# Semi-inclusive WG report

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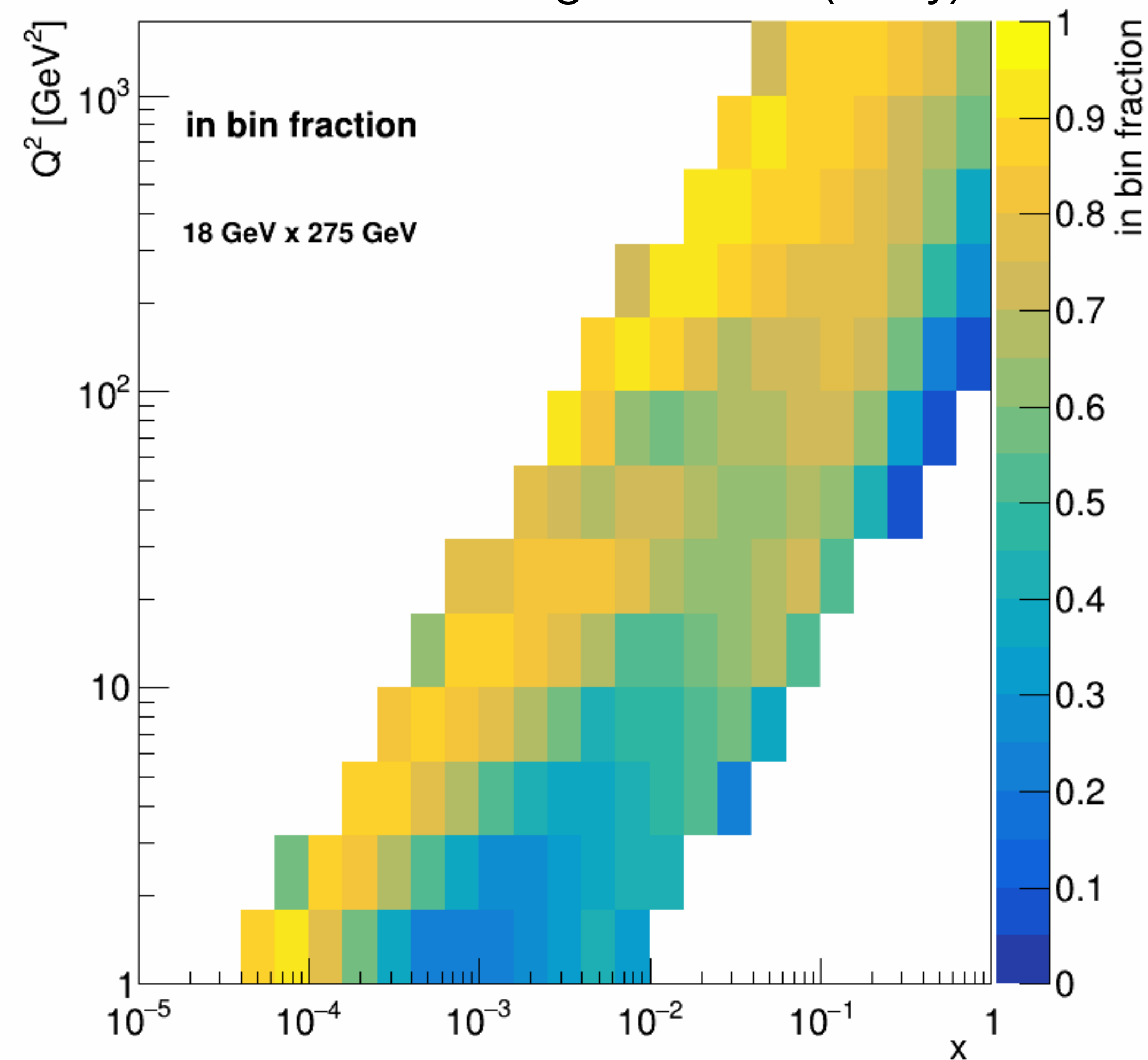
# DIS reconstruction

Various reconstruction methods tested:

- Scattered lepton

- Jacquet-Blondel method

- Double-angle method

- Sigma method

- Machine learning: combination of

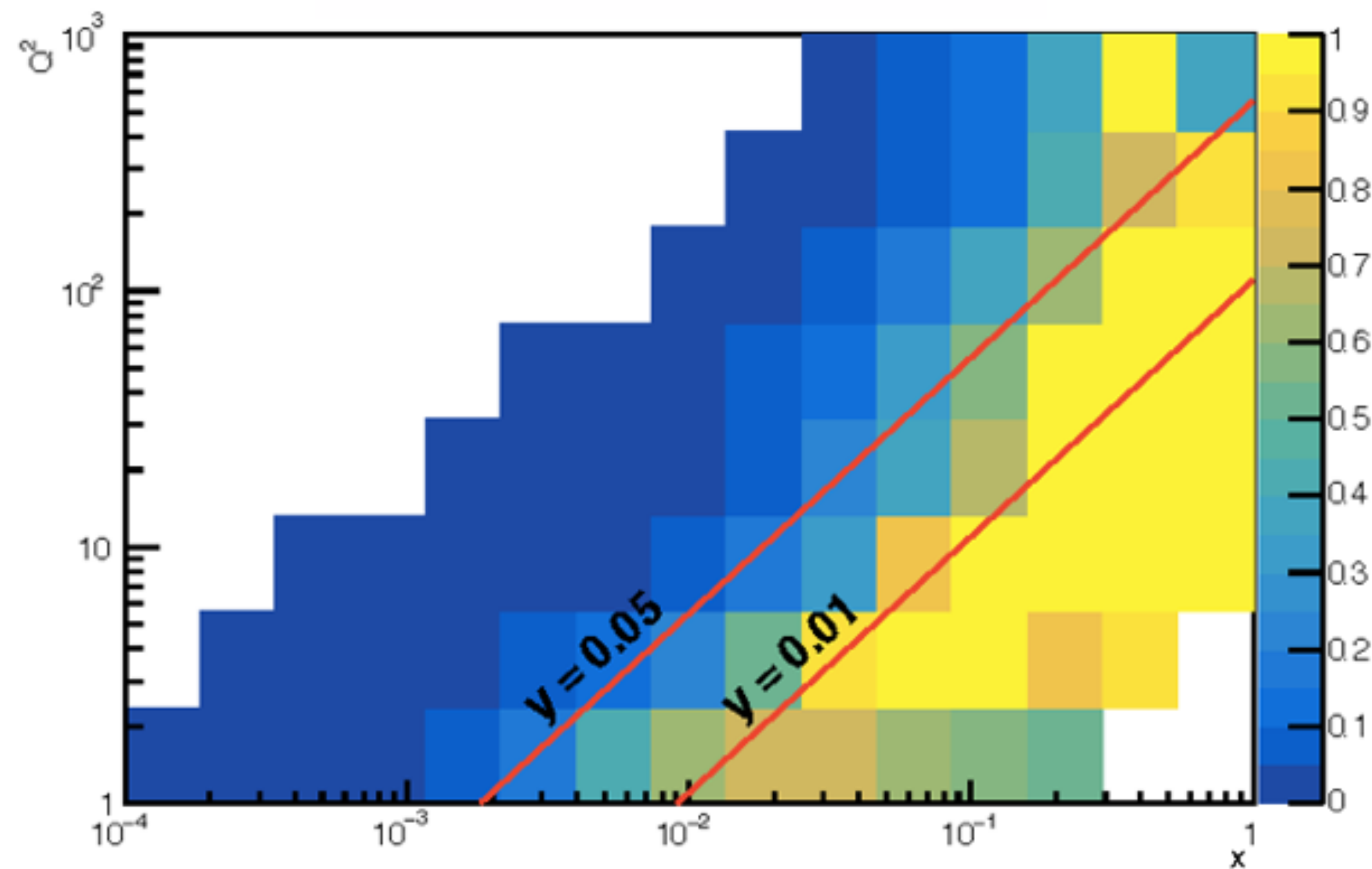  hadronic final states and scattered lepton

Reconstruction via scattered lepton (high y)
and double-angle method (low y)
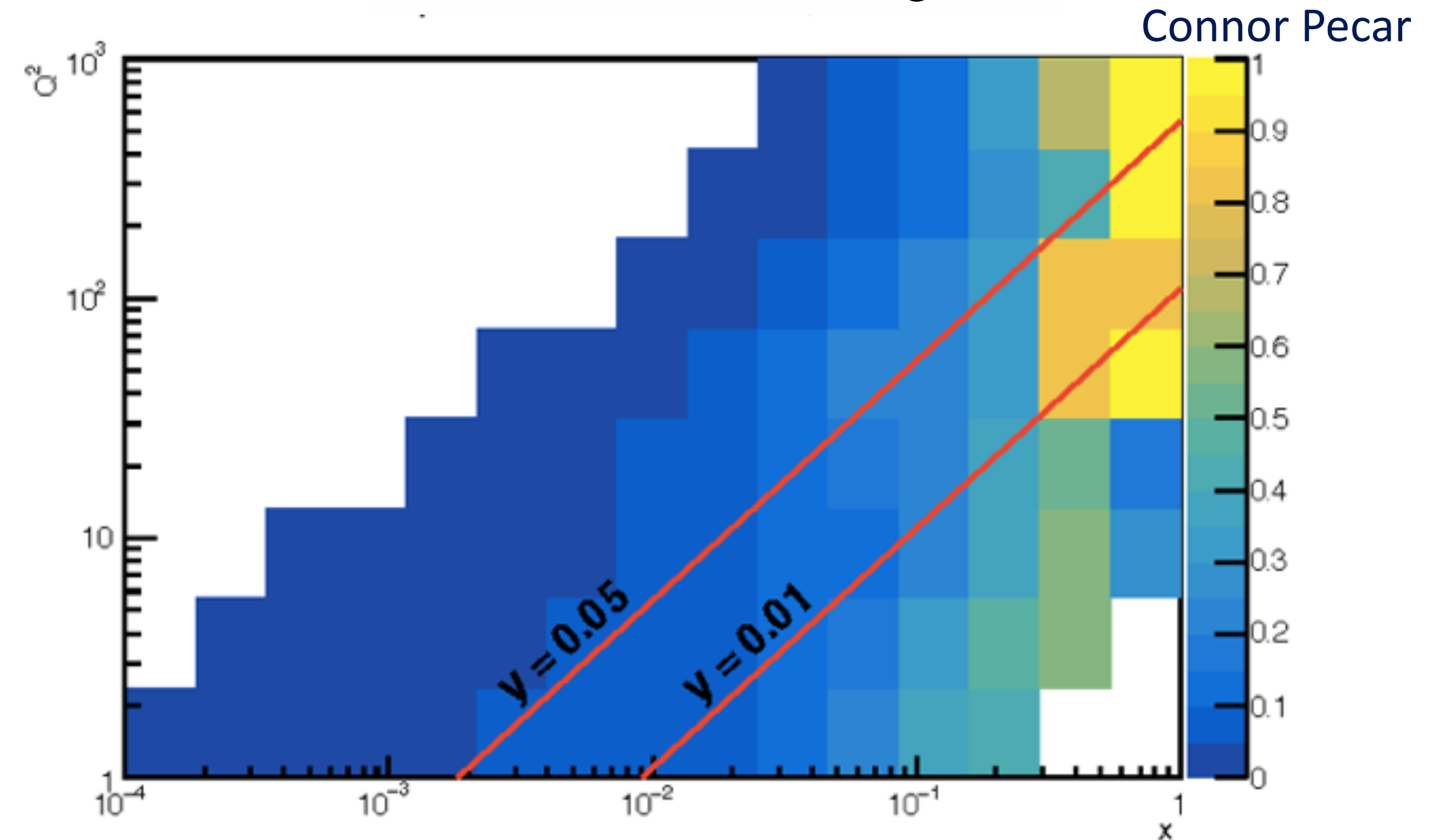


in bin fraction

18 GeV x 275 GeV

# Reconstruction of hadron SIDIS variables

$$\frac{p_{hT,\text{reconstructed}} - p_{hT,\text{true}}}{p_{hT,\text{true}}}$$

electron method

machine learning

Connor Pecar

In general, SIDIS variables are well reconstructed.
Improvements are possible using machine-learning techniques.

# Plans for (SI)DIS variables

Reconstruction of particles:

- Electron: track ↔ EMCAL

- Charged hadron: track ↔ HCAL

- Neutral hadrons: cluster isolation

# Plans for (SI)DIS variables

Reconstruction of particles:

- Electron: track $\leftrightarrow$ EMCAL

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Plan to implement common interface containing (SI)DIS variables reconstructed via various existing and
newly implemented (improved ML, kinematic fitting) reconstruction methods, e.g., sidis-eic interface from Chris Dilks.

$\rightarrow$ facilitate analysis for users

$\rightarrow$ Need to coordination between various WGs: inclusive, semi-inclusive, jets, simulation

$\rightarrow$ Identify a dedicated task force

# Physics channels

- Collinear double-helicity asymmetry → sea-quark helicity PDFs

- Unpolarised TMD measurements → spin-independent TMD PDFs/FFs

- Sivers and Collins asymmetry → Sivers TMD, transversity and tensor charge, Collins FF

- Dihadron asymmetry → transversity and tensor charge via collinear dihadron FF

- High-$p_T$ dihadron asymmetry → gluon Sivers

- Lambda polarisation → polarised FF

- Back-to-back hadrons → saturation

# PID

Need realistic PID for hadrons and electrons and study effects on measurements.

Study effect of PID via
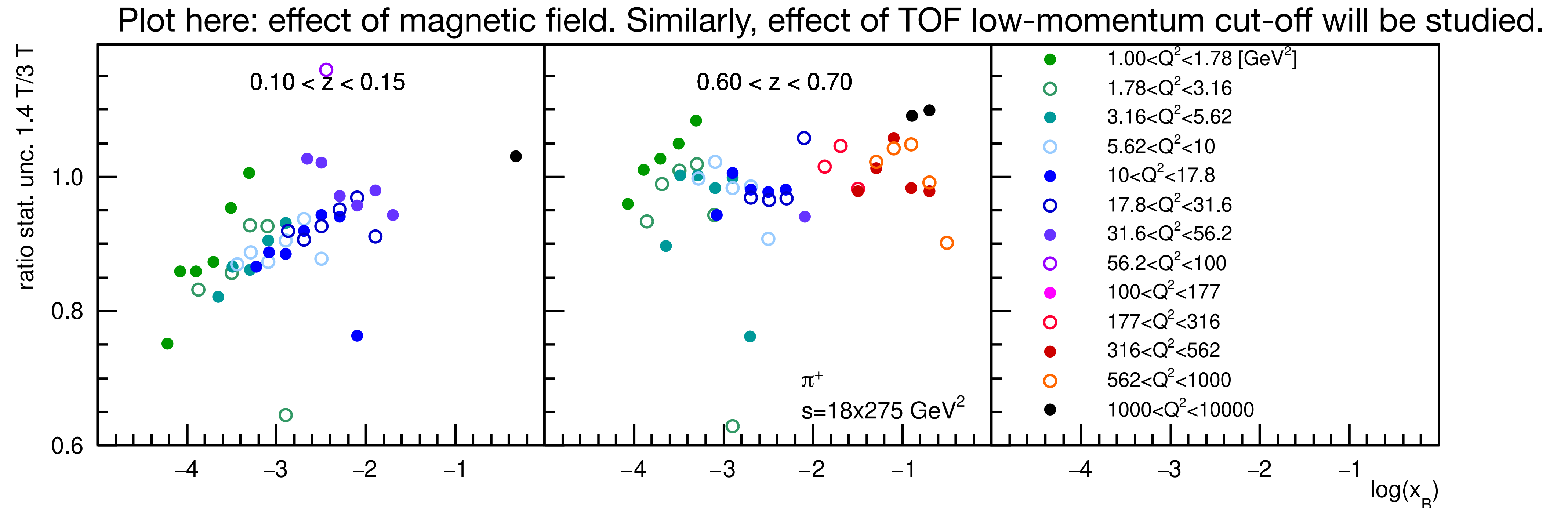
- Cherenkov detectors
- TOF

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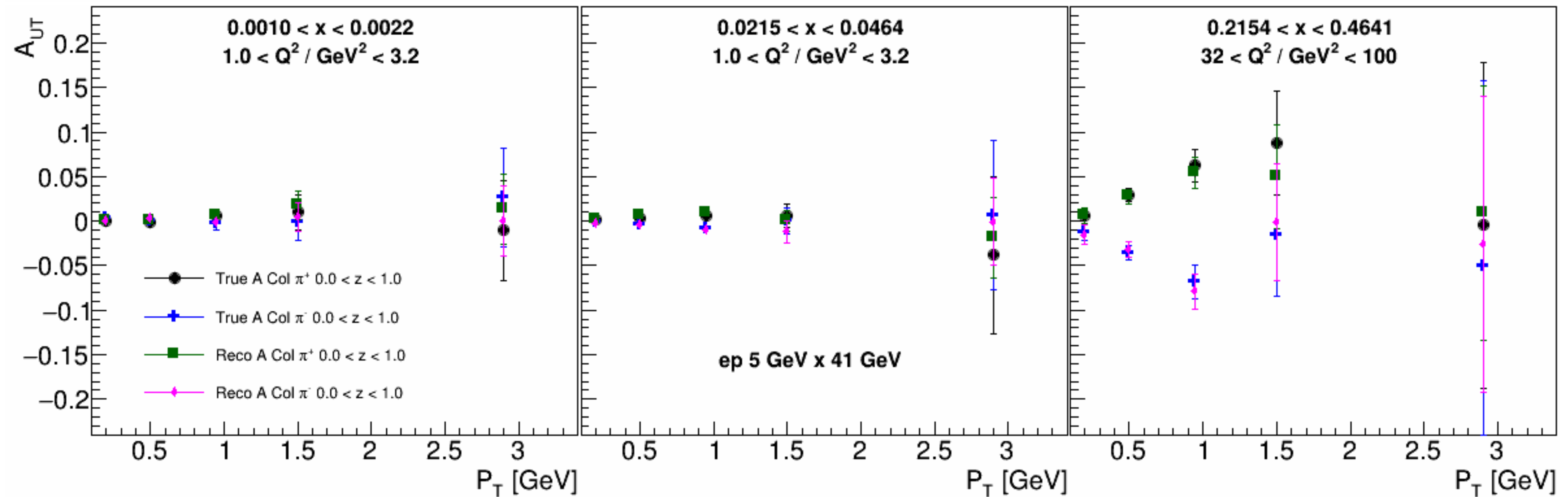
Study effect of PID via

- Cherenkov detectors

- TOF

Ongoing: impact of TOF on low-momentum particles for $A_{LL}$

Plot here: effect of magnetic field. Similarly, effect of TOF low-momentum cut-off will be studied.

# Radiative effects
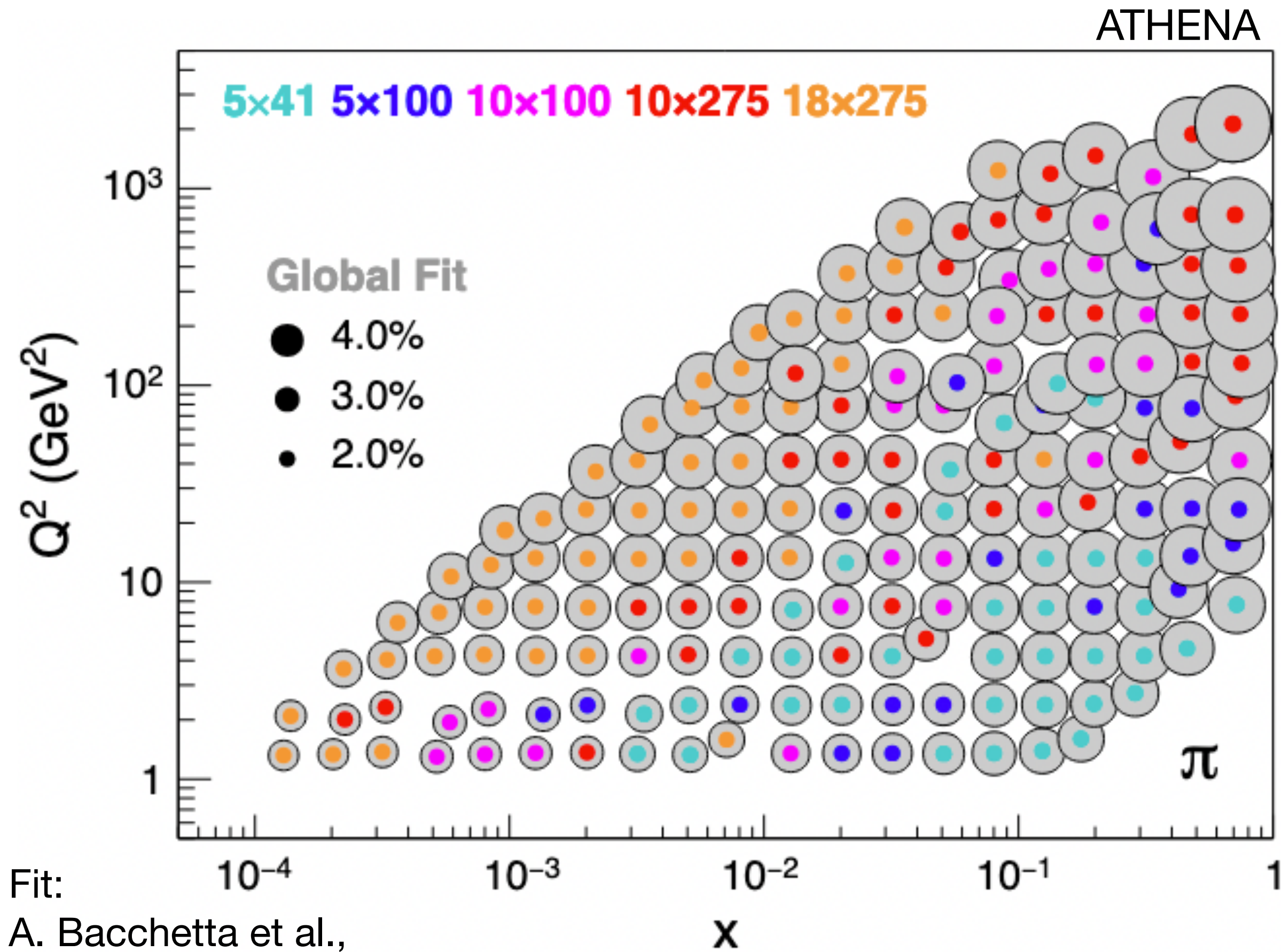


So far only effects in PYTHIA6 included.

Started to analyse dedicated simulation samples (DJANGOH form inclusive WG) to study radiative effects.

Can be extended using e.g. RadGen.

# Influence of (TMD) PDFs/FFs

Weighting of simulation using different (TMD) PDFs/FFs.

Study impact of EIC on (TMD) PDFs/FFs from different fits.

ATHENA



Fit:
A. Bacchetta et al.,
JHEP 06 (2017) 081,
JHEP 06 (2019) 051 (erratum)

ECCE



$\delta f_1(x = 10^{-3}, k_T)$

$\delta f_1(x = 10^{-2}, k_T)$

$\delta f_1(x = 10^{-1}, k_T)/\mathbf{4}$

DIS vari

$k_T[\text{GeV}]$  $8 \times 275 \ \text{GeV}^2$

$W > 10 \ \text{GeV}^2$

$\mathcal{L} = 10$
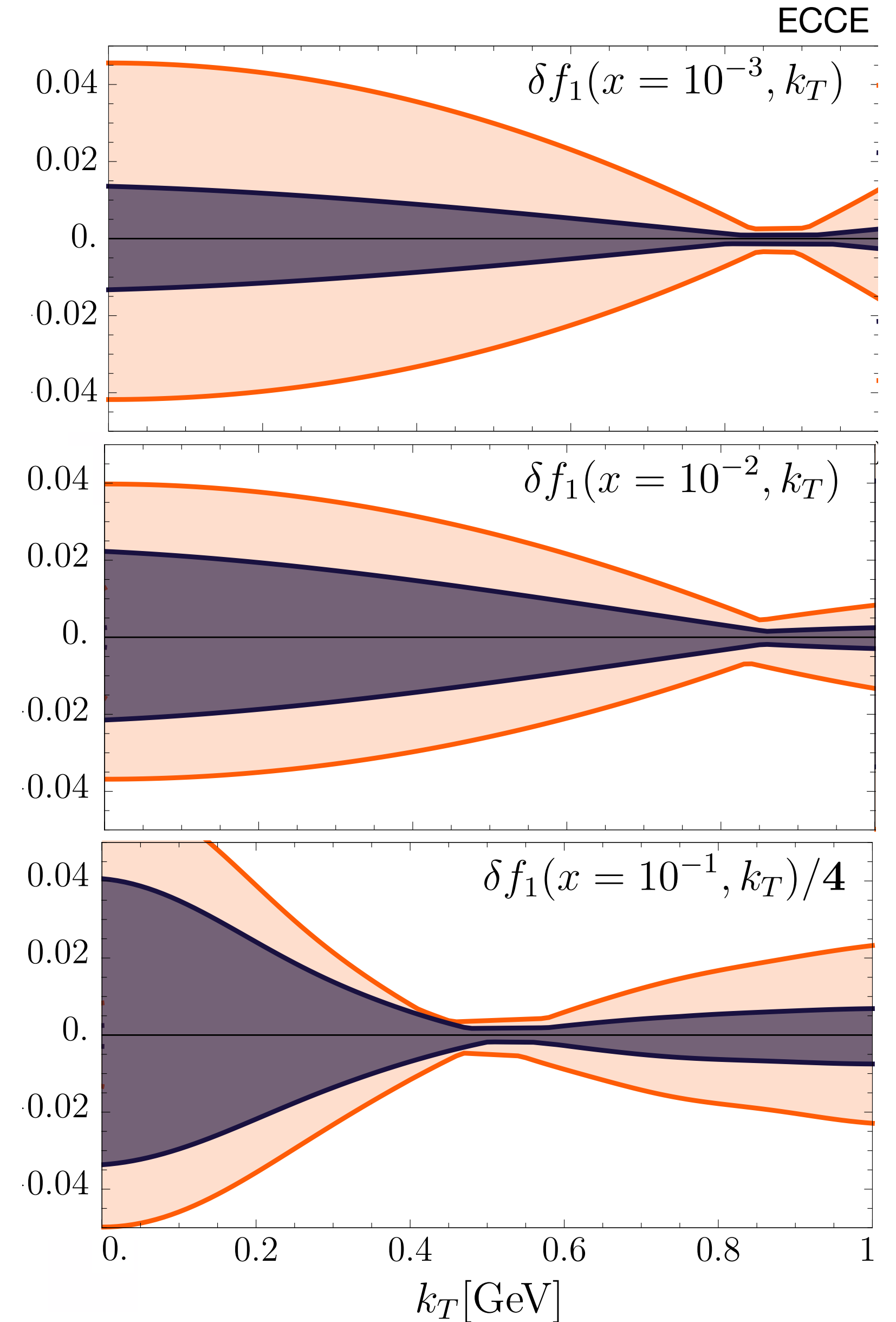
Fit: I. Scimemi, A. Vladimirov, JHEP, 06:137, 2020

# Status simulation

Validation simulation, based on PYTHIA and fun4all,

is ongoing and ready soon (or just now)

| WG | Generator | energy | events | $Q^2$ range | comments |
|---|---|---|---|---|---|
| SIDIS | Pythia6 | 18x275 | 20 M | General $Q^2$ | 1st priority |
| SIDIS | Pythia6 | 18x275 | 20M | $(1<Q^2<100)$ | 2nd |
| SIDIS | Pythia6 | 18x275 | 4 M | $(Q^2>100)$ | 3rd |
| SIDIS | Pythia6 | 5x41 | 20 M | General $Q^2$ | 4th |
| SIDIS | Pythia6 | 5x41 | 20 M | $(1<Q^2<100)$ | 5th |
| SIDIS | Pythia6 | 5x41 | 1 M | $(Q^2>100)$, | 6th |
| SIDIS | Pythia6 | 10x100 | 20 M | General $Q^2$ | |
| SIDIS | Pythia6 | 10x100 | 20 M | $(1<Q^2<100)$ | |
| SIDIS | Pythia6 | 10x100 | 2 M | $(Q^2>100)$ | |

✳ Additionally 5x100, 10x275 specialised eA

# Plans, in summary

Continue demonstrating feasibility of main physics measurements, including

- Kinematic reconstruction:

    - Resolution studies of reconstructed electron and hadrons via track/calorimeter

    - Implementation of (SI)DIS variables, through common platform and efforts,

        and comparison of various reconstruction methods

- Study effect of realistic electron and hadron PID

- Study radiative effects, via appropriate simulations

- More realistic simulation, including backgrounds

- Identify smaller and medium-size tasks for interested groups with more limited manpower

- Personally contact specific groups to encourage increase in manpower

- PDF/FF/MC-tune variations

- Implement unfolding

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SIDIS meetings: (bi-)weekly on Tuesdays, at 9:15 EDT.

Please, come and join!

Subscription to email list:

https://lists.bnl.gov/mailman/listinfo/eic-projdet-semiincl-l

Indico:

https://indico.bnl.gov/category/418/