DIS2023

Summary WG1

Conveners:
Simone Amoroso (DESY), Claire Gwenlan (University of Oxford), Aurore Courtoy (UNAM)

MSU, 23/03/31

Working Group 1 — structure functions and parton densities

PDFs are two-fold

— they provide essential inputs for predicting and interpreting high-energy physics experiments;

— they also allow us to test the theoretical framework of perturbative QCD and to gain insights into the internal structure of hadrons, in the non-perturbative regime of QCD.

WG1 encompasses more and more data from low to high energies, with different target types.

New jet measurements

- Photonuclear jet production in PbPb collisions by ATLAS

  Steinberg

- Correlations between lepton and jets at ZEUS

  Nam

- New high-Q^2 jet production at ZEUS

  Wichmann

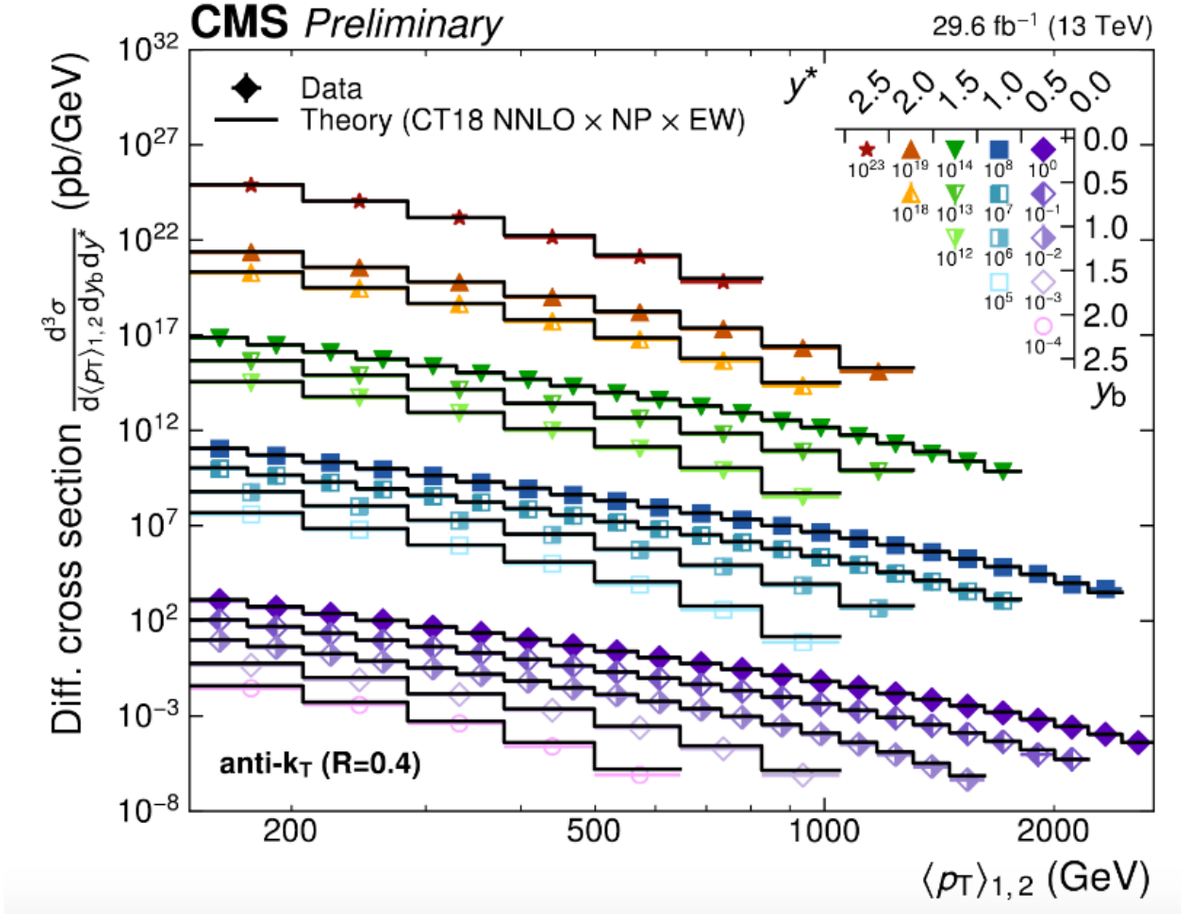
- CMS 13 TeV jet measurements and constraints on α_s

  Wichmann

- Helix string fragmentation measurements in ATLAS

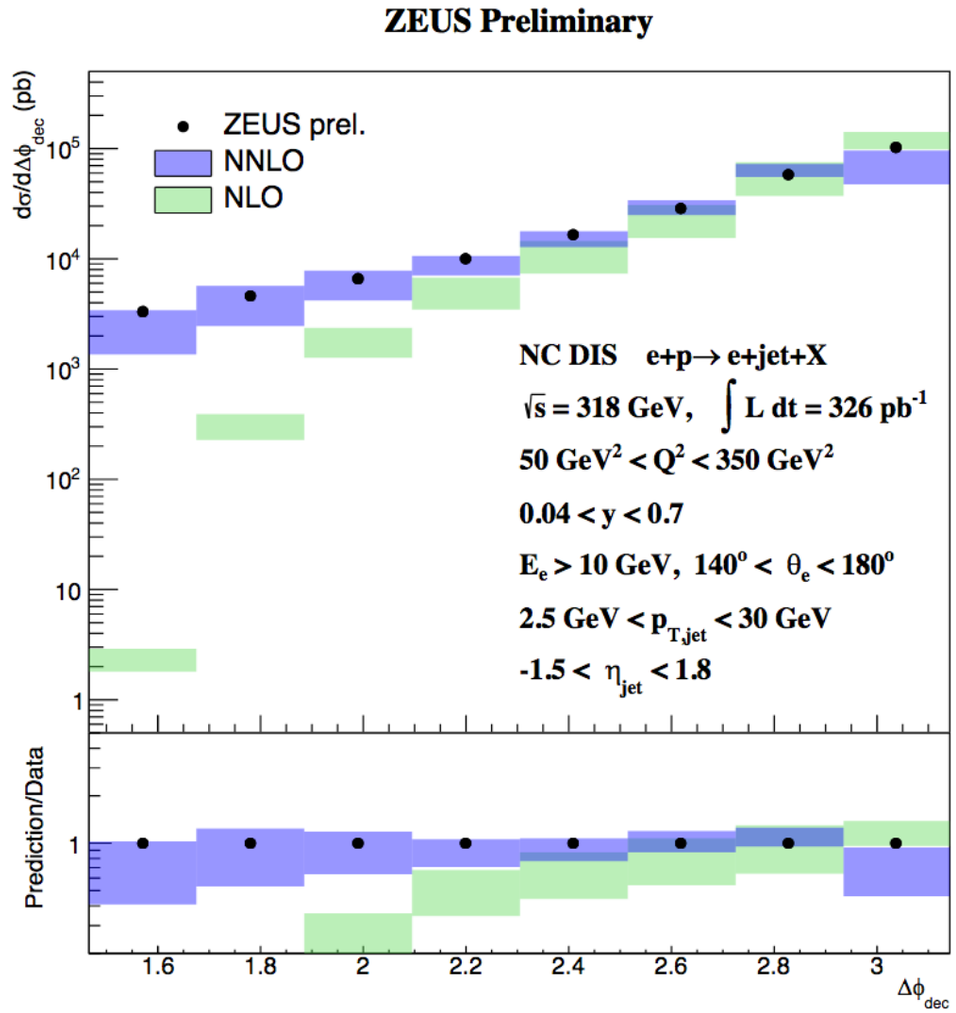
  Sykora

New jet measurements



- Triple-differential dijet cross-sections to fully resolve parton kinematics

Wichmann



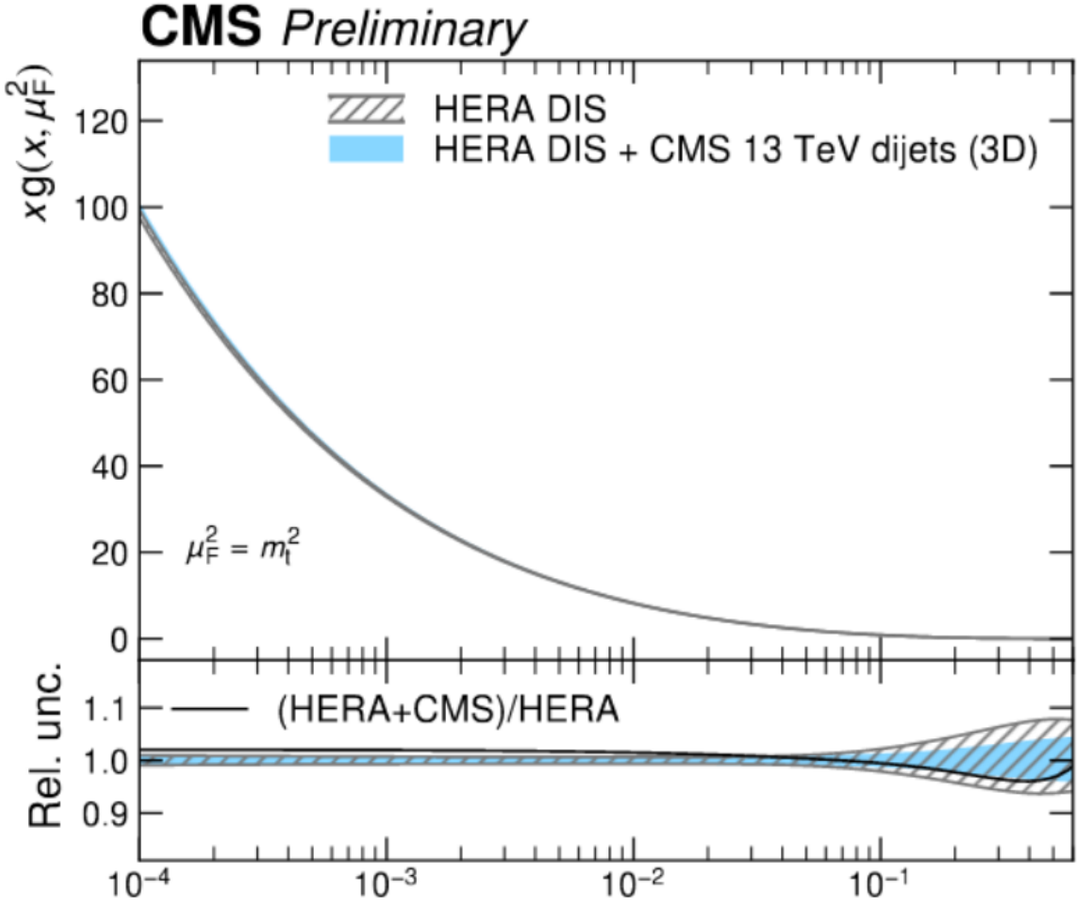
- Azimuthal decorrelations to test higher-orders and extract TMDs

Nam

Updates on the strong coupling

- Simultaneous determination of PDFs and strong coupling

- Now with jet predictions at NNLO QCD accuracy



- New ZEUS measurement from high-Q^2 jet production

$\alpha_s(M_Z^2) = 0.1138 \pm 0.0014\,(\text{exp/fit})\ ^{+0.0004}_{-0.0008}\,(\text{model/parameterisation})\ ^{+0.0012}_{-0.0005}\,\textbf{(scale)}$

- CMS 13 TeV inclusive jets

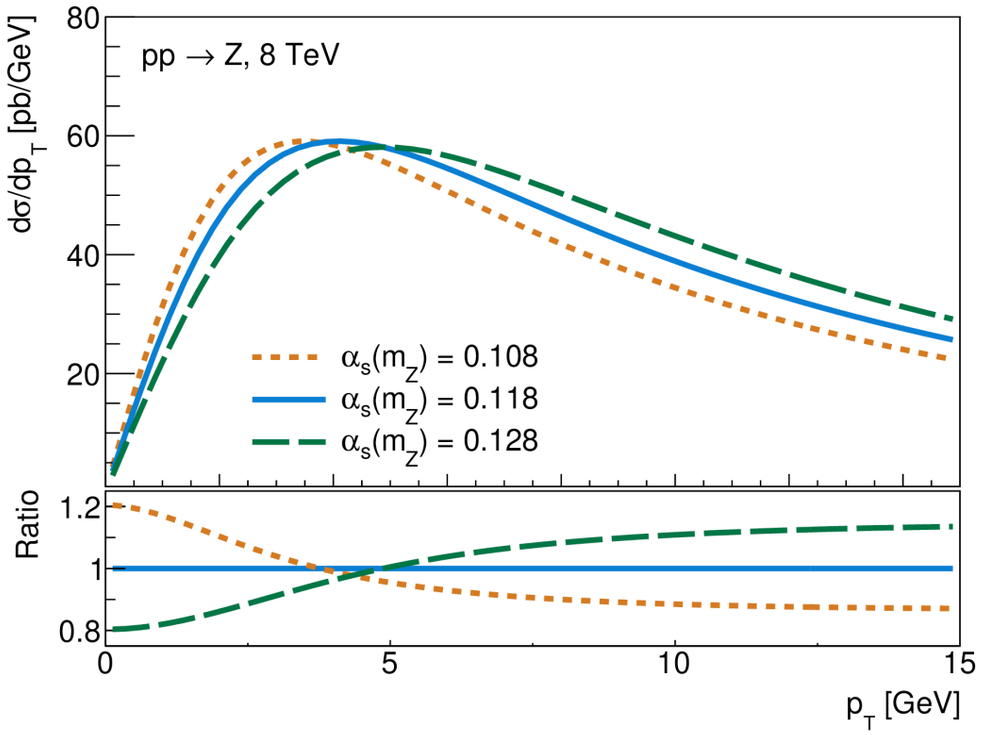
$\alpha_s(m_Z) = 0.1170 \pm 0.0014\,(\text{fit}) \pm 0.0007\,(\text{model}) \pm 0.0008\,(\text{scale}) \pm 0.0001\,(\text{param.})$

- CMS 3D dijet cross-sections

$\alpha_s(m_Z) = 0.1201 \pm 0.0010\,(\text{fit}) \pm 0.0005\,(\text{scale}) \pm 0.0008\,(\text{model}) \pm 0.0006\,(\text{param.})$

Wichmann

Updates on the strong coupling



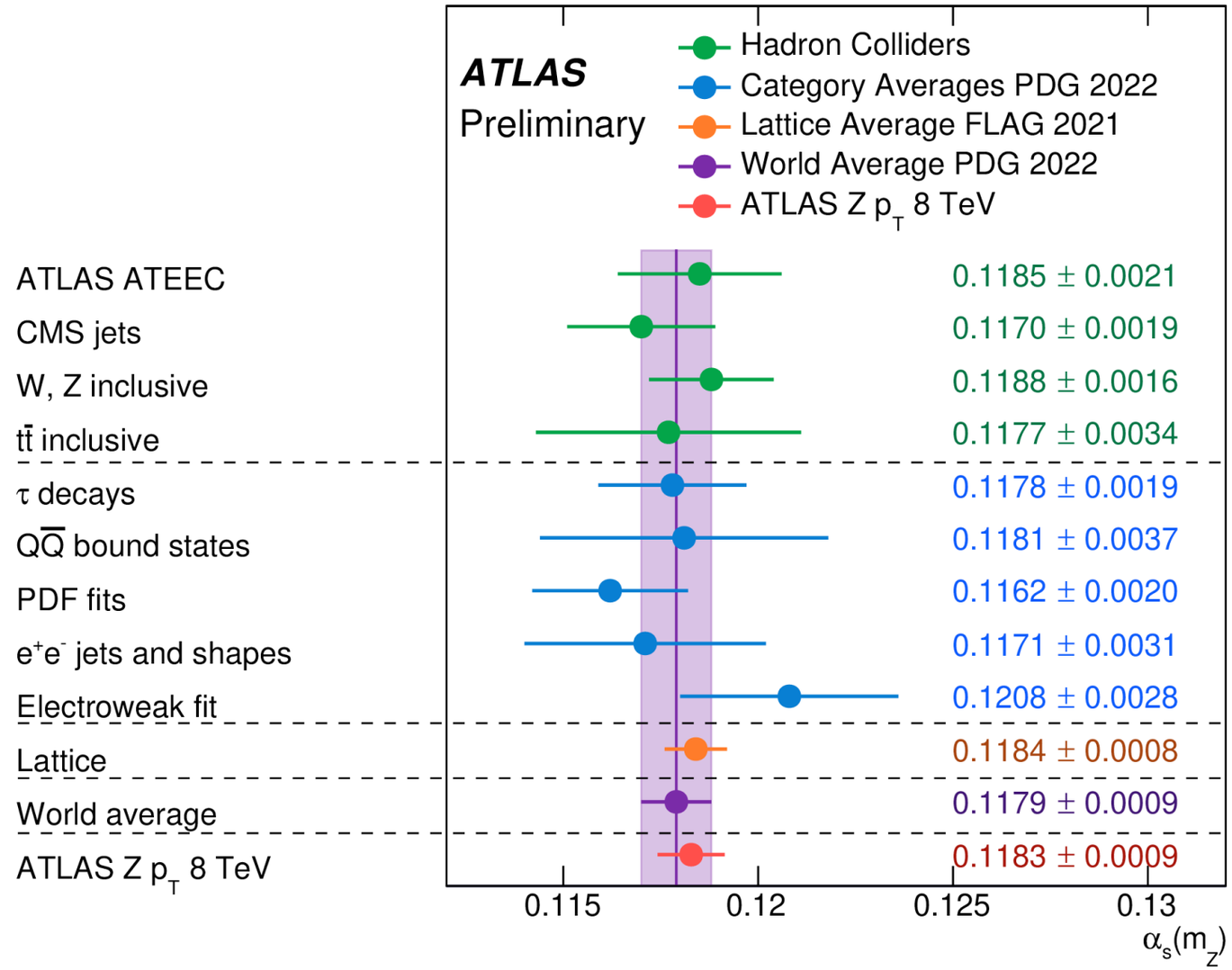
- New ATLAS measurement from Sudakov peak of Z-boson p_T (WG3)

Beauchemin

- Most precise collider measurement

- N3LO+N4LL theory, requires N3LO PDFs!

  for now MSHT20aN3LO



Amoroso, Gwenlan, Courtoy_____

New and upcoming results @JLab

- Updated inclusive electron measurement at CLAS12

  Klimenko

- Studying charge asymmetry violations
  from measurement of pi+/pi- in SIDIS at Hall-C

  Armstrong

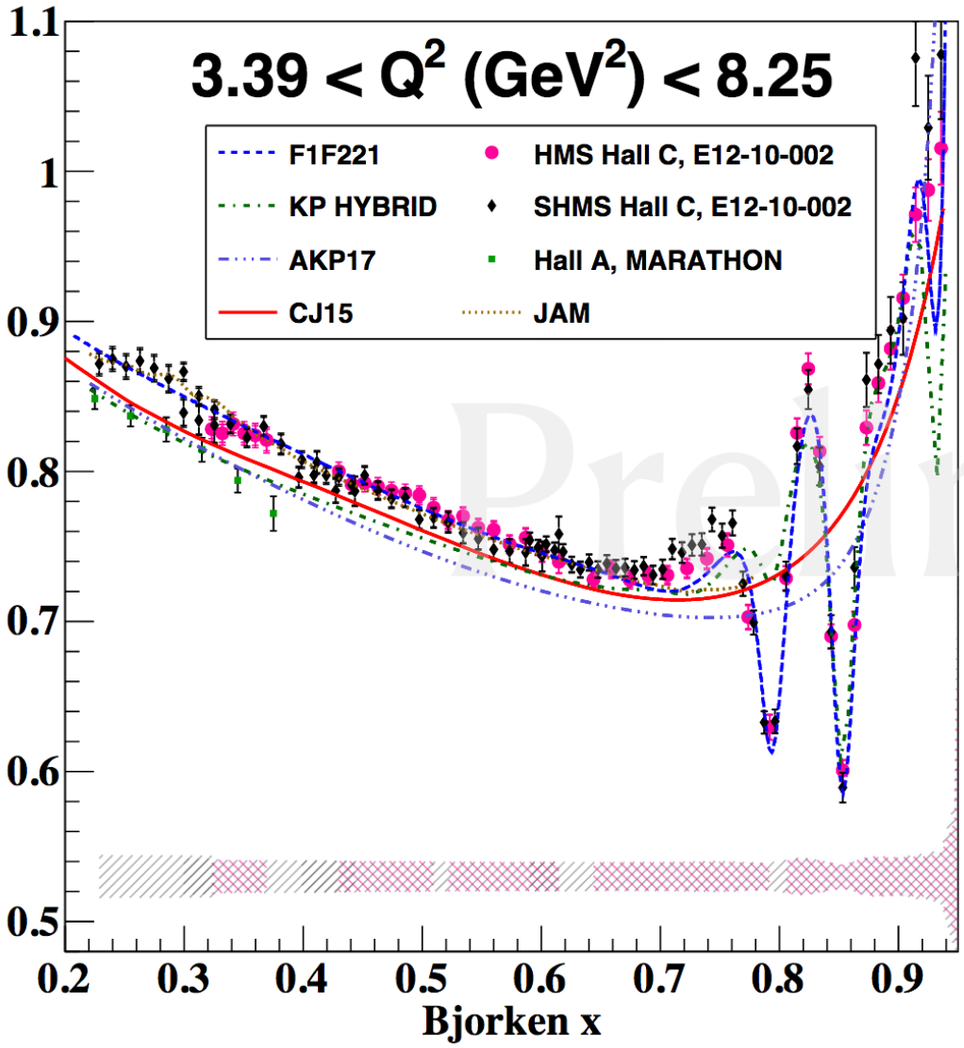
- F2p and F2d at large-x from E12-10-002

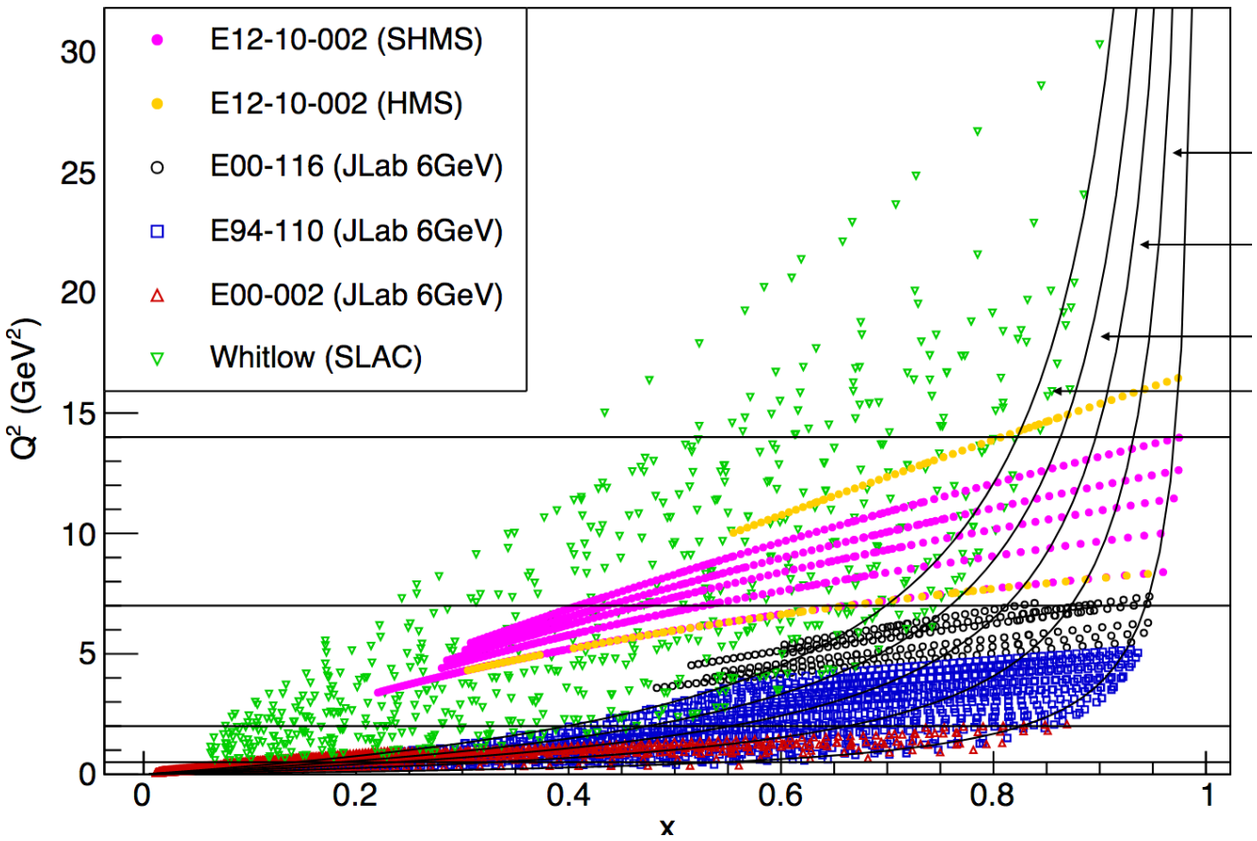
  Biswas

- Flavor dependence of nuclear PDFs and EMC effect
  from PVDIS on neutron-rich target 48Ca

  Beminiwattha

Testing local quark-hadron duality





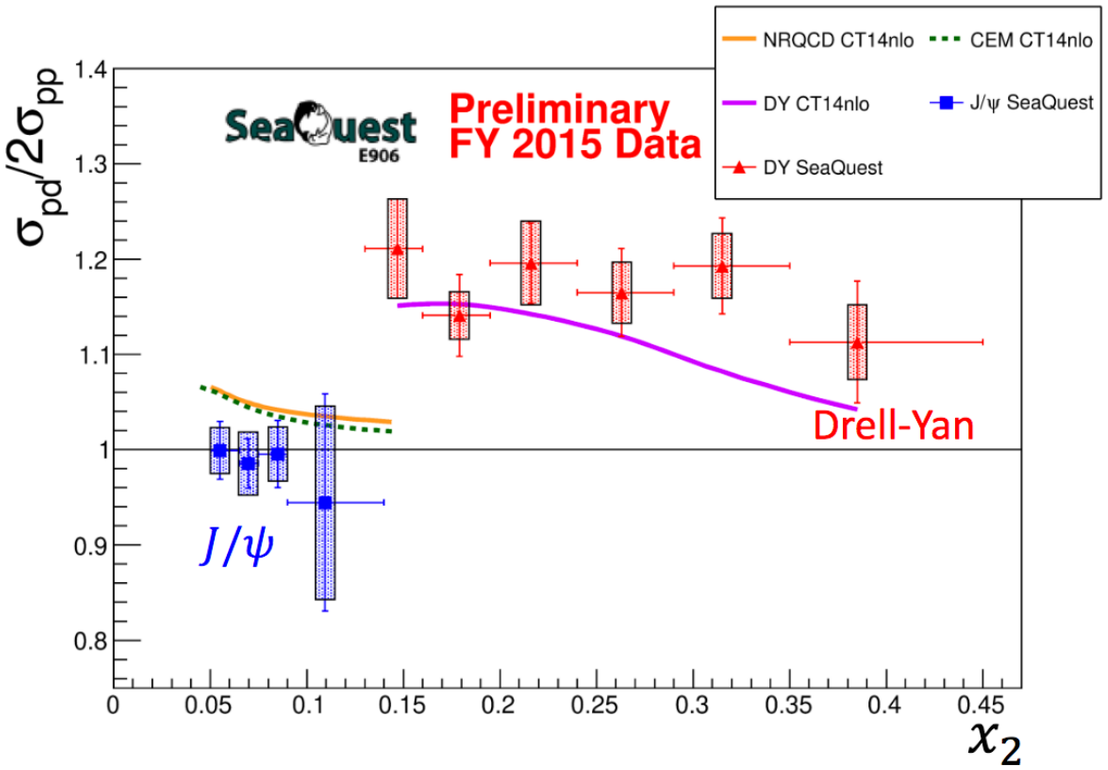
- New measurement from Hall-C at JLab extending to the resonances region

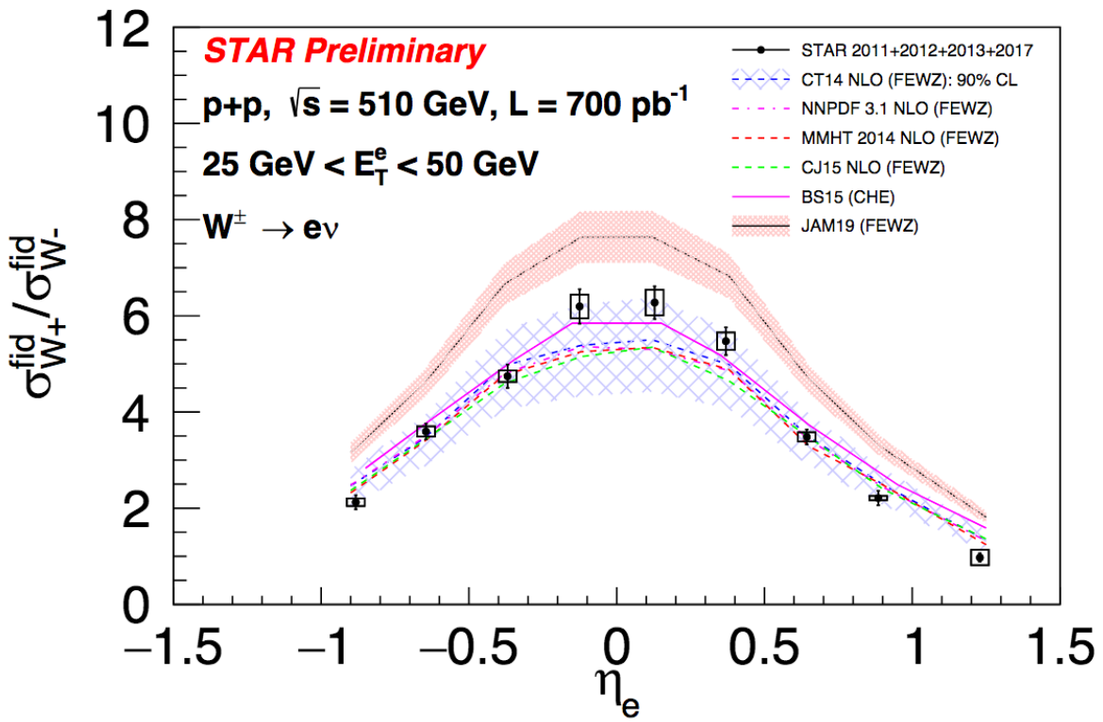
Biswas

New constraints at large-x

- Drell-Yan and charmonium production at SeaQuest

Leung





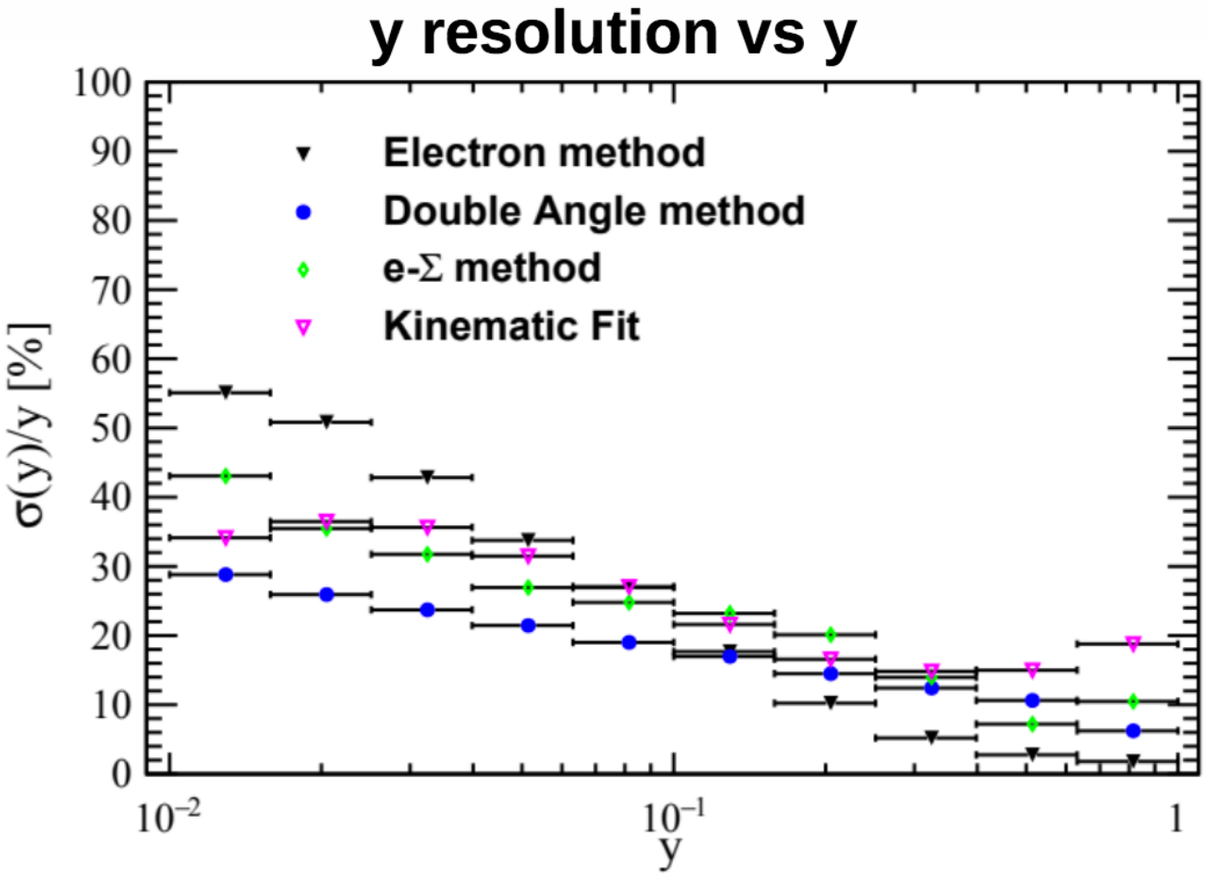
- Updated W+/W- cross-sections at STAR

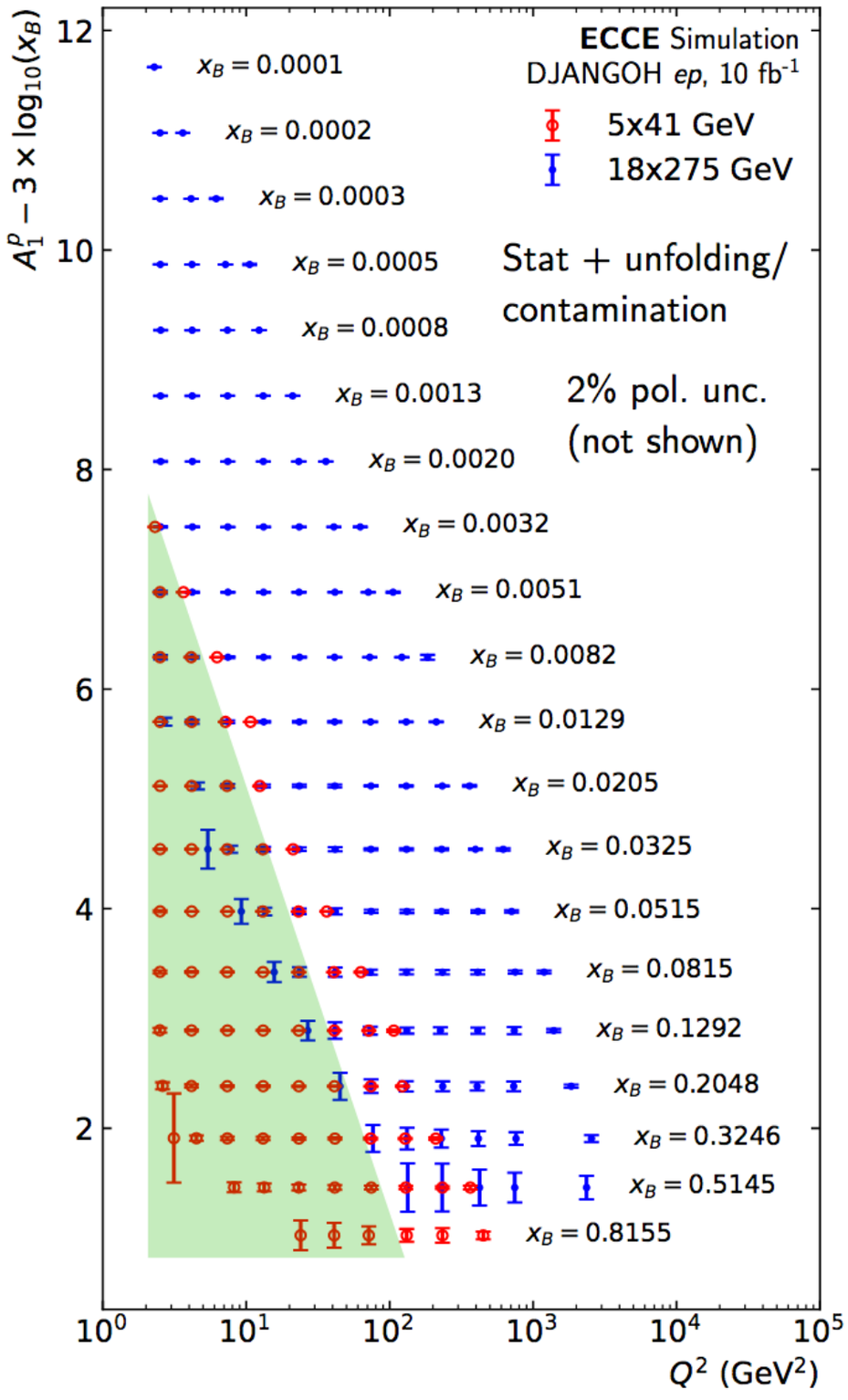
Nam

Gearing up for the EIC

- Inclusive physics at the EIC

Kutz





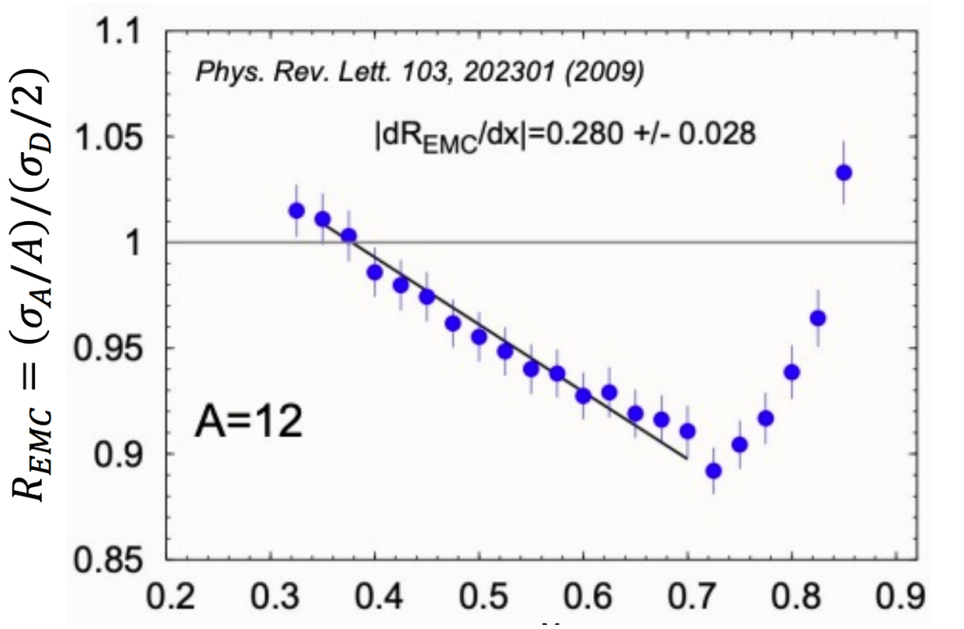
- Kinematic fitting for NC-DIS at EIC

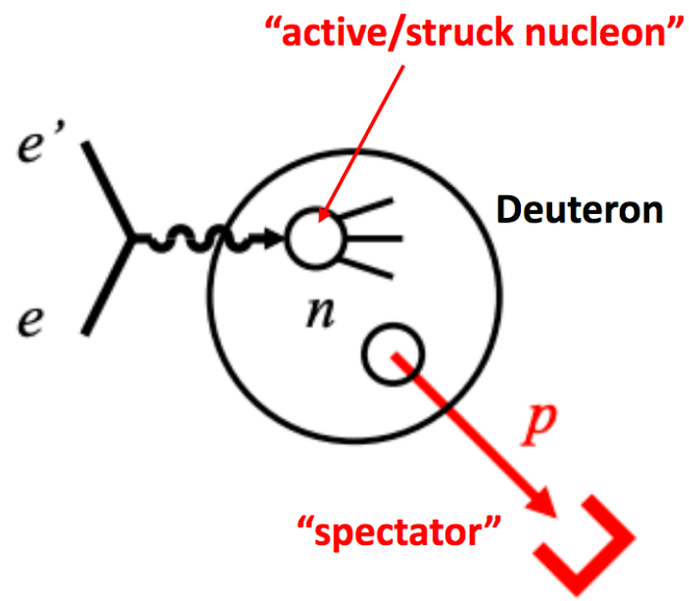
Maple

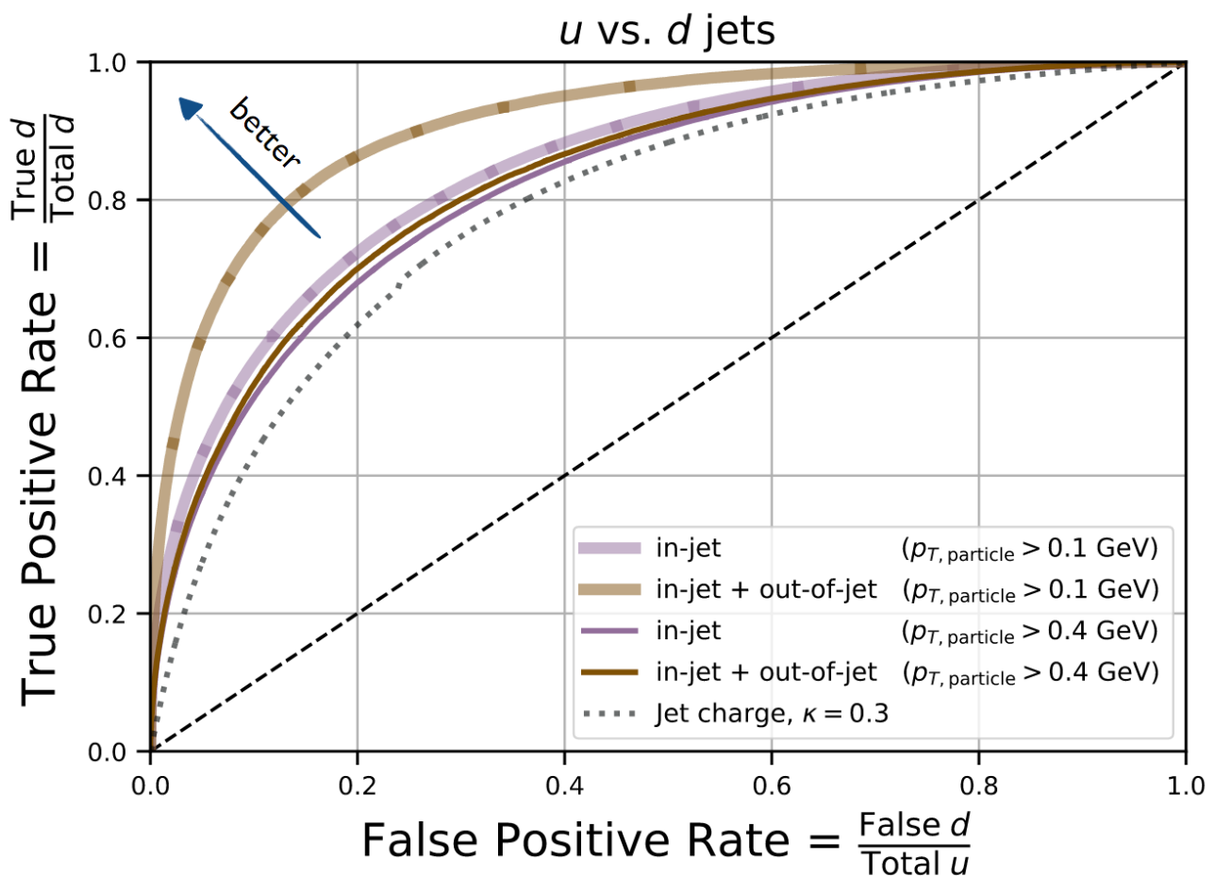
Gearing up for the EIC

- Tagged DIS to probe the EMC effect at the EIC

Jentsch







- Machine Learning for jet flavour tagging

Ringer

Global analyses

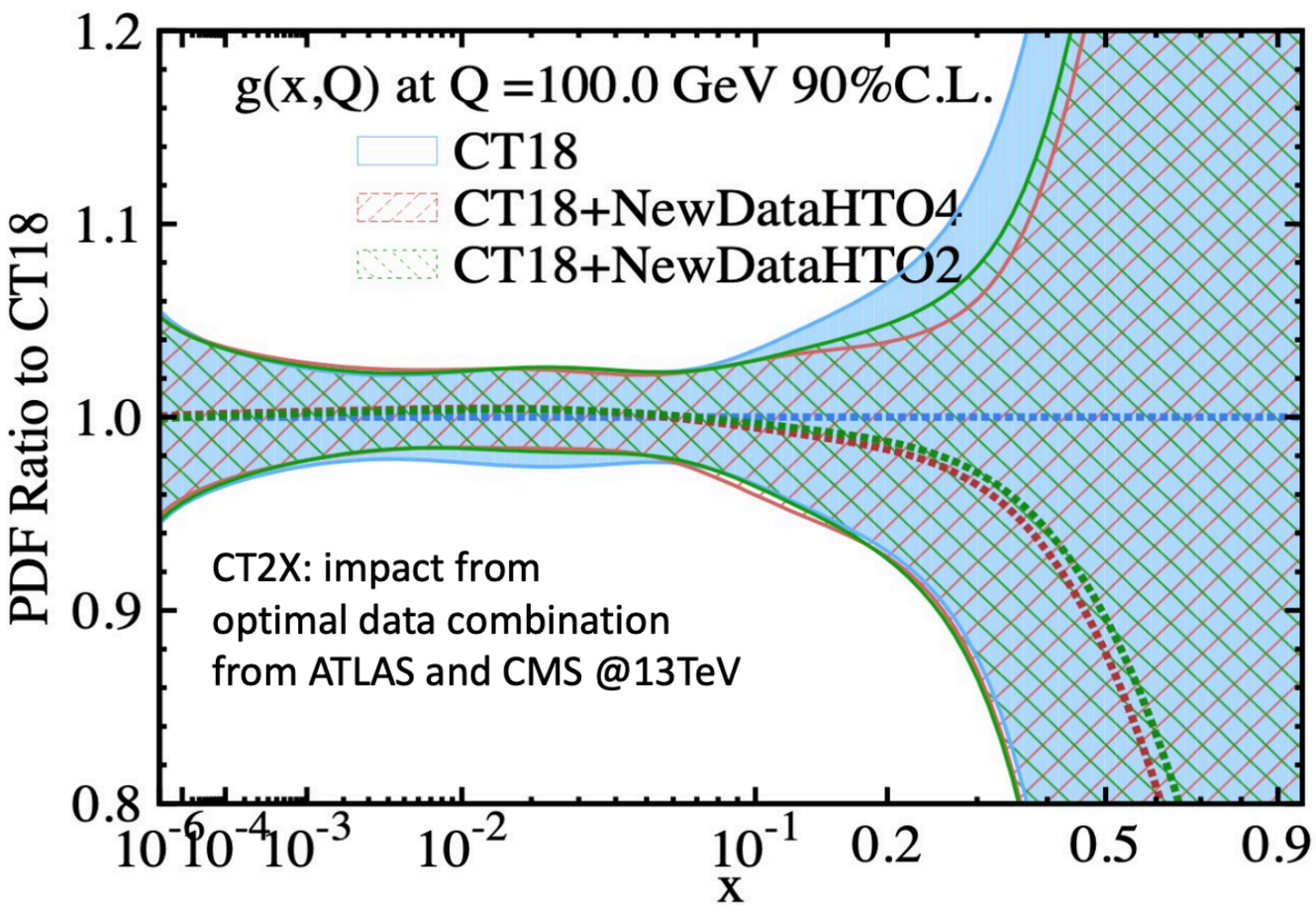
MSHT, NNPDF and CT moving toward next generation fits

- N3LO,
- inclusion of LHC data (top-quark pair, jet + dijet, DY),
- methodology improvements.

Harland-Lang

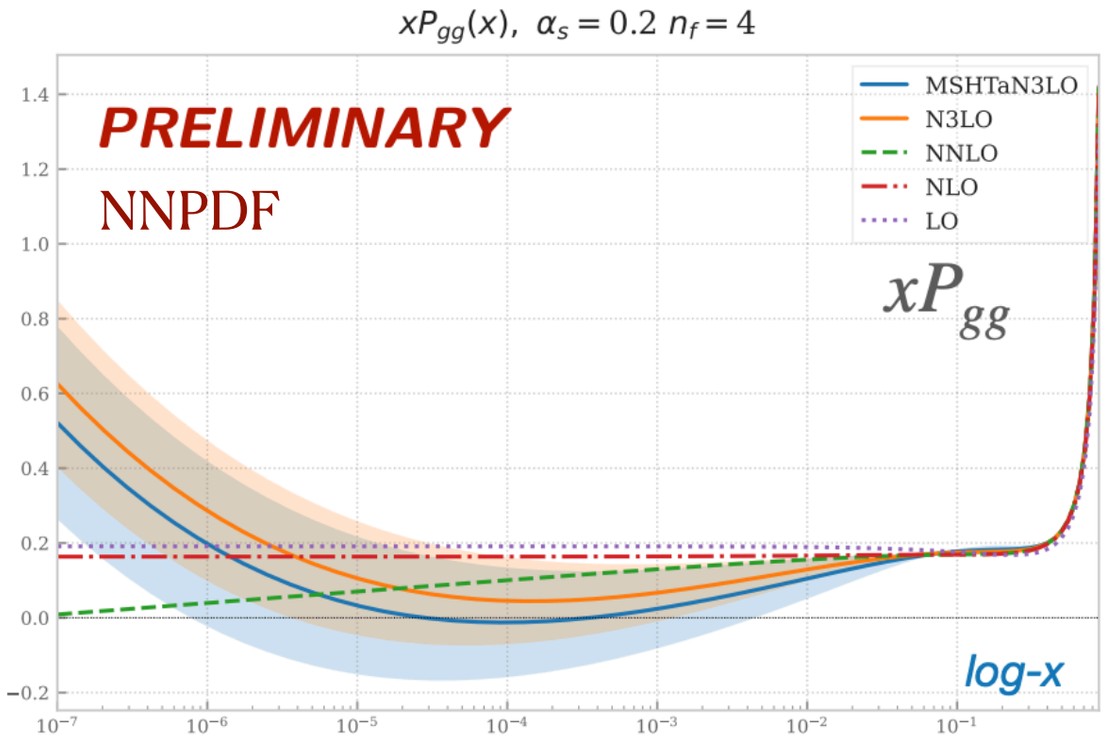
Guzzi, Nadolsky

Magni, Rabemananjara



Toward N3LO

- theory developments to reach N3LO in phenomenology



Cridge

Magni

- role of scale dependence, small-x corrections to DGLAP

Duwentäster, Magni, Nadolsky+WG2

- splitting functions, Wilson coefficients, renormalization

Pelloni, Schönwald, Yang +WG4

Global analyses — physics interpretation

- no evidence for fitted charm in CT analysis

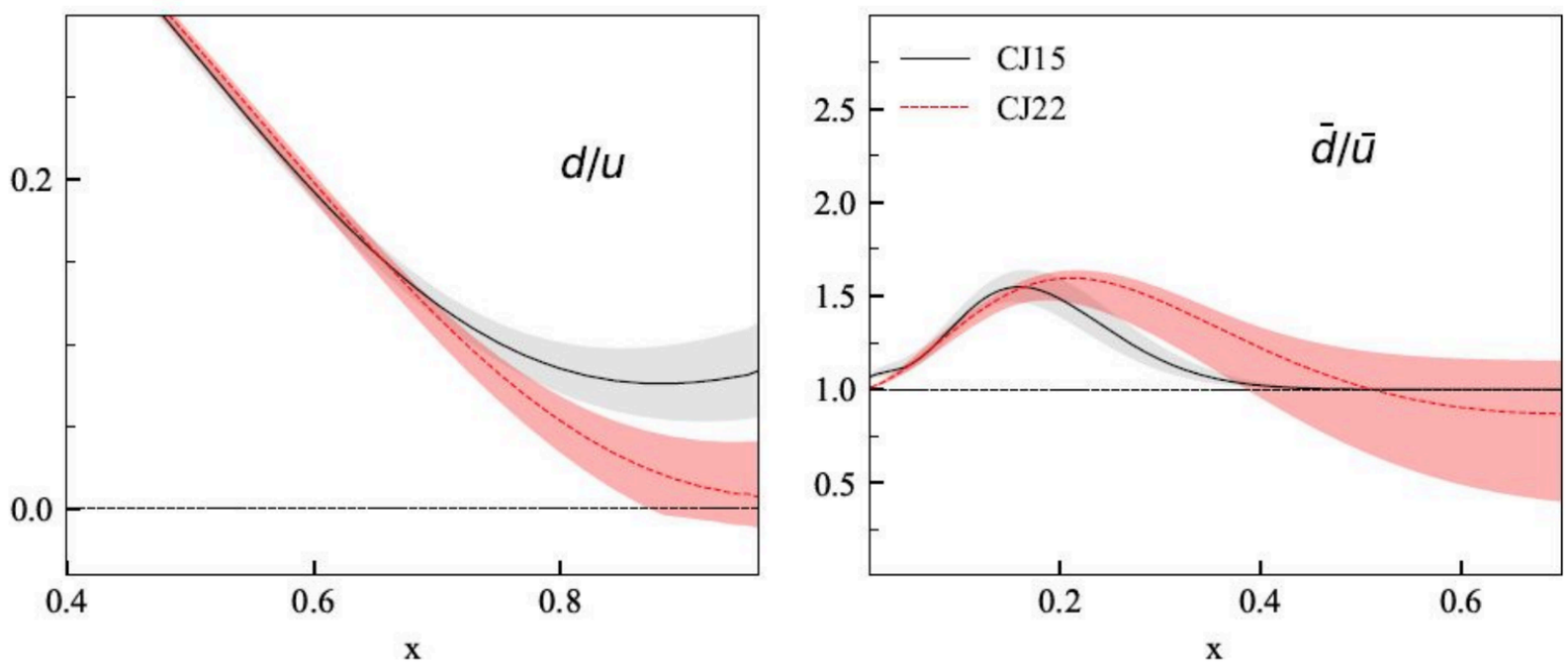
Hobbs

- large-x, high-Q^2 data from Zeus

Verbytskyi

- frontier with non-perturbative regime: new CJ22 result

Accardi



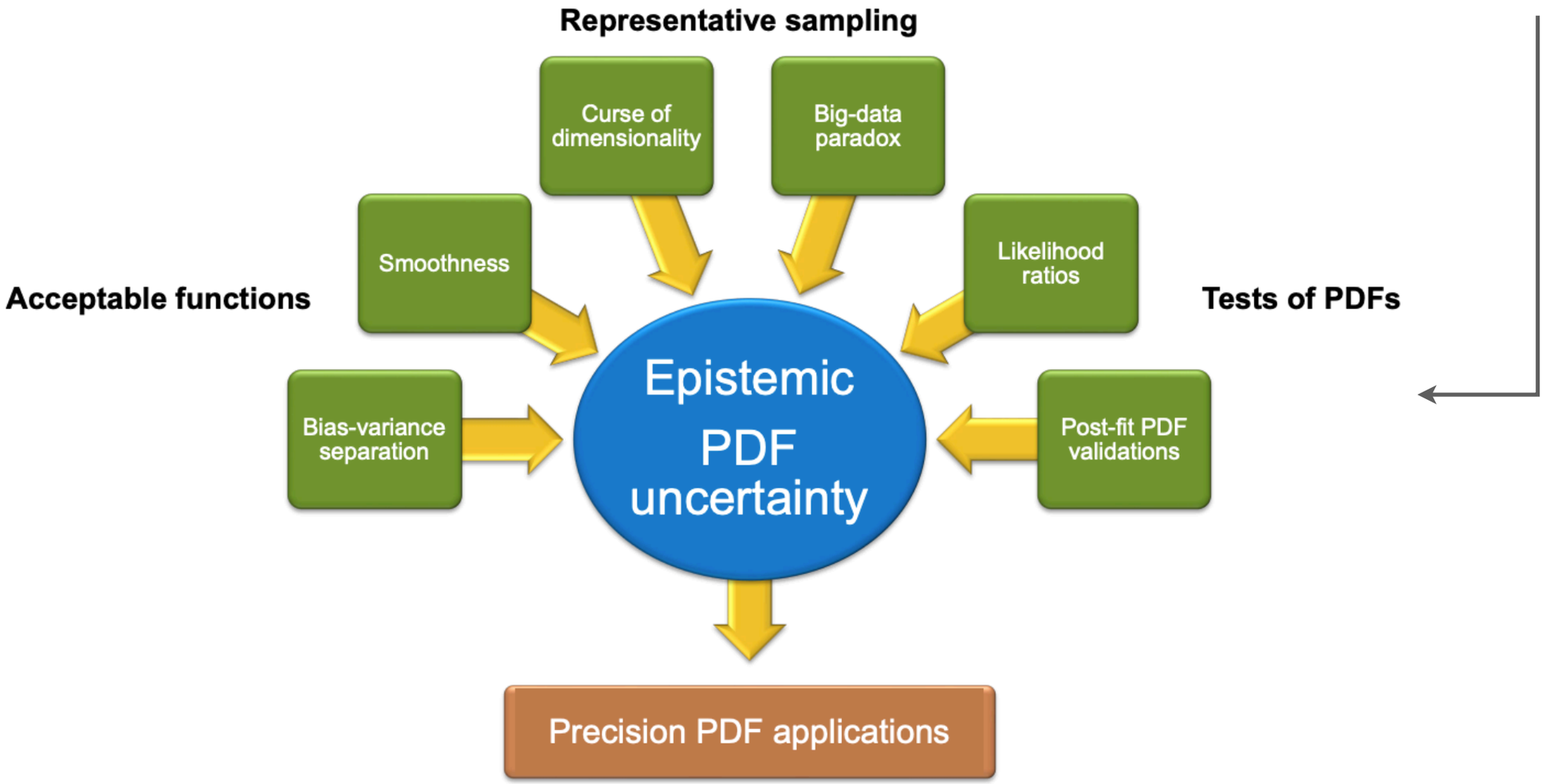
Emergent and urgent: uncertainty quantification

- Aleatoric uncertainties vs. methodologies

Accardi

- Epistemic uncertainties for reliable PDF uncertainties

Nadolsky



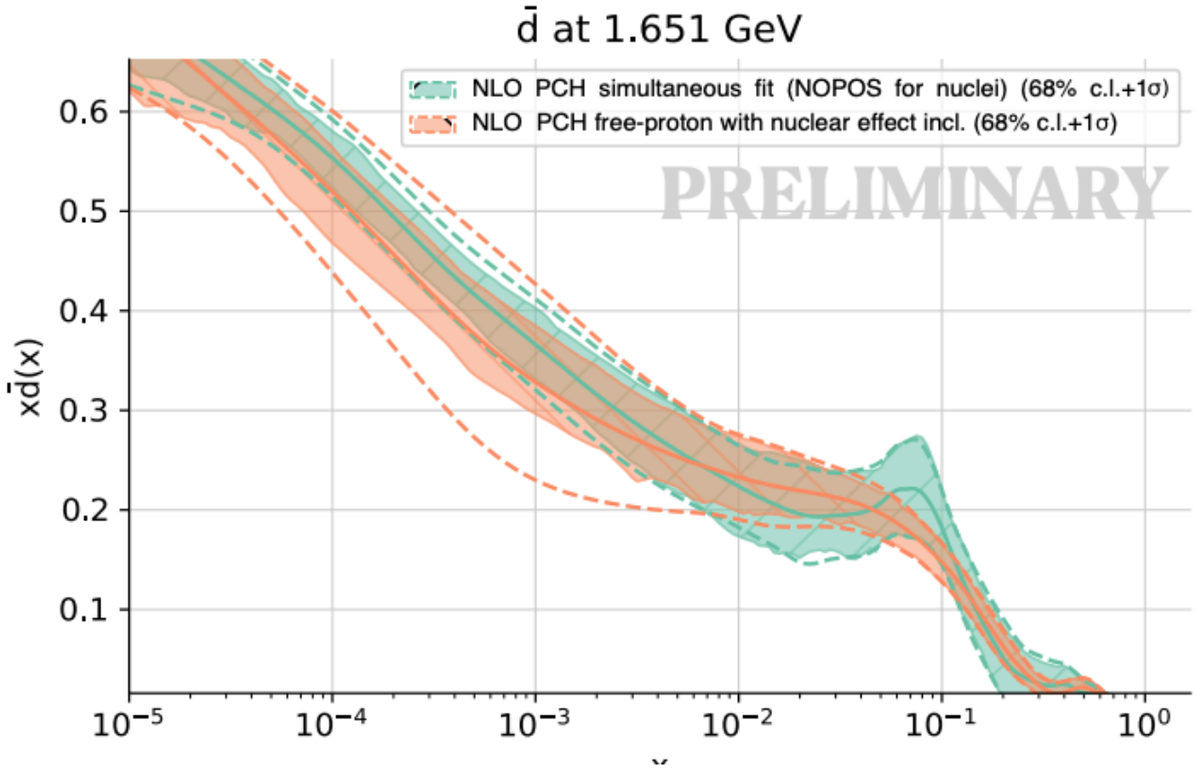
Nuclear PDF

- nCTEQ — new constraints at low and large Q^2

Risse

- nNNPDF — integrate A dependence in nuclear fits ($A = 1$ baseline)

Rabemananjara



Nuclear effects

- Offshellness effects — analysis of JLab MARATHON data

Petti

- Target Mass Correction in nuclear language [review 2301.07715]

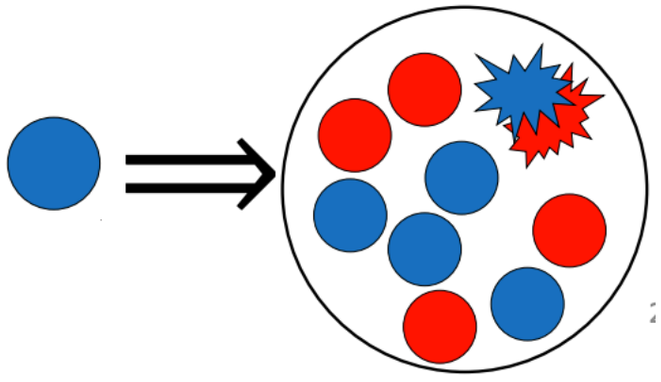
Schienbein

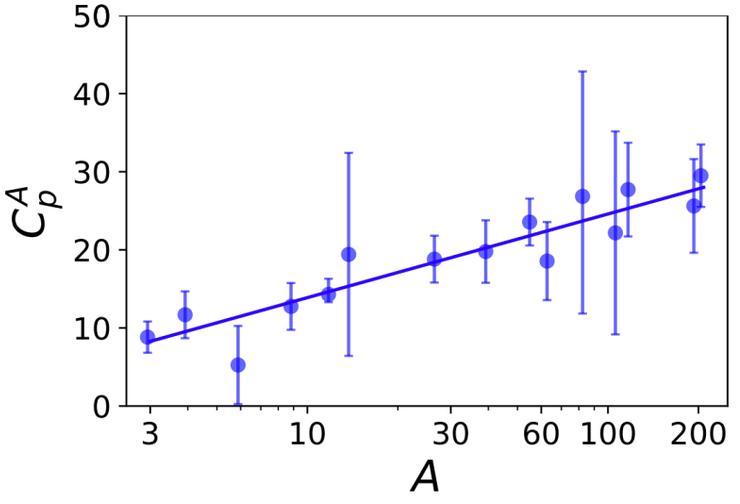
- Trying to understand the EMC effect

Denniston

Liuti

Short Range Correlations incorporated in
Deep Inelastic description for nuclei



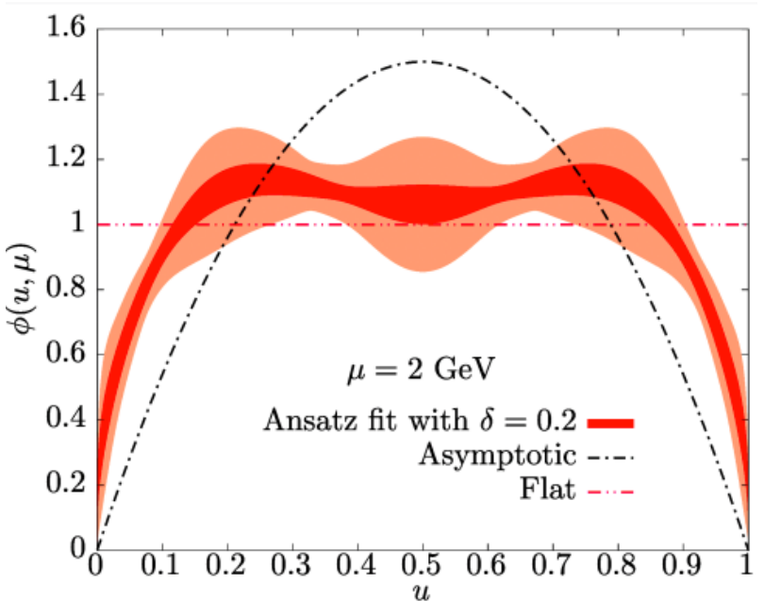


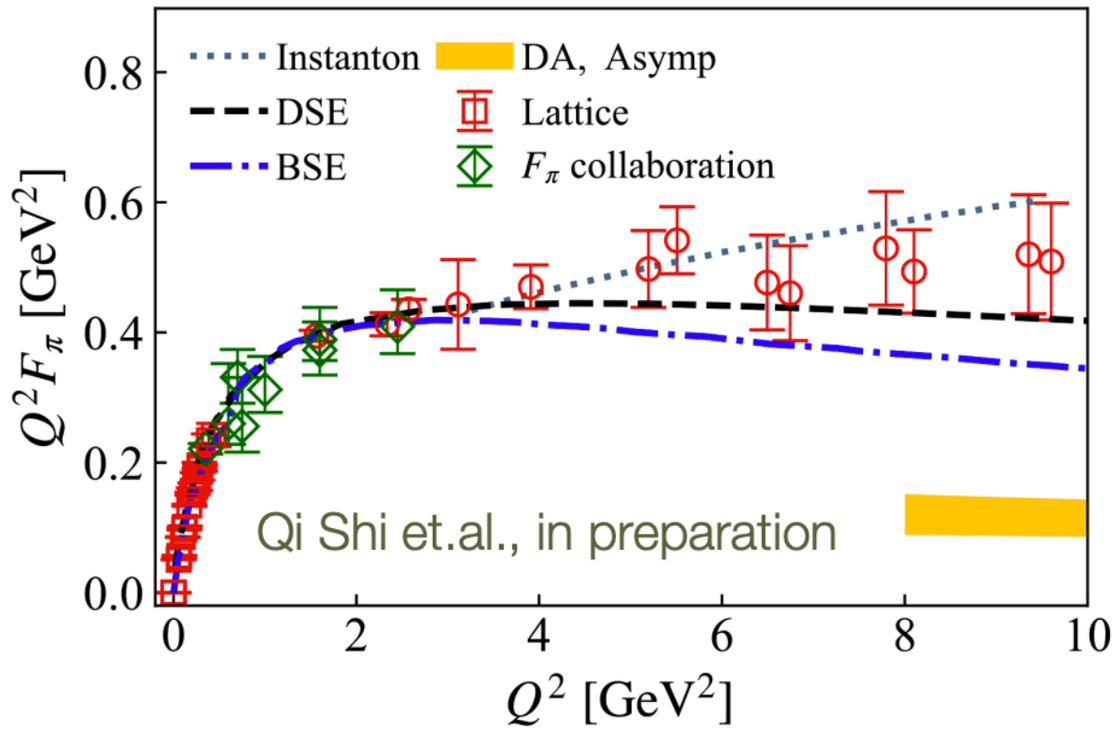
Pion observables

- Pion PDF in *global* analyses — scattered between WG1, WG5 and WG6

Kotz, *Barry, Venturini*

- Probe of non-perturbative manifestations of QCD on the lattice —exclusive processes





S. Mukherjee

- Pion PDF on the lattice — the inverse problem

Hanlon

Lattice

Toward proton distribution functions

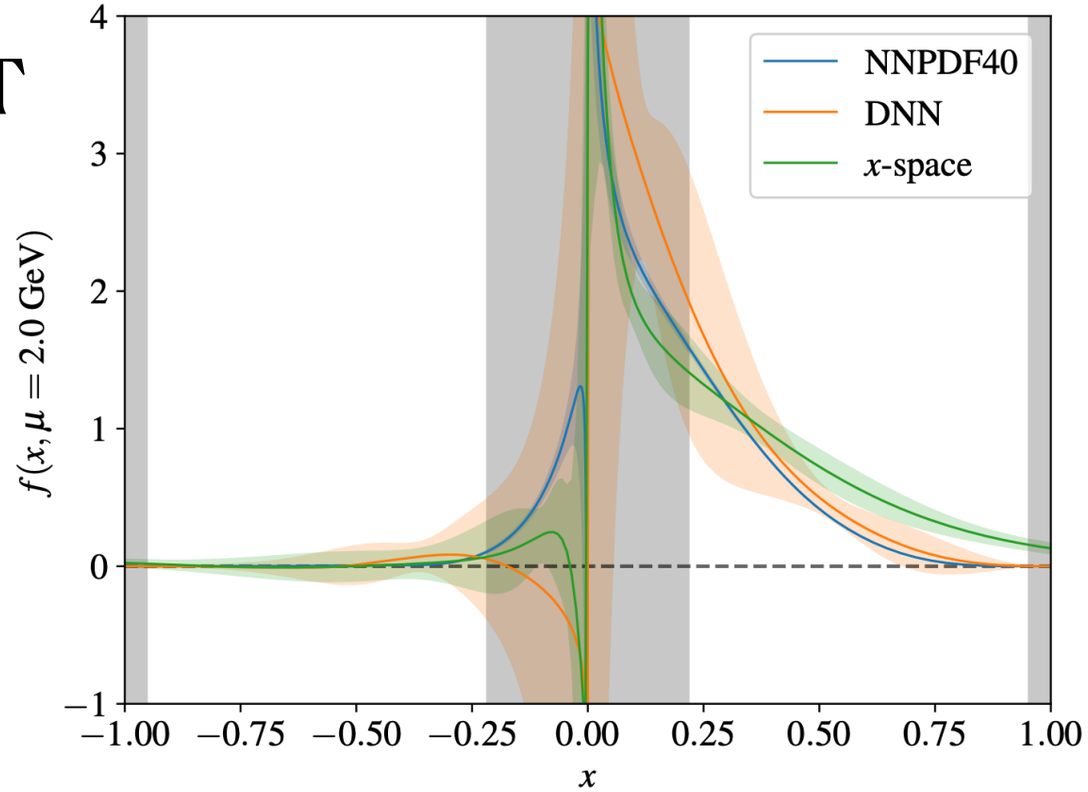
- access to Mellin moments

Can, Rodekamp

- gluon PDF in Reduced Pseudo Ioffe Time Distribution (RpITD)

Good

- comparison of LaMET and RpITD matching



Hanlon, Holligan

Toward inclusive processes with real-time computation

Briceño

Global-analyses tools

- xFitter developments — open access fitting code

  Giuli

- PartonDensity with Bayesian approach in Julia

  Verbytskyi

- Fantômas4QCD module — Bézier-curve parametrization

  Kotz

- Gaussian Mixture Model — uncertainty quantification

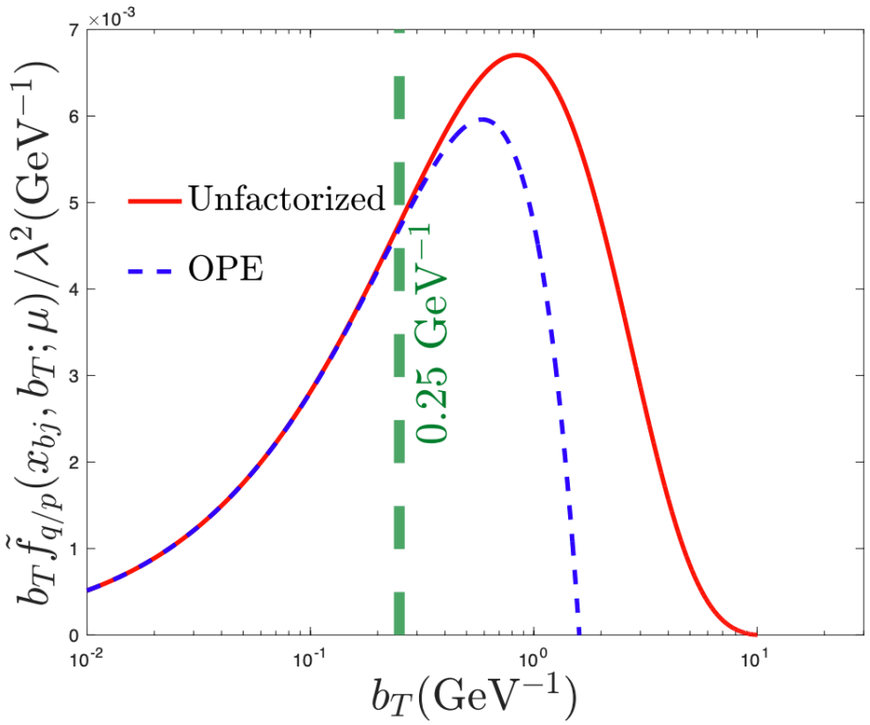
  Mohan

- Inclusion of lattice data for less constrained flavors — strangeness

  Hou (plenary)

Factorization and related

- Factorization in Yukawa theory as a sandbox for QCD studies



Rainaldi

- QED effects in SIDS

Cammarrota

- Mini-global parton-branching TMD fits

Wichmann

- Observables expressed in terms of structure functions

Tevio

Conclusions

Lively and productive working group.

The community is heading toward a more precise theoretical framework (N3LO) for PDF extraction.

2 sessions on precision theory and phenomenology
+ 1 global analyses session.

The assessment of reliable uncertainties becomes crucial to attain our goals.

1 session on uncertainty quantification.

Incorporation of low-energy and nuclear data focuses on QCD in its non-perturbative regime.

1 session on nuclear effects
+ 1 session on nuclear PDFs
+ 1 joint session on nuclear effects at the EIC.