

Roadmap towards TDR (physics performance) and the INFN involvement

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Structure of Physics Working Groups

ANALYSIS COORDINATORS

Salvatore Fazio (Cosenza)
Rosi Reed (Lehigh)

INCLUSIVE PHYSICS

Tyler Kutz (MIT)
Claire Gwenlan (Oxford)

SEMI-INCLUSIVE PHYSICS

Charlotte Van Hulse (Alcala)
Stefan Diehl (UConn)

JETS AND HEAVY FLAVOR

Brian Page (BNL)
Olga Evdokimov (UIC)

EXCLUSIVE, DIFFRACTION AND TAGGING

Raphael Dupre (Orsay)
Rachel Montgomery (Glasgow)

BSM AND PRECISION EW

Ciprian Gal (JLab)
Michael Nycz (Virginia)

- Each PWG convener is for a two-years term
 - Rotations in each PWG are staggered every year
- Conveners in blue are ending their term after Lehigh meeting

Meeting time: Mondays (biweekly) at 12pm ET
Mailing list: eic-projdet-Inclusive-I@lists.bnl.gov
Indico: <https://indico.bnl.gov/category/417/>

Meeting time: Tuesdays (biweekly) at 8:30am ET
Mailing list: eic-projdet-semiincl-I@lists.bnl.gov
Indico: <https://indico.bnl.gov/category/418/>

Meeting time: Wednesdays (biweekly) at 12:00pm ET
Mailing list: eic-projdet-jethf-I@lists.bnl.gov
Indico: <https://indico.bnl.gov/category/420/>

Meeting time: Mondays (biweekly) at 12pm ET
Mailing list: eic-projdet-excldiff-I@lists.bnl.gov
Indico: <https://indico.bnl.gov/category/419/>

Meeting time: Tuesdays (biweekly) at 8:30am ET (together with Inclusive PWG)
Mailing list: eic-projdet-semiincl-I@lists.bnl.gov
Indico: <https://indico.bnl.gov/category/421/>

TDR structuring & companion papers

pre-TDR (60% design completion) \Rightarrow early 2025

TDR (90% design completion) \Rightarrow ~ early 2026

- (pre)TDR are a **deliverable of the EIC Project** (project manager acts as editor)
 - describe the accelerator + **ePIC experiment**
 - **Chapter 8:** (hundreds pages) focus on the ePIC Detector Description, basic performance, Software, and data preservation
 - **Chapter 2:** (~60 pager) focus on holistic detector performance, physics performance and science reach
 - Holistic detector performance \rightarrow Technical Coordinator office acts as editor
 - Physics and science reach \rightarrow Analysis Coordinators act as editors
 - We envision a **couple of performance plots per PWG**

ePIC Physics “White Paper”

Delivered by ~ (early?) 2026 aligned with the final TDR

- The Physics WP is a **deliverable of the ePIC Collaboration**
- To be published on a scientific peer-reviewed journal (such as PRC or similar)
 - **Extended description** of the physics performance and science reach at ePIC
 - Holistic detector performance → Technical Coordinator office acts as editor
 - Physics and science reach → Analysis Coordinators act as editors
 - **Gives full details** on physics studies and performance plots
 - **Includes physics impact studies** (extraction of physics, e.g. PDFs, GPDs, TMDs)
- Authorship regulated by ePIC membership and publication policies
- ❖ Spin-off papers can also be published by individual study groups (**theorists included**)



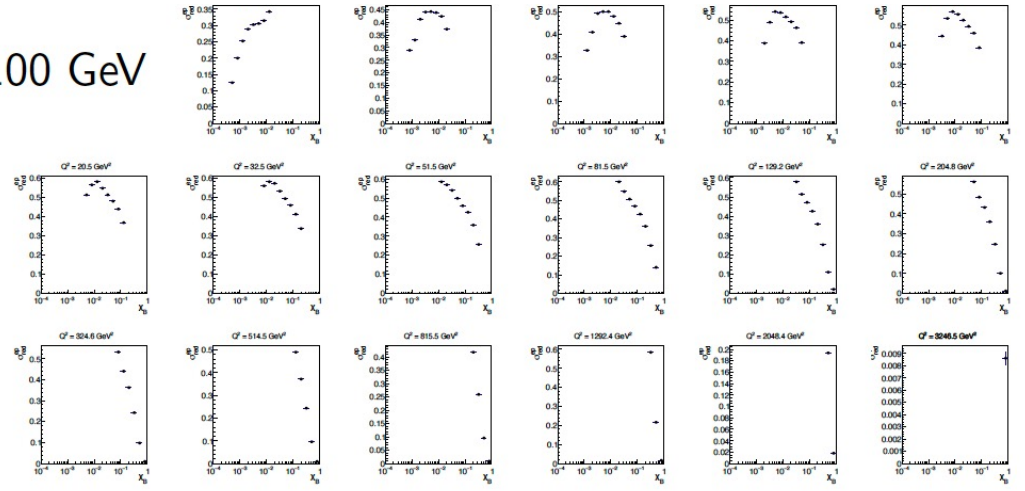
Progress on pre-TDR plots – Inclusive PWG

- Inclusive NC cross sections (Tyler)
 - Acceptance-corrected cross sections complete
 - Need more work on systematics
- Double-spin asymmetries (Win, SBU)
 - Starting with ep asymmetry (hope to have update at next inclusive meeting)
 - Looking into generating eHe3 events with Pythia8
- Inclusive CC cross sections (no one currently active)

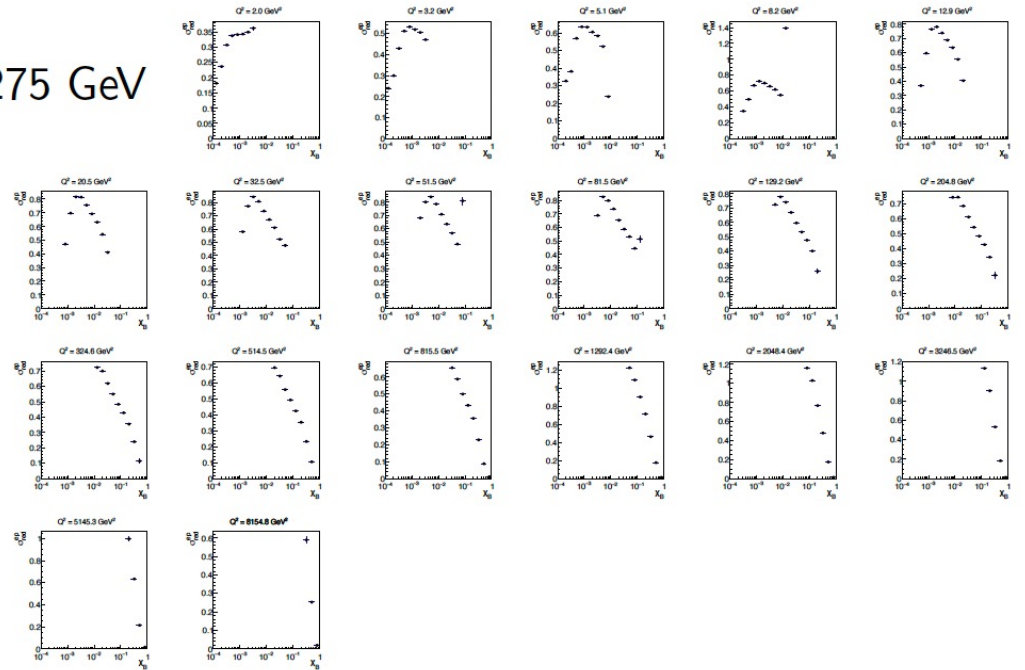
Caveats to all of the above:

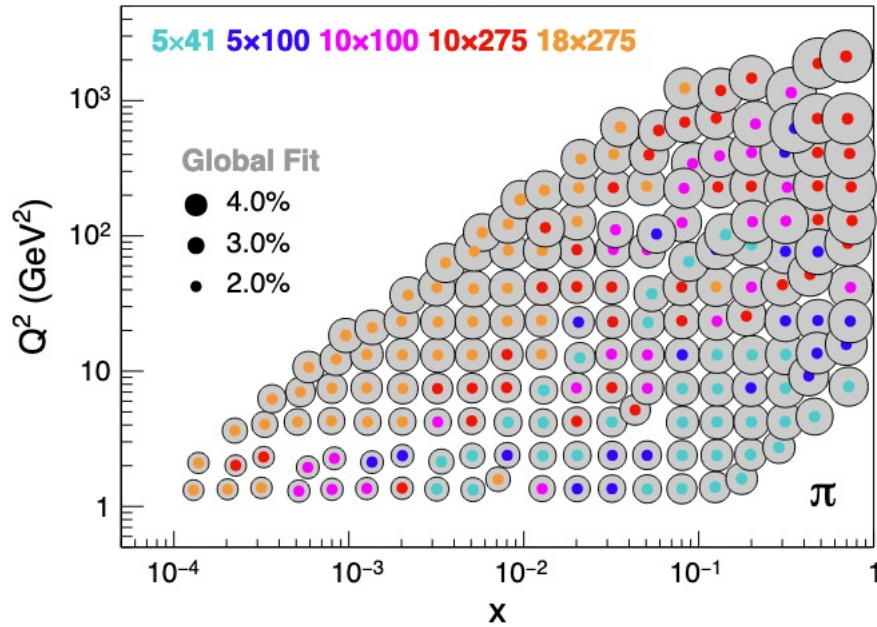
- Electron ID from truth information
- Kinematic reconstruction strictly from electron track

10x100 GeV

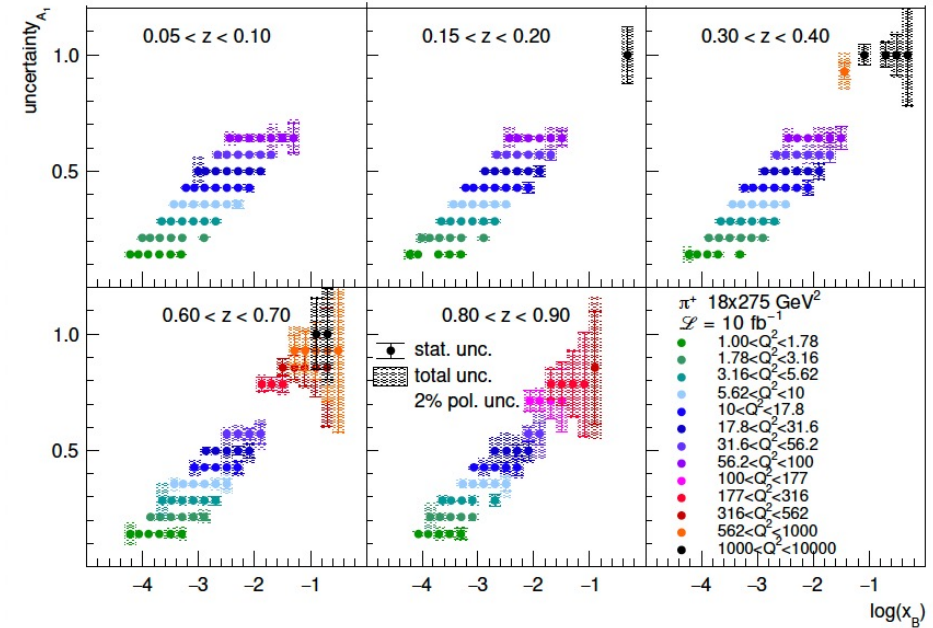


18x275 GeV





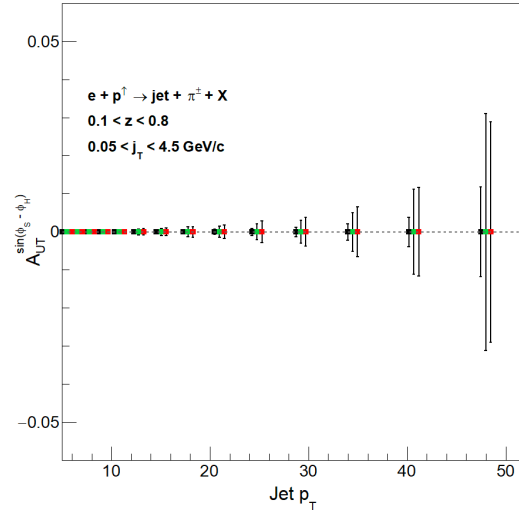
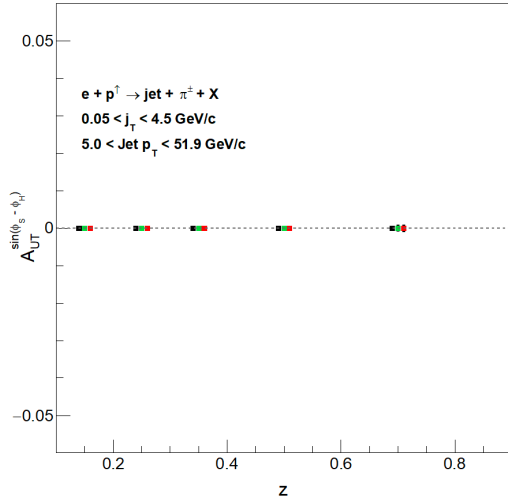
Unpolarised TMDs



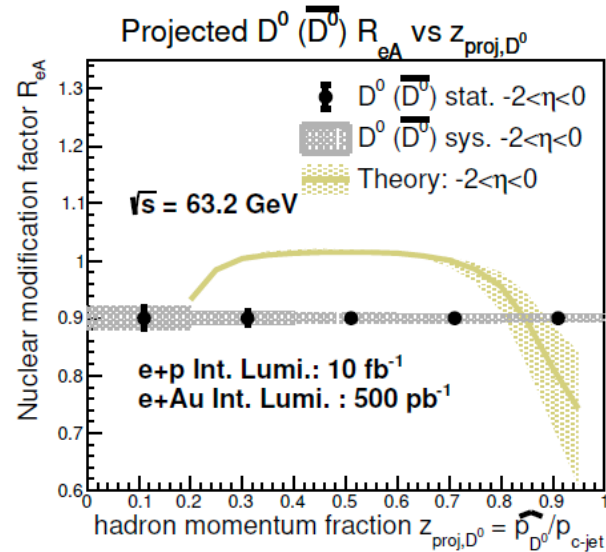
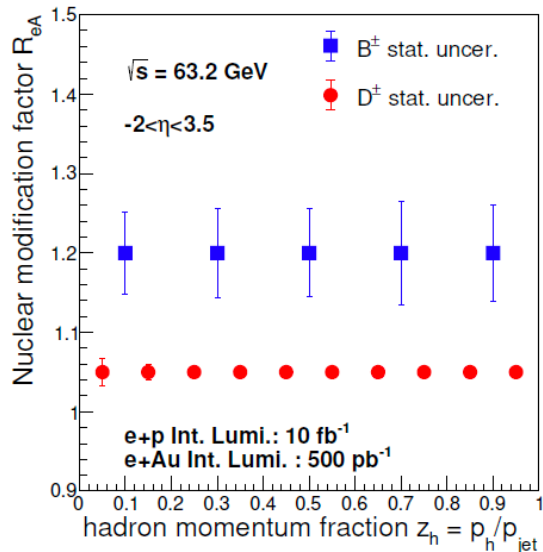
A_{LL} to access helicity PDFs

- Foreseen deadline for above two plots: end of June
- Maybe also asymmetries for transversely polarised beam, to be confirmed later

Progress on pre-TDR plots – **Jets+HF PWG**



- Work on **Hadron-in-Jet TDR plots** progressing
 - Added appropriate cut on electron-jet momentum imbalance
 - Working on combining Q^2 bins
 - Need realistic electron handling



- Projections for **Hadron-in-Jet nuclear modification factor, R_{eAu}**
 - Still in a standalone simulation with performance projections
 - Have some developments in full reco (Diptanil, Tanmay); not quite on a mass-shell yet

What we need to succeed

○ Performance plots

- Analysis of simulated events to show detector capability of measuring a certain process and observable
- Analysis tutorials set in place: <https://eic.github.io/documentation/landingpage.html>

○ Analysis tools

- Many reconstruction tools at embryo stage (e.g., electron finder, particle ID) or still not ready (e.g., secondary vertexing)
- Work with Software & Computing group - requires strong coding background

○ Work force is crucial!

- We are in the process of matrixing in people and tasks/analyses
- Opportunity for new/emerging Institutions with students/postdocs available
 - impact on TDR (current ePIC's topmost priority) and on a large scientific publication

How can we help?

- Opportunity for M.Sc. and Ph.D. students -> **make plots out of reconstructed root trees**
- Opportunity for experienced Ph.D.s and postdocs
 - **Holistic detector performance**
 - **join efforts with reconstruction**
 - **impact studies for the enlarged physics paper**
- Italy has some potential to exploit (and help with the TDR cause):
 - diffractive PDFs for studying the transition into saturation
 - observables related to TMDs
 - observables related to GPDs (e.g. TCS is currently an open task)
 - computing -> via OSC
- **New Workforce being gathered**
 - We are matching Institutions (and each of their students) to proposed tasks

Exclusive Physics: Cosenza (S. Fazio) - Milestone y23

- Use the novel E_{pIC} generator [[Eur. Phys. J. C 82 \(2022\) 9, 819](#)] to produce DVCS, TCS and mesons pseudodata
- Extract GPDs by performing global NLO fits of various models in order to quantify the impact of ePIC in constraining CFFs and GPDs, from DVCS and TCS measurements -> [paper in final editing stage](#)

SIDIS Physics:

- **Bologna (L. Polizzi, F. Bellini)**: investigate the need for PID in the different kinematic regions (*see Lorenzo Polizzi's talk*)
- **Pavia (S. Costanza + postdoc)**: quantify the impact of the acceptance on the extraction of TMDs.

Inclusive Physics:

- **Torino (M. Ruspa) - Cosenza (H. Hashamipour, M. Capua, S. Fazio, E. Tassi)**: extraction of diffractive PDFs in protons and nuclei a probe for gluon saturation

Heavy flavor Physics:

- **Bari (S. Kumar, A. Mastropietro)**: impact for the tracker into heavy flavor physics (*see Shyam Kumar's talk*)
- **Pavia (G. Boca)**: vertexing for heavy flavor tagging

Interest from other groups: Salerno (Annalisa De Caro), LNS (Dario Lattuada)



Wrapping up...

- pre-TDR + physics paper: plots are being produced; studies are being performed
- INFN involvement: still at an initial stage but fast growing
- **HOW do I join a PWG?**
 - step 1: email the conveners of your favorite PWG and subscribe the mailing list!
 - step 2: join the (bi)weekly meetings
 - step 3: actively engage in studies and efforts



WE WANT YOU