDFs
- ▶ 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) [\[2401.10319\]](#)

Summary

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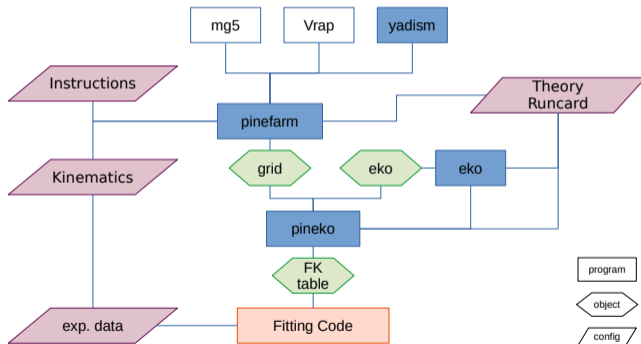
Danke! Thanks! Kiitos!

The background consists of two large, overlapping geometric shapes. A teal-colored shape is in the upper-left corner, and a light gray shape is in the lower-left corner. The rest of the slide is white.

Backup slides

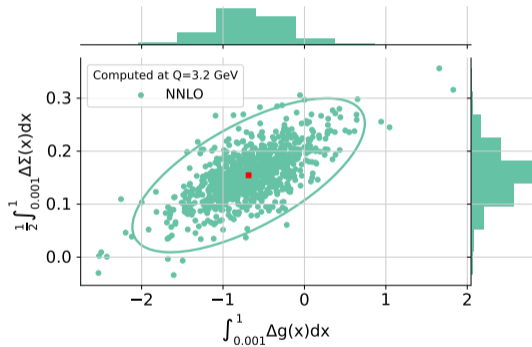
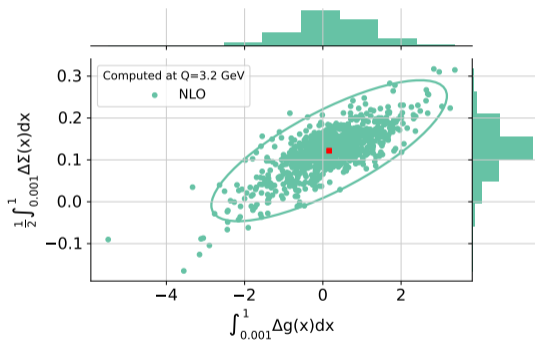
New Theory Prediction Pipeline Pipeline

Produce FastKernel (FK) tables!

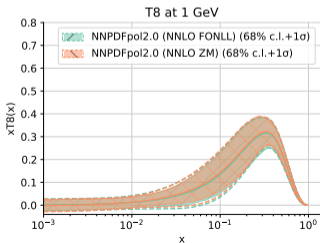
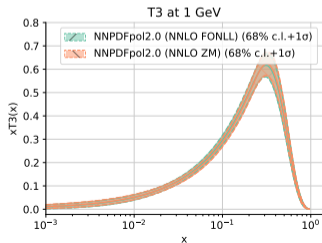
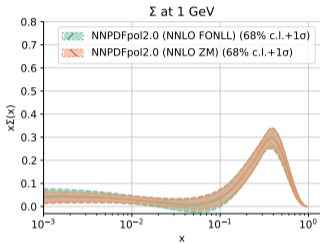
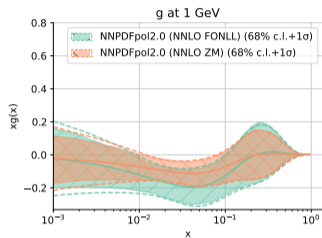


The workhorse in the background: PineAPPL

Spin momentum



FONLL vs. ZM-VFNS - PRELIMINARY



FONLL: NLO vs. NNLO

