Status of SIDIS working group

Physics meeting
July 30

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Ralf Seidl (RIKEN)

RIKEN

Status (7/31)

- Actual prop.2 production analyzed so far:
  - ep-5x41: ~17.5 M DIS events
  - ep-18x275: ~18 M DIS events
  - ep_18x100lowq2: 15.1M DIS events
  - ep-10x100:
  - All but 18x100 are all Q^2, likely limiting high Q^2 statistics

- *Used local EventEvaluator variant, output in ~/spin2/ECCE/ana/prop2/…*

- *Hadronic DIS reconstruction working with track-cluster matching (currently using $R^2 = (\Delta\eta^2 + \Delta\phi^2) < 0.05$ for charged track)*
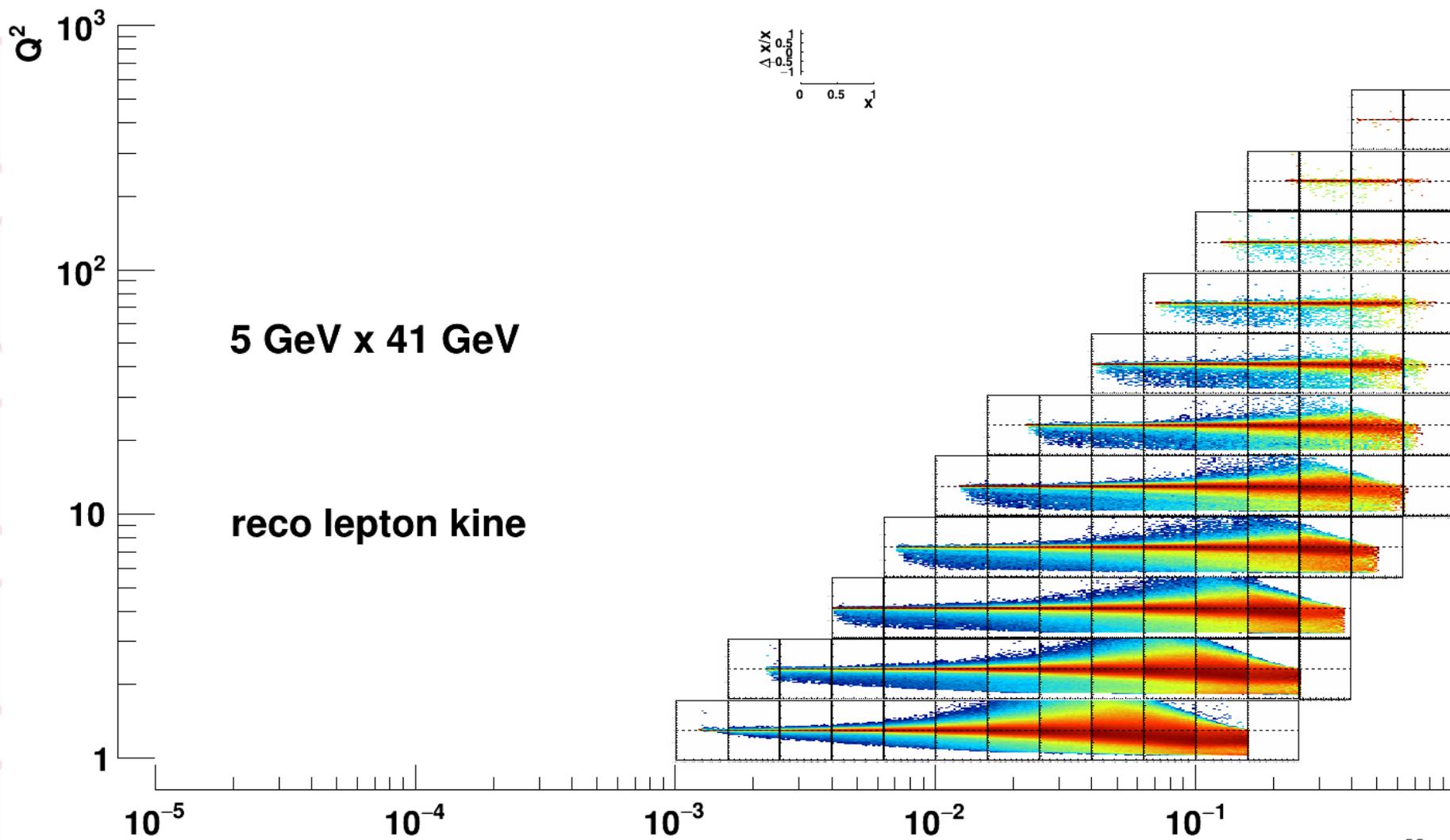
- *PID still used PDG values*

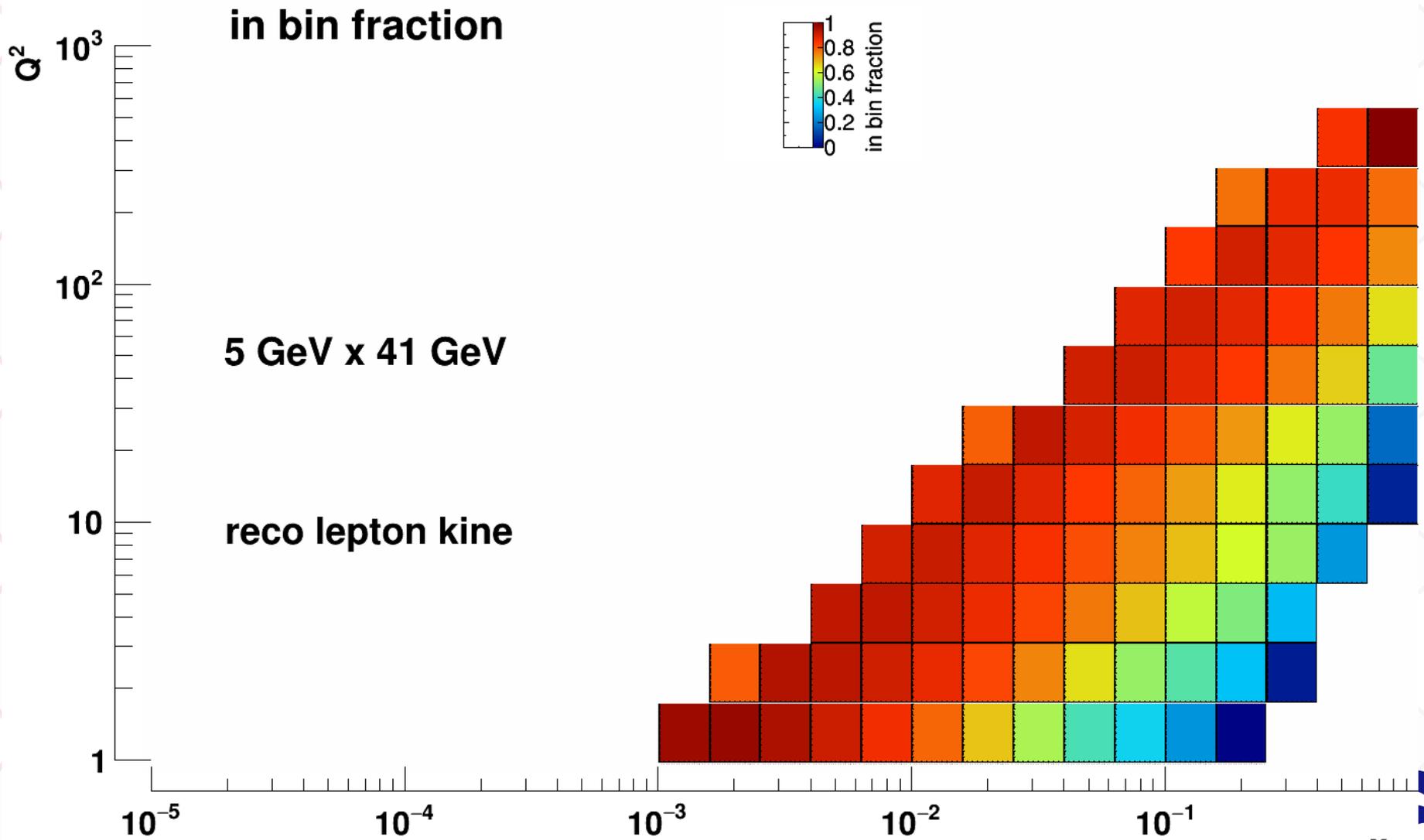# Example x resolutions, 18x100, 3 x bins at intermediate Q²
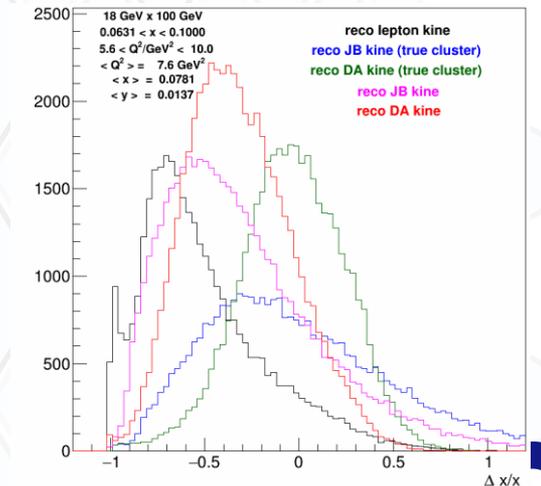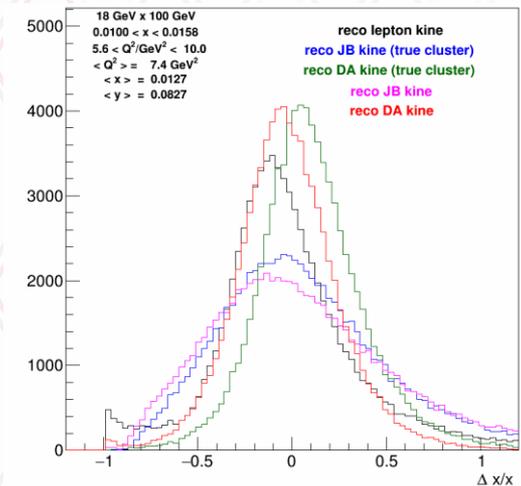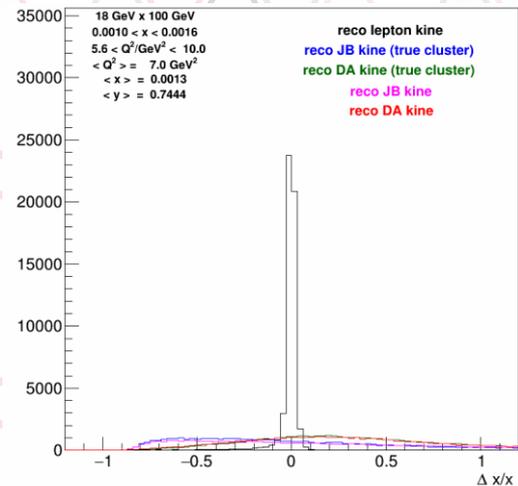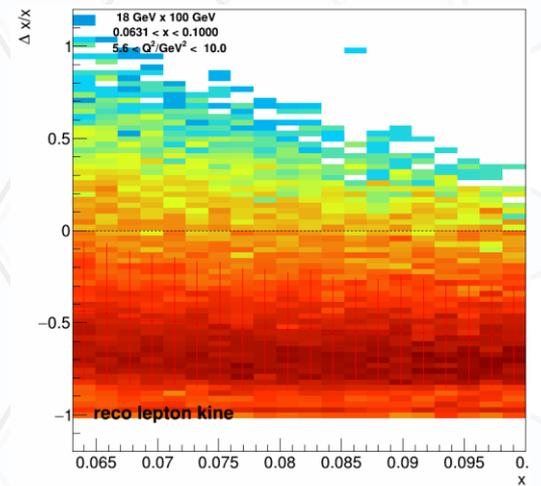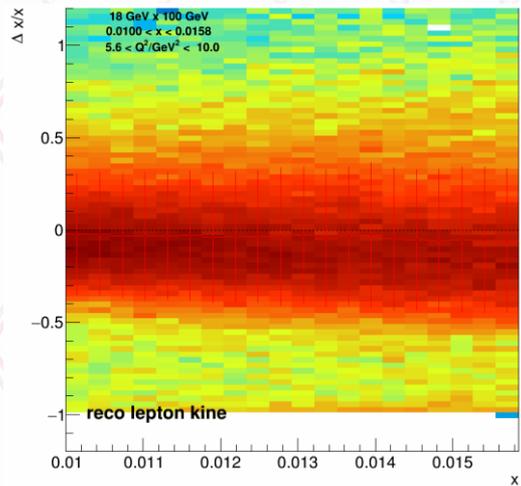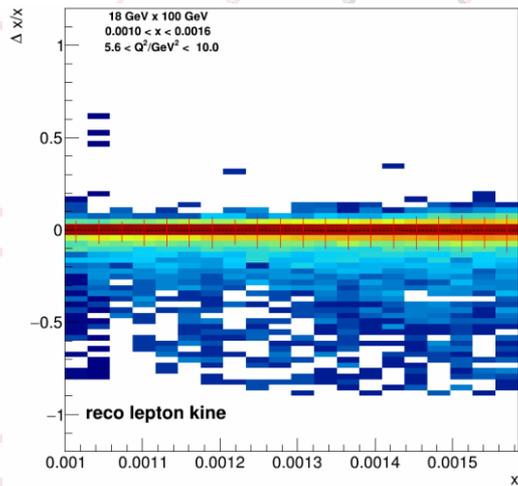
Example x and y resolutions, 18x100, 3 x bins at intermediate Q^2

Level of x smearing
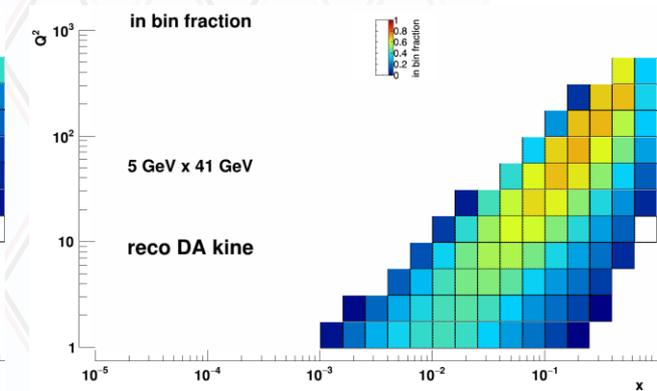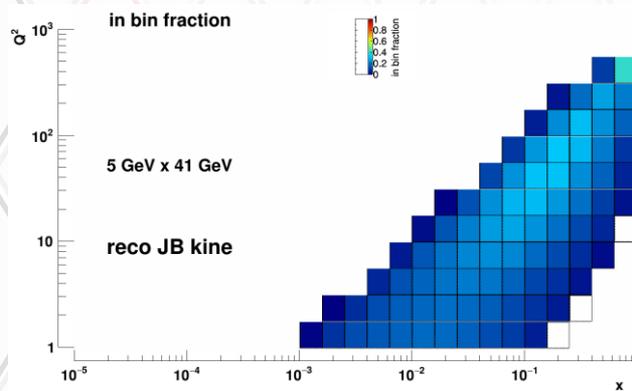

5 GeV x 41 GeV
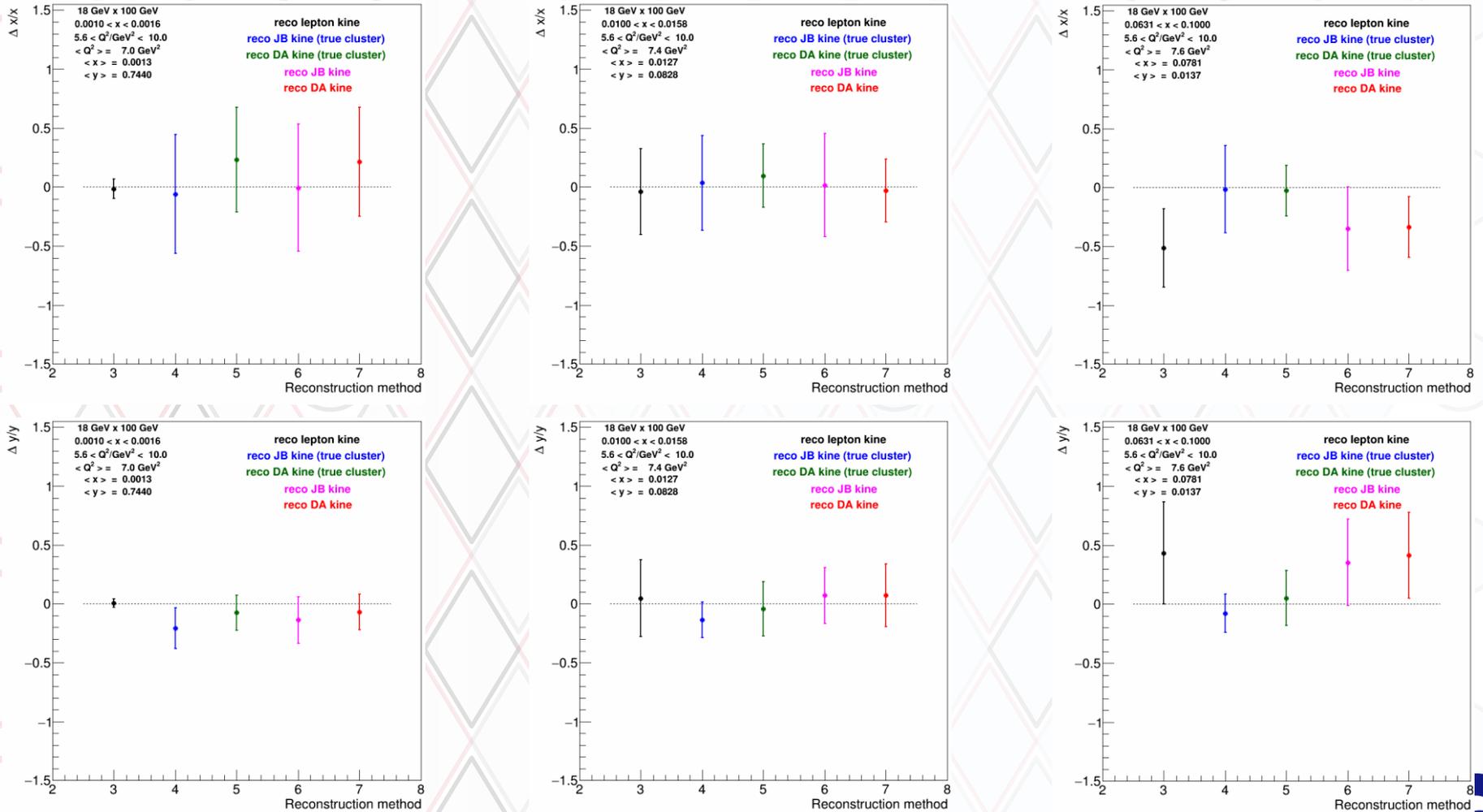
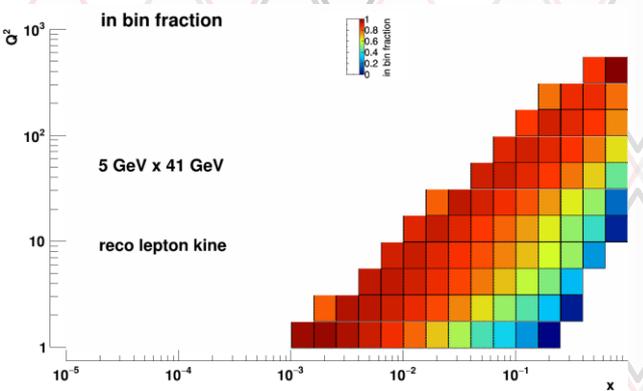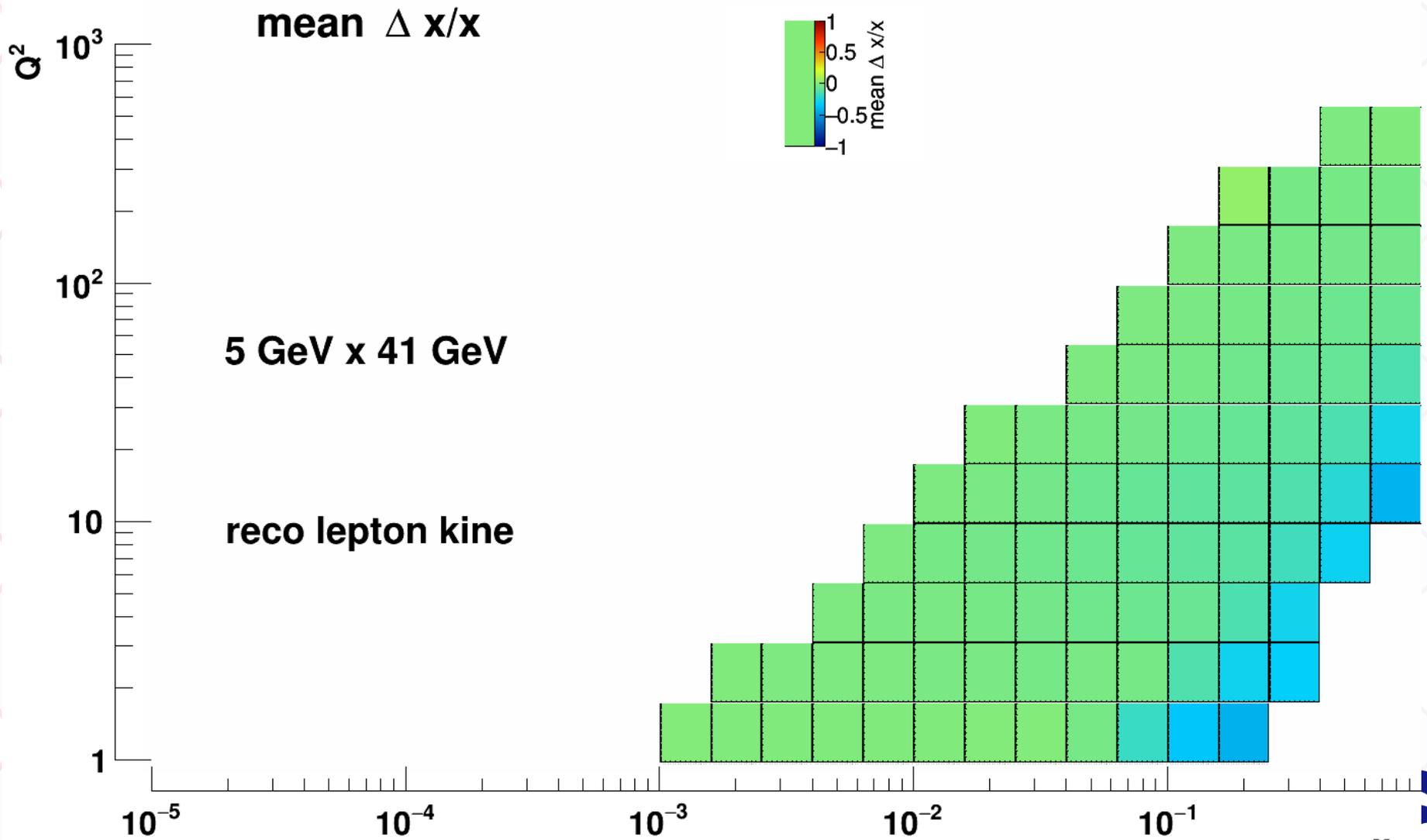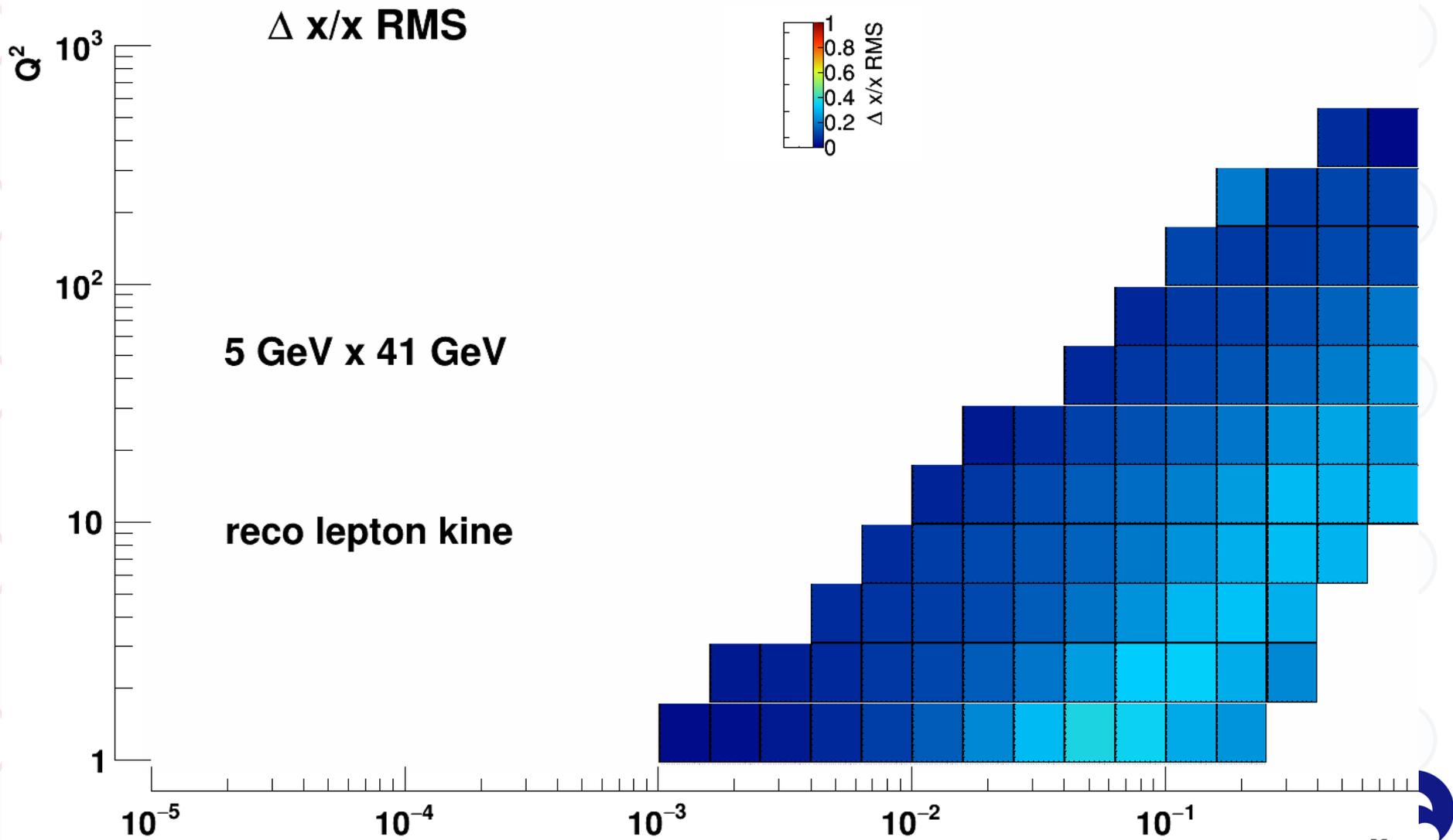reco lepton kine

In x-Q^2 bin fraction using lepton kinematics

x-Q^2 bin retention fractions for 3 methods
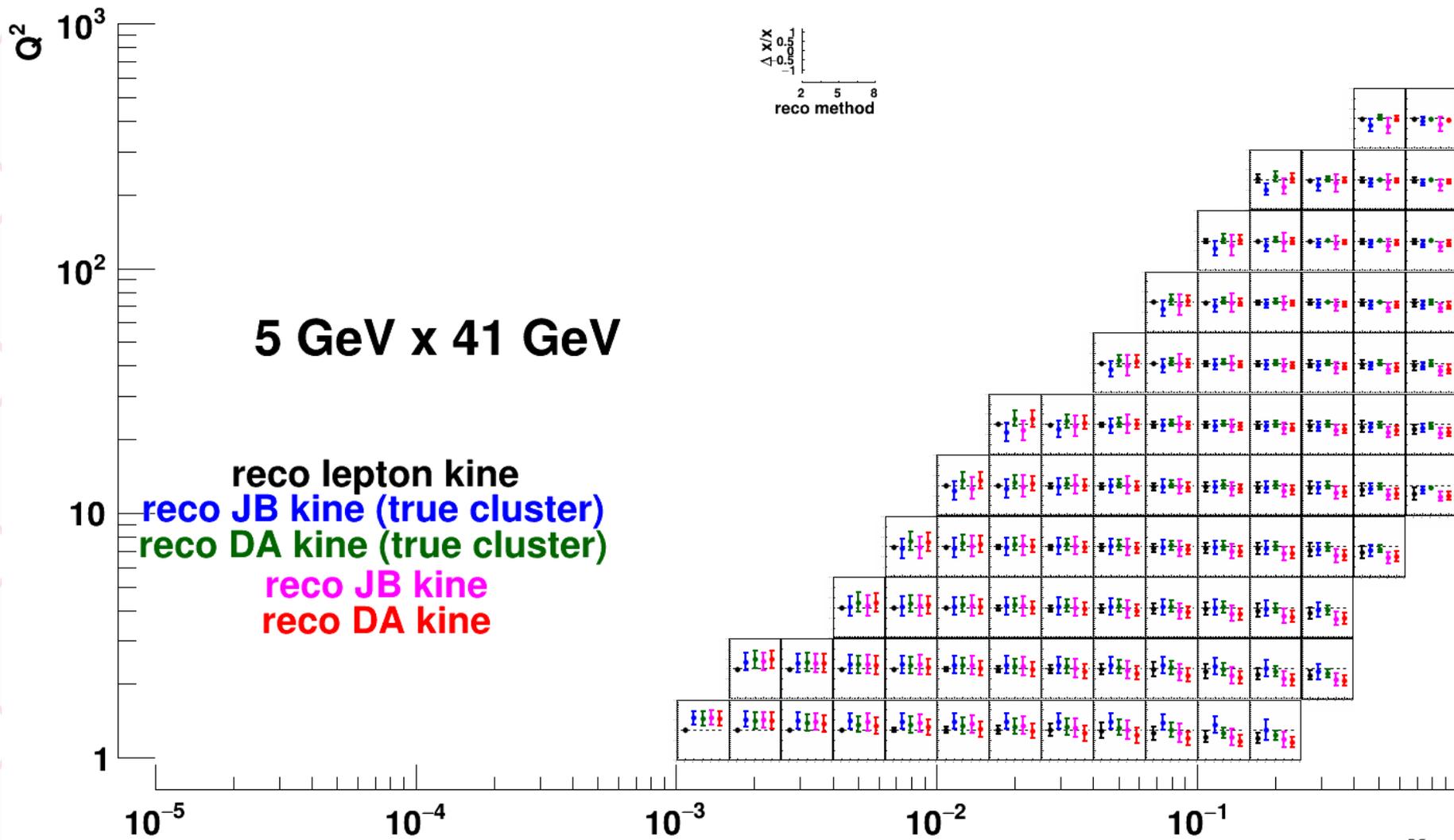
Mean relative x deviation
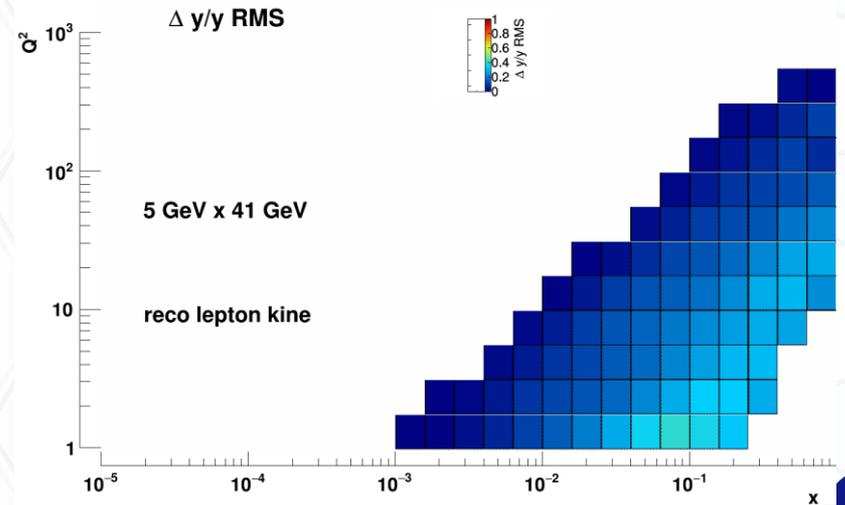
Width of x deviation

Overall x resolutions for all reco methods

5 GeV x 41 GeV

reco lepton kine
reco JB kine (true cluster)
reco DA kine (true cluster)
reco JB kine
reco DA kine

Other DIS kinematic variables

Overall resolutions in y

5 GeV x 41 GeV

reco lepton kine
reco JB kine (true cluster)
reco DA kine (true cluster)
reco JB kine
reco DA kine

Overall resolutions in Q^2

5 GeV x 41 GeV

reco lepton kine
reco JB kine (true cluster)
reco DA kine (true cluster)
reco JB kine
reco DA kine
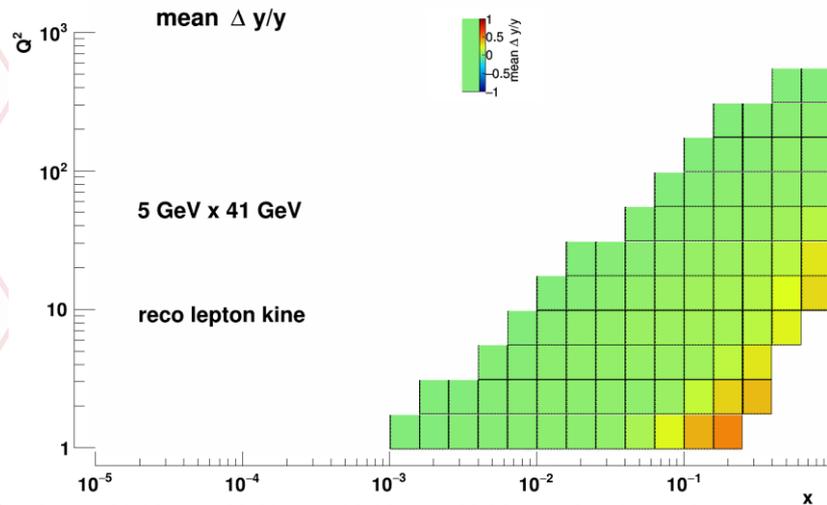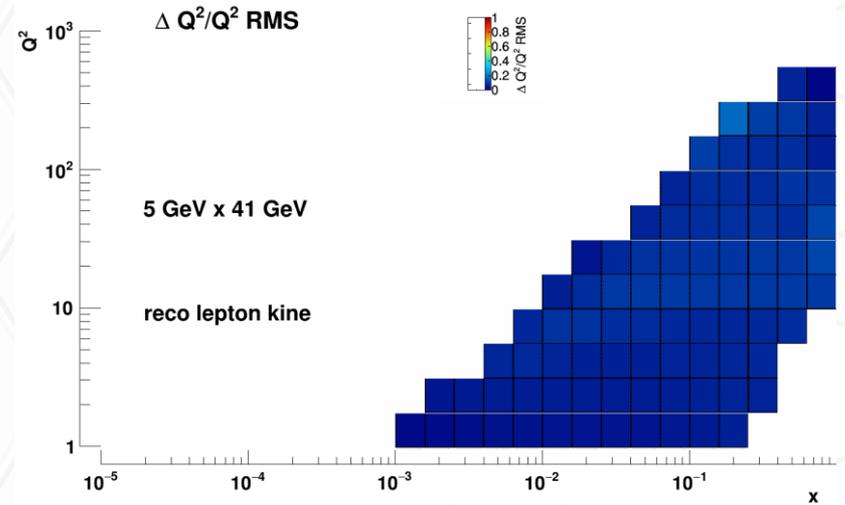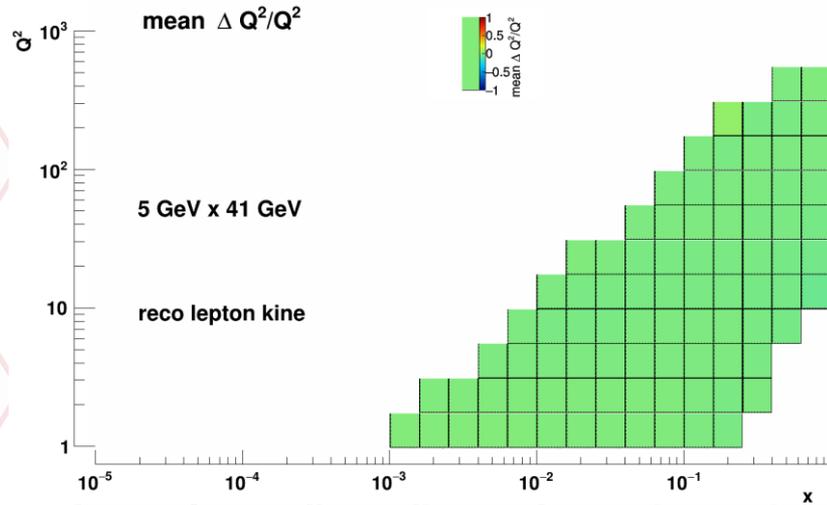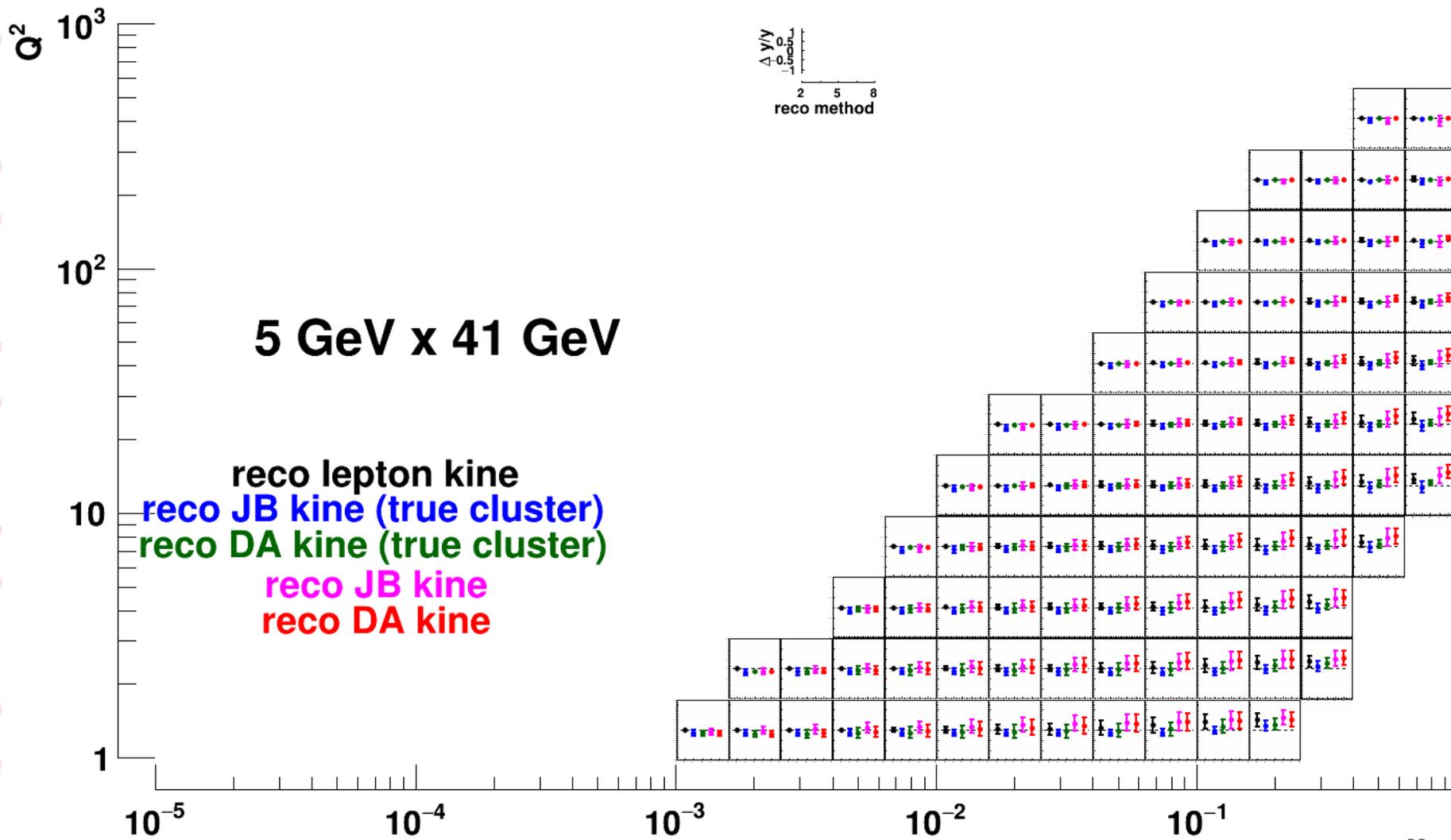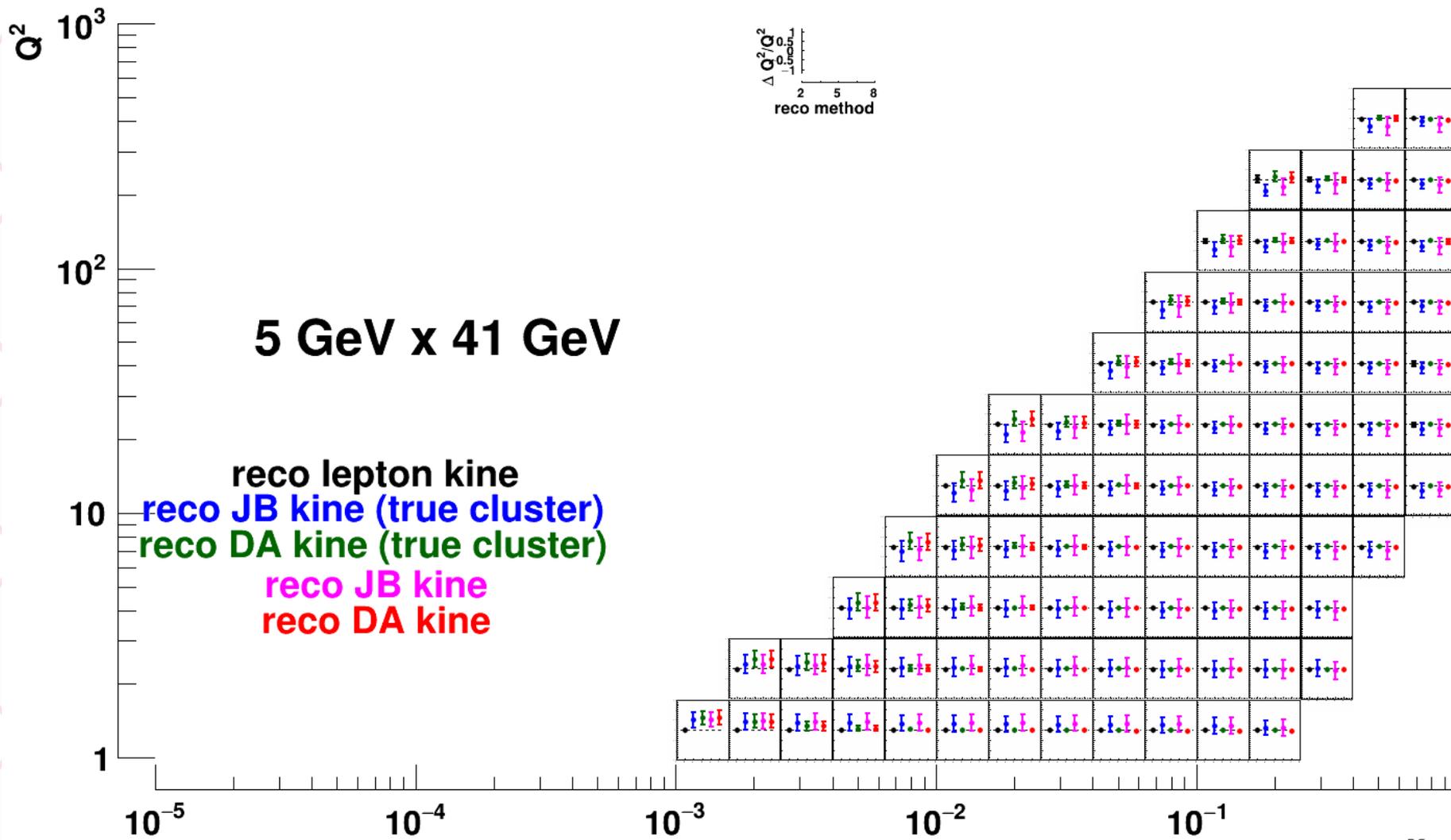
z resolutions for lepton method
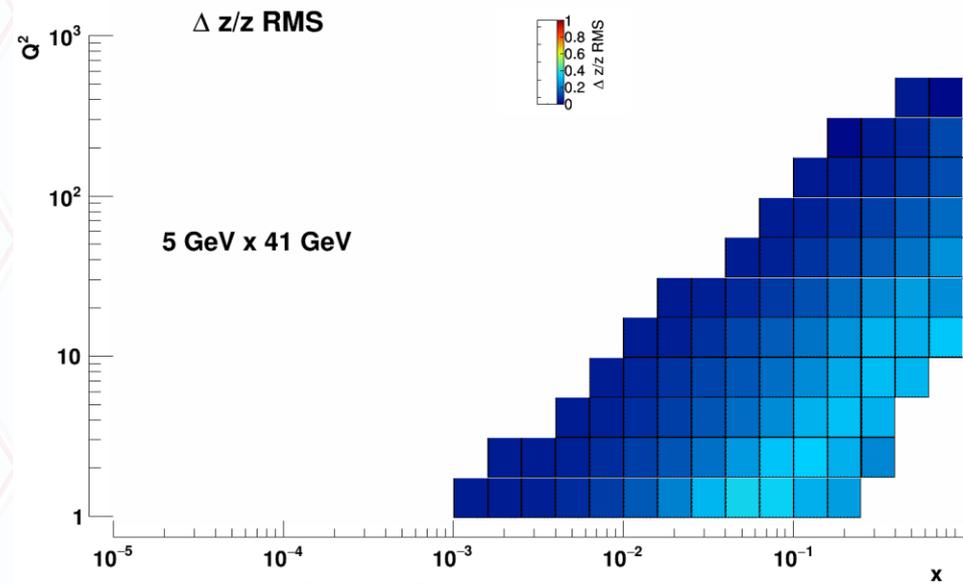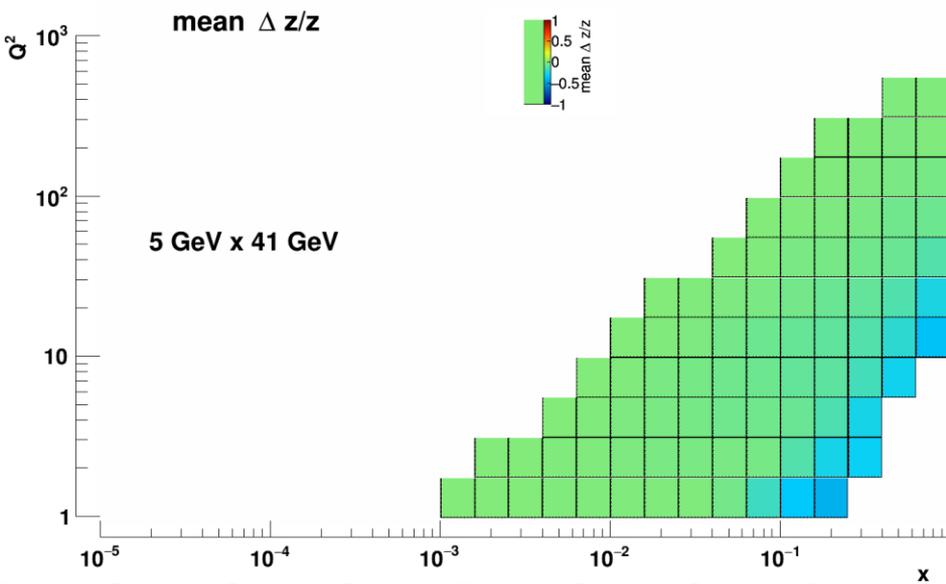
z resolutions for DA method
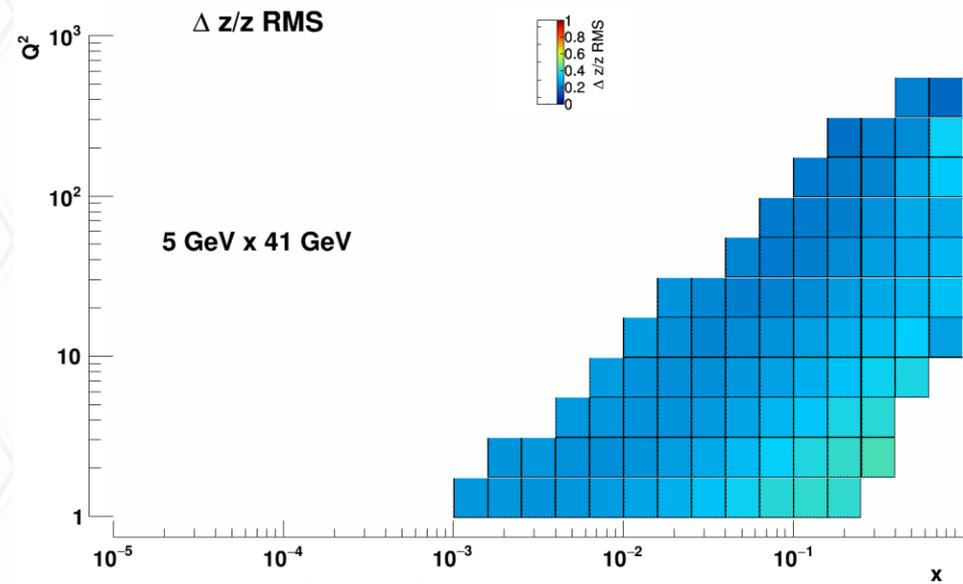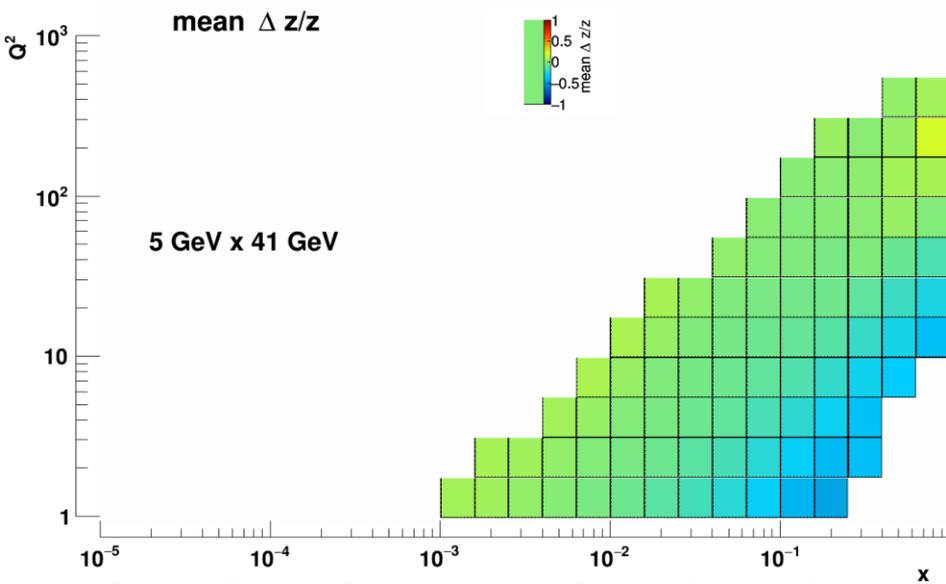
Overall z resolutions for various methods

5 GeV x 41 GeV

reco lepton kine
reco JB kine (true cluster)
reco DA kine (true cluster)
reco JB kine
reco DA kine
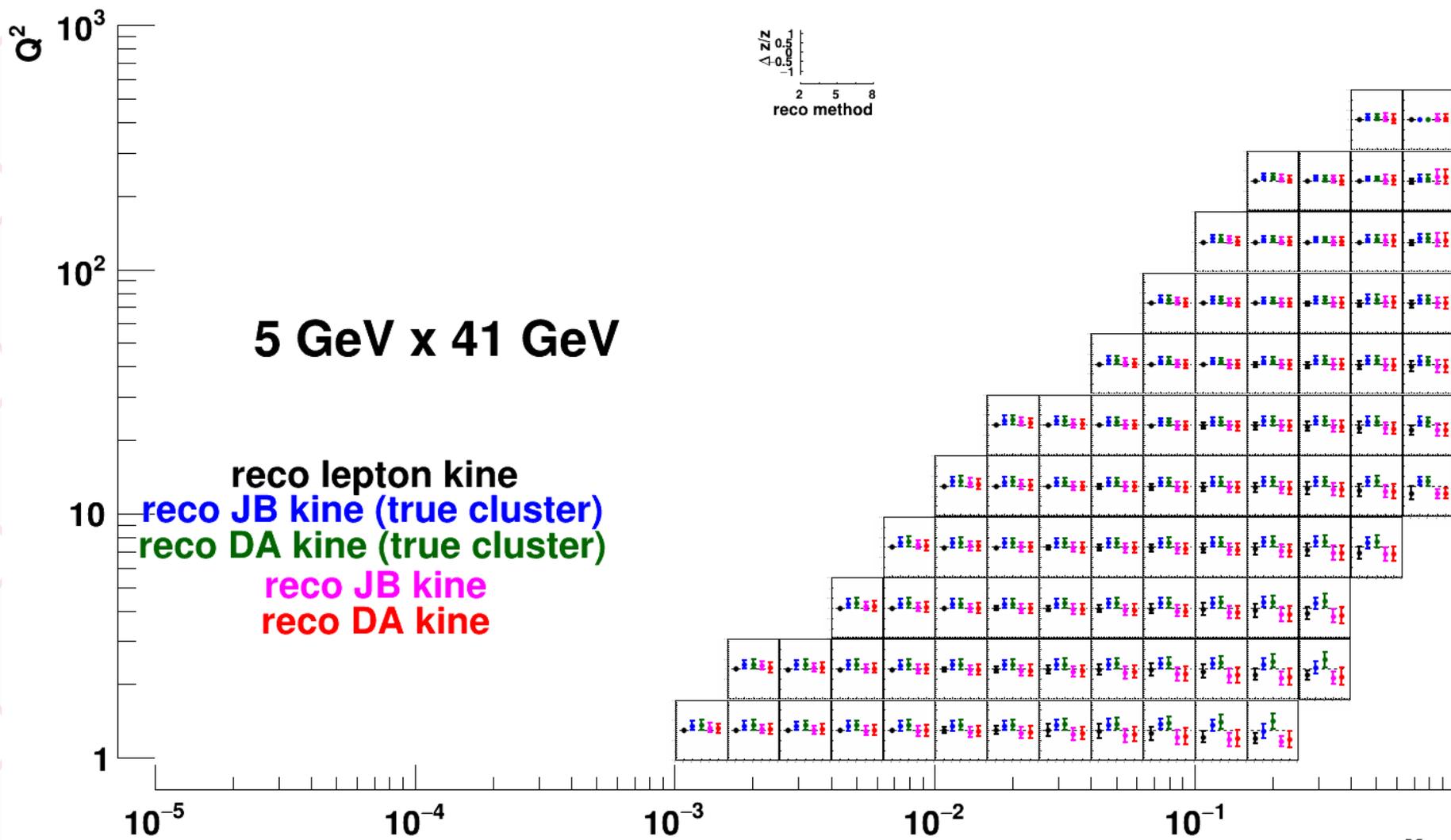
Pt resolutions for lepton method
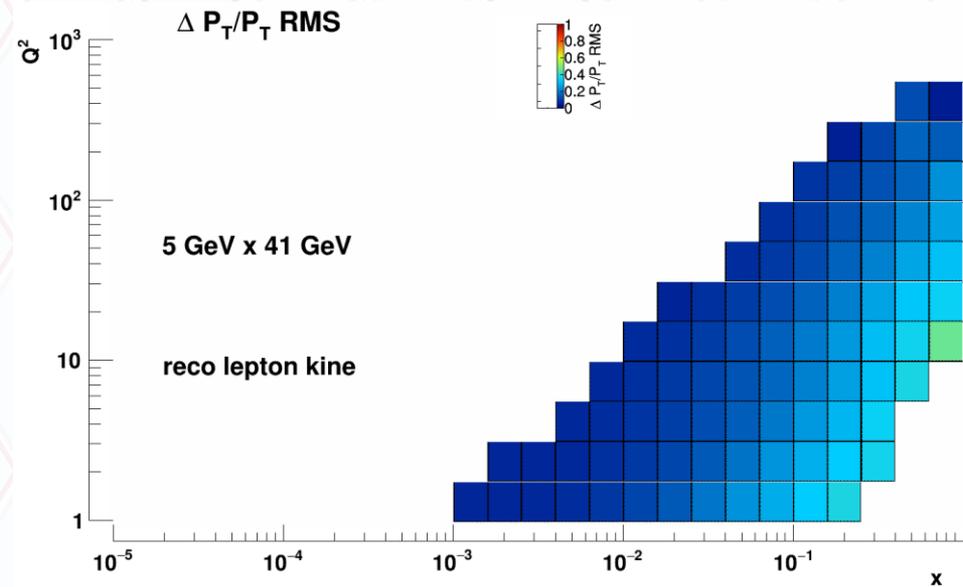
Pt resolutions for DA method
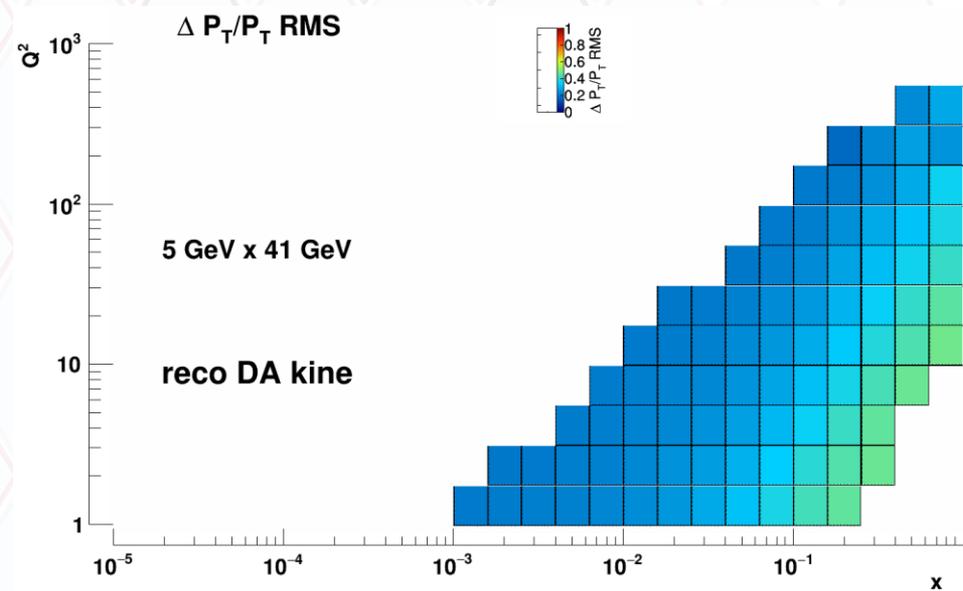
Overall Pt resolutions for various methods

5 GeV x 41 GeV

reco lepton kine
reco JB kine (true cluster)
reco DA kine (true cluster)
reco JB kine
reco DA kine
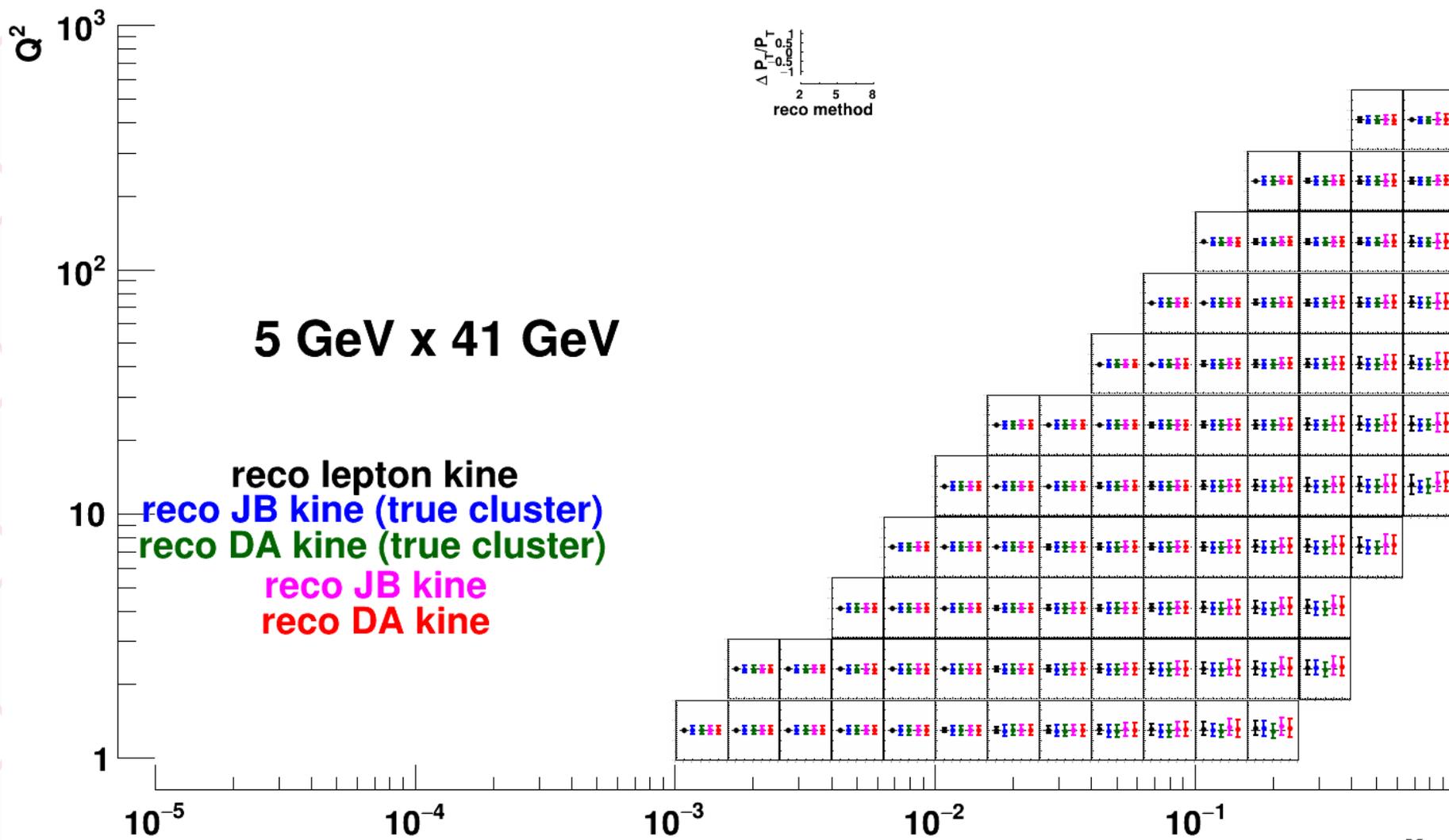
ϕ_h resolutions lepton method
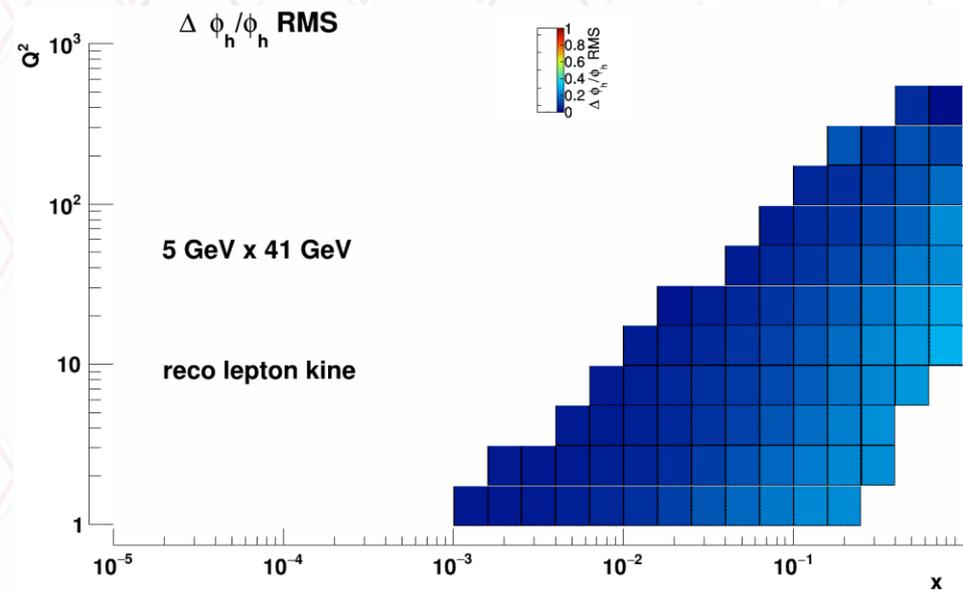
ϕ_h resolutions DA method

Overview of ϕ_h resolutions

5 GeV x 41 GeV

reco lepton kine
reco JB kine (true cluster)
reco DA kine (true cluster)
reco JB kine
reco DA kine
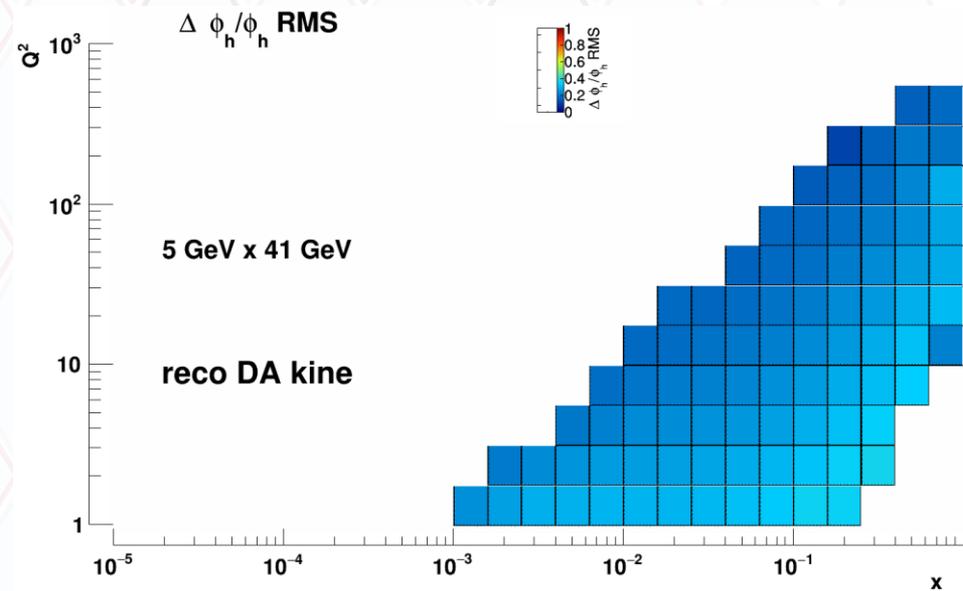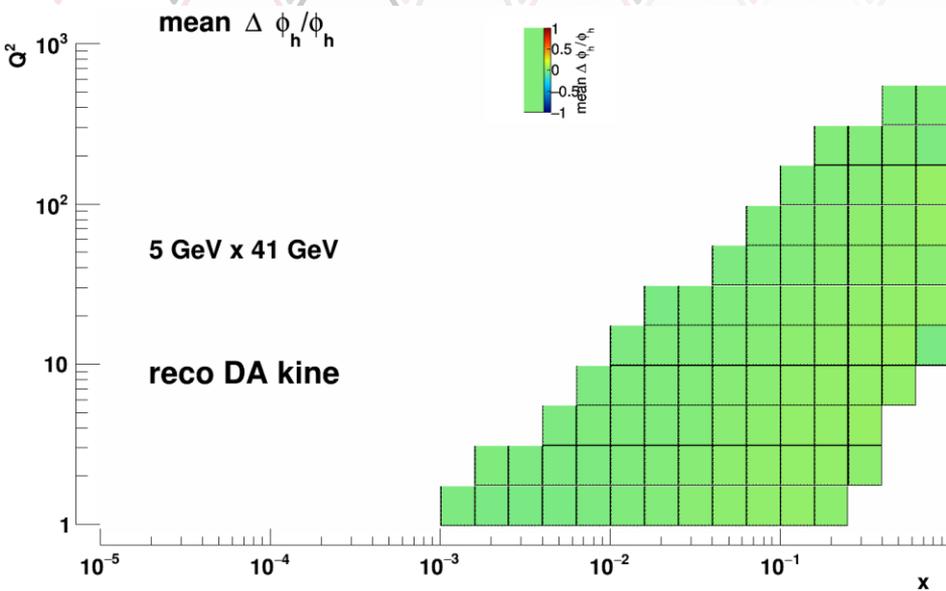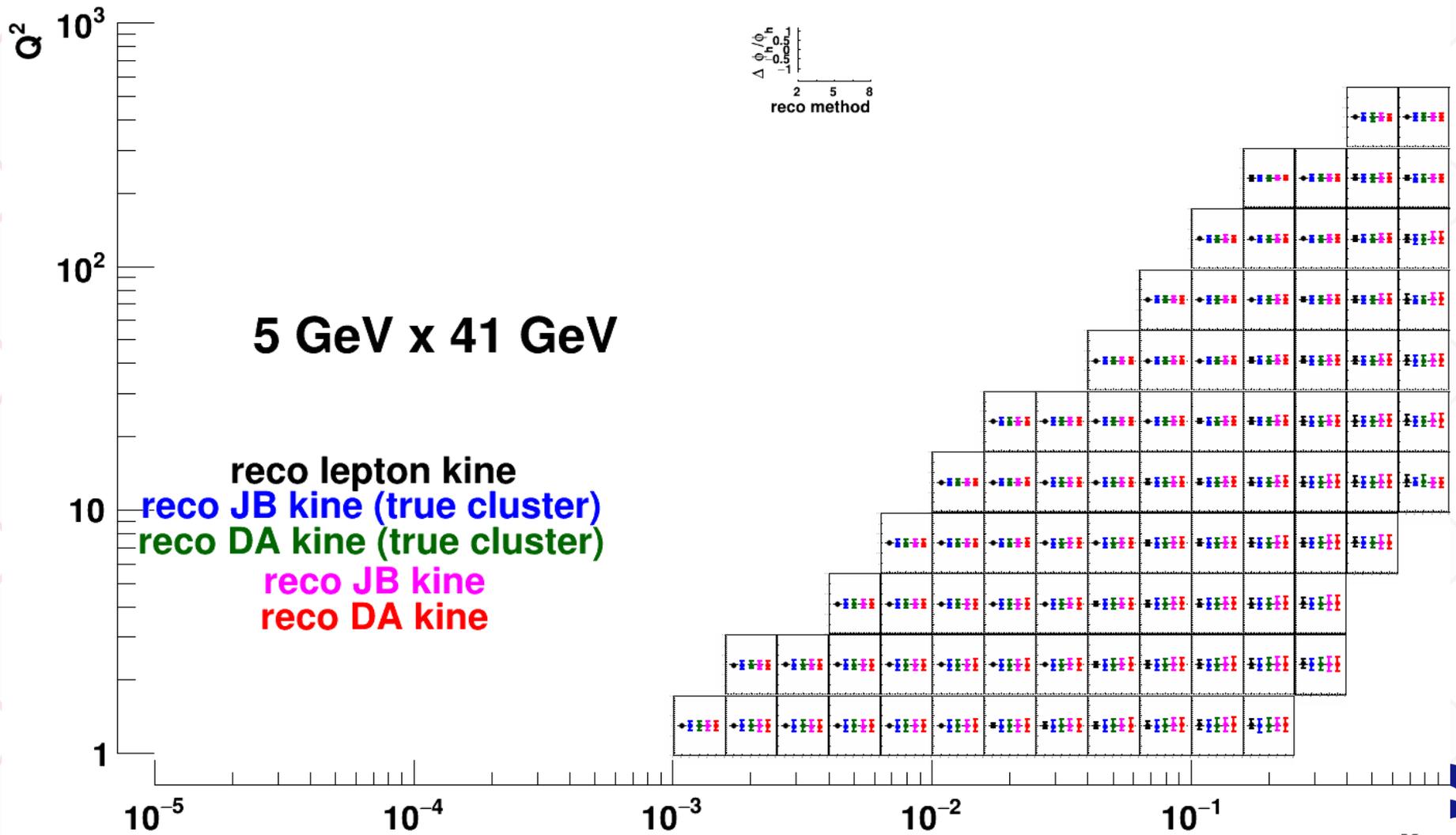
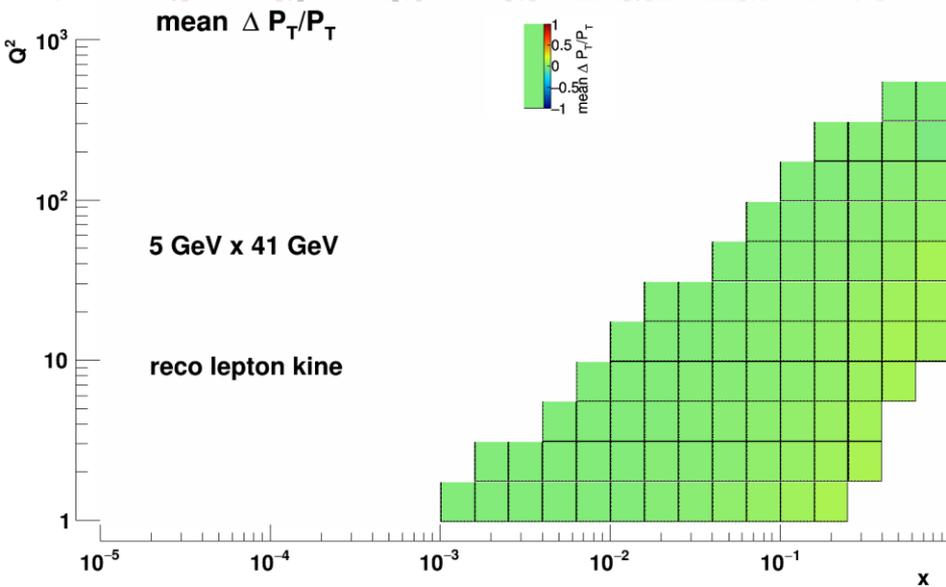# ϕ_S resolutions lepton method
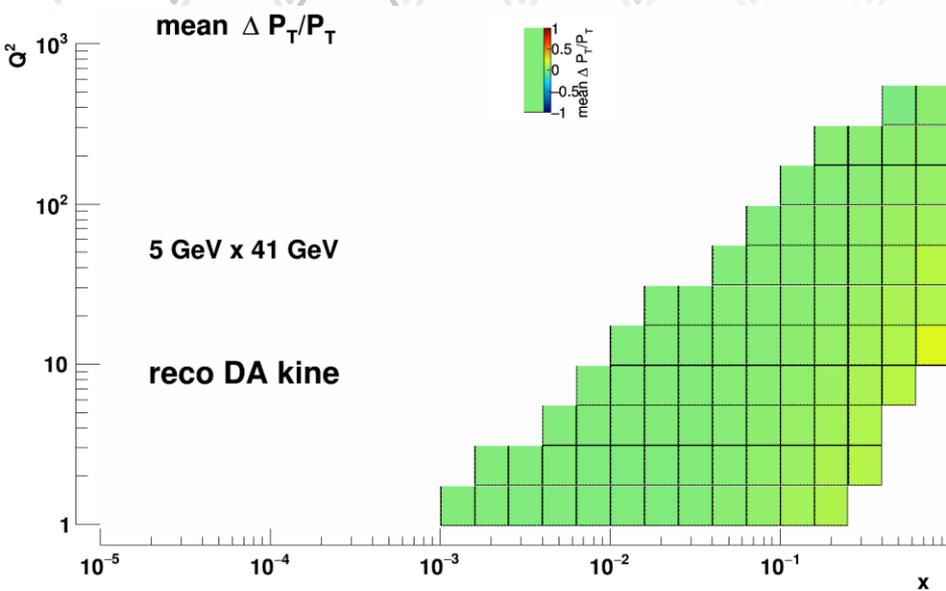
ϕ_S resolutions DA method

Overall ϕ_S resolutions for various methods

5 GeV x 41 GeV

reco lepton kine
reco JB kine (true cluster)
reco DA kine (true cluster)
reco JB kine
reco DA kine
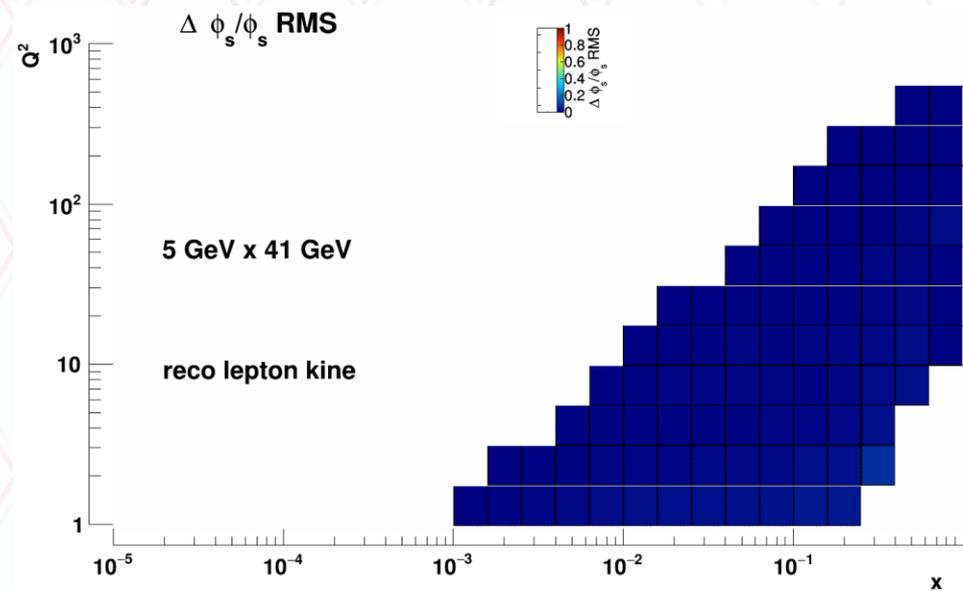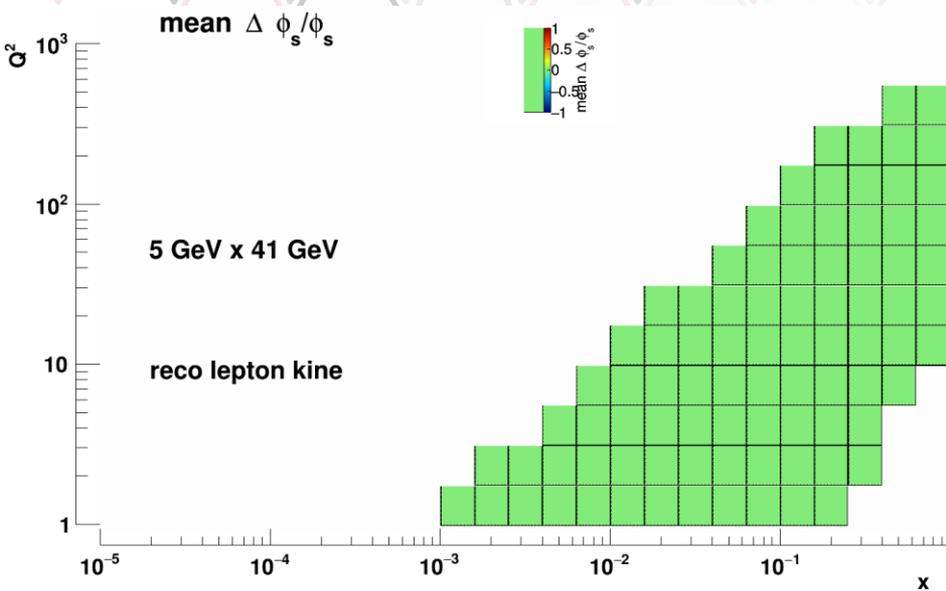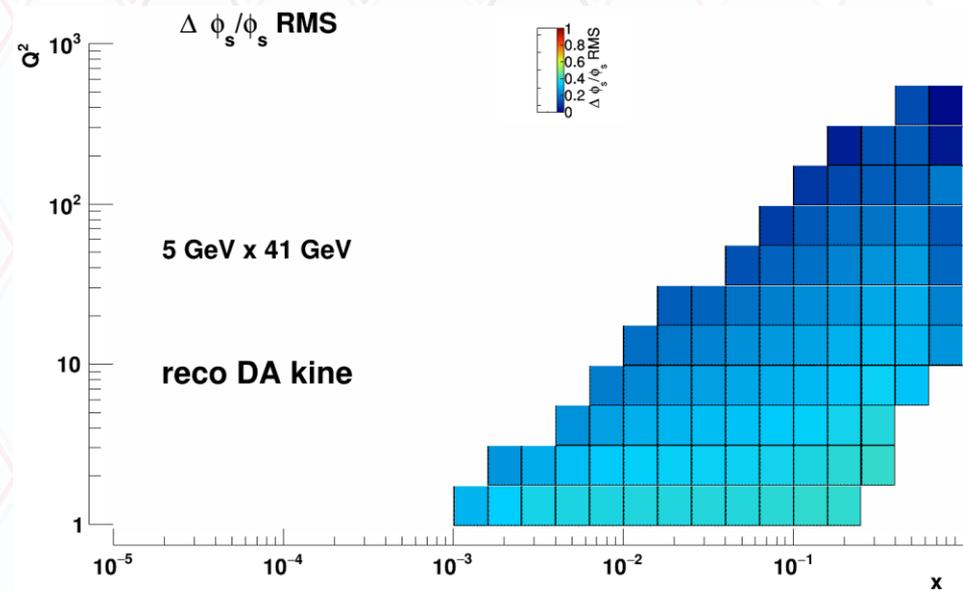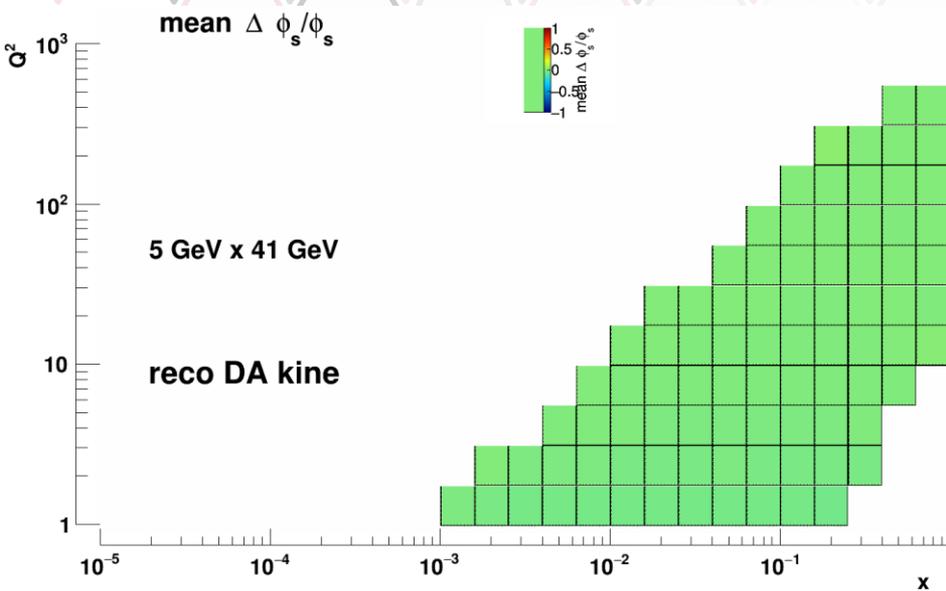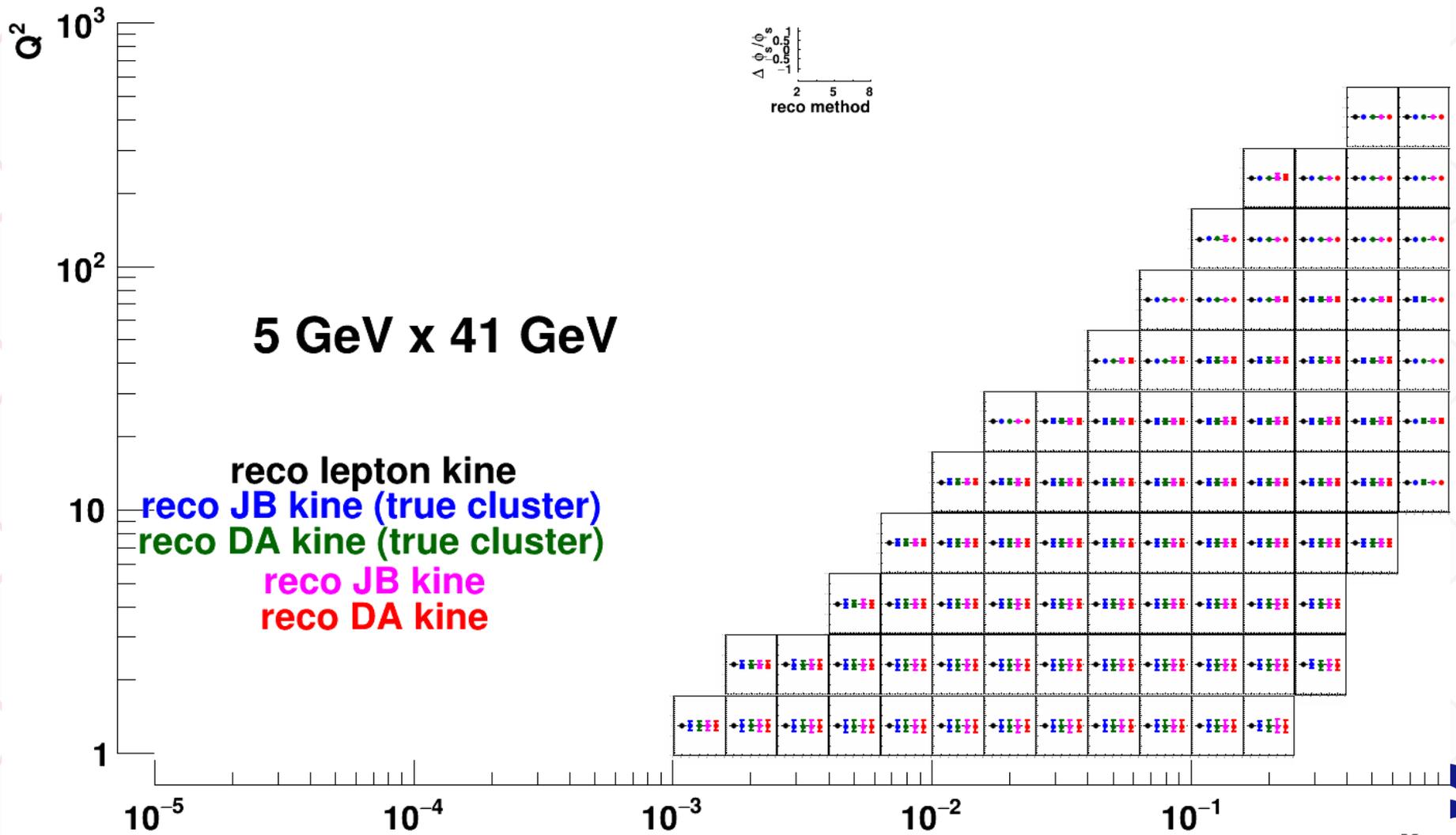
Summary

- Prop2 simulations look reasonable

- Expected degradation of resolutions at low y seen, can be slightly recovered by DA method (might need still some optimization on track-cluster matching)

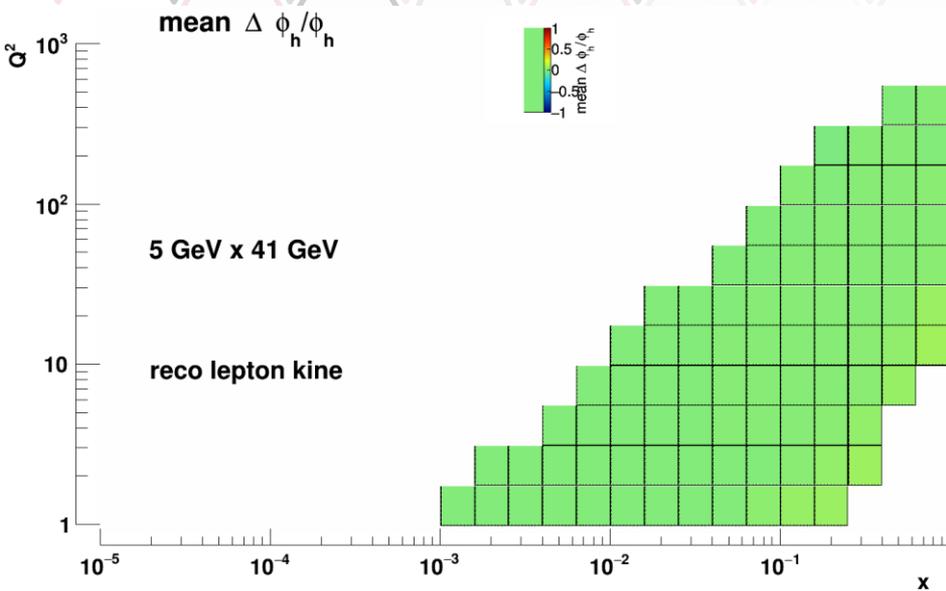- SIDIS variables show similar behavior as DIS variables, but deviations generally moderate, azimuthal angles are particularly robust (good for azimuthal asymmetries)

Simulation status (8/3)

- Full Geant3 simulation of pythiaeRHIC data for:
  - ep 18 x 100 (15M events $1<Q2<100$ ~ 0.022 fb^{-1} , 3.7 M events $Q2>100$ ~2 fb^{-1})
  - ep 10 x 100 (19.2M event $1<Q2<100$ ~ 0.035 fb^{-1} , 1M events $Q2>100$ ~0.86 fb^{-1})

- DIS Reconstruction via scattered lepton

- Hadron ID still using PDG information

- Reweighted asymmetries based on truth x, Q^2, z, P_T, ϕ_h, ϕ_S and struck parton flavor applied as weights to the reco events using Sivers/Collins/unpol TMD structure functions from Torino'08 global SIDIS+e$^+$e$^-$ fit(*EPJA* 39 (2009) 89)
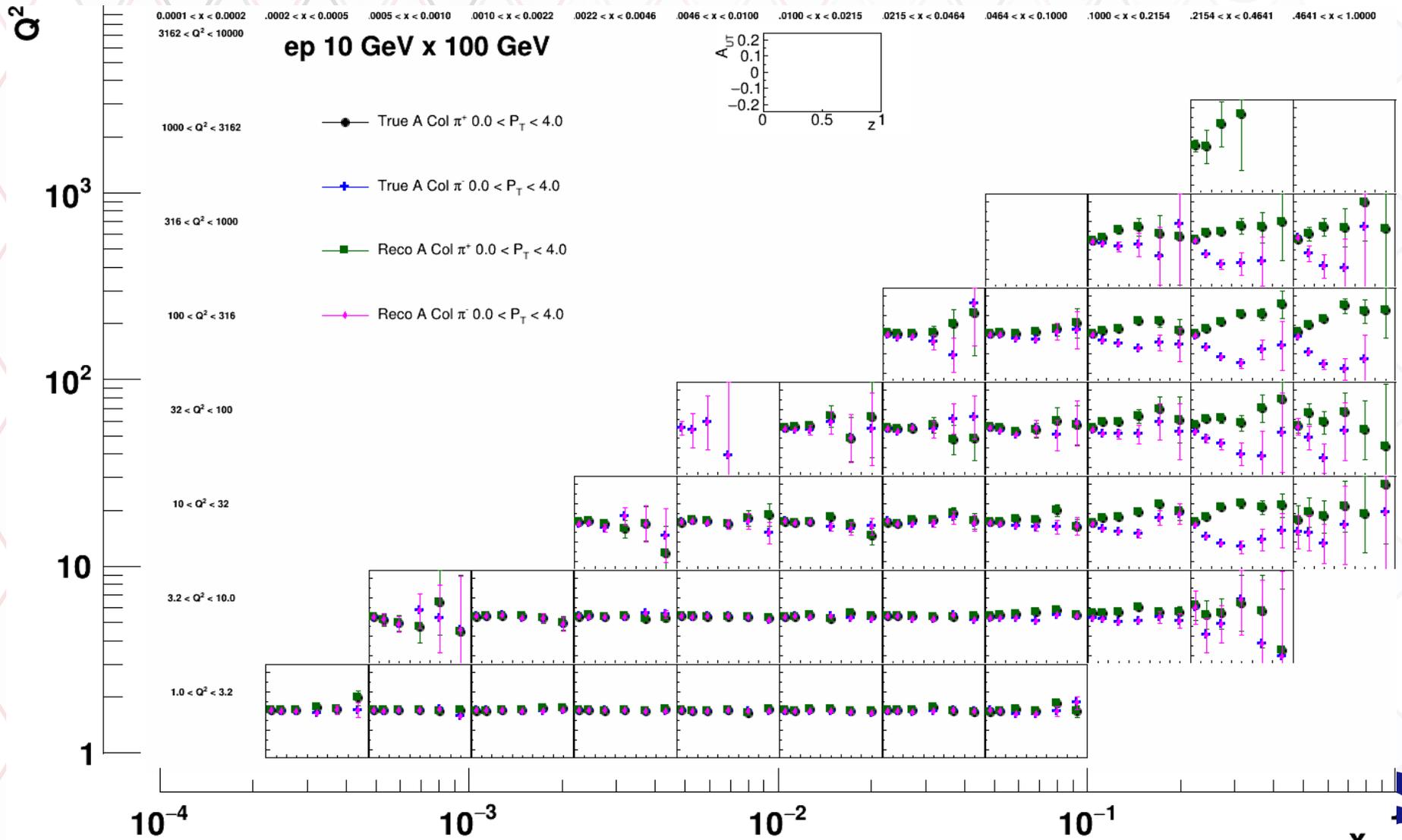 - TMD evolution effects will likely reduce size of asymmetries at higher Q^2, but only logarithmic effect
  - No sea quarks included in global fit → even lower x Sivers weights all close to zero

Collins asymmetries

Sivers asymmetries

ep 10 GeV x 100 GeV

- True A Siv π^+ $0.0 < P_T < 4.0$
- True A Siv π^- $0.0 < P_T < 4.0$
- Reco A Siv π^+ $0.0 < P_T < 4.0$
- Reco A Siv π^- $0.0 < P_T < 4.0$

Collins asymmetries

ep 18 GeV x 100 GeV

- True A Col π^+ 0.0 < P_T < 4.0
- True A Col π^- 0.0 < P_T < 4.0
- Reco A Col π^+ 0.0 < P_T < 4.0
- Reco A Col π^- 0.0 < P_T < 4.0
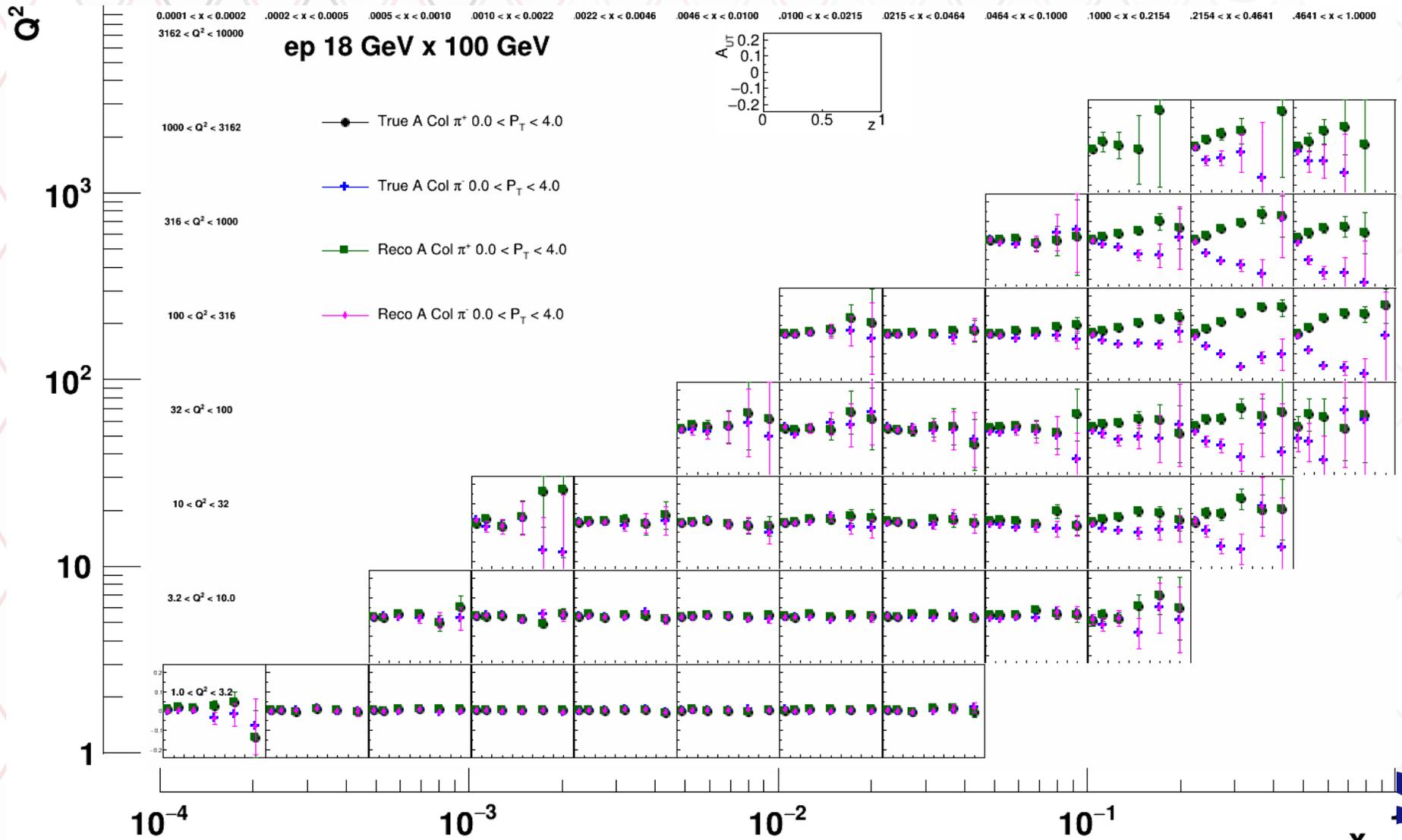
Sivers asymmetries
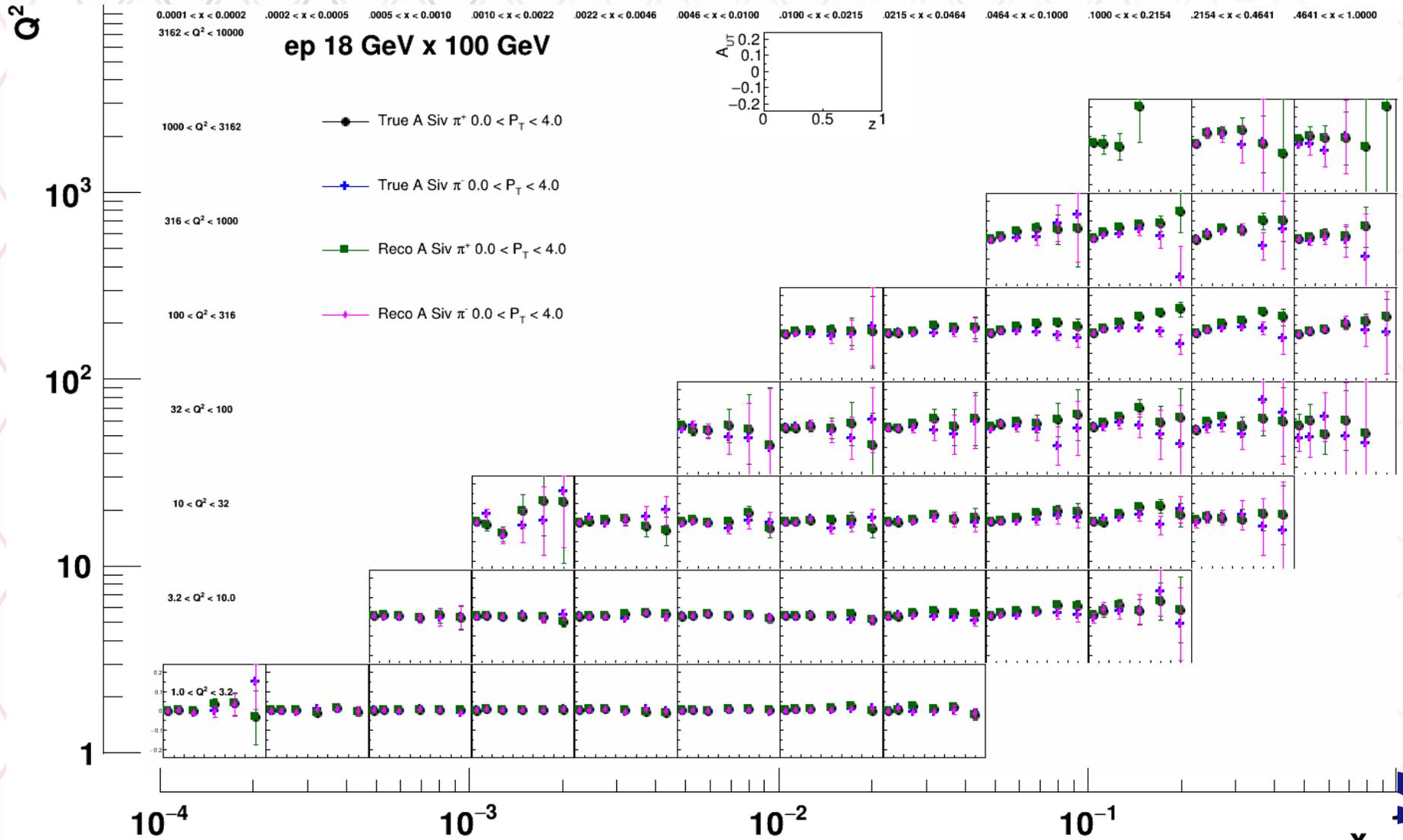
Error Projections to 10fb⁻¹ - systematics based on true-reco deviations
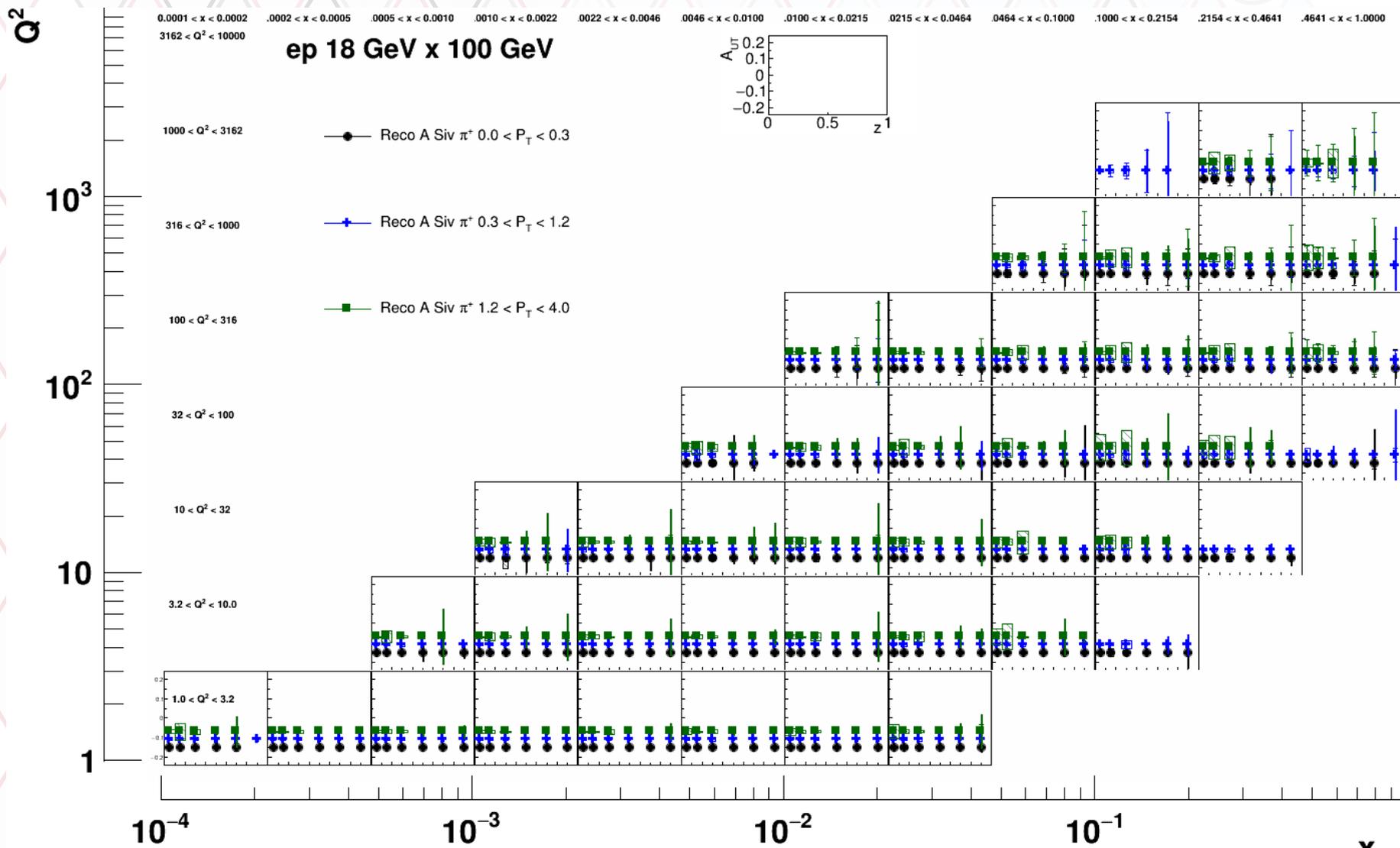
Conclusions

- Full GEANT simulations of ECCE detector used to create and extract re-weighted Sivers/Collins single spin asymmetries

- Smearing of kinematic variables moderate to reproduce generated asymmetries well (ie small systematics due to unfolding expected)

- Sub-percent level precision expected for asymmetries over large range in phase space while binned in x, Q^2 , z and P_T