D^0 efficiency and R_{AA} in Isobar

2022.3.7

PID method

if(p<1.6 && (!isTOFAvailable)) continue; clean pid

if(isTOFAvailable) nsigtof_X

else nsig_X hybrid PID

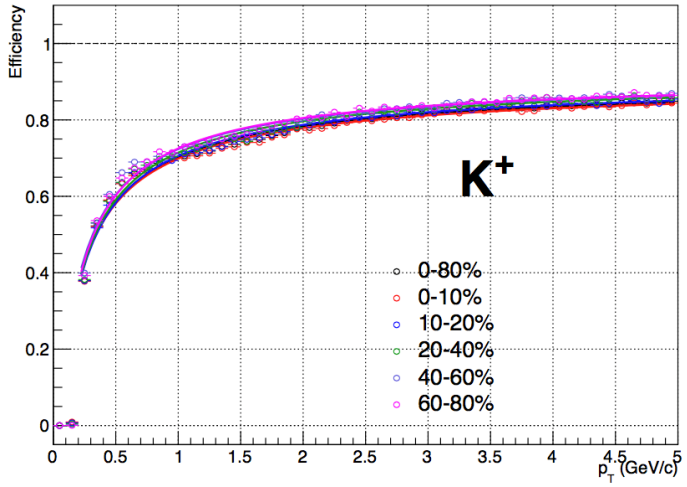
$\epsilon_{D^0}^{reco} = \epsilon_{Accept} \otimes \epsilon_{Track}$

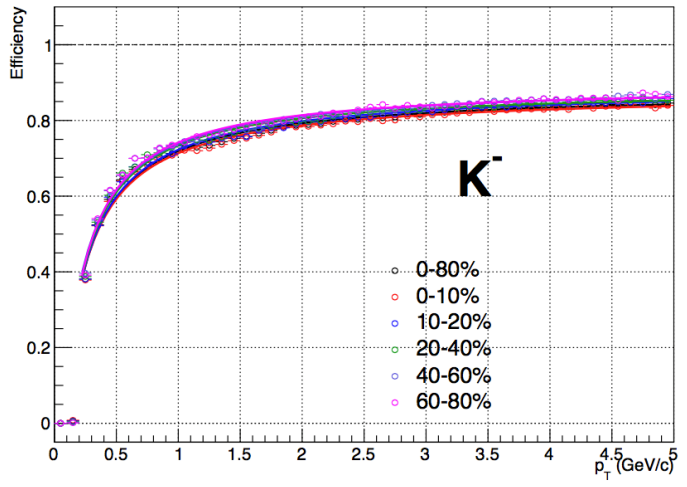
$\epsilon_{Track} = \epsilon_{TPC} \otimes \epsilon_{PID}$

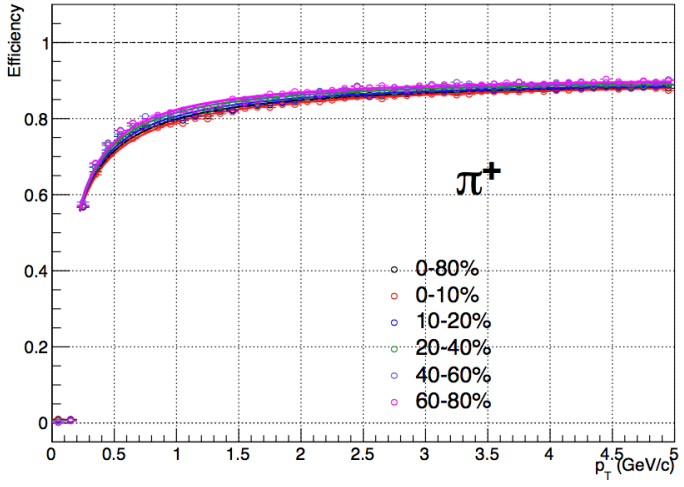
$\epsilon_{PID\_clean} = \epsilon_{n\sigma_X} \cdot \epsilon_{TOF} \cdot \epsilon_{\Delta\frac{1}{\beta}}$

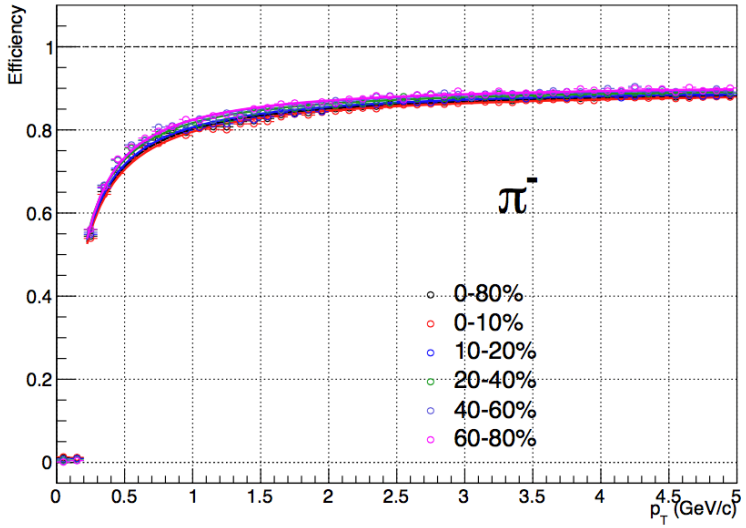
$\epsilon_{PID\_hybrid} = \epsilon_{n\sigma_X} \cdot \epsilon_{TOF} \cdot \epsilon_{\Delta\frac{1}{\beta}} + \epsilon_{n\sigma_X} \cdot (1 - \epsilon_{TOF})$

TPC tracking efficiency

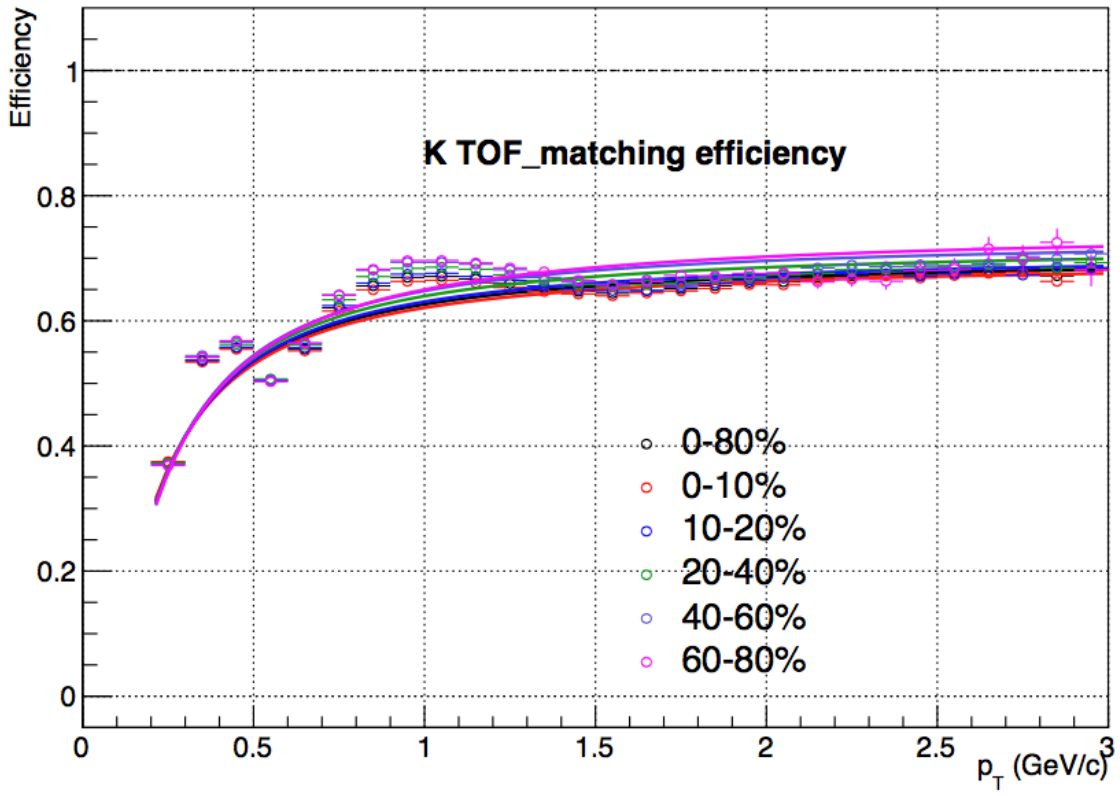


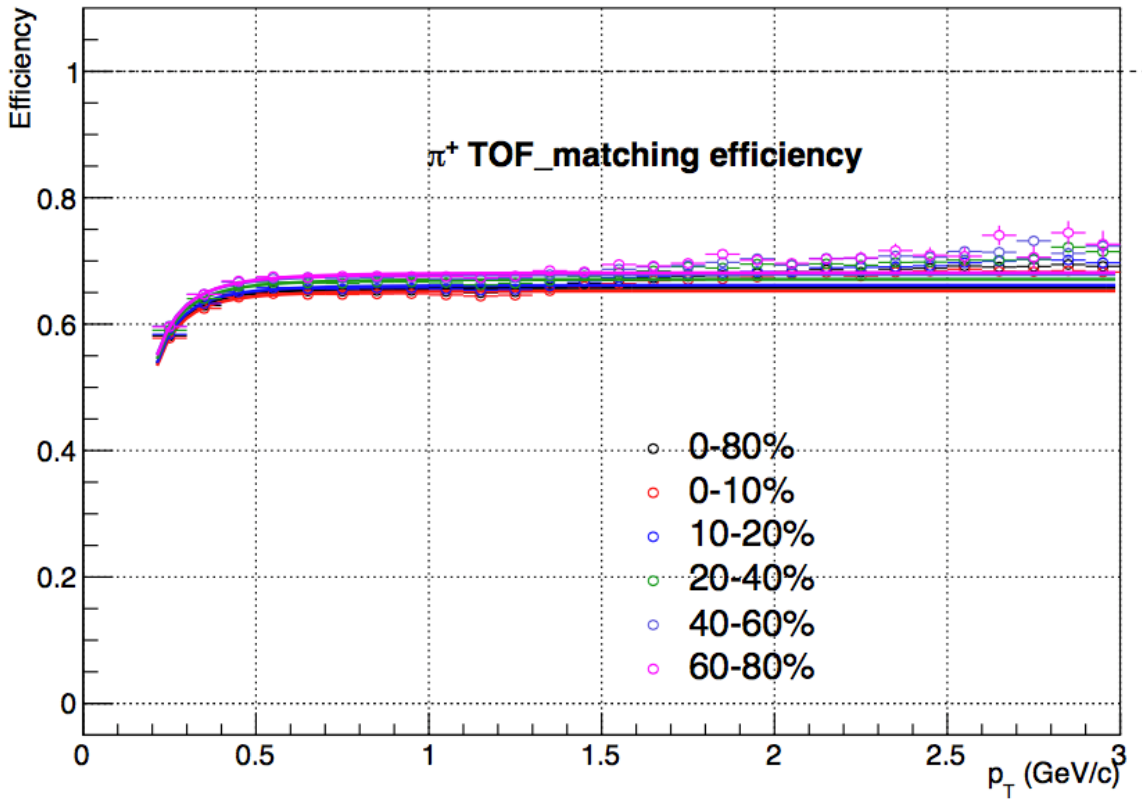






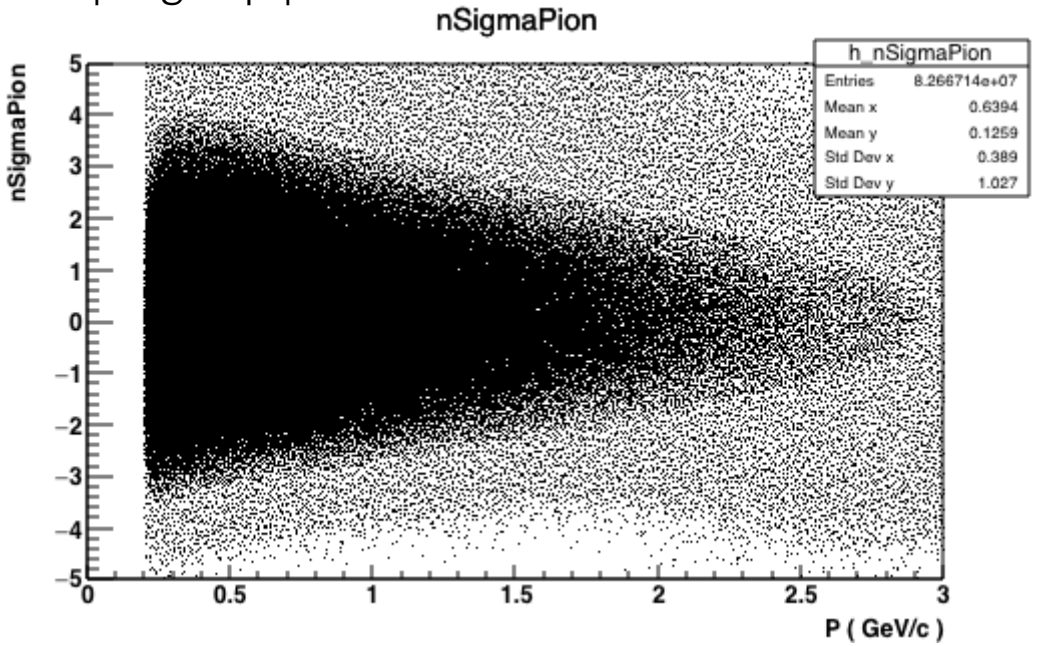
TOF matching efficiency



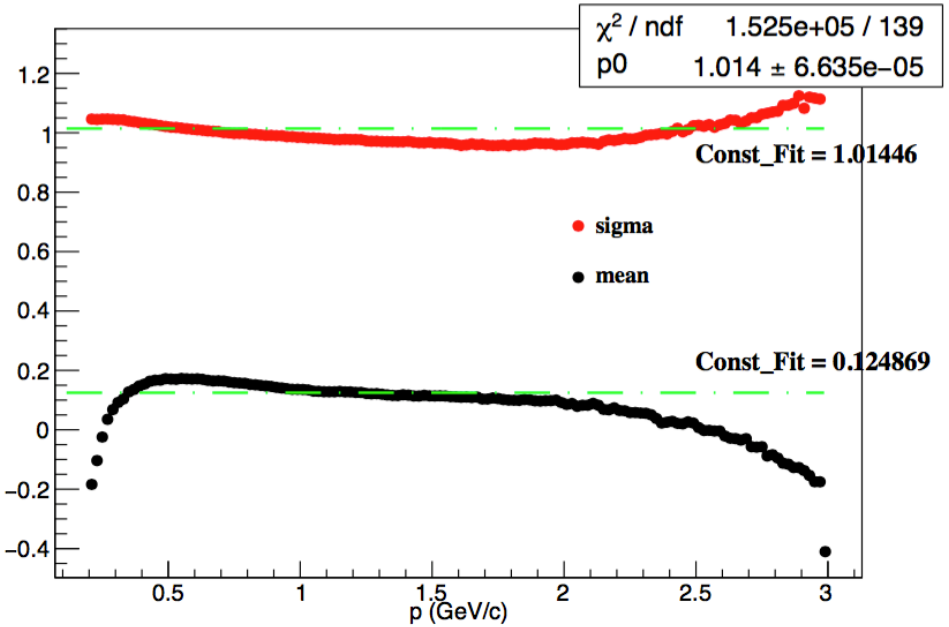


TPC cut efficiency

|nsigtofpi| < 0.1



[-5.0, 5.0]

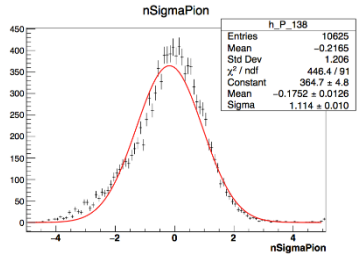


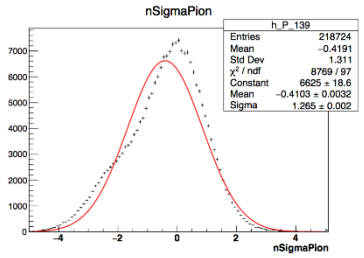
P ≈ P1*P2 ≈ 95.4%

Note: nsig_x from calculation between Bichsel function and measured dE/dx value, mean value 0.15 shift or a small shift has a small effect on verdicting x.

P1 = 1.0

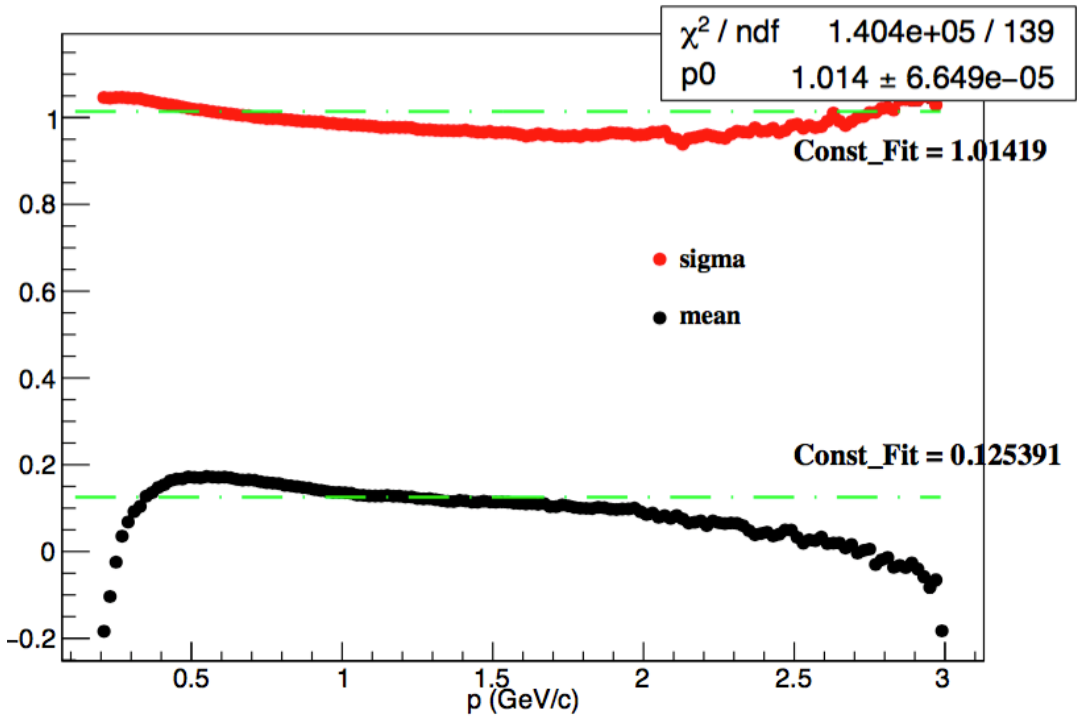
|nsigpi| < 2.0 ≈ 2<σ> P2 = 95.4%

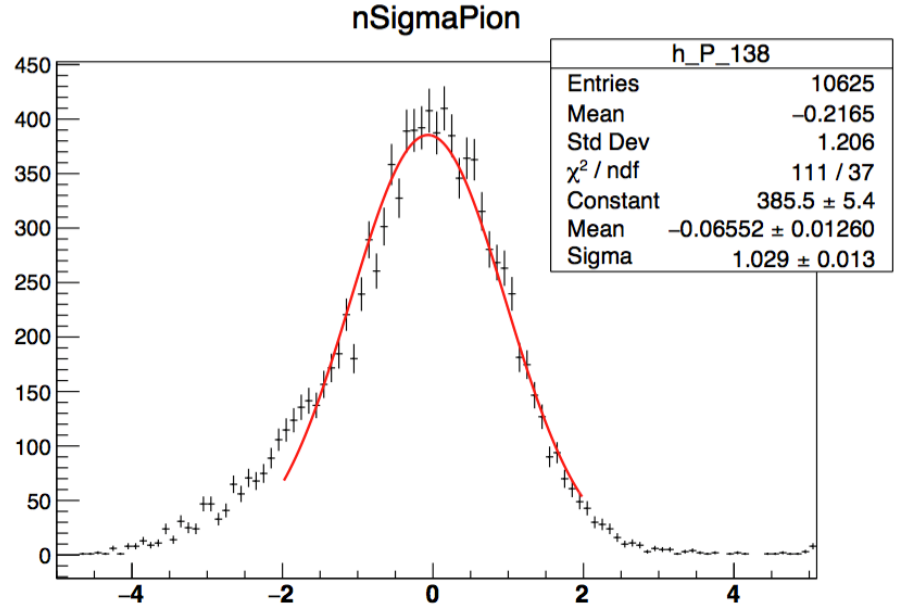


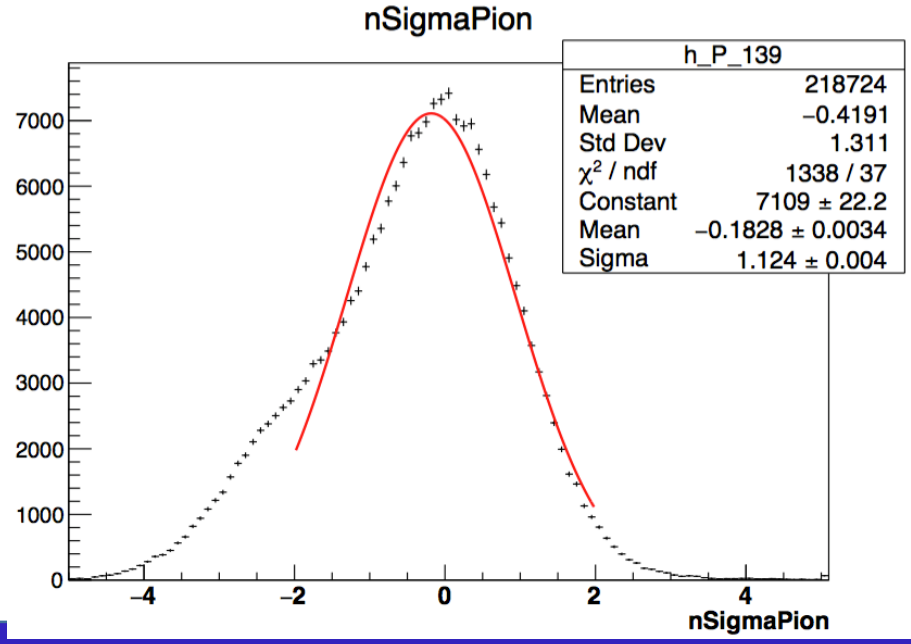


TPC cut efficiency

(0.2, 2.06] ~ [-5.0, 5.0]
(2.06, 3.0] ~ [-2.0, 2.0]



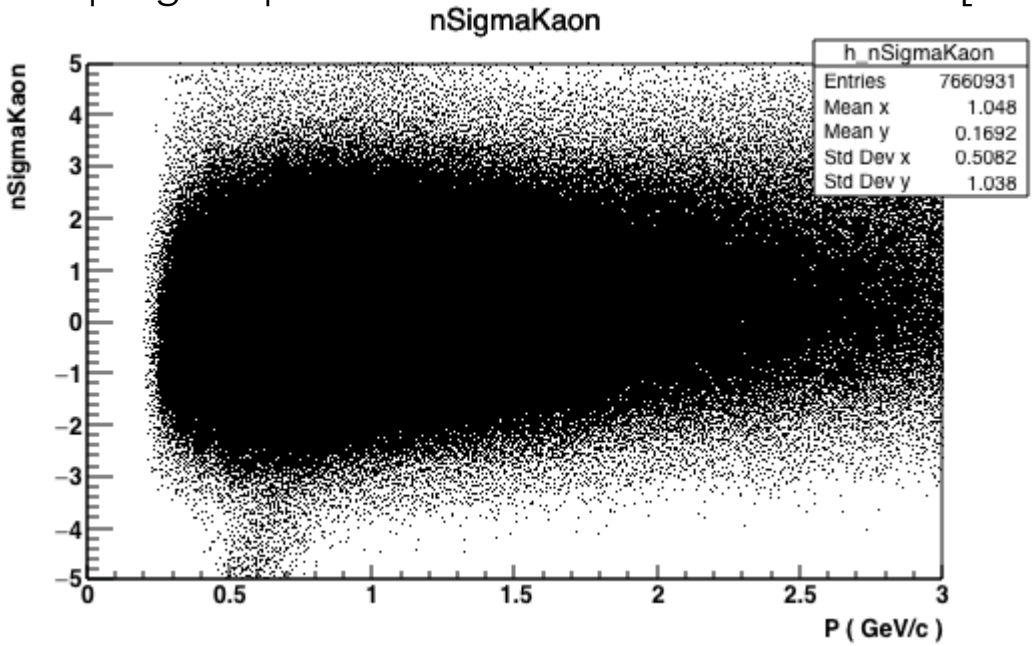




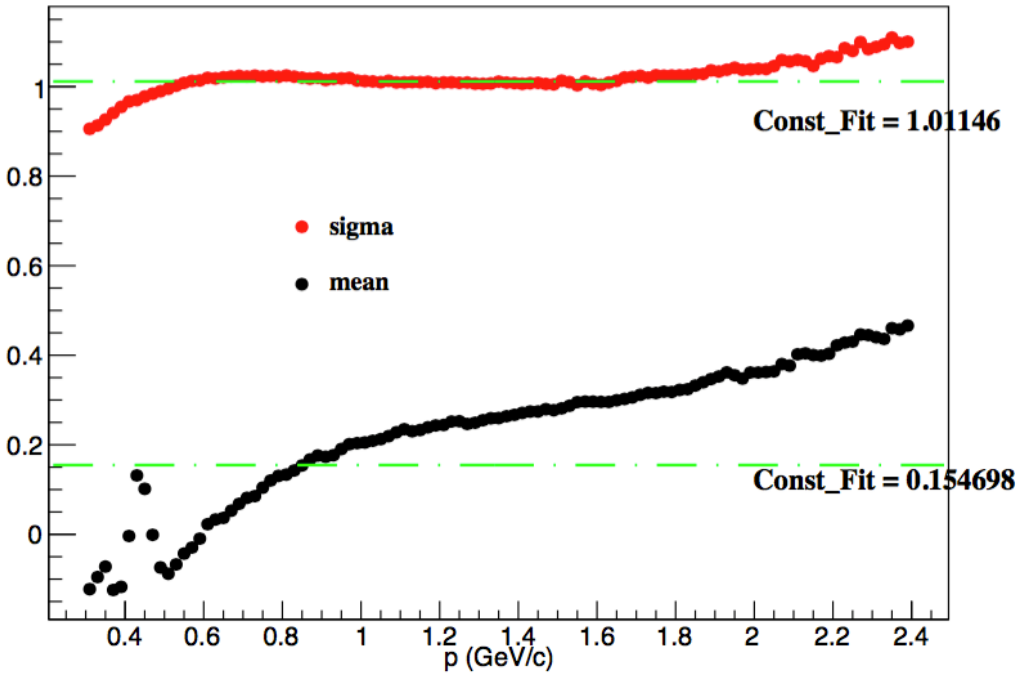
- 0.13 shift

TPC cut efficiency

|nsigtofk| < 0.1

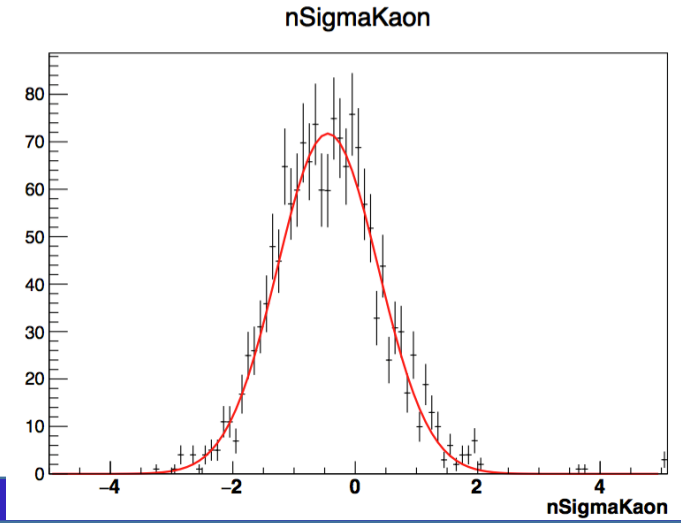


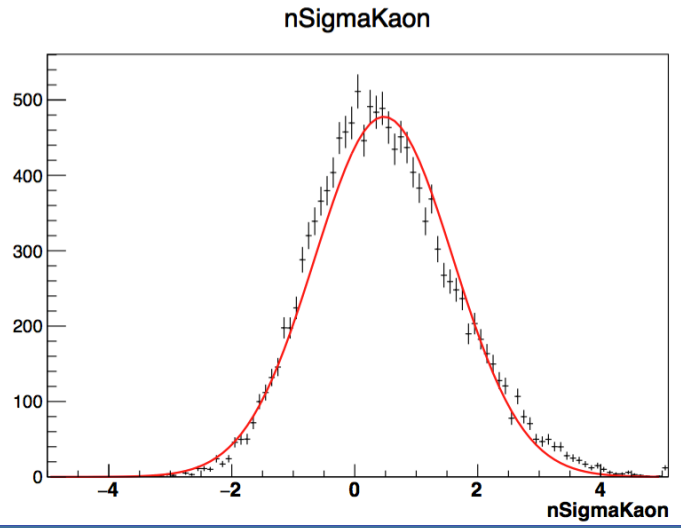
[0.3, 2.4] ~ [-5.0, 5.0]



|nsigk| < 2.0 ≈ 2<σ>

P ≈ 95.4%





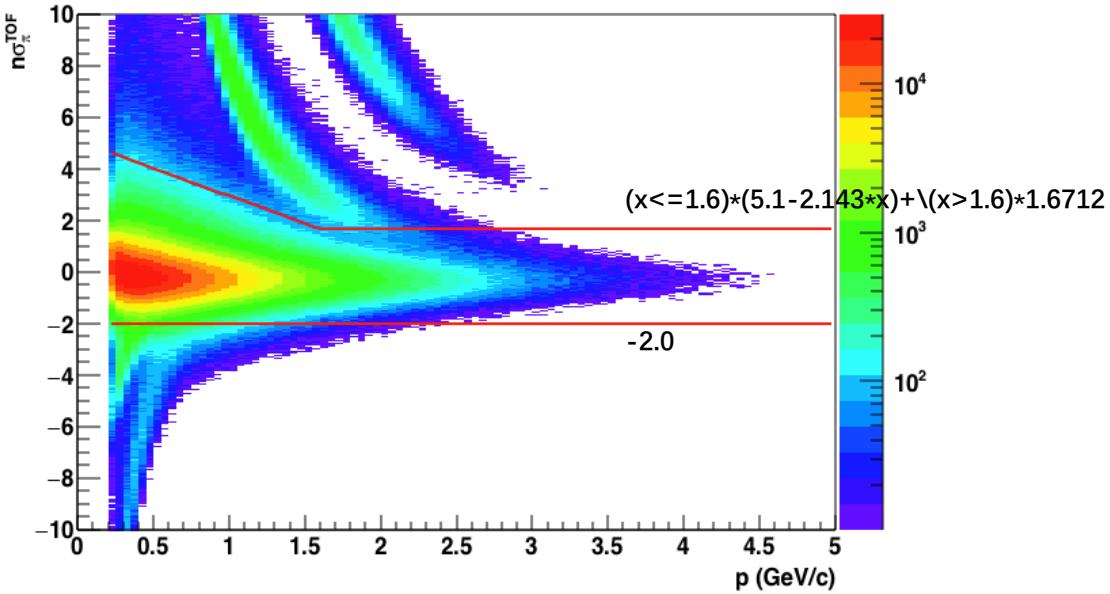
- 0.15 shift

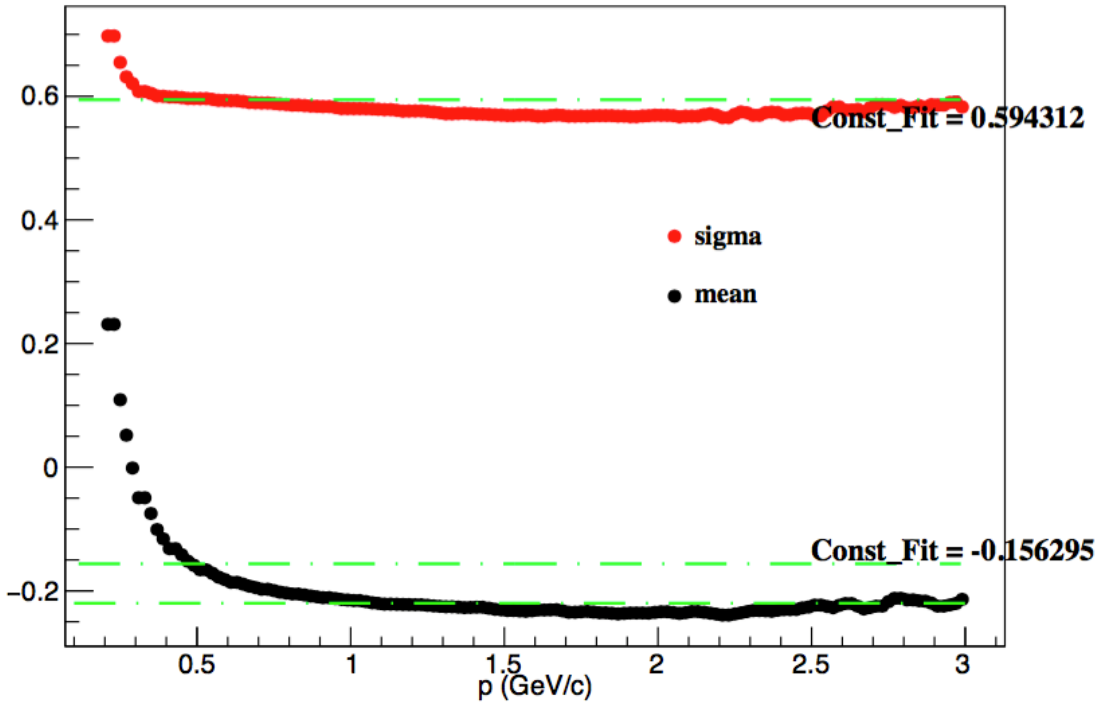
TOF cut efficiency

case1 |nsigpi| < 0.1

[0.2, 3.0] ~ [-1.2, 0.8]

Pion selection more stringent



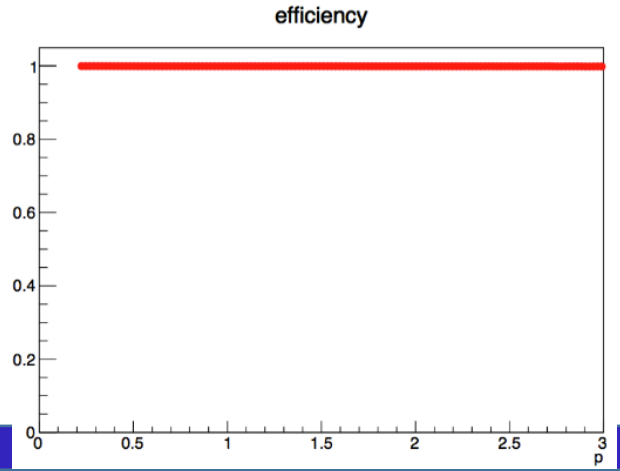


case2

|nsigpi| < 2.0 (data cut) ≈ 2<σ>

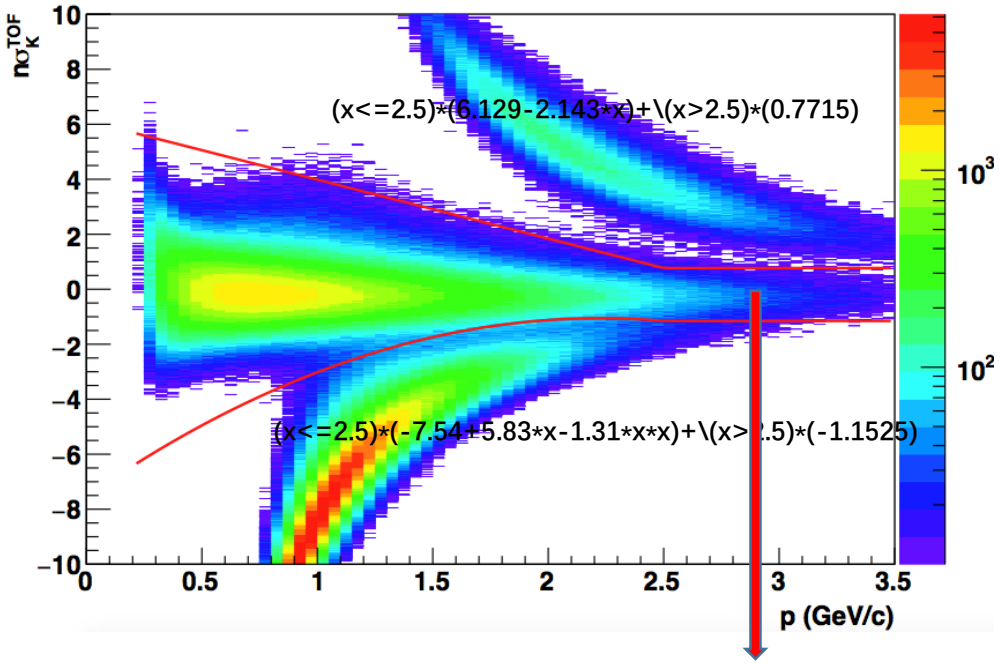
P ≈ 1.0 for two cases.

➢ -0.16 shift

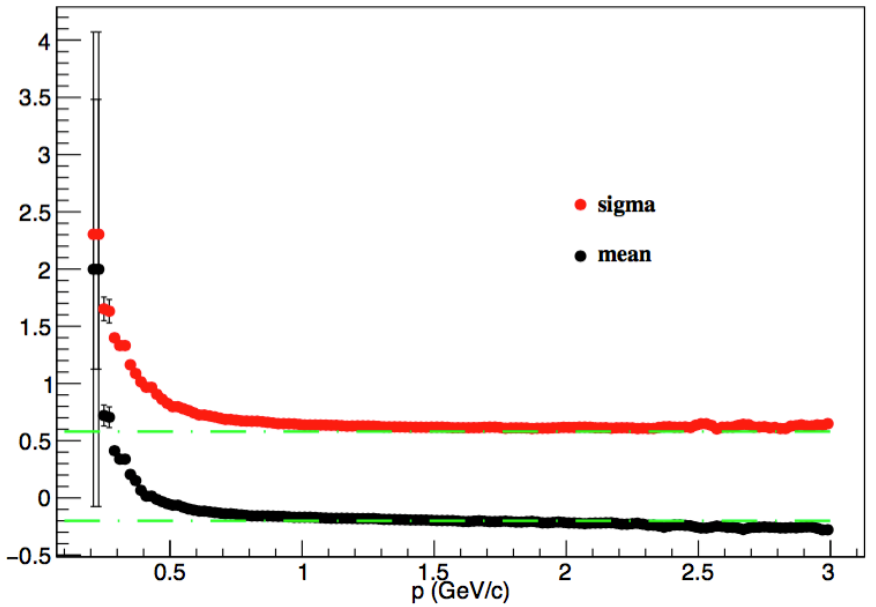


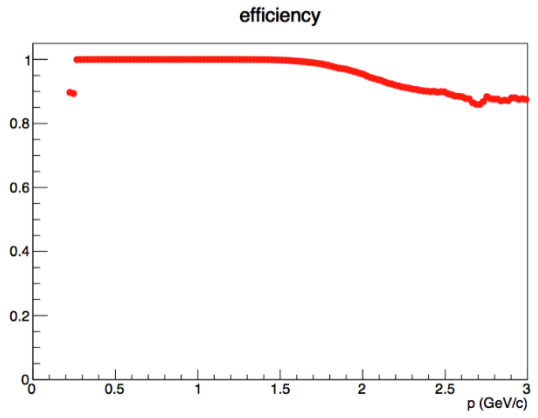
TOF cut efficiency

case1 |nsigk| <0.1



Stringent cut!

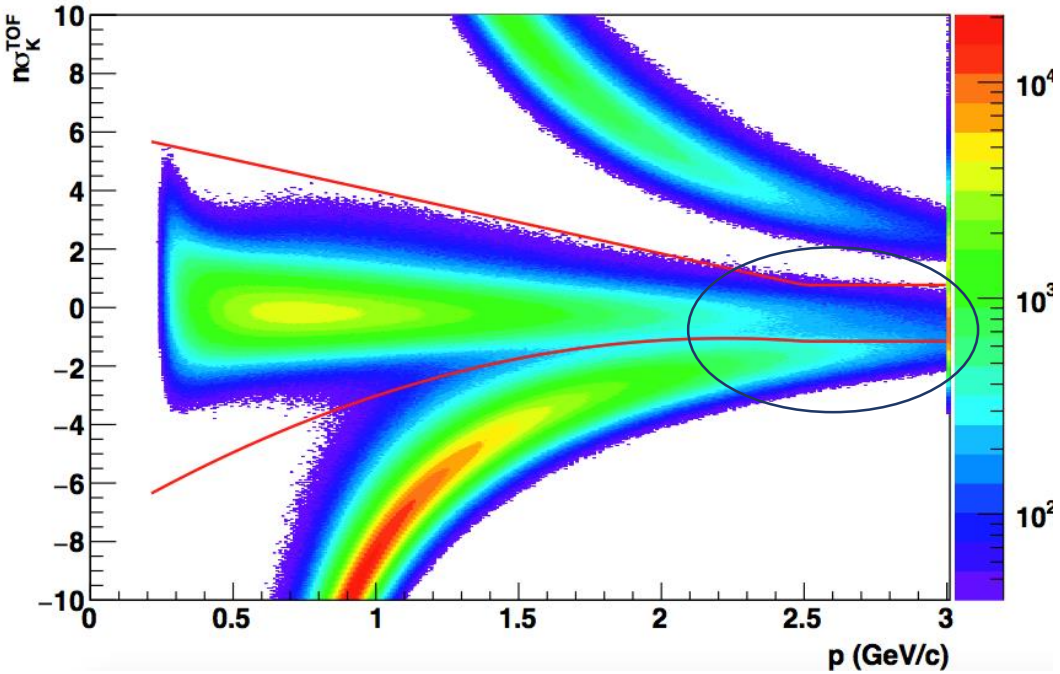


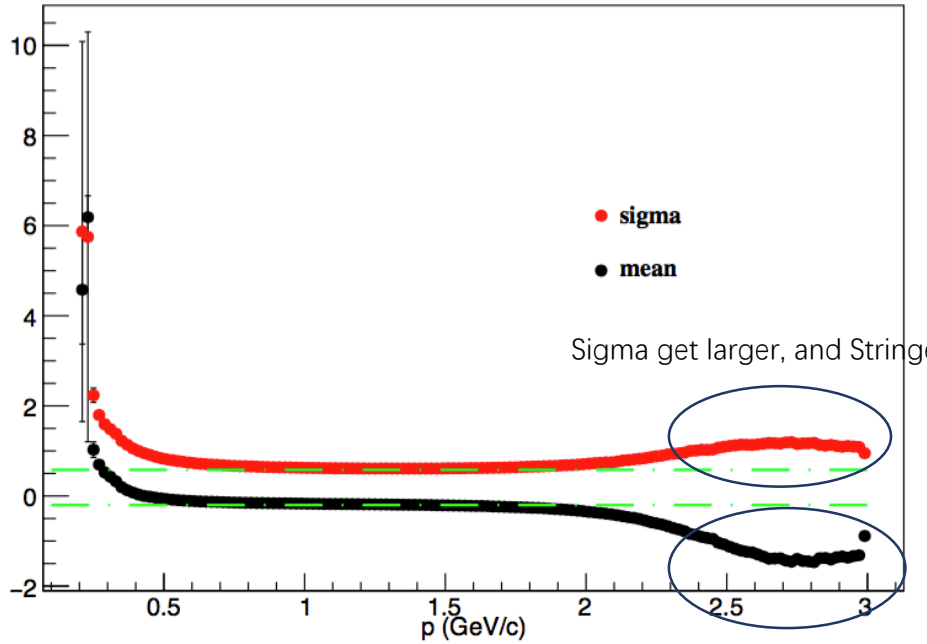


Stringent cut!
~(1.15-0.2)/0.6 ≈ 1.6
P ≈ 0.9

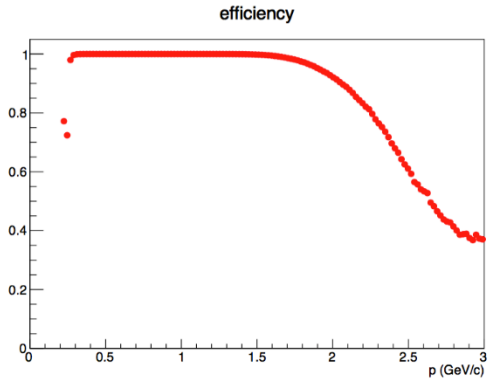
TOF cut efficiency

case2 |nsigk| < 2.0



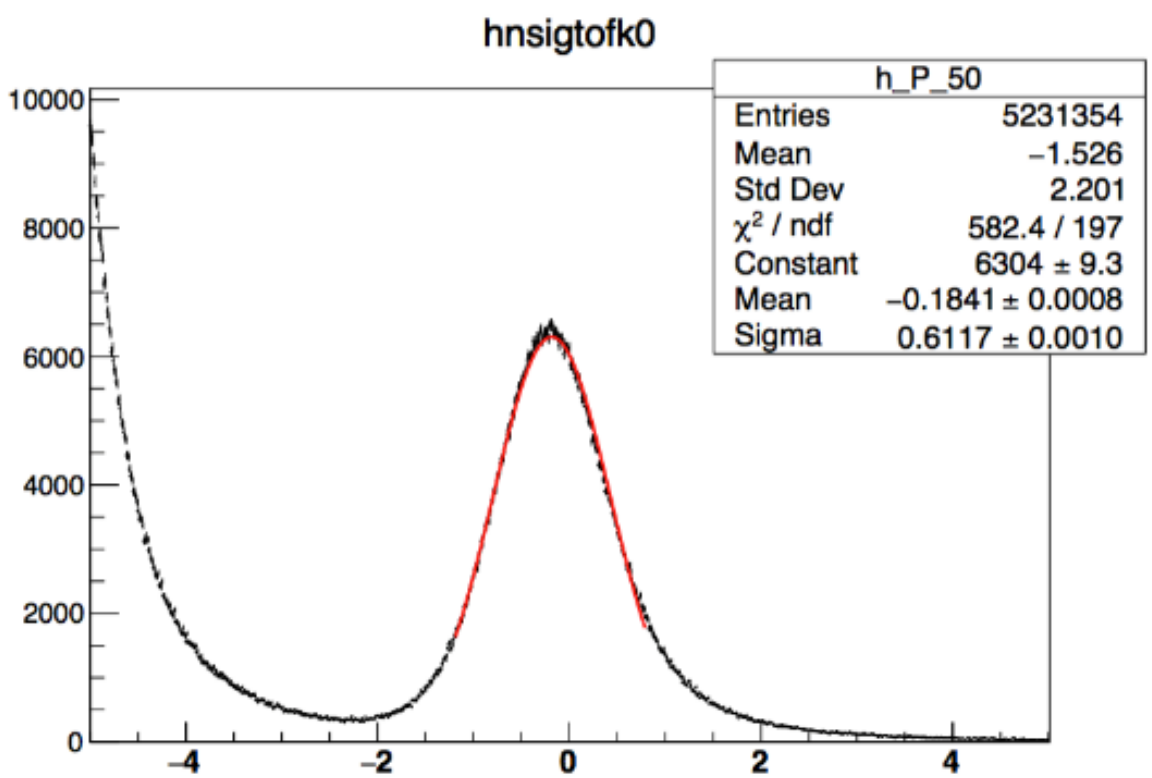


Sigma get larger, and Stringent cut!

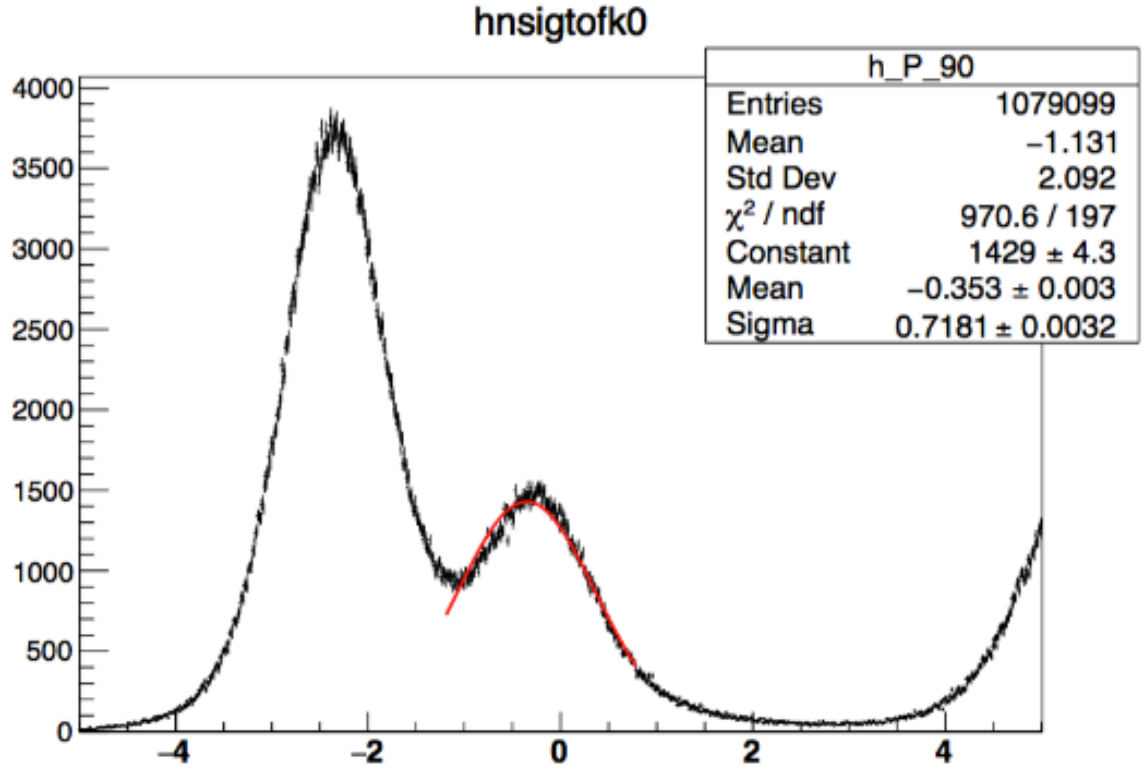


TOF cut efficiency

case2 |nsigk| < 2.0



p=1.2

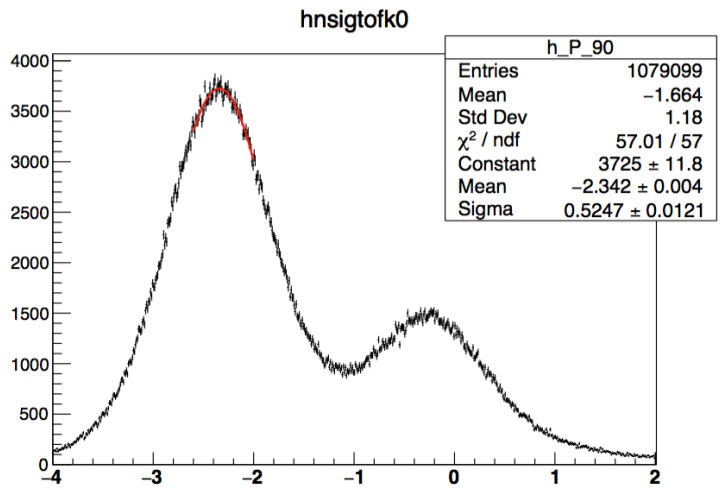


p=2.0

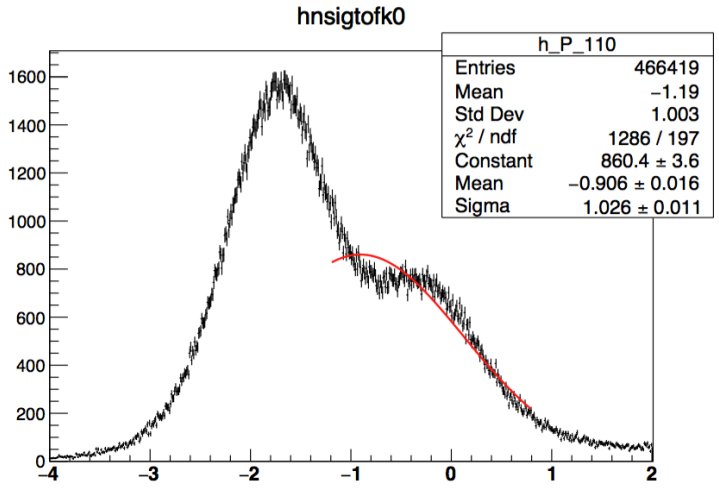
pion contaminent

TOF cut efficiency

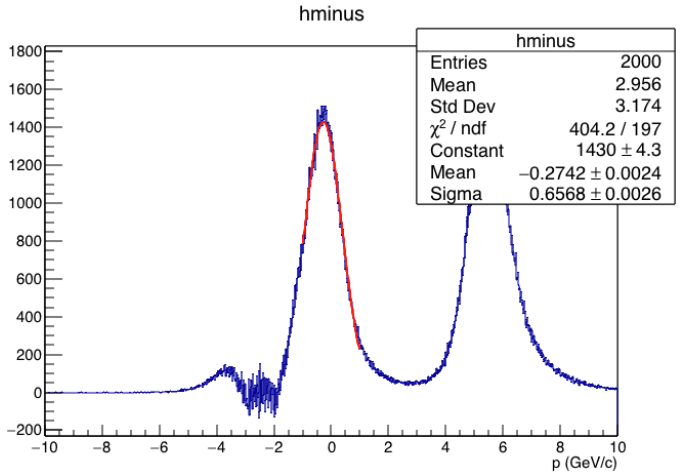
case2 |nsigk| < 2.0



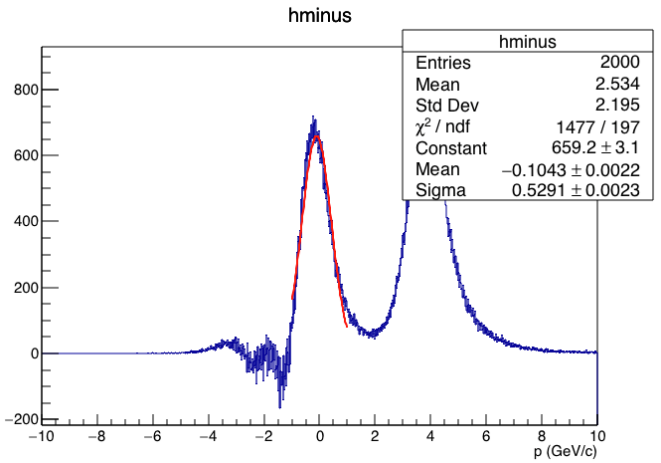
p=2.0 Fit: (-2.8, -2.2)



p=2.4 Fit: (-2., -1.6)



P ≈0.9 Cut: (-1.12, 1.84)



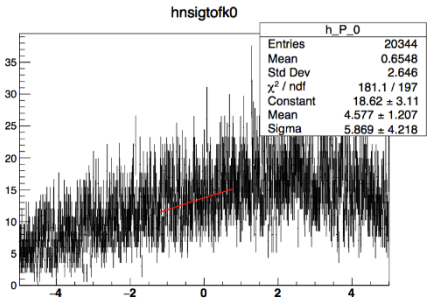
P ≈0.9 Cut: (-1.15, 0.77)

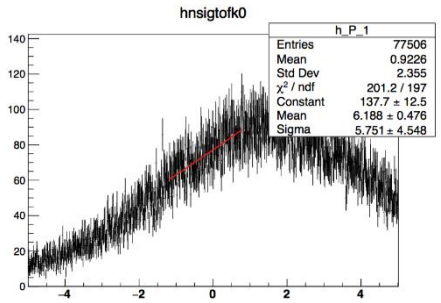
TOF cut efficiency

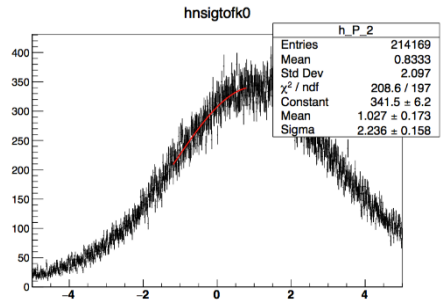
case2 |nsigk| < 2.0

The gauss Fit does not apply, a count ratio to extract efficiency.

Note: count ratio method is consistent with gauss fit for other points.



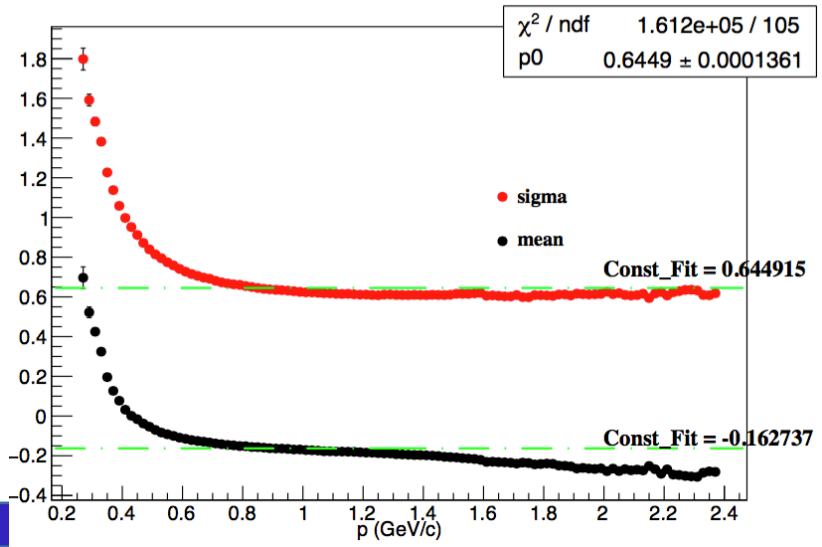




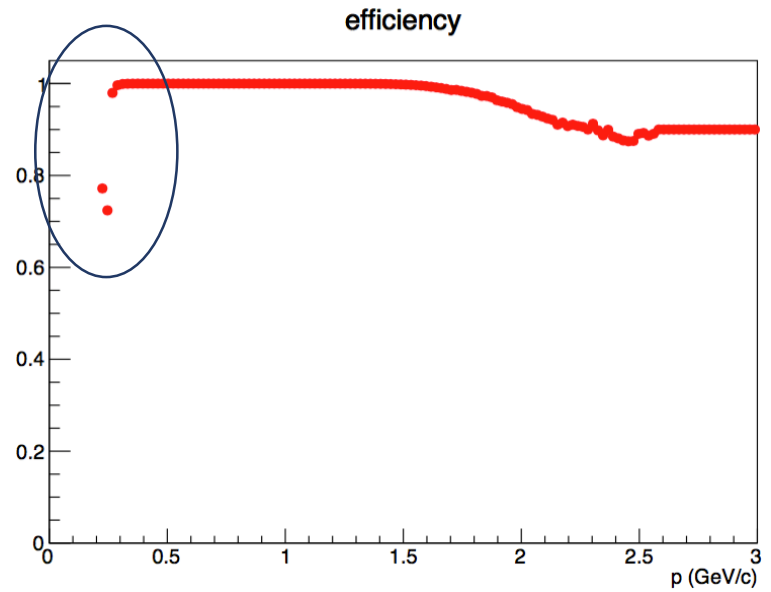
$P=\frac{13784}{20344} \approx 0.68$

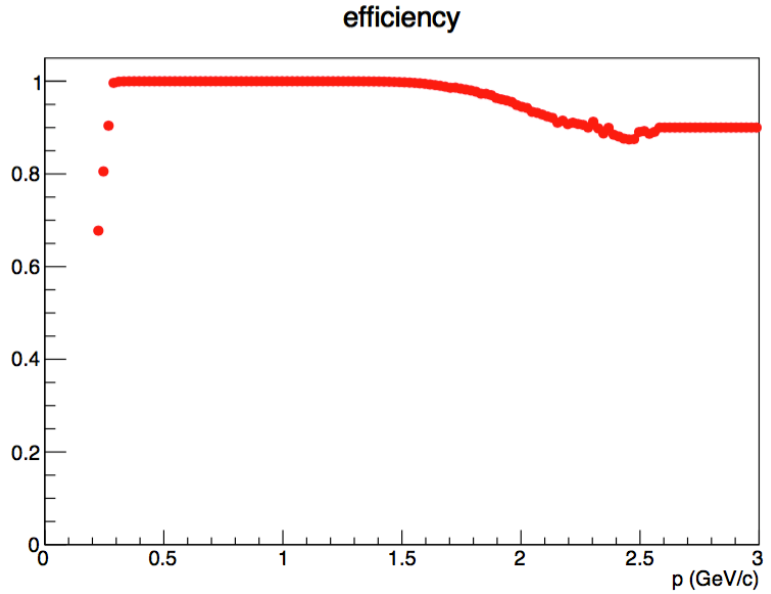
$P=\frac{62426}{77506} \approx 0.81$

$P=\frac{193633}{214168} \approx 0.90$

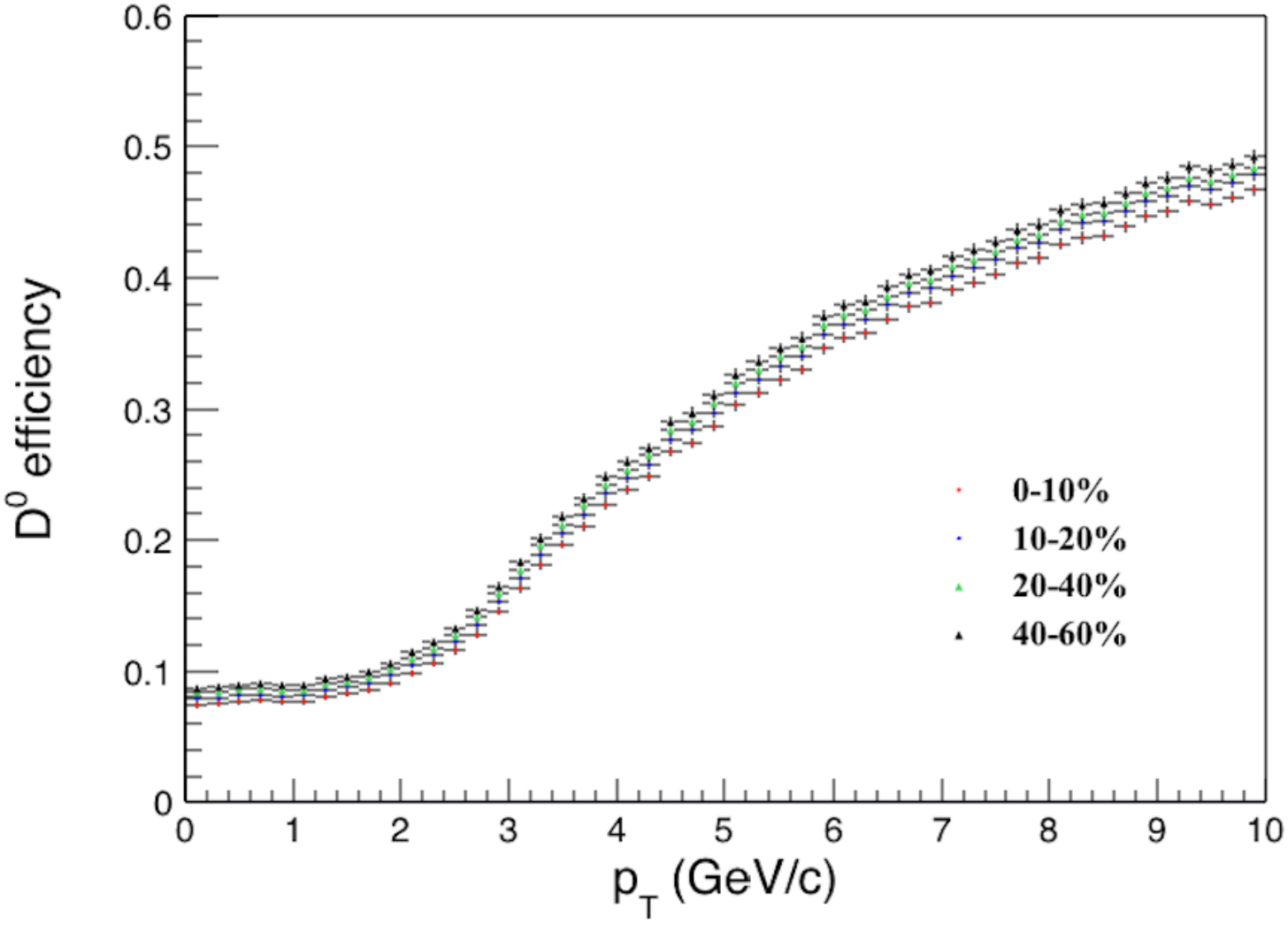


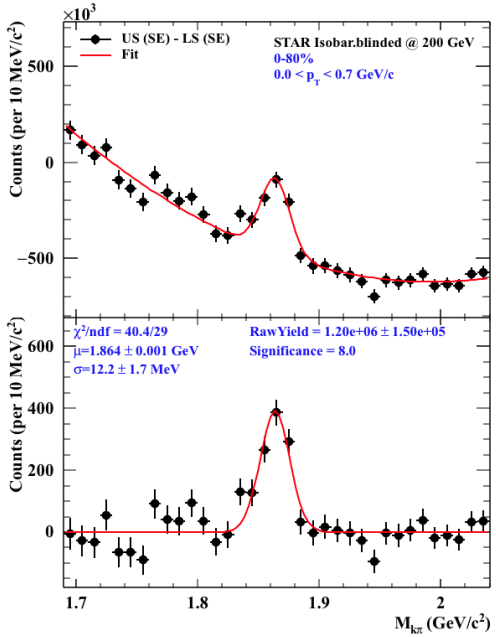
- -0.16 shift

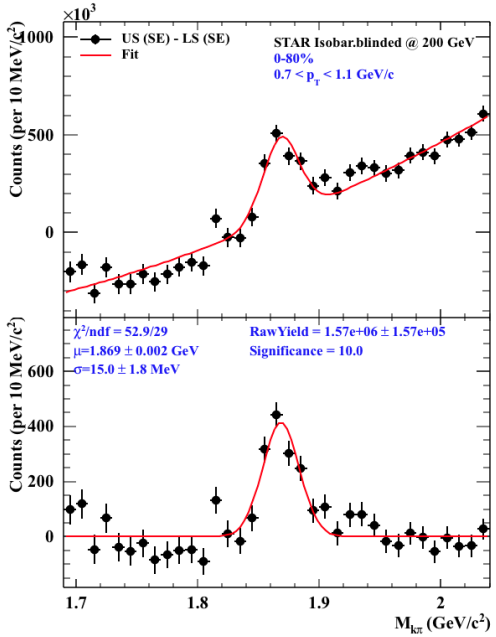


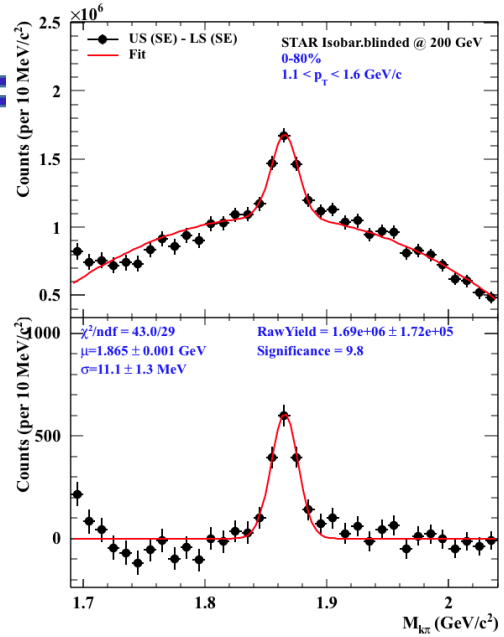


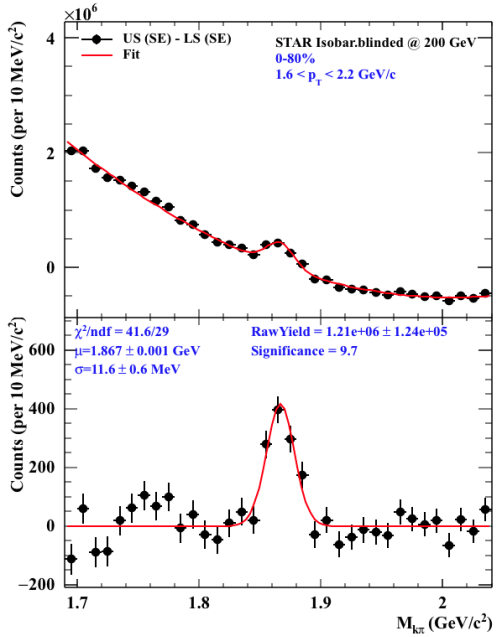
D^0 efficiency

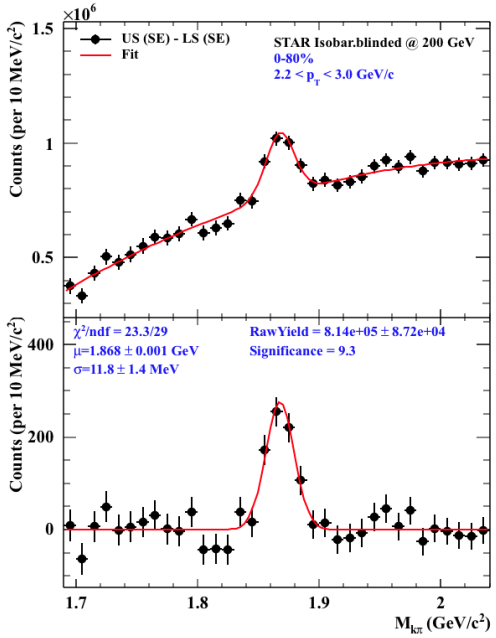


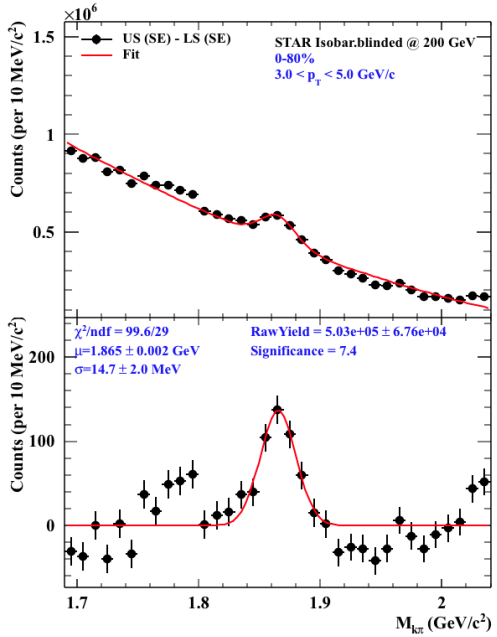

US (SE) - LS (SE)
Fit
STAR Isobar.blinded @ 200 GeV
0-80%
0.0 < p_T < 0.7 GeV/c
χ²/ndf = 40.4/29
μ=1.864 ± 0.001 GeV
σ=12.2 ± 1.7 MeV
RawYield = 1.20e+06 ± 1.50e+05
Significance = 8.0
Counts (per 10 MeV/c²)
M_kπ (GeV/c²)

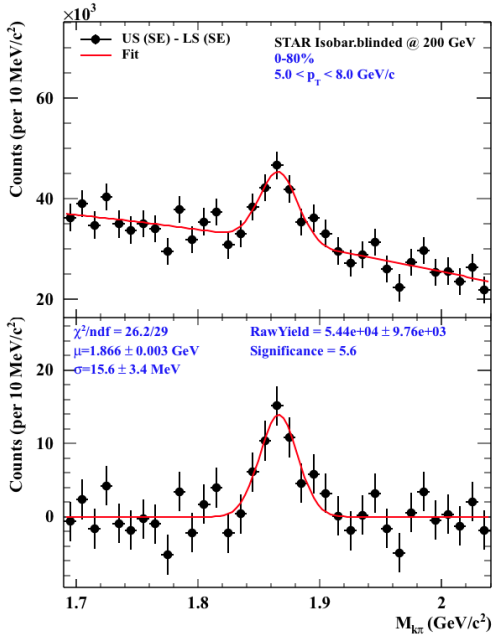

US (SE) - LS (SE)
Fit
STAR Isobar.blinded @ 200 GeV
0-80%
0.7 < p_T < 1.1 GeV/c
χ²/ndf = 52.9/29
μ=1.869 ± 0.002 GeV
σ=15.0 ± 1.8 MeV
RawYield = 1.57e+06 ± 1.57e+05
Significance = 10.0
Counts (per 10 MeV/c²)
M_kπ (GeV/c²)

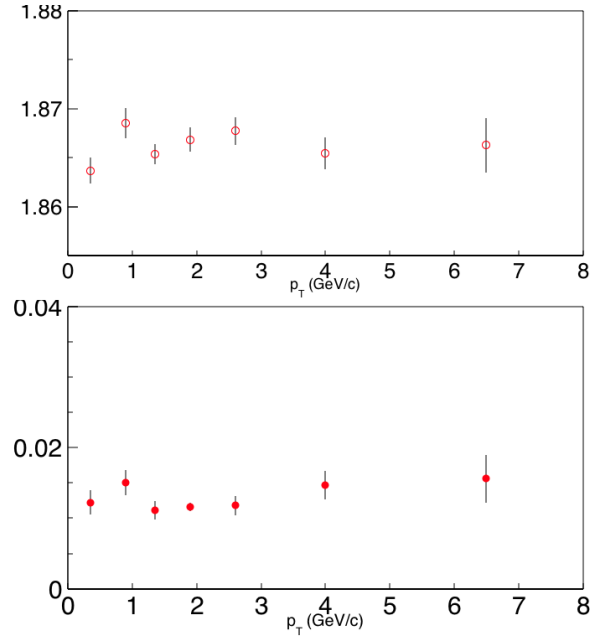

US (SE) - LS (SE)
Fit
STAR Isobar.blinded @ 200 GeV
0-80%
1.1 < p_T < 1.6 GeV/c
χ²/ndf = 43.0/29
μ=1.865 ± 0.001 GeV
σ=11.1 ± 1.3 MeV
RawYield = 1.69e+06 ± 1.72e+05
Significance = 9.8
Counts (per 10 MeV/c²)
M_kπ (GeV/c²)


US (SE) - LS (SE)
Fit
STAR Isobar.blinded @ 200 GeV
0-80%
1.6 < p_T < 2.2 GeV/c
χ²/ndf = 41.6/29
μ=1.867 ± 0.001 GeV
σ=11.6 ± 0.6 MeV
RawYield = 1.21e+06 ± 1.24e+05
Significance = 9.7
Counts (per 10 MeV/c²)
M_kπ (GeV/c²)

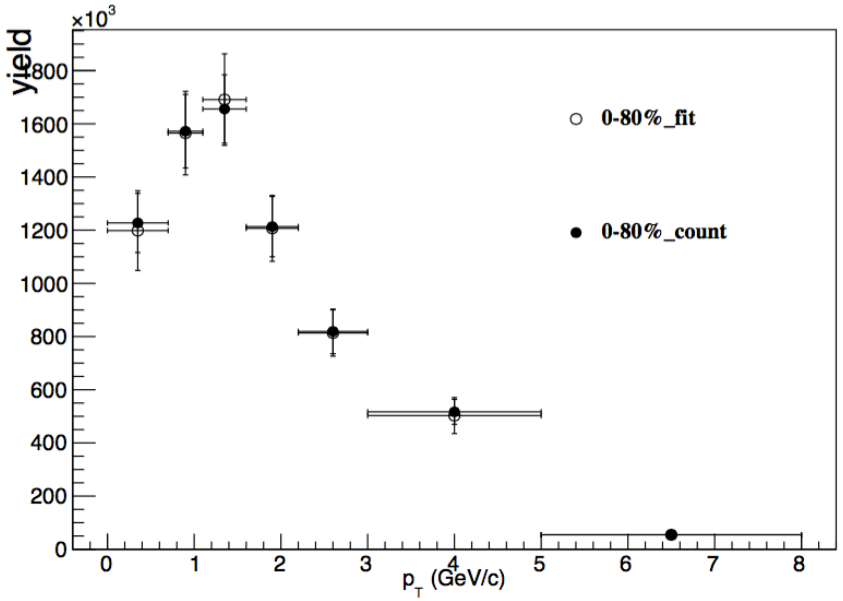

US (SE) - LS (SE)
Fit
STAR Isobar.blinded @ 200 GeV
0-80%
2.2 < p_T < 3.0 GeV/c
χ²/ndf = 23.3/29
μ=1.868 ± 0.001 GeV
σ=11.8 ± 1.4 MeV
RawYield = 8.14e+05 ± 8.72e+04
Significance = 9.3
Counts (per 10 MeV/c²)
M_kπ (GeV/c²)

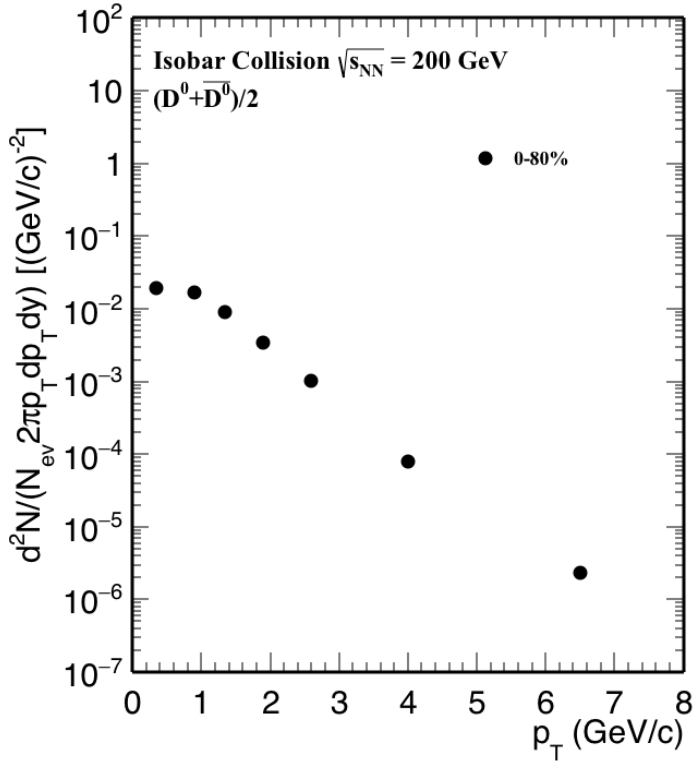

US (SE) - LS (SE)
Fit
STAR Isobar.blinded @ 200 GeV
0-80%
3.0 < p_T < 5.0 GeV/c
χ²/ndf = 99.6/29
μ=1.865 ± 0.002 GeV
σ=14.7 ± 2.0 MeV
RawYield = 5.03e+05 ± 6.76e+04
Significance = 7.4
Counts (per 10 MeV/c²)
M_kπ (GeV/c²)

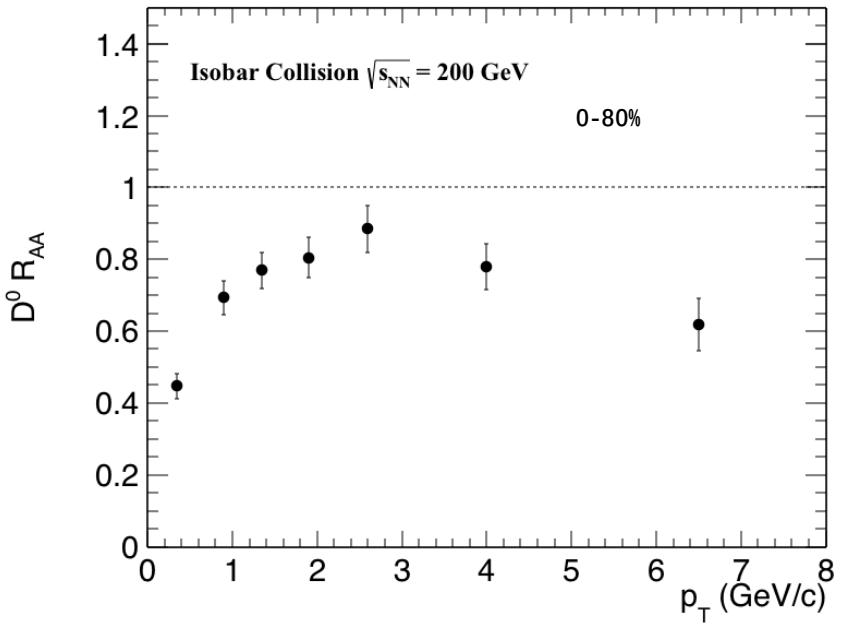

US (SE) - LS (SE)
Fit
STAR Isobar.blinded @ 200 GeV
0-80%
5.0 < p_T < 8.0 GeV/c
χ²/ndf = 26.2/29
μ=1.866 ± 0.003 GeV
σ=15.6 ± 3.4 MeV
RawYield = 5.44e+04 ± 9.76e+03
Significance = 5.6
Counts (per 10 MeV/c²)
M_kπ (GeV/c²)


p_T (GeV/c)
p_T (GeV/c)

D^0 R_{AA}

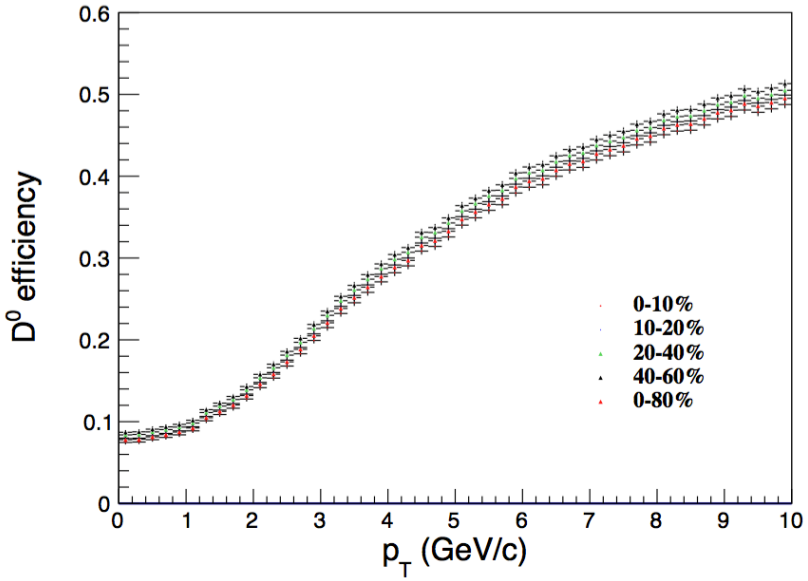


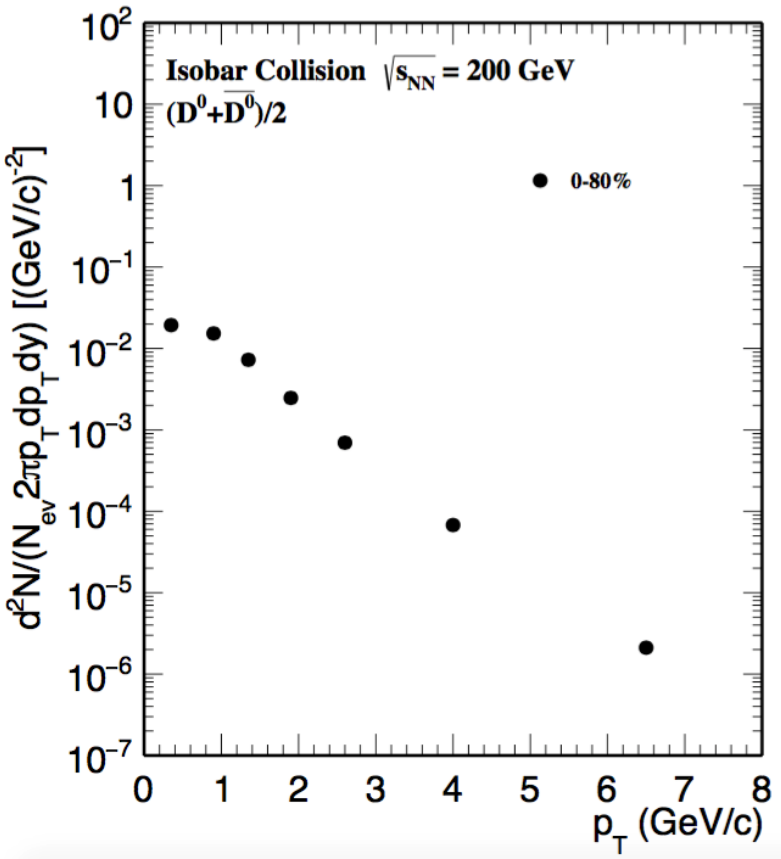


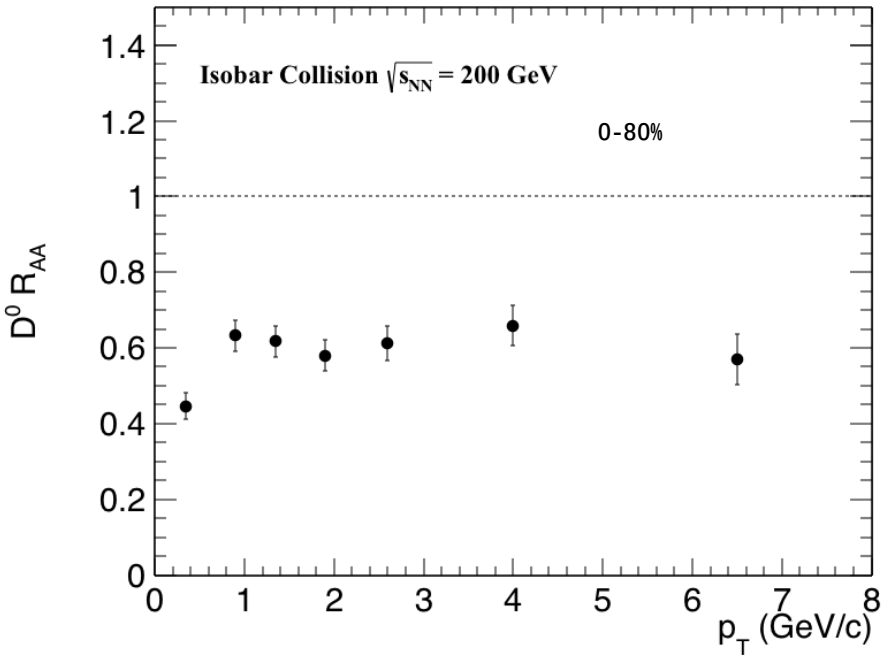


Nbin ratio used to get pp D^0 yield directly for 0-80%.

D^0 R_{AA}


D⁰ efficiency
p_T (GeV/c)
0-10%
10-20%
20-40%
40-60%
0-80%


Isobar Collision √s_NN = 200 GeV
(D⁰+D̄⁰)/2
0-80%
d²N/(N_ev 2πp_T dp_T dy) [(GeV/c)⁻²]
p_T (GeV/c)


Isobar Collision √s_NN = 200 GeV
0-80%
D⁰ R_AA
p_T (GeV/c)

Z_r

- Vz (-35, 25) event plane index for mix_event method;
- nsig_X shift 0.13/0.15 & nsigtof_X shift -0.16 (-0.2 for pion);
- 60-80% get weight.

- Pure template pion sample to calibrate kaon