Inclusive DIS with RGE

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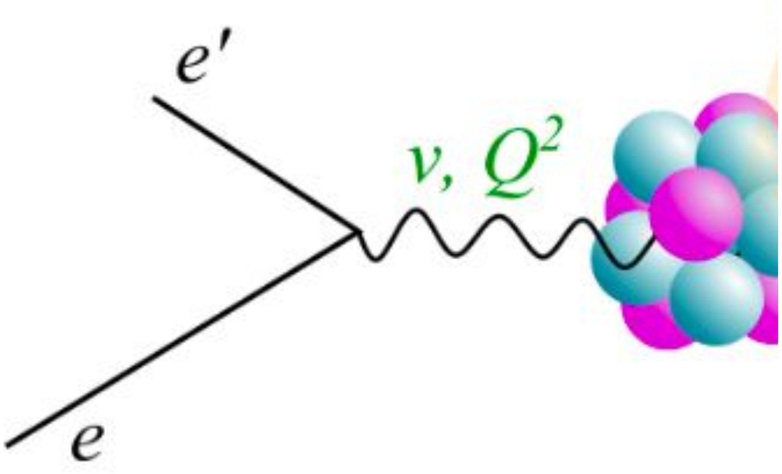
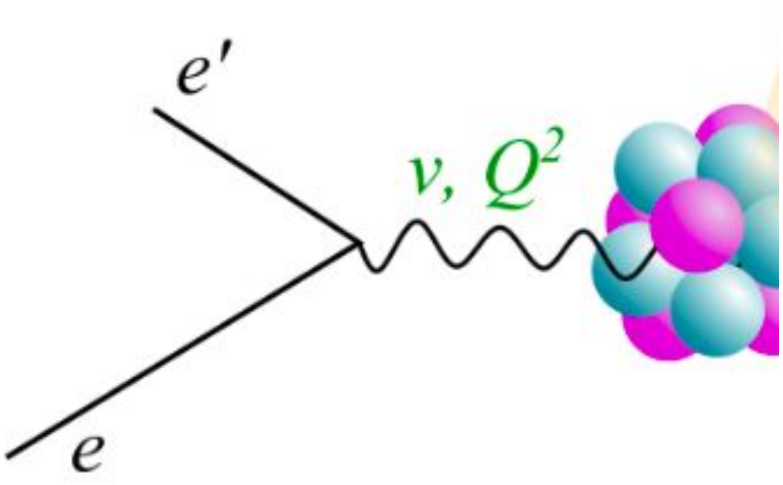
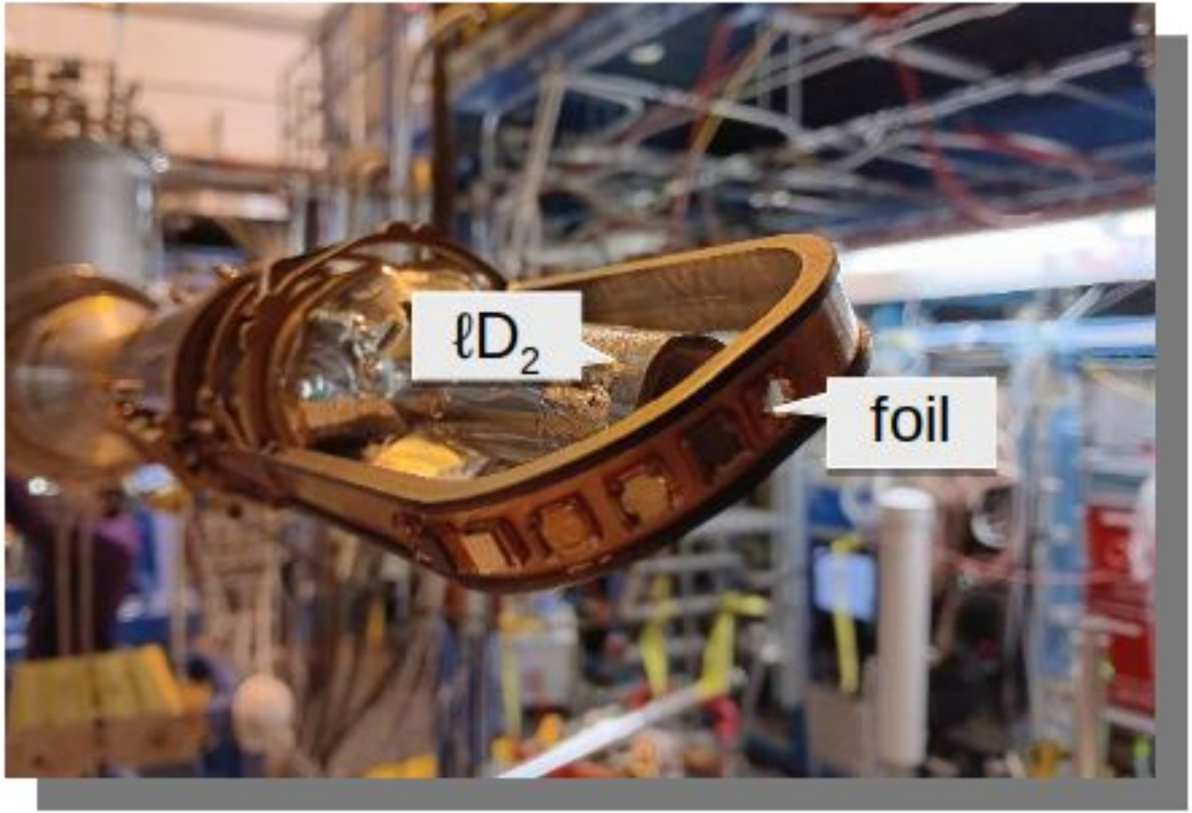
UC RIVERSIDE



Why Inclusive DIS with RGE?

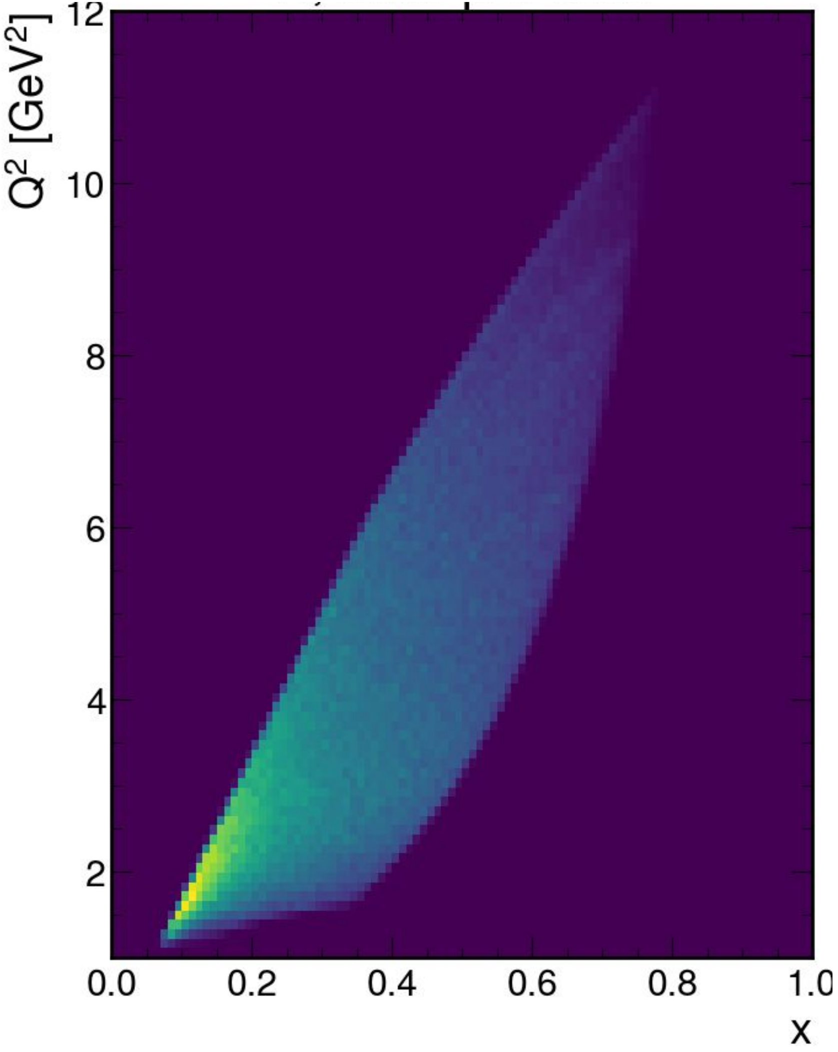




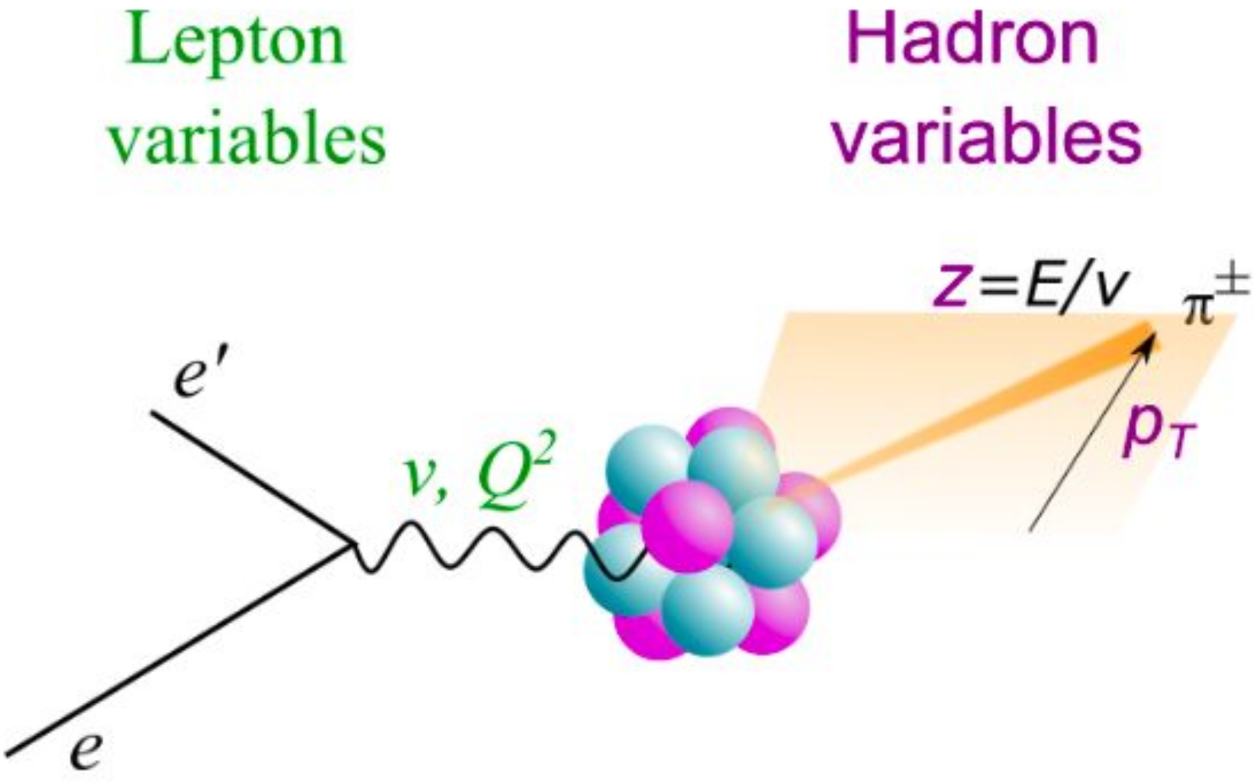
Data-taking on **five solid RG-E targets** with comparable luminosity:

- C x ℓD_2: 23 1/fb
- Al x ℓD_2 : 24 1/fb
- Cu x ℓD_2 : 22 1/fb
- Sn x ℓD_2 : 22 1/fb
- Pb x ℓD_2 : 26 1/fb

Ultimate dataset for key phasespace for probing Q2, A dependence of nuclear PDFs

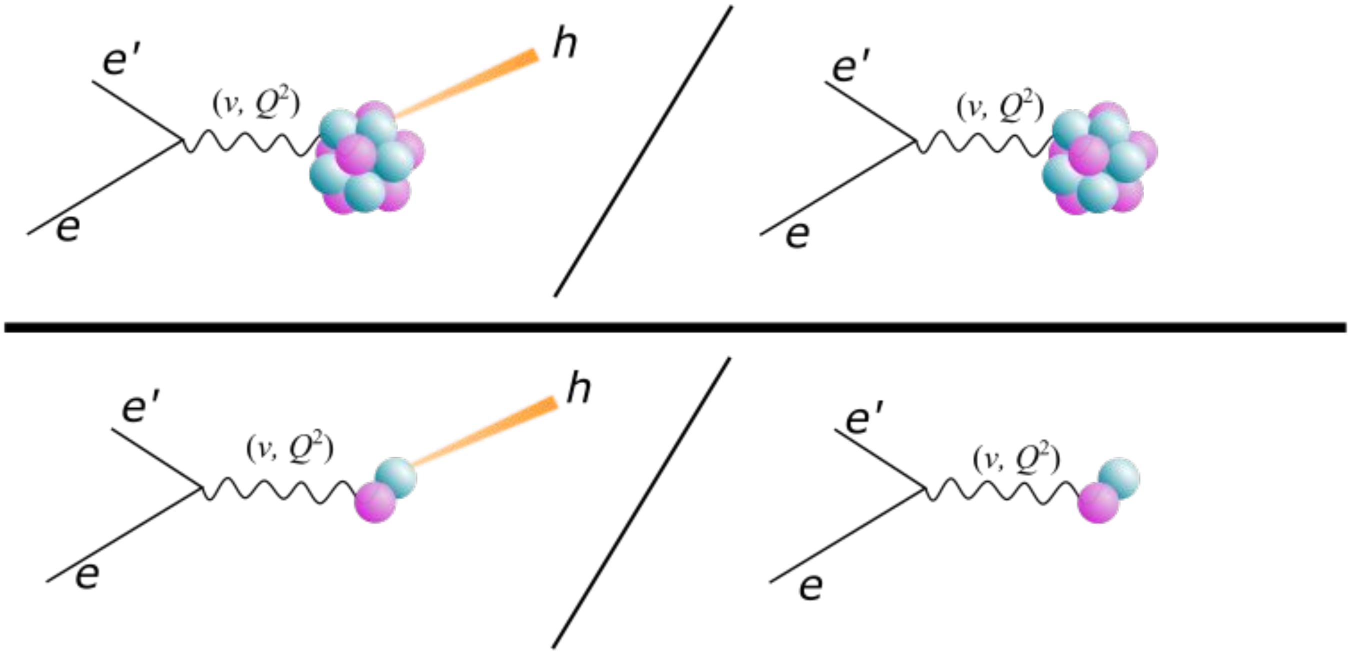


DIS is needed for SIDIS

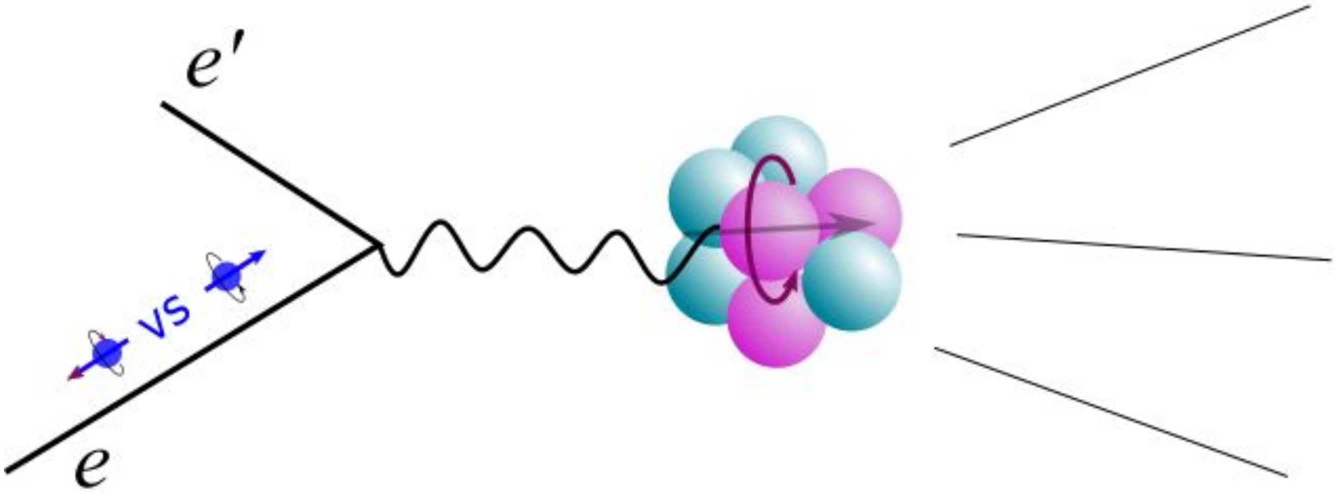


Inclusive DIS is literally part of the multiplicity ratio definition

$$R_h^A =$$

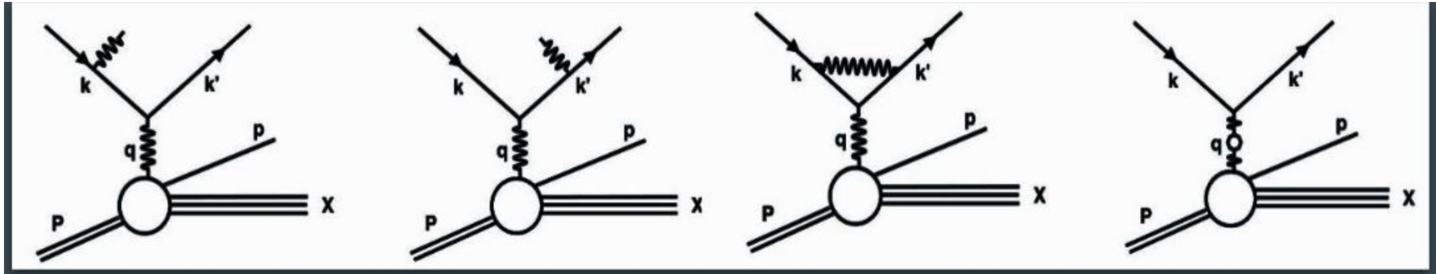


Dry run for Nuclear DIS with Lithium7 (RG-G exp)



Once upon a time, CLAS was pursuing multiplicity ratio with 5 GeV data, some groups did use different frameworks for Radiative Corrections.

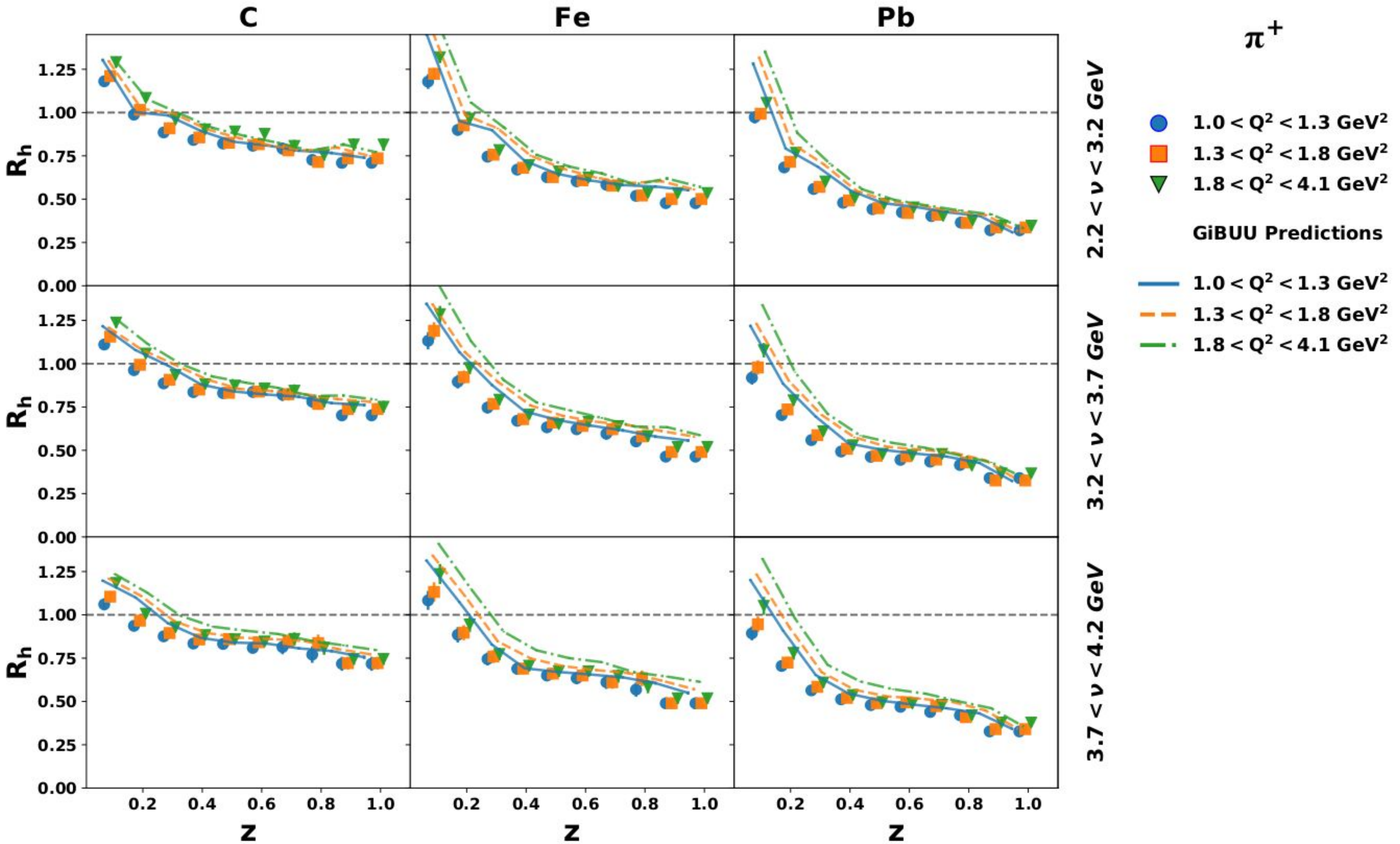
*…**~few percent difference***



$$N_{RC} = \frac{N_{meas}}{\delta_{RC}} \quad ; \quad \sigma_{Rad} = \delta_{RC} \times \sigma_{Born}$$

A normalization off a few percent …matters!

S. Moran et al.
PRC 105, 015201, (2022)



We traced down the sources of discrepancies, wrote a paper about it:

arXiv > nucl-ex > arXiv:2402.17147

Nuclear Experiment

[Submitted on 27 Feb 2024]

On the significance of radiative corrections on measurements of the EMC effect

S. Moran, M. Arratia, J. Arrington, D. Gaskell, B. Schmookler

Analyzing global data on the EMC effect, which denotes differences in parton distribution functions in nuclei compared to unbound nucleons, reveals
Jefferson Lab, studying both x and A dependence, show systematic discrepancies among experiments, making the extraction of the A dependence of
selection of datasets. By comparing various methods and assumptions used to calculate radiative corrections, we have identified differences that, wh
EMC ratios and show that using a consistent radiative correction procedure resolves this discrepancy, leading to a more coherent global picture, and
of the EMC effect for infinite nuclear matter.

Dependence on program
(full 2D integral vs peaking approximation)

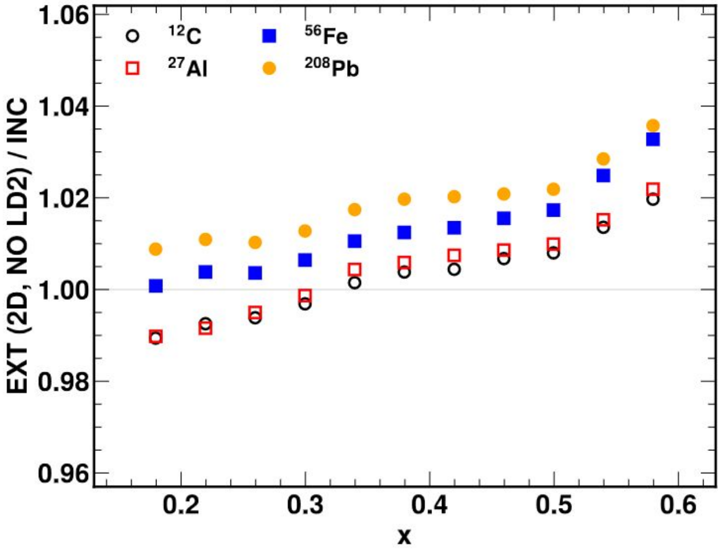
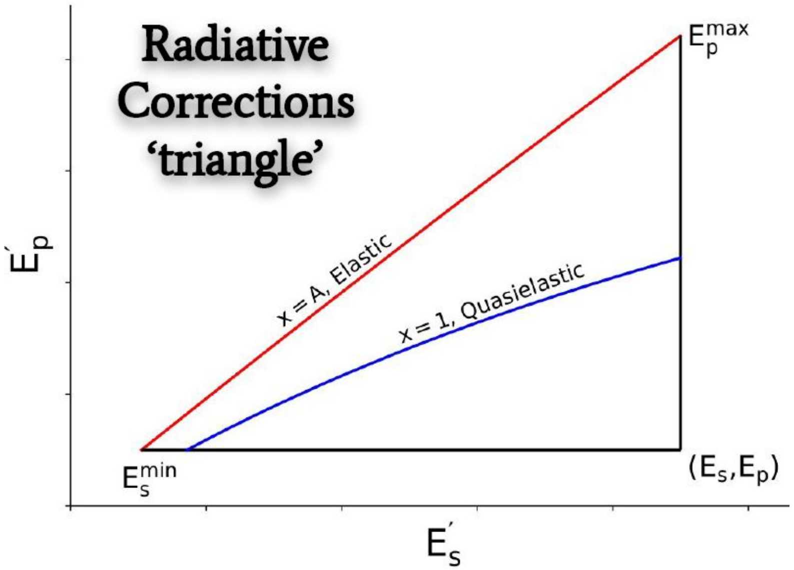
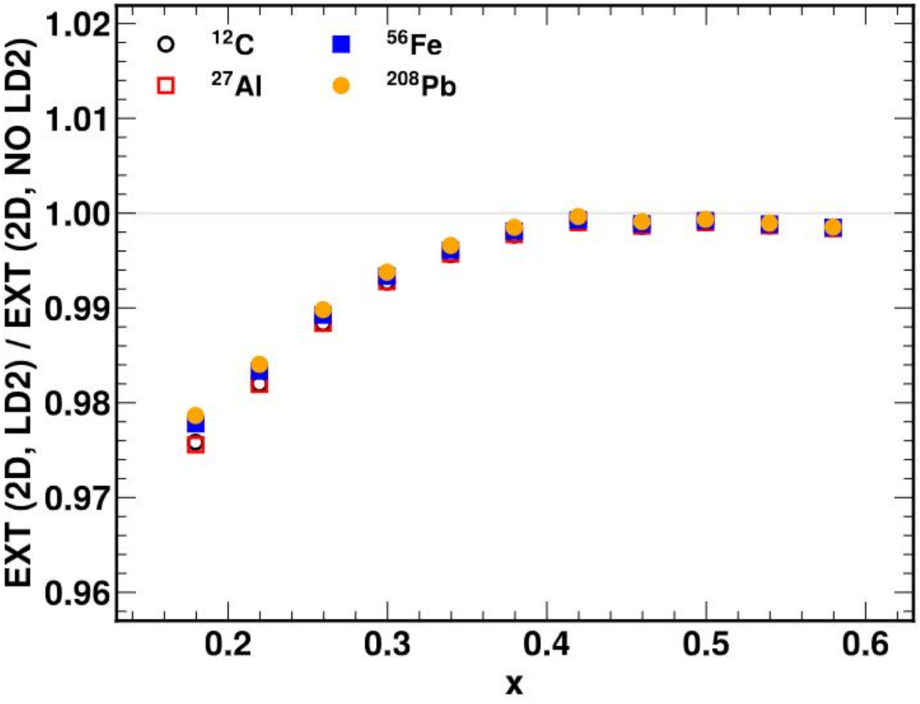


FIG. 8. Ratio of radiative correction factors for the targets used in the CLAS EMC effect extraction calculated using the EXTERNALS program (but without including the LD2 target that was upstream of the solid targets) relative to the RC factor calculated using INCLUSIVE (i.e., making use of the energy peaking approximation).



Impact of deuterium target upstream



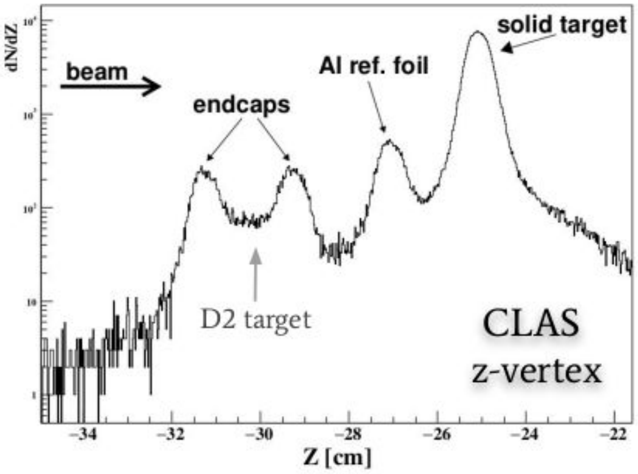


FIG. 9. Ratio of radiation correction factors calculated using EXTERNALS with and without the upstream LD2 target included in the calculation.

Net Result

Matters!

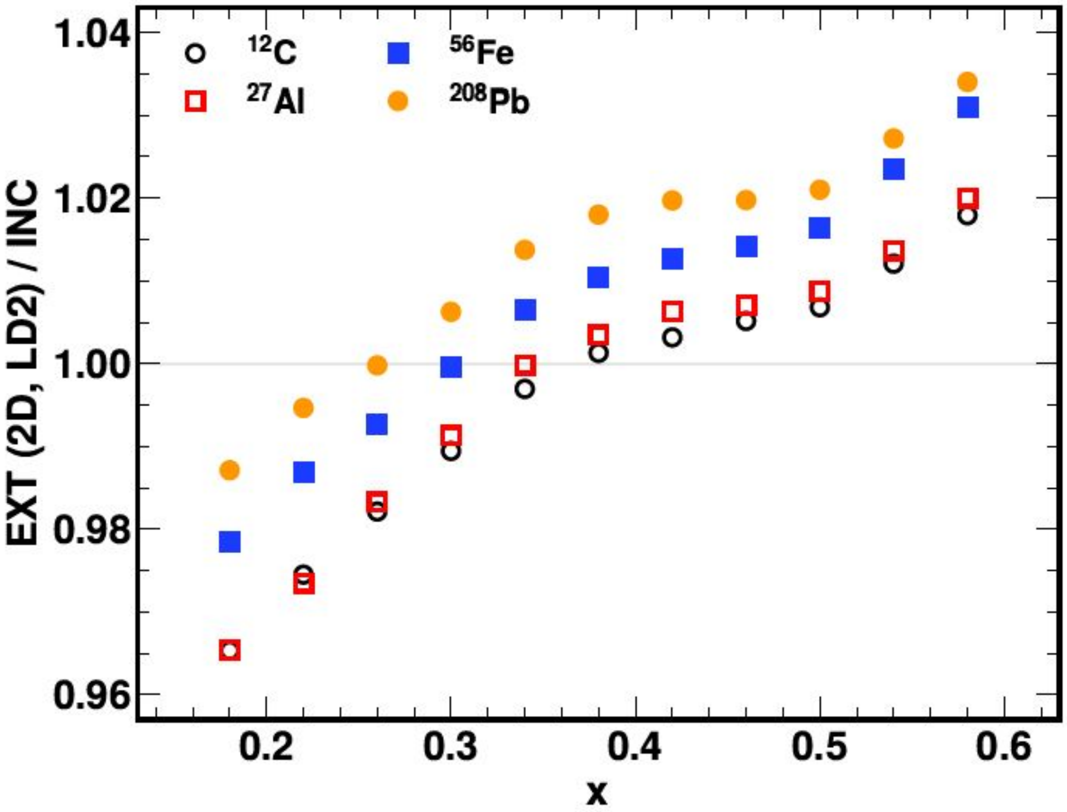
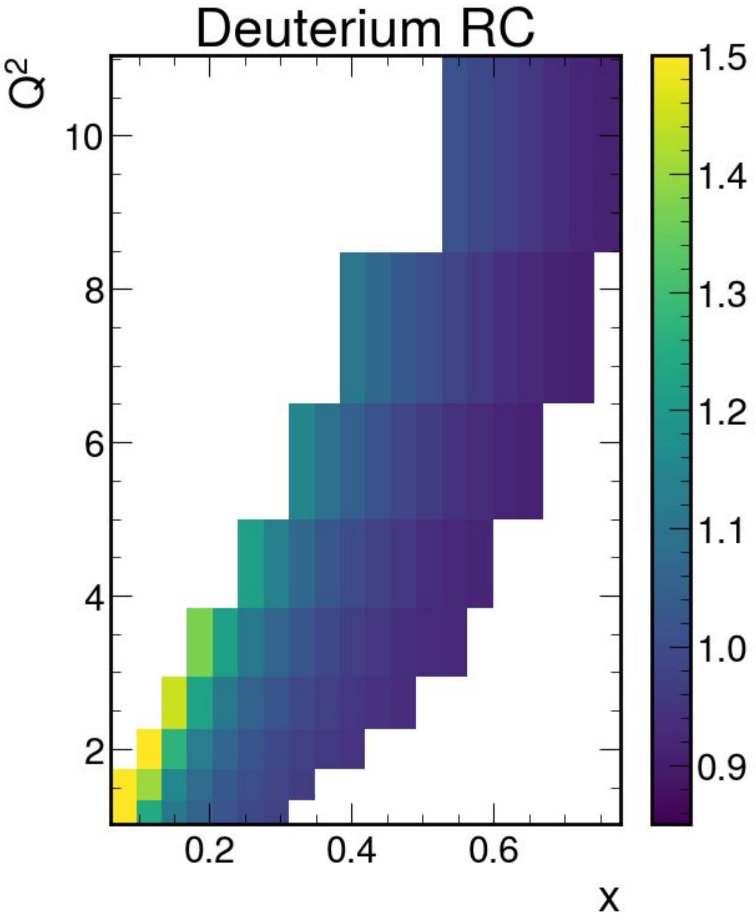
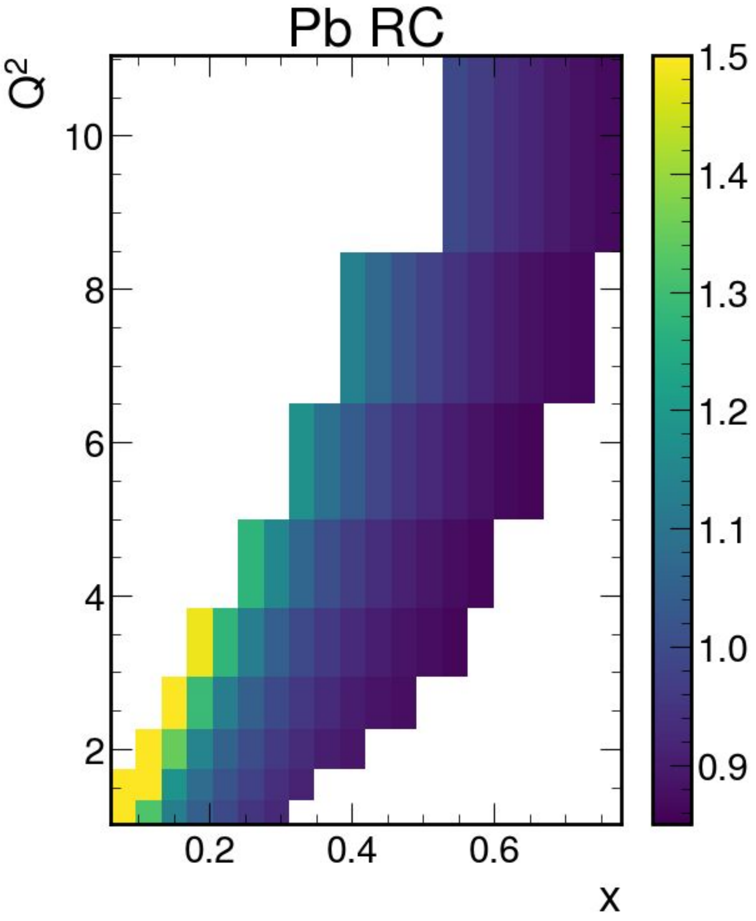
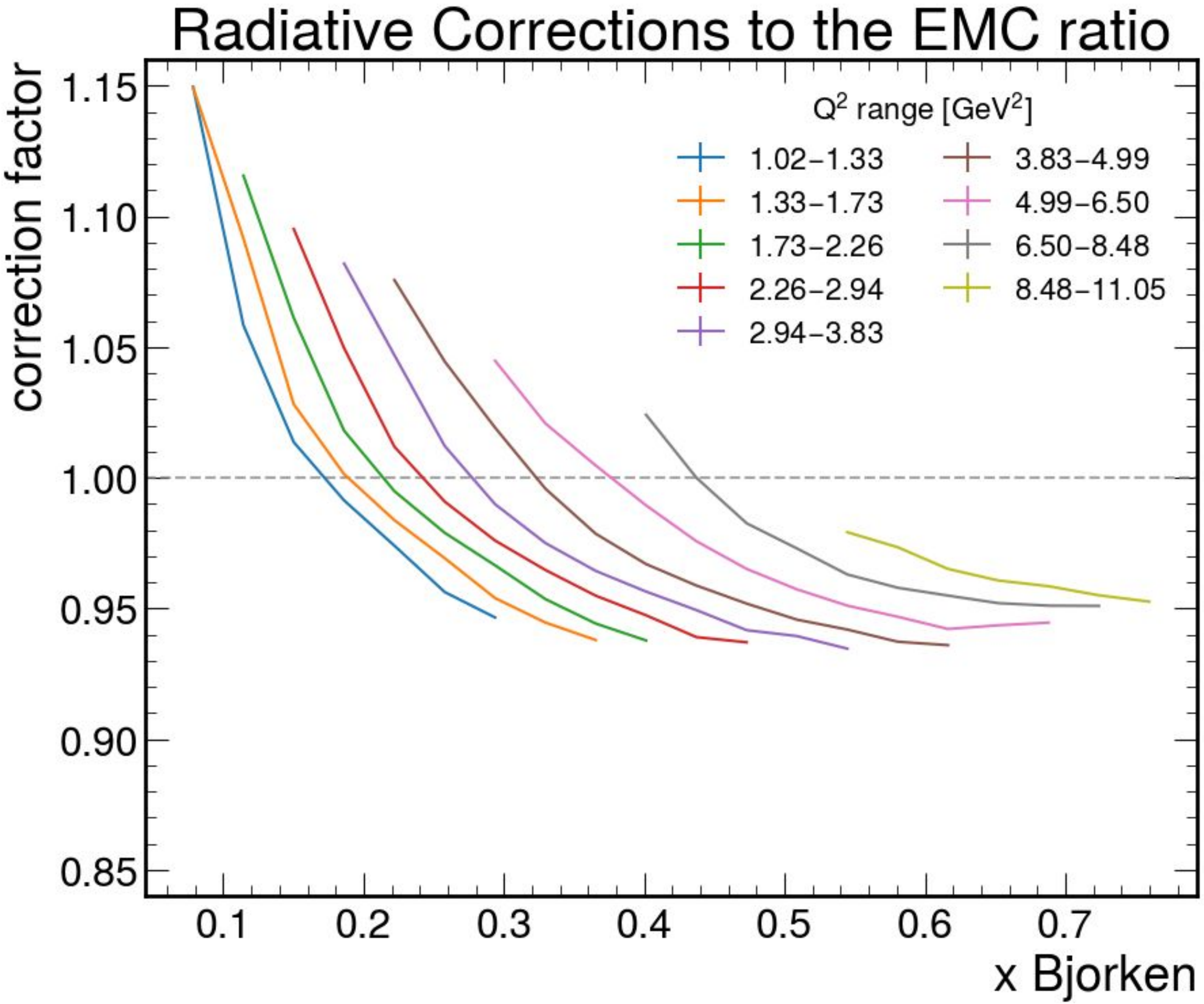


FIG. 3. Impact of the RC procedure (EXTERNALS, including upstream LD2 target) vs original (INCLUSIVE, no LD2 target) on the EMC ratios.

Radiative Corrections for RG-E

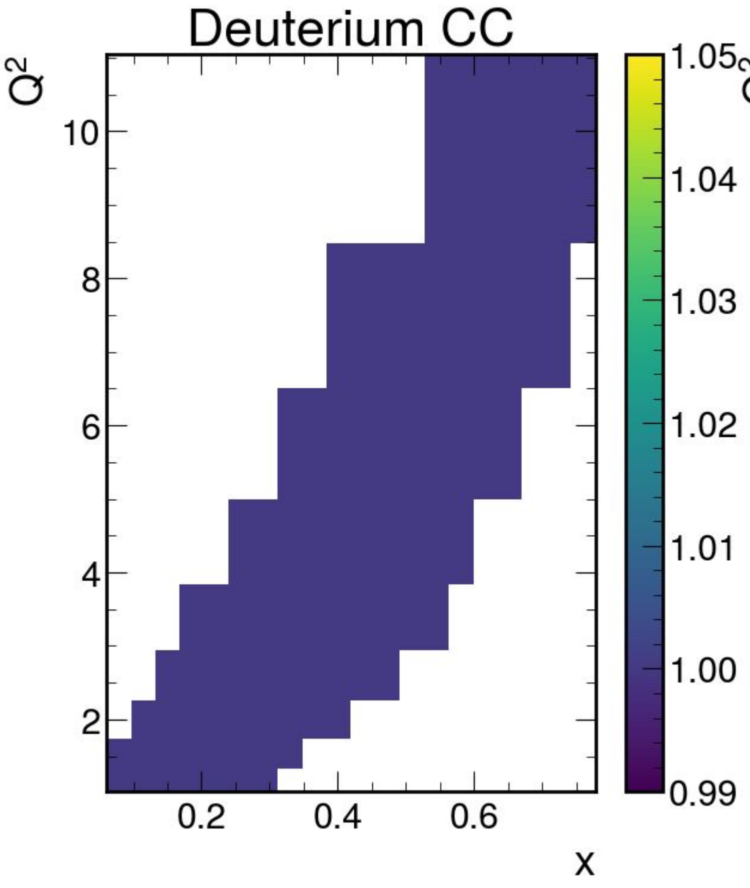


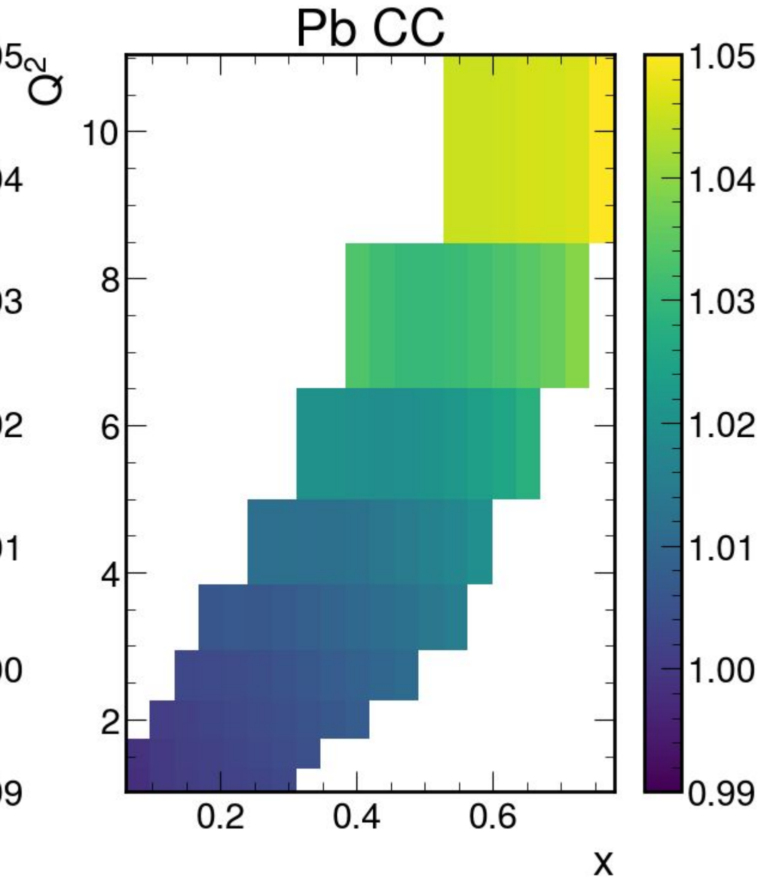


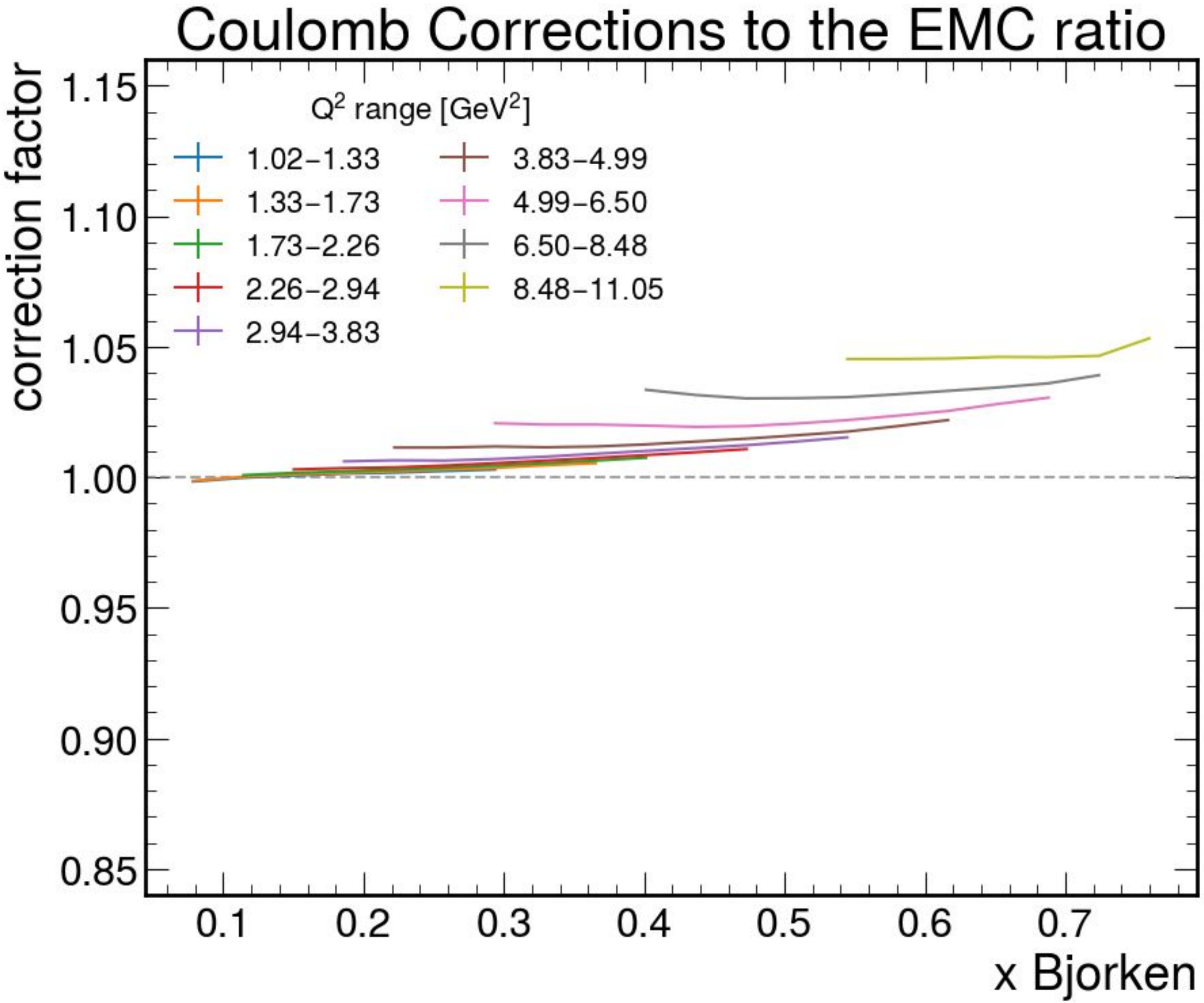


Radiative Corrections to the EMC ratio
correction factor
x Bjorken
Q^2 range [GeV^2]
1.02−1.33
1.33−1.73
1.73−2.26
2.26−2.94
2.94−3.83
3.83−4.99
4.99−6.50
6.50−8.48
8.48−11.05
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.1
0.2
0.3
0.4
0.5
0.6
0.7

Coulomb Corrections







Coulomb Corrections to the EMC ratio
correction factor
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Q^2 range [GeV^2]
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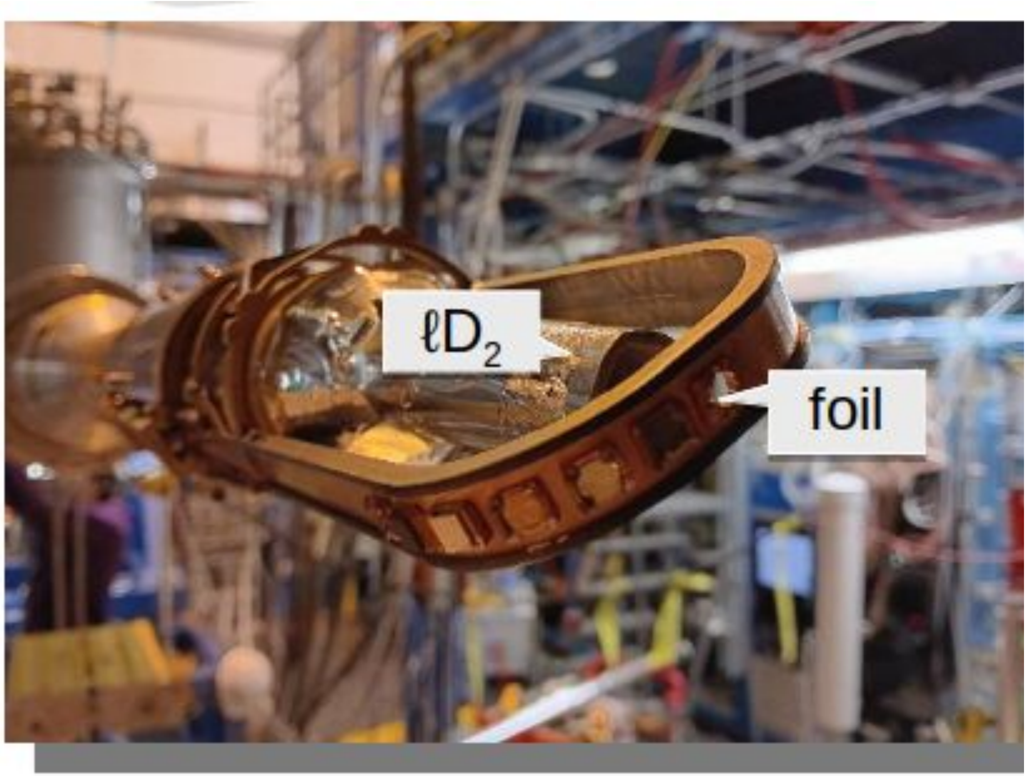
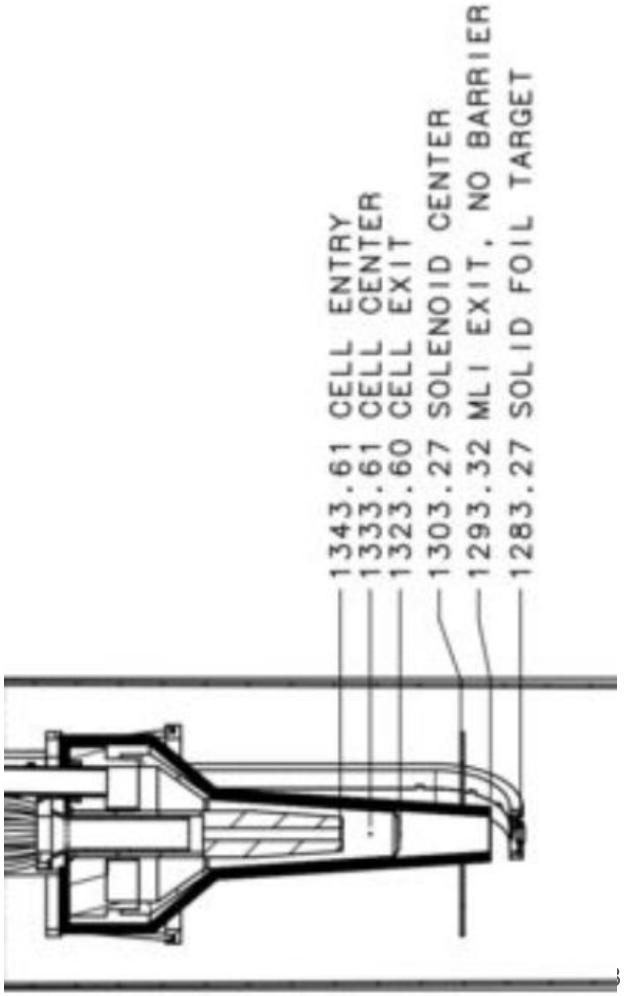
1.73−2.26
2.26−2.94
2.94−3.83
3.83−4.99
4.99−6.50
6.50−8.48
8.48−11.05
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.1
0.2
0.3
0.4
0.5
0.6
0.7

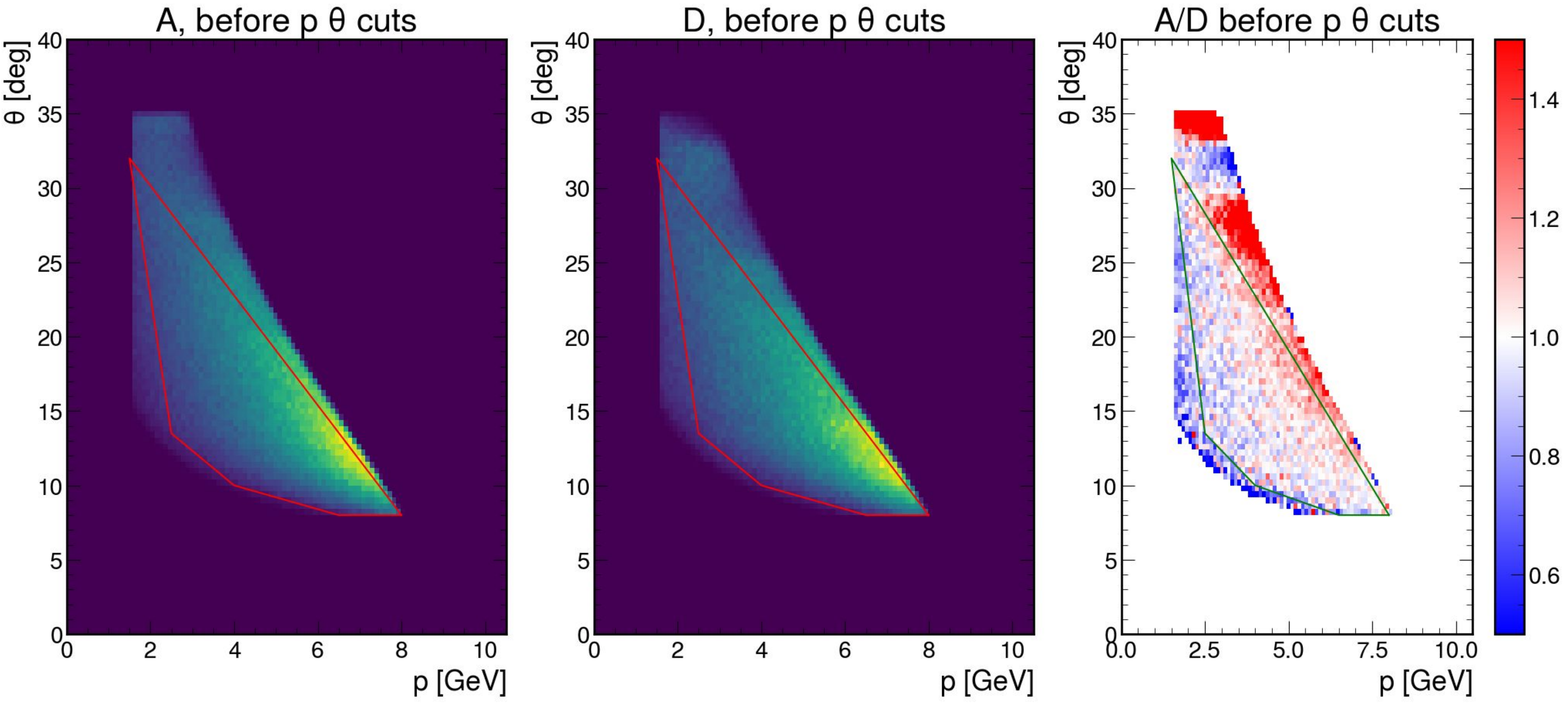
Acceptance in dual-target mode

Liquid and solid target are pretty close.
Will yield mostly same acceptance for most angles

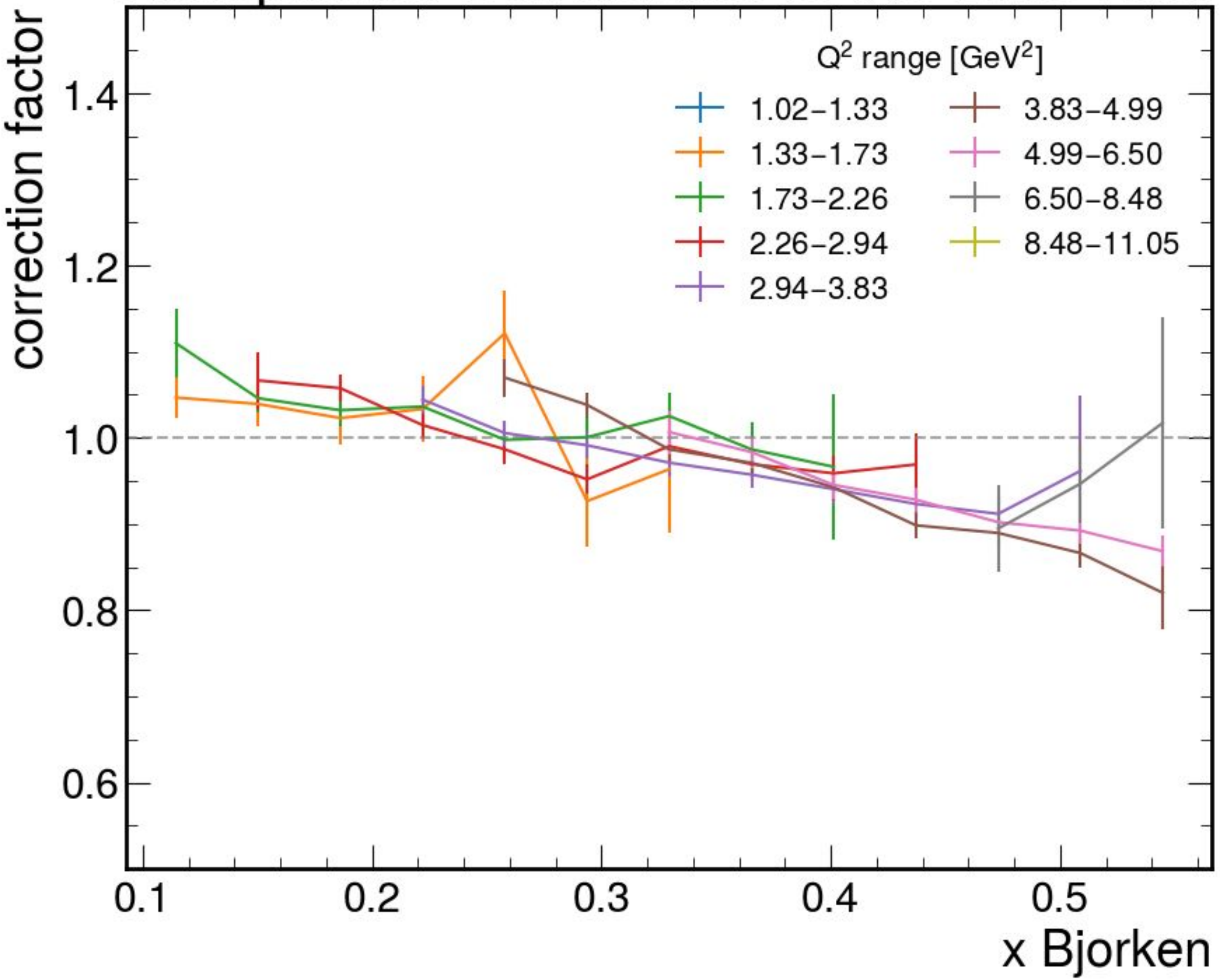




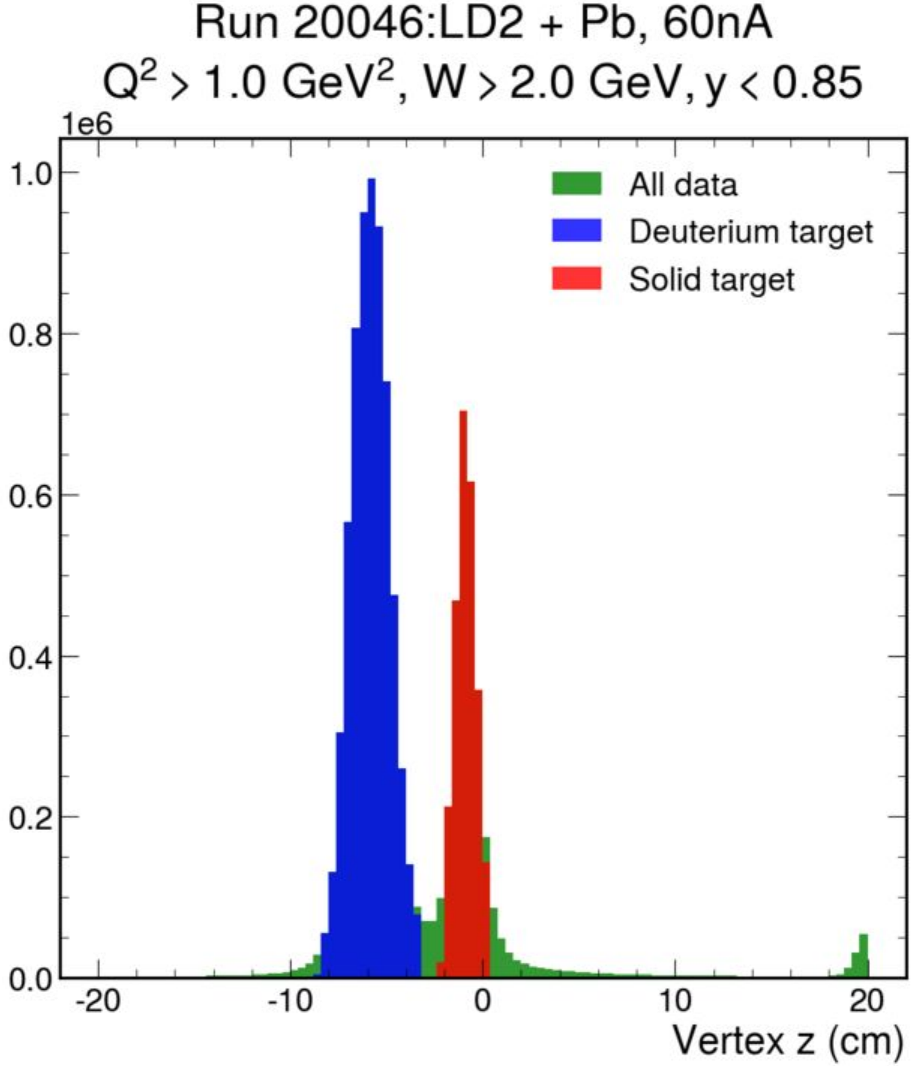
First look at the acceptance using simulation



Acceptance Corrections to the EMC ratio

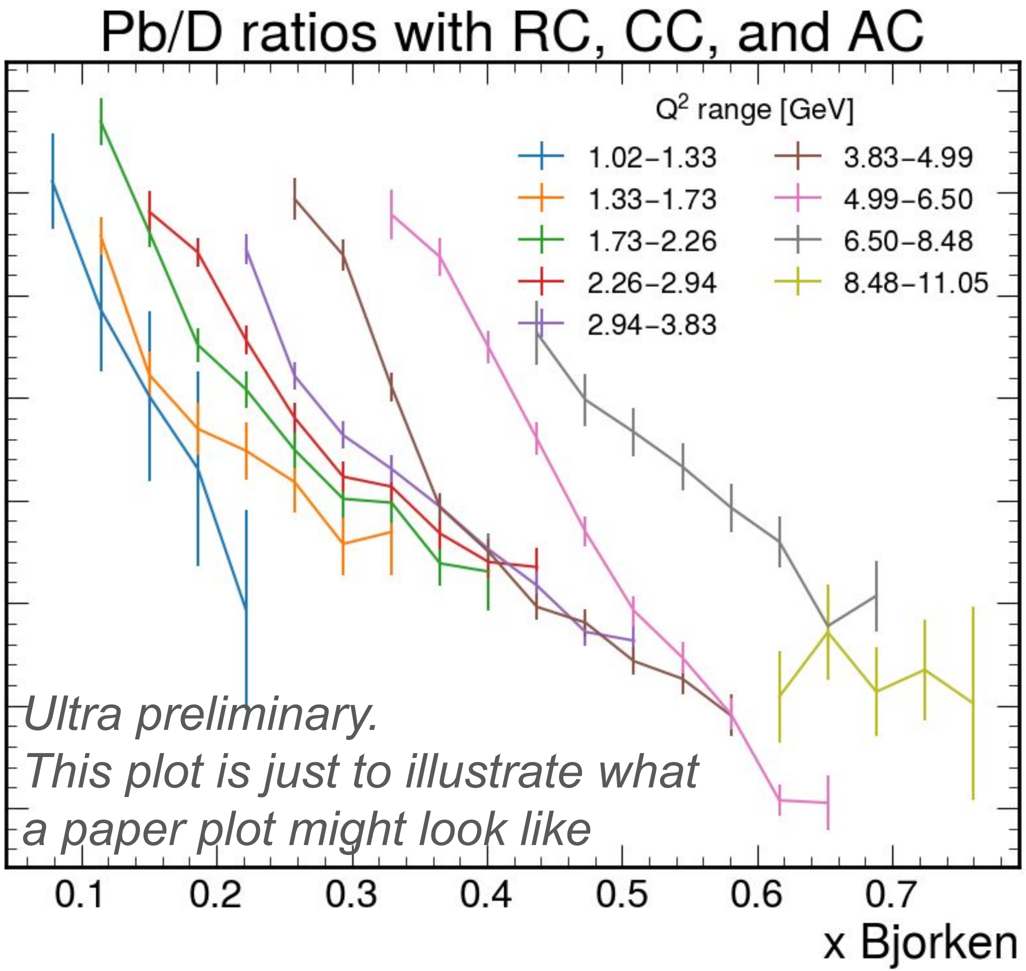


A peak at a single run of RGE data (pass0)



A peak at a single run of RGE data (pass0)

No fiducial cuts or Proper vertex or Proper ID cuts…



Ingredients for Inclusive DIS

- Vertex Selection (needs calibration / cooking)
- Electron ID and fiducial cut (needs calibration / cooking)
- Acceptance Correction (started, using CLAS12 GEMC)
- Radiative Correction (Done)
- Coulomb Correction (Done)
- ….

Conclusions

- Inclusive DIS with RGE data is pre-requisite for SIDIS analysis
- Pieces are moving, specially the model/simulation ones.
- Should be a straightforward, standalone, “legacy” measurement for nuclear PDFs, unique, high-luminosity coverage in A, x, and Q2

Credit to Ryan, Sebouh for plots, and RGE team for data