Collins paper code QA
Run 12+15 pp200 Collins analysis (psn0782)

Code QA: Xilin Liang

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Brief status

- run15
  - Step 1 , 2: jet tree and embedding generation
  - Step 3: "analysis" , run over all the jet tree from data, embedding and pure pythia level.
  - Step 4: "asymmetry", calculate the final asymmetry
  - Final plots for run15

Part 1 & 2 : jet tree and embedding produce

- I only generate some jet tree from the MuDst files. The results are within 3% difference from Ting's jet tree root files.

Part 3 "analysis"

- Copy Ting's StRoot library from and compile: /star/u/tinglin/gpsf01/Run15/finalcode_Collins/finalPlots_20211122/run15/jettree/StRoot/

- Run through the whole data in some PID selected.
  - Number of entries difference is less than 1% compared with Ting's root files.

- Run through the whole embedding data. Results are same as Ting's files.

- Run through the whole pure pythia data. Results are same as Ting's files.

- Note: the data (jet tree), embedding , pythia root files that I use are from Ting's rootfiles. Not from Part 1 & 2 for code QA
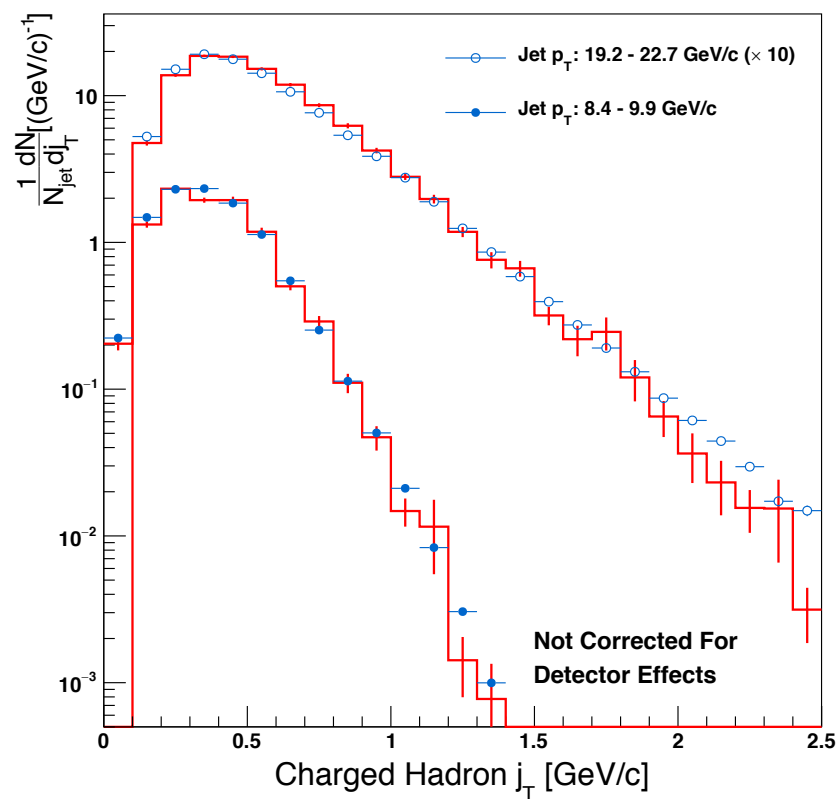
Part 4 "asymmetry"

- Use all the root files from Ting: /star/u/tinglin/gpsf01/Run15/psn0782/run15/rootfile/*.root

- Repeat: Sivers asymmetry, Collins and Collins-like asymmetry

- Generate: PID, underlying event fractions, pure pion asymmetries for Collins, pure pion asymmetries for Collins-like

- Fix x-axis and y-axis and calculate the systematic uncertainty.

- Last, calculate pure kaon asymmetries for Collins

Final plots for run15

- Part 1: kinematic

Kinematic plots

FIG. 5. Distribution of charged hadrons within jets in the 2015 data as a function of the hadron longitudinal momentum fraction, z, in two different jet p_T bins. The blue points represent the data, and the red histograms show the simulation.

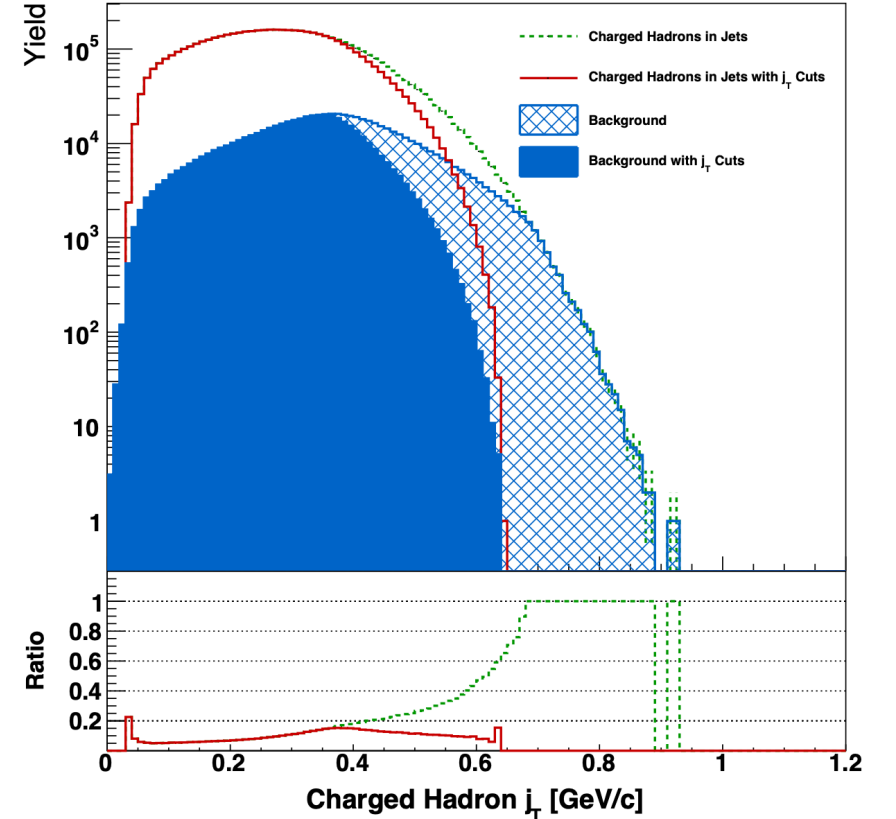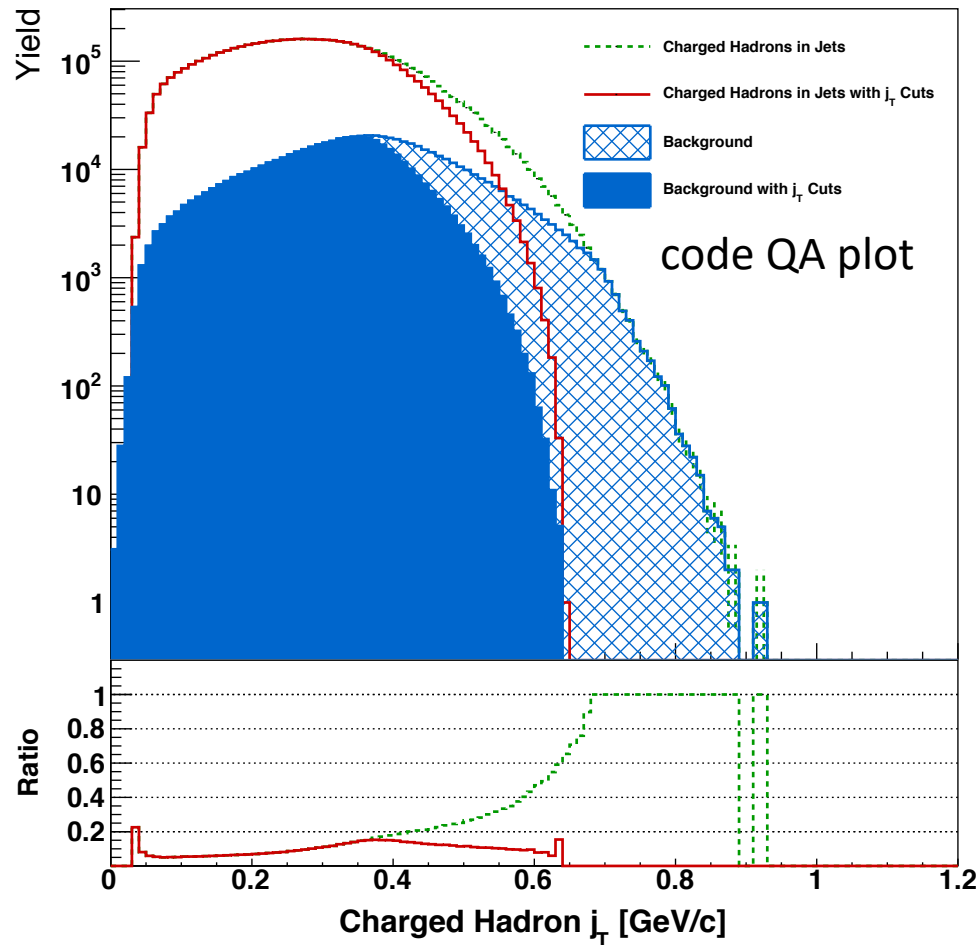FIG. 6. Distribution of charged hadrons within jets in the 2015 data as a function of the hadron momentum transverse to the jet axis, j_T, in two different jet p_T bins. The blue points represent the data, and the red histograms show the simulation.

Paper Fig. 5, 6

- Top rows are from code QA Plots.

Charged hadrons in jets (paper Fig. 3)

FIG. 3. Distribution of the charged hadrons inside jets as a function of the hadron momentum transverse to the jet thrust axis, j_T, for jets with $6.0 < p_T < 7.1$ GeV/c and hadrons with $0.1 < z < 0.2$. The lines show all the hadrons inside the jets, while the blue filled areas are the background from the off-axis cones before and after the upper j_T cut described in Eq. (3).
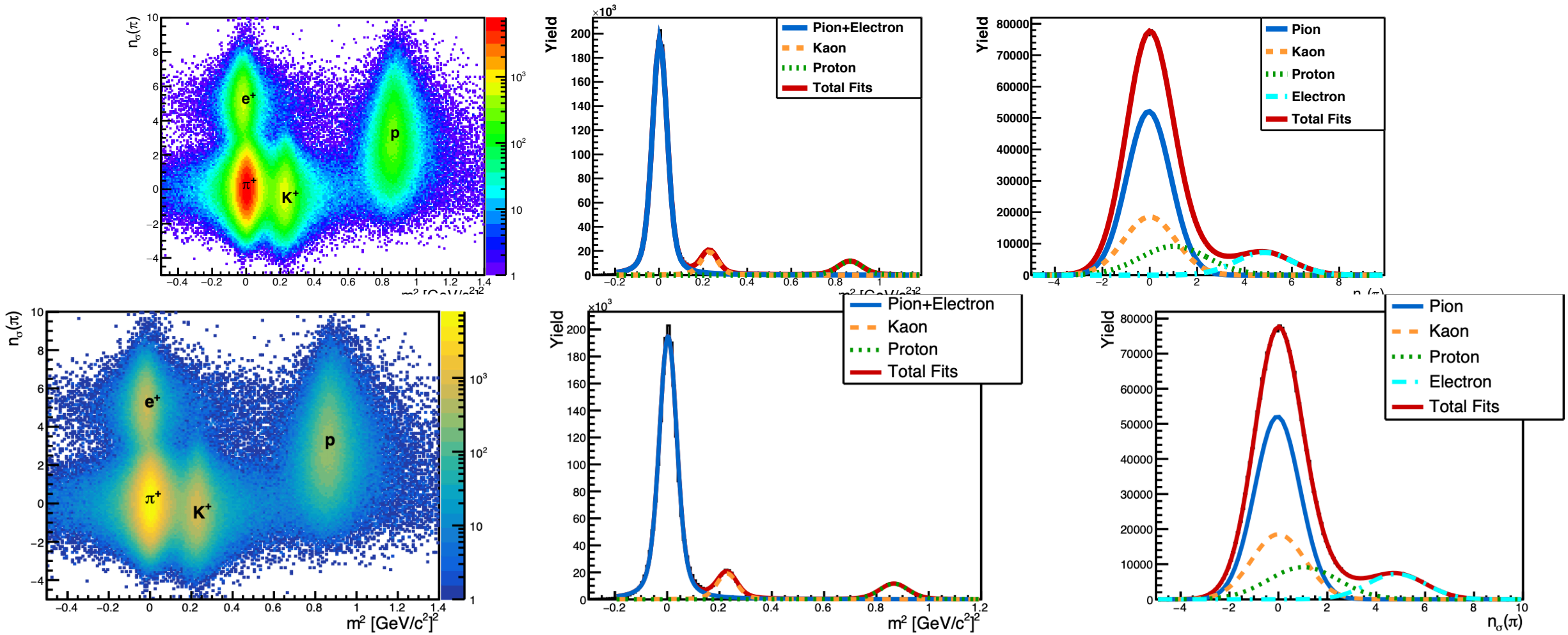
PID plots paper Fig.7 (code QA plots are on top)

FIG. 7. Left: The correlations of $n_\sigma(\pi)$ *vs.* m^2 for positively charged particles carrying momentum fractions of $0.1 < z < 0.13$ in jets with $8.4 < p_T < 9.9$ GeV/c. Middle: Multi-Voigt profile fits to the m^2 distribution. Right: Multi-Gaussian fits to the $n_\sigma(\pi)$ distribution.

Charged particle fractions paper Fig. 8
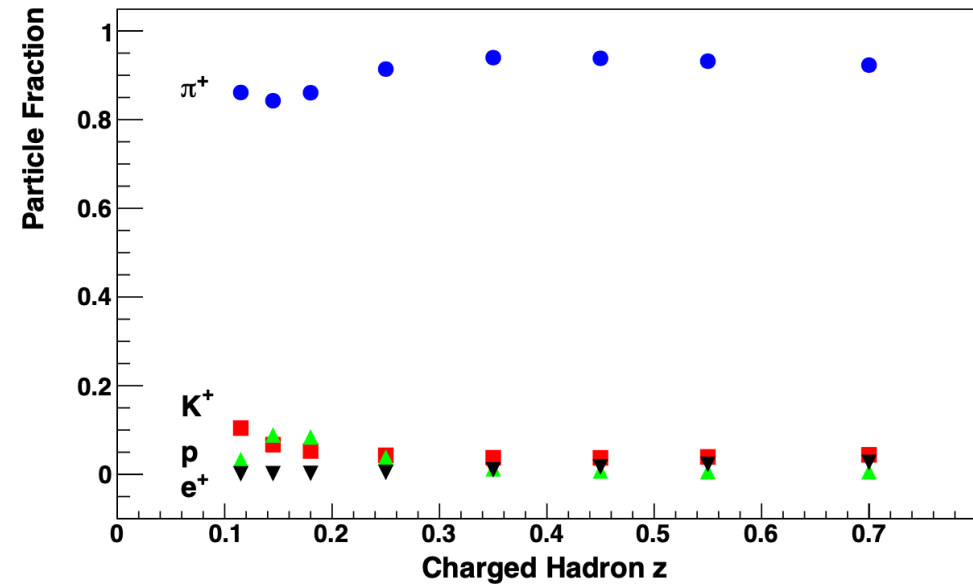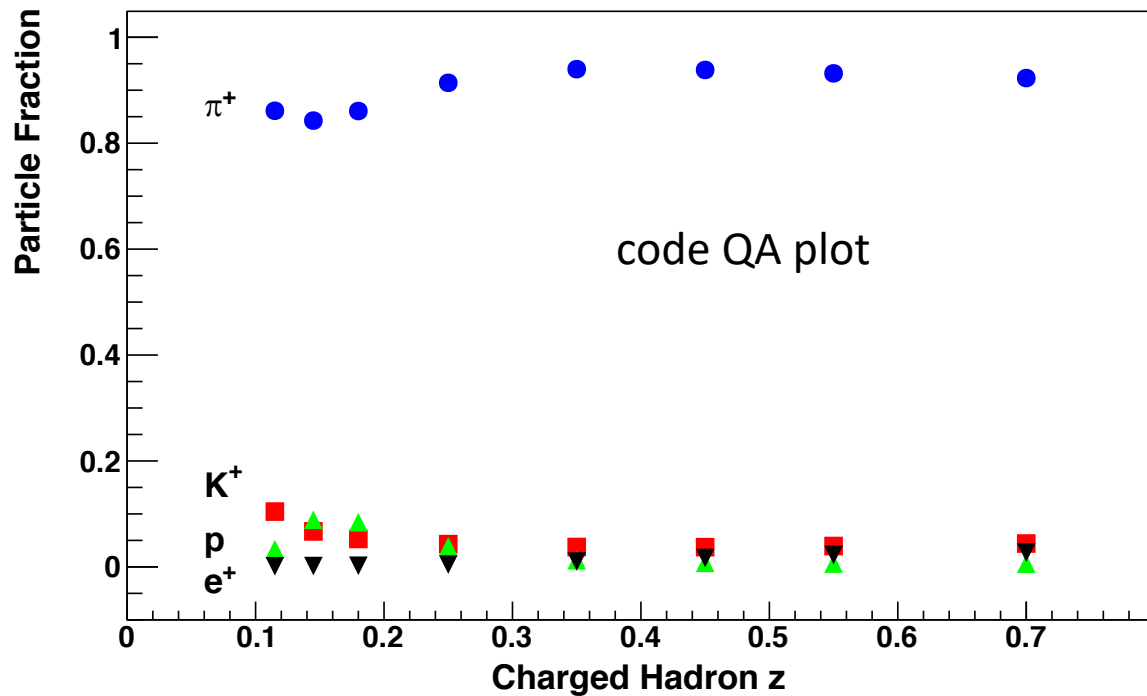
FIG. 8. Charged particle fractions as a function of the hadron longitudinal momentum fraction, z, for charged particles that satisfy $-1 < n_\sigma(\pi) < 2$ (pion-rich region), in jets with $8.4 < p_T < 9.9$ GeV/c. The blue solid circles are π^+, red squares are K^+, green up triangles are protons and the black down triangles are positrons.

Analysis Note Figure 85
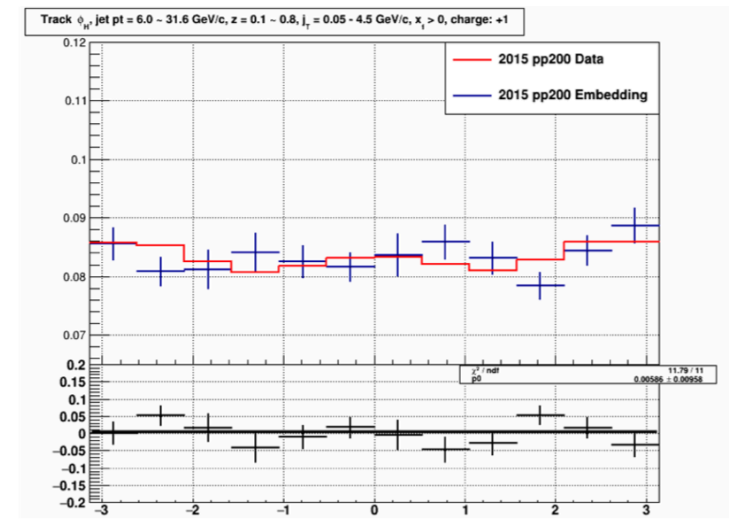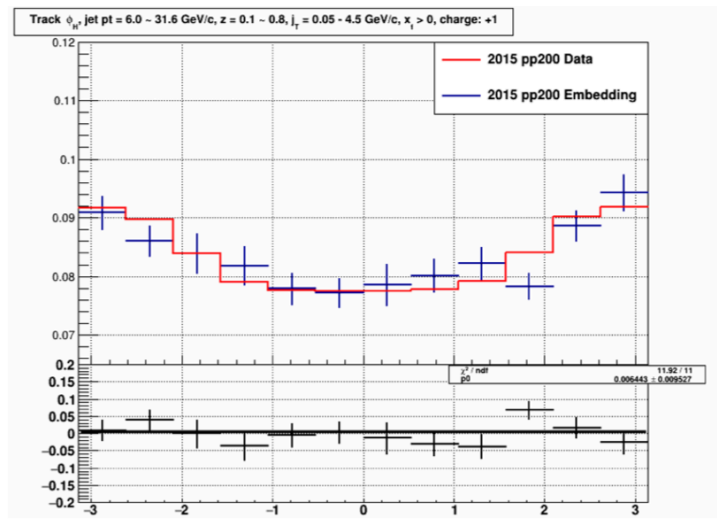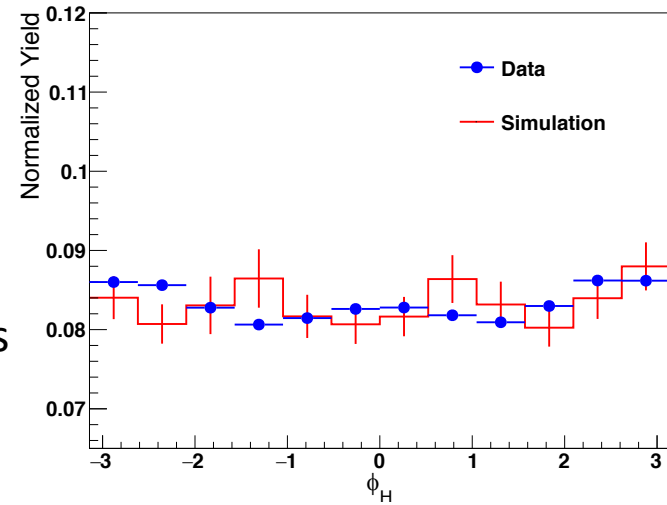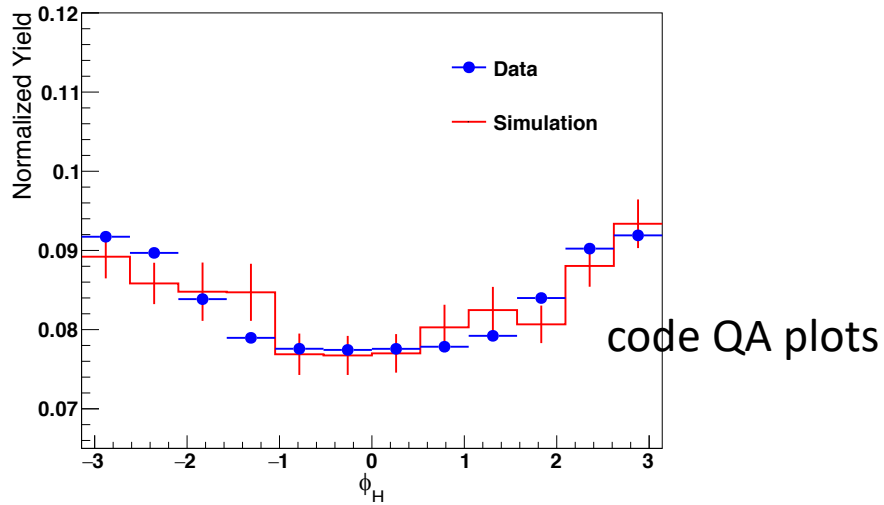
Figure 85: ϕ_H distribution before (left) and after (right) the η correction.

- Part 2: Sivers

Analysis Note Figure 92 , paper Fig. 10
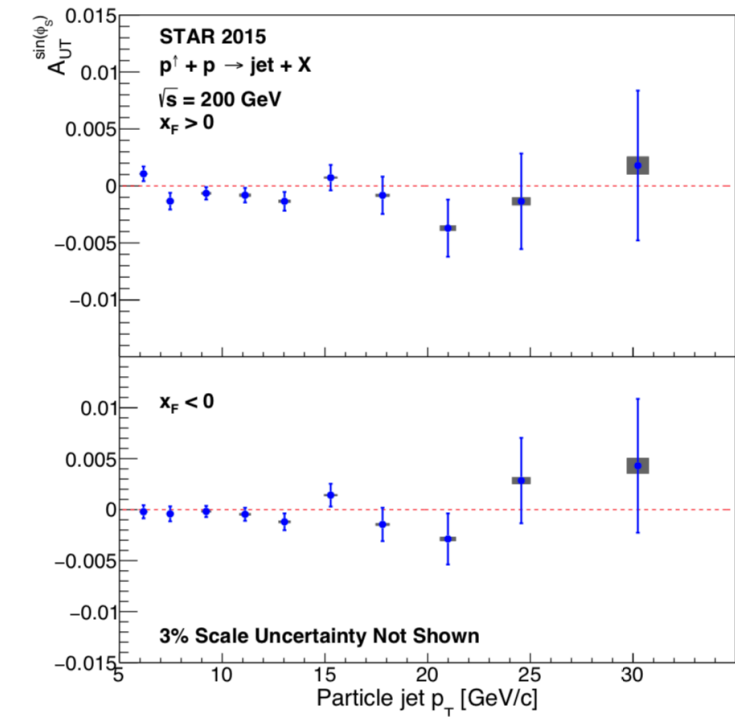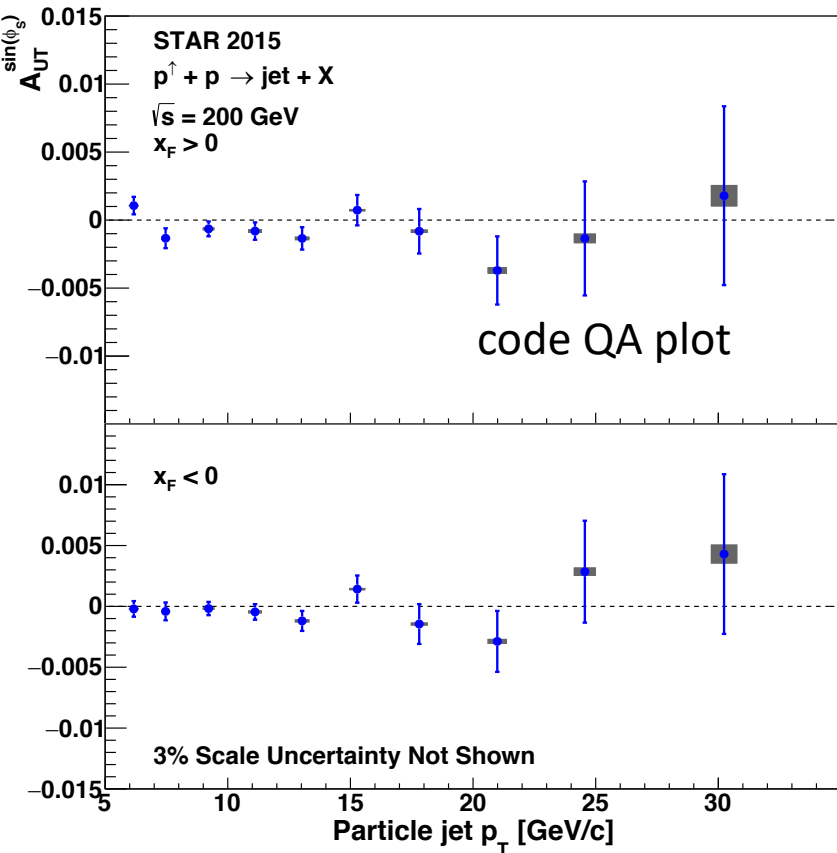
Figure 92: Sivers asymmetry for inclusive je
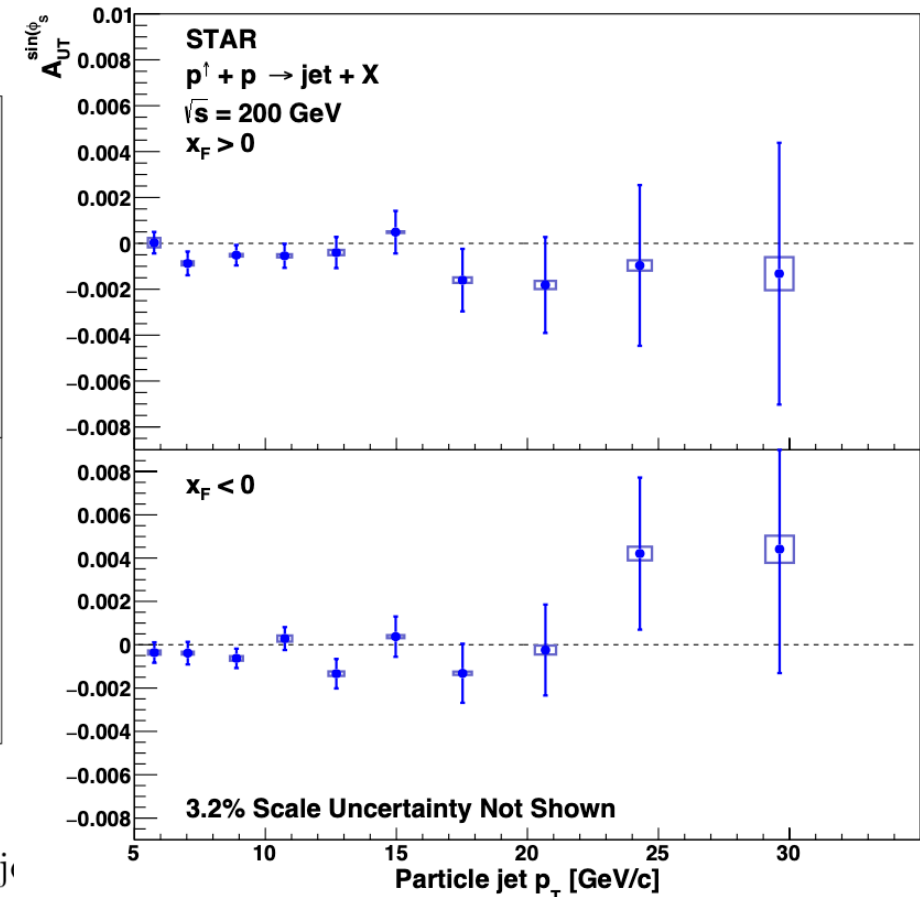
Fig.10: Inclusive jet asymmetries

Analysis Note Figure 122, paper Fig. 11
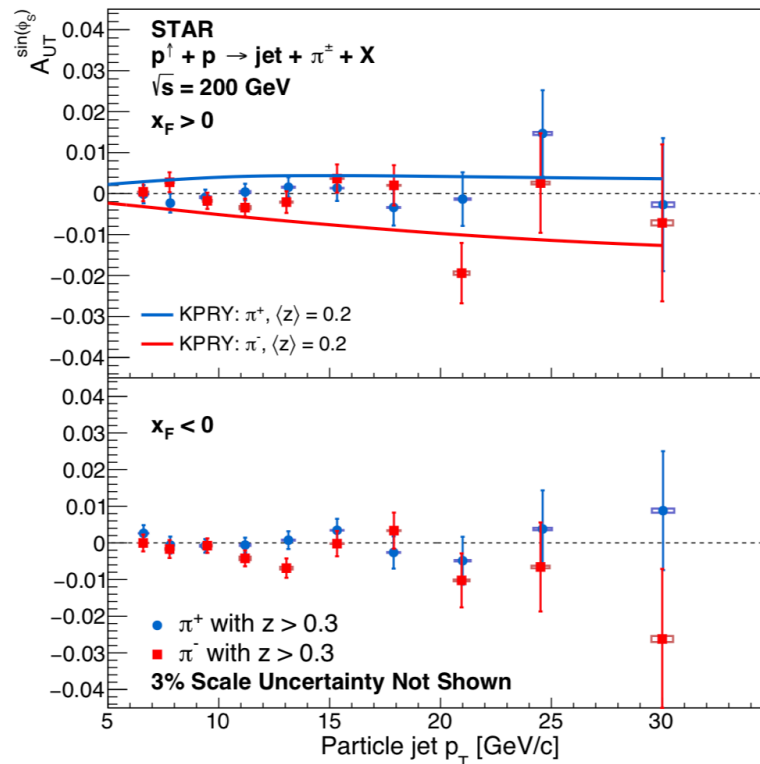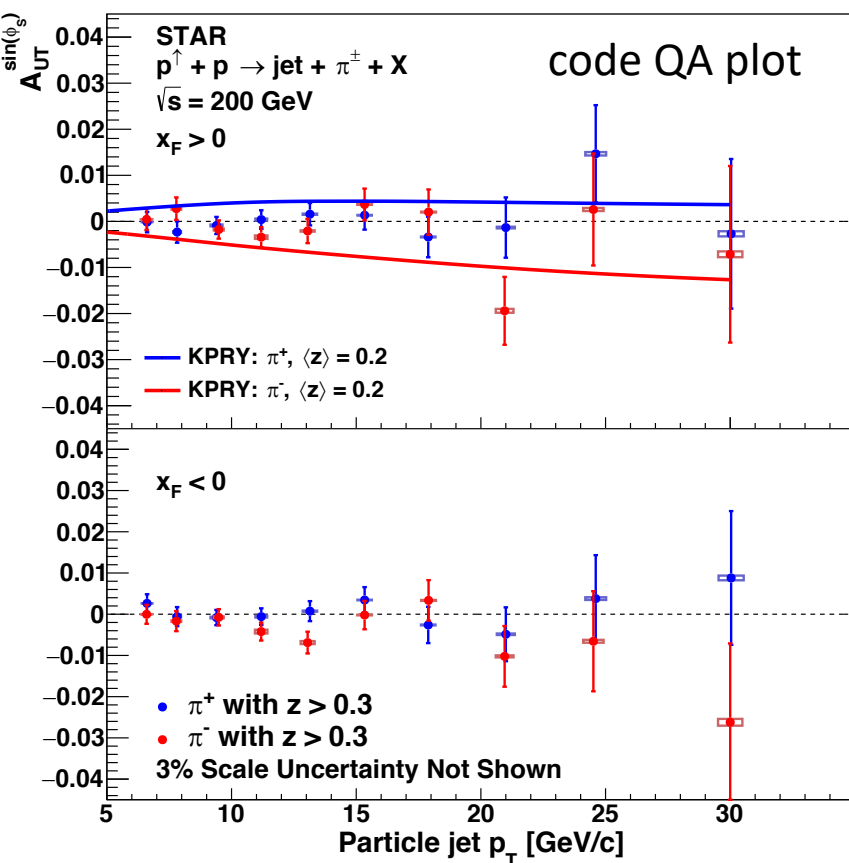
Figure 122: Sivers asymmetry for inclusive jets
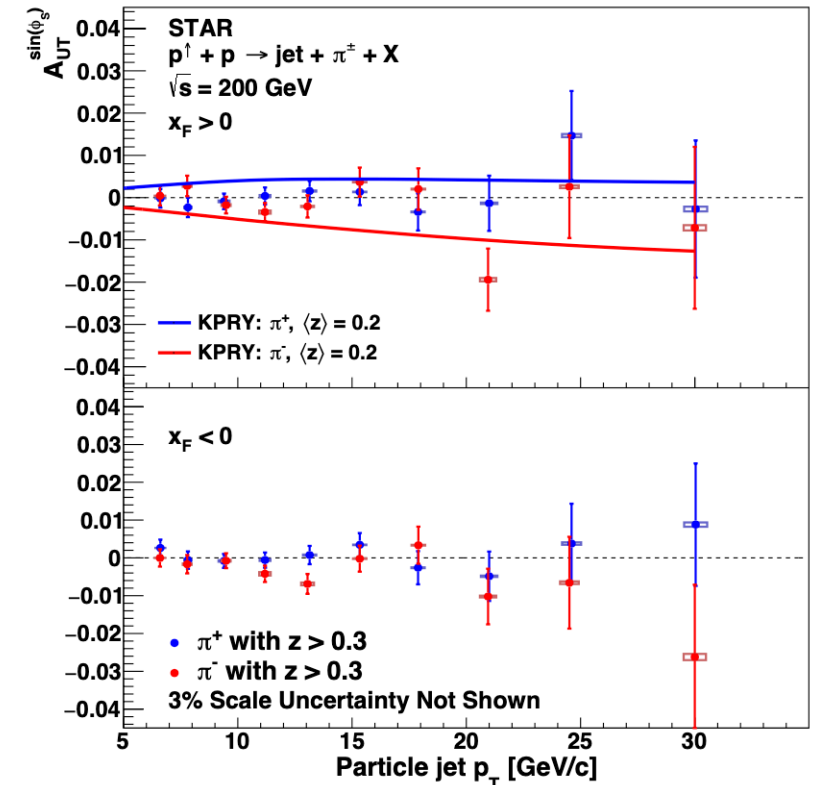
Fig.11: Inclusive jet asymmetry for charged pions inside jets

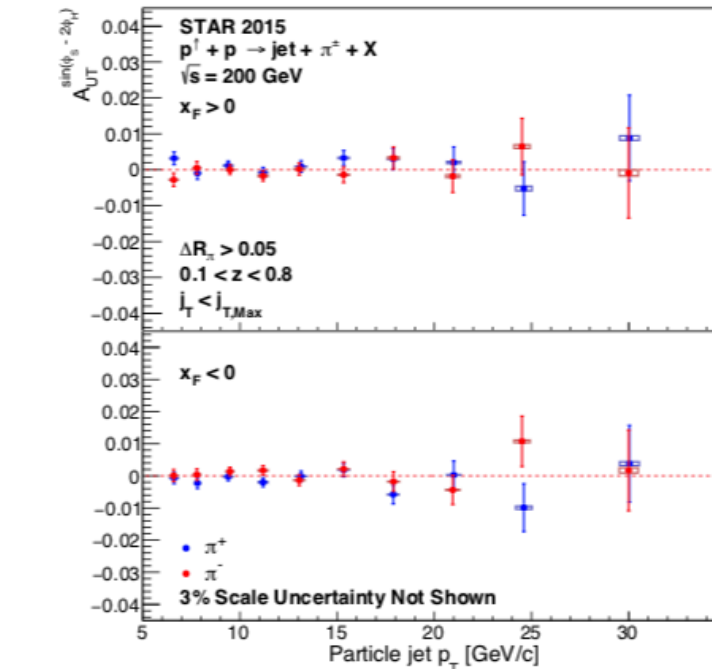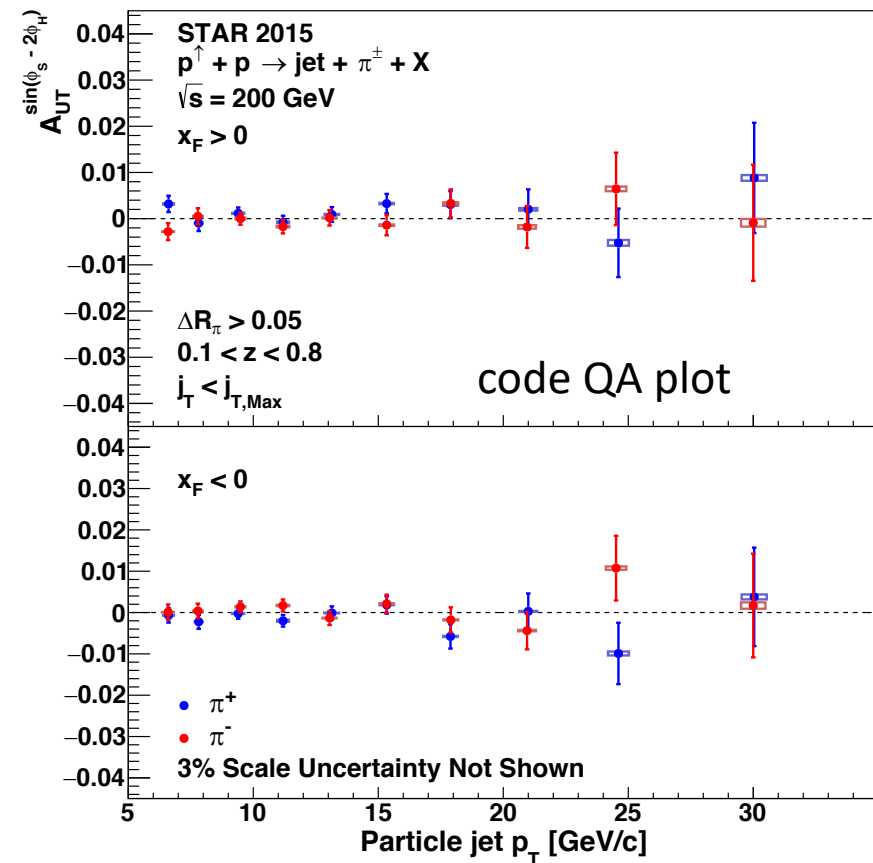- Part 3: Collins like

Analysis note Figure 100, paper Fig. 12

Figure 100: Collins Like asymmetry vs. p_T
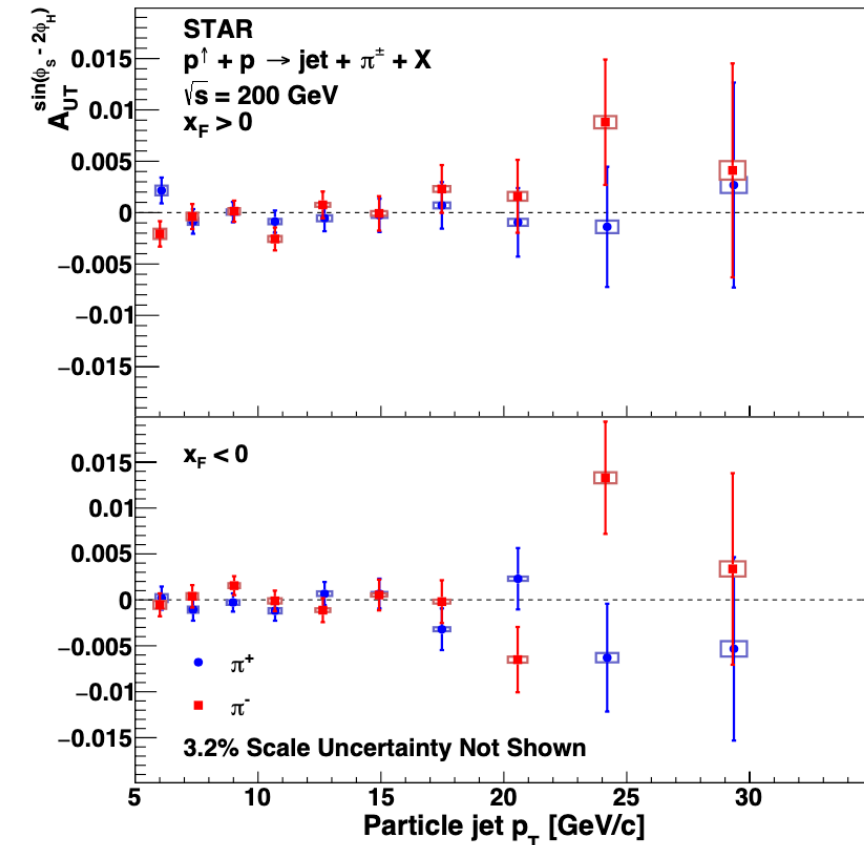
FIG. 12. Collins-like asymmetries as a function of particle jet p_T.

Analysis note Figure 101
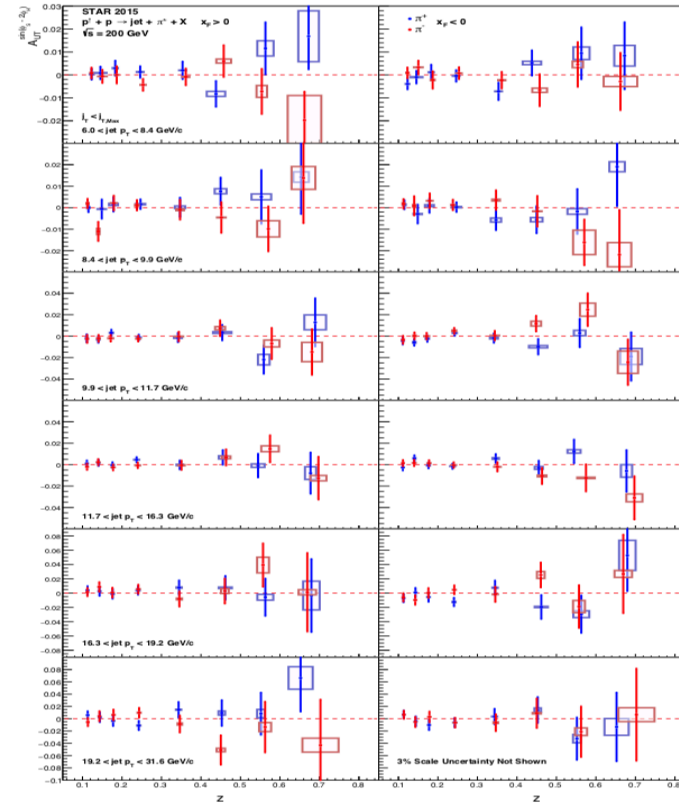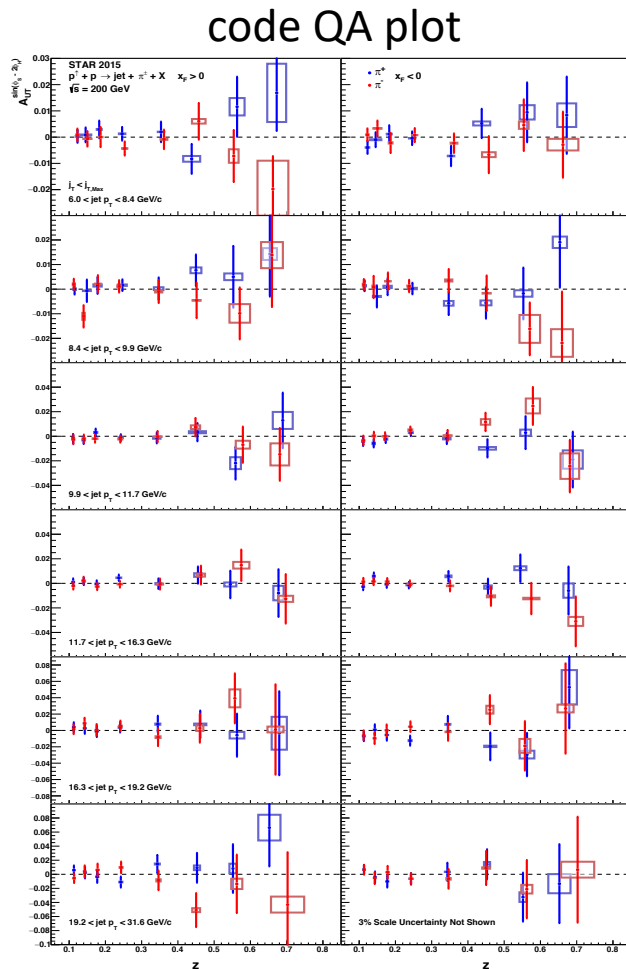
code QA plot

Figure 101: Collins Like asymmetry vs. z in different jet p_T range

Analysis note Figure 102

code QA plot
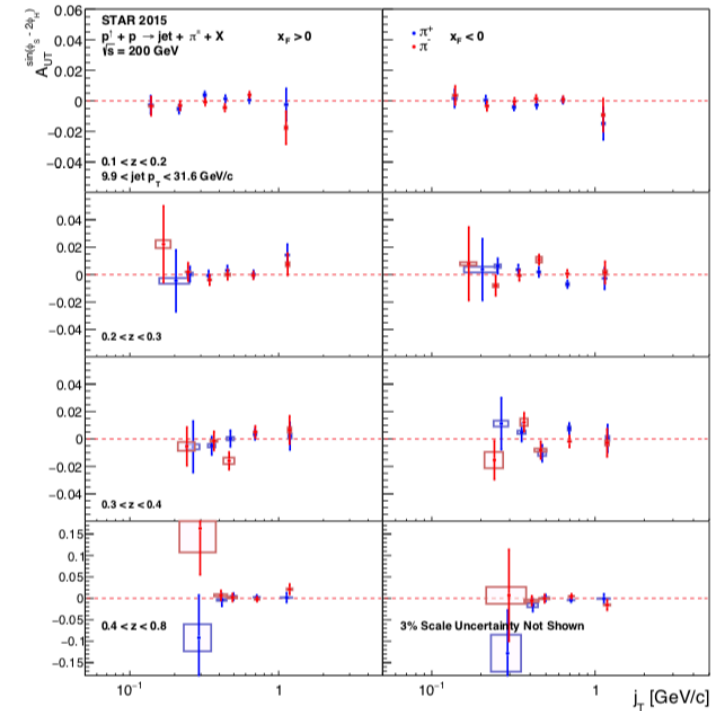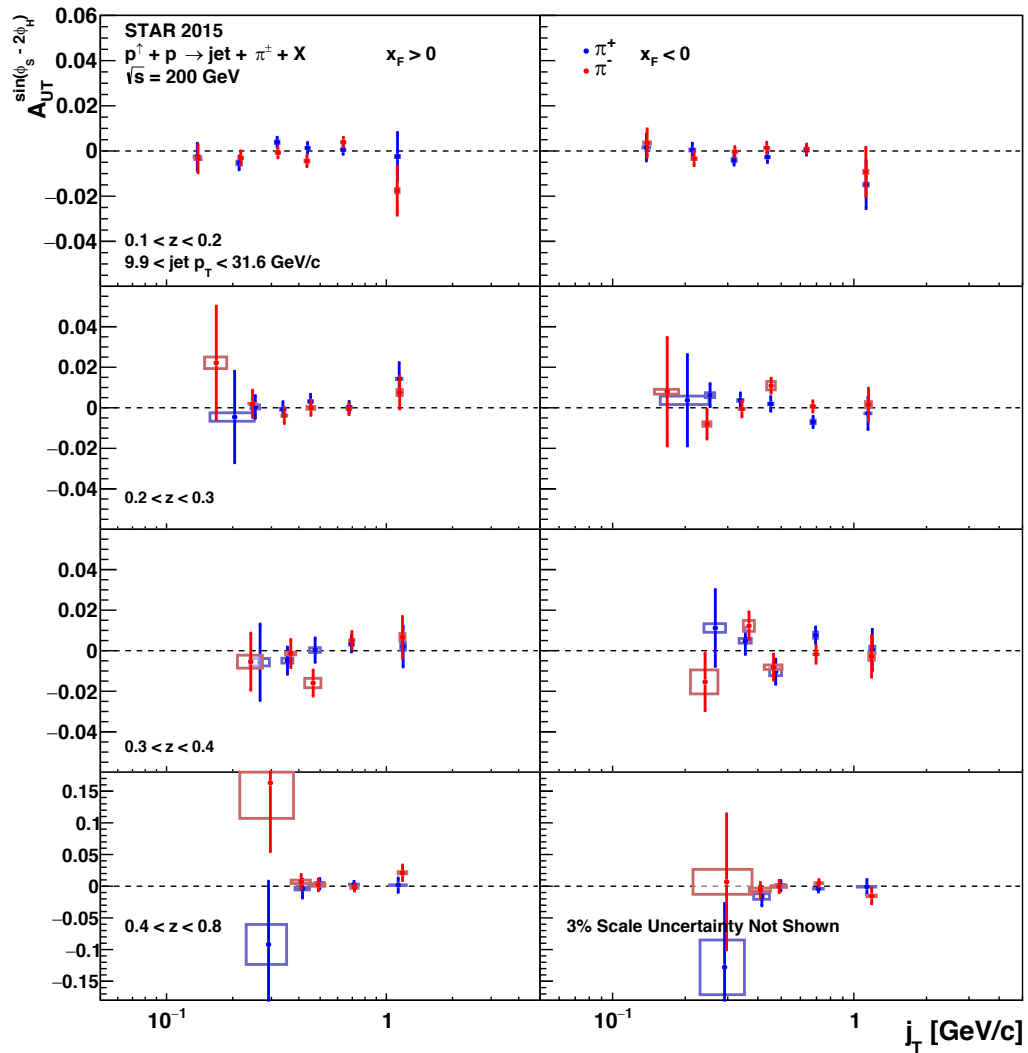
Figure 102: Collins Like asymmetry vs. j_T in different z range
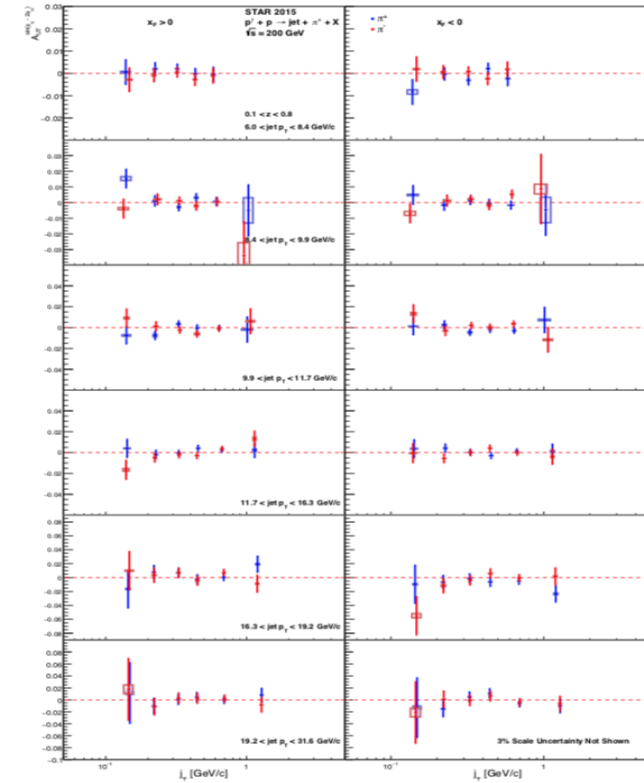
Analysis note Figure 103

code QA plot
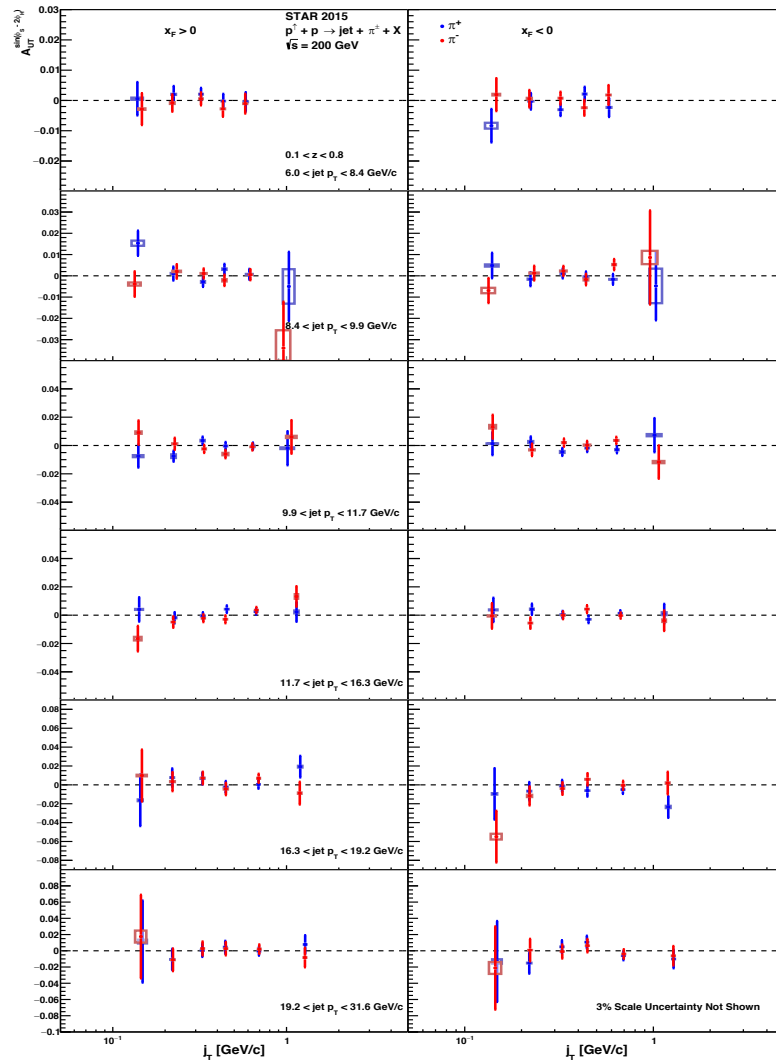
Figure 103: Collins Like asymmetry vs. j_T in different jet p_T range

- Part 4: Collins
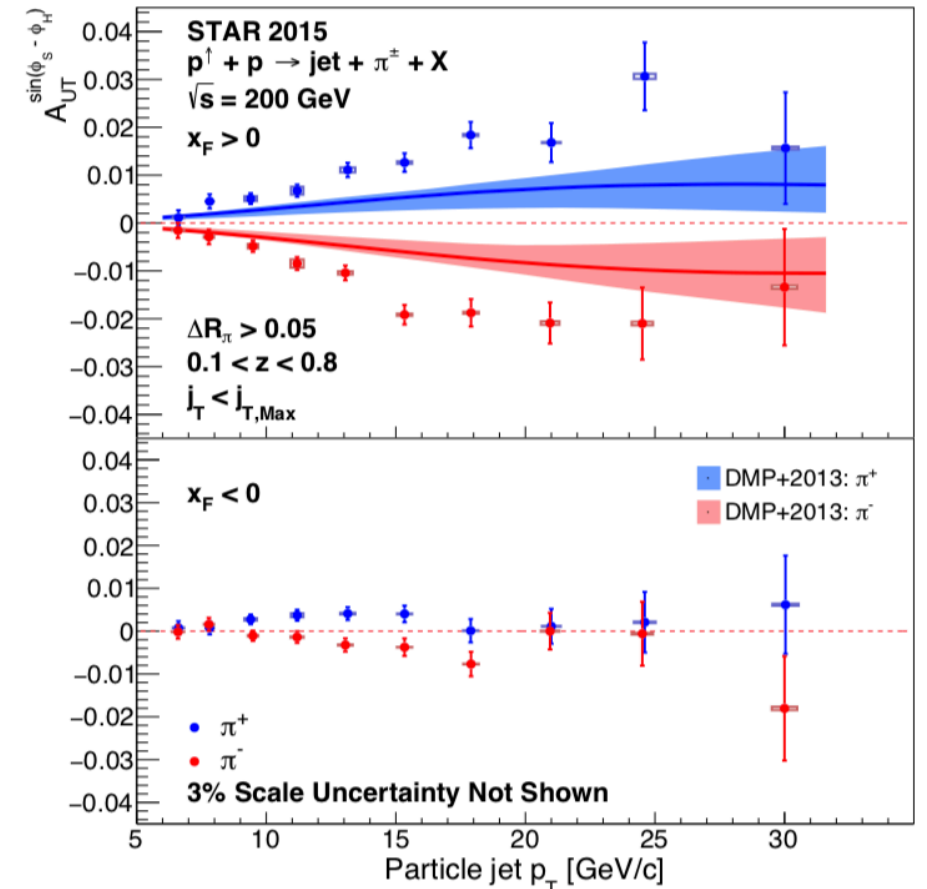
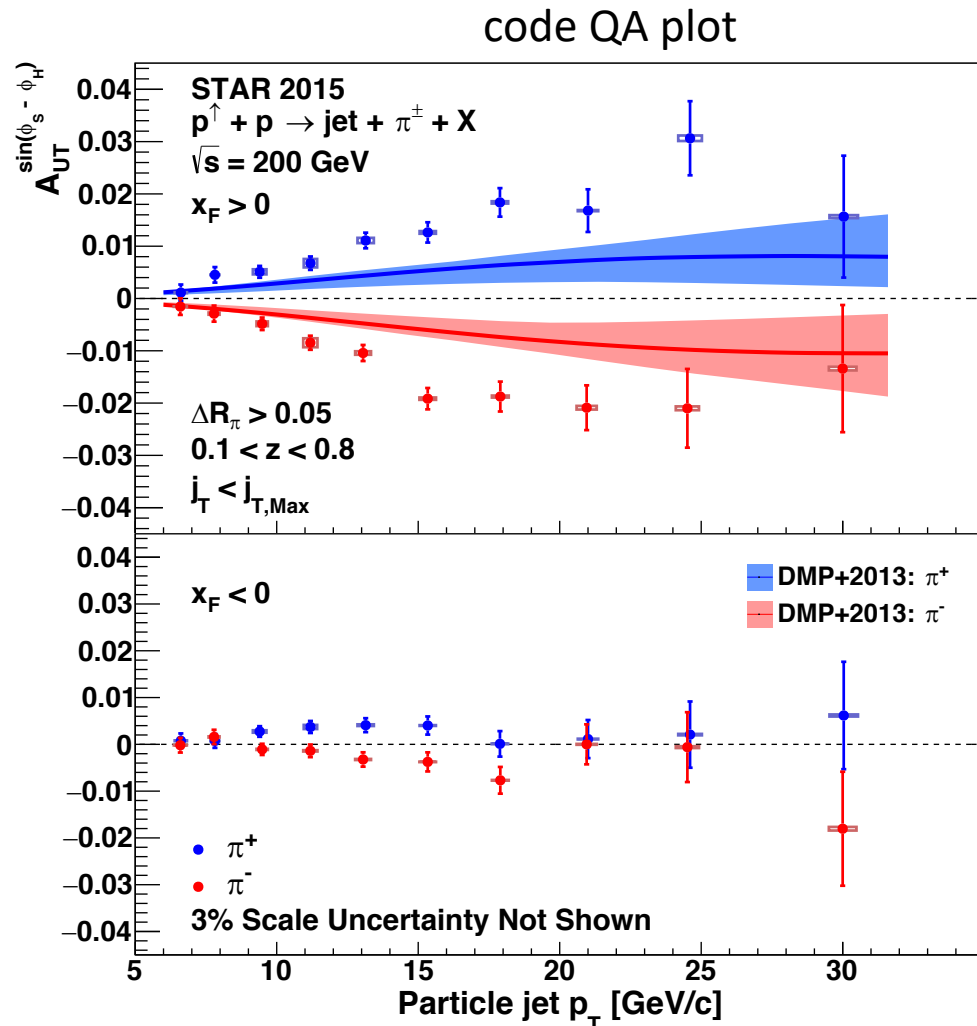# Analysis note Figure 94, paper Fig. 15

code QA plot

Figure 94: Collins asymmetry vs. p_T

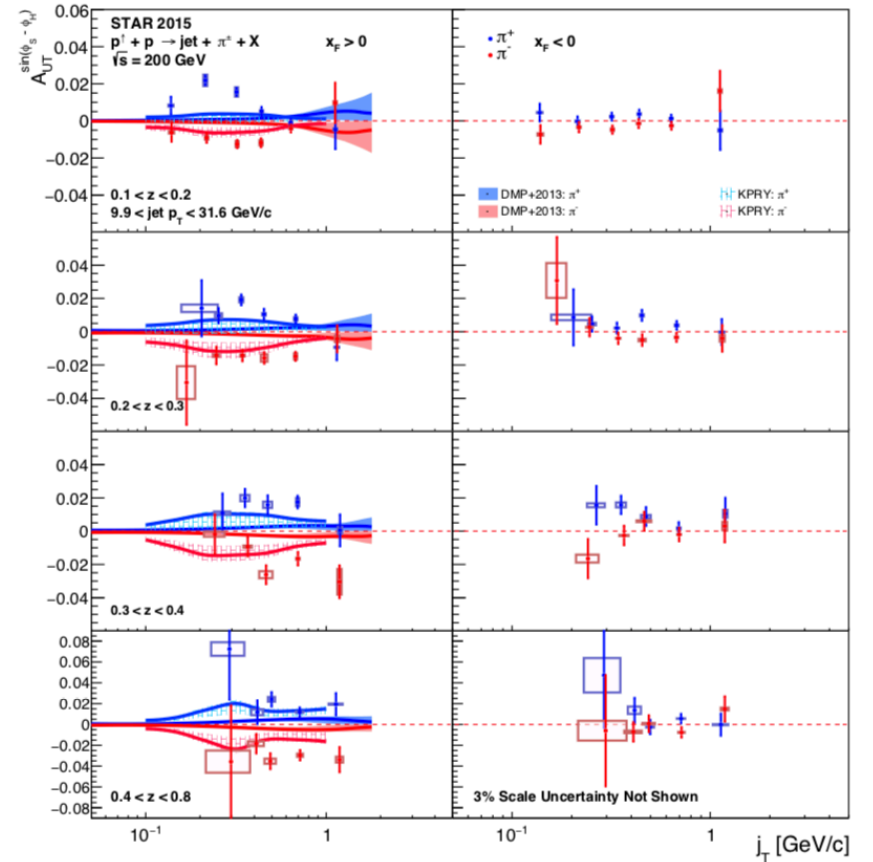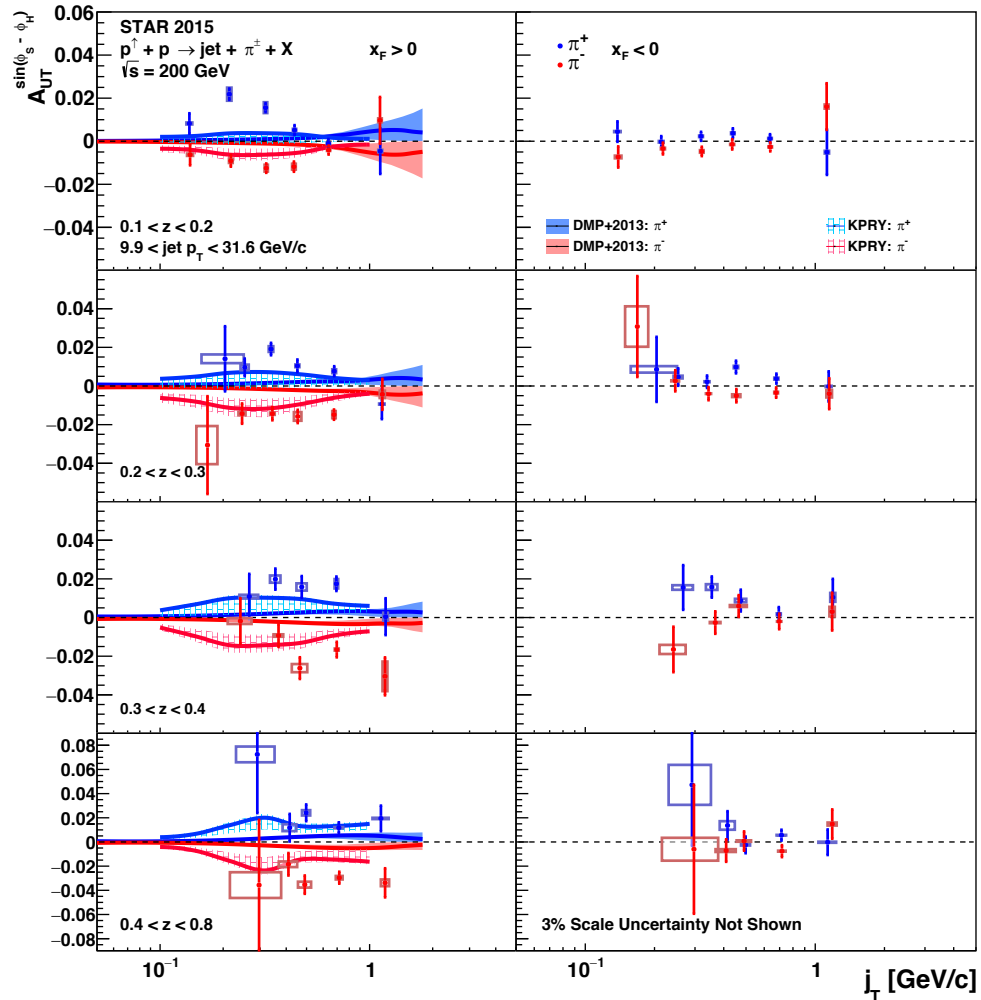# Analysis note Figure 95

code QA plot

Figure 95: Collins asymmetry vs. j_T in different z range

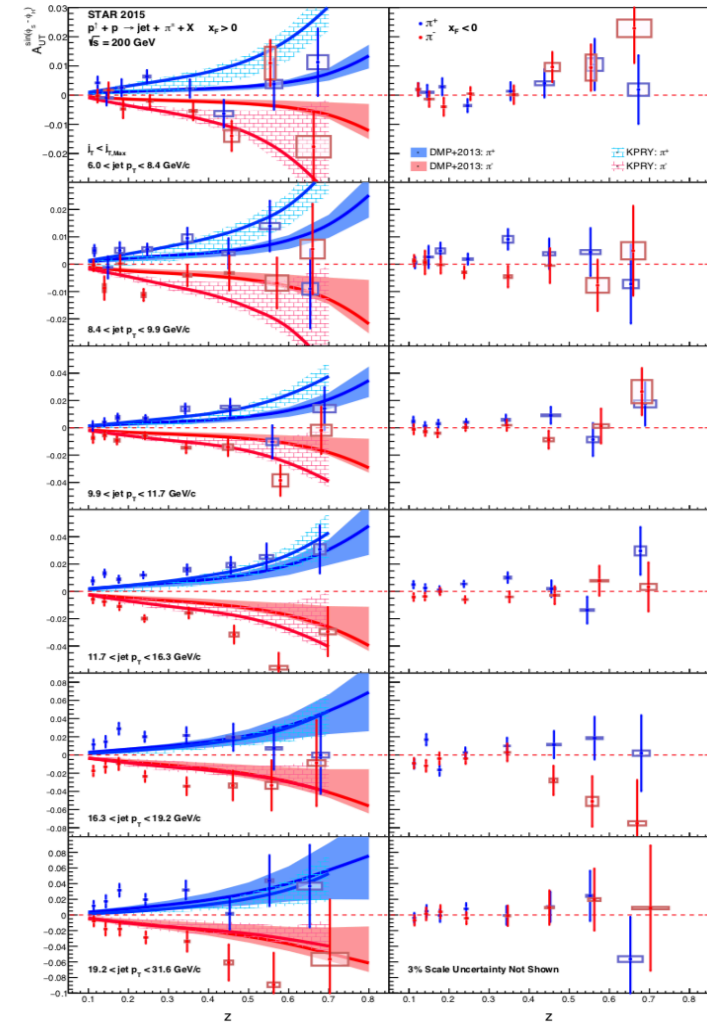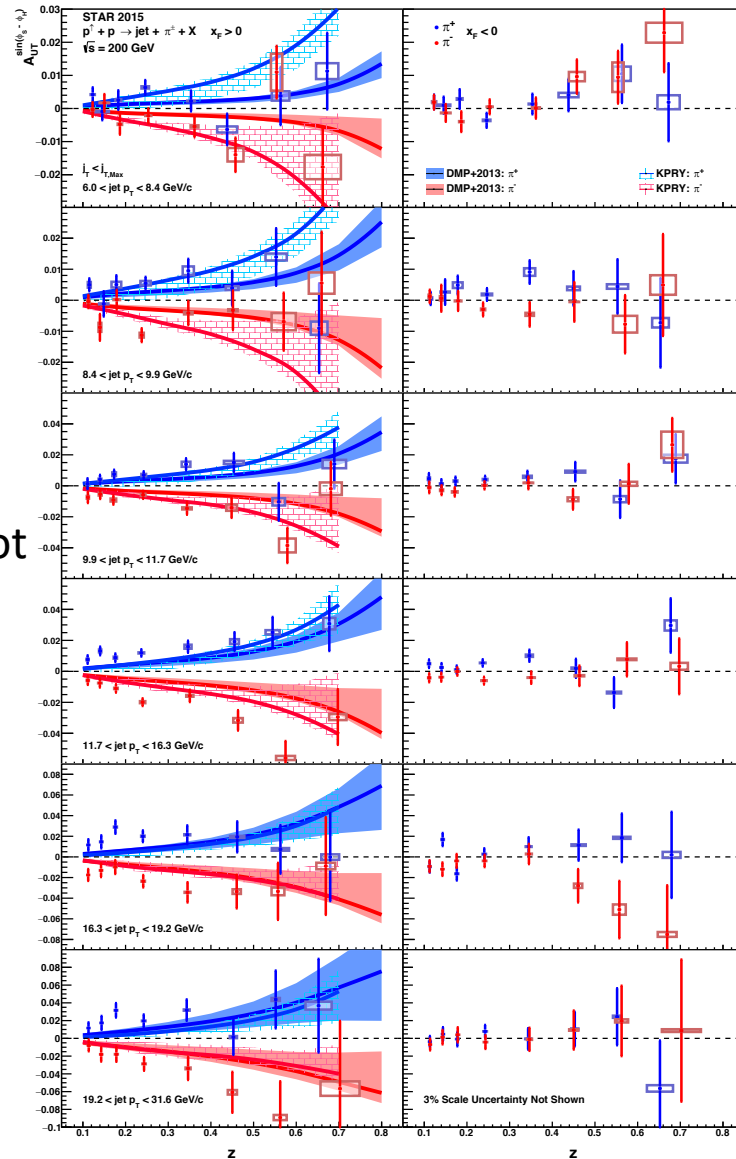# Analysis note Figure 96

code QA plot

Figure 96: Collins asymmetry vs. z in different jet p_T range
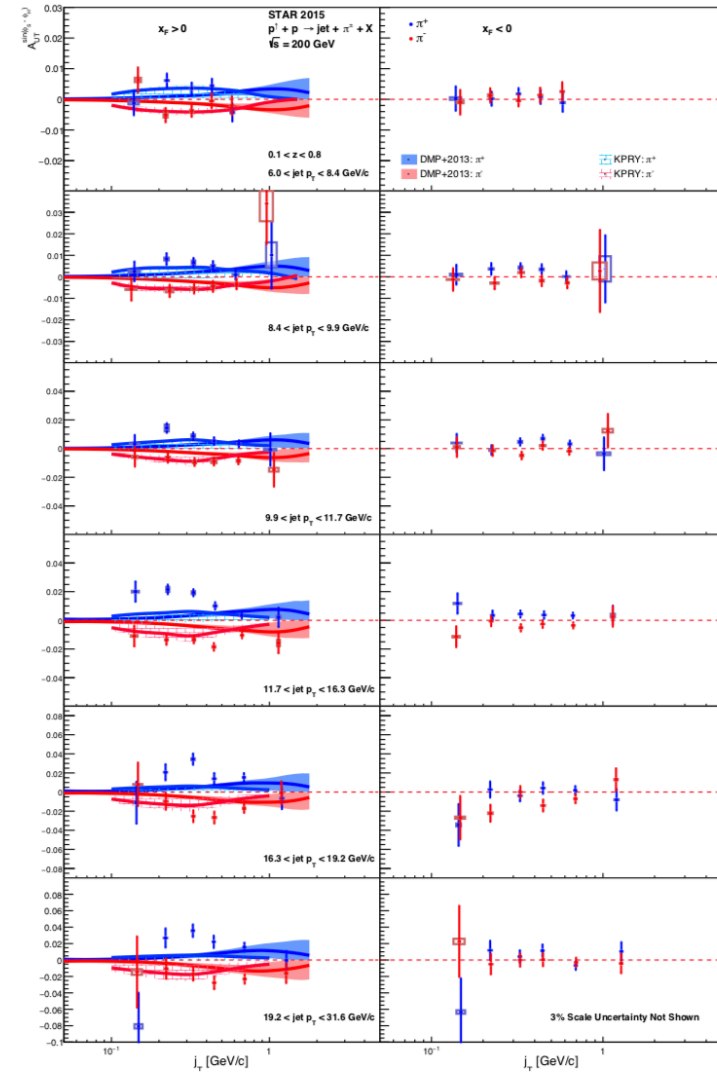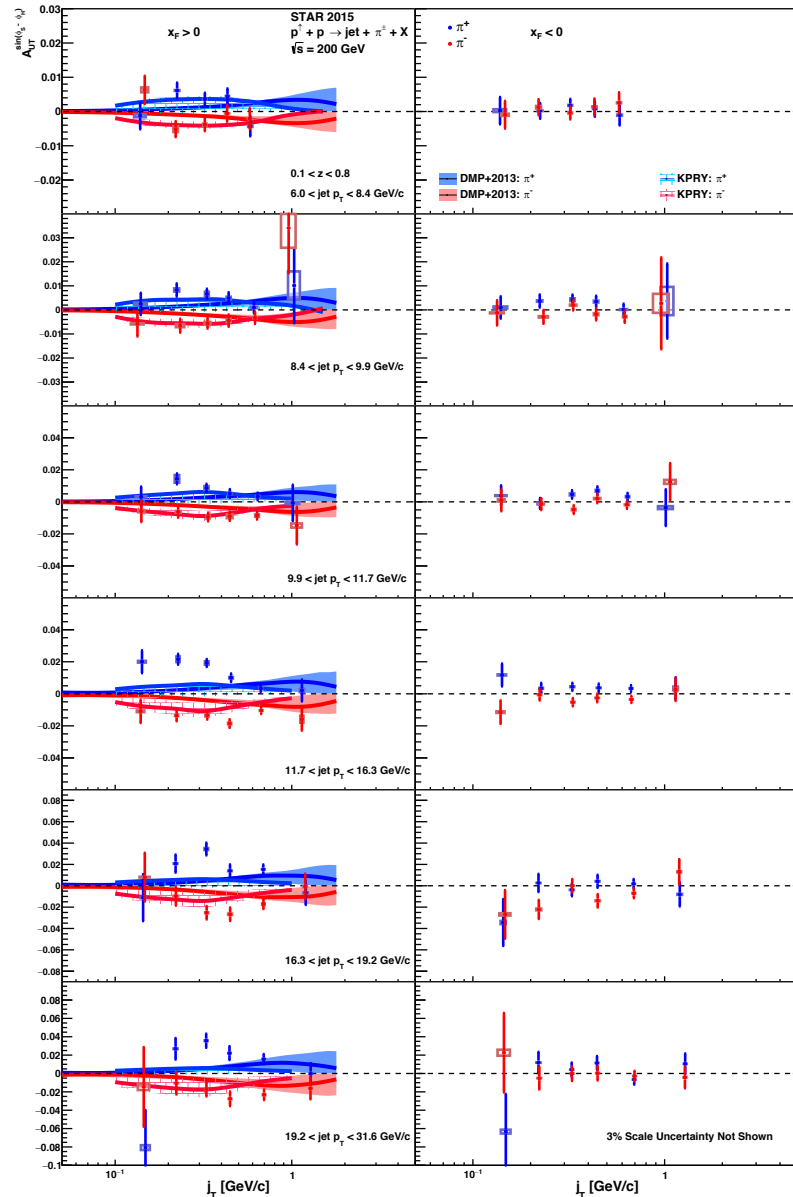
Analysis note Figure 97

code QA plot

Figure 97: Collins asymmetry vs. j_T in different jet p_T range
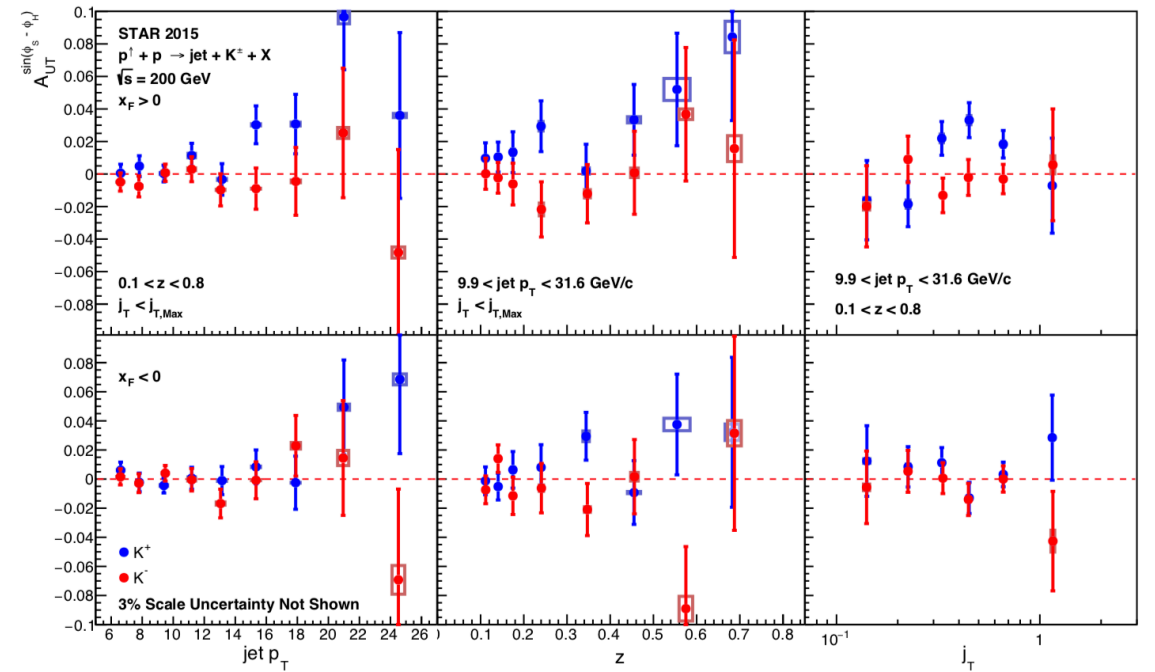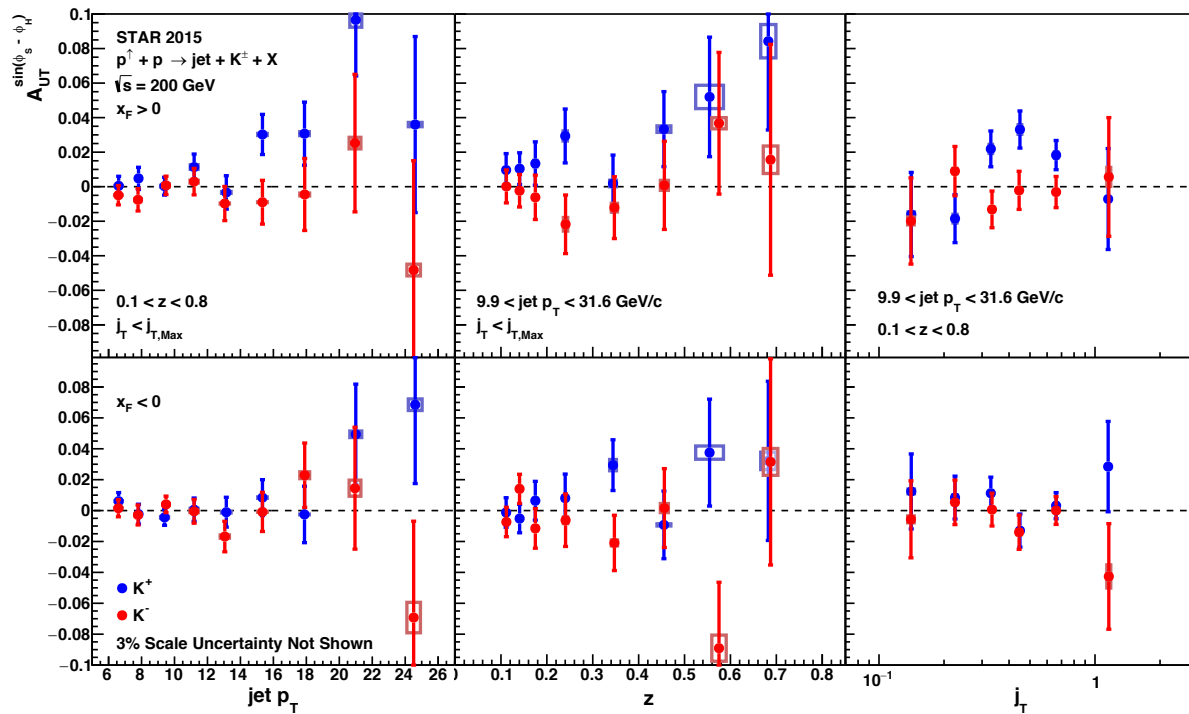
Analysis note Figure 98

code QA plot

Figure 98: Collins asymmetry for $K^{\pm}$ vs. p_T, vs. hadron z and hadron j_T

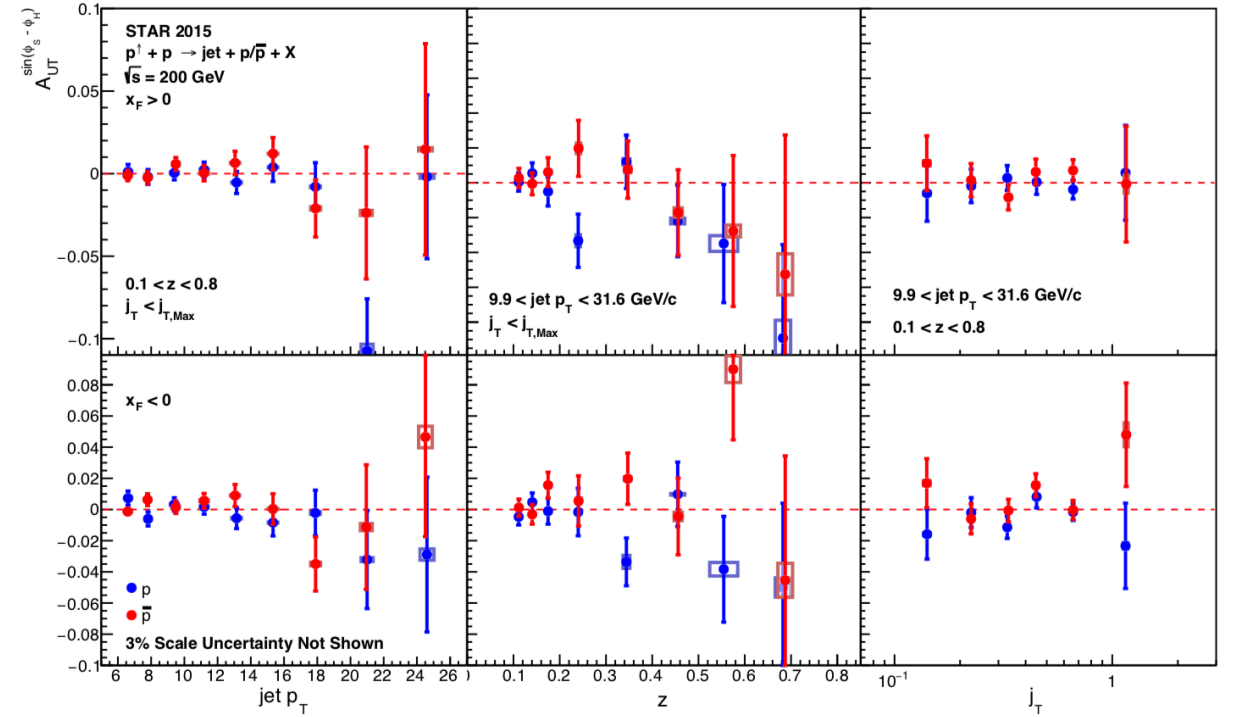# Analysis note Figure 99

code QA plot

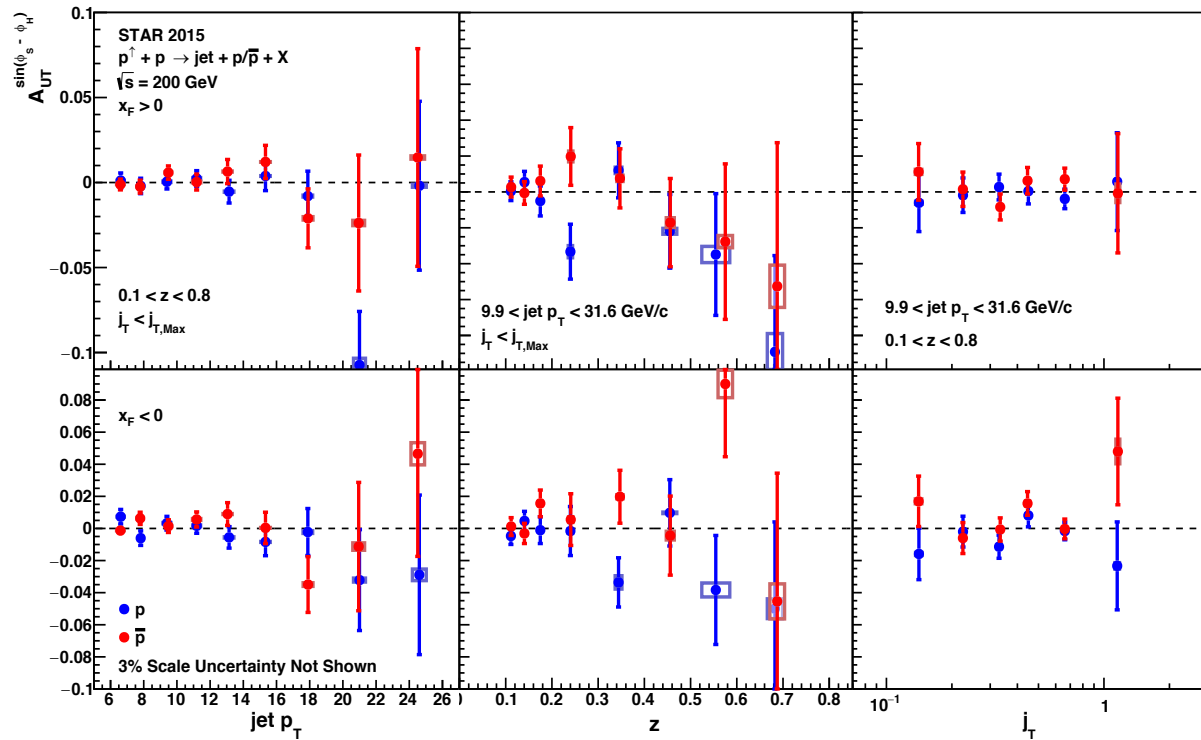Figure 99: Collins asymmetry for proton vs. p_T vs. p_T, vs. hadron z and hadron j_T