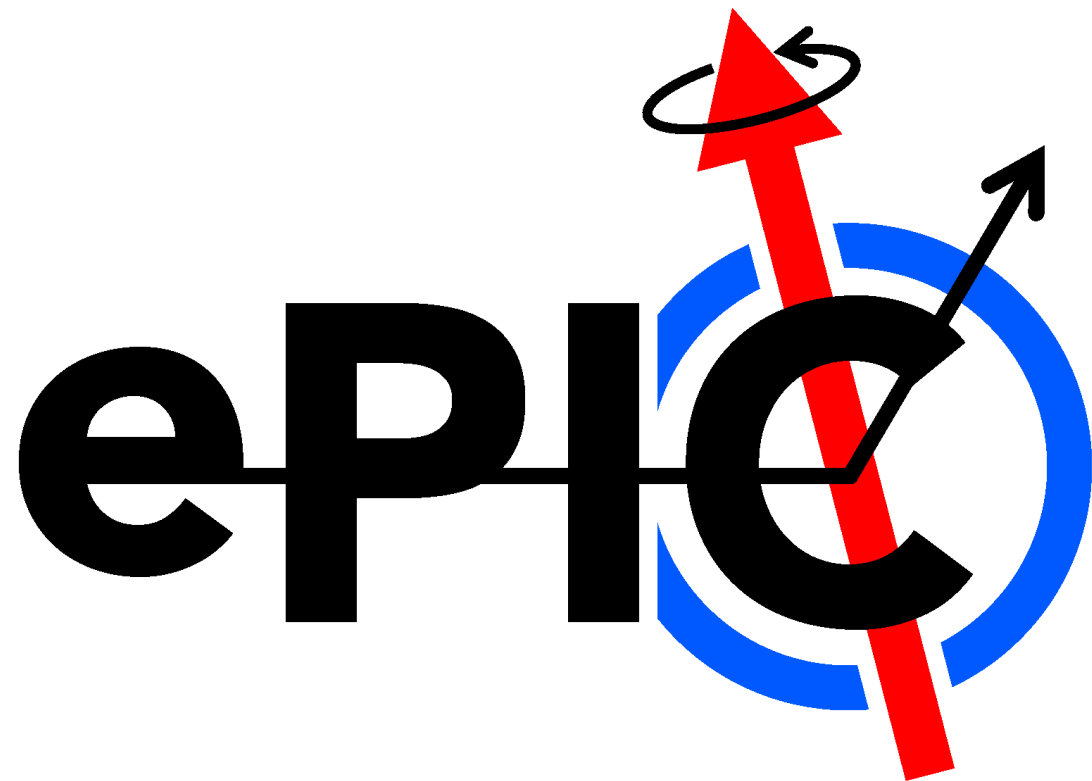


Inclusive physics for the TDR

Tyler Kutz & Claire Gwenlan

ePIC TDR kickoff meeting

February 5, 2024



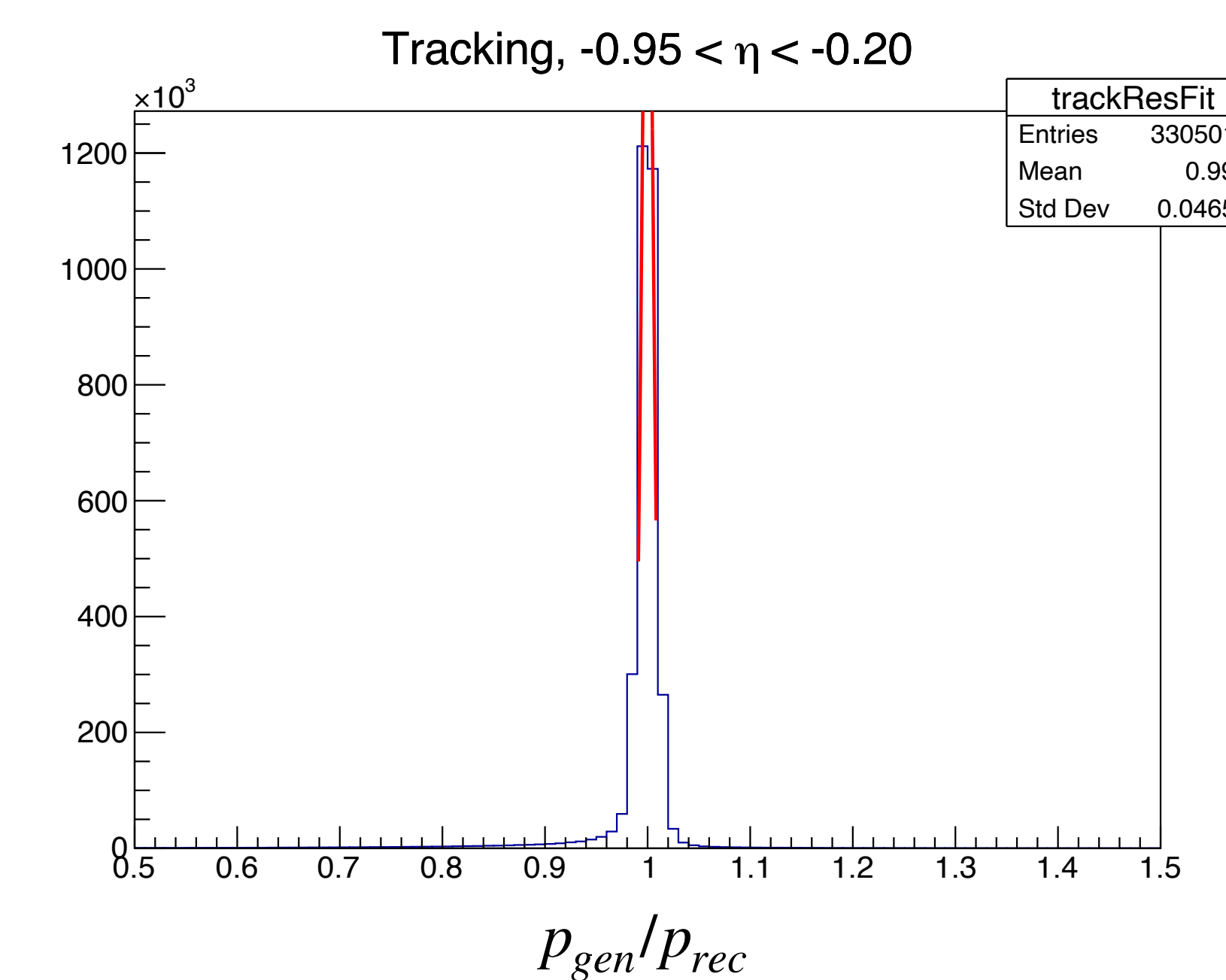
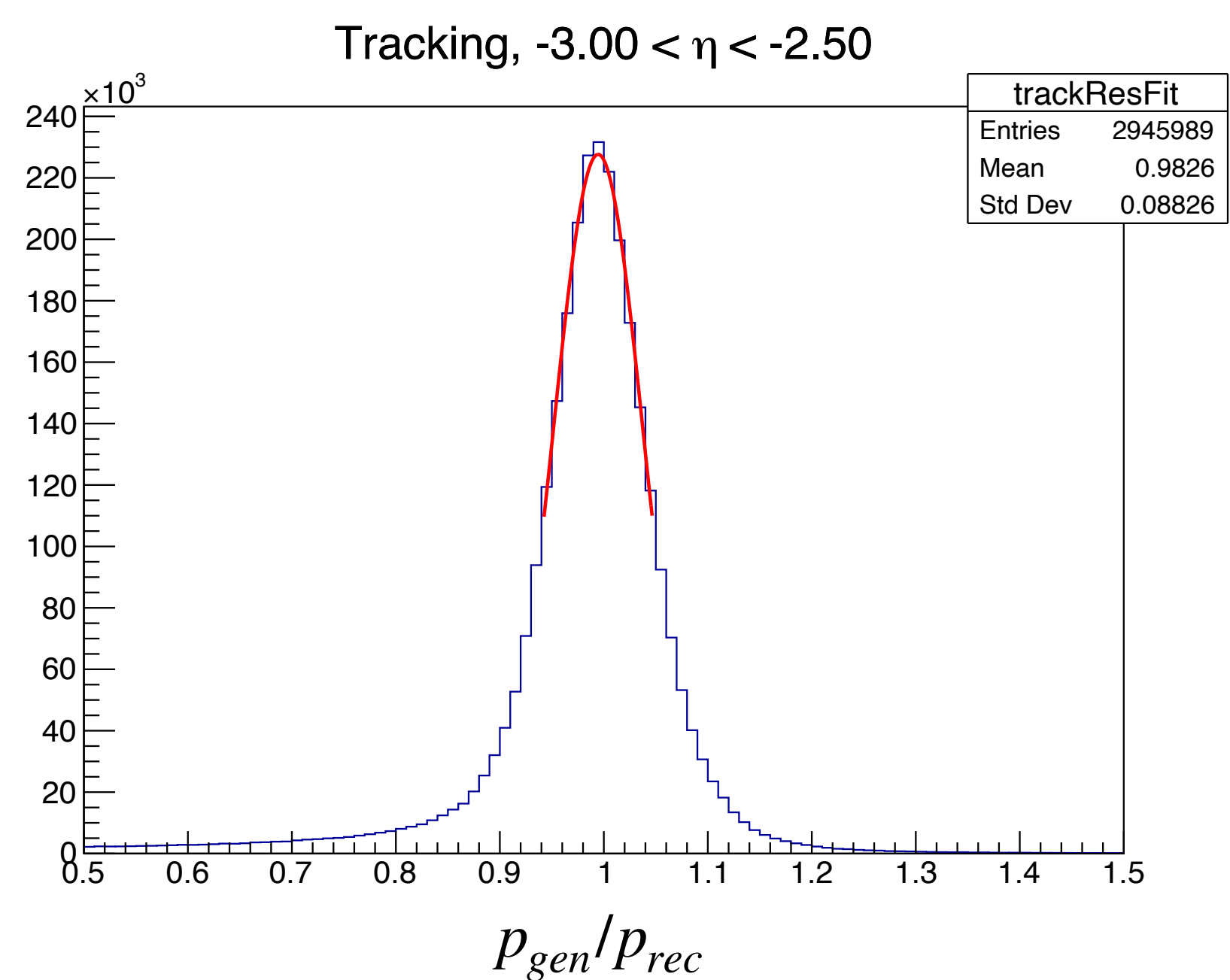
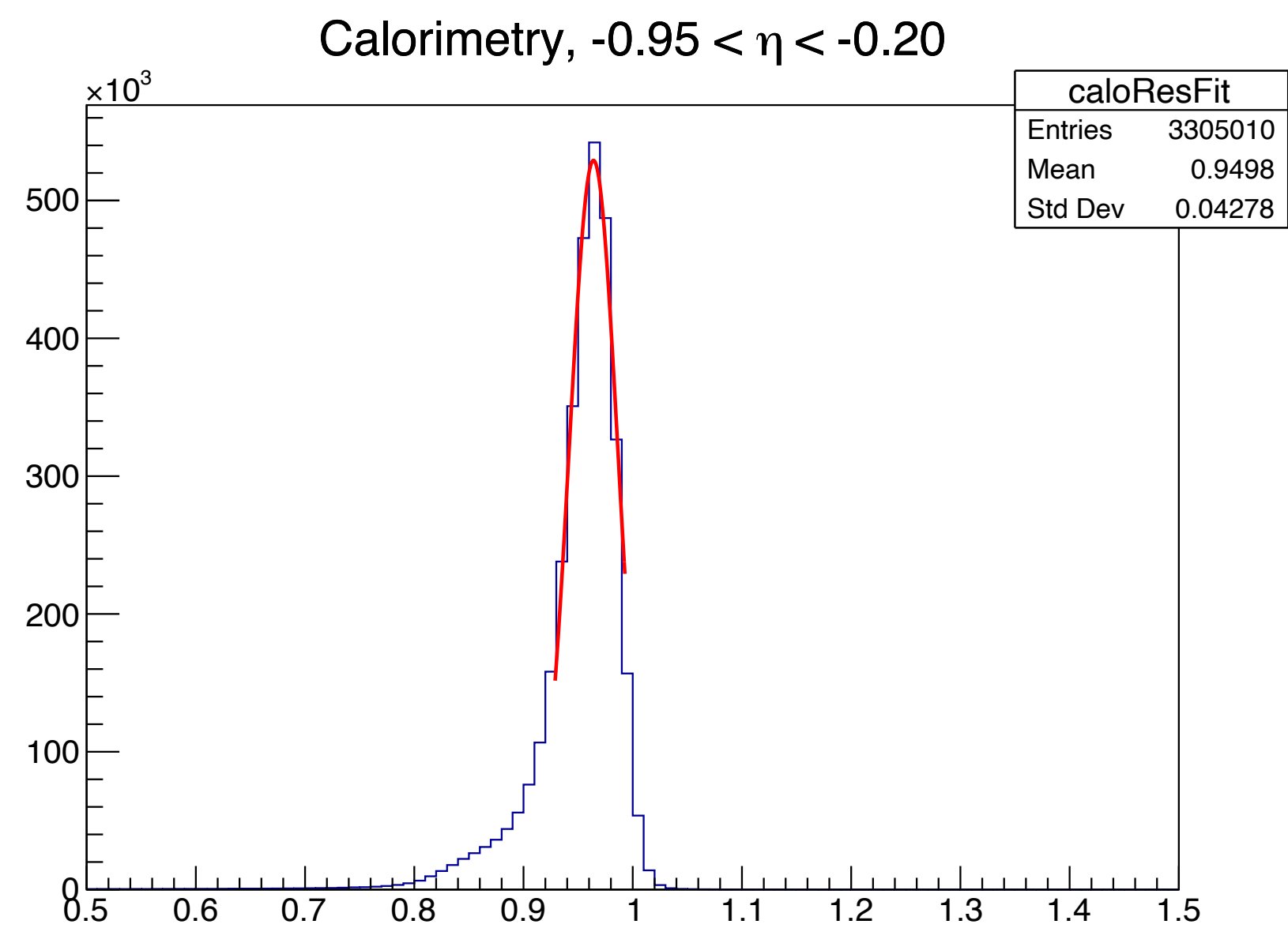
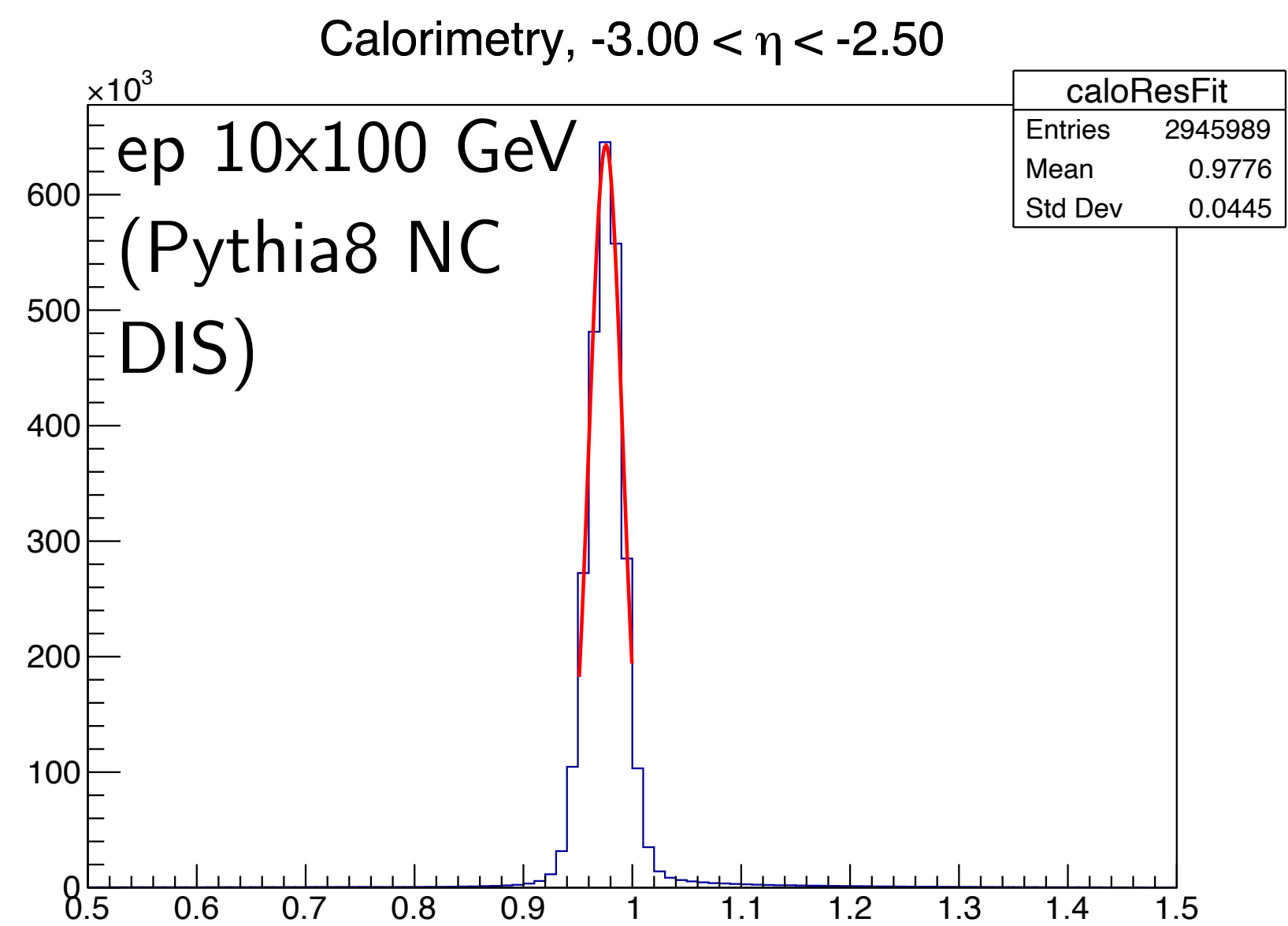
Goals for TDR

- Electron ID
- Resolutions (electron energy, kinematic variables)
- Corrections, stability/purity
- Physics studies
 - Neutral-current reduced cross sections, F_L
 - Double-spin asymmetries A_1^p , $A_1^{^3He}$, A_1^n
- Systematics...

General comments/caveats

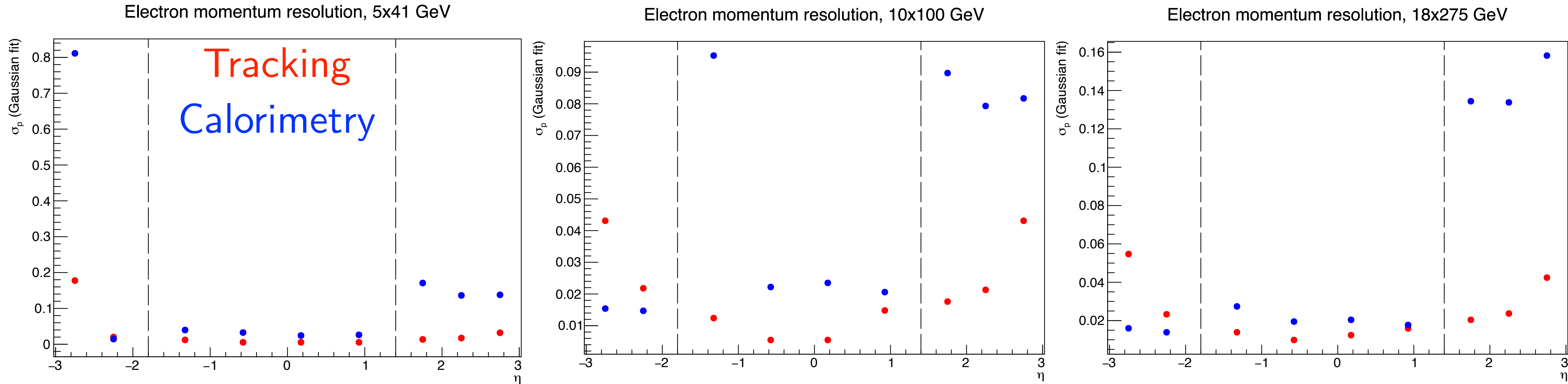
- Pythia 8 NC DIS simulation
- 10x100 GeV unless otherwise specified
- Truth-seeded tracks, truth calorimeter clusters (where available)
- Using “standard” (x_B, Q^2) binning of 5 logarithmic bins per decade (to be optimized based on resolutions)

Electron momentum resolutions



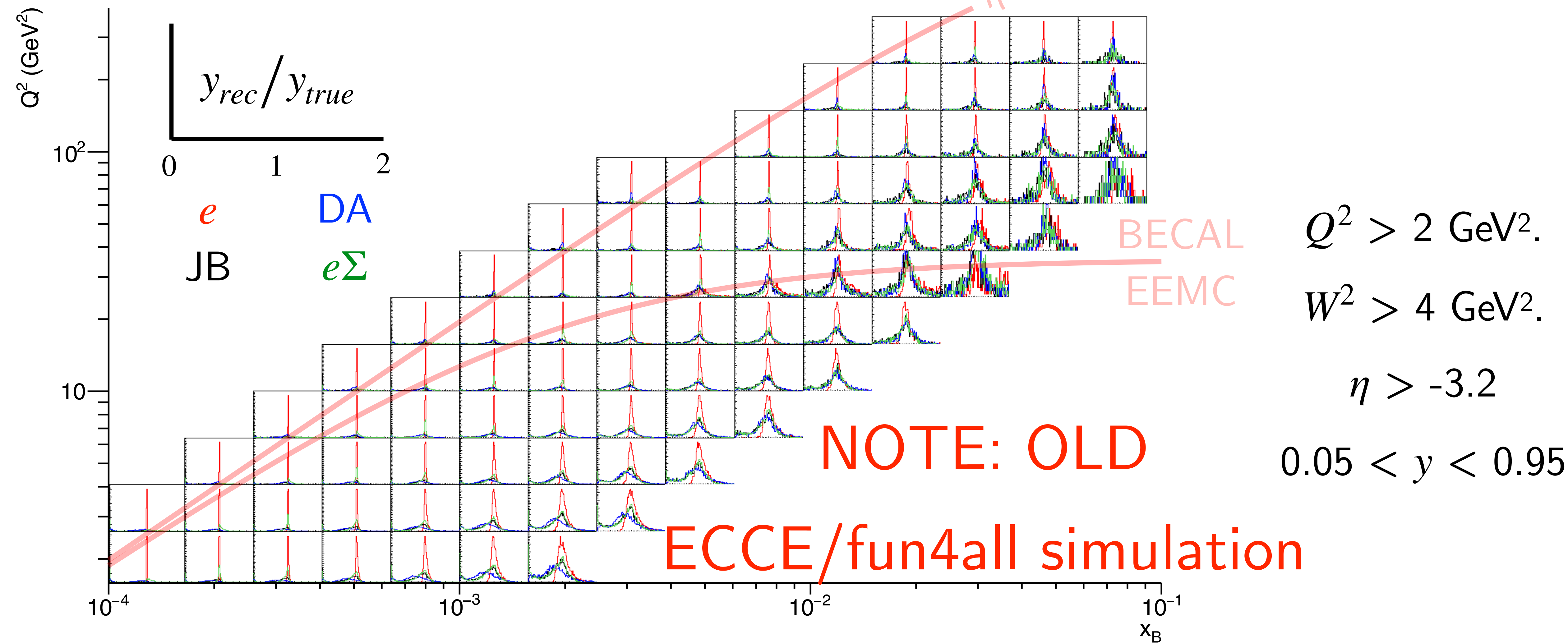
- Calorimeter requires calibration
- Calorimeter resolution better in electron endcap
- Tracking resolution better in barrel
- Quantify with fits (but this ignores tails...)

Electron momentum resolutions



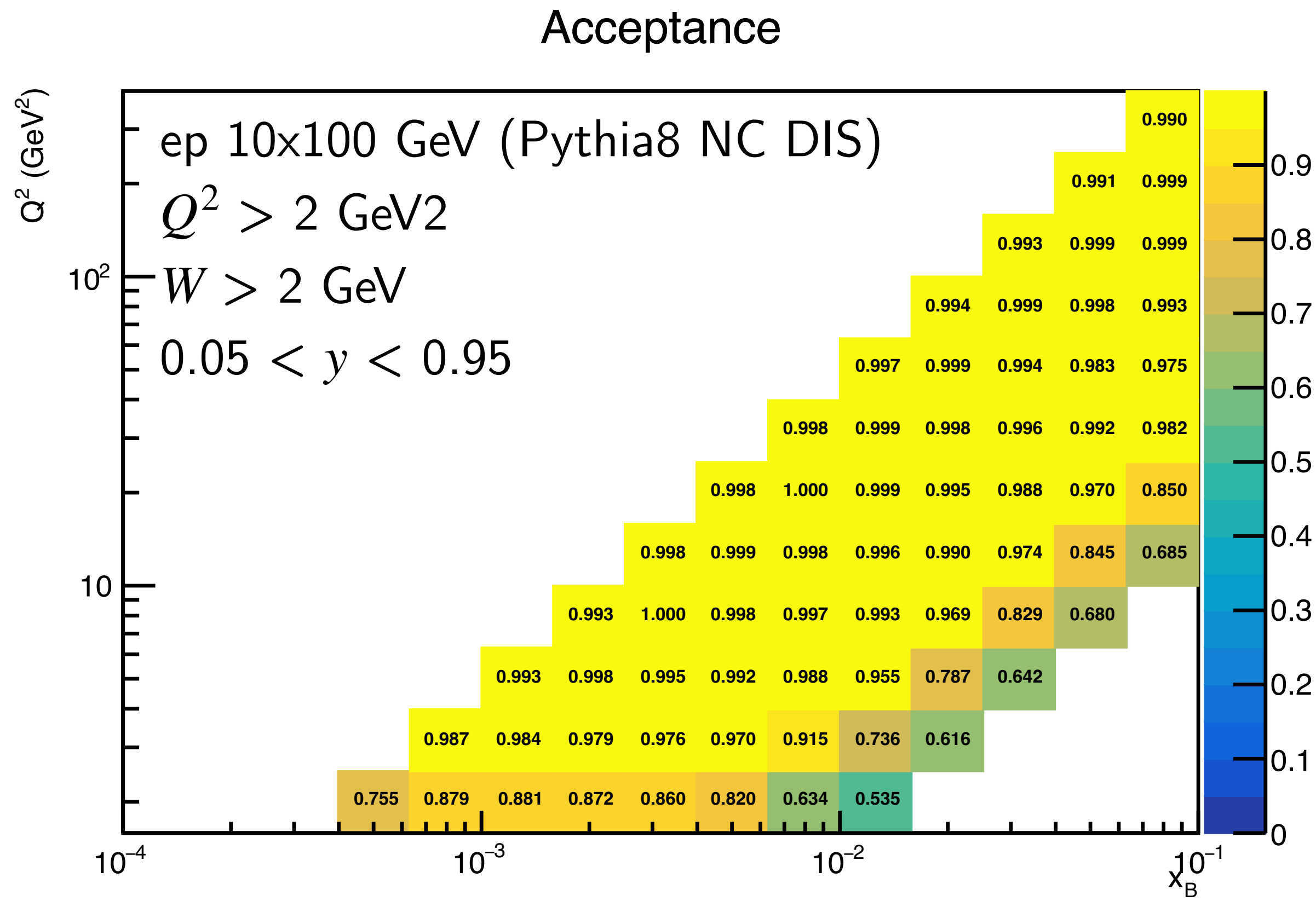
- Some outliers need additional investigation/work (e.g. cluster merging?)
- Use resolution maps for weighted combination of tracking, calorimetry

Kinematic resolutions

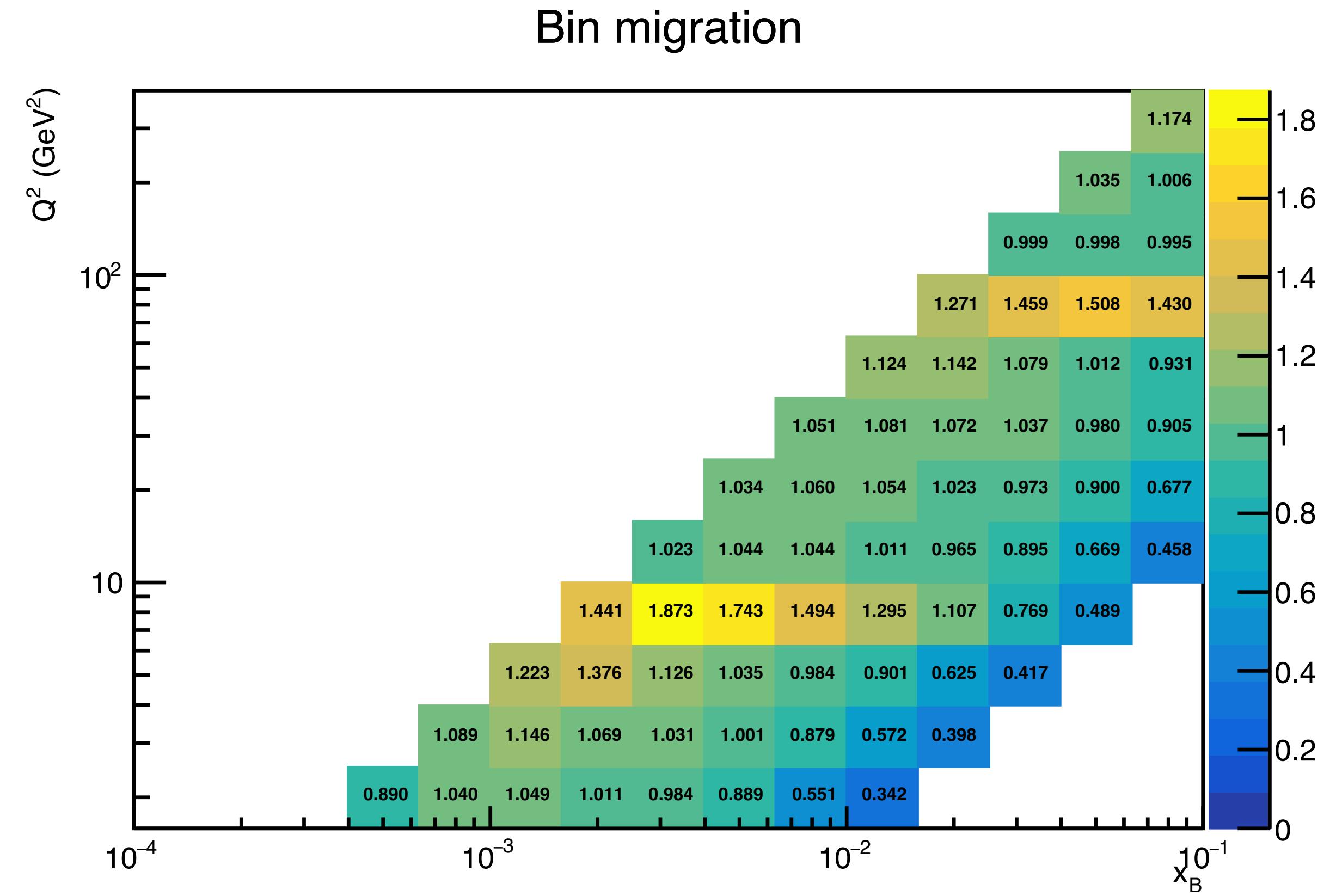


- Working on reproducing this with ePIC simulation

Acceptance and bin migration corrections

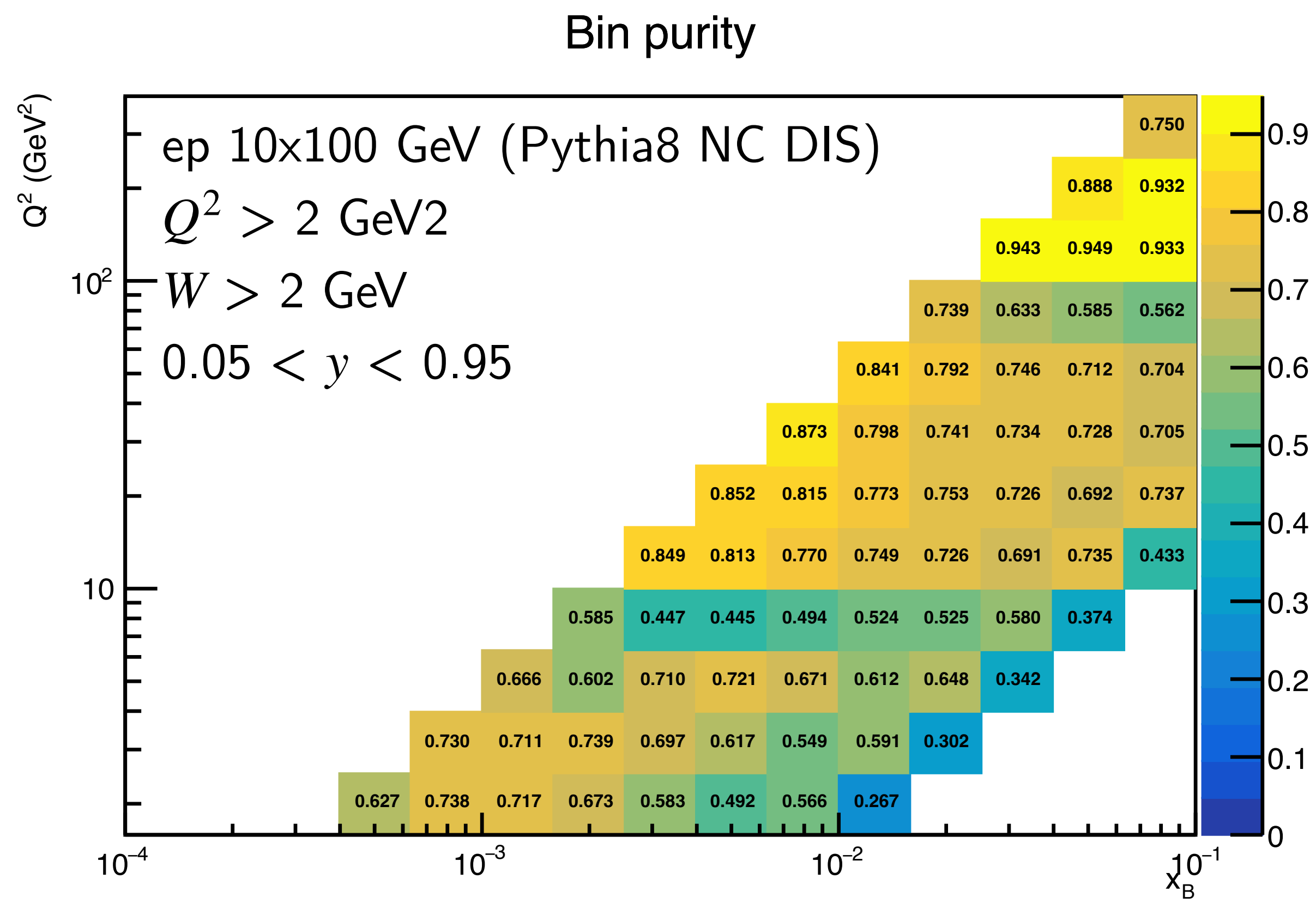


$$C_{acc} = \frac{N_{rec}(x_{gen}, Q_{gen}^2)}{N_{gen}(x_{gen}, Q_{gen}^2)}$$

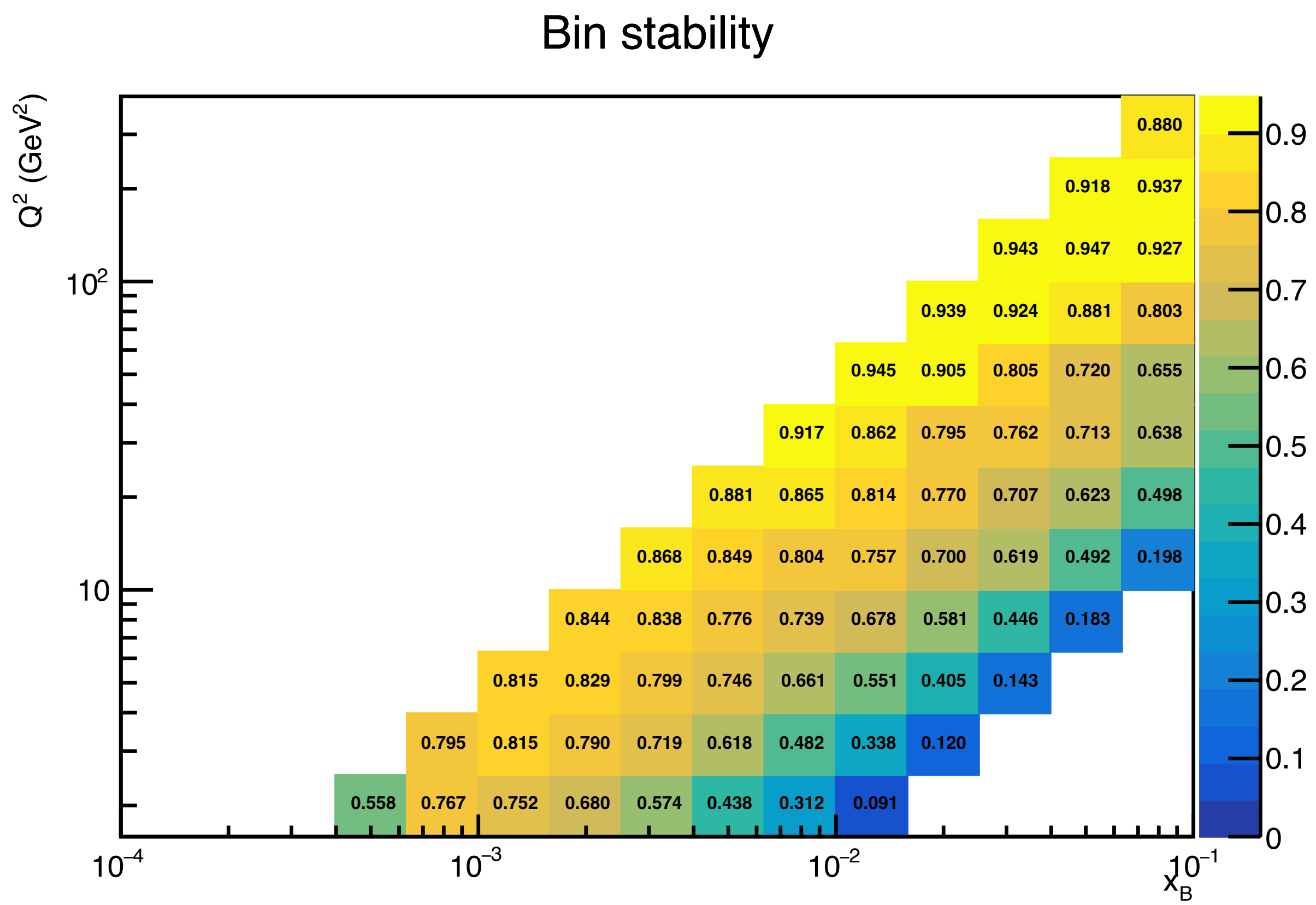


$$C_{bin} = \frac{N_{rec}(x_{rec}, Q_{rec}^2)}{N_{rec}(x_{gen}, Q_{gen}^2)}$$

Bin stability and purity



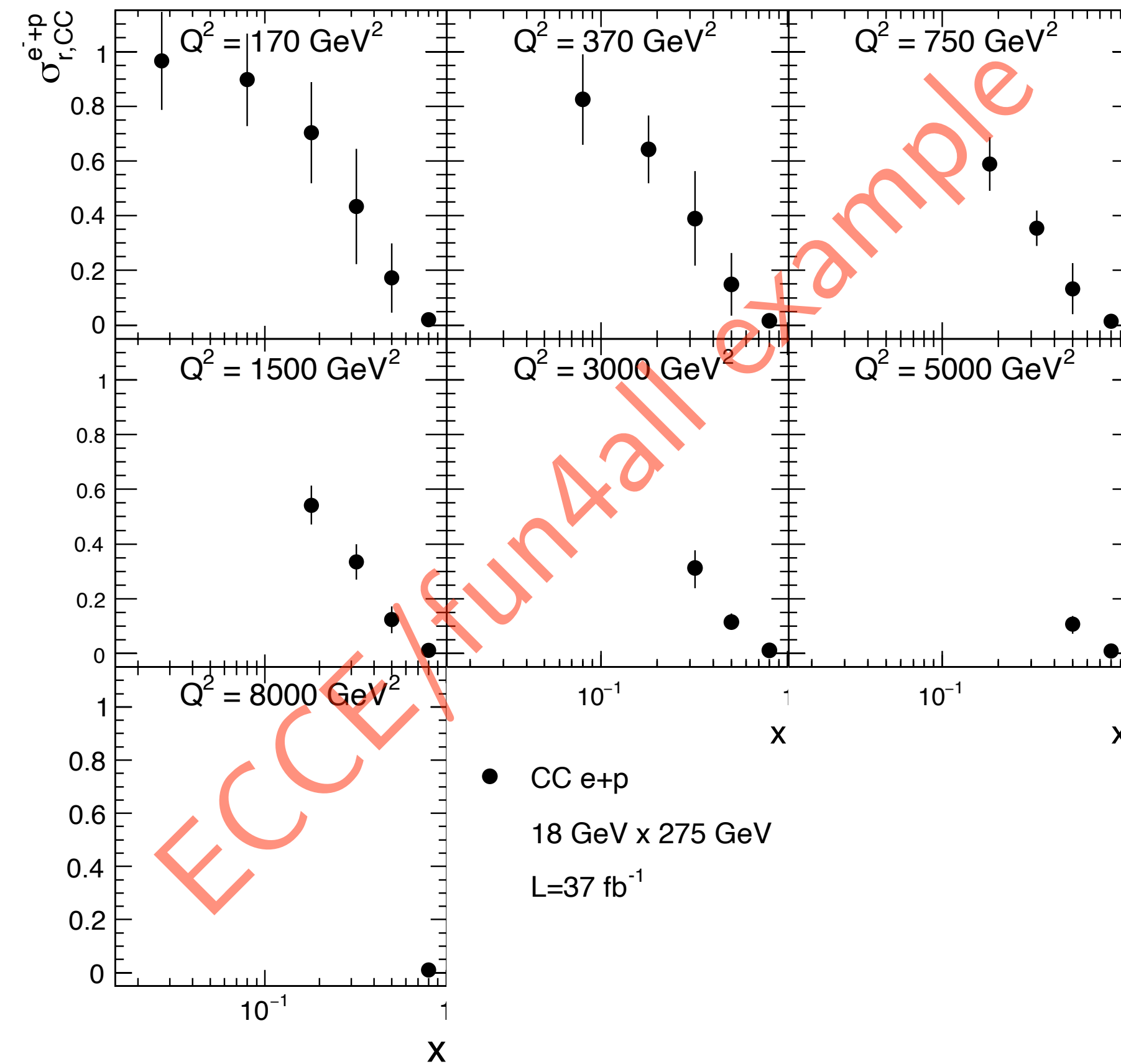
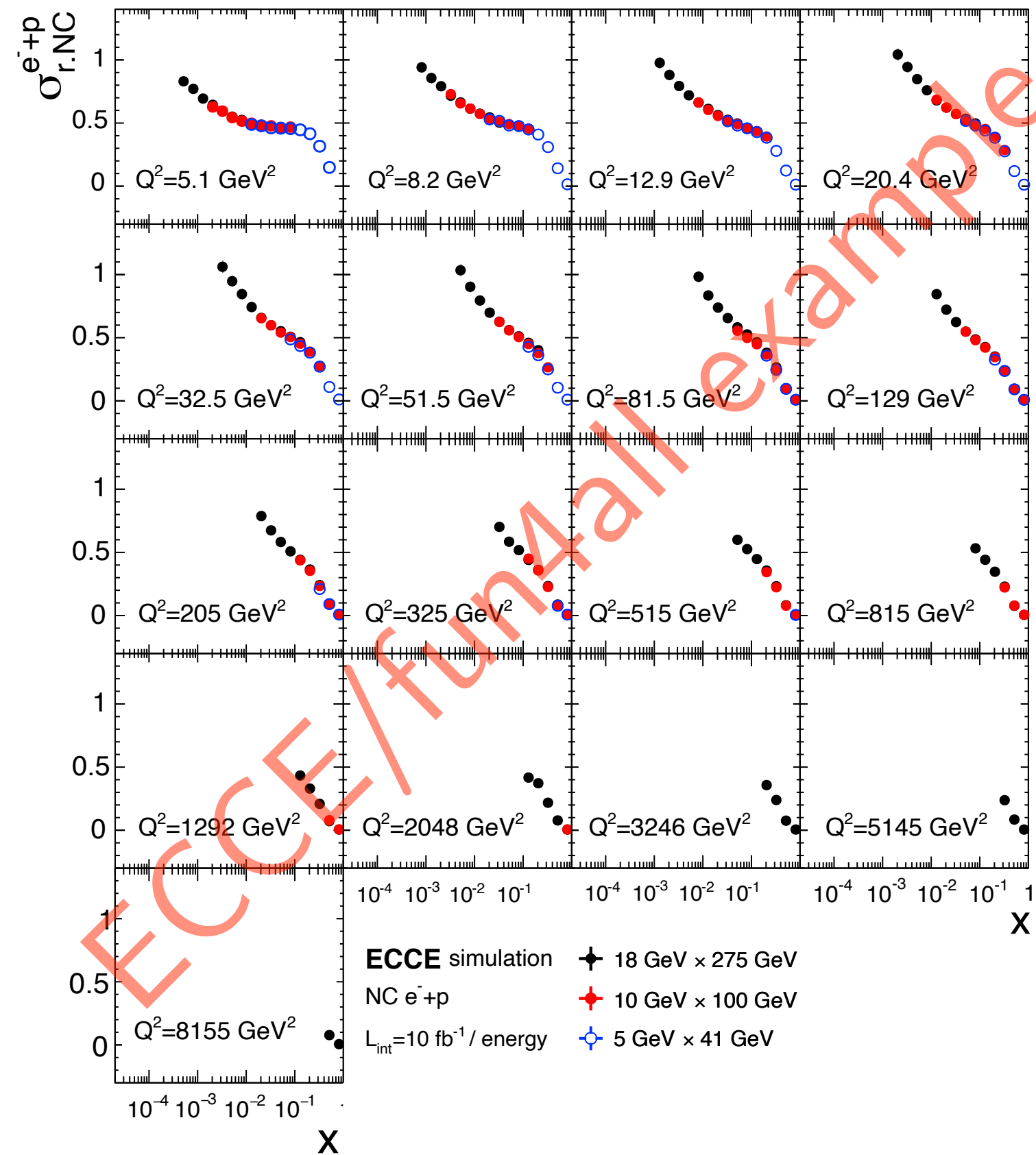
$$P = \frac{N_{gen+rec}}{N_{rec}}$$



$$S = \frac{N_{gen+rec}}{N_{gen}}$$

Physics: reduced cross sections, structure functions

Proton

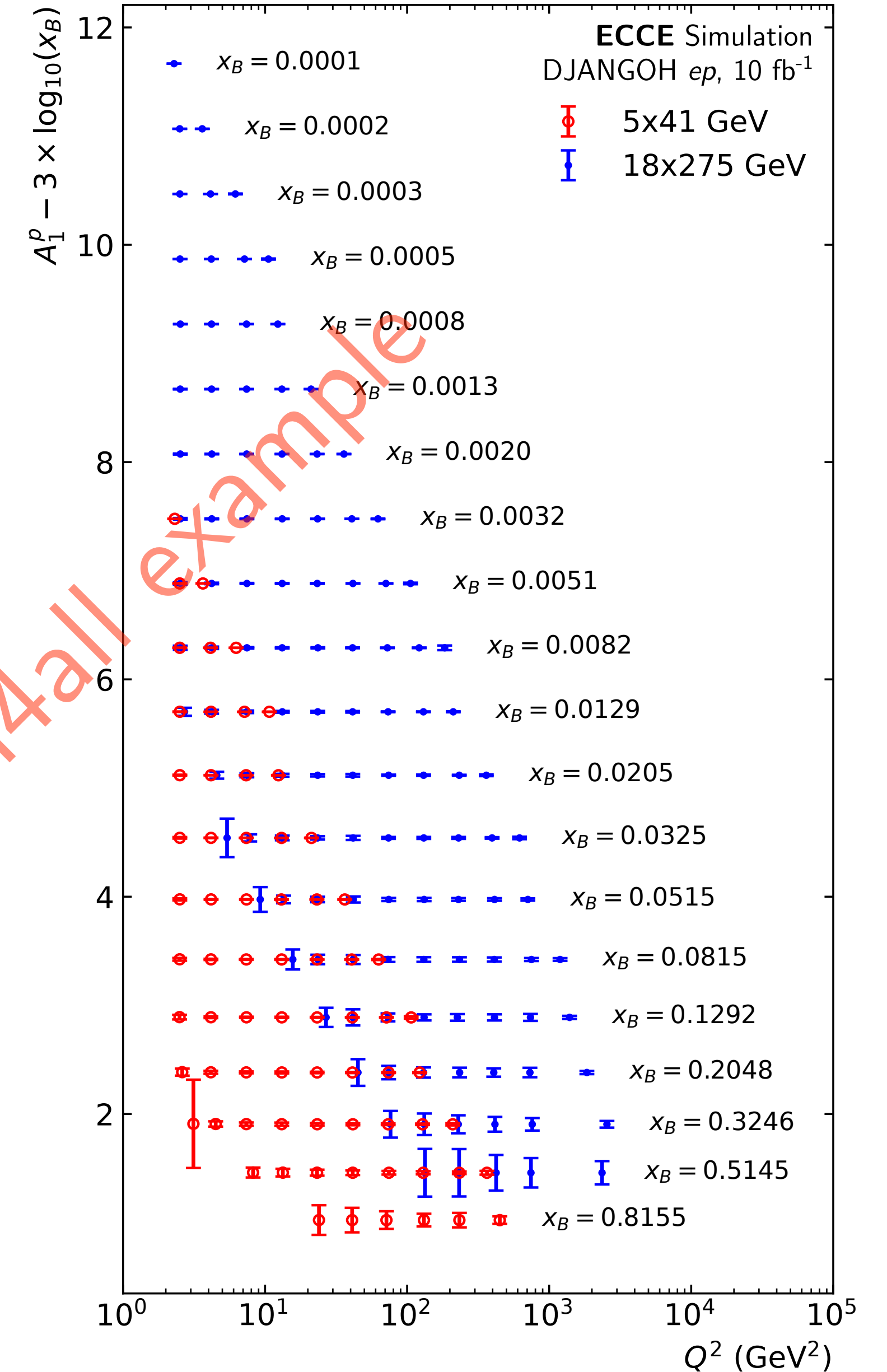
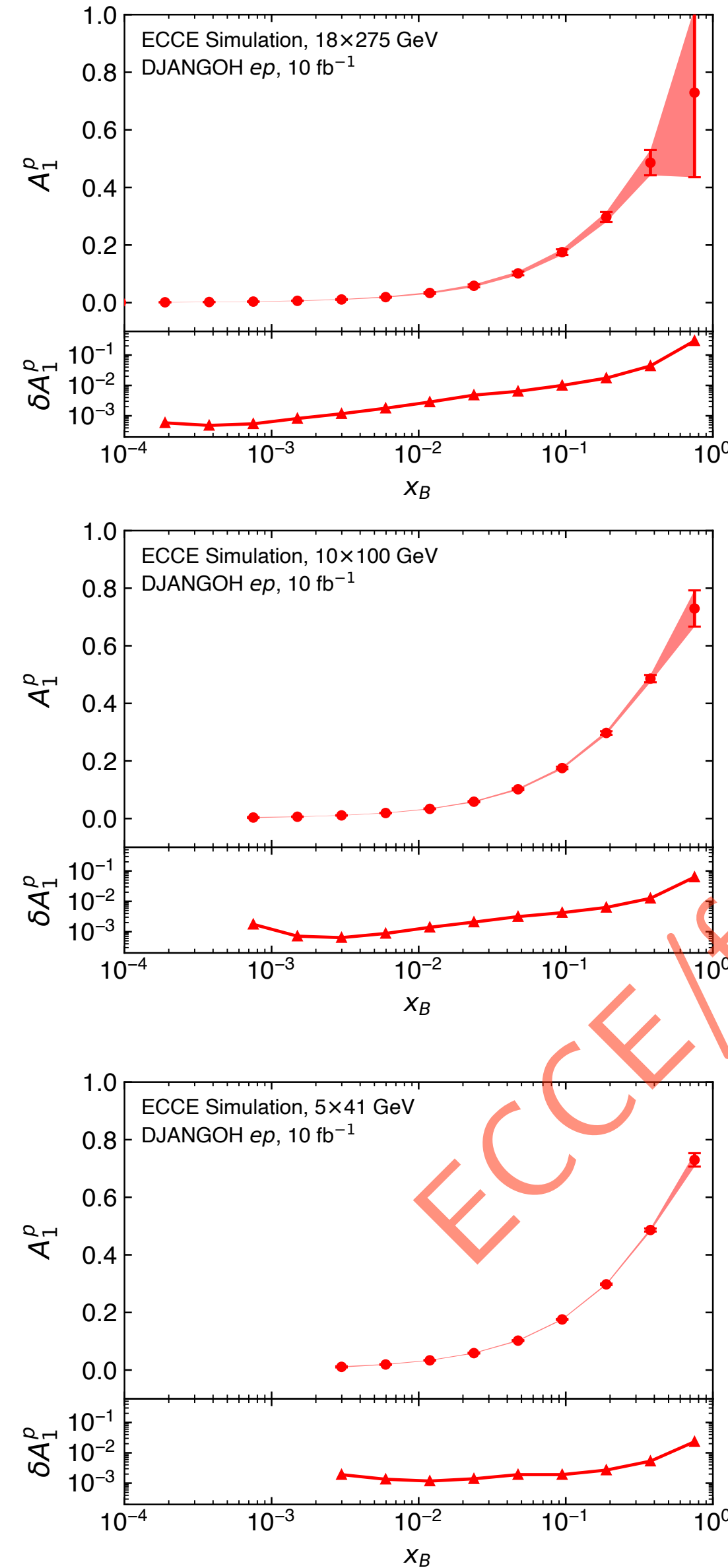


- NC: proton, deuterium, helium-3
- Extract F_L (estimate uncorrelated systematics between beam energies)

- CC: proton

Double-spin asymmetries

- A_1^p, A_1^{3He}
(+ inclusive A_1^n extraction)
- Crucial to show minimum and maximum $\sqrt{s}$
- Rigorous estimation of electron purity



Figures for TDR, extended document

- TDR:

- Projected $\sigma_{r,NC}^p$, $\sigma_{r,NC}^d$, $\sigma_{r,NC}^{^3He}$
- Projected $\sigma_{r,CC}^p$
- Projected A_1^p , $A_1^{^3He}$

- Extended physics document:

- Kinematic resolutions
- Electron ID efficiency/purity
- Acceptances, corrections
- Extracted quantities:
 - F_L , A_1^n , impact plots

Comments and (developing) task list

- Multiple physics analyses may need same studies, corrections
- Do not have stringent generator requirements...coordinate with other physics working groups (such as EW/BSM)
- Resolution study to determine/validate binning
- Acceptance, bin migration correction
- Projected statistics for cross section, asymmetry bins
- Weight events by model A_1^p for central value
- F_L , A_1^n extraction