DIFFRACTIVE DIS

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Inclusive DIS Analysis Cuts

Primary Kinematic Cuts:

- Inelasticity (y): $0.01 < y < 0.95$

Lower cut removes the poorly reconstructed events; upper cut removes challenging electron finding

- Photon virtuality: $Q^2 > 1.0\ \mathrm{GeV}^2$

Can start at 2 for better quality

- Light cone energy: $32 < E - p_z < 40\ \mathrm{GeV}$

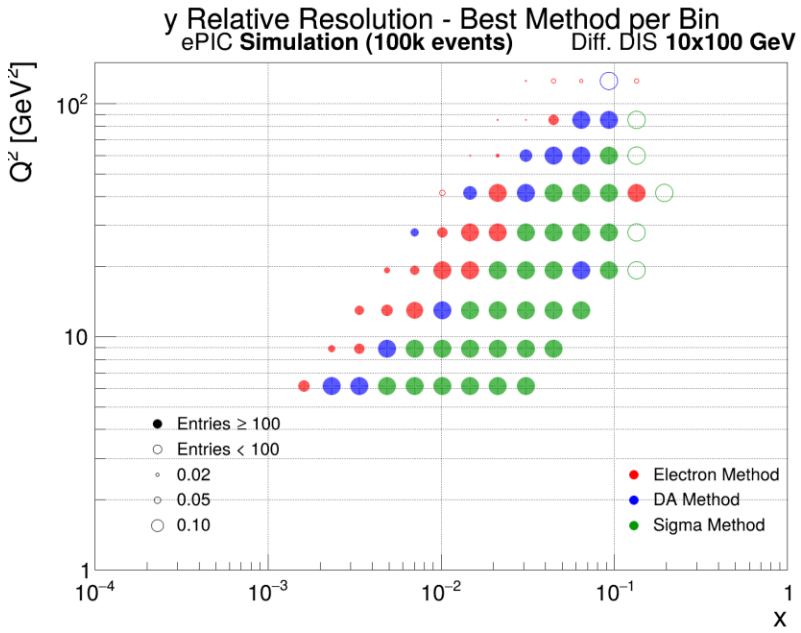
Lower cut removes ISR; upper cut removes poorly reconstructed

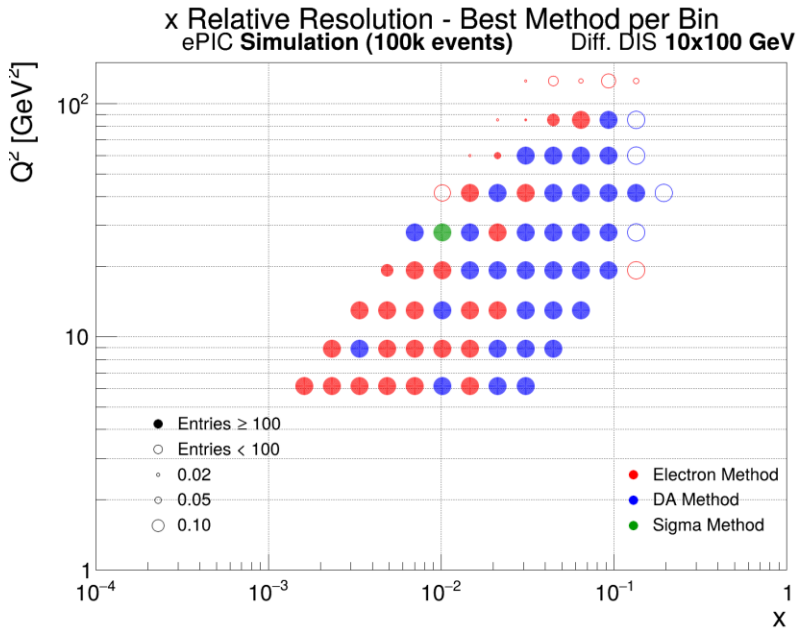
PDF impact studies: $W^2 > 10\ \mathrm{GeV}^2$

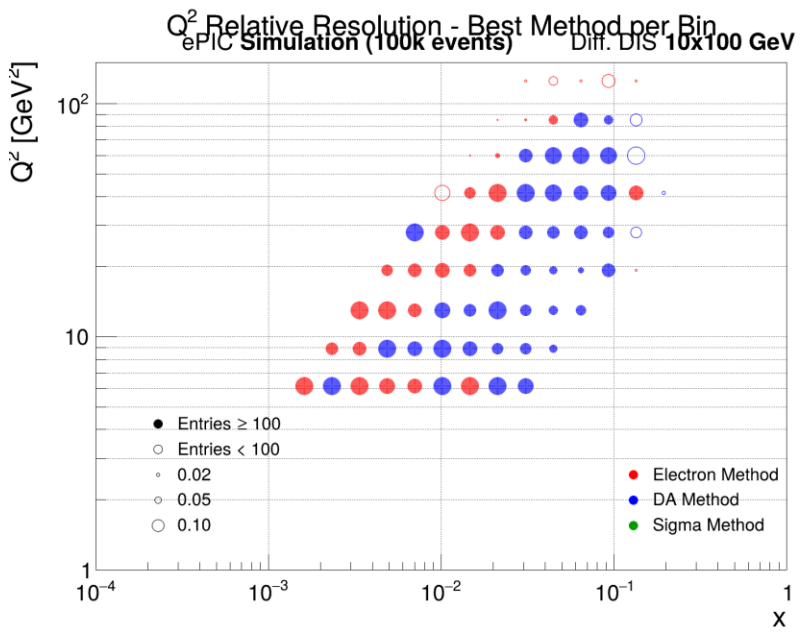
Avoids higher-twist effects

$M_X^2 > 4\ \mathrm{GeV}^2$

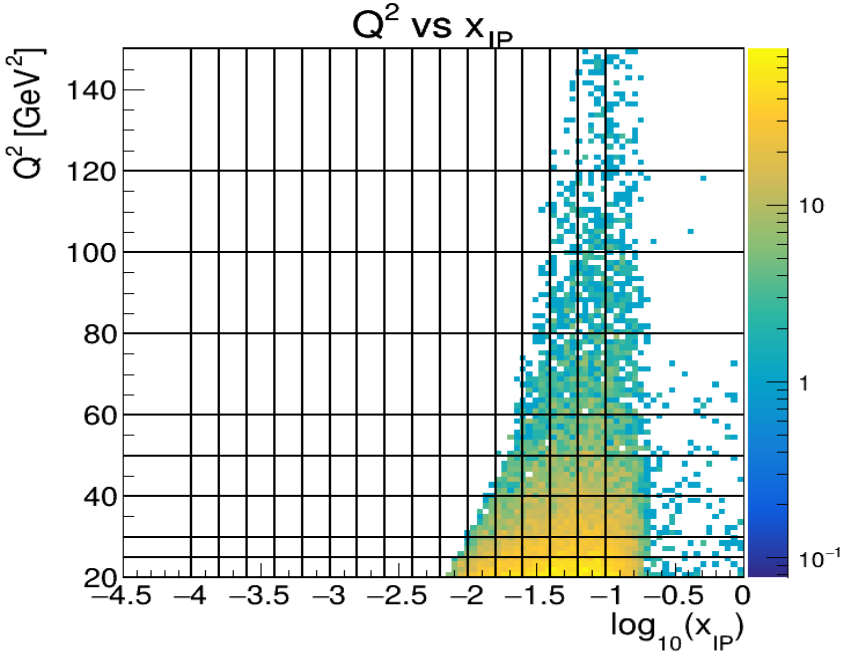
Update of phase space plot – Inc.Variables

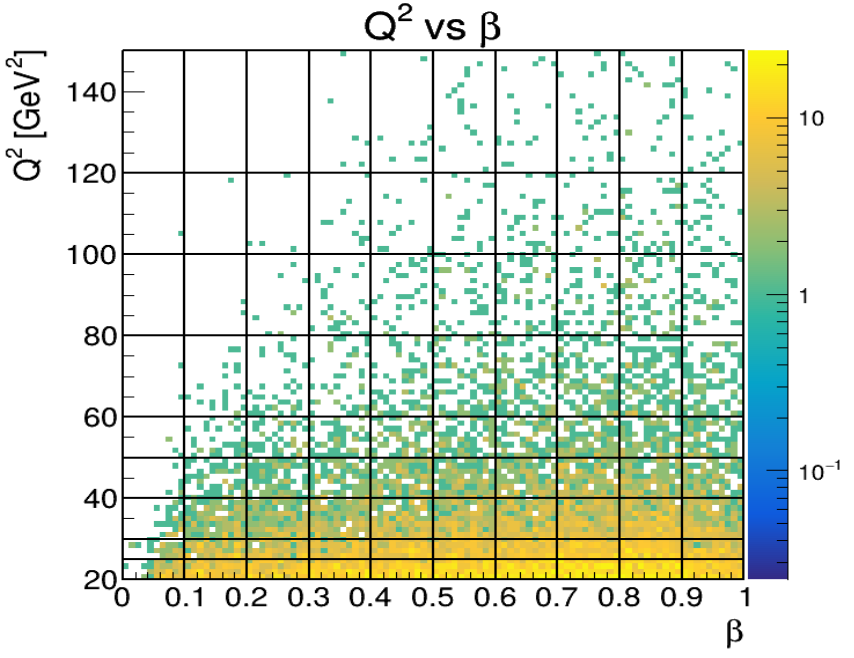


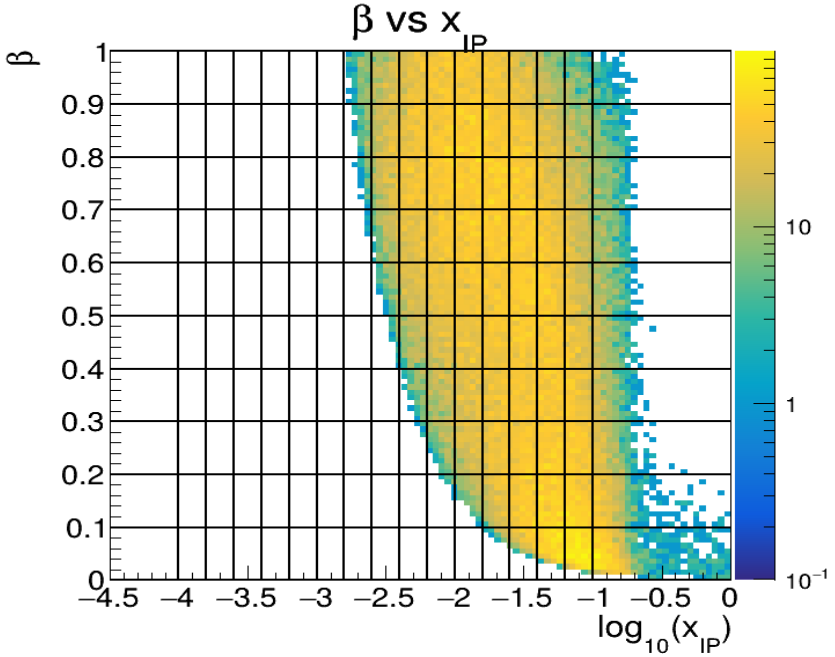


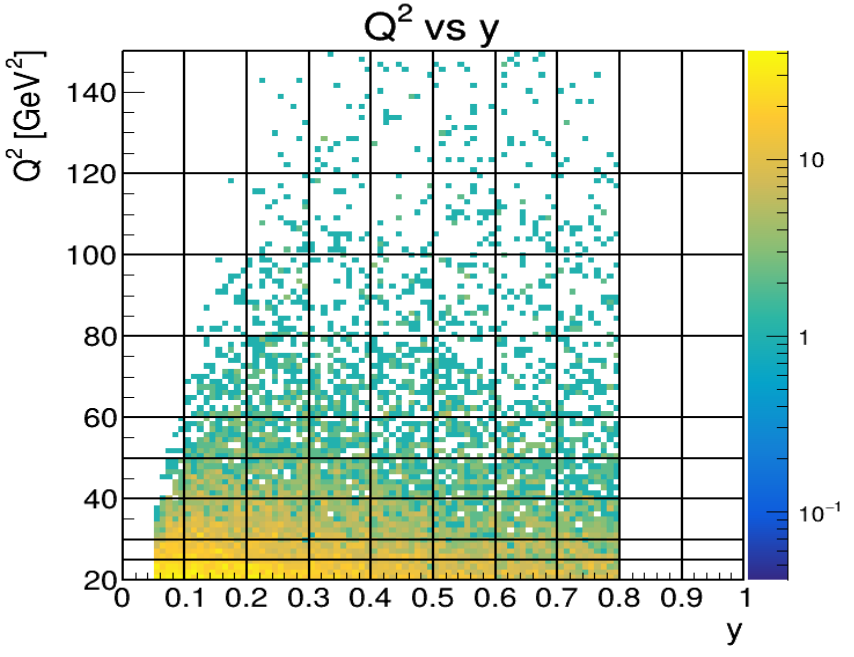


Binning Scheme









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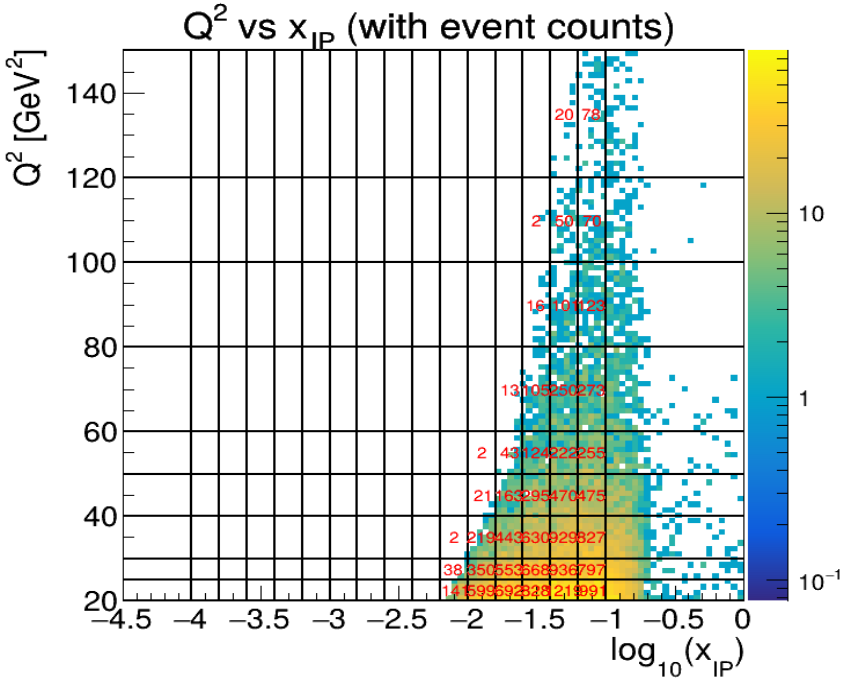
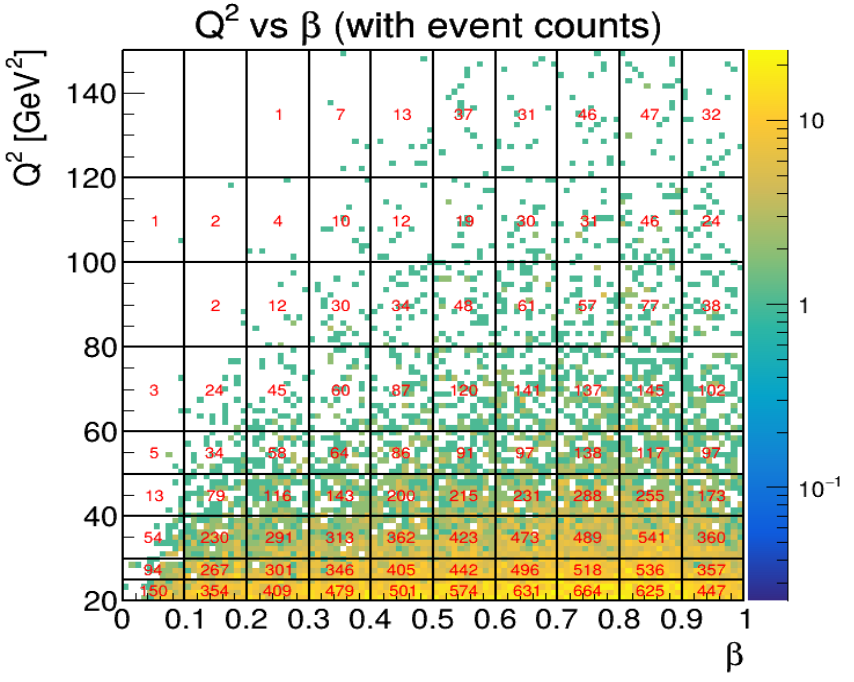
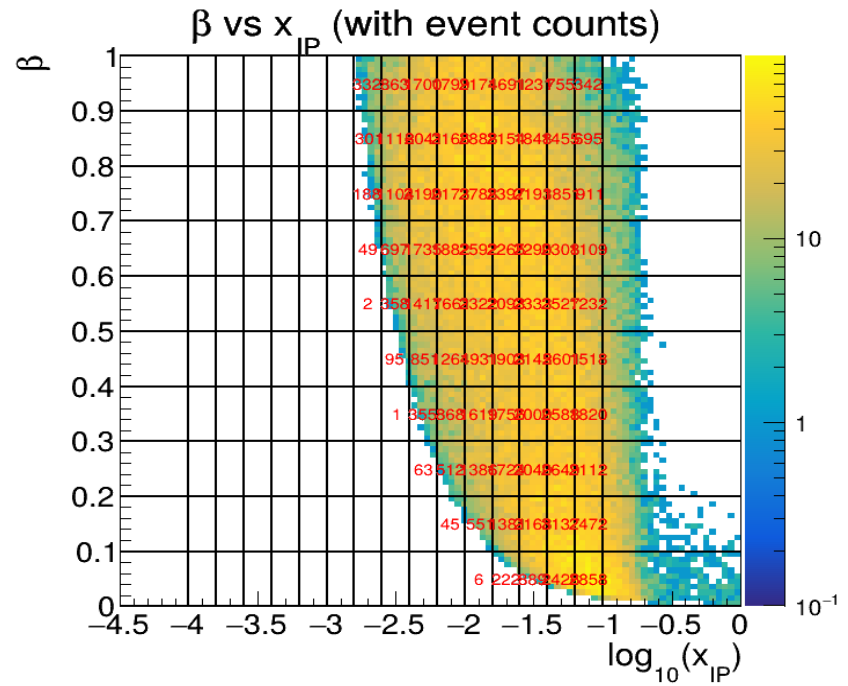
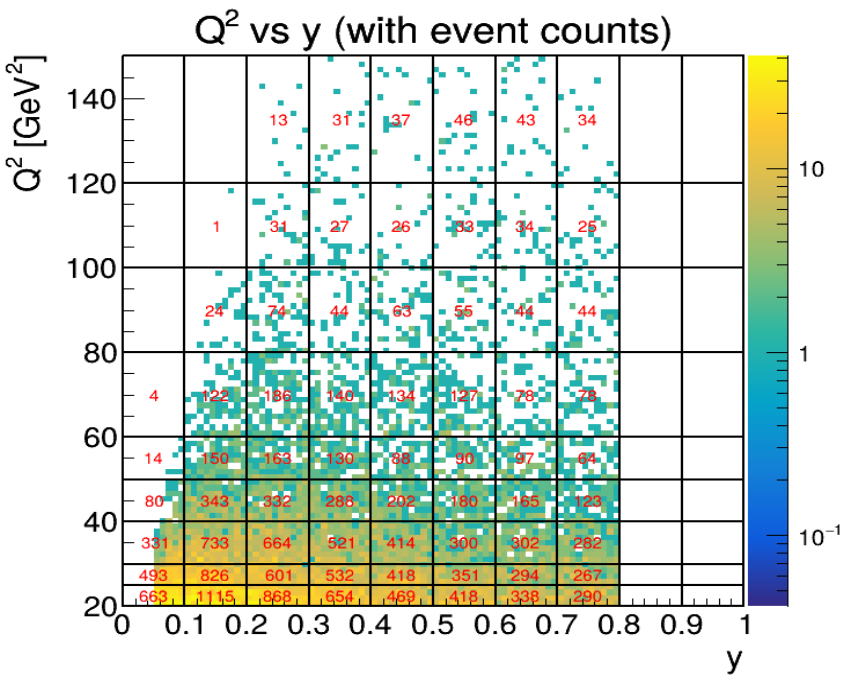
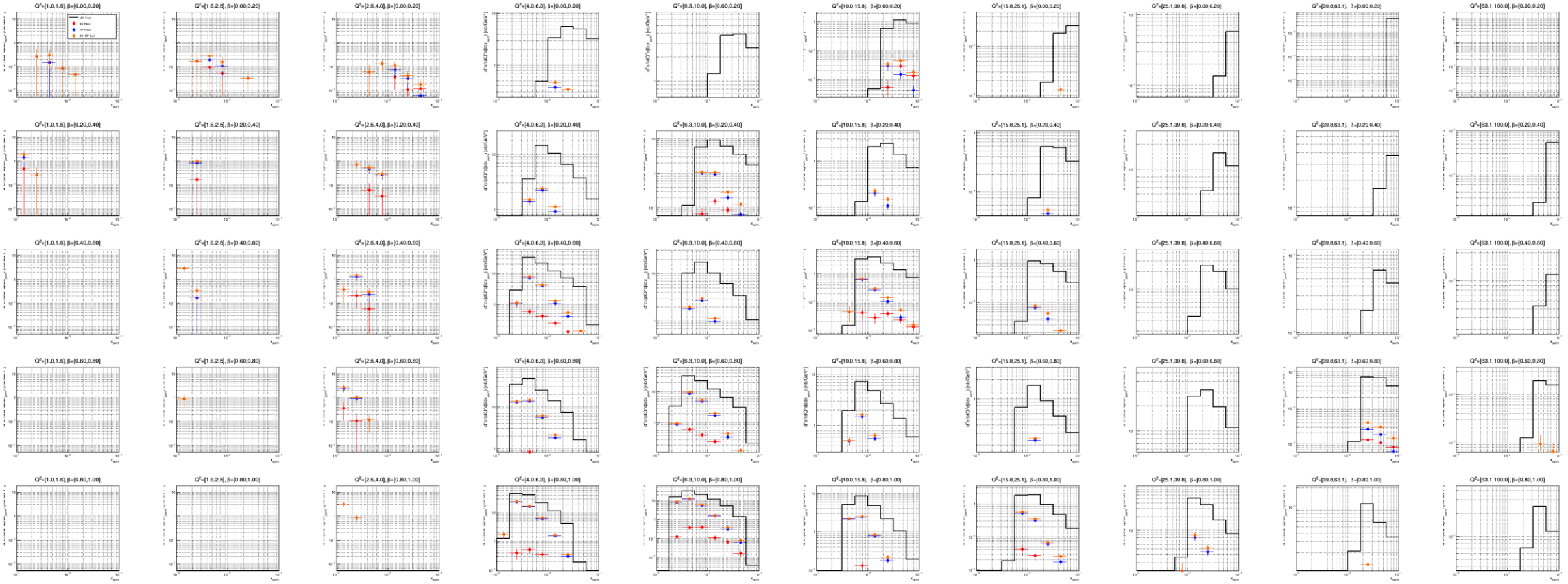








Triple differential Corss-section

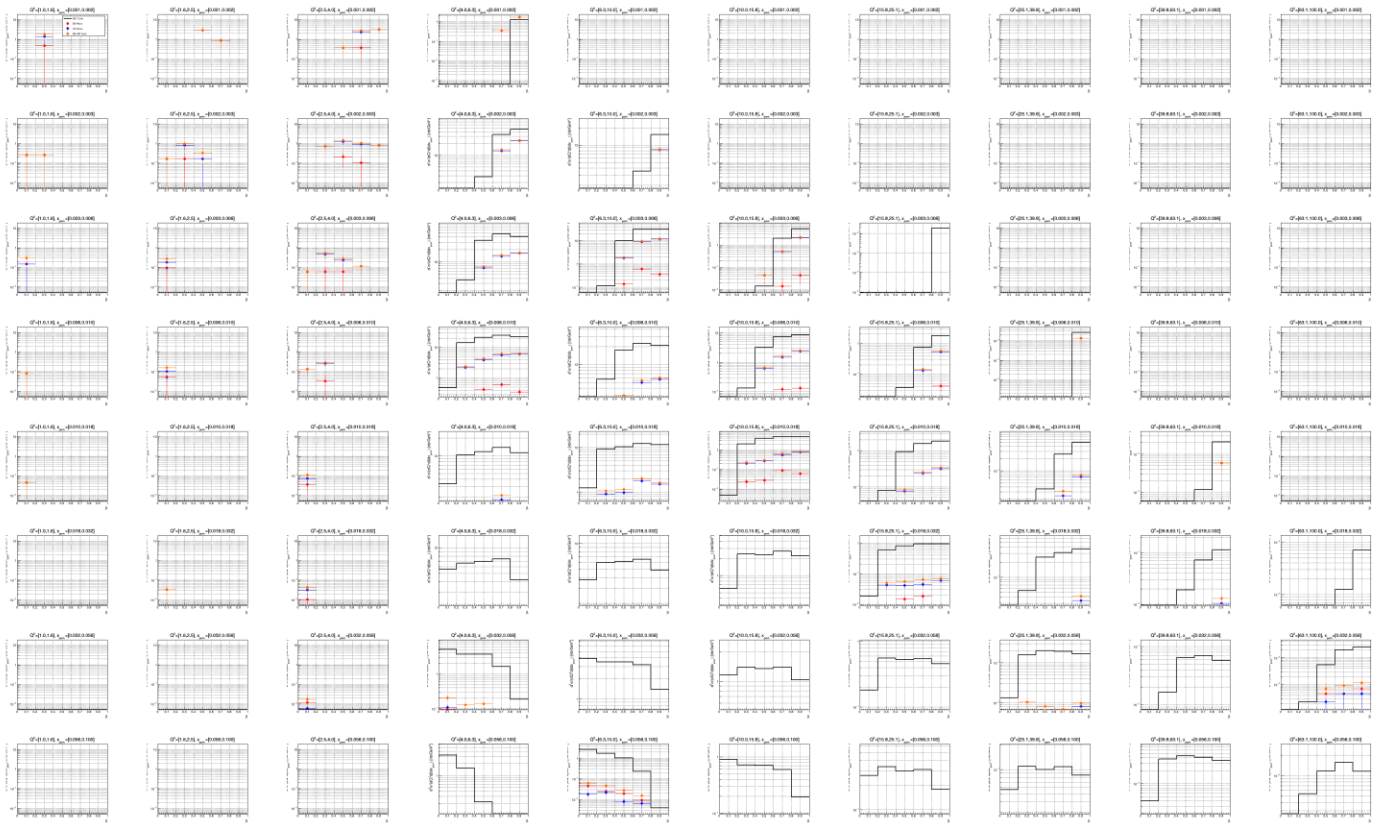


Kinematic reconstructions	quantity	Reco	Truth	Response (2D)	Purity/bin migration	detector acceptance-only corrected	Unfolding/full correction
(electron,JB, DA,sigma, e-sigma)	Q2	☐	☐	☐	☐	☐	☐
	x	☐	☐	☐	☐	☐	☐
	y	☐	☐	☐	☐	☐	☐
	dQ2/Q2	☐	☐	☐	☐	☐	☐
	dx/x	☐	☐	☐	☐	☐	☐
	dy/y	☐	☐	☐	☐	☐	☐
	e' energy	☐	☐	☐	☐	☐	☐
	e' theta	☐	☐	☐	☐	☐	☐
	HFS (E-pz)	☐	☐	☐	☐	☐	☐
	HFS (pT)	☐	☐	☐	☐	☐	☐
Event level		☐	☐	☐	☐	☐	☐
	E-pz (e'+HFS)	☐	☐	☐	☐	☐	☐
	E/p for calorimeter	☐	☐	☐	☐	☐	☐
	Calo clusters	☐	☐	☐	☐	☐	☐
Observable of interest		☐	☐	☐	☐	☐	☐
	e.g., t,u,etc.	☐	☐	☐	☐	☐	☐
Detector specific variables	Depends	☐	☐	☐	☐	☐	☐
PID quantities:	Add when it comes	☐	☐	☐	☐	☐	☐

Next

- Selection cut
- Binning scheme
- Redo the resolution study after selection+binning
- Comments/suggestions welcome

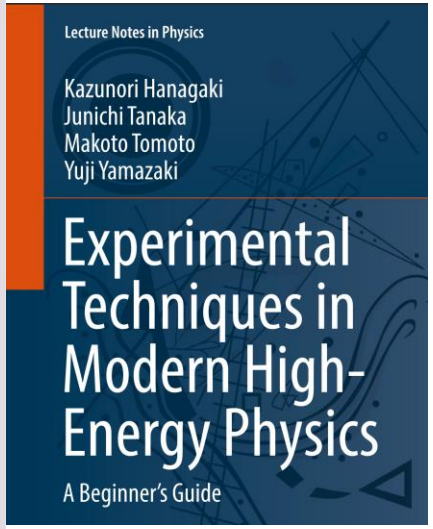
Triple differential cross section vs. beta



Acceptance vs. acceptance

The number of events which are measured in the bin i(passing all the selection cuts), divided by the number of generated events in the i-th bin. (V.Sola pp139)

$$A_i = \frac{N_i^{\mathrm{rec}}}{N_i^{\mathrm{gen}}}$$



$$(\text{acceptance}) = \frac{N_{\mathrm{sel}}}{N},$$

where N_{sel} denotes the number of events passing the selection criteria, imposed on *true* four-momenta of particles, while N is the number of events from the processes in concern. Here, the *true* four-momentum means that it is used in theoretical calculation without detector smearing. This may be available in event generators (see Chap. 7).

Purity vs. purity

Purity in i-th bin is number of **MC events generated and reconstructed (selection cut passed) in i-th bin** divided by **number of MC generated events in i-th bin**. (V.Sola pp139)

$$P_i = \frac{N_i^{\text{gen \& rec}}}{N_i^{\text{gen}}}$$

https://arxiv.org/pdf/2503.19836v2

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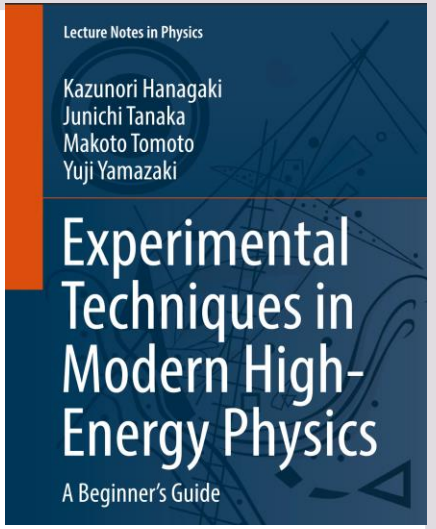
The purity in each bin is the fraction of fiducial events in a given detector-level bin which are in the same bin at particle-level. This is essentially the diagonal component of the migration matrix divided by the sum of the reconstruction level column for each bin. It is about 70% for masses of 150 GeV, and larger



efficiency

Since there is no detector with 100% detection efficiency, we necessarily lose events by the inefficiencies of the detectors. We often treat the loss of this effect to the acceptance separately from the geometrical acceptance and call it *efficiency*, defined as

$$(\text{efficiency}) = \frac{N_{\text{det} \bigcap \text{sel}}}{N_{\text{sel}}},$$

where $N_{\text{det} \bigcap \text{sel}}$ denotes the number of events passing the selection criteria imposed on quantities obtained from measurements, while N_{sel} is the number of events passing the selection criteria imposed on true four-momenta of particles.

Note that a detailed definition of acceptance and efficiency may be different from what is given above and may depend on physics analysis or literature.

Current Definitions

Acceptance:

Definition Acceptance = N(gen in i AND reco in i with cuts) / N(gen in i)

Physical meaning: Fraction of generated events in bin i that are successfully reconstructed in the same bin AND pass selection cuts

Efficiency:

Definition Efficiency(i) = N(reco in bin i with cuts) / N(reco in bin i before cuts)

Differs from V.Sola thesis

Physical meaning: Fraction of reconstructed events (in correct bin) that pass the selection cuts; measures cut efficiency

Purity:

Definition Purity = N(gen in i AND reco in i) / N(all reco in i)

Physical meaning: Fraction of reconstructed events in bin i that truly originated from bin i; quantifies bin contamination from migrations

Dear Sakib,

I'm preparing a simulation production request for inclusive diffractive DIS analysis using RAPGAP 3.303, and I'd like to confirm the correct procedure based on the epic-prod documentation.
Planned Setup:

Generator: RAPGAP 3.303 (steering files only, not modifying source)
Physics: Diffractive inclusive DIS
Beam configuration: 10x100 GeV, (18x275 later)
Q2 range: >1 GeV2
Repository tag scheme: rapgap3.303-1.0

My Understanding of the Steps:

- Create a GitHub repository (under EIC organization) containing RAPGAP steering files and documentation (I have access)
- Generate HepMC3 output files from RAPGAP
- Convert to ROOT format using hepmc3ascii2root converter
- Name files following the convention:
- rapgap3.303-1.0_DIFFR-DIS_10x100_q2_1to10000_run<index>.hepmc3.tree.root
- Upload to S3/JLab xrootd following directory structure:
  DIFFR/DIS/rapgap3.303-1.0/10x100/q2_1to10000/
- Fill out the production request form

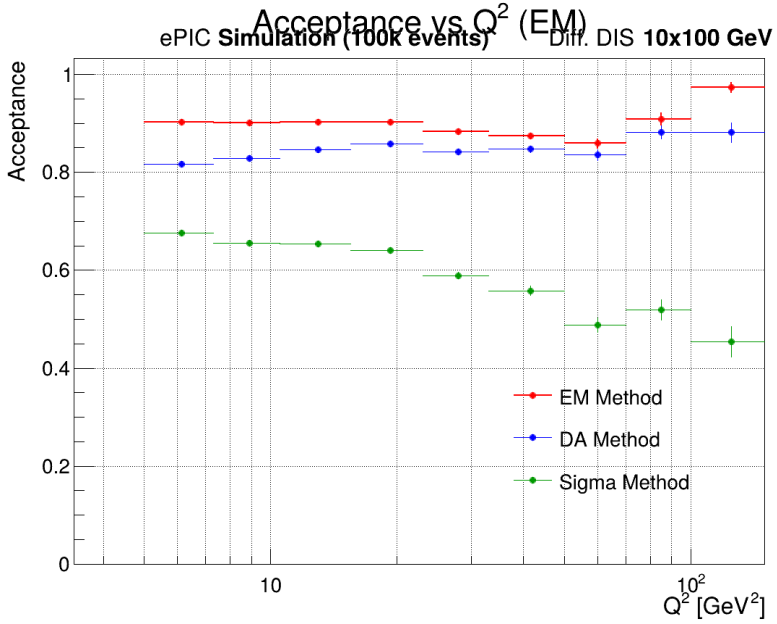
Questions:

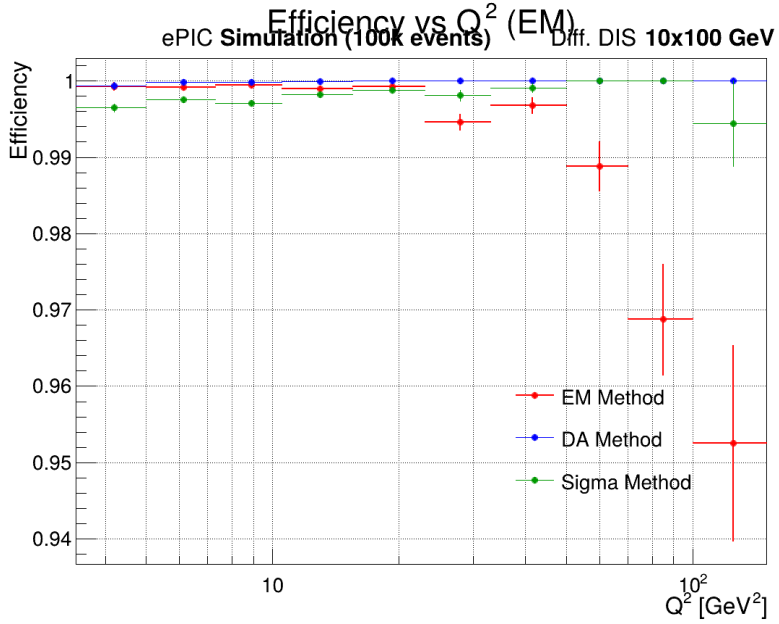
1) Can you confirm these steps are correct?
2) I don't have a BNL account - should I run RAPGAP and generate the HepMC files myself?
If yes, what's the preferred method to transfer the hepmc3.tree.root files to you?
3) Are there any specific requirements for the GitHub repository structure or documentation?
Any suggestions for the repository name?

The conveners have approved this production request. Please let me know if you need any additional information.

SIMULATION CAMPAIGN

Asked Sakib


Acceptance vs Q^2 (EM)
ePIC **Simulation (100k events)** Diff. DIS **10x100 GeV**
Acceptance
Q^2 [GeV^2]
EM Method
DA Method
Sigma Method


Efficiency vs Q^2 (EM)
ePIC **Simulation (100k events)** Diff. DIS **10x100 GeV**
Efficiency
Q^2 [GeV^2]
EM Method
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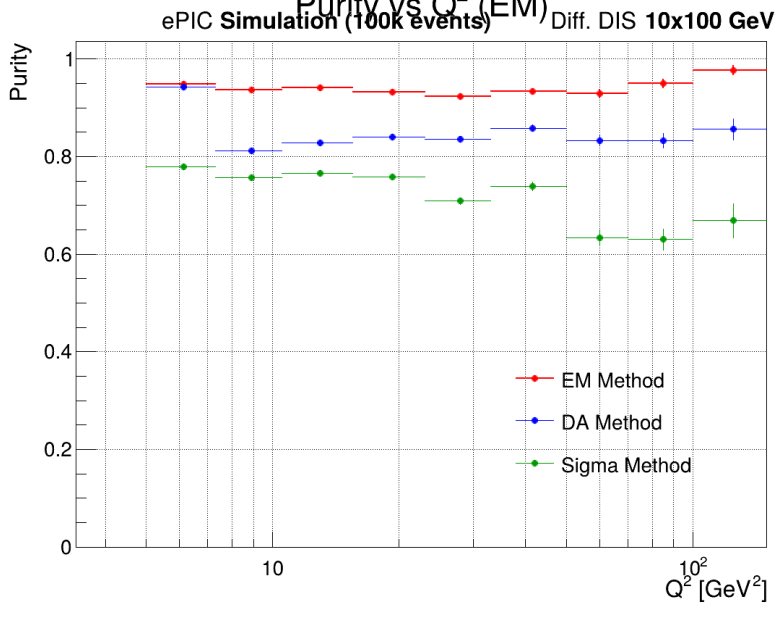
Purity vs Q^2 (EM)
ePIC **Simulation (100k events)** Diff. DIS **10x100 GeV**
Purity
Q^2 [GeV^2]
EM Method
DA Method
Sigma Method

- Currently working on the acceptance, efficiency and purity
- In parallel will work on the rapidity gap method
- Plot η_MAX distribution : have
- Validate kinematics: have
- Check resolutions : partially have
- Test binning schemes: need to do
- Working on finalizing the binning
- In contact with the people for simulation
- As far as I know the B0 problem is still there