

Discussion topics

**SIDIS meeting
June 21**

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Status

- Changed to own analysis module strongly based on EventEvaluator (file ending sidispico.root)
- Combine all Calorimeter's clusters in one set of variables, assuming z vertex at origin for theta calculation (as vertex info not available or not correctly addressed)
- Currently use true PID of clusters to select neutrals (track projections not quite filled properly or not correctly addressed), or just veto charged tracks based on common barcode
- Using these Clusters also Reco JB and DoubleAngle method working
- TODO: Projections and vertex info, check matching problems

- JB method: use only hadronic final state

$$y = \frac{E_p \sum_h E_h - p_{z,p} \sum_h p_{z,h} - m_p^2}{E_p E_e - p_{z,p} p_{z,e}}$$

$$Q^2 = \frac{\sum_h p_{x,h}^2 + \sum_h p_{y,h}^2}{1 - y}$$

$$x = \frac{Q^2}{ys}$$

- DA method: use both

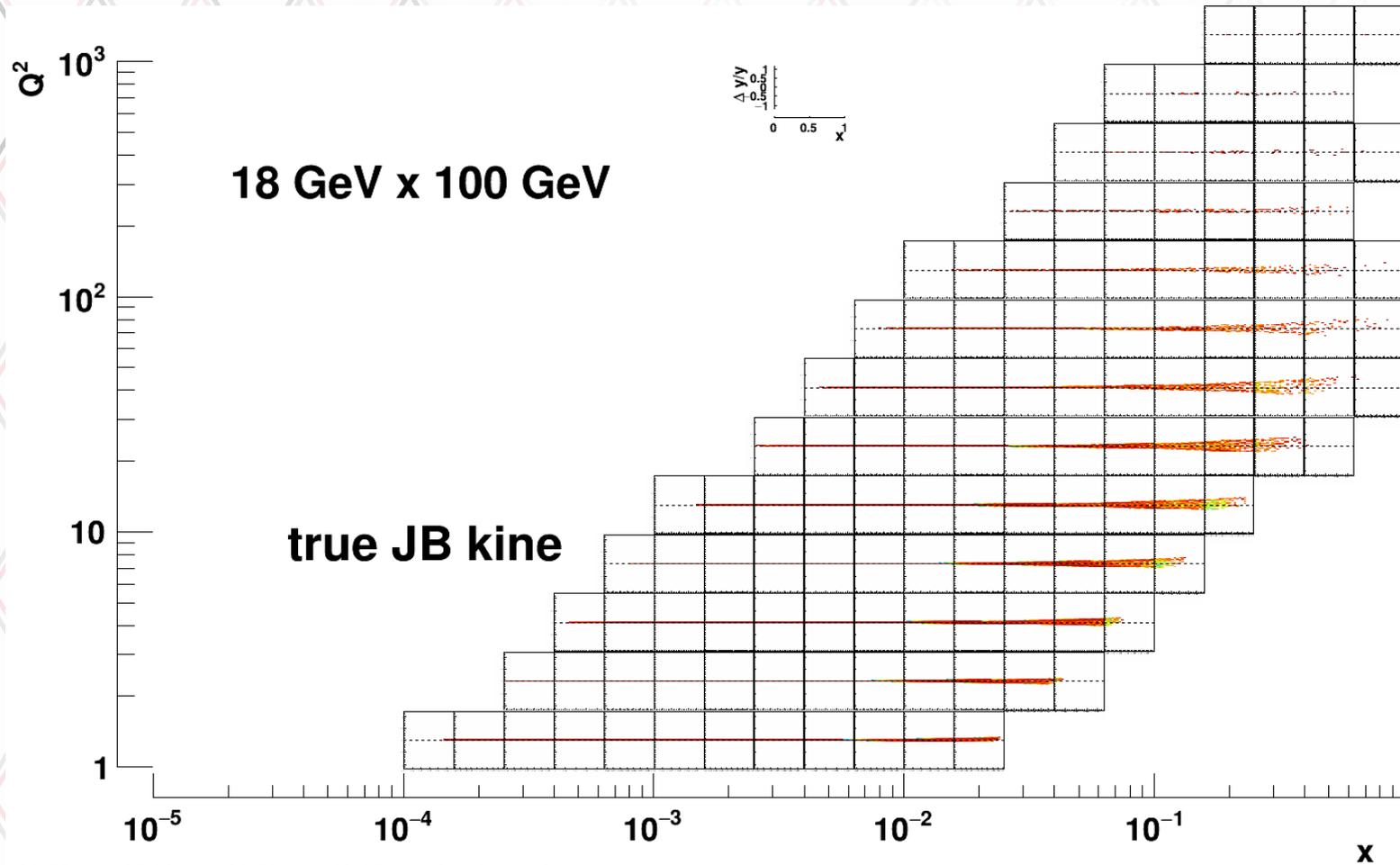
$$y = \frac{\tan \theta_h/2}{\tan \theta_e/2 + \tan \theta_h/2}$$

$$Q^2 = \frac{4E_2^2}{\tan \theta_e/2 (\tan \theta_e/2 + \tan \theta_h/2)}$$

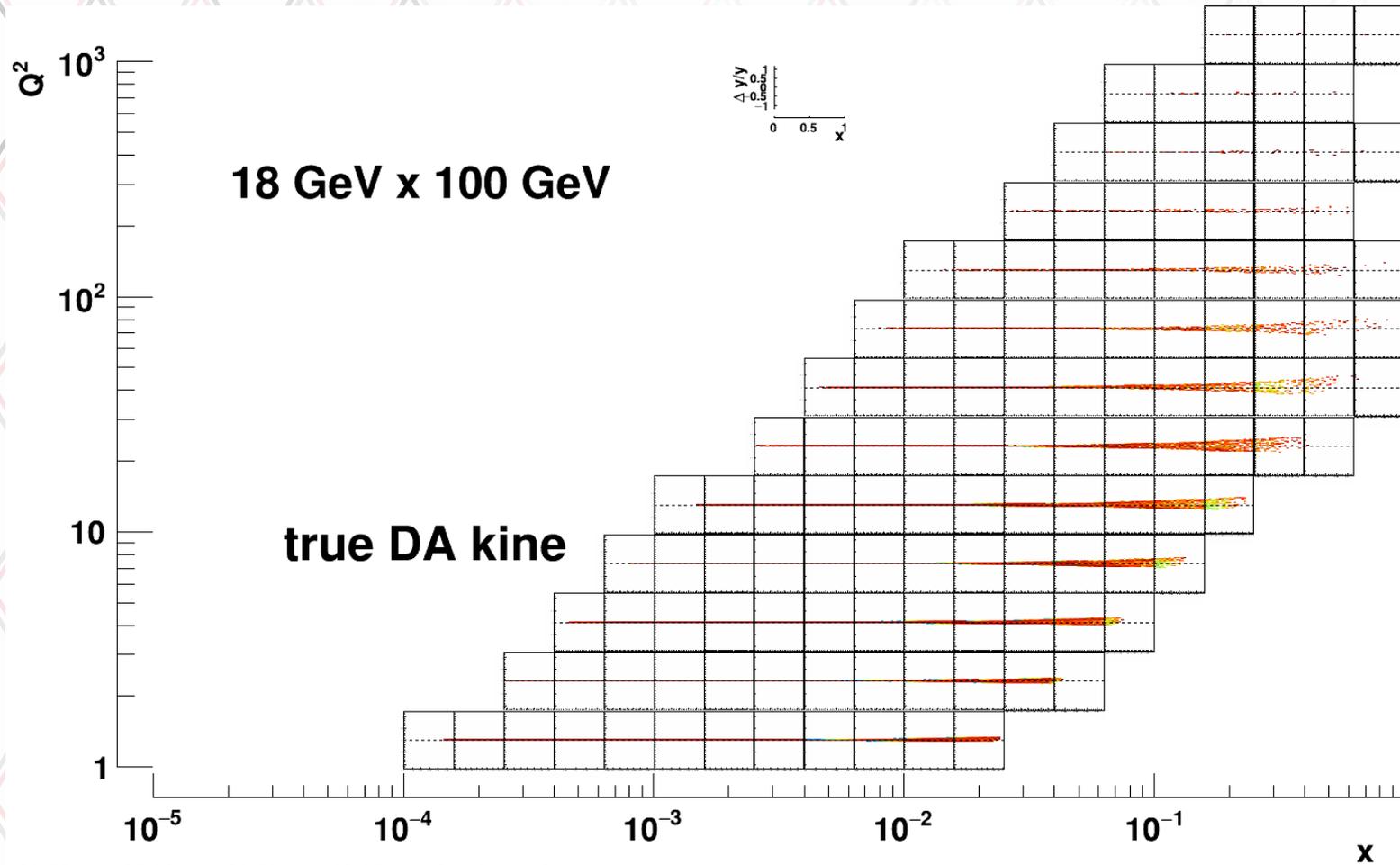
$$x = \frac{Q^2}{ys}$$

$$\tan \theta_h/2 = \frac{\sum_h E_h - \sum_h p_{z,h}}{\sqrt{\sum_h p_{x,h}^2 + \sum_h p_{y,h}^2}}$$

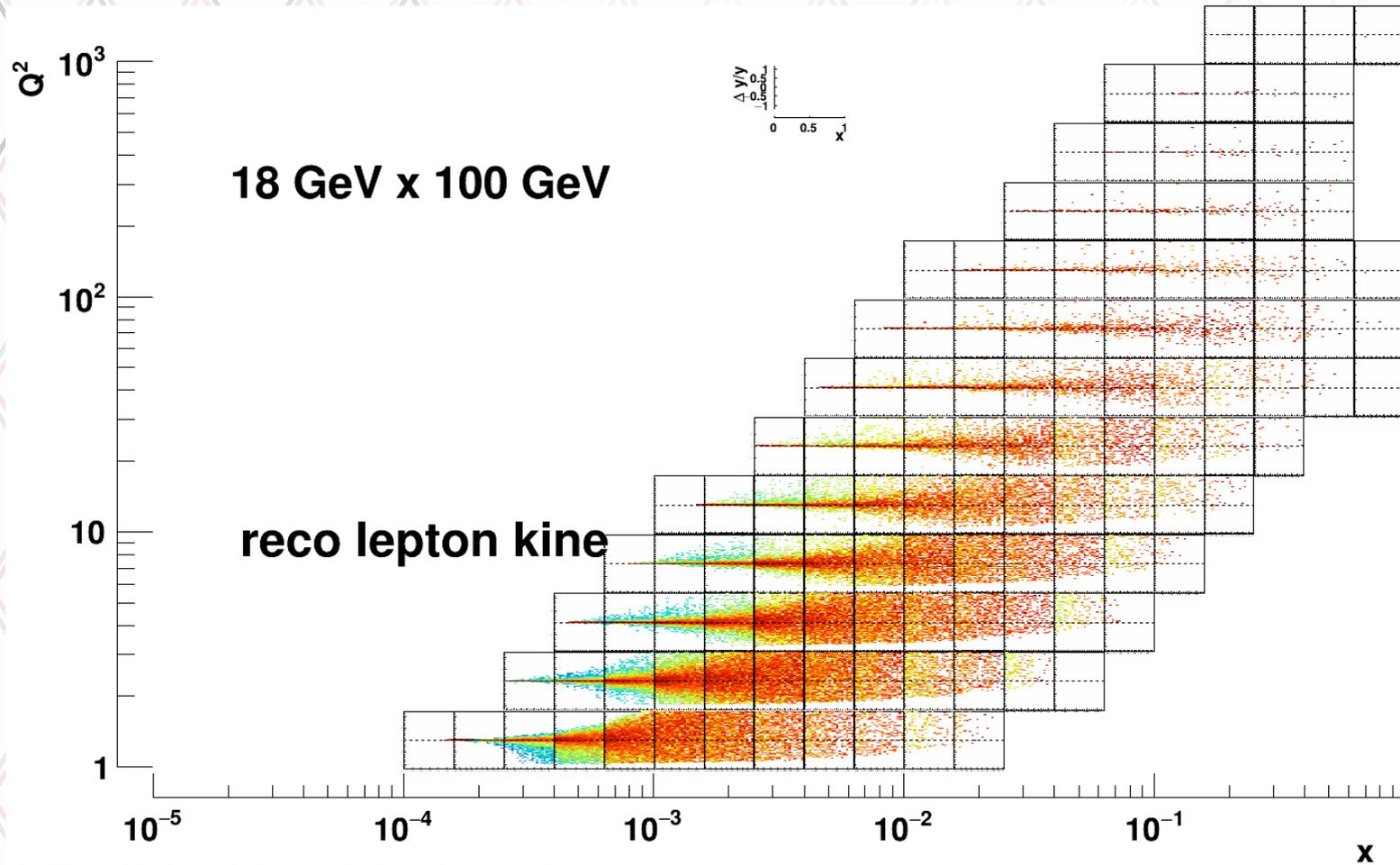
y res JB method (true particles)



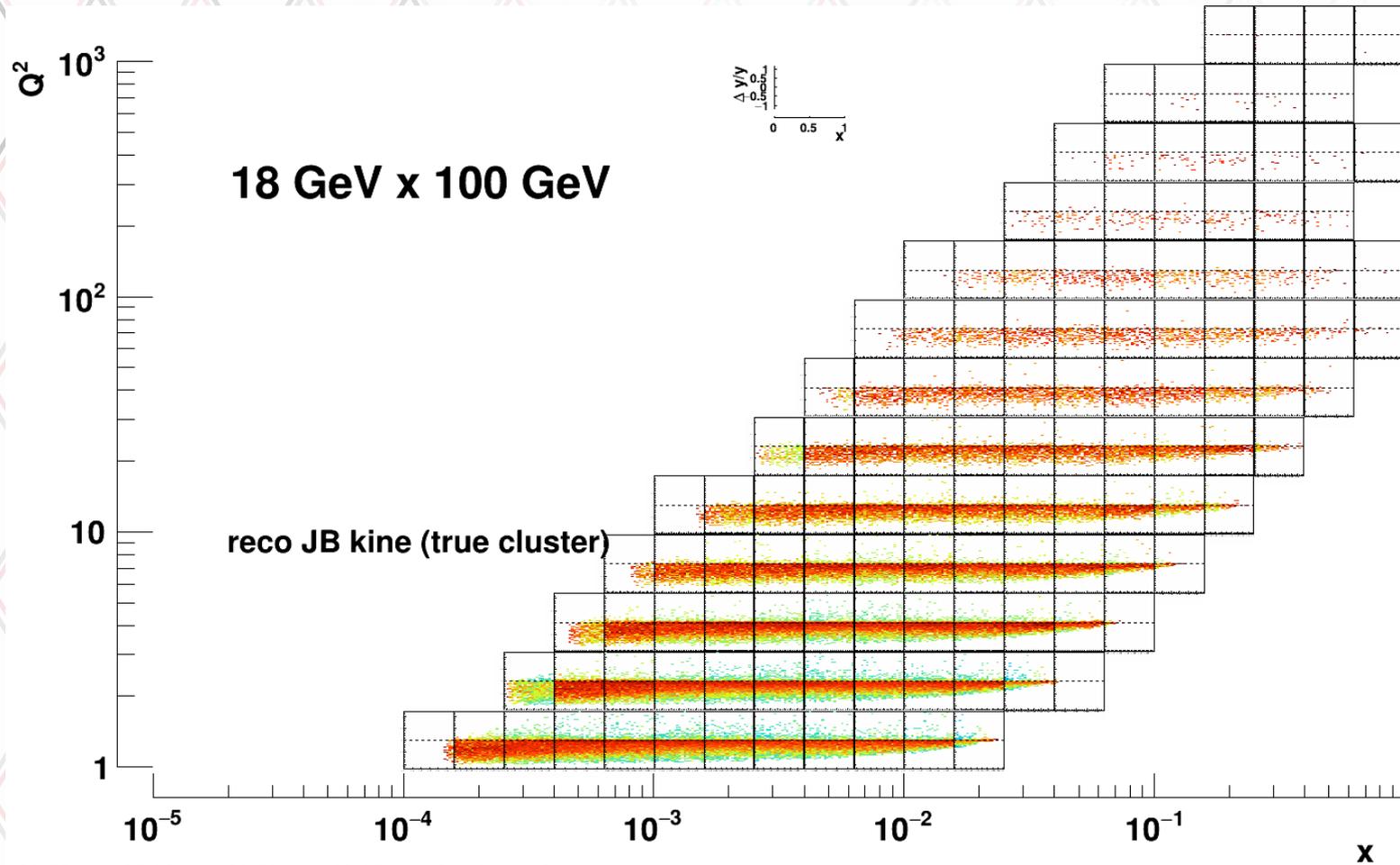
γ res DA method (true particles)



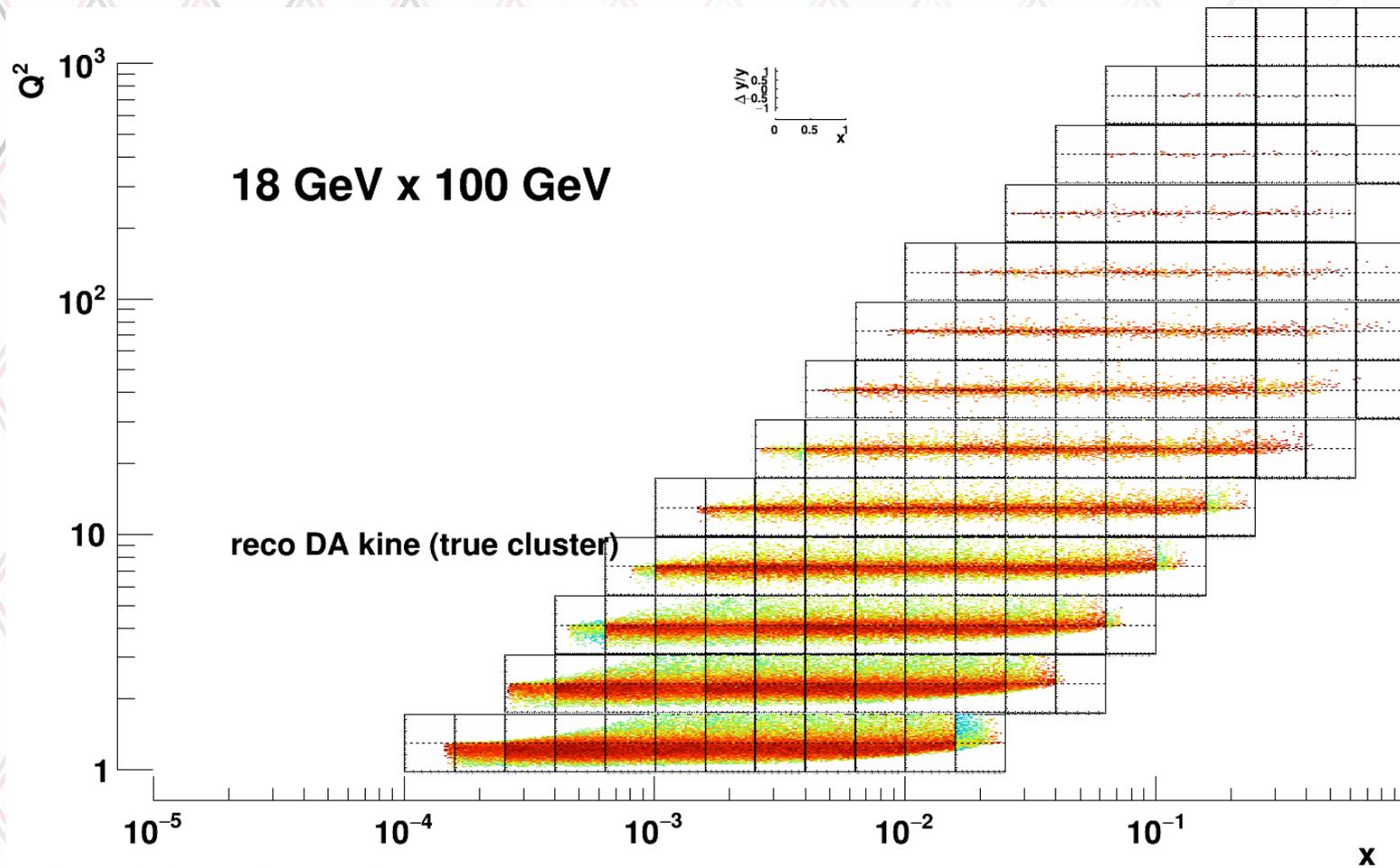
y res lepton

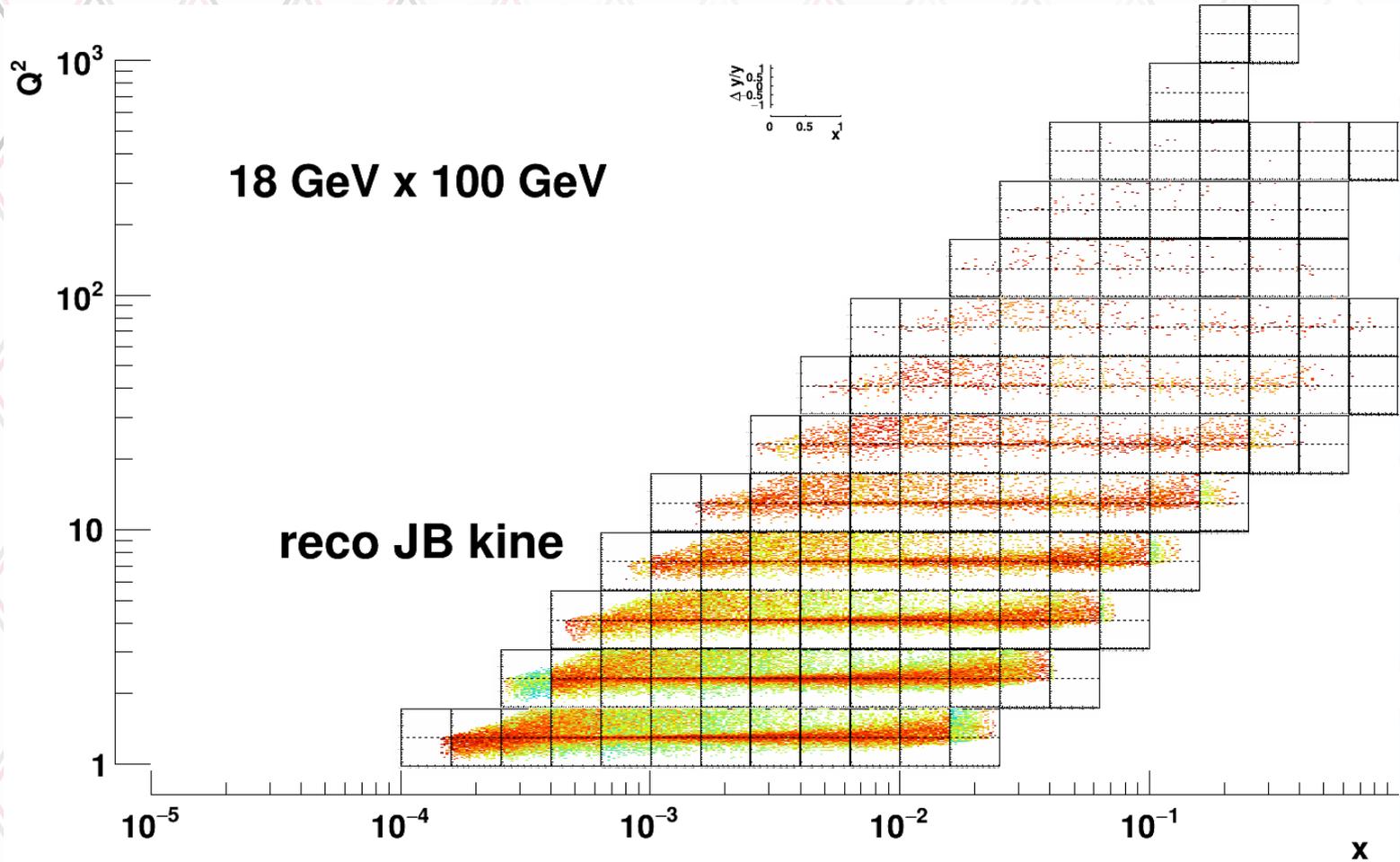


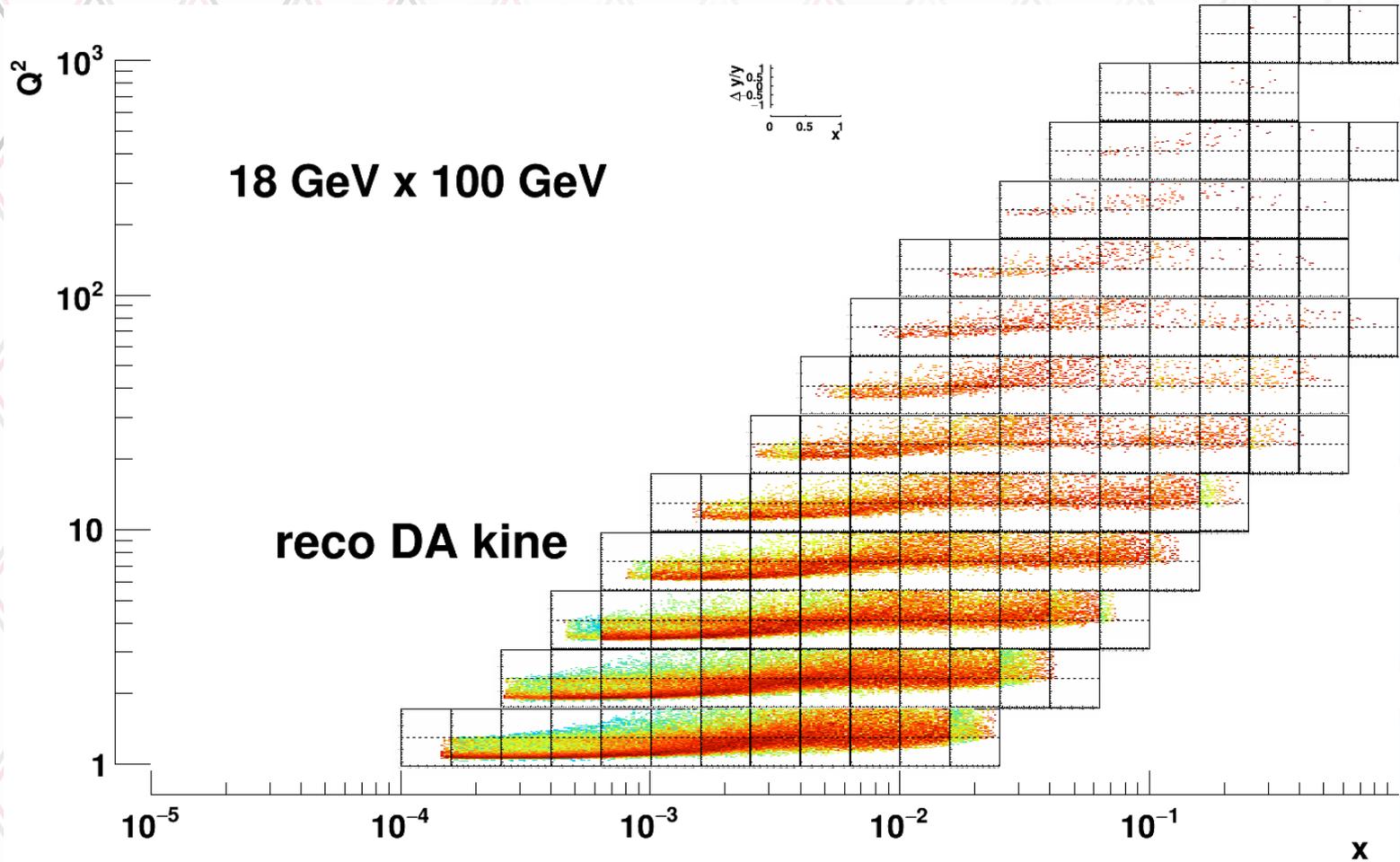
γ res JB true clusters

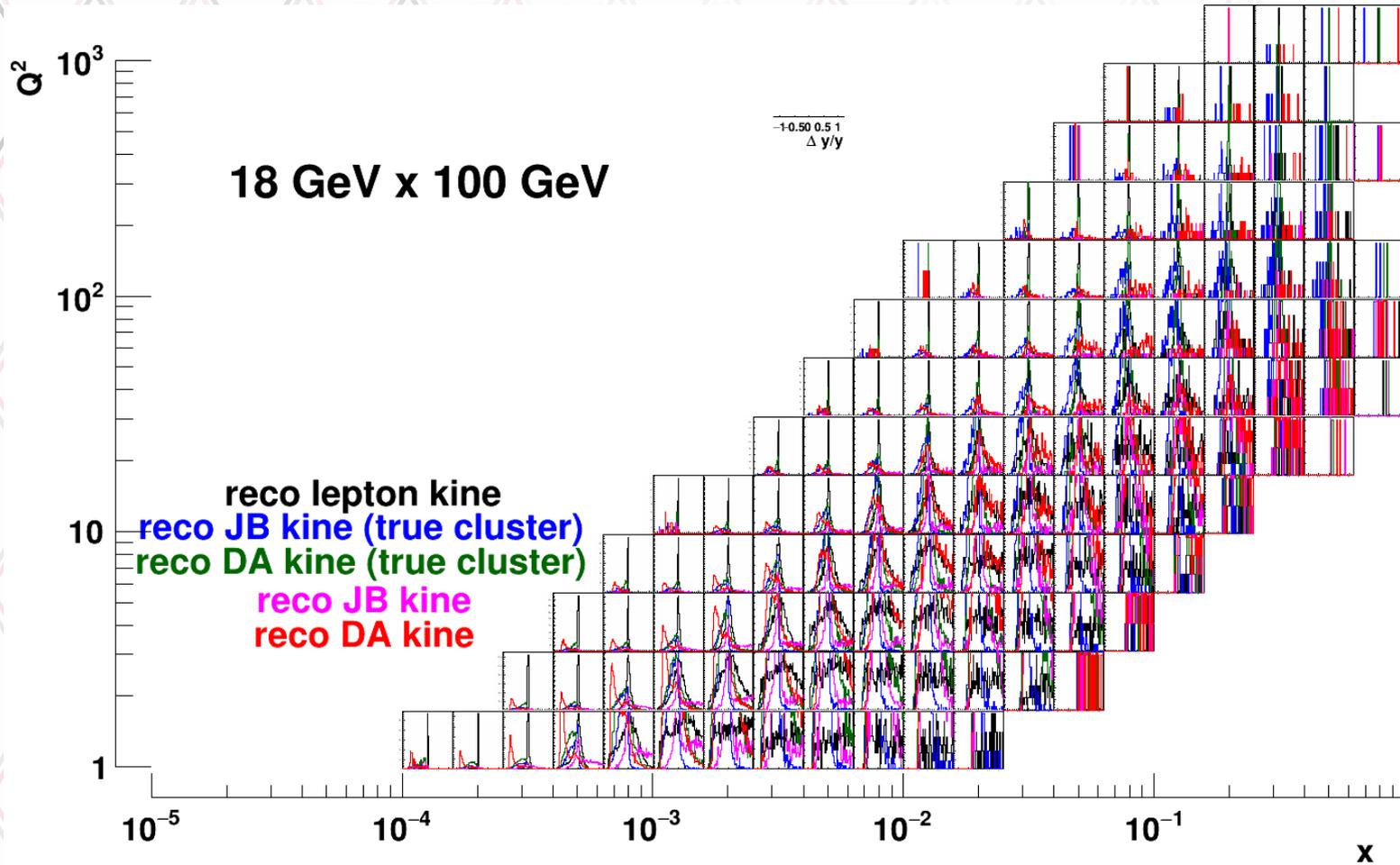


Y res DA true clusters

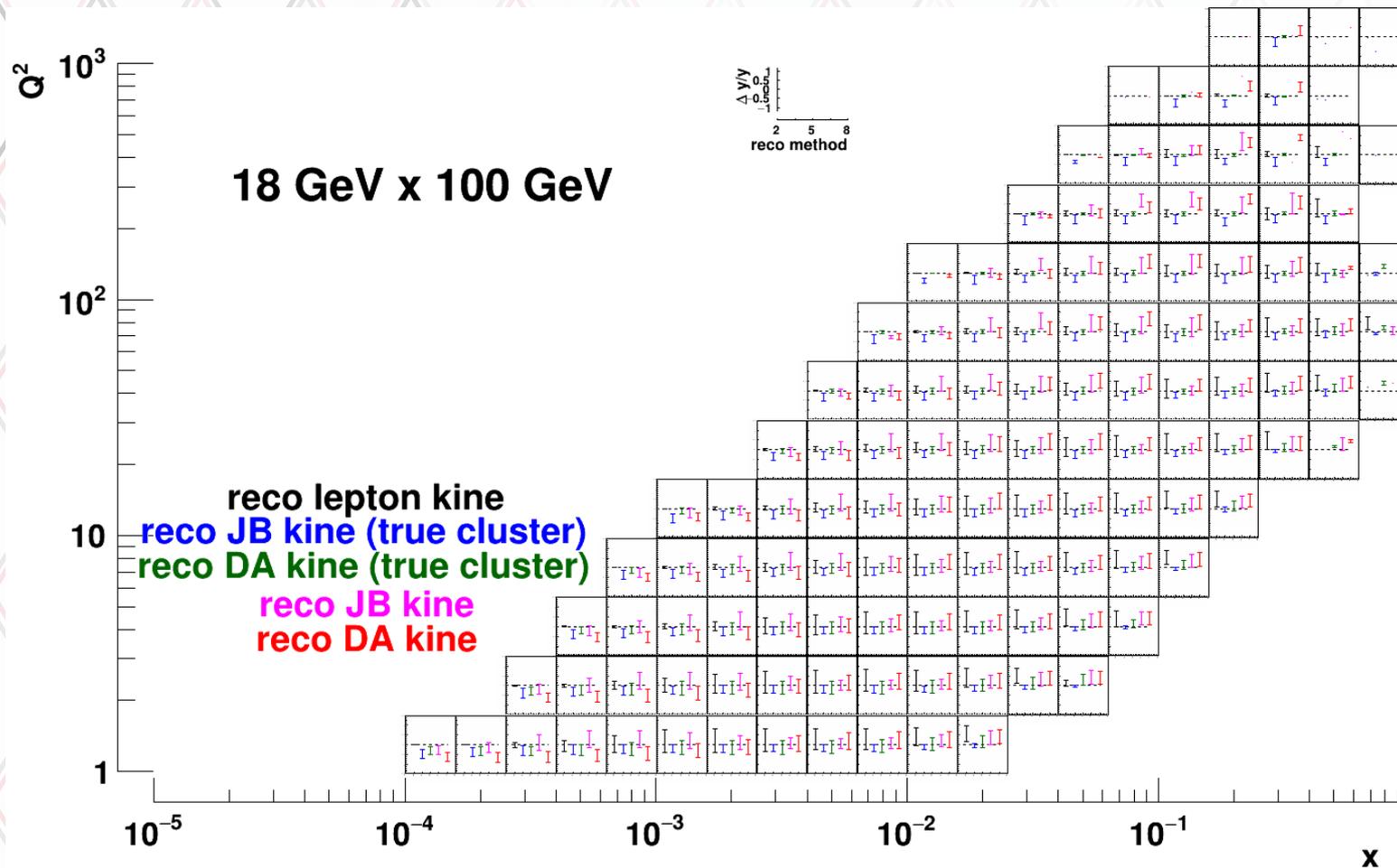




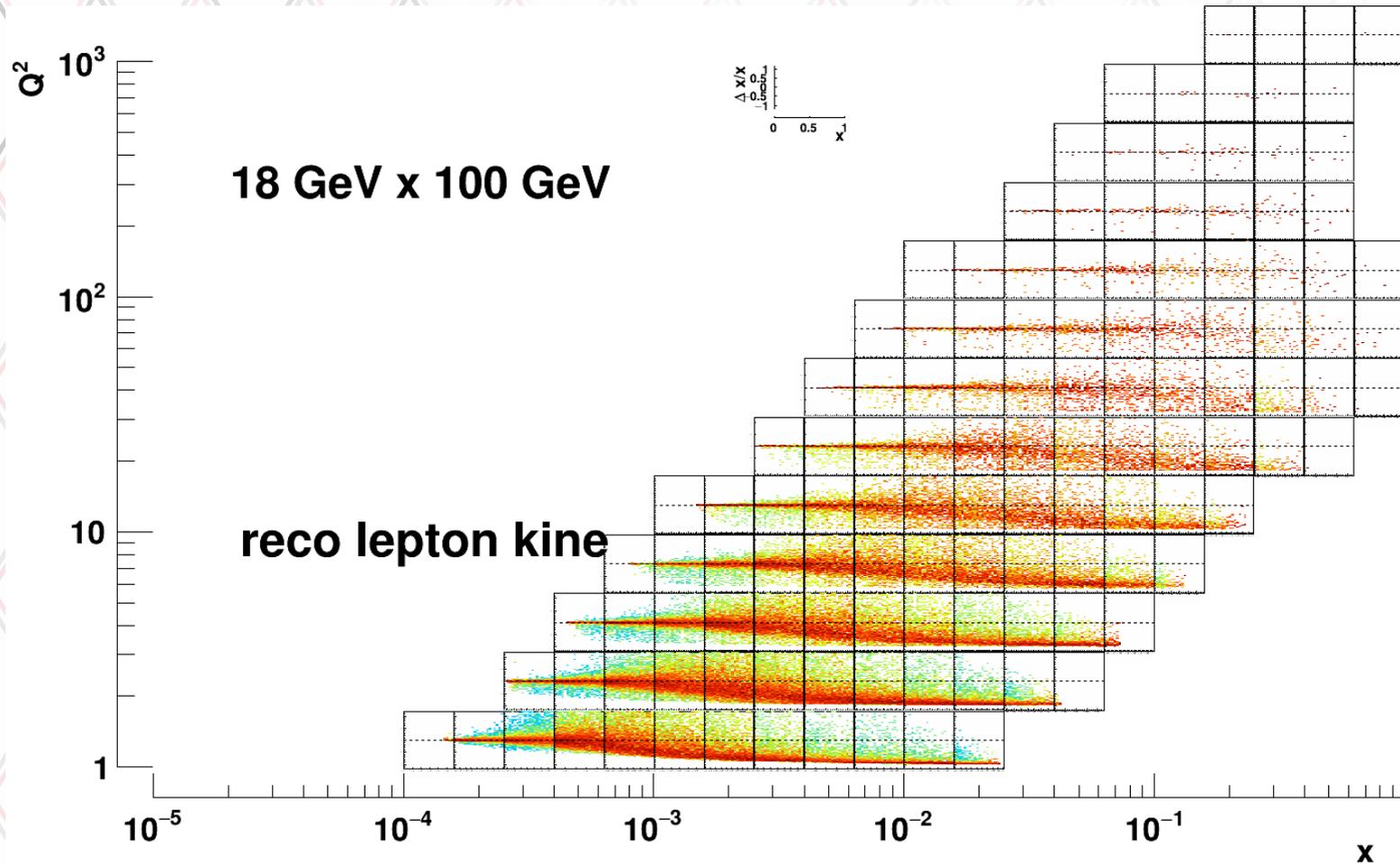




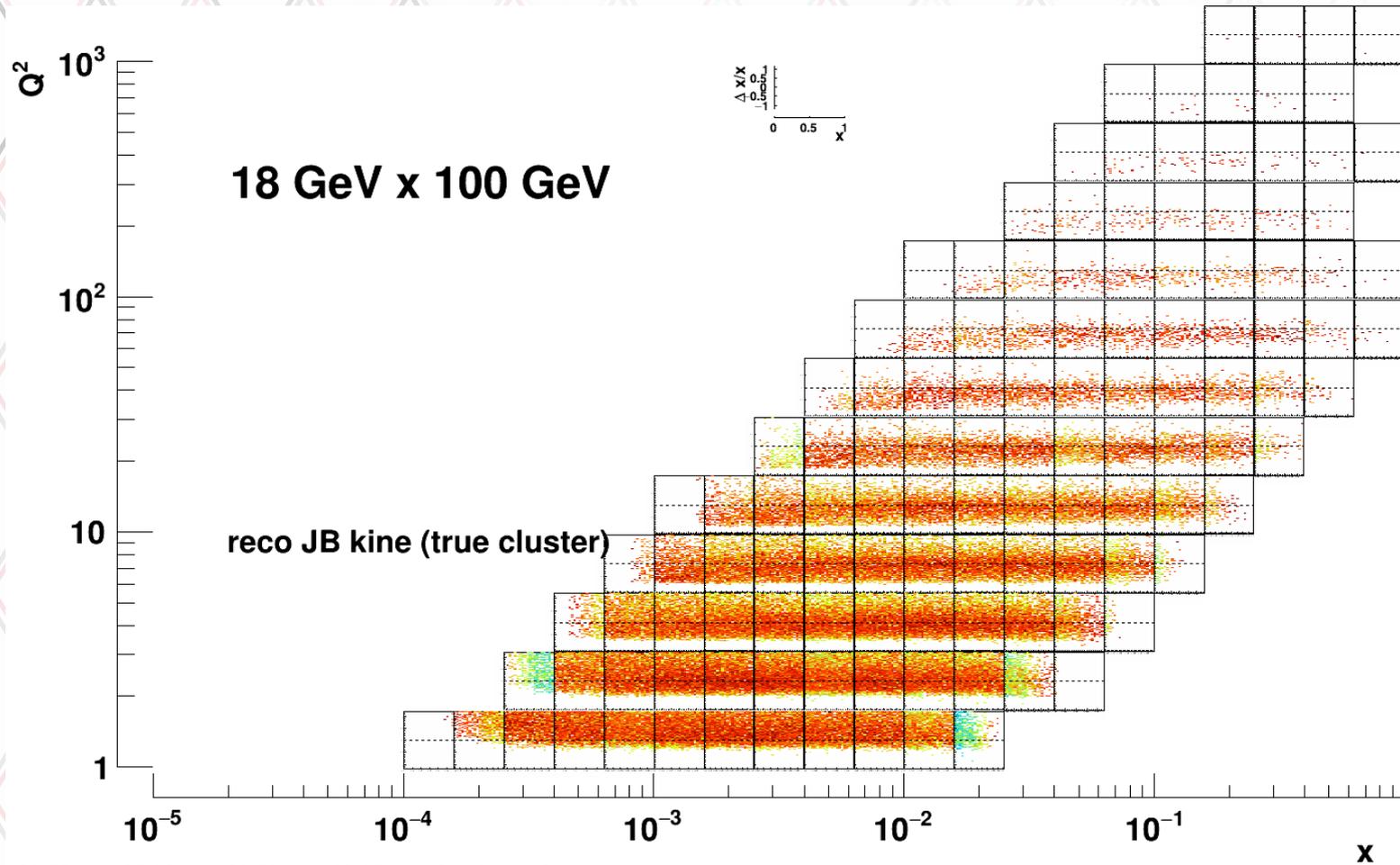
All γ reco widths and means



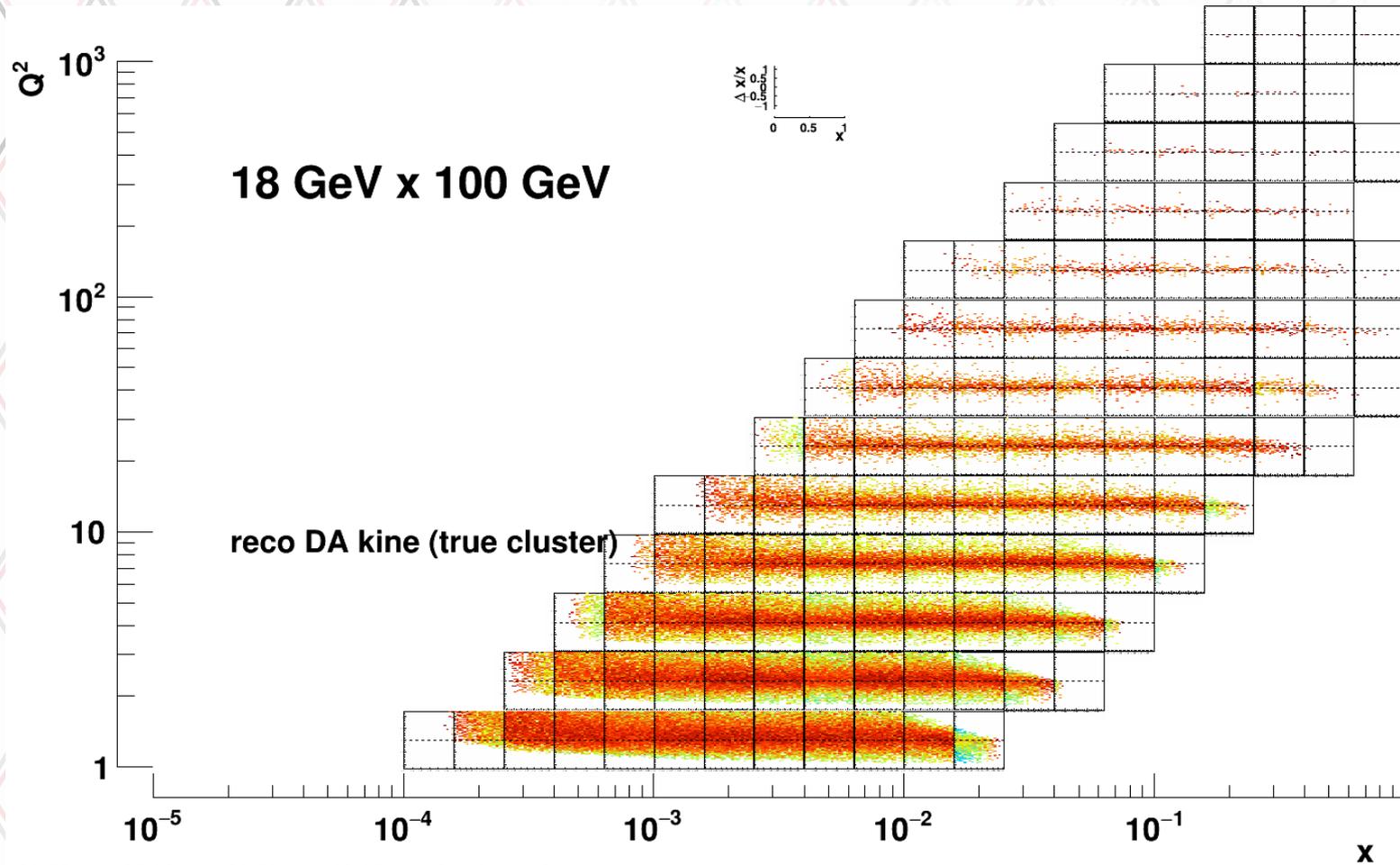
x resolution, lepton method



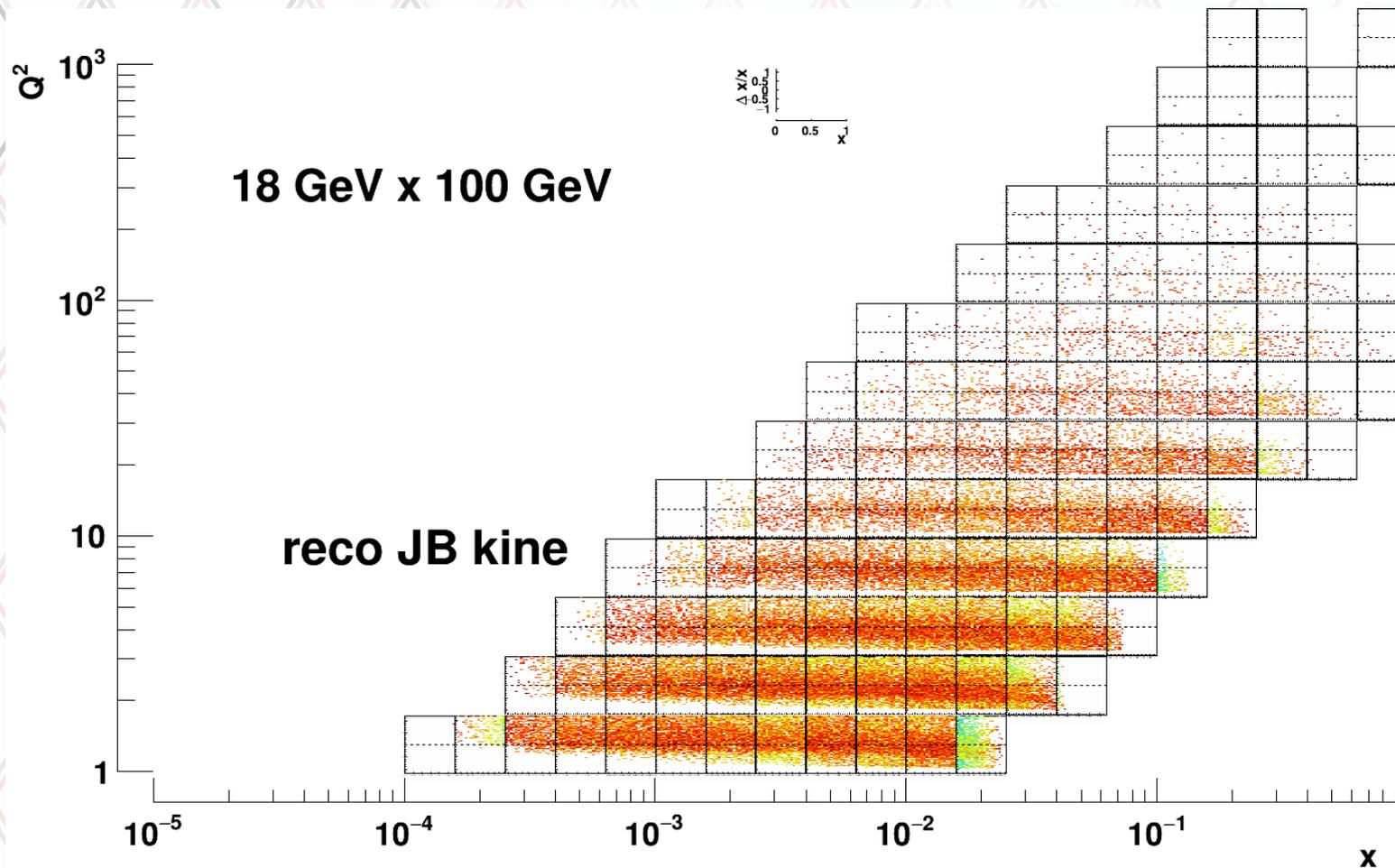
x resolution JB, reco tracks, rue clusters



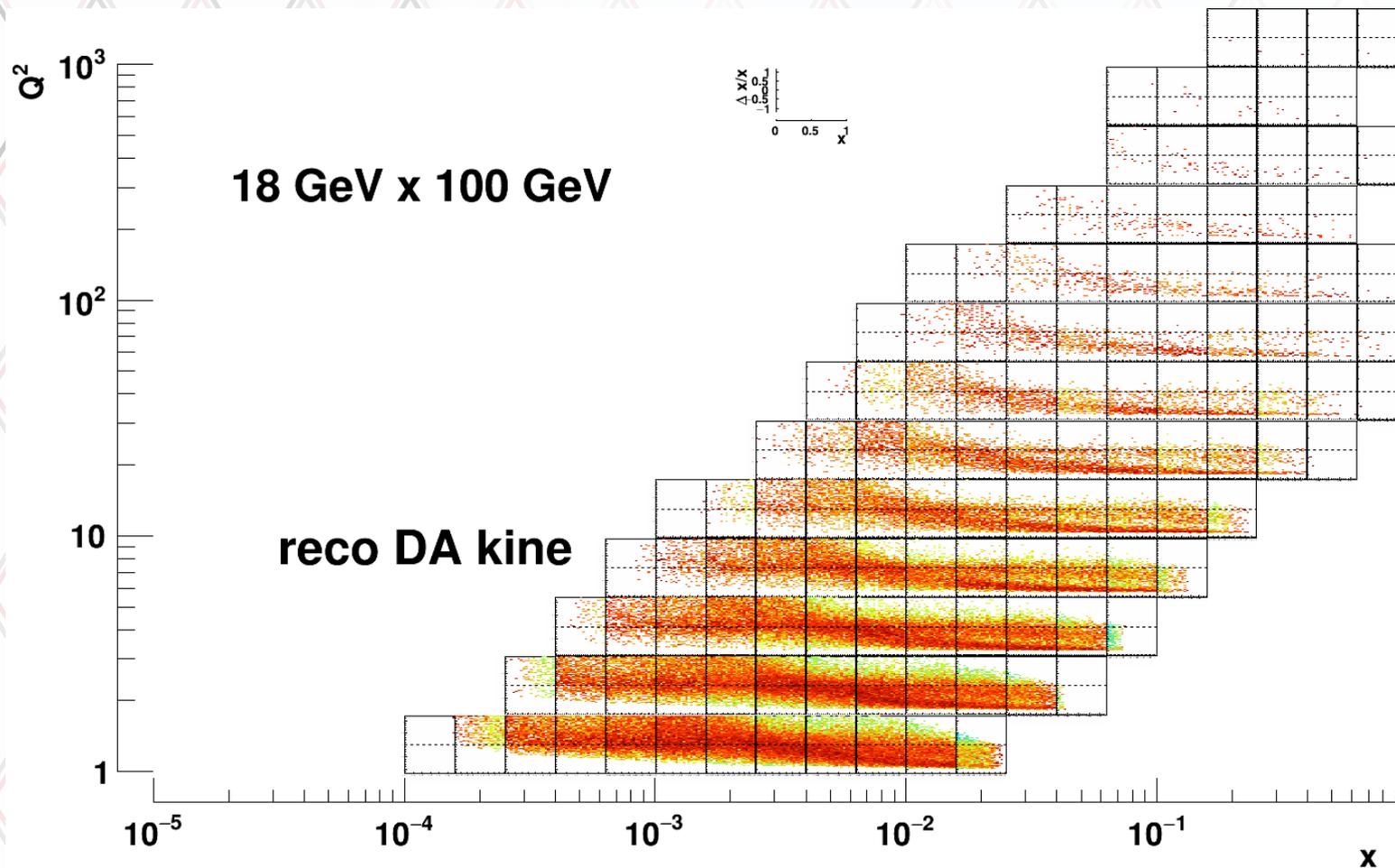
x resolution DA, true clusters



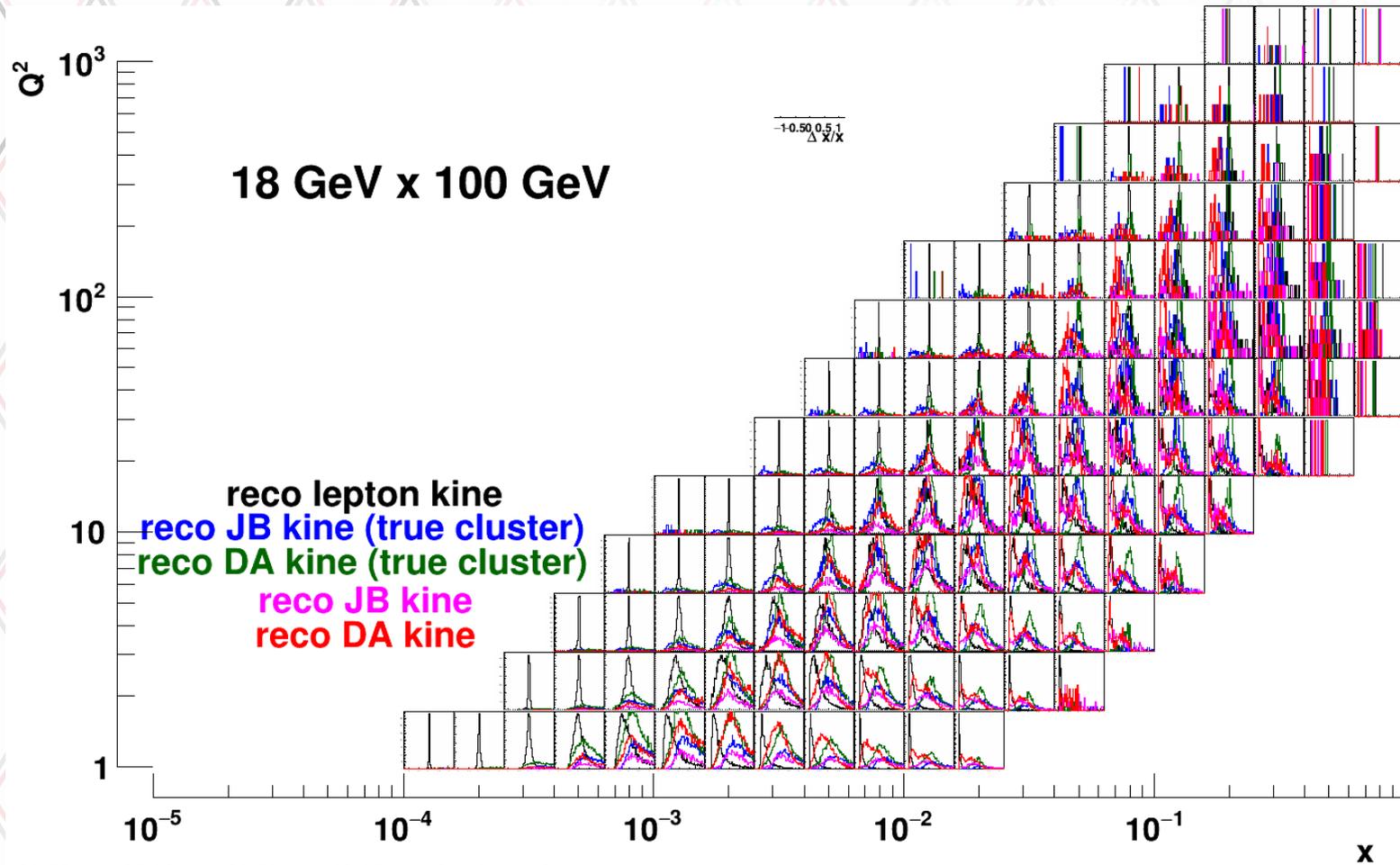
Reco JB, clusters via Barcode



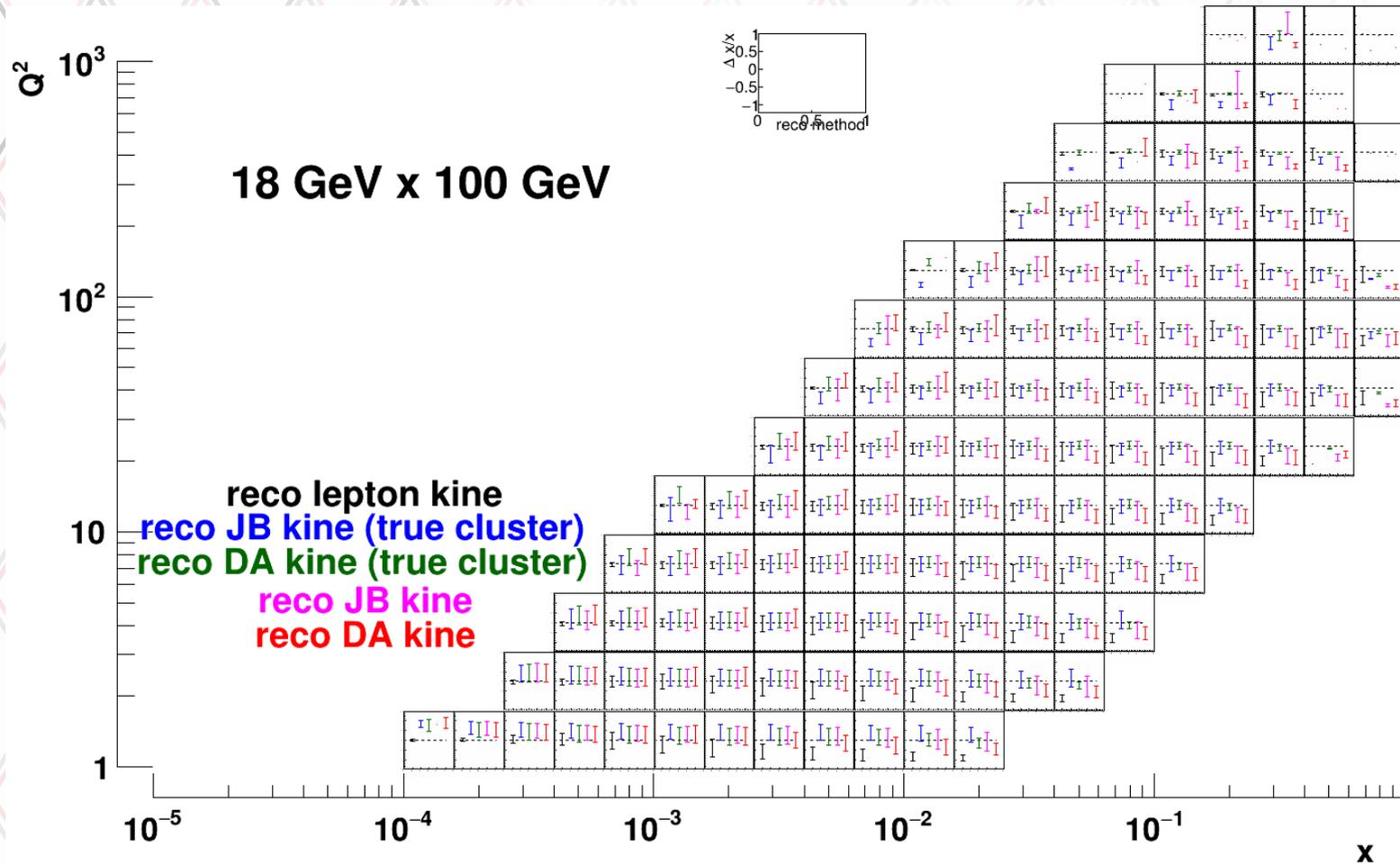
Reco DA, clusters via Barcode



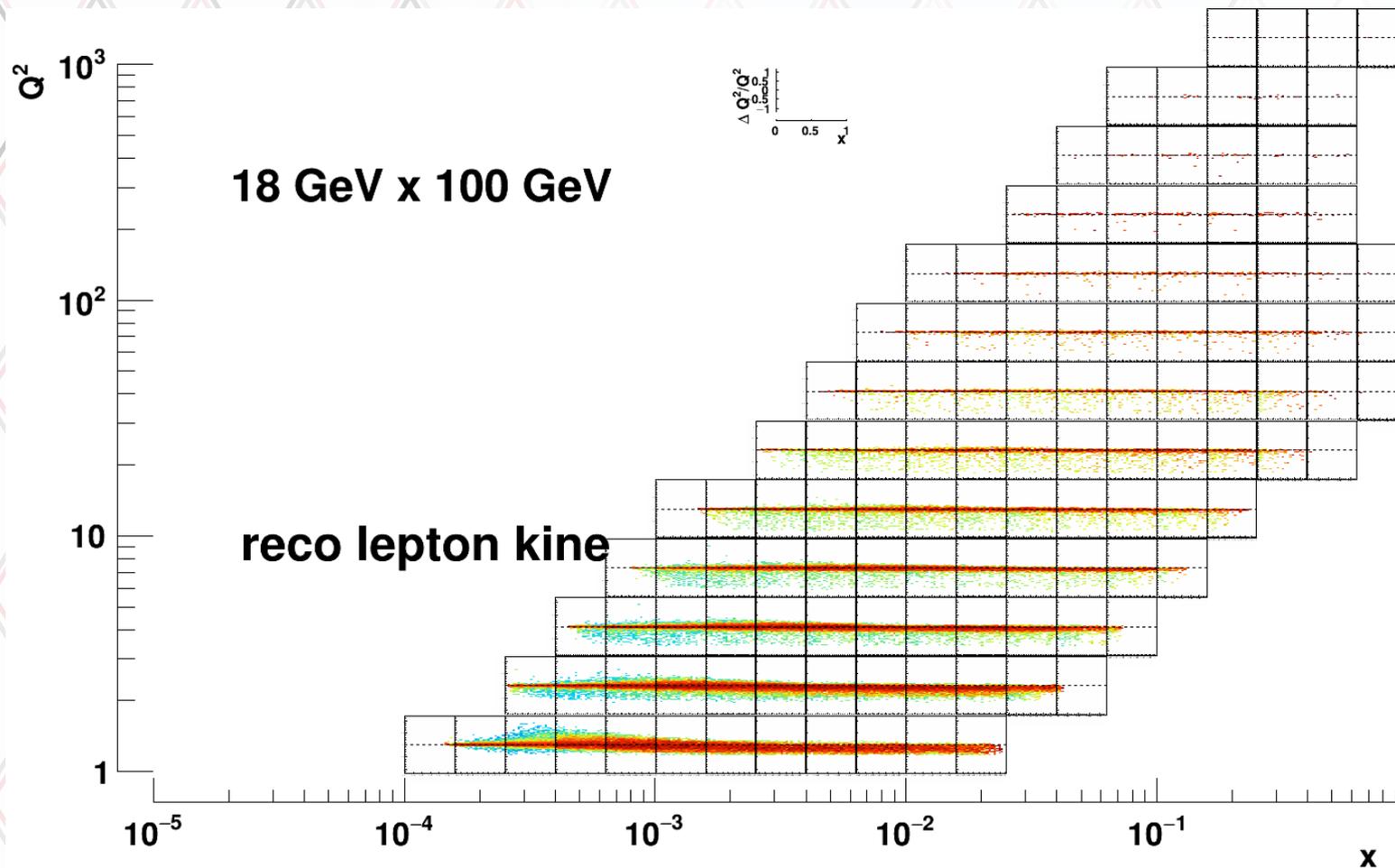
All reco x distributions



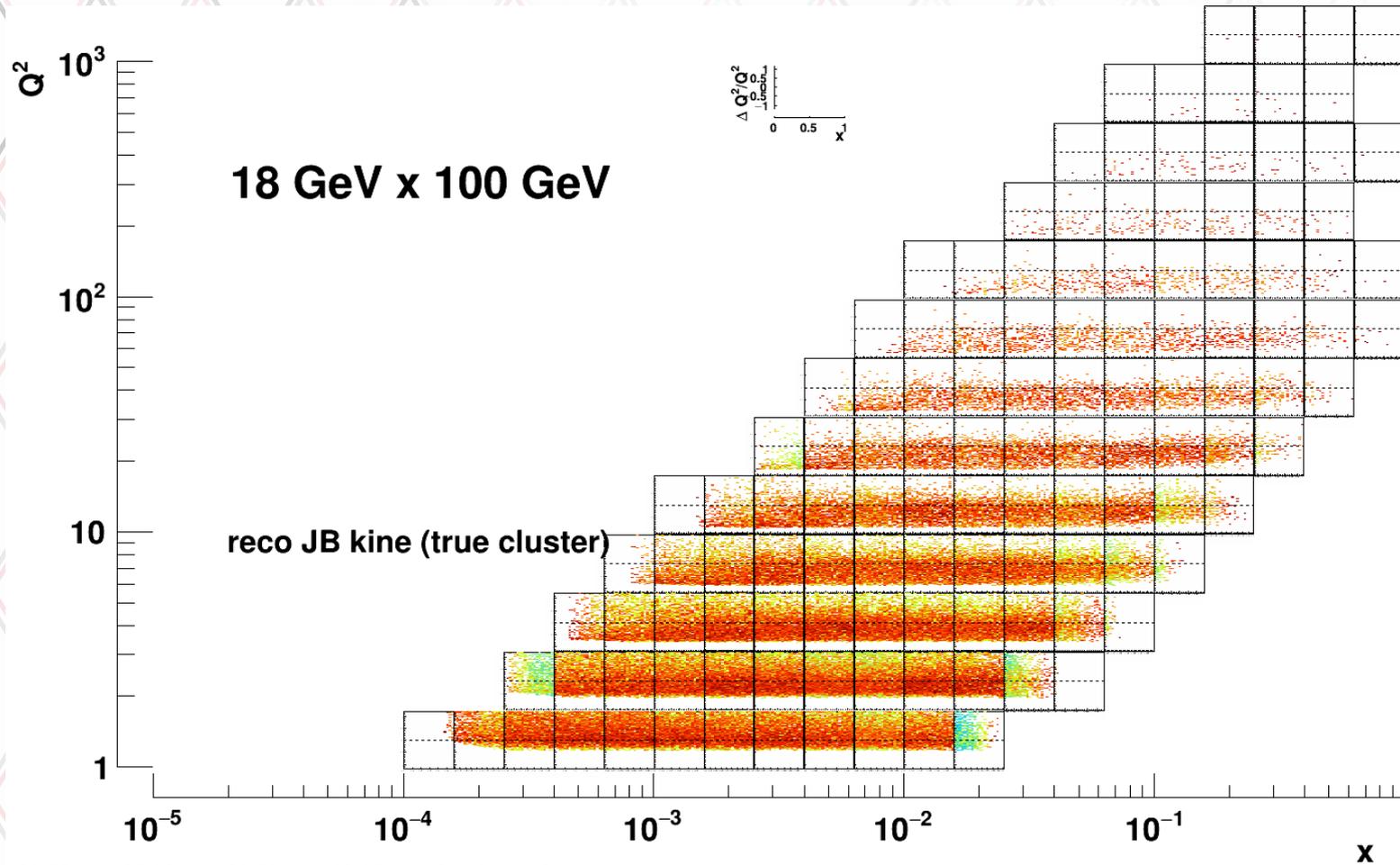
All x reco widths and means

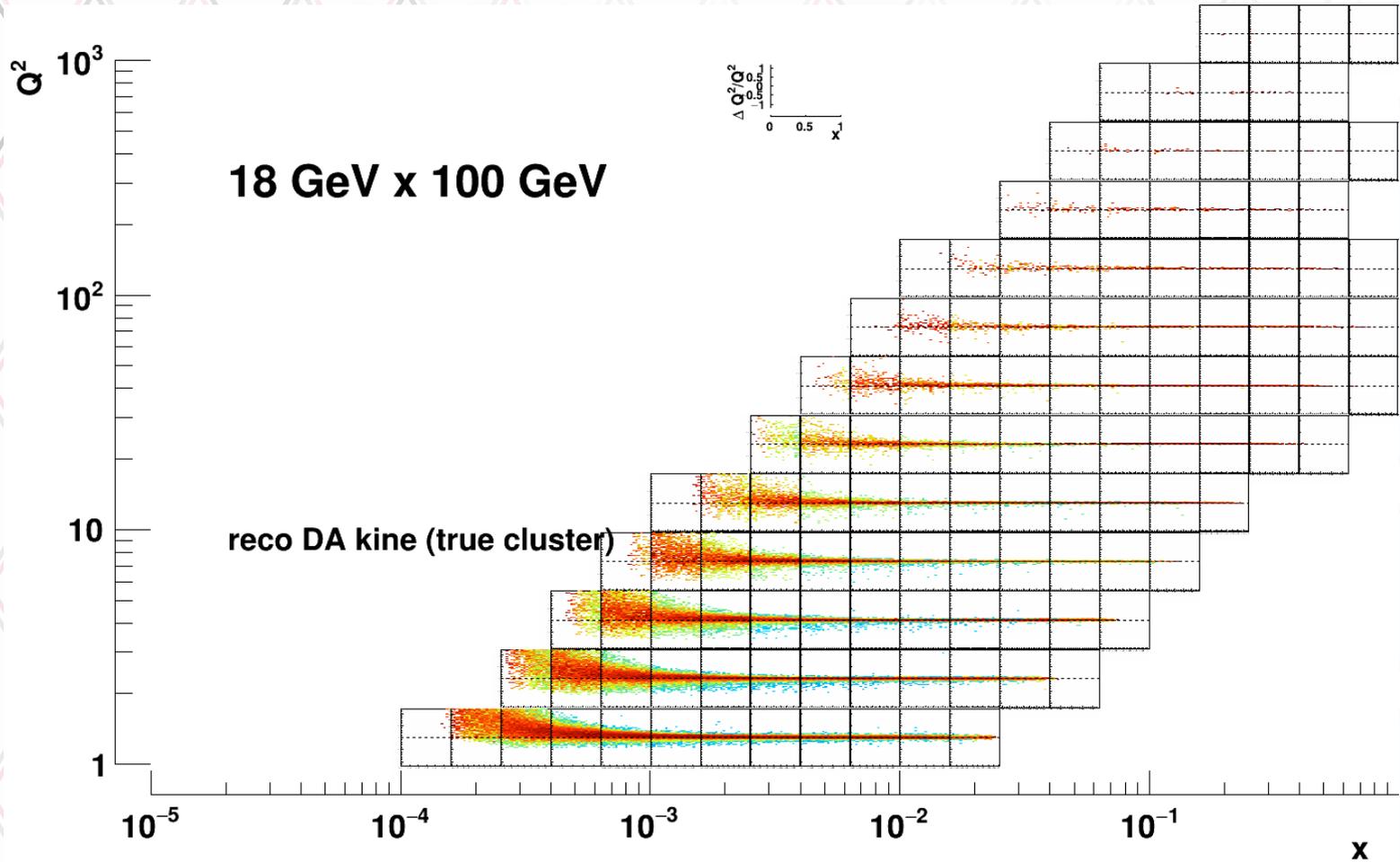


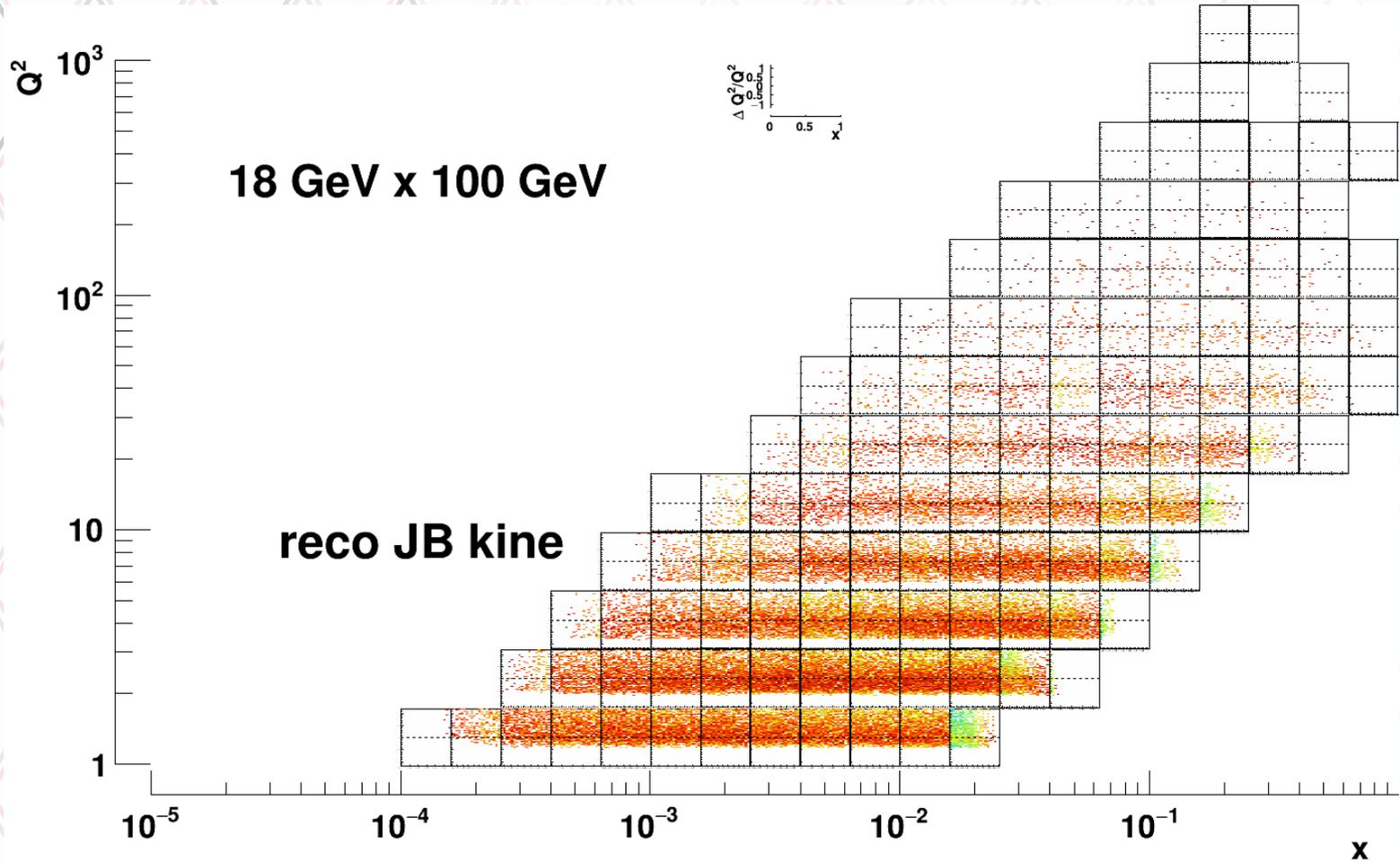
Q2 res lepton method



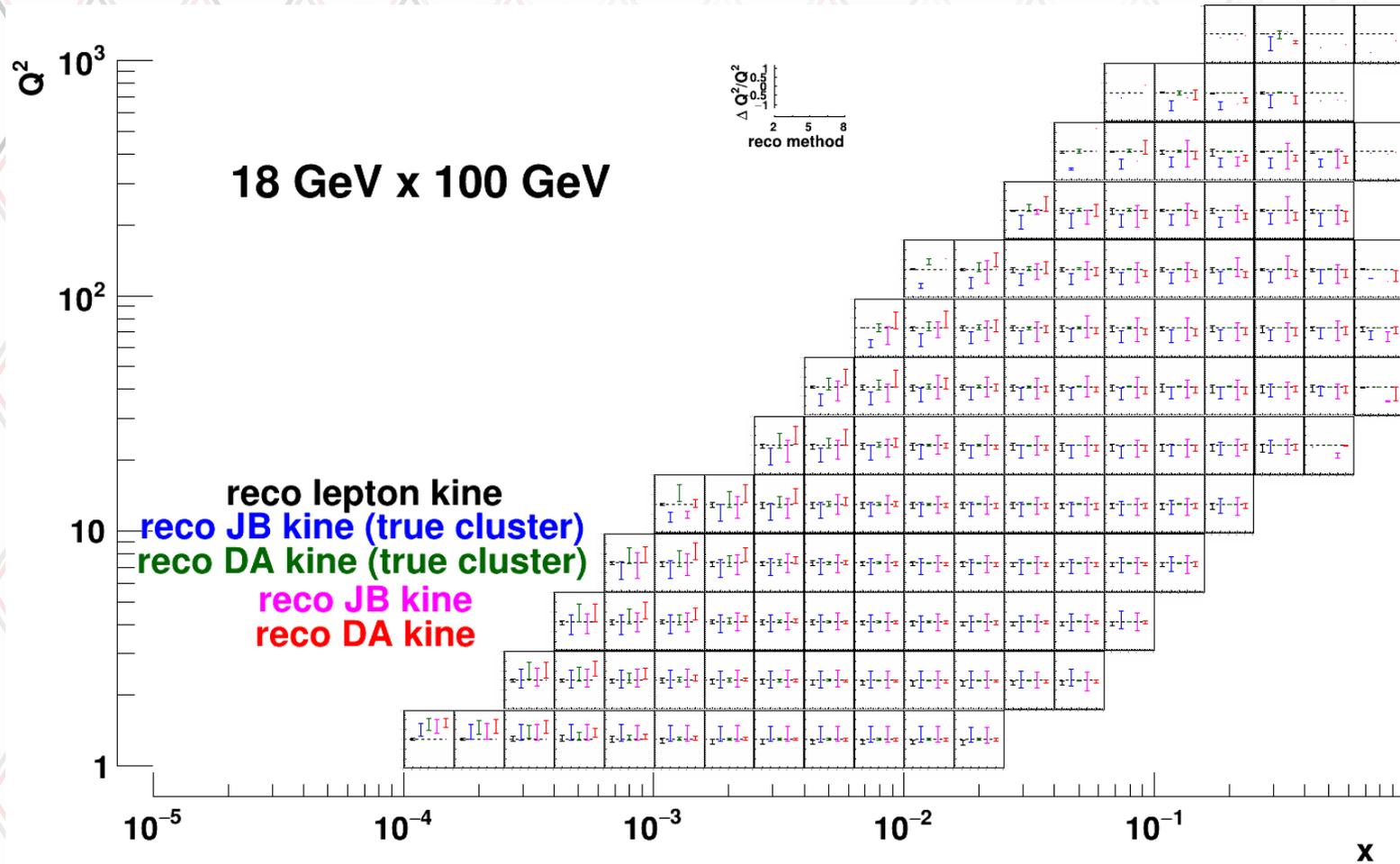
Q2 res JB, true clusters

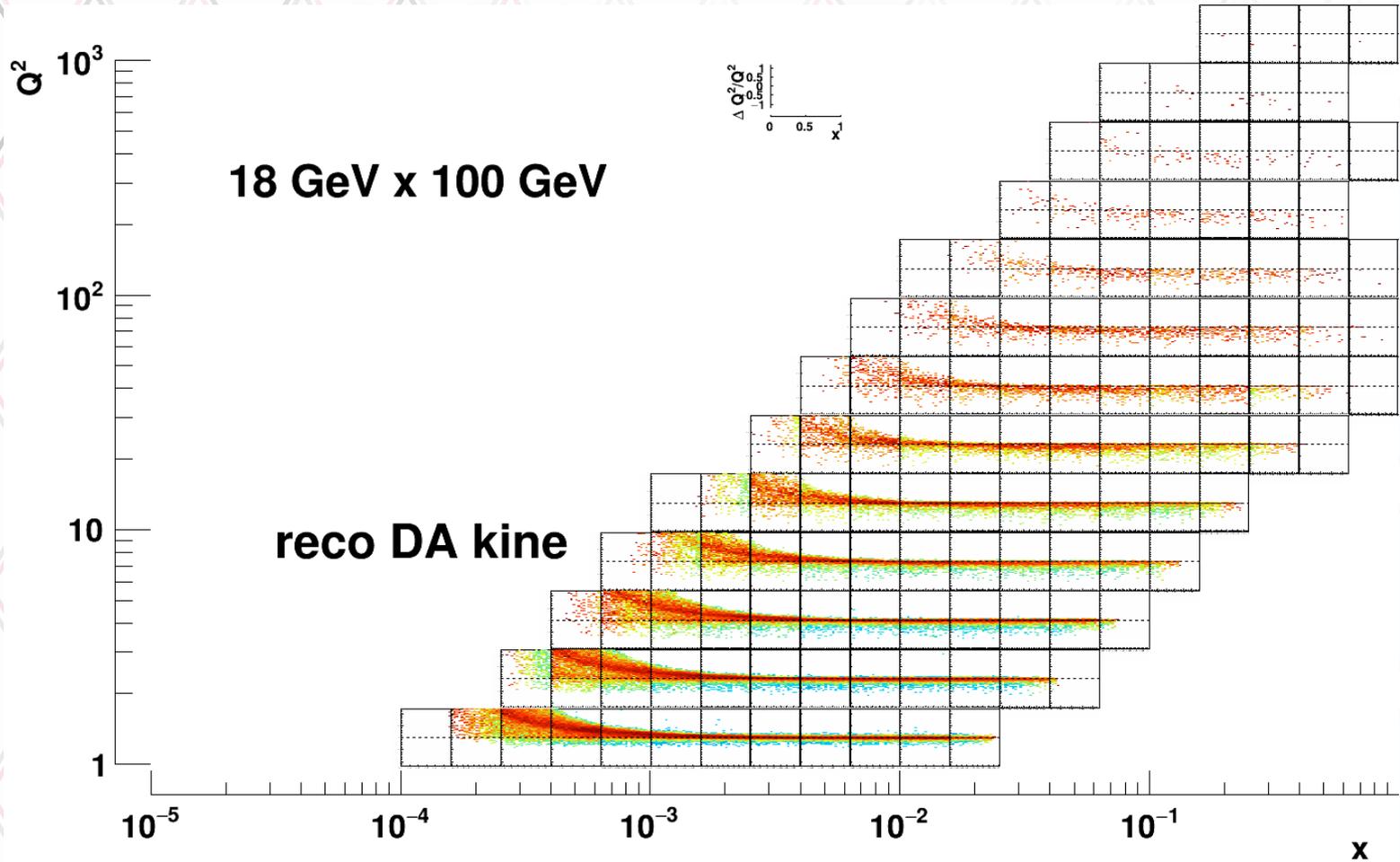


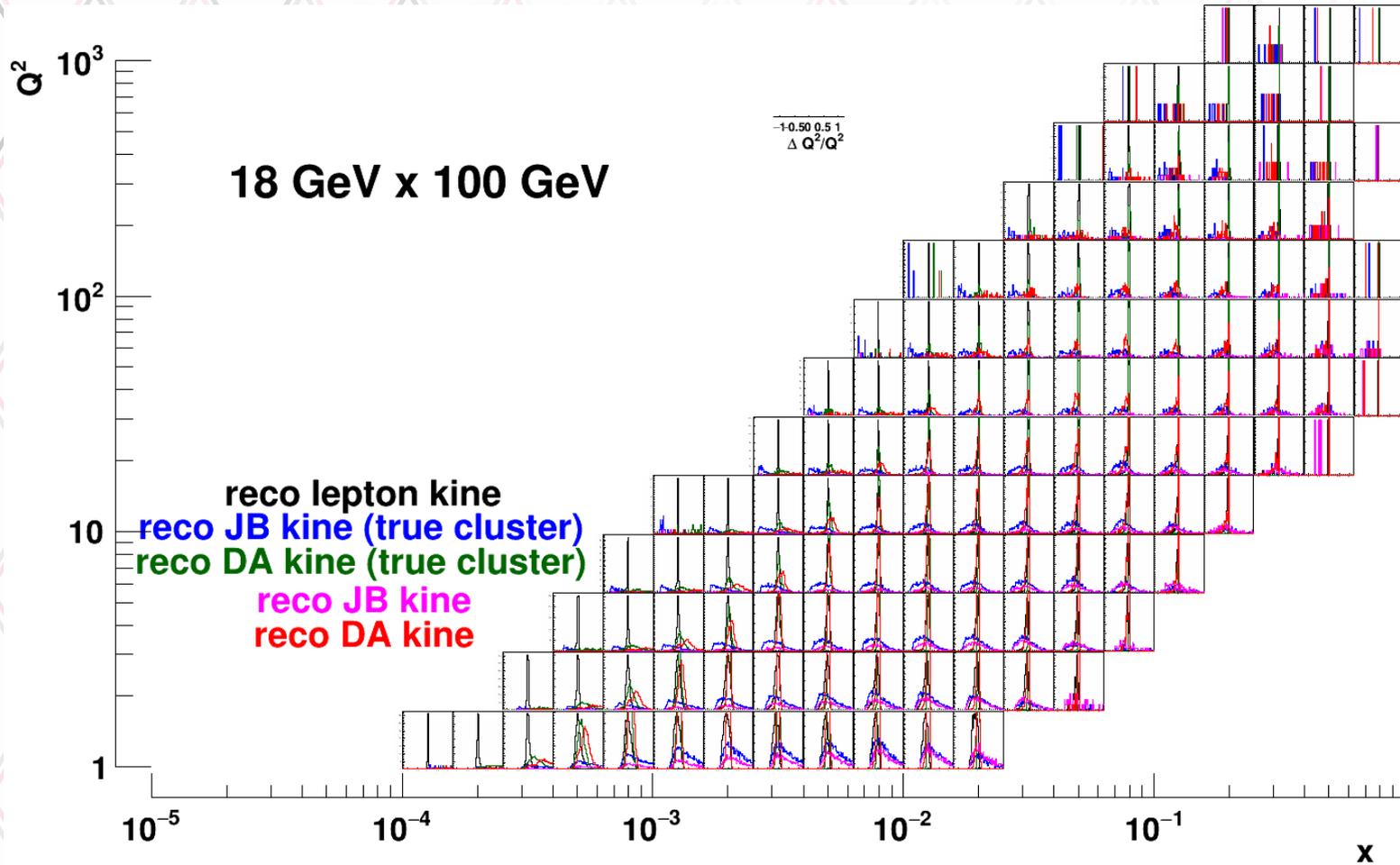




All Q2 reco widths and means

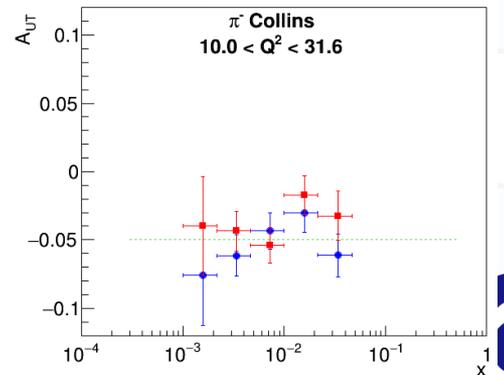
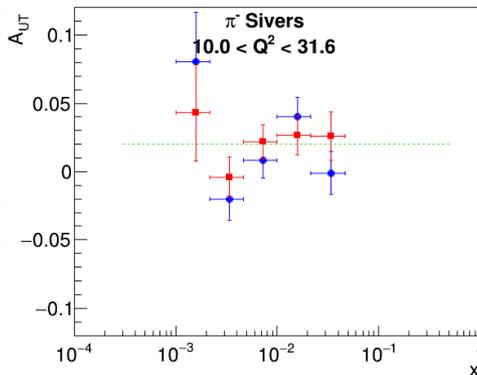
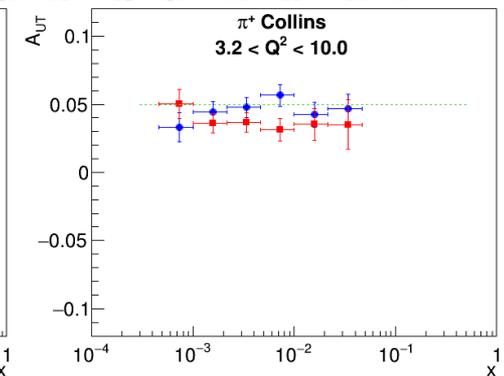
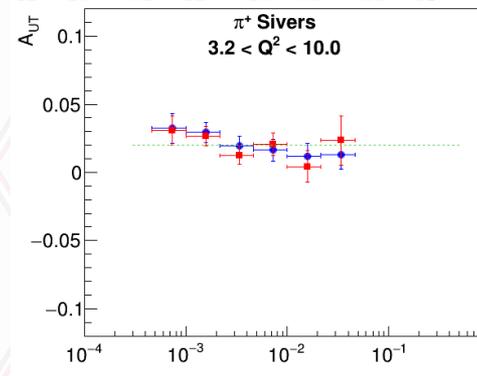
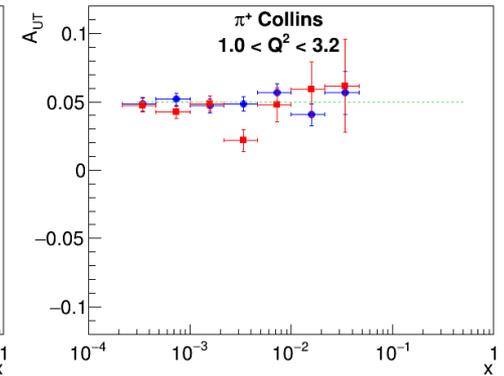
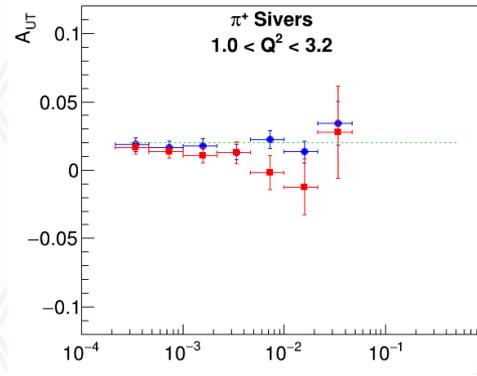






Sample asymmetries

- Sample asymmetries produced with currently available stat (3M DIS events)
- Sufficient for flat asymmetries, but not enough for kinematically dependent asymmetries
- Full Sivers/Collins weighting set up
- All implemented for all kinematic reconstructions



Conclusions

- JB and DA methods with reco charged particles and neutral clusters works reasonably well, but still some issues when matching via barcode to charged particles only
- Fix a few other smaller issues
- New production to become available soon
 - Will need to test vertex implementation, projections, and how PID information will be available to us (currently not in our output)
- For the most part ready for test production

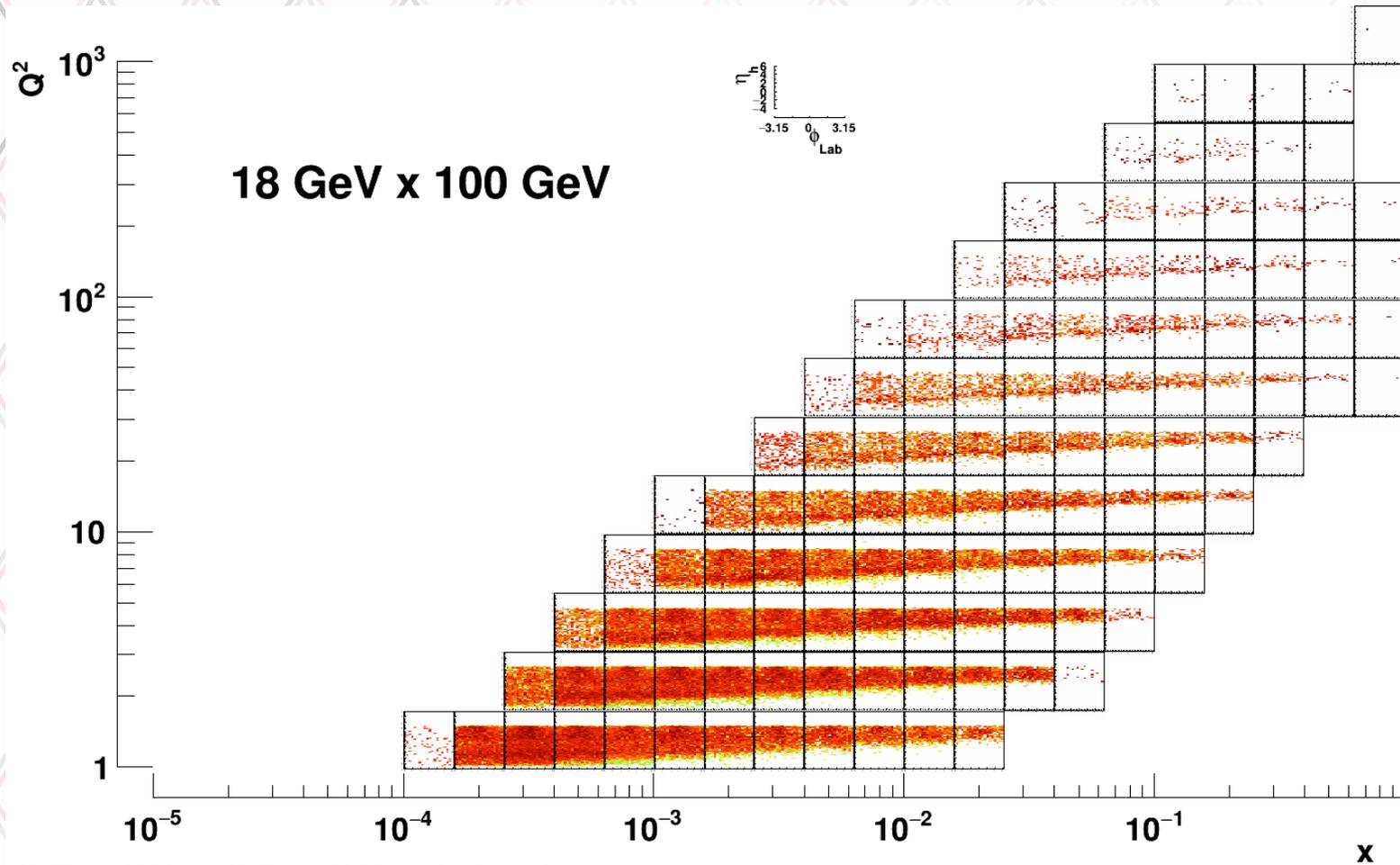
Analysis notes to accompany proposal

- Kinematics smearing note
- Sivers/Collins note
- Helicity note
- Unpol TMD note
- IFF note?
- Others

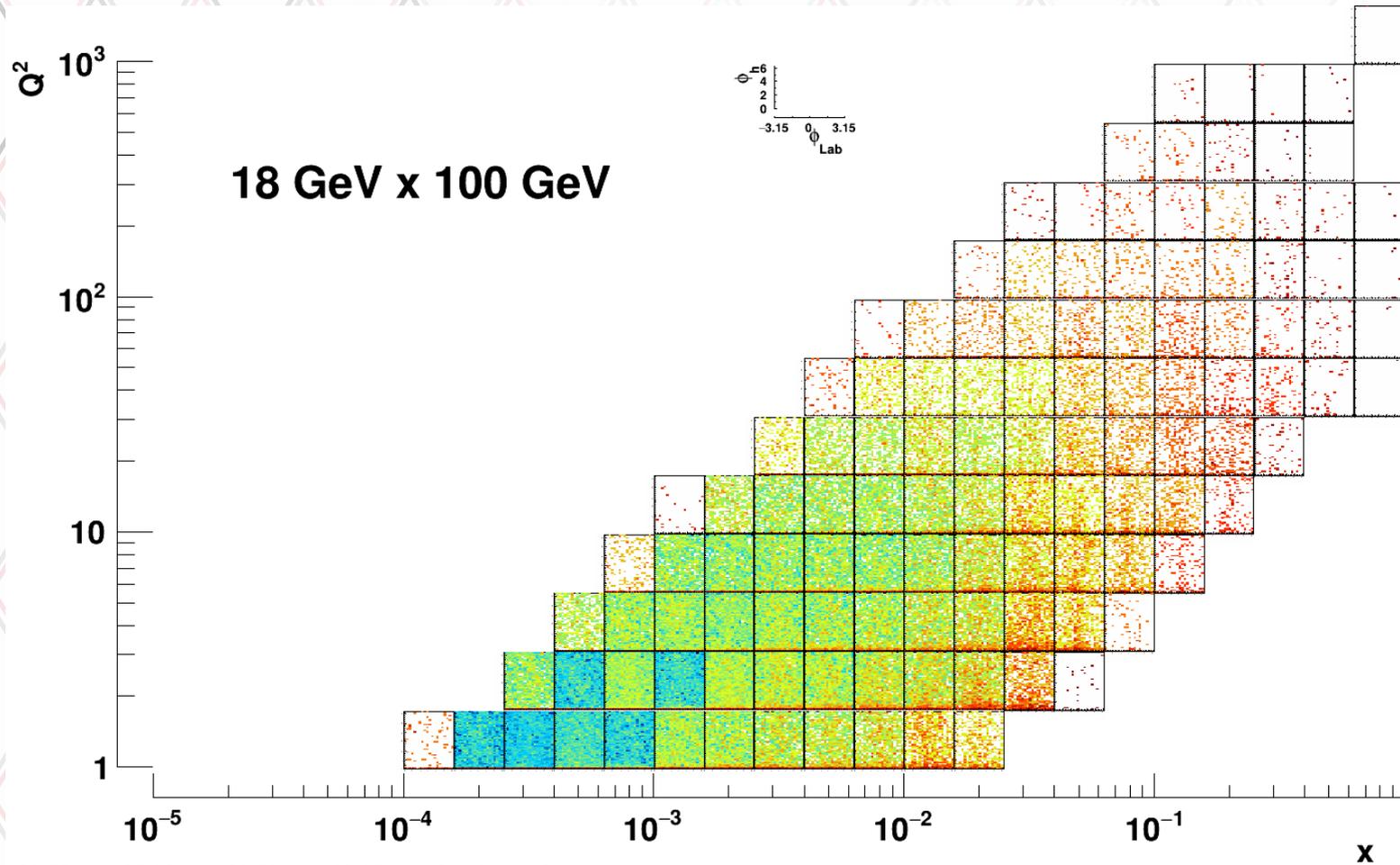
Crossing angle

- Crossing angle of 25mrad seems to correctly implemented in simulations (checked between HEPMC and G4Truth)
- Question in simulation/physics meeting about impact from limited acceptance on azimuthal angles → next slides

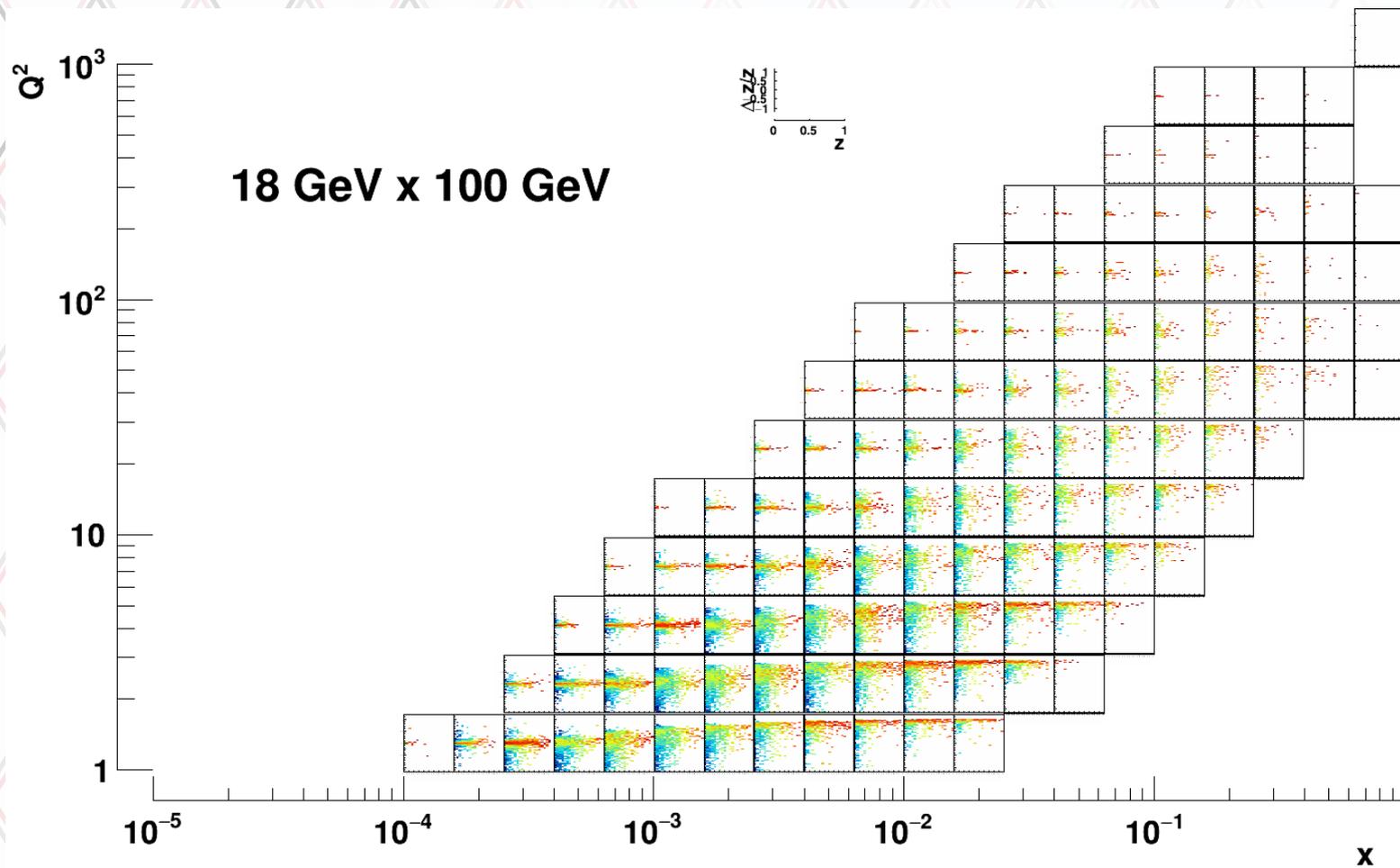
Lab ϕ and rapidity distribution for pions



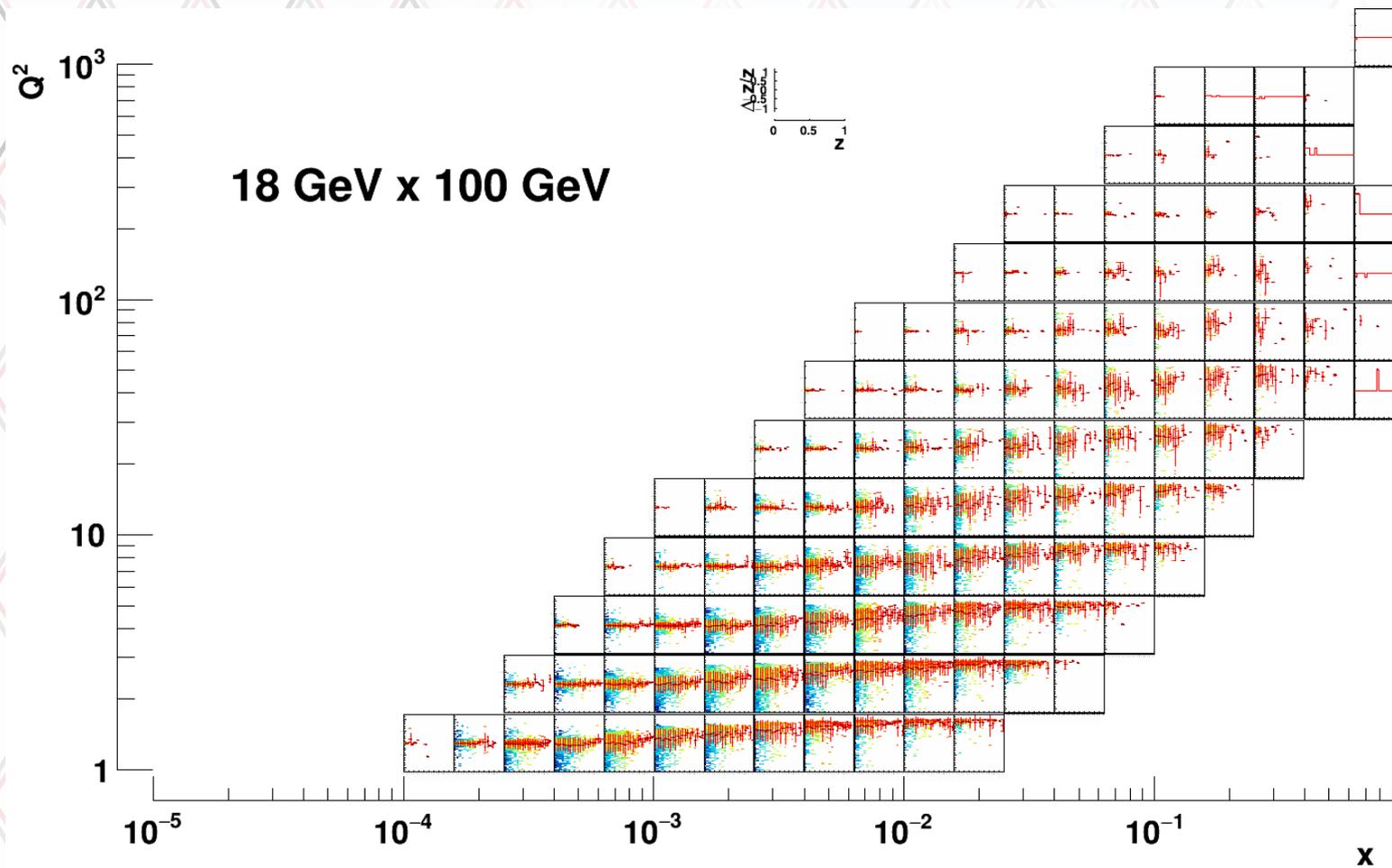
ϕ_h and lab ϕ distribution



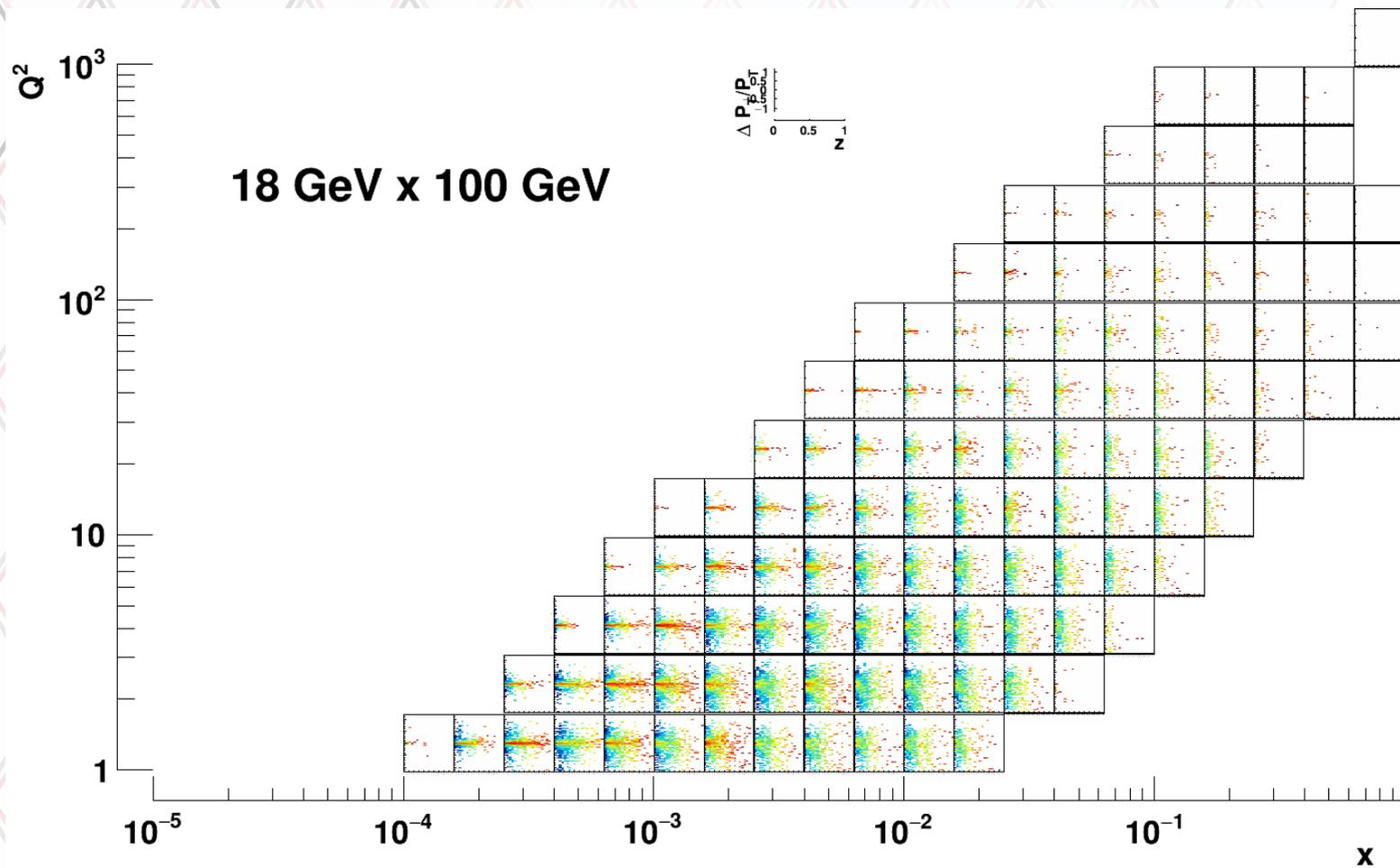
Resolutions in z for pions

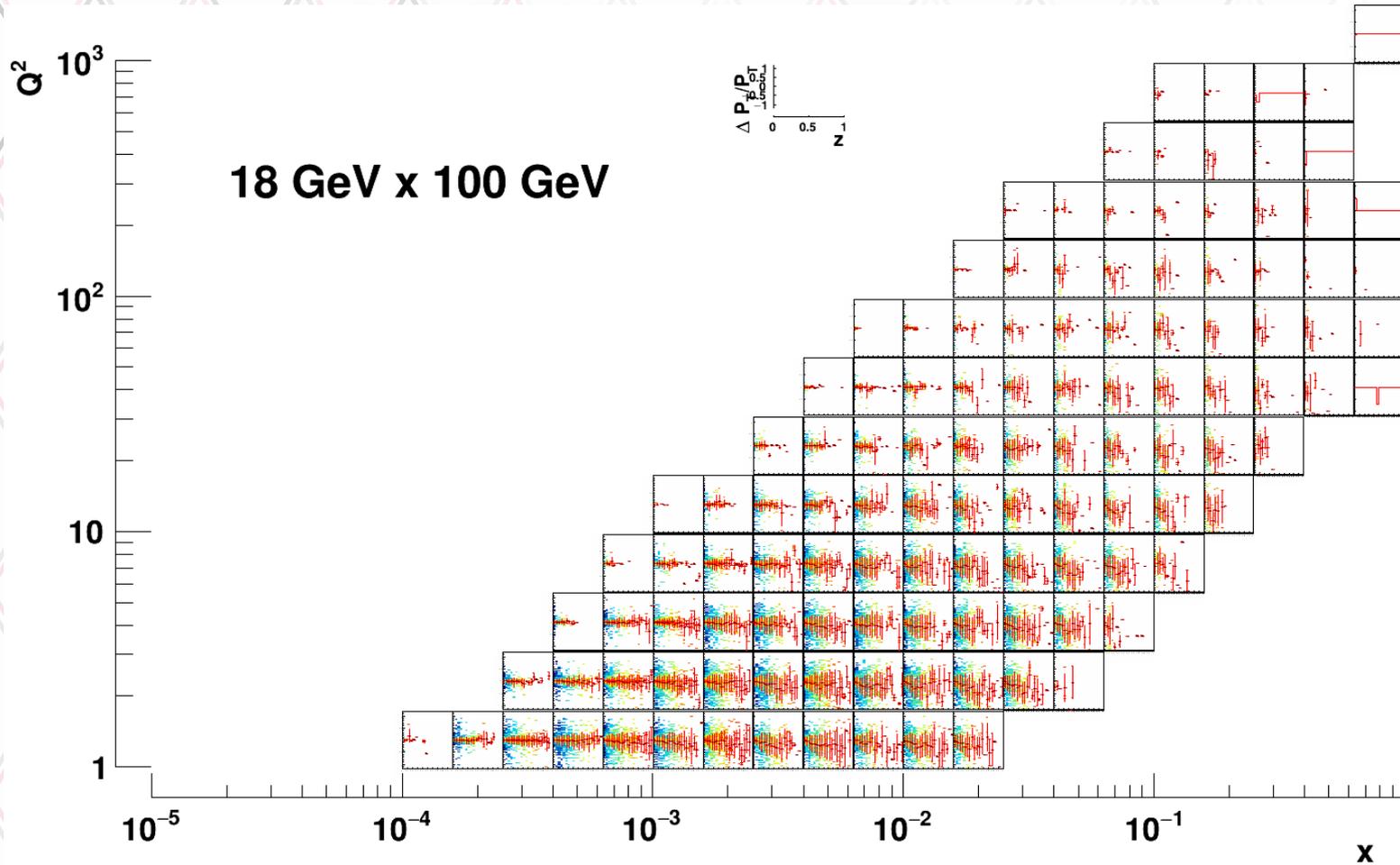


..including profile

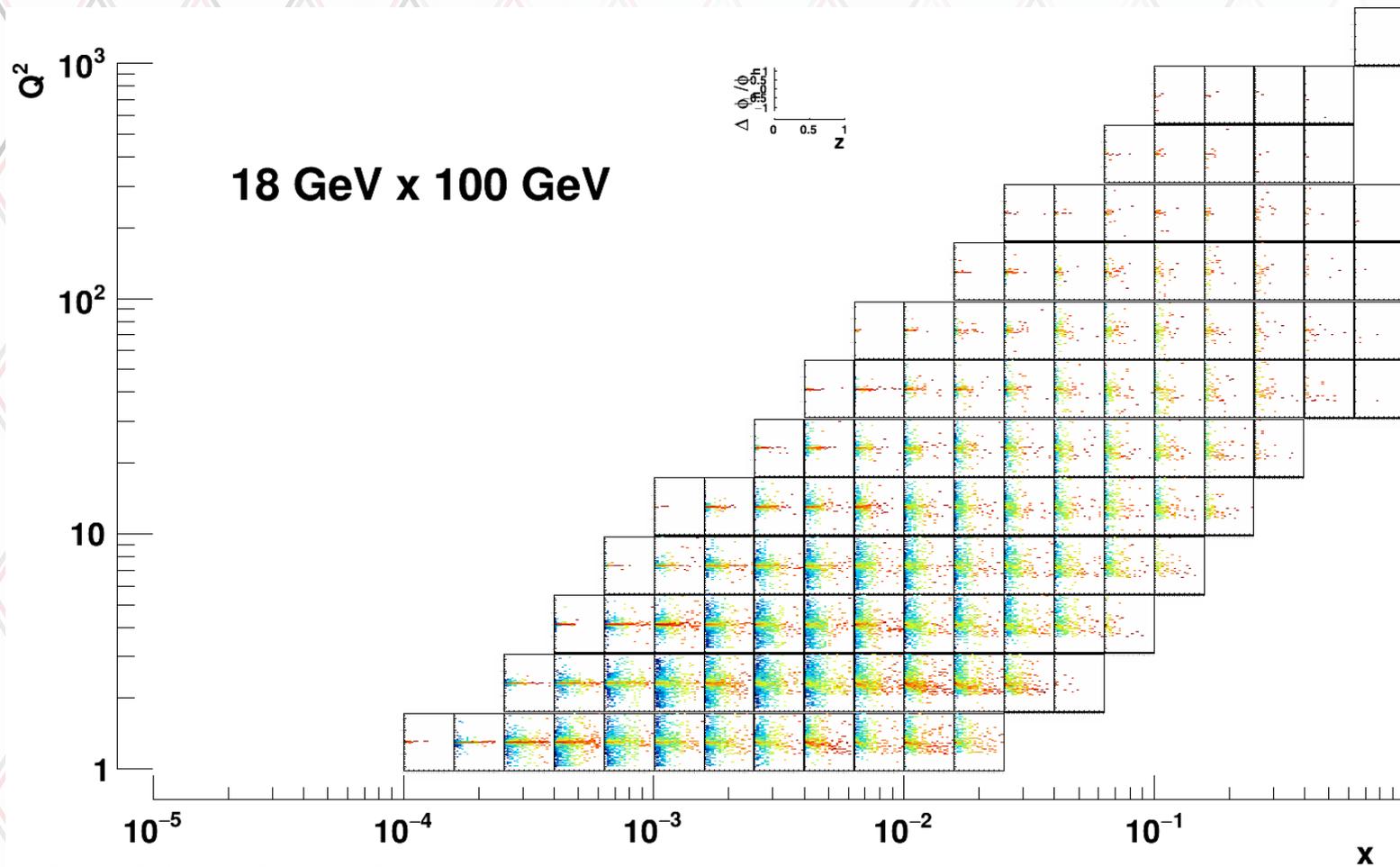


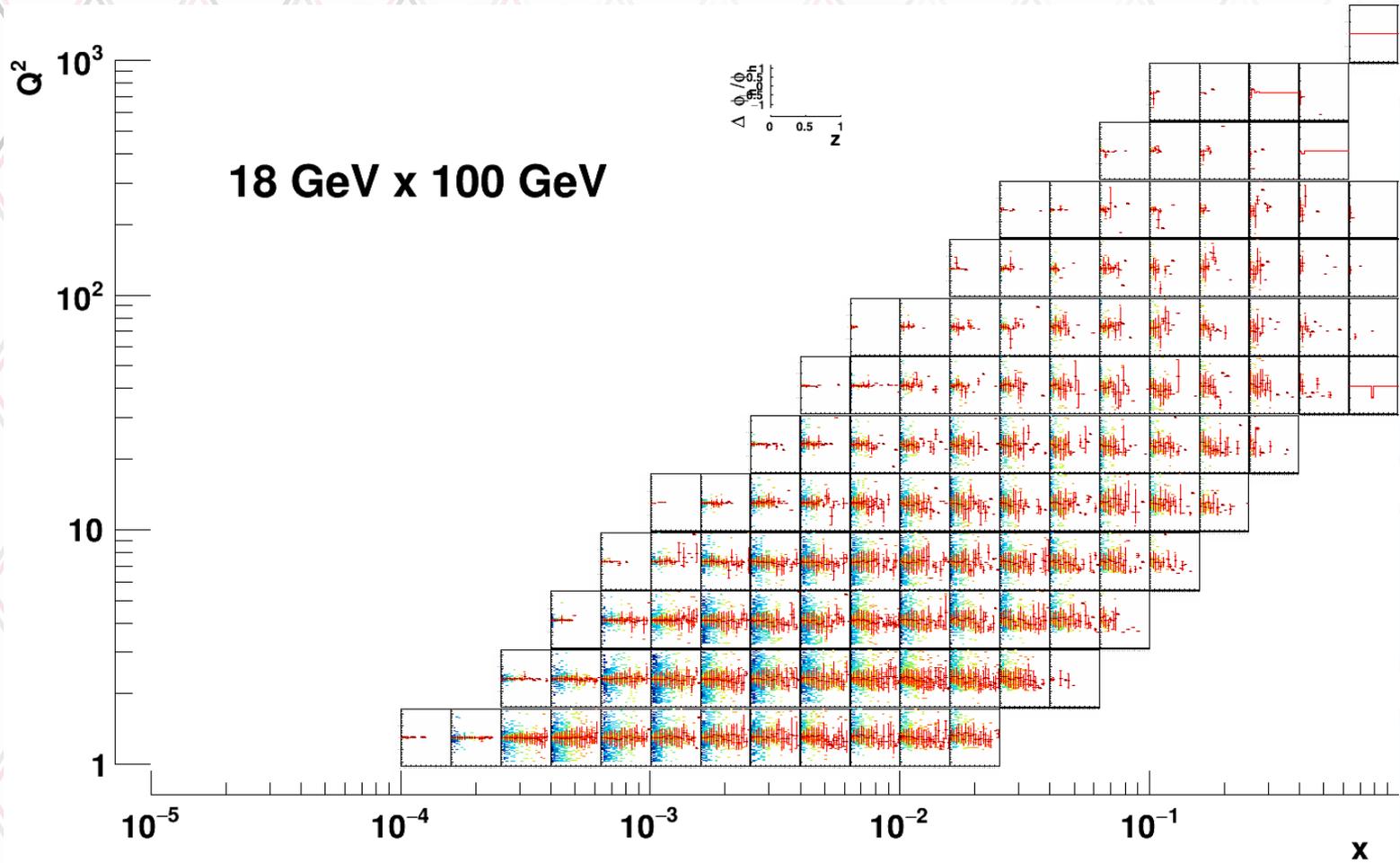
Pt resolutions





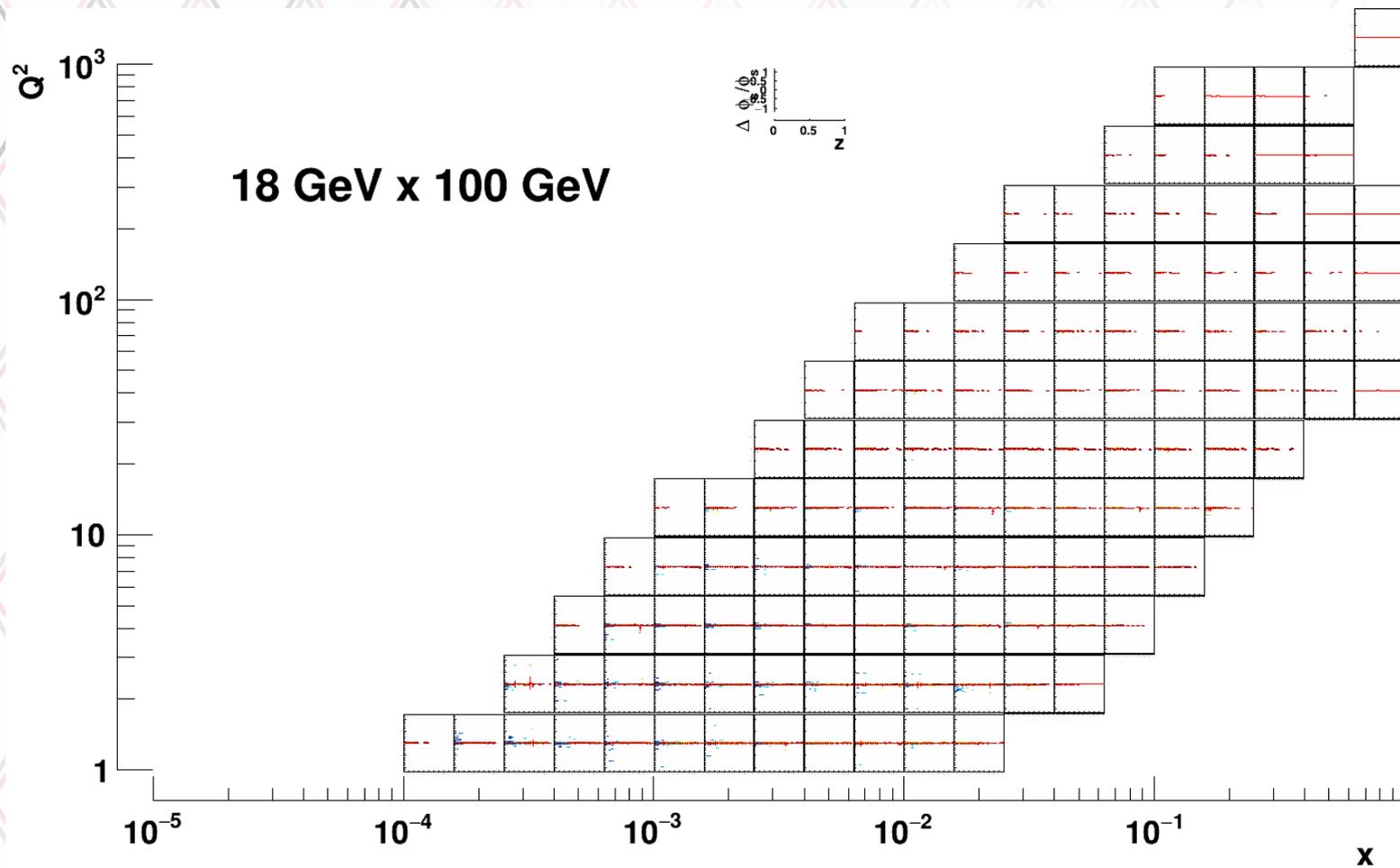
ϕ_h resolutions

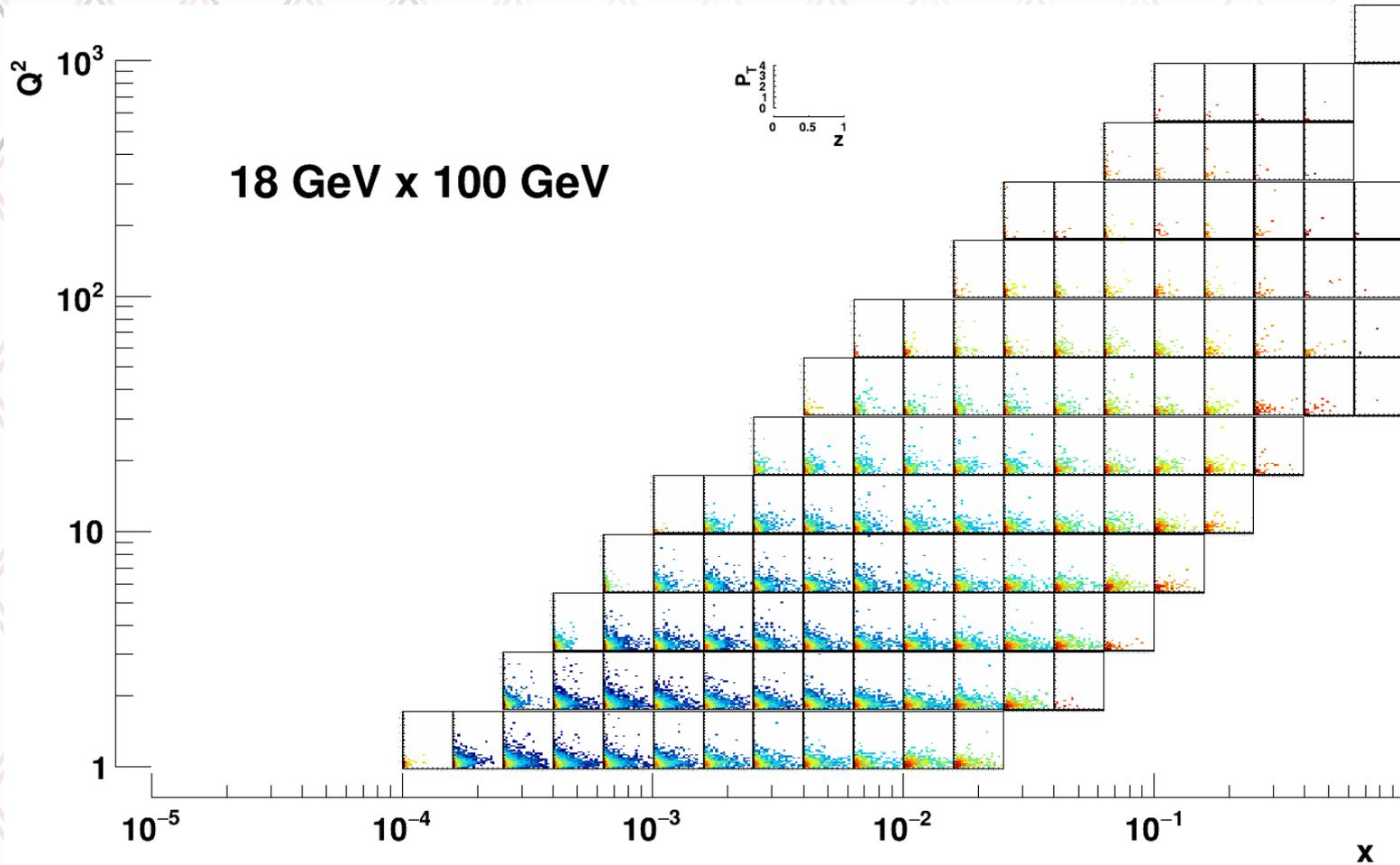


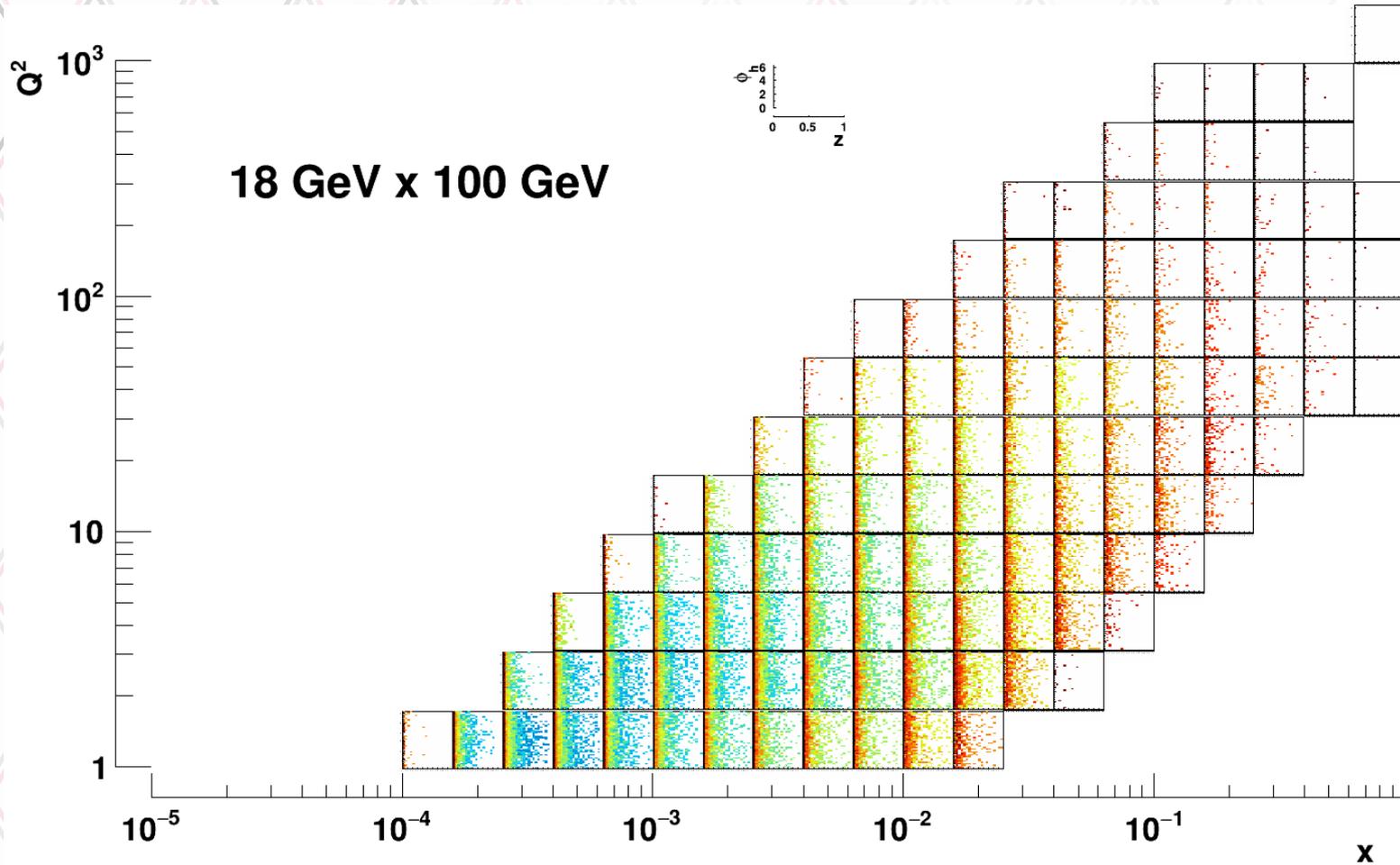




phis







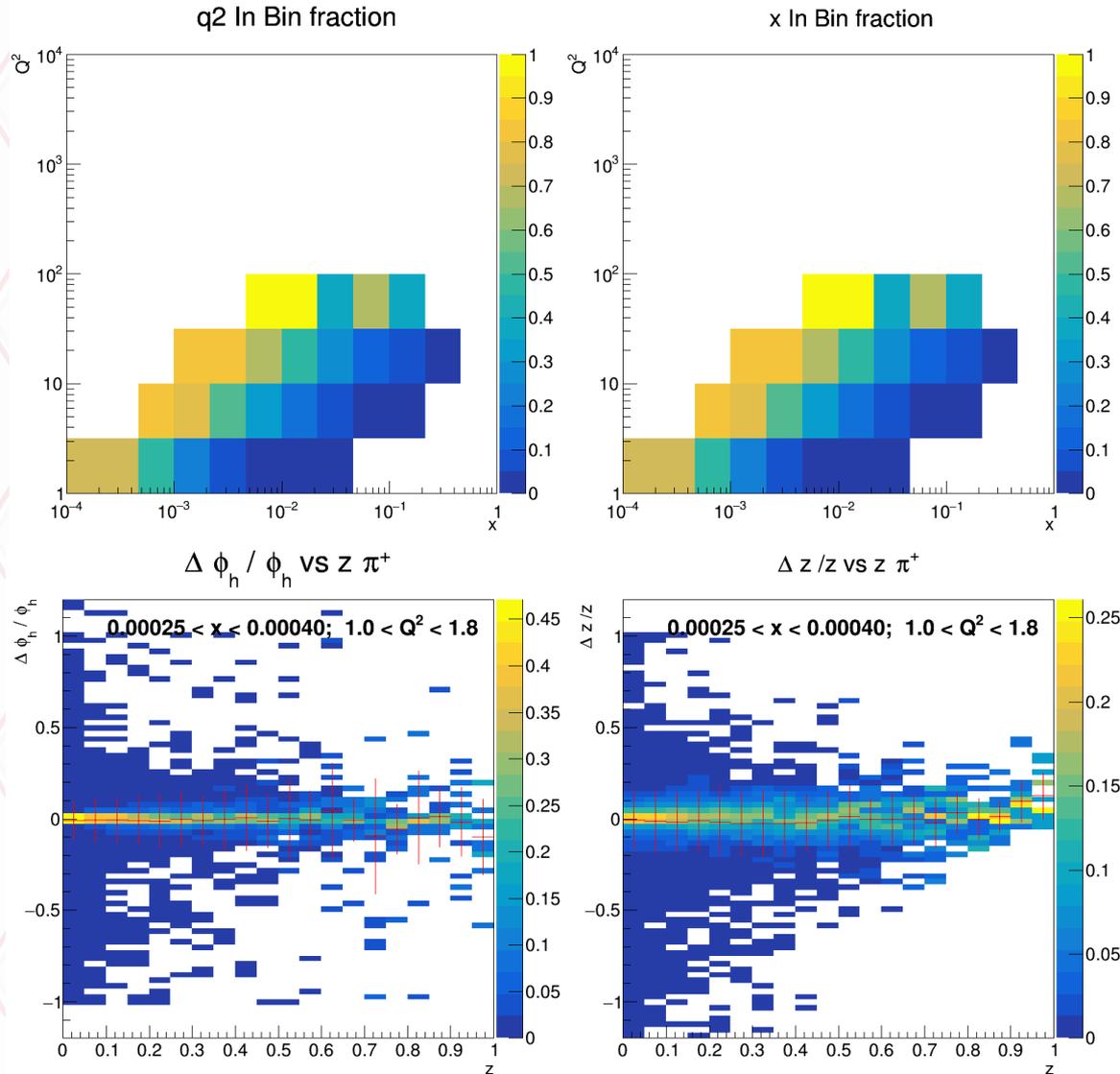
- Tracking group requests input about tracking requirements from physics groups:
 - How to address this?
 - x , Q^2 , ϕ_S and z , P_{hT} , ϕ_h resolutions for different tracking assumptions ?
 - Could be done via eic-smear studies rapidly.
- require momentum resolutions as a function of rapidity from tracking group and feed it into eic-smear
- Would minimum momentum ranges for detector options affect measurements?
 - Check 4D plots for different min possibilities

Impact studies and plots for proposal

- Concentrate on two energy combinations? Highest and lowest energies (5x41, 18x250 or only 10x250,)? Reasonable for simple asymmetry feasibility at low x/low Q² corner, high x/high Q² corner and low y corners
- What are the early physics goals that can be achieved in 1st year 5fb⁻¹?
- Apart from impact plots also show the explicit expected asymmetries, or both
 - Compare perfect detector, YR, 1-2 ECCE configurations?
 - How to discuss and estimate systematics?
- Sample asymmetry plots (fixed bin(s)), show asymmetries for different configurations and effect of smearing

Some example Output I

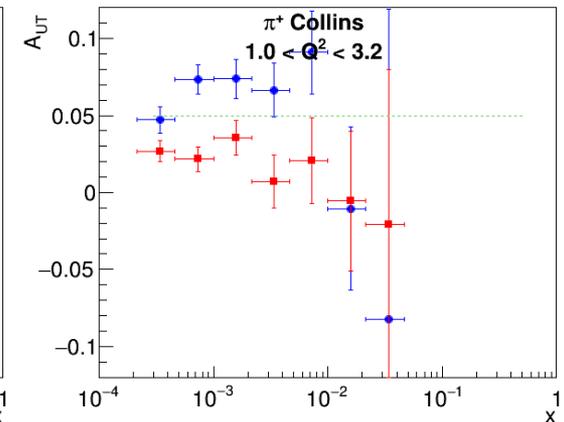
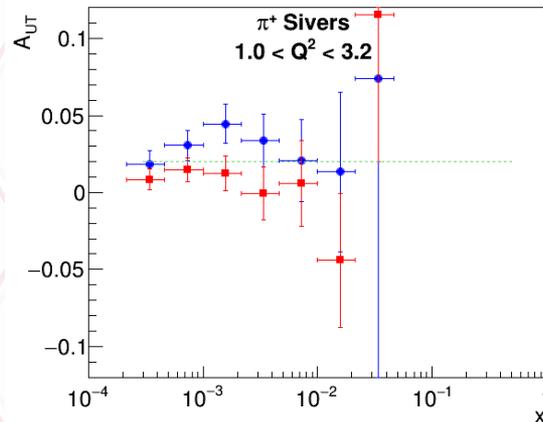
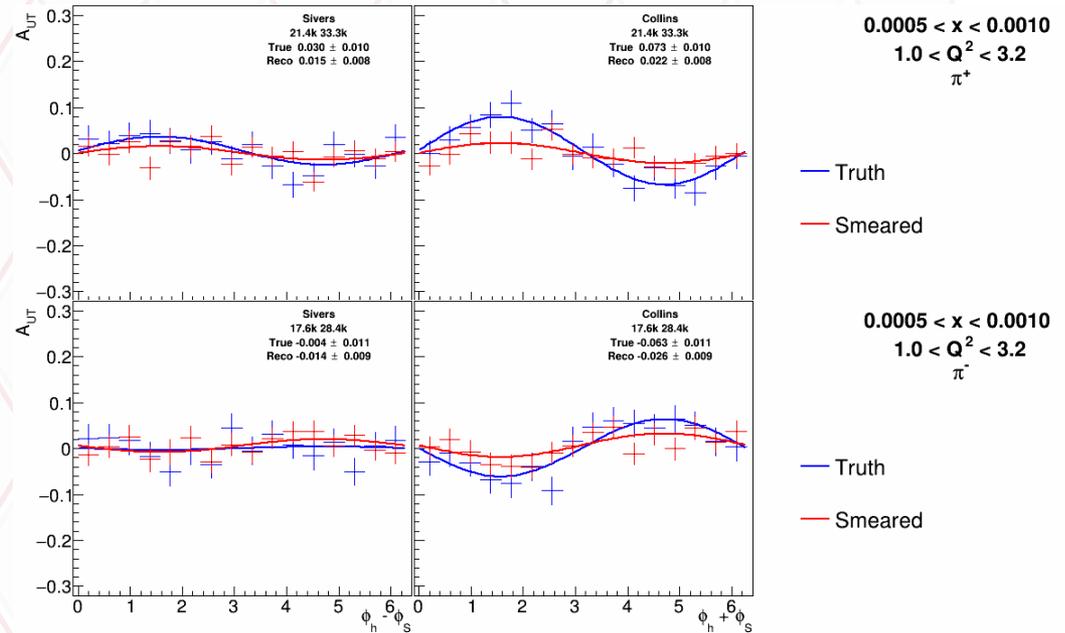
- Low level: DIS in-bin efficiencies (using scattered lepton only)
- Medium level: Some resolutions for hadron z , azimuthal angles in one particular z - Q^2 bin



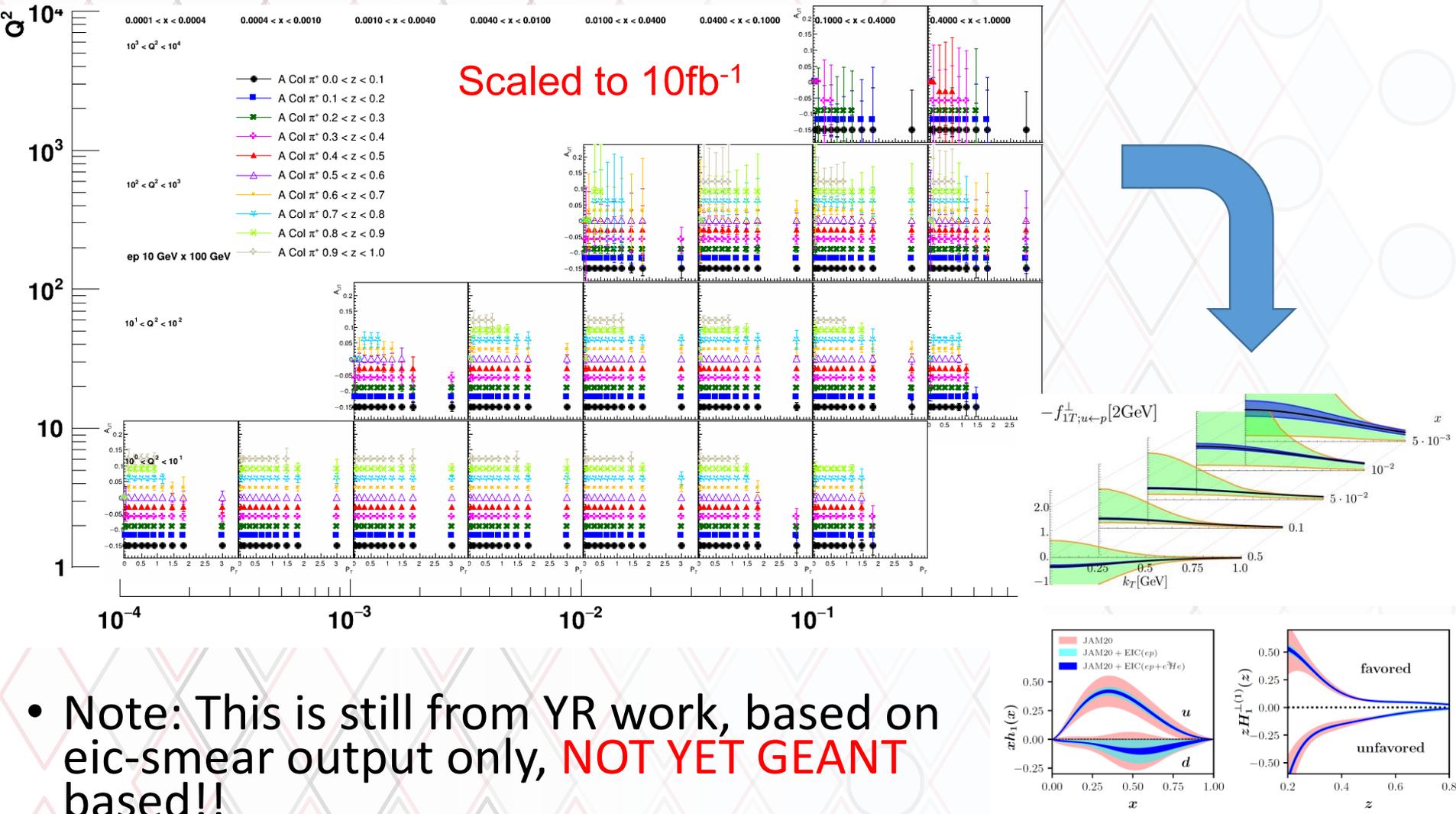
Some example Output II

- High level: Reweighted azimuthal single spin asymmetries

- Very simplified constant (in x , Q^2 , z , P_{hT}) weights in true variables
- Far from enough statistics, but demonstration of smeared asymmetry test



Expected Sivers/Collins asymmetries



• Note: This is still from YR work, based on eic-smear output only, **NOT YET GEANT** based!!

Key SIDIS physics measurements (must-do)

- Quark Sivers function as a function of x , k_t for valence and sea flavors: $A_{UT} \sin(\phi_S - \phi_h)$ moments for IDed pions and kaons (Golden channel)
- Tensor charges for valence and sea quarks $A_{UT} \sin(\phi_S + \phi_h)$ moments for IDed pions and kaons (silver channel)
- Unpolarized TMD PDFs and its QCD evolution (silver channel, implicit requirement for Sivers)
- Sea quark helicities via SIDIS A_1 (A_{LL}) measurements for IDed pions and kaons (golden channel)
- Gluon Sivers function via di-jet or HF pair A_{UT} s (Still open)

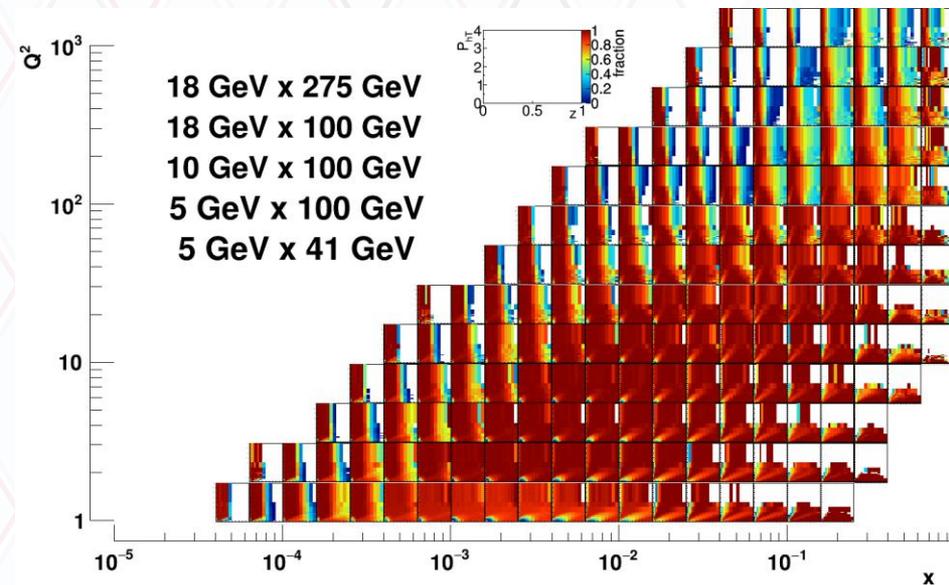
Other measurements (can-do)

- Boer-Mulders function measurements via IDed pion and kaon $\cos(n\phi_h)$ moments (likely most acceptance sensitive)
- Fragmentation function FF measurements and nFF measurements for light hadrons
- Unpolarized sea quark PDF measurements using FFs
- Various other single and di-hadron azimuthal moments related to tensor charge, higher twist function e , and others
- XYZ production measurements (mostly photo-production, not SIDIS but part of SIDIS YR, could also be in HF group)
- Other Jet related TMD measurements \rightarrow HF/Jet group?

Main figures for the report

- 4D (x - Q^2 - P_{hT} - z) kinematical + PID coverage figure similar to YR
 - Concentrate for the most part on certain x - Q^2 ranges due to simulation cost
- Closely related: z , P_{hT} and ϕ_s , ϕ_h smearing figure for different ECCE configurations
- Simulations can start from the YR Pythiaerhic/eic-smear files

Fig. 8.29



→ Already prepared for the most part

Sivers/Collins/unpol TMD figures

- Redo these YR analyses (AUTs require reweighting of events in truth kinematics+parton flavor)
- Need to take into account crossing angle and related acceptance/smearing effects
- Similar to YR guess systematics via variation between perfect and smeared options
- Extrapolate from some x-Q2 bins to all and give to Alexey Vladimirov (Sivers, unpol TMD) or Daniel Pitonyak (Tensor charge) for impact studies

Fig. 7.53: Sivers

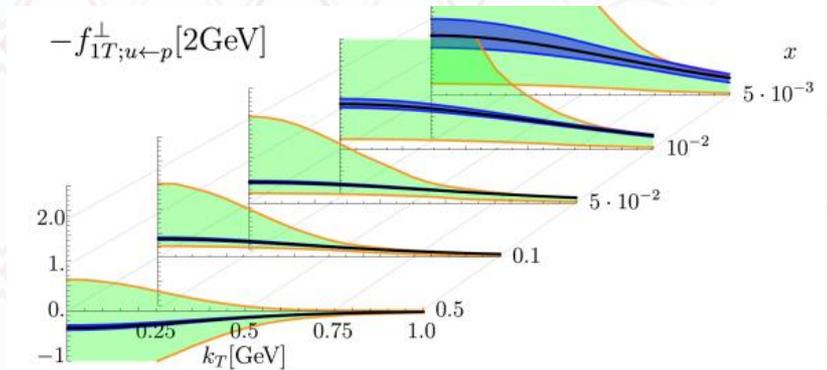
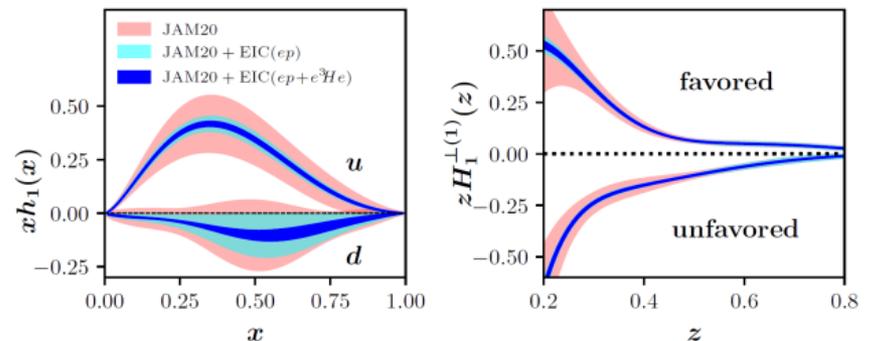


Fig. 7.54: Transversity



→ feasible using EventEvaluator, reweighting machinery still to be transferred from eic-smear based work