SIDIS Instrumentation Critical to ‘golden Channels’

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Overview

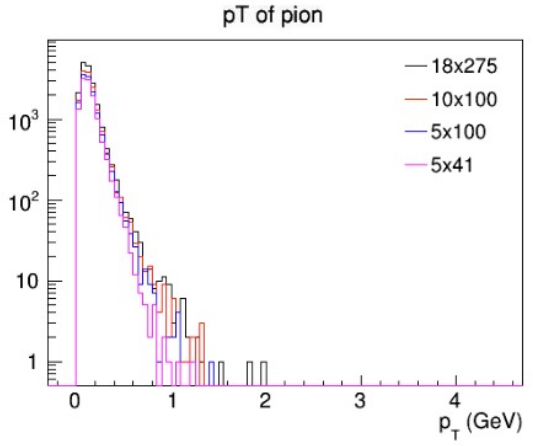
- SIDIS studies in their infancy→What is shown here is based on what we learned during the YR
  →Still applicable to tentative golden channels, (Sivers+Evolution, sea quark helicities) and others (lambda, di-hadron etc).

- Critical ingredients for SIDIS identified for the YR
  - PID at high momenta in the barrel
- Somewhat less critical
  - Min track p_T (100 MeV)→This is very important for the Λ program
  - Min photon energy (better than 200 MeV, mainly central)
  - Maximize coverage in η (e.g. $\eta = 4$ would be nice)

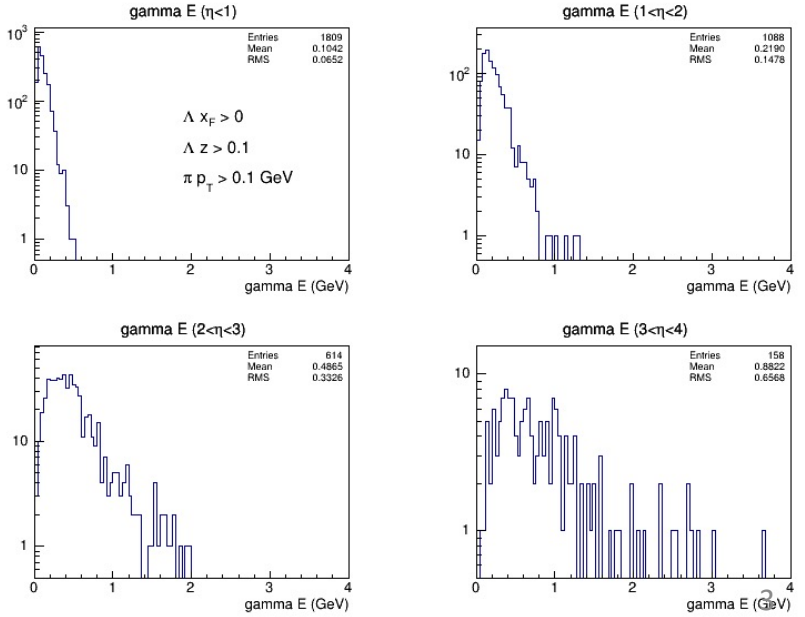
- ToDo:
  - Complete studies including lower PID cutoff for channels of interest

Min track pT and photon energies

- Min track p_T studies concentrated on needs for Λ analysis and partial waves for di-hadrons
- For Λ analysis, need p_T resolution $\leq$ 100 MeV
  →better resolution → more lambdas
- For PWs 100 MeV is good, lower not much of an improvement (but 50% worse at 300 MeV)
- Min γ Energy requirement driven by $\Sigma \rightarrow \Lambda\gamma$ →should be better than 200 MeV

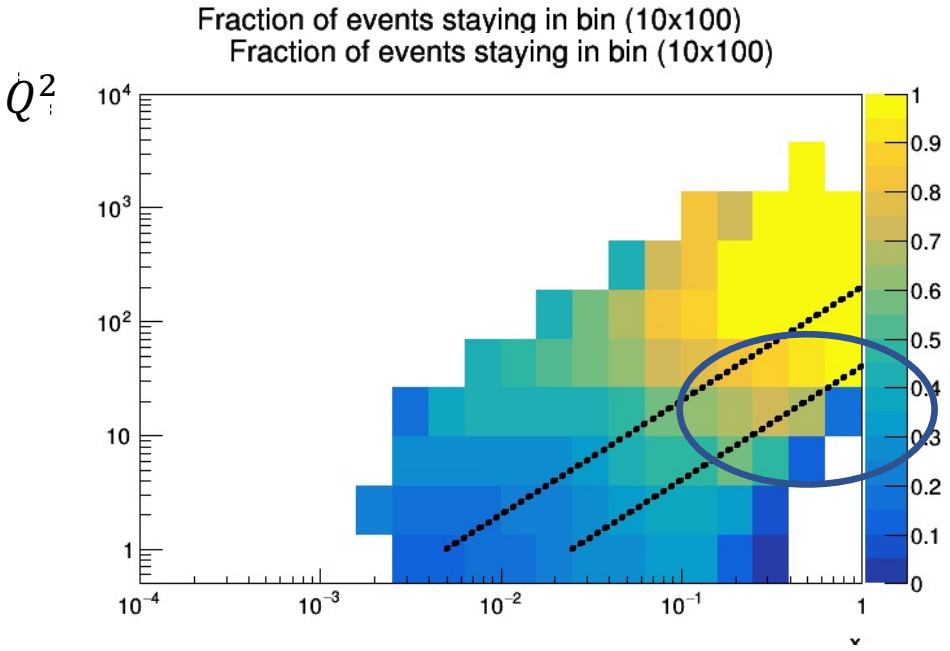


5x41 but other options similar

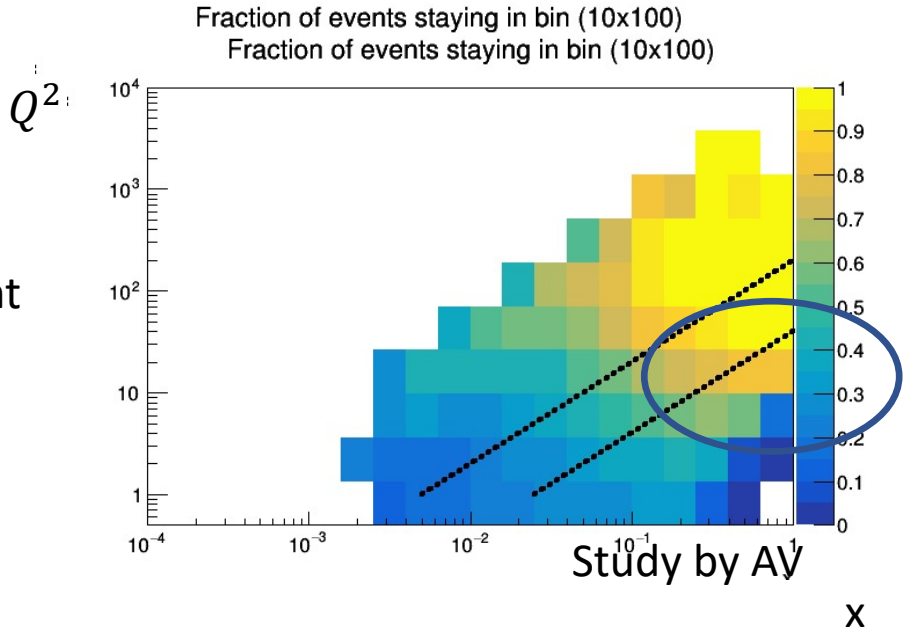


Study by Jinlong Zhang

Extended coverage to eta of 4



Some improvement
At low x high Q^2

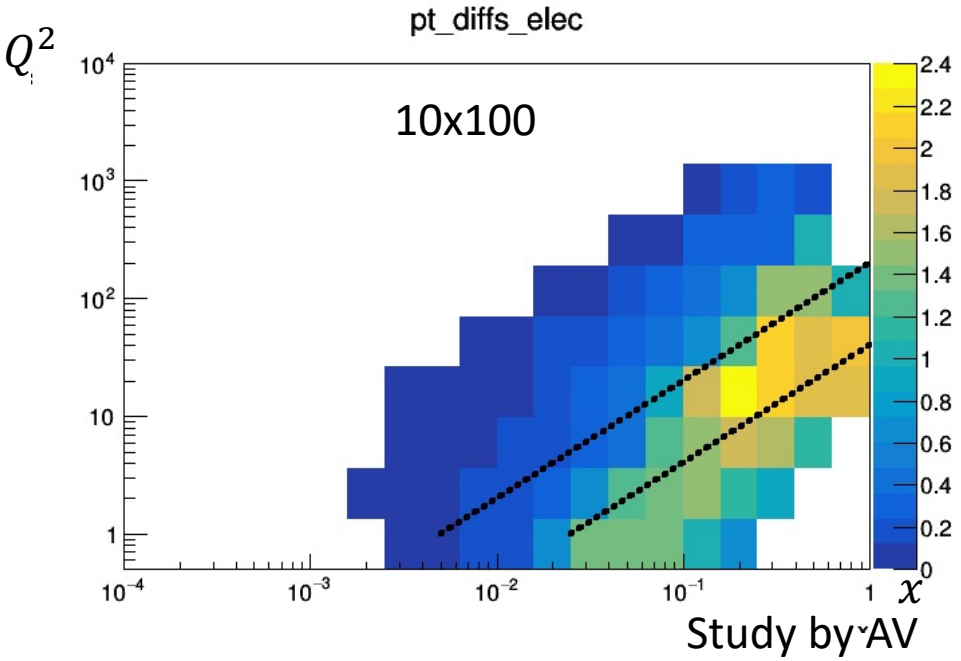


Study by AV

- Extending coverage will help with extending kinematic range with hadronic methods

Tracking resolution

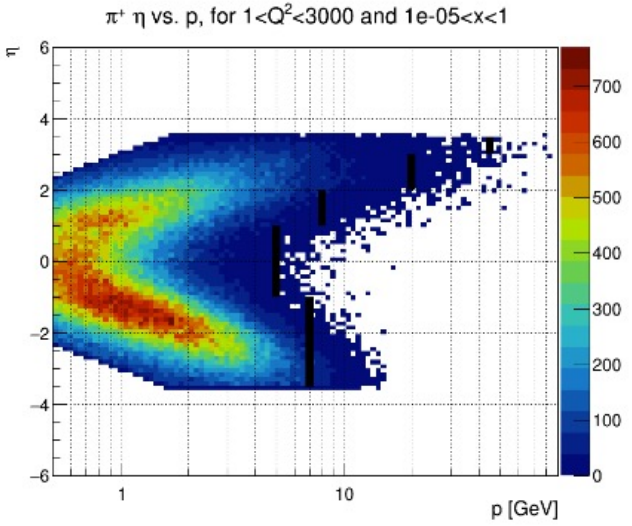
- Tracking resolution sufficient on hadron side
- Momentum resolution on electron side limits access to high x /low Q^2



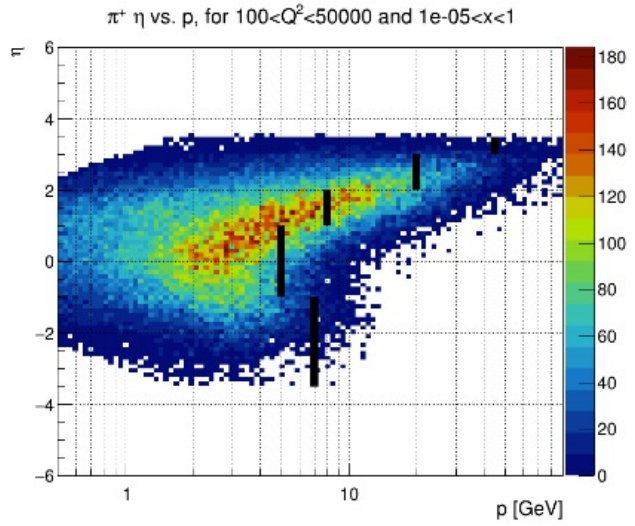
PID → arguably most important change

- PID of utmost importance in SIDIS (in particular π/K)
- Present limits cuts severely in high Q^2, moderate to high z
- NB: Electron/pion separation at forward η will be important for spectroscopy program, but details still being investigated

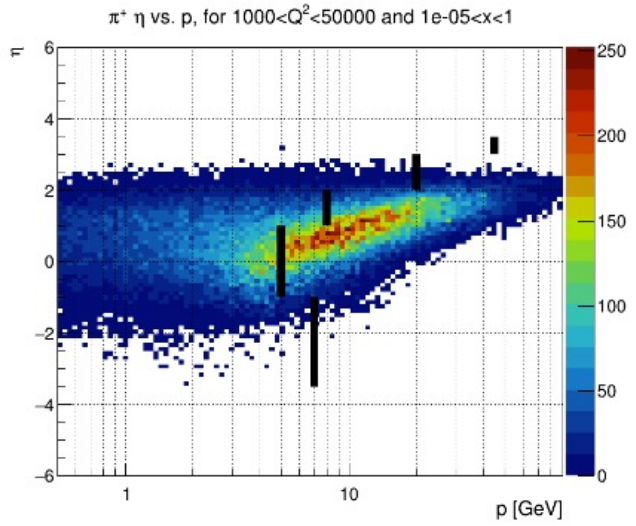
$Q^2 > 1$ GeV²



$Q^2 > 100$ GeV²



$Q^2 > 1000$ GeV²



With z > 0.2

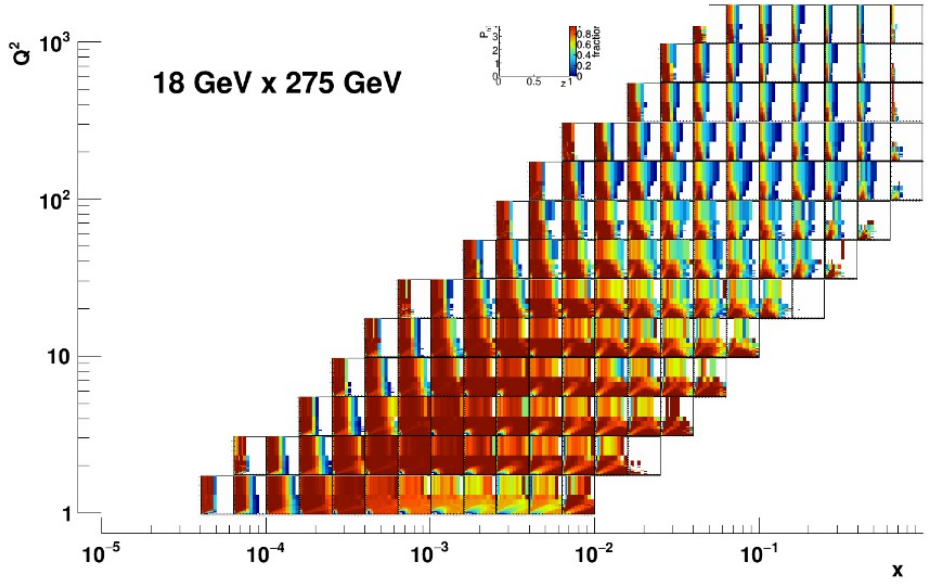
This is equal counts, not equal *lumi*!!
(equal lumi in backup)

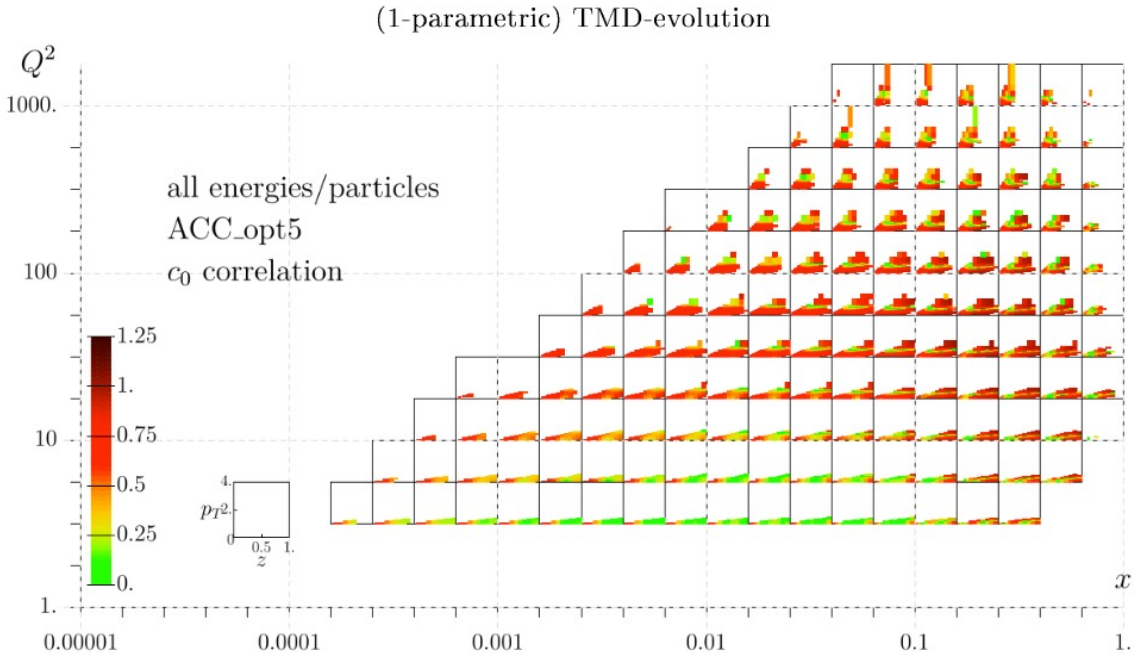
Study by Chris Dilks

Original PID has low efficiency at high x/high Q^2

- Impact of data in this region large!

4D ratios (PID acc/perfect):

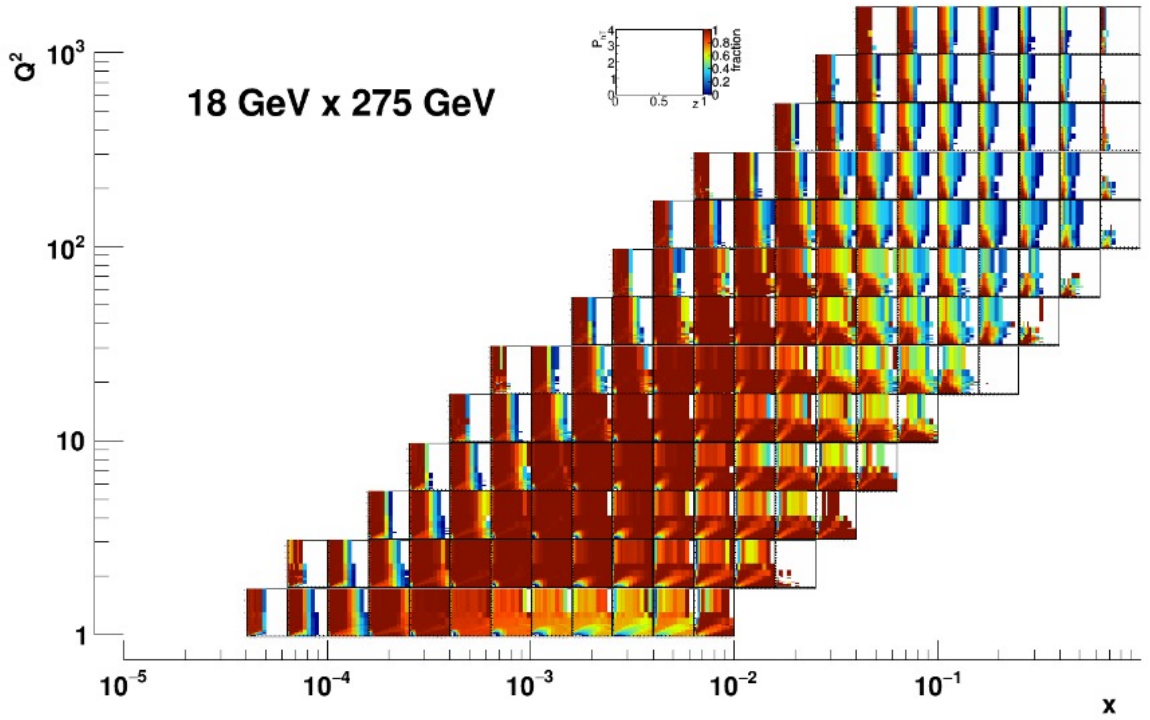


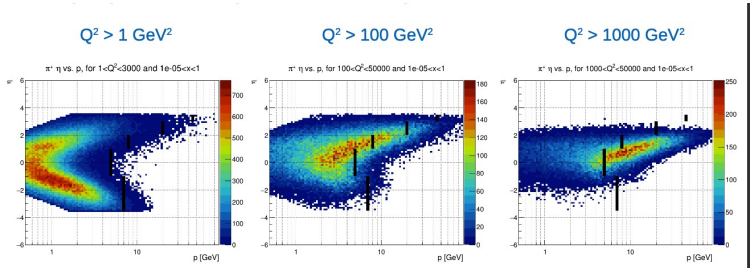


Study by Alexey Vladimirov

SIDIS request improves high x/high Q^2

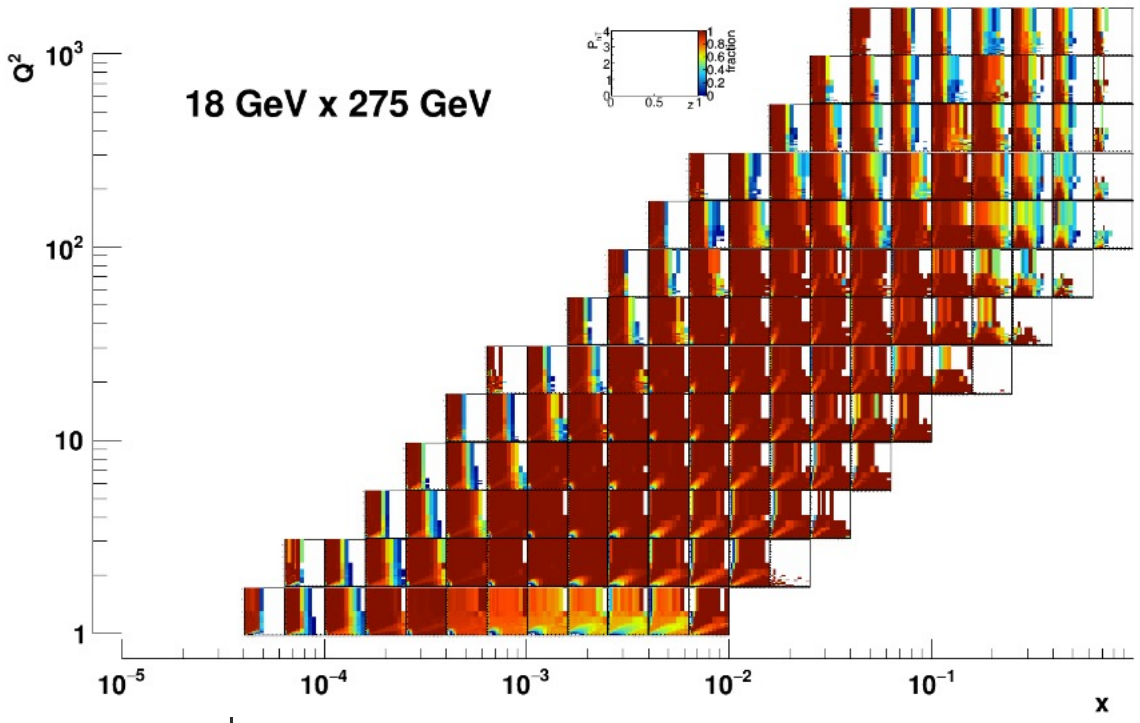
- Request driven by our understanding of detector limitations

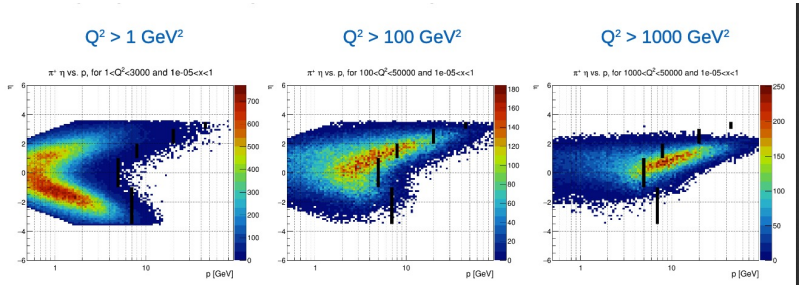




SIDIS request	π/K/p
-3.5 - -1.0	0.2 - 7
-1.0 - 1.0	0.2 - 8
1.0 - 2.0	0.2 – 20
2.0 - 3.0	0.5 – 30
3.0 - 3.5	0.5 – 45

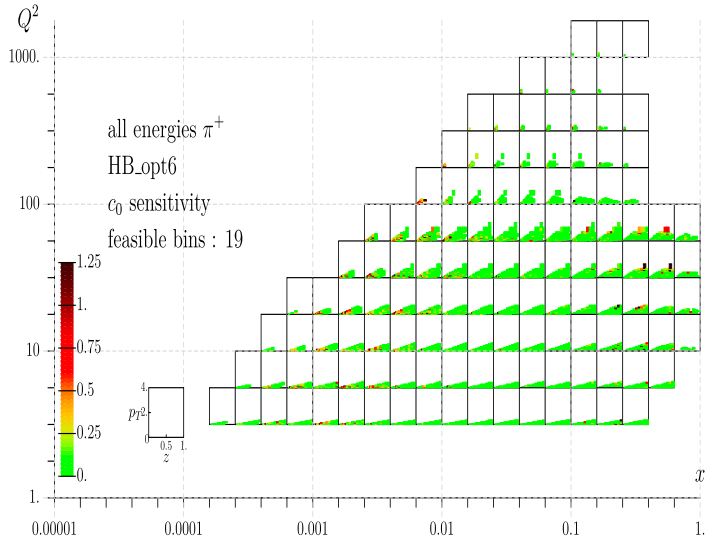
What we would like in a better world:



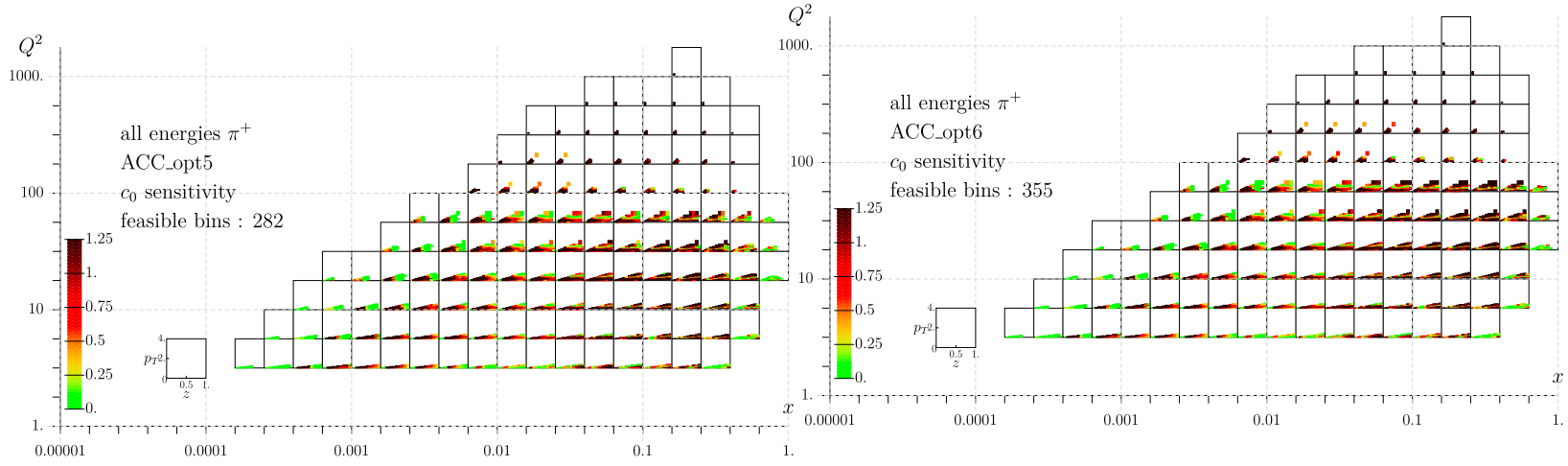


Anselm special	π/K/p
-3.5 - -1.0	0.2 - 7
-1.0 - 1.0	0.2 - 10
1.0 - 2.0	0.2 – 40
2.0 - 3.0	0.5 – 45
3.0 - 3.5	0.5 – 50

Study by Alexey Vladimirov

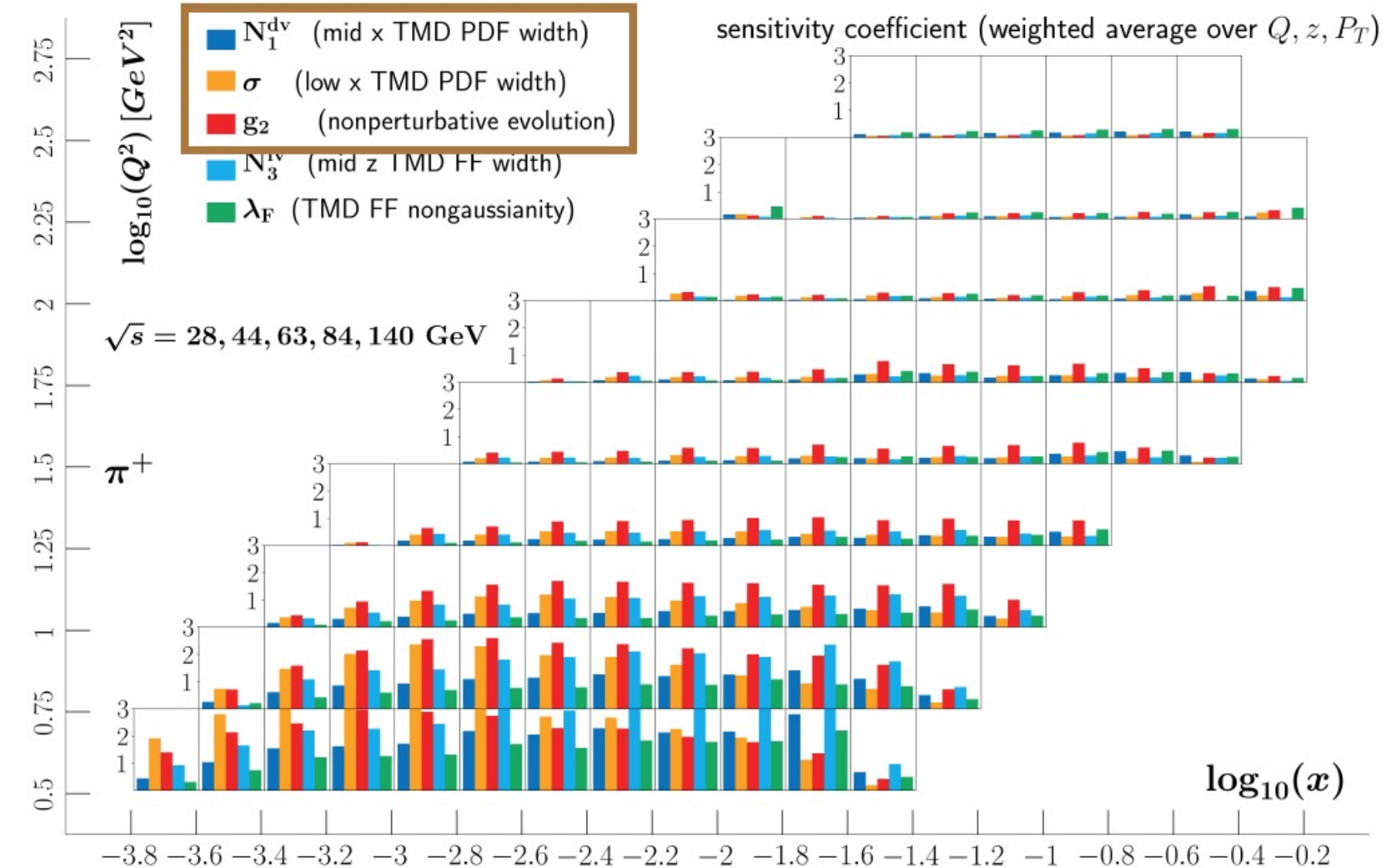


handbook



SIDIS request

Optimal request



Pavia NP fit

Figure 8.30: Expected sensitivities to various TMD PDF and FF parameters, as well as the TMD evolution as shown for the verious collision energy options and for detected final-state positive pions. The impact has been averaged over final state hadron transverse momentum and fractional energy for better visibility.