



Introduction from PACs

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Physics Readiness Workshop (2nd Edition)
17th March 2026, University of Calabria, Italy

Some shared notes for this week's workshop

[Link to Shared Notes](#)

Can use for notes, comments, extra questions, or to-dos during discussion session - anyone feel free to edit

Put link on indico page too

ESR Roadmap - Currently top priority in PWGs

- April 2025 - ES workshop at CFNS/SBU
- June 2025 - receive charge from David Dean, Abhay Deshpande to write ESR, due May 1st 2026
- “ ... *the ePIC collaboration should summarize for the broader nuclear physics community, the funding agencies, and for the Labs, what exciting scientific results would be possible from this period (ramp-up during early operating phase) ... Beyond the physics of interest, we think that this ePIC early physics document would also be useful to demonstrate the collaboration’s engagement and getting prepared for physics at the EIC and capture the status of ePIC collaboration’s activities at this stage ..* ”
- Sept 2025 - Physics Readiness Workshop London, for preTDR and ESR
- Dec 2025 - preTDR submission and main priority in PWGs swapped to ESR
- Jan 2026 - Readiness Workfest at ePIC Collaboration Meeting, BNL
- Jan-Feb 2026 - coordination of March simulation campaign for ESR
- March 6th 2026 - first draft of ESR to reviewers and uploaded to Zenedo
- **March 17-19** – Calabria workshop. Expect **first feedback** from reviewers and collaboration

- Next - re-draft, implement feedback, update plots with March simulations
- **April 13 - second draft** to reviewers and ePIC collaboration (for inputs/comments)
- Implement feedback
- **May 1 - final deadline for polished ESR**
- **Re-focus priority to TDR, develop publications**
- **Later in year ~ July-September** - submit **papers** to **NIM A special edition (next slide)**

Nim A Special Issue

- Will be discussed more on Thursday at 12:30 pm
- Brief outline of recent plans here
- **Later in year ~ July-September** - submit papers to **NIM A special edition**
- Plans:
 - Physics performance paper -> spin off from TDR ch.4
 - Scientific impact of EIC early running -> spin off from ESR main document
 - ES with Inclusive processes -> spin off from ESR appendix A
 - ES with SIDIS processes -> spin off from ESR appendix B
 - ES with Exclusive and Diffractive processes -> spin off from ESR appendix C
 - ES with Jets and HF -> spin off from ESR appendix D
 - Opportunities for BSM & EW with a full scope EIC

ESR First Draft – big team effort

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|---|----|
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Link on [zenedo](#) and [workshop indico](#)

Current Structure:

- main report w/ highlights
- PWG appendices w/ more detailed studies and more results

- Editing Team and main document: S. Fazio, C. Munoz Camacho, R. Montgomery, R. Reed
- Thank you to Carlos for joining efforts
- Thank you to PWGs & PWG convenors who put together the appendices, using all the input and materials from the principal analysers
- PWG convenors for ESR: S. Maple; W. Lin; R. Seidl; A. Vossen; R. Ma; S. Kumar; S. Kay; K. Tu
- Thank you to software and computing for simulation productions and coordination

ESR First Draft

- We are still very much in the drafting stage of this report!
- We have circulated our **very preliminary first draft** to reviewers, and participants of this workshop and we are holding this workshop to get feedback on the **direction** the document is taking
- We are not looking for specific line by line comments at this stage but more advice on the direction, content, structure, physics studies (are any missing?), impact plots, accessibility for non experts... etc
- We want to take your feedback on board to shape the direction of the document as we work through it, because the timeline is very tight and we don't want to stray too long in the wrong direction
- Nb we also do not have all ESR simulation files yet to analyse

ESR First Draft - main report

- Introduction - discuss aim of report and context
- NAS Science Pillars and physics processes
 - Re-state science questions from NAS report
 - How does mass of nucleon arise?
 - How does spin of nucleon arise?
 - What are the emergent properties of dense systems of gluons?
 - give links between pillars and example channels at EIC
 - give links between pillars and PWG appendices
- Early Physics Running Conditions - table of current configurations and description
- PWG-themed sections (inclusive, sidis, EDT, jets/hf)
- Conclusions - results highlighted in previous sections linked back to NAS pillars

ESR First Draft - main report

This is the table of configurations we used at the moment in current ESR draft

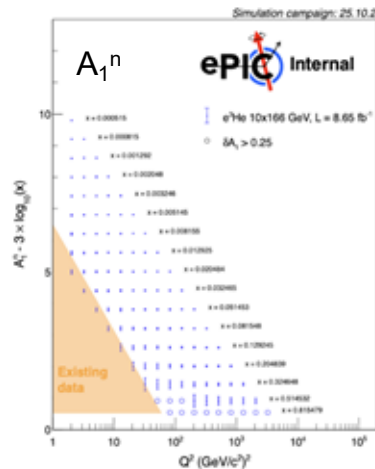
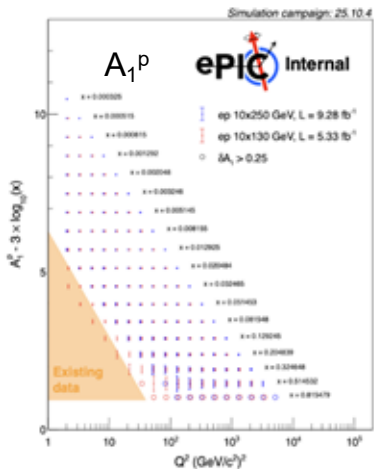
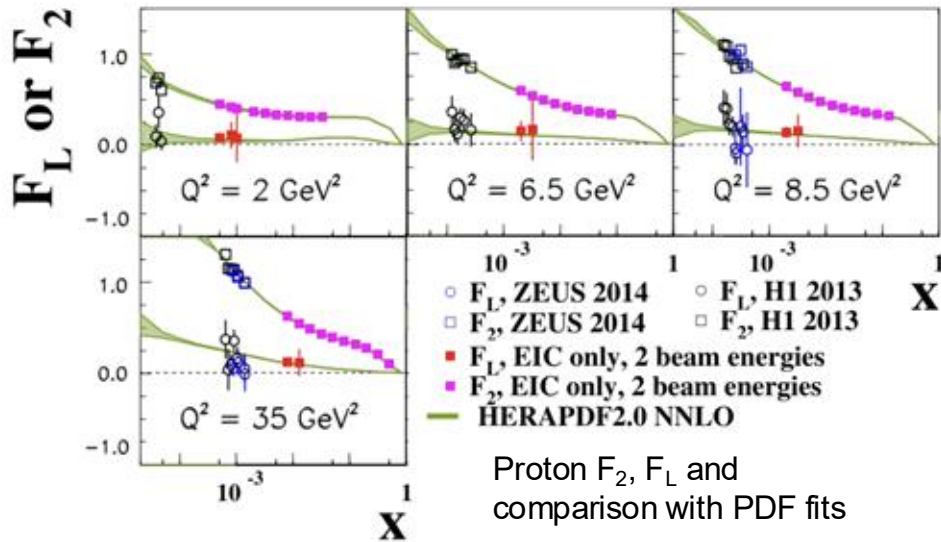
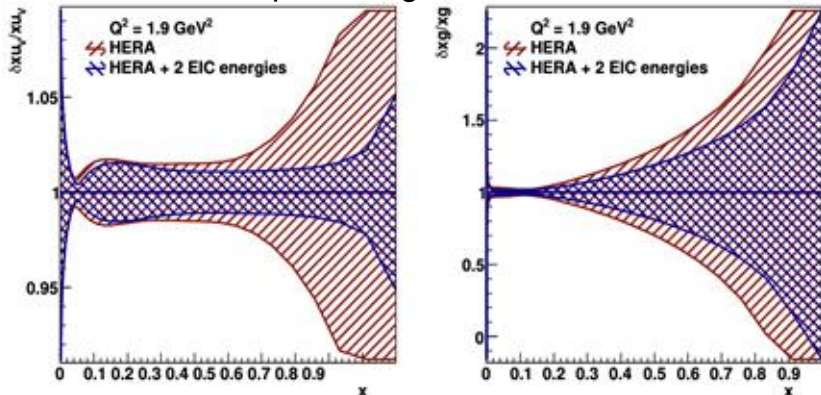
| | Species | Energy (GeV) | Lumi./year (fb ⁻¹) | e- pol. | p/A pol. |
|---------------|--|-----------------|-----------------------------------|-----------------------|-------------------|
| YEAR 1 | <i>e+Ag, e+Ru</i> or <i>e+Cu...</i> | 10 × 115 | 0.9 | NO (Commissioning) | N/A |
| YEAR 2 | <i>e+D</i> | 10 × 130 | 11.4 | LONG | NO |
| | <i>e+p</i> | 10 × 130 | 4.95–5.33 | | TRANS |
| YEAR 3 | <i>e+p</i> | 10 × 130 | 4.95–5.33 | LONG | TRANS and/or LONG |
| YEAR 4 | <i>e+Au</i> | 10 × 100 | 0.84 | LONG | N/A |
| | <i>e+p</i> | 10 × 250 | 6.19–9.18 | | TRANS and/or LONG |
| YEAR 5 | <i>e+Au</i> | 10 × 100 | 0.84 | LONG | N/A |
| | <i>e+³He</i> | 10 × 166 | 8.65 | | TRANS and/or LONG |

Table 1: EIC Early Science Matrix. The eA luminosity is per nucleon.

Will likely need to be adjusted and we should discuss at workshop a version for the ESR

ESR First Draft - main report

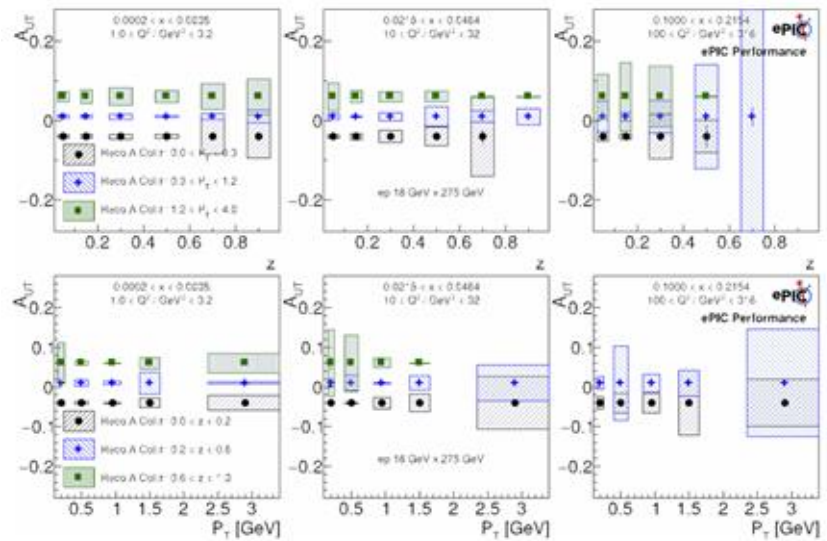
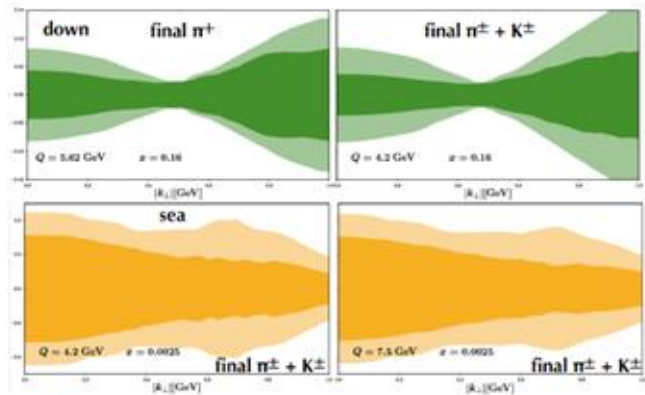
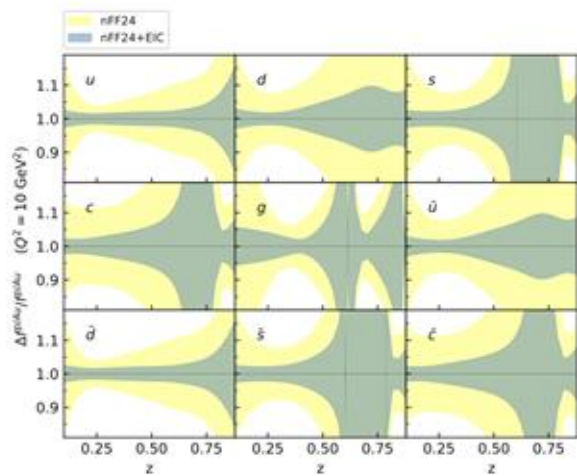
Proton PDF impact using HERAPDF2.0 NNLO



- Inclusive topics mentioned in main report:
 - F_2 and F_L ; proton valence quark and gluon PDF fits; nuclear effects on F_2 ; A_1^p and A_1^n

ESR First Draft - main report

Impact of e+Au on nuclear pion FF

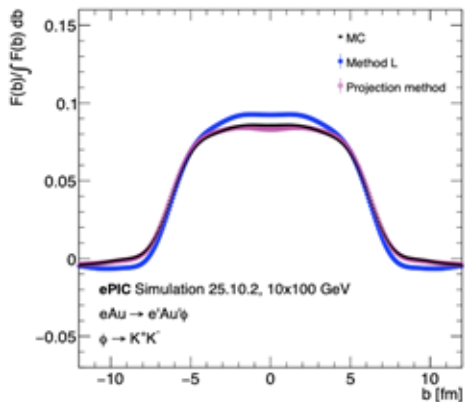
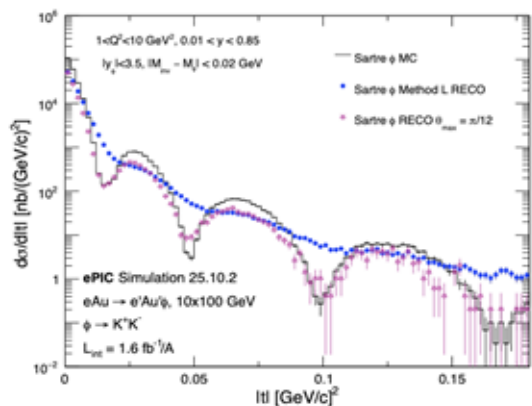
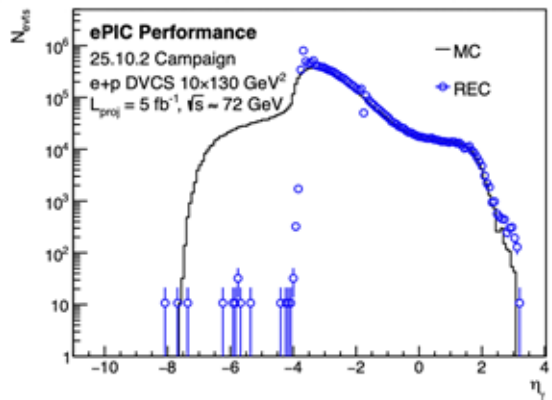
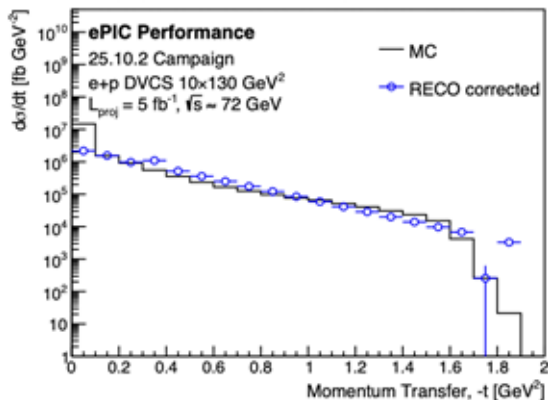


Uncertainties for Collins asymmetries for positive pions

- SIDIS topics mentioned in main part of report:
 - nFFs and nPDFs; di-hadrons and di-jets, unpolarised TMDs, Sivers and Collins FF

ESR First Draft - main report

DVCS x-sec vs t and reco η_γ

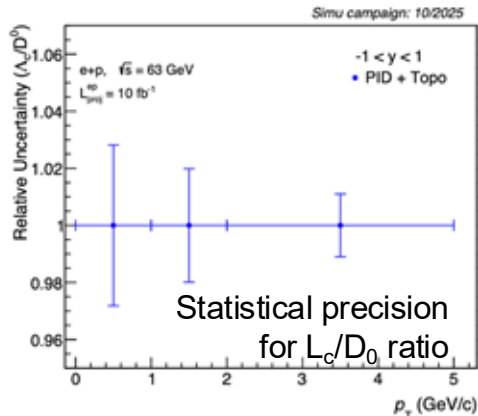
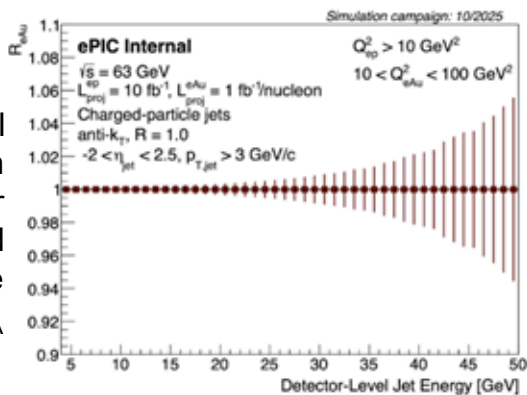


- EDT topics mentioned in main part of report:
 - DVCS, exclusive vector meson production including j/psi and Sullivan processes, diffractive processes like coherent diffractive VM production, spectator tagging in light nuclei eg A_1^n

Diffractive phi in eAu x-sec vs t and FT giving transverse gluon distr.

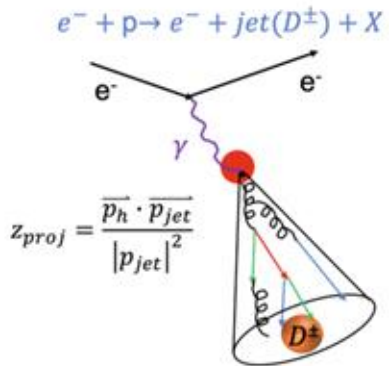
ESR First Draft - main report

Statistical precision for charged inclusive jet $R_{e,A}$

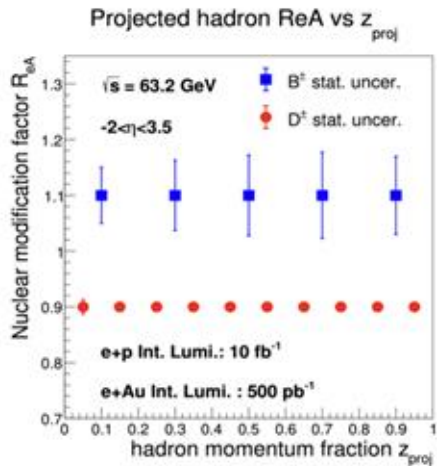


Statistical precision for L_C/D_0 ratio

- Jets/HF topics mentioned in main part of report:
 - Nuclear modification factor $R_{e,A}$ for inclusive charged jets and parton shower propagation in cold nuclear matter, heavy flavour production (L_C/D_0 production ratio), $R_{e,A}$ for D_0 in jets



$$R_{eA} = \frac{1}{A} \frac{\sigma_{eA}}{\sigma_{ep}}$$



Statistical precision for R_{eA} for D_0 reco within jets

ESR First Draft - main report

- Conclusions of main report using examples from PWGs to link back to NAS pillars
- Origin of **mass**: gluon dynamics and hadron structure
 - Inclusive DIS, F_2 , F_L , PDFs
 - Exclusive quarkonium production, DVCS and GPDs
 - SIDIS TMD observables and 3D imaging
 - Jett/hf photon-gluon fusion processes
- Origin of **spin**: helicity, orbital motion and correlations
 - Inclusive double spin asymmetries and A_1
 - SIDIS Sivers and Collins asymmetries
 - Jets/HD charm production and hadron-in-jet observables
- Emergent **gluon dynamics** and **saturation**
 - Diffractive VM production off nuclei
 - Jets/HF $R_{e,Au}$ and L_c/D^0 production ratio

Reviewers for drafting stages

- We sent first draft to a group of reviewers on 6th March
- Reviewers:
 - *General*: Thomas Ulrich; Taju Gunki; John Lajoie; Wim Cosyn
 - *Inclusive*: Katarzyna Witchman; Pia Zurita; Paul Newman; Enrico Tassi; Andy Buckley
 - *Exclusive, Diffractive, Tagging*: Kresimir Kumericki; Nicole D'Hose; Alex Jentsch
 - *SIDIS: Marco Mirazita*; Marco Radici; Marco Contalbrigo; Charlotte Van Hulse
 - *Jets/HF*: Olga Evdokimov; Deepa thomas; Brian Page; Rithya Kunnawalkam Elayavalli; Cameron Dean
- **Thank you** to these colleagues who offered their time to help during the drafting stages
- **Link on zenedo was circulated to workshop participants around same time**
- We will hear feedback from reviewers and participants at this workshop

Workshop Agenda

Tuesday

○ Morning:

- EIC running conditions in 1st 5yrs (Elke)
- ESR feedback from reviewers on main part of ESR
- Discussion on feedback for main part of ESR and structure of ESR as a whole
- Theory session - updates from theorists and discussion

○ Afternoon:

- Inclusive part of ESR
 - Overview of appendix
 - Feedback from reviewers
 - Discussion on inclusive topics
- Exclusive part of ESR
 - Overview of appendix
 - Feedback from reviewers
 - Discussion on exclusive topics
- Discussion session for any outstanding ESR topics from the day

Workshop Agenda

Wednesday

- **Morning:**
 - Talks on synergy with other experiments
 - Elastic ep study with ES and ePIC
 - dRICH simulations and planned performance studies; holistic PID reco; Jets reco
- **Afternoon:**
 - Jets/HF part of ESR
 - Overview of appendix
 - Feedback from reviewers
 - Discussion on jets/hf topics
 - BSM/EW topics
 - Plans for impact studies and paper
 - Discussion on BSM/EW
 - Outreach session - Italian activities, masterclasses, discussion for outreach ideas]
- **Evening: walking tour and social dinner (Cosenza)**

Workshop Agenda

Thursday

- **Morning:**
 - Analysis updates (DVCS, diffractive phi, di-hadron correlations)
 - Background planning discussion
 - TDR plans, timelines and discussion wrt our readiness for TDR
 - NIM A special issue plans and discussion
- **Afternoon:**
 - Joint afternoon with Software and Computing
 - PID reco, particle flow and electron finder, muon finder
 - Background tutorial, background effects on tracking, beam background in physics
 - Simulation campaign update
 - Rucio (tags for finding simulations)

Summary

- Our goals of workshop include (but are not limited to):
 - Assess and check-in on our readiness and plans wrt ESR and TDR
 - Receive feedback on current draft of ESR
 - Define actionable next steps for next draft of ESR
 - Discuss theory updates, synergetic experiment updates, analysis updates
 - Discuss systematics (reco and performance) and backgrounds
 - Discuss topics with software and computing wrt reco, backgrounds, campaigns ...
 - Discuss outreach activities and plans with an aim to enhancing our physics outreach
 - Discuss NIM A plans
- Took a team effort to meet timeline of current ESR draft - thank you to all who have inputted
- Thank you for attending workshop - and have fun :)