SIDIS status

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Comments from Readers of Early science document (Charlotte + Marco^3)

Note: main section was put together by Sal, Rachel and Carlos based on our Appendix

General

*) What is the goal of the document? If this is meant for non-physicists, the language, in particular of the introduction, is too technical.

*) In general, one needs to explain and highlight what one can gain wrt. previous knowledge. E.g., the text assumes that one knows TMDs, GPDs, instead of explaining the importance of dynamics (correlations, spin-orbit, orbital motion, mechanical properties) in mass/spin budget; or that one knows cold nuclear matter physics instead of arguing that hadron formation (in vacuum or in nuclear media) is an essential process at the base of the mass/spin generation or a gluon density probe. The introduction may assume the subsections take this task, but the SIDIS one (at least) does not do it.

*) One needs a clear list of priorities and explain what the flagship measurements are and what the strategy is. Instead of giving a full list, it is better to highlight what is really going to be impactful.

*) Justify better why we choose the chosen runs and which are the most impactful measurements for each run that are in line with NAS questions.

*) Collins, Sivers and A1 measurements assume a total luminosity of 10 fb^-1. However from the table, 10 fb^-1 is the TOTAL luminosity with polarized beams. Assuming a 50/50 sharing between long. and transv., the integrated luminosity for the two measurements must be reduced by a factor of 2.

After new project settings, possibly use 1 and 5 fb-1 options instead?

Comments from Readers (Charlotte + Marco^3)

SIDIS

Introduction

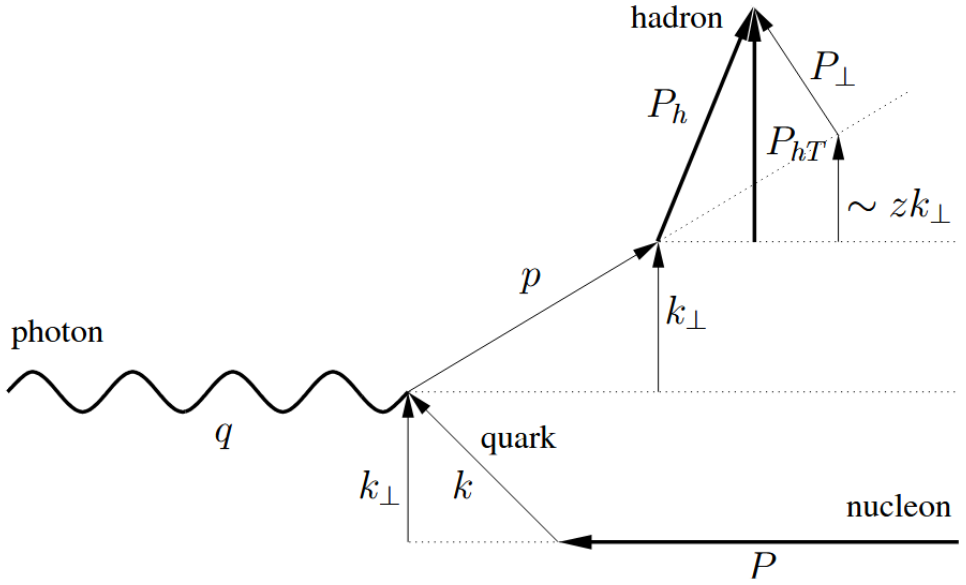
*) Explain better what can be gained with SIDIS wrt. inclusive DIS:
Make explicit that one of the requirements is to identify not only the species of final-state hadrons, but also its full kinematics, in particular its transverse momentum, because it's key to access info on 3-dim kinematics of partons inside hadrons.

*) Say also what EIC will bring for SIDIS which was not present before in other experiments.

*) Again: Instead of giving a full list, it is better to highlight what is really going to be impactful.

*) The connection of the physics to the observables is not so clear. Need to explain what every observable can bring.

*) Fig. 5: replace diagram by a diagram where all kinematic variables of interest are indicated and explained. Something along the lines of



Comments from Readers (Charlotte + Marco[3])

Nuclear modifications and fragmentation

*) This section is too long compared to other sections.

*) Add, if possible, an impact plot of the EIC on the determination of flavour-dependent nuclear PDFs. Here emphasis is placed on the nuclear FFs, but the EIC will also have impact on the flavour-dependence of the nuclear PDFs.

*) L217: remove model independent statement (also in the appendix). It is not model independent.

*) Nuclear FF plots (e.g. Fig. 6 left and Fig. B.1, B.2): do not include regions that we cannot access, such as z<0.2.

*) Appendix: If plots from two different models are given, explain why this is done.

We do not have any nPDF SIDIS impact st
→prepare?

These need to be updated anyway with updated studies by Charlotte and Pia

Saturation

*) Fig. B.5: If possible add a different model prediction, in order to have an idea on the model uncertainty.

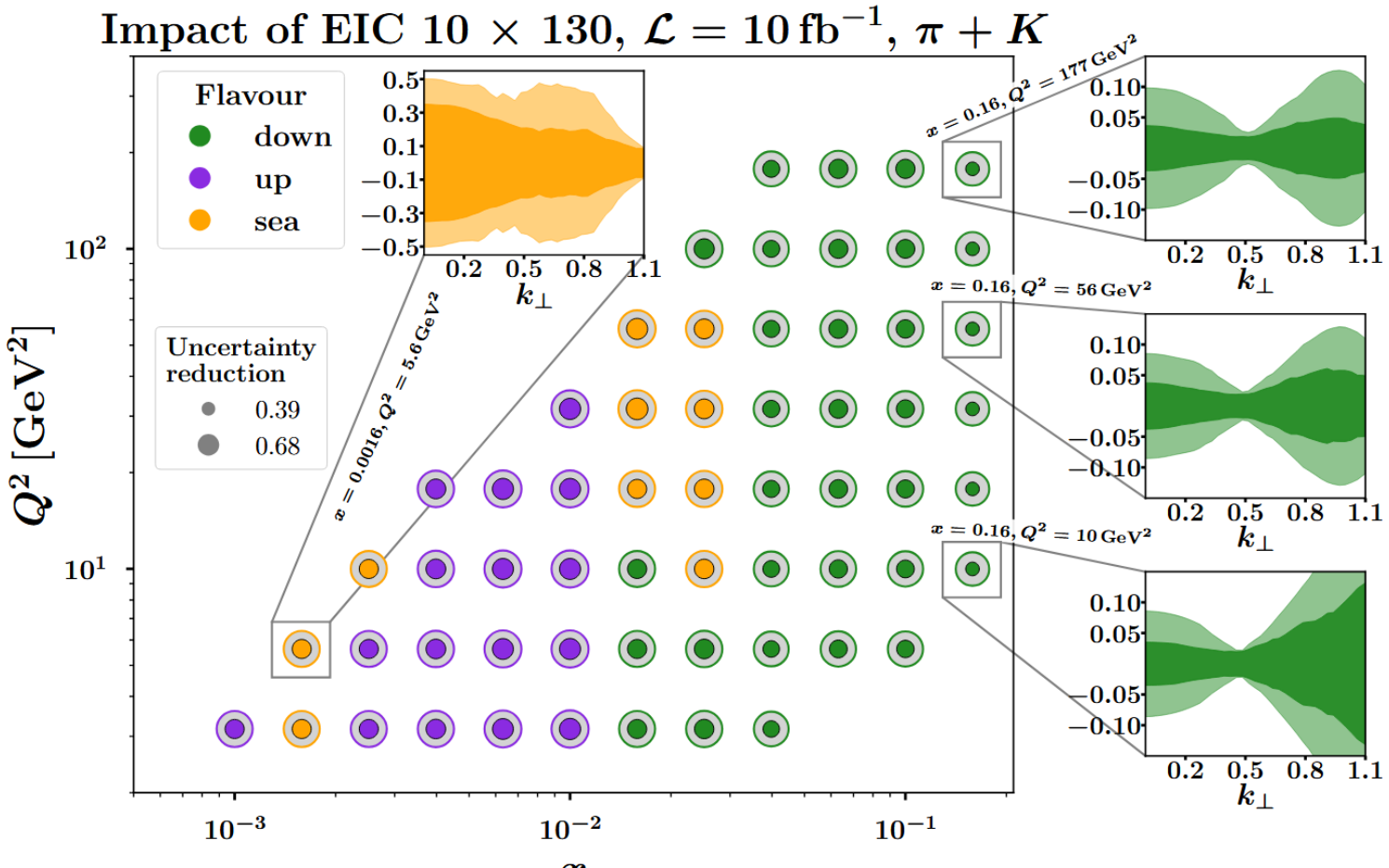
Add Gabriel's studies

Unpolarised TMDs

*) Extend the text (equilibrium with FF section) and explain better why it is a key measurement: important to have 3D picture. Stress that unpol. TMDs affect all spin asymmetries used to extract the polarized TMD partners.

*) Reference to recent extractions on unpolarised TMDs. Explain what precision is currently reached and what the EIC will bring and specify what is the baseline of Fig.6 left (MAPTMD24, stressing the capability of distinguishing kT distributions of different flavors).

*) Replace Fig. 6 right by plot from Pavia group, see here below. (Such plots are available for different lumi and hadrons, and they can be shown in App.B.3 - see below.)



We agreed in the meeting to use these figures, but have 3 separate plots for up, down, sea (BTW would it make sense to have the current uncertainties absolute, instead of set to 1?)

*) Appendix B.3: While it indeed will be very useful to have the EIC to check, a.o., if the non-perturbative part of the Collins-Soper kernel indeed is flavour-independent, there is precise LHC data available at very high Q2, not reachable at the EIC, which allows to probe (flavour-blind) Q2 evolution. Given this and the fact that the EIC early runs will not provide the highest Q2 range, the probing of Q2 evolution might be a slippery argument. The current plot (Fig. B.6, bottom) also does only show two Q2 ranges that are very close to each other, so a different figure would be needed.
*) Fig. B.6 top: The two top plots are supposed to show the impact of the inclusion of kaon data on the extraction of the down quark, but they show different kinematic bins, therefore cannot be compared.

Update the plots to show similar kinematics

Sivers TMD and Collins FF

*) It is better to show the Sivers asymmetry instead of the Collins asymmetry, since Sivers has been identified as golden channel and Collins as silver channel. For the figure itself, add existing data on top: show what kinematic bins are covered and add the uncertainties from the existing data, so that one can have an idea of the impact of the EIC. Update with early science kinematics.

No, because of Tensor charges and BSM.

*) L253: Clarify “Transverse polarization of the proton beam is expected to become available at the third year of the EIC running”, when table 1 shows that polarisation is included starting from the second year. (Or make the table unambiguous in case this is misunderstood from our side.)
*) Extend the text (equilibrium with the FF section).

Appendix

*) What is the goal of the appendix? Why making a list of subjects? It is better to drop subjects if they do not appear as highlights.

*) Appendix B.5: If this section is kept, new studies at the early EIC kinematics are needed and the Fig. should be replaced by impact plots. Also there is no gain in duplicating the plots that are in the main body.

*) Appendix B.6 and B.7: If these sections are kept, one needs to add studies and indicate why they are of importance for SIDIS and impactful in the early EIC run.

Early science document discussions (more comments for workshop):

- more impact plots rather than uncertainties figures (such as the Collins ones -> I will prepare the uncertainties for Daniel Pitonyak to get the corresponding impact plots, as we are also in contact with Alexey, maybe also see about Sivers impact as well)

-discussion of "state of the art" at the start of various sections and mention of expected improvements before the EIC, also add more references to existing measurements and theory

- have White-paper-like tables at the beginning of the appendix to summarize the measurements in increasing timescale

- 10 GeV electron beams will not bring us into the saturation region for the di-hadrons -> rewrite as baseline measurement

- start thinking about how hadron-in jet FFs and nFFs could be included in global fits (not really for the ESR other than as mention)

- start looking at EIC-only impact global fits w/o fixed target data (again more long-term)

- some discussion of the role of beam backgrounds

- I think the conclusion about the unpol TMD plots from Marco R is to have his suggested plots with the inlets for u, d and sea separately.

- longer term: Marco R and theorists look at the impact of EIC TMDs on determination of W and Higgs masses

- for 3He running we need to qualify that it might be difficult at 166 GeV in the early science years, but around 100 or 130 should be possible

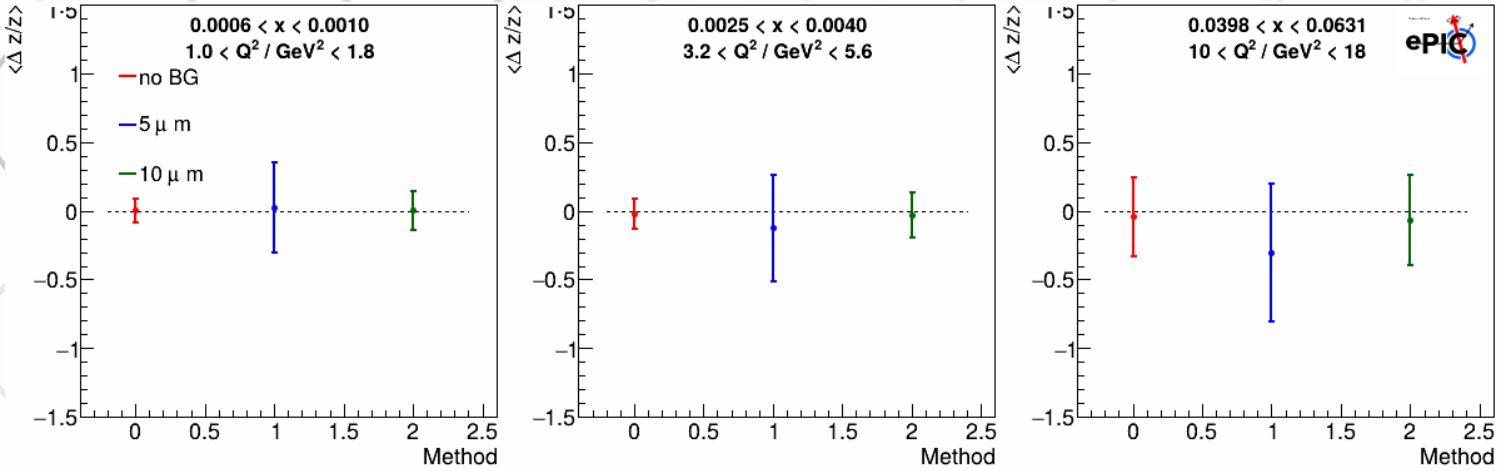
- more discussion about the CS kernel started with Alexey

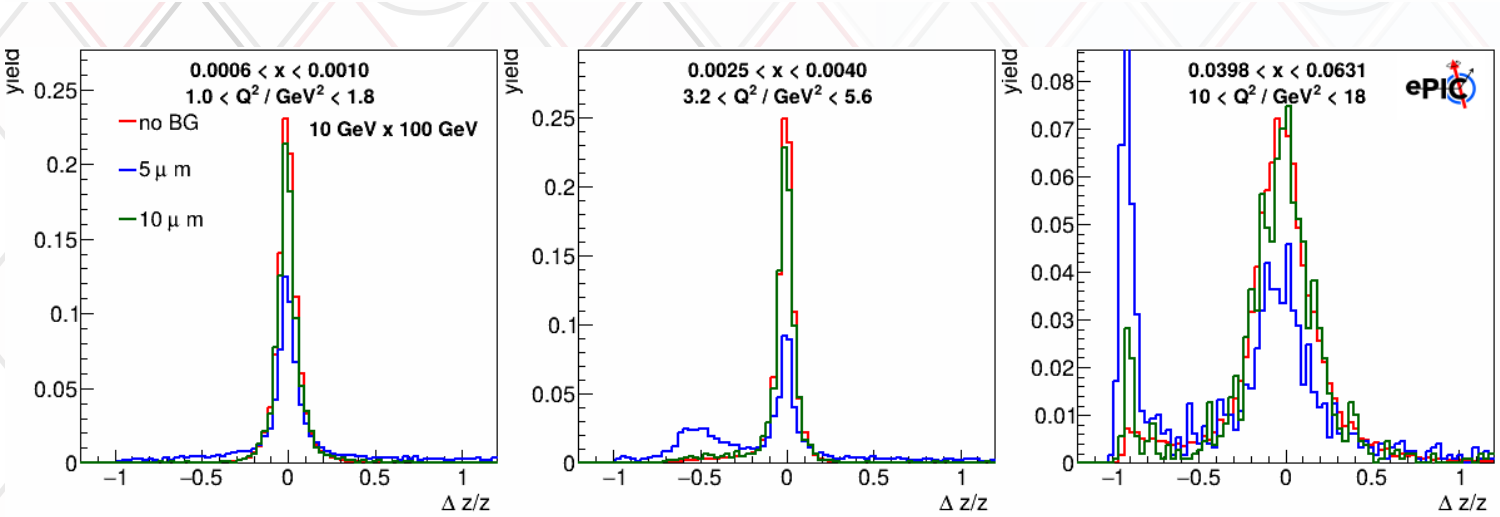
Second look at Beam background files

- Tried 10x100 GeV DIS/NC files Q2>1 and similar files with Bkg_Exact_2us/GoldCt/[5,10] μm
- Used Electron kinematics
- Statistics in BG samples is very limited

- Not studied: impact of background on PID

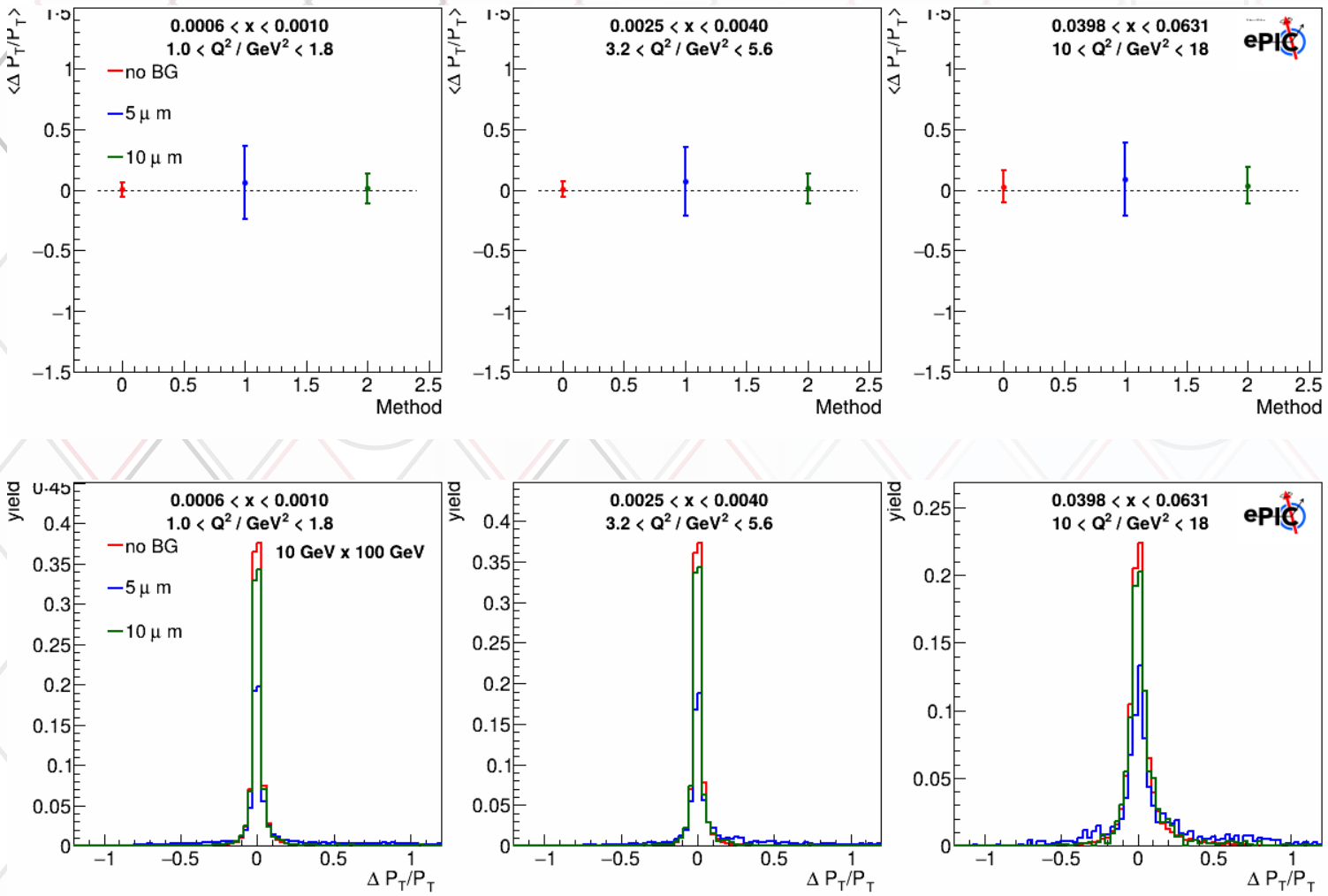
Z resolutions



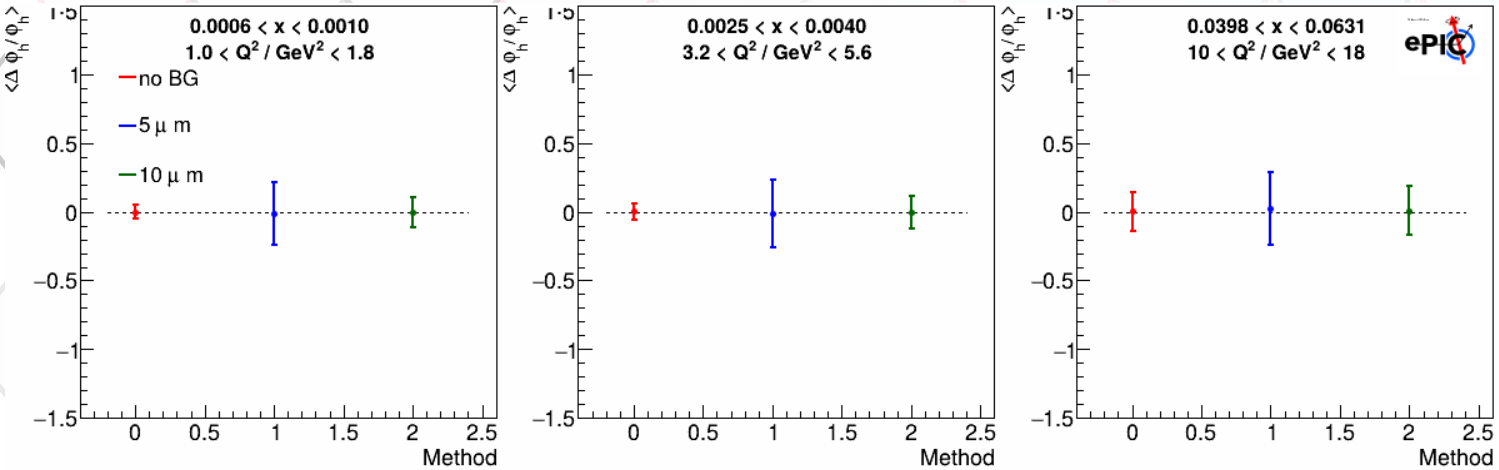


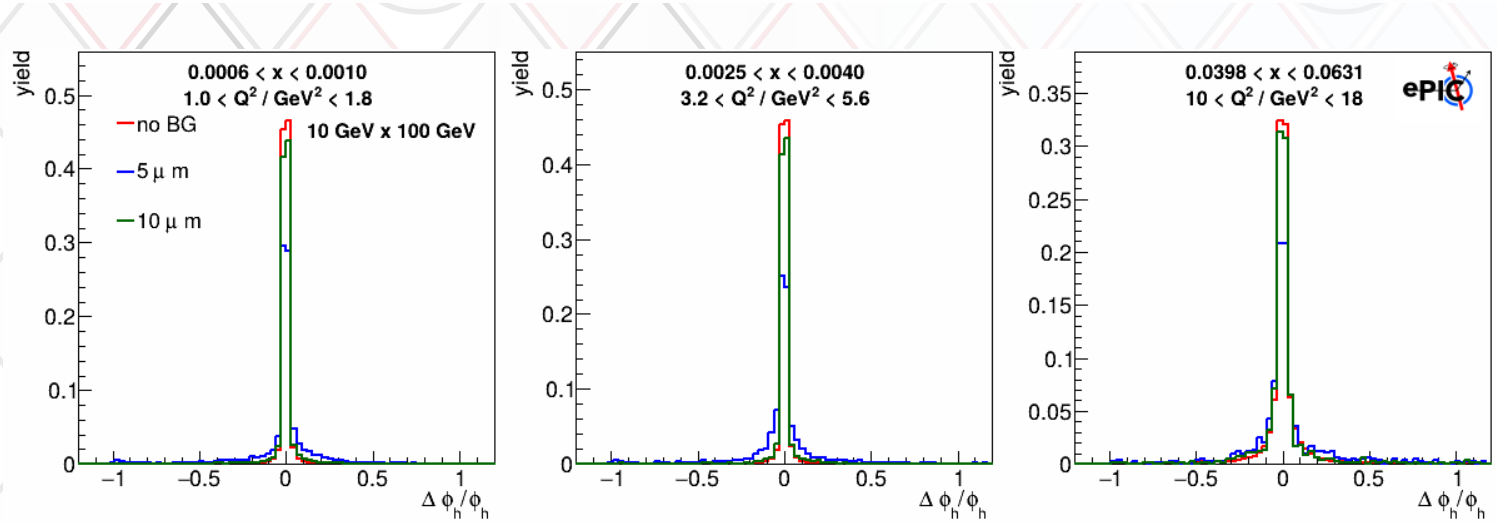
Method 0: default (no BG)
Method 1: 5μm
Method 2: 10μm

P_{hperp} resolutions

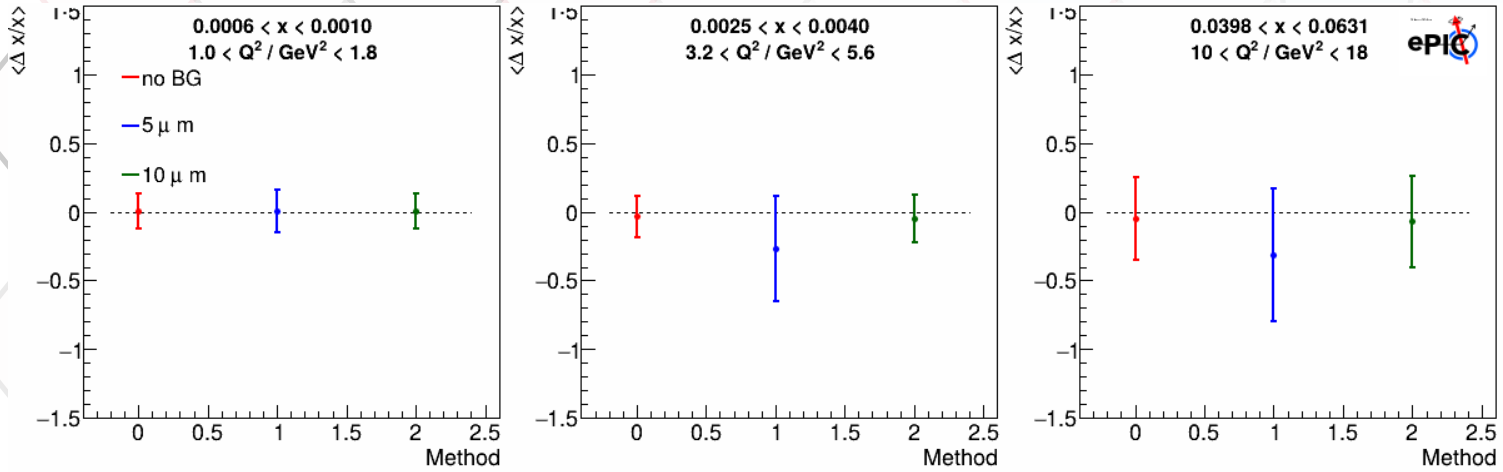


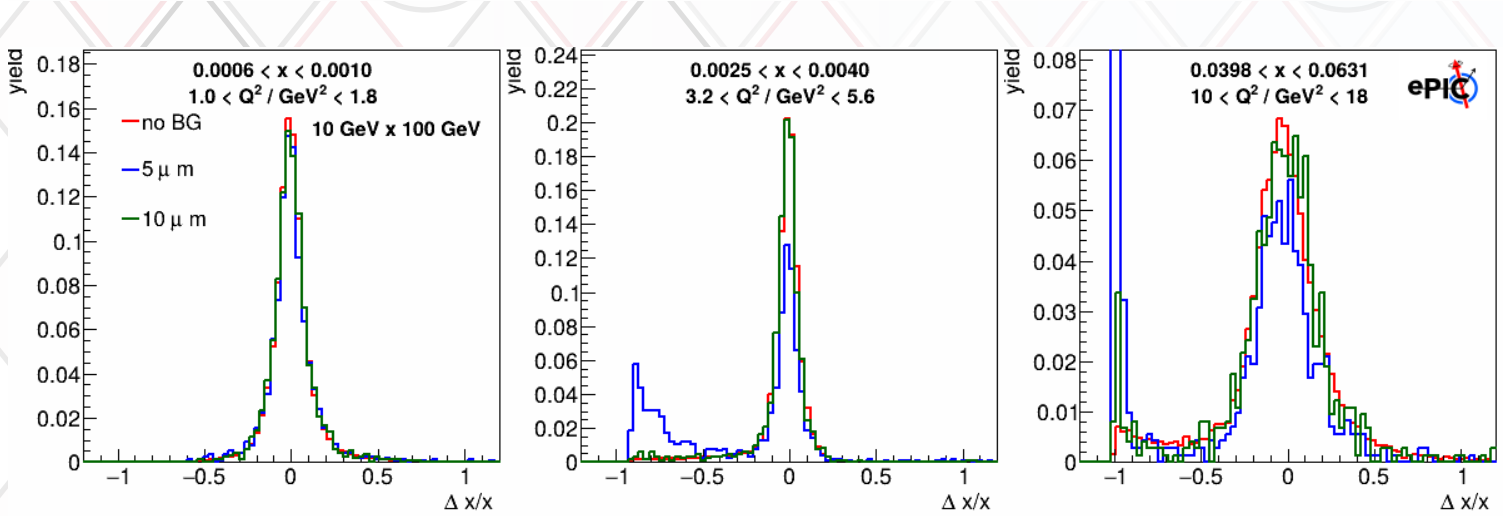
ϕ_h resolutions



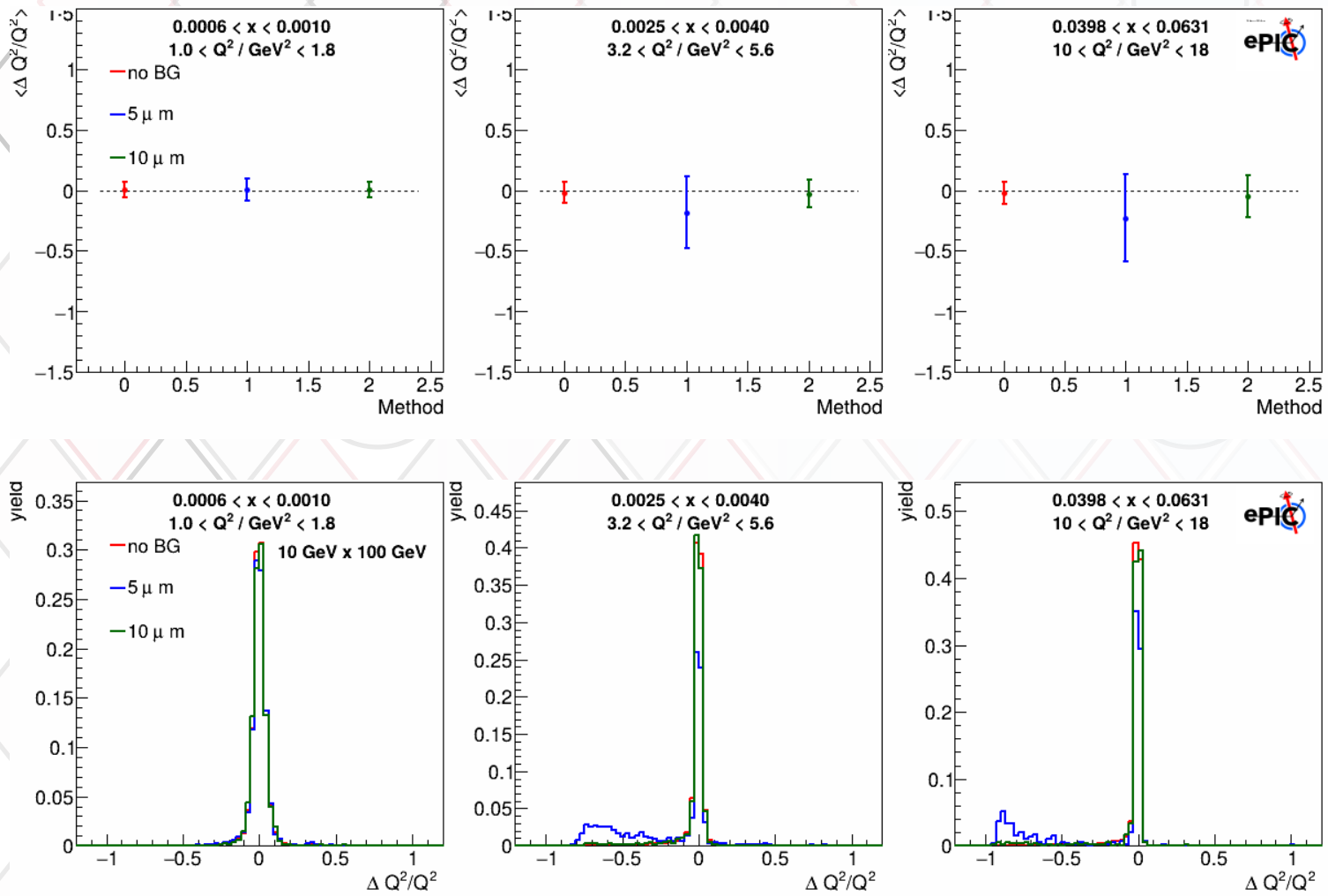


x resolutions



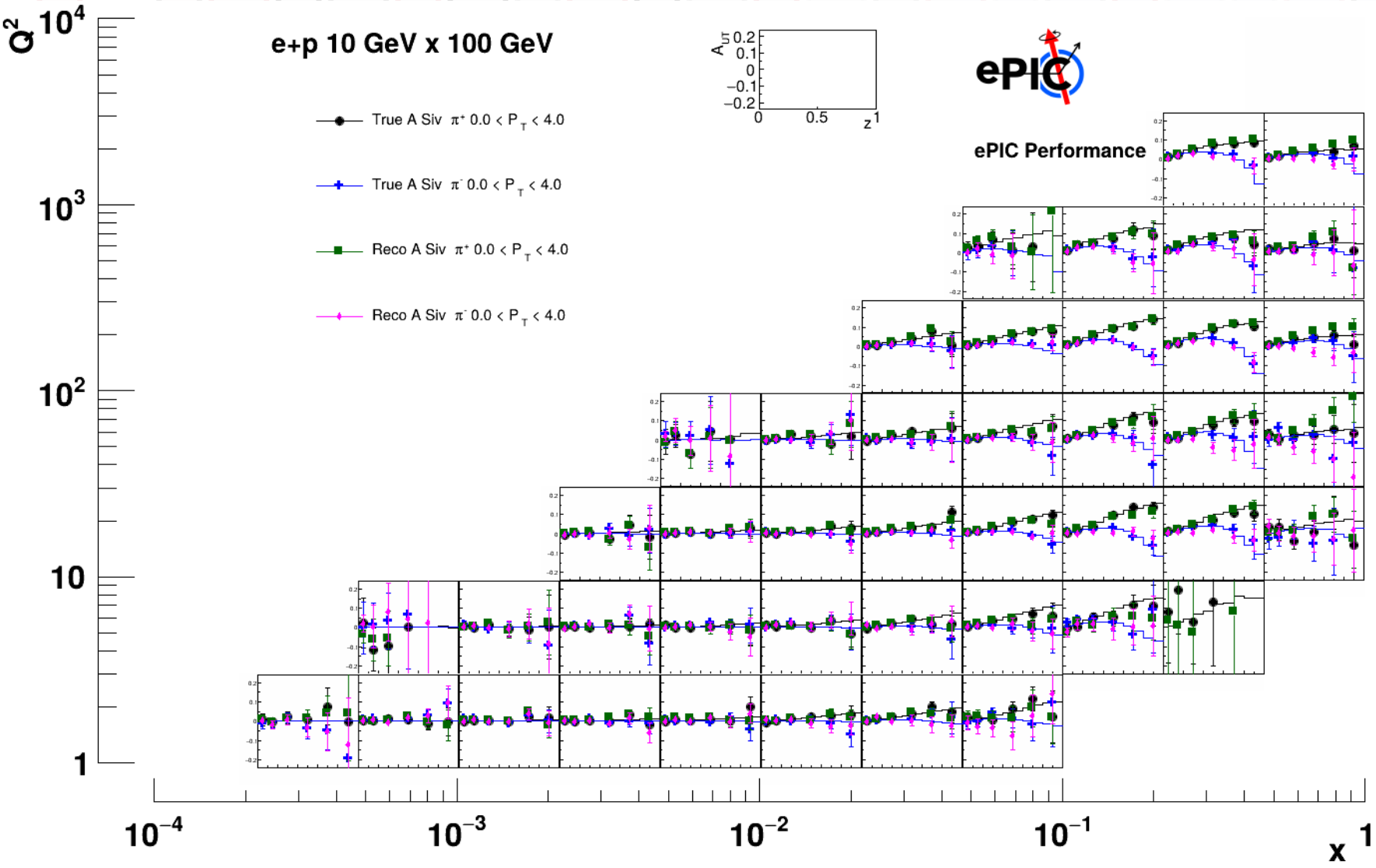


Q resolutions



- Conclusion from (SI)DIS variable resolutions: With 10 mm coated beampipe mostly ok, 5 shows large degradation
- According to Reconstruction expert discussion at Early science workshop: higher purity and minimal reduction of efficiencies expected when changing minimum from 3 to 4 hits for tracking → need to test

Updated Collins/Sivers figures



- Still waiting for the 10x130 and 10x250 files from the March campaign
- also add e3He(initially w/o tagging)
- Everything set up using 10x100 and 18x275 productions for now.
- Asked for possibility of more parameterizations + uncertainties such that we can show them directly on expected Asymmetry figures

More:

- As the simulation campaign data is now split between BNL and JLAB, one needs to use Rucio to get the filelists
- See Steve Kay's Tutorial (still under development)