

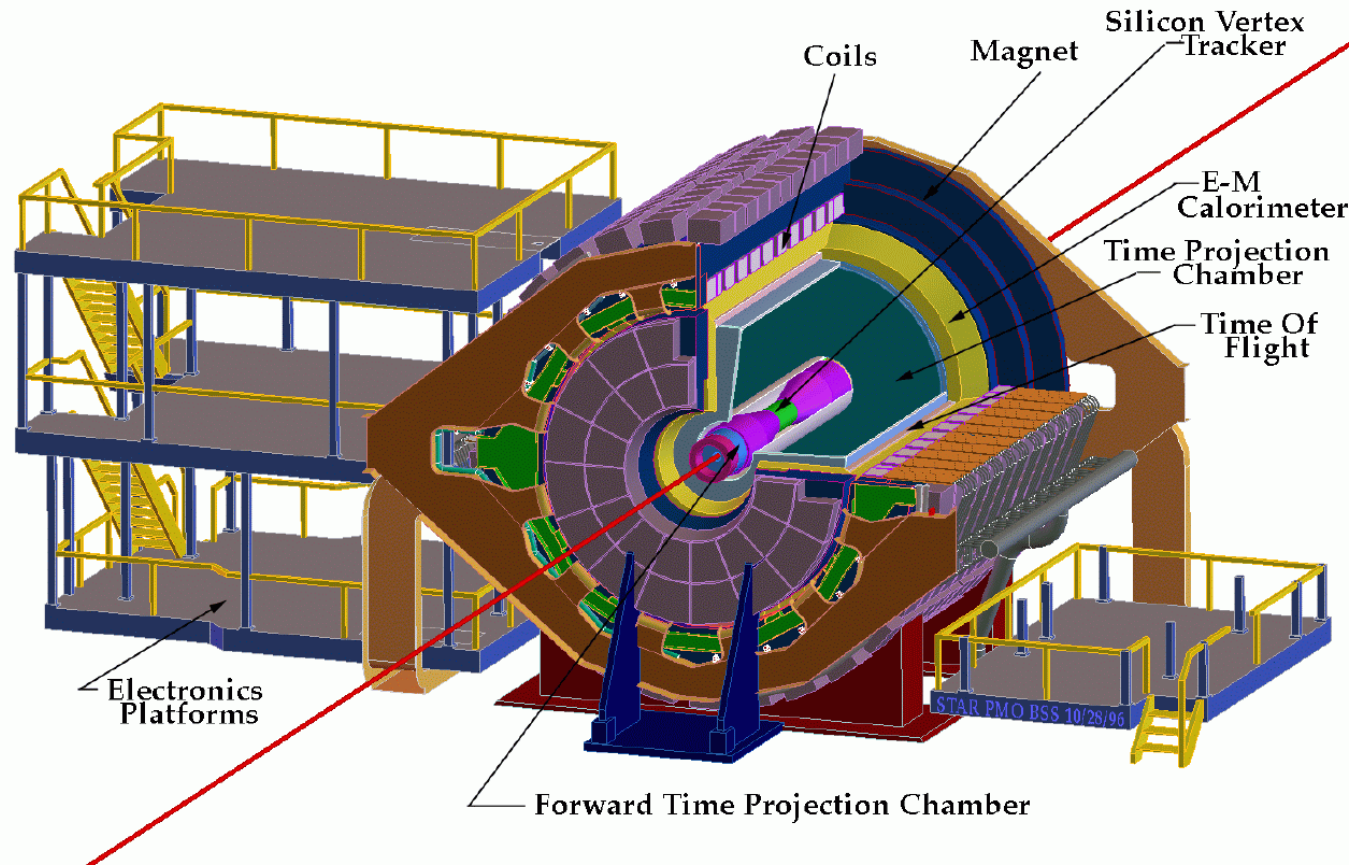
# Charged pion pT spectra in Au+Au collisions at 62.4 GeV

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BNL

for the STAR Collaboration

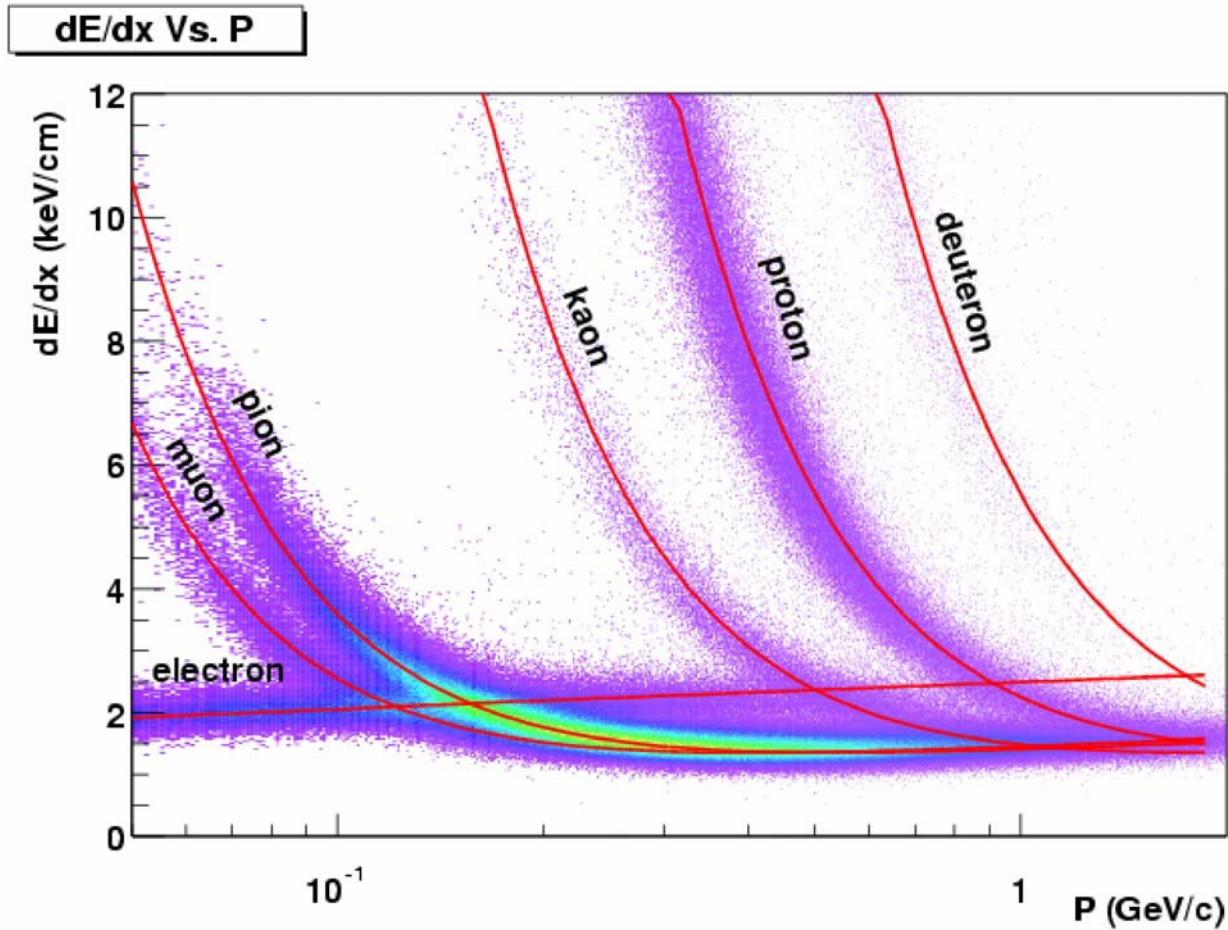
# STAR Detector



**T**ime **P**rojection **C**hamber: 45 padrow, 2 meters (radius),  $\sigma(dE/dx) \approx 8\%$ ,  $-1 < \eta < 1$

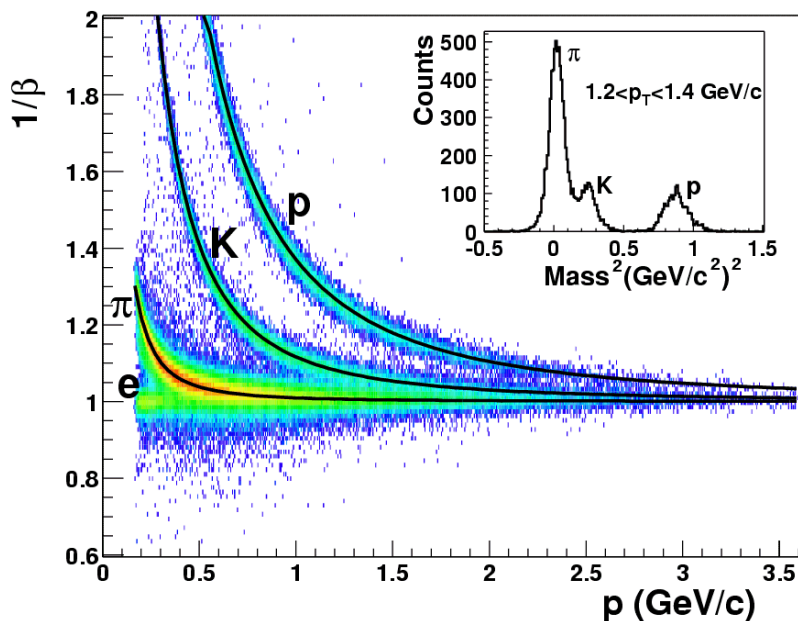
**M**ulti-gap **R**esistive **P**late **C**hamber **T**O**F**r: 1 tray ( $\sim 1/200$ ),  $\sigma(t) = 85\text{ps}$

# dE/dx at low pT



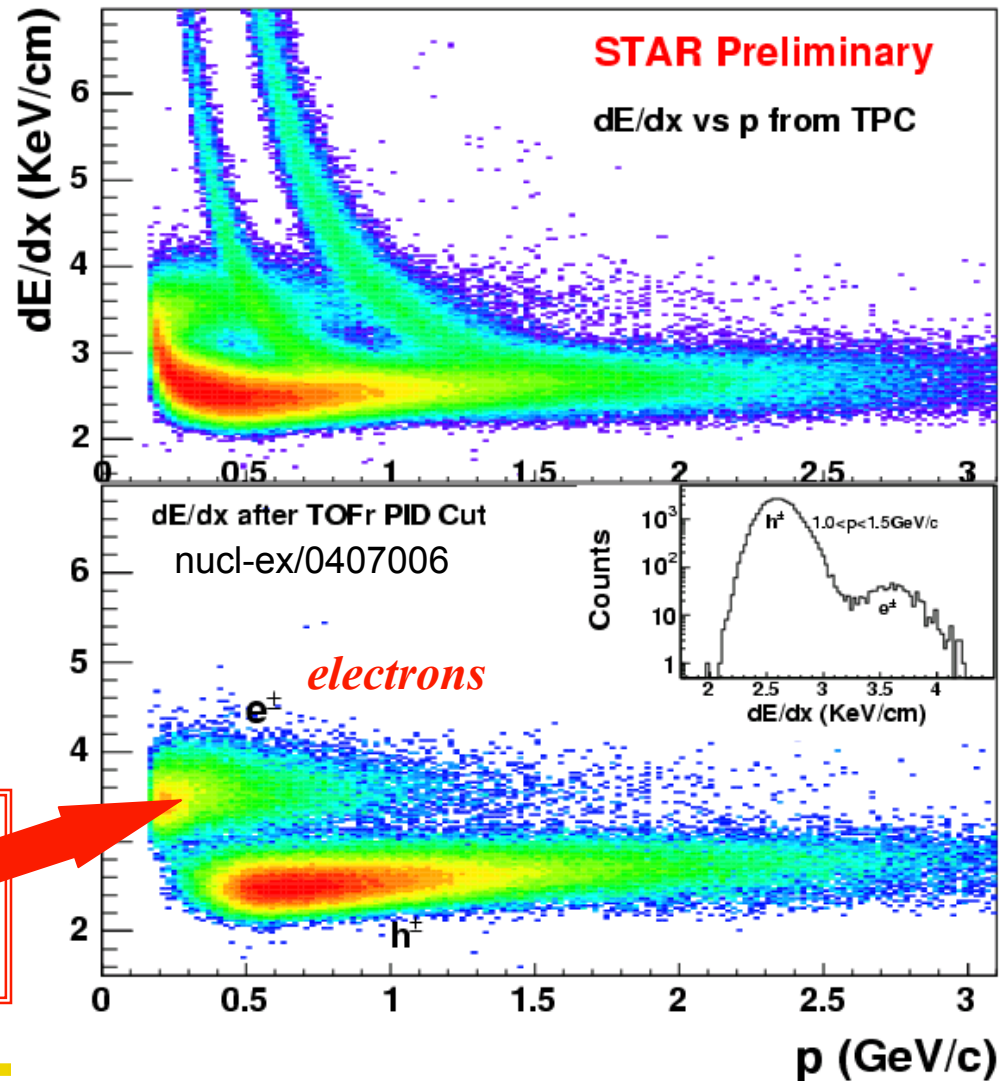
M. Anderson et al., Nucl. Instrum. Meth. A 499, 659 (2003)

# A New Hadron-Blind Detector

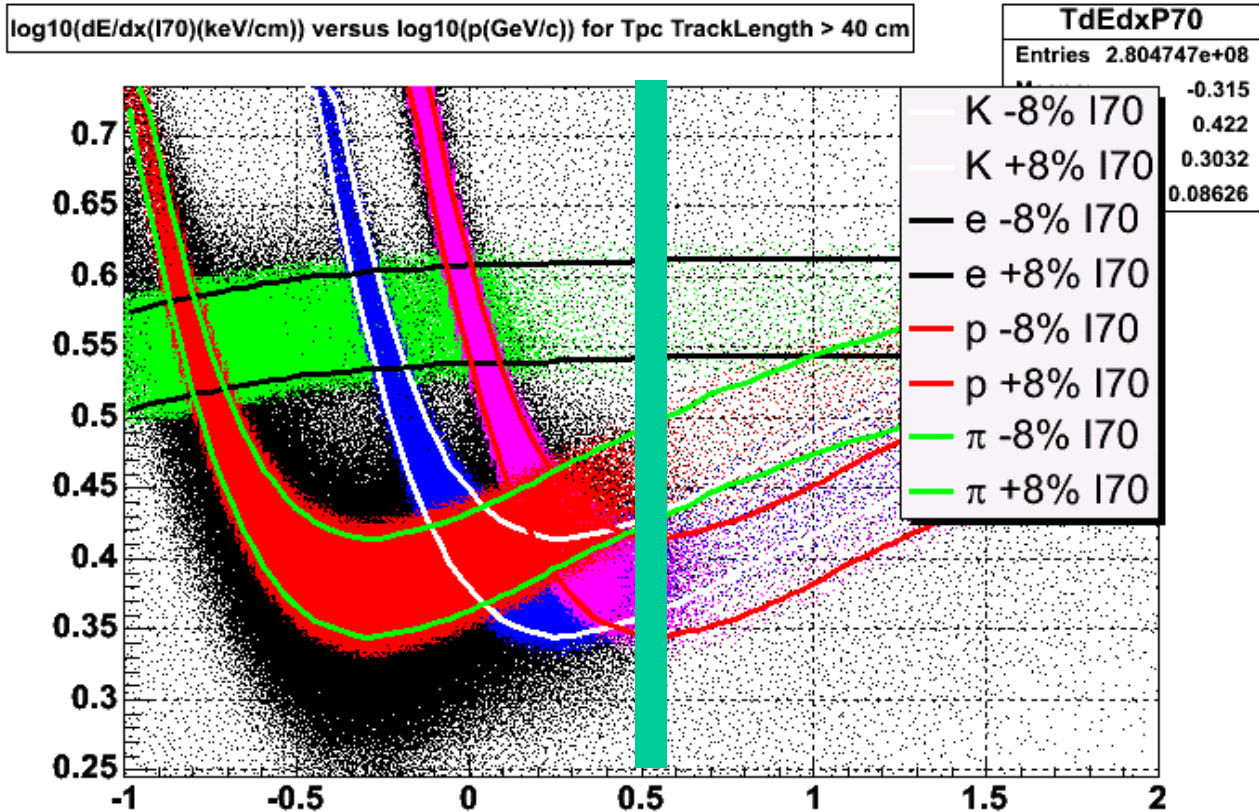


Hadron identification:  
STAR Collaboration, [nucl-ex/0309012](#)

**Electron identification:**  
TOFr  $|1/\beta - 1| < 0.03$   
TPC  $dE/dx$  **electrons!!!**

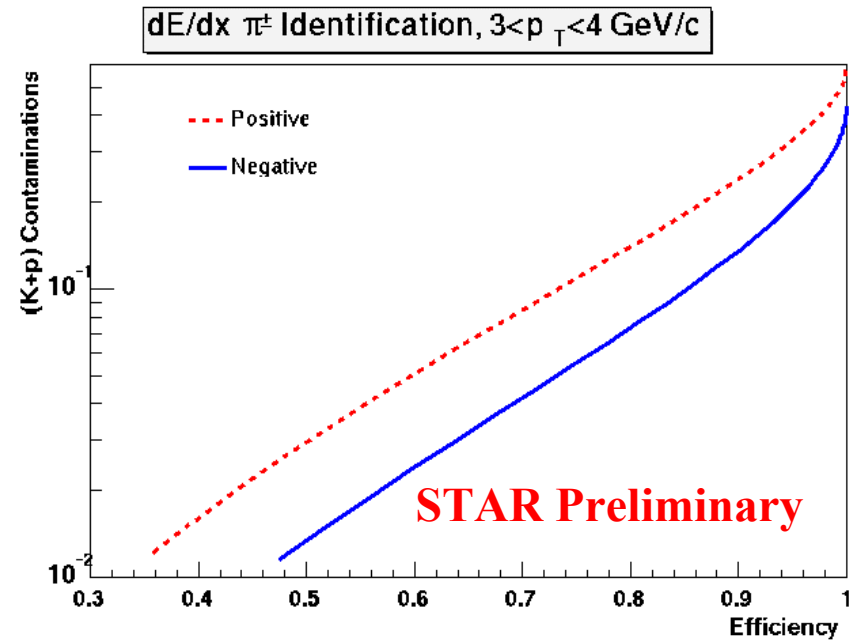
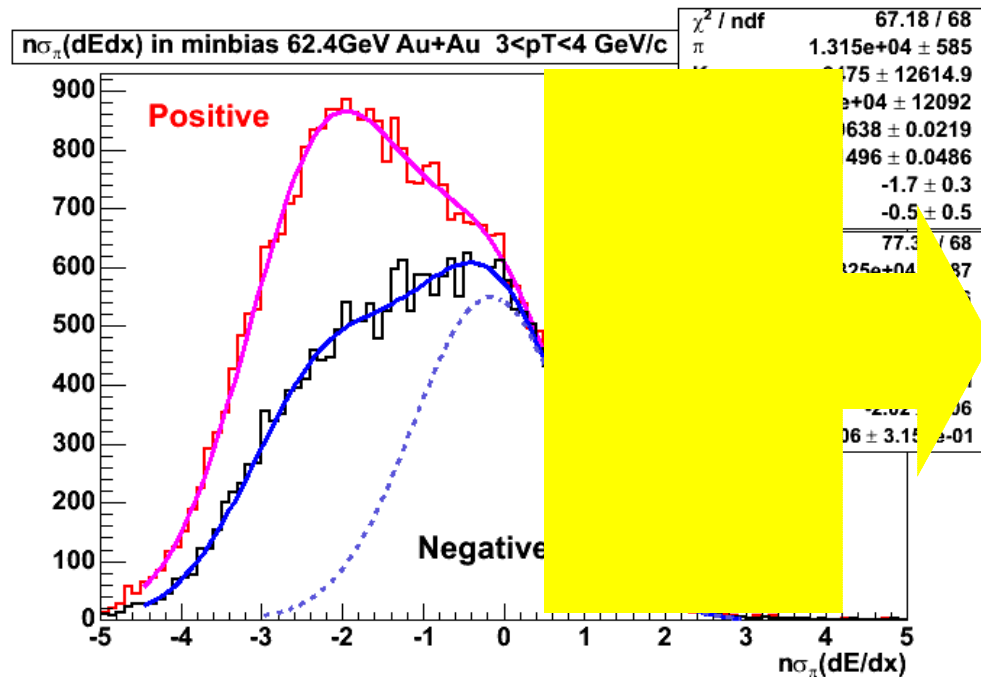


# dE/dx at higher pT



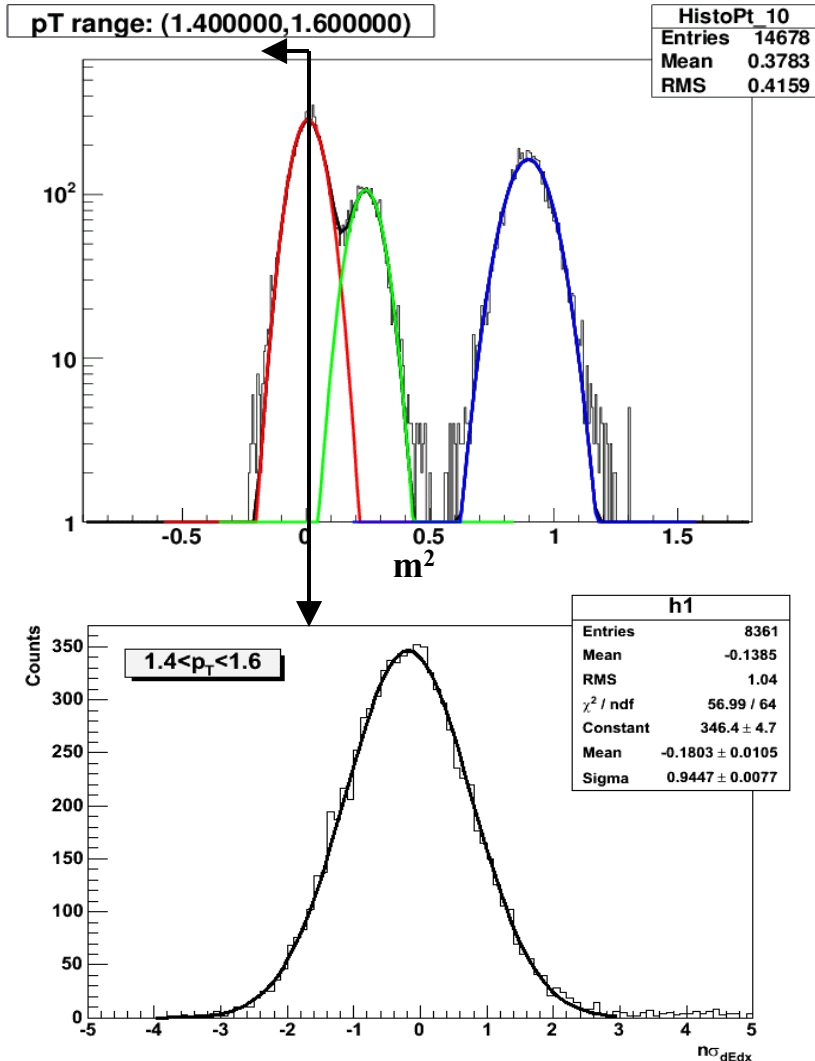
Momentum:  $3 < p \lesssim 10$  GeV/c  
dE/dx of  $\pi$  (K,p) separation:  $2\sigma$

# $\pi$ -(K+p) Separation



- 3 Gauss fits:  $dE/dx(\pi) > 1.3 * dE/dx(K)$   
 $dE/dx(\pi)$  as normal Gauss:  $\sigma=1$ , mean=0
- $\pi$ -(K+p) Separation:  $\sim 1.5-2\sigma$
- Worst Contamination:  
 $1-3\%$  at  $50\%$  Eff,  $10\%$  at  $70-90\%$  Eff

# Do we know where dE/dx is?



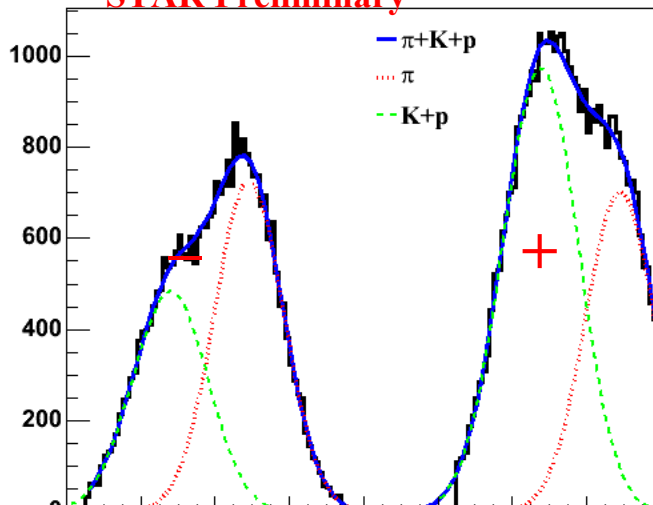
## TOFr PID Cross Check

$p_T$ range (GeV/c)	$n\sigma_\pi$ Gaussian parameters	
	mean	sigma
0.9-1.0	-0.194	0.981
1.0-1.2	-0.200	0.970
1.2-1.4	-0.185	0.943
1.4-1.6	-0.186	0.949
1.6-1.8	-0.209	0.915
1.8-2.0	-0.256	0.916
2.0-2.5	-0.194	0.962

# Example of dE/dx in pT bins

pt (3.5,4.0) pi+ distribution in minbias (-0.5<eta<0.5)

STAR Preliminary

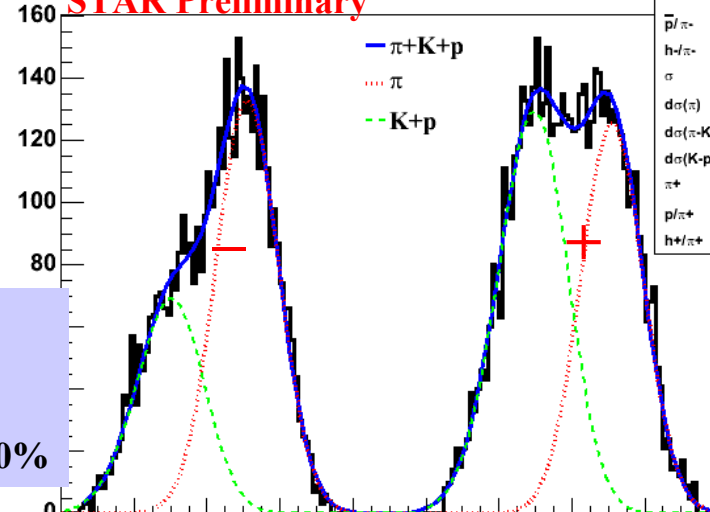


$\chi^2 / \text{ndf}$	152 / 128
$\pi^-$	$1.684\text{e}+04 \pm 280$
$\bar{p}/\pi^-$	$0.2173 \pm 0.0119$
$h^-/\pi^-$	$1.723 \pm 0.027$
$\sigma$	$0.9278 \pm 0.0107$
$d\sigma(\pi)$	$-0.09224 \pm 0.01860$
$d\sigma(\pi-K)$	$-1.889 \pm 0.017$
$d\sigma(K-p)$	$-0.8299 \pm 0.0792$
$\pi^+$	$1.628\text{e}+04 \pm 314$
$p/\pi^+$	$0.5 \pm 0.3$
$h^+/\pi^+$	$2.513 \pm 0.047$

-0.5<eta<0.5  
Minbias: 0-80%  
Central: 0-10%  
Peripheral: 40-80%

pt (3.5,4.) pi+ distribution in cent4080 (-0.5<eta<0.5)

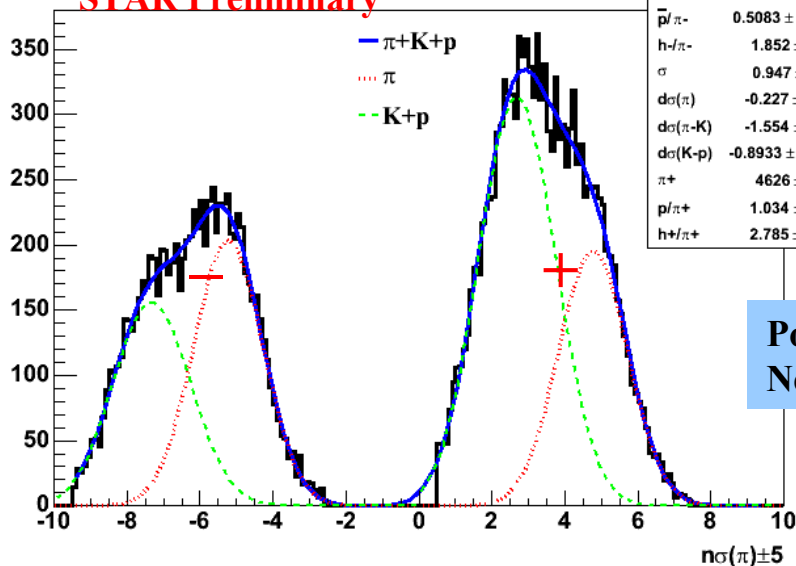
STAR Preliminary



$\chi^2 / \text{ndf}$	127.1 / 127
$\pi^-$	$2842 \pm 62.5$
$\bar{p}/\pi^-$	$0.09445 \pm 0.03098$
$h^-/\pi^-$	$1.564 \pm 0.025$
$\sigma$	$0.8544 \pm 0.0117$
$d\sigma(\pi)$	$0.1 \pm 0.1$
$d\sigma(\pi-K)$	$-1.977 \pm 0.063$
$d\sigma(K-p)$	$-1 \pm 0.1$
$\pi^+$	$2690 \pm 65.9$
$p/\pi^+$	$0.2564 \pm 0.0623$
$h^+/\pi^+$	$2.143 \pm 0.044$

pt (3.5,4.0) pi+ distribution in cent10 (-0.5<eta<0.5)

STAR Preliminary

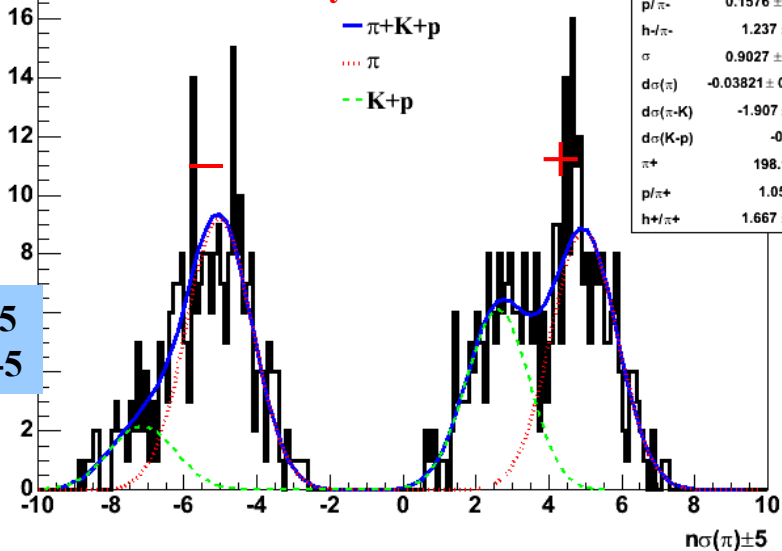


$\chi^2 / \text{ndf}$	136.4 / 128
$\pi^-$	$4815 \pm 307.6$
$\bar{p}/\pi^-$	$0.5083 \pm 0.2446$
$h^-/\pi^-$	$1.852 \pm 0.116$
$\sigma$	$0.947 \pm 0.031$
$d\sigma(\pi)$	$-0.227 \pm 0.064$
$d\sigma(\pi-K)$	$-1.554 \pm 0.718$
$d\sigma(K-p)$	$-0.8933 \pm 0.1991$
$\pi^+$	$4626 \pm 376.7$
$p/\pi^+$	$1.034 \pm 0.496$
$h^+/\pi^+$	$2.785 \pm 0.224$

Positive:  $n\sigma(\pi)+5$   
Negative:  $n\sigma(\pi)-5$

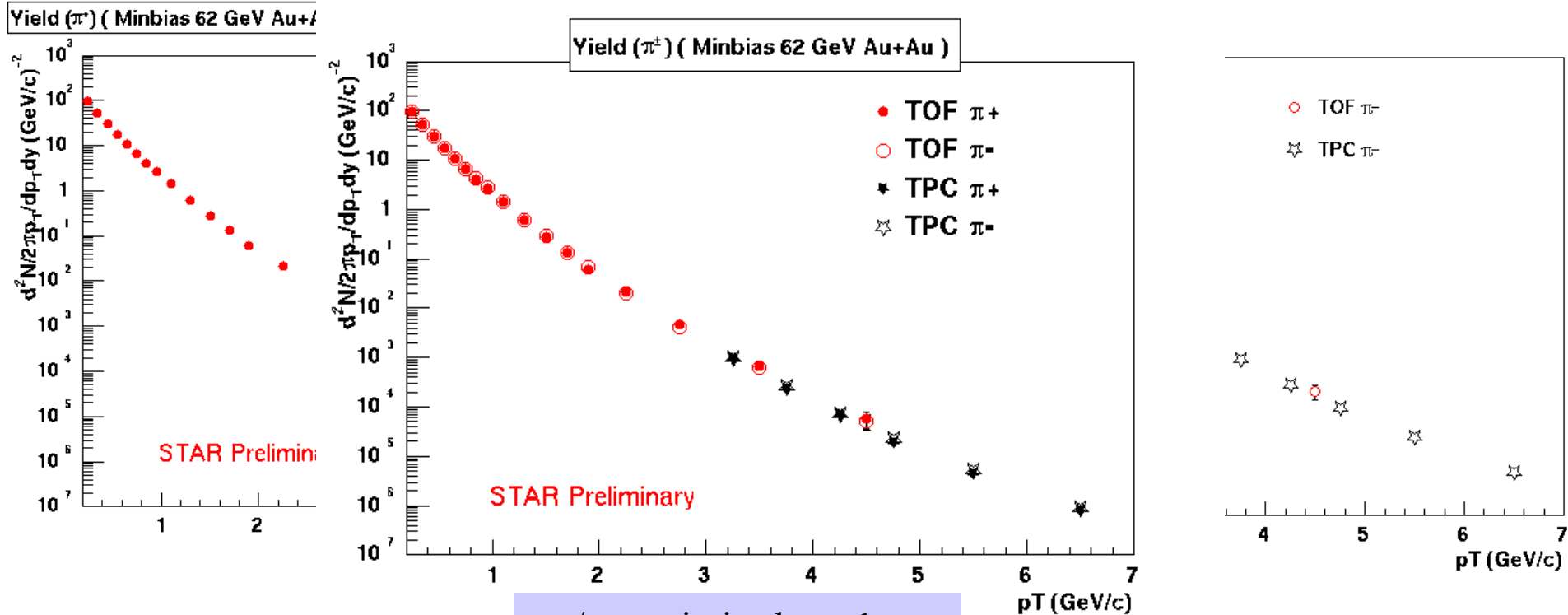
pt (6.,7.) pi+ distribution in minbias (-0.5<eta<0.5)

STAR Preliminary



$\chi^2 / \text{ndf}$	105.3 / 110
$\pi^-$	$208.2 \pm 20.3$
$\bar{p}/\pi^-$	$0.1576 \pm 0.4187$
$h^-/\pi^-$	$1.237 \pm 0.092$
$\sigma$	$0.9027 \pm 0.0496$
$d\sigma(\pi)$	$-0.03821 \pm 0.09495$
$d\sigma(\pi-K)$	$-1.907 \pm 0.582$
$d\sigma(K-p)$	$-0.3 \pm 0.6$
$\pi^+$	$198.1 \pm 25.7$
$p/\pi^+$	$1.05 \pm 0.98$
$h^+/\pi^+$	$1.667 \pm 0.195$

# Preliminary pion Spectra



$\pi^+/\pi^-$  ratio is about 1

pbar/p  $\approx$  0.5

TPC+TOF:

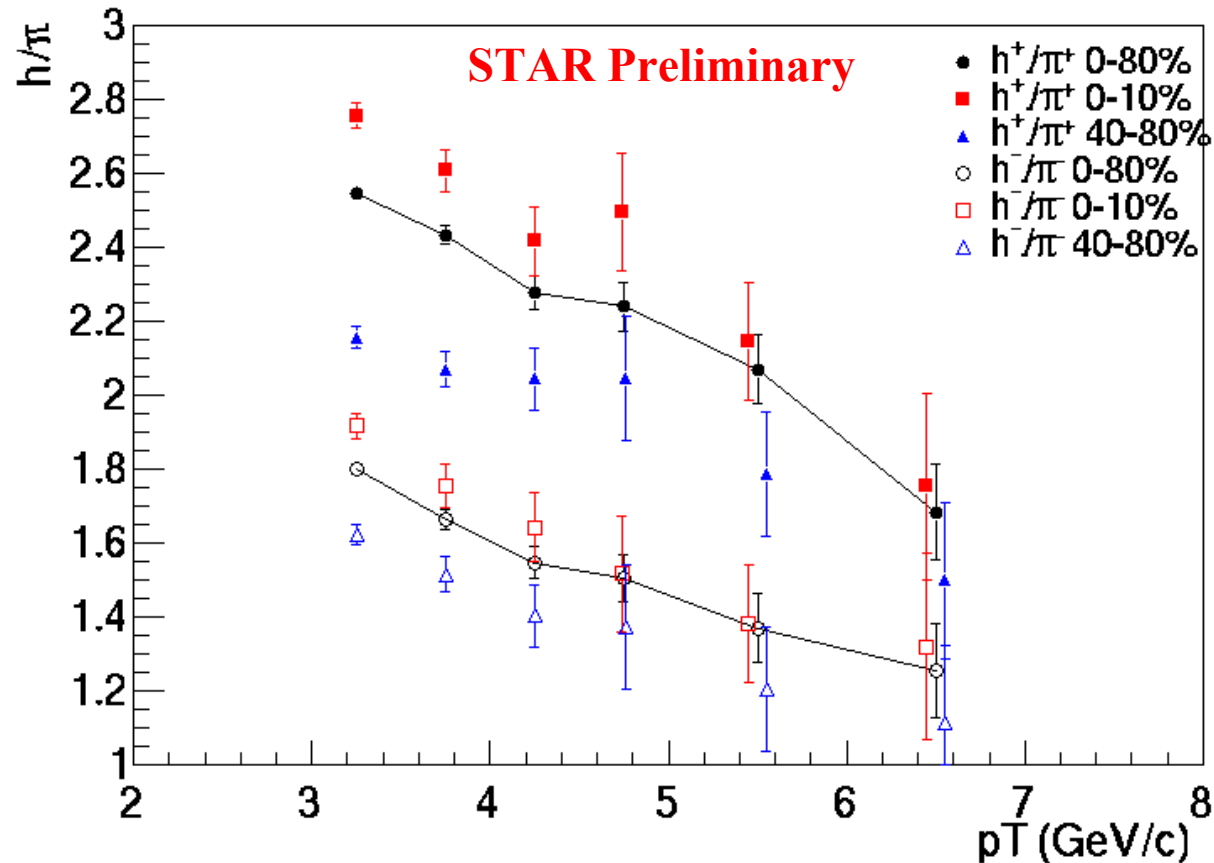
• TPC:

- Pion: 0-~0.6 GeV/c
- Kaon: 0.2-~0.6 GeV/c
- Proton: 0.2-~1 GeV/c

- Pion: 0.2-~1.6 GeV/c
- Kaon: 0.2-~1.6 GeV/c
- Proton: 0.2-~3 GeV/c

- Pion: 0.-~10 GeV/c
- Kaon: 0.2-~3 GeV/c
- Proton: 0.2-~5 GeV/c

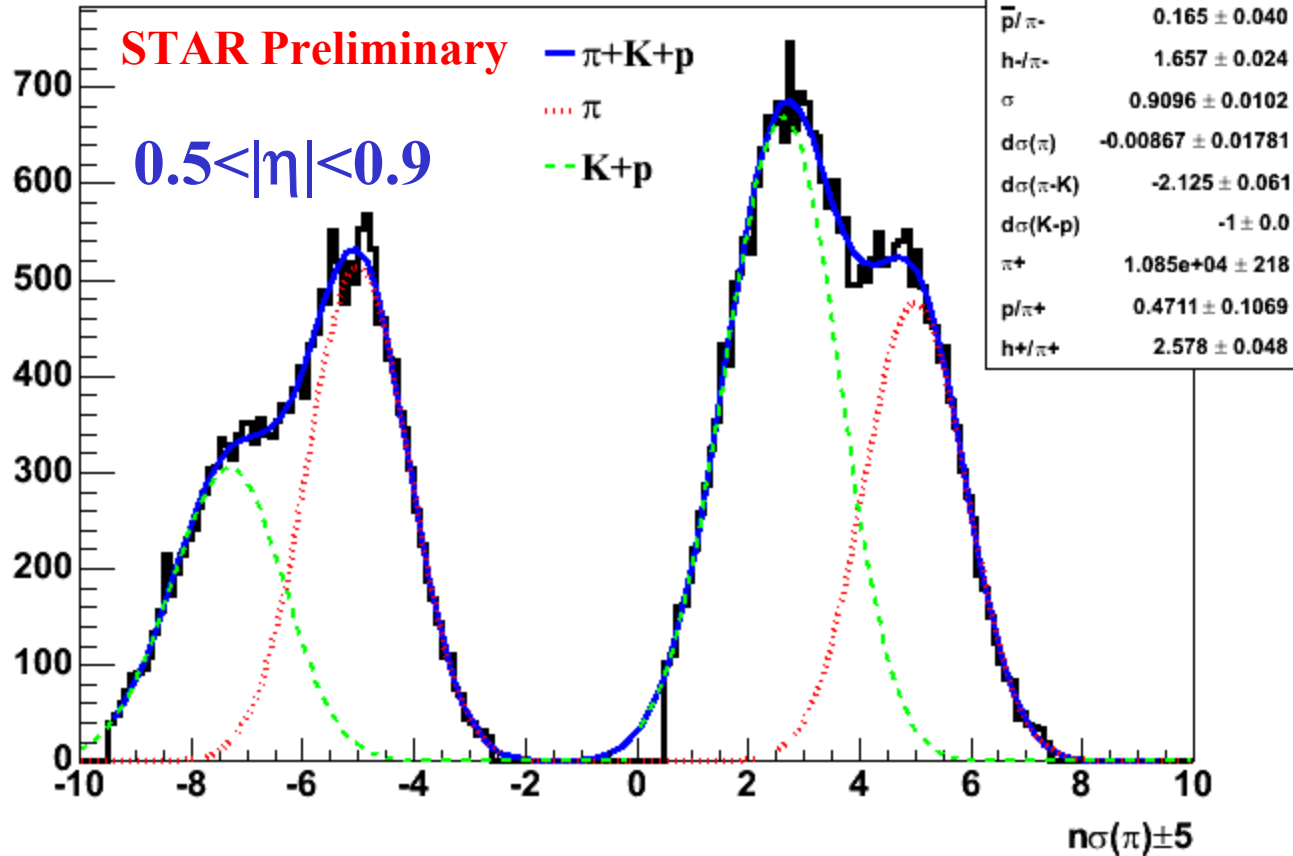
# h/ $\pi$ ratios



- $h/\pi$  peripheral < central but approach each other at  $p_T > 5 \text{ GeV}/c$  for both negative and positive
- $(K+p)/\pi$   
Positive = 2 \* Negative  
50% higher in central than in peripheral
- $(h^+ + h^-)/(\pi^+ + \pi^-)$   
about 20% higher in central than in peripheral  
 $\pi^+/\pi^-$  ratio is about 1.

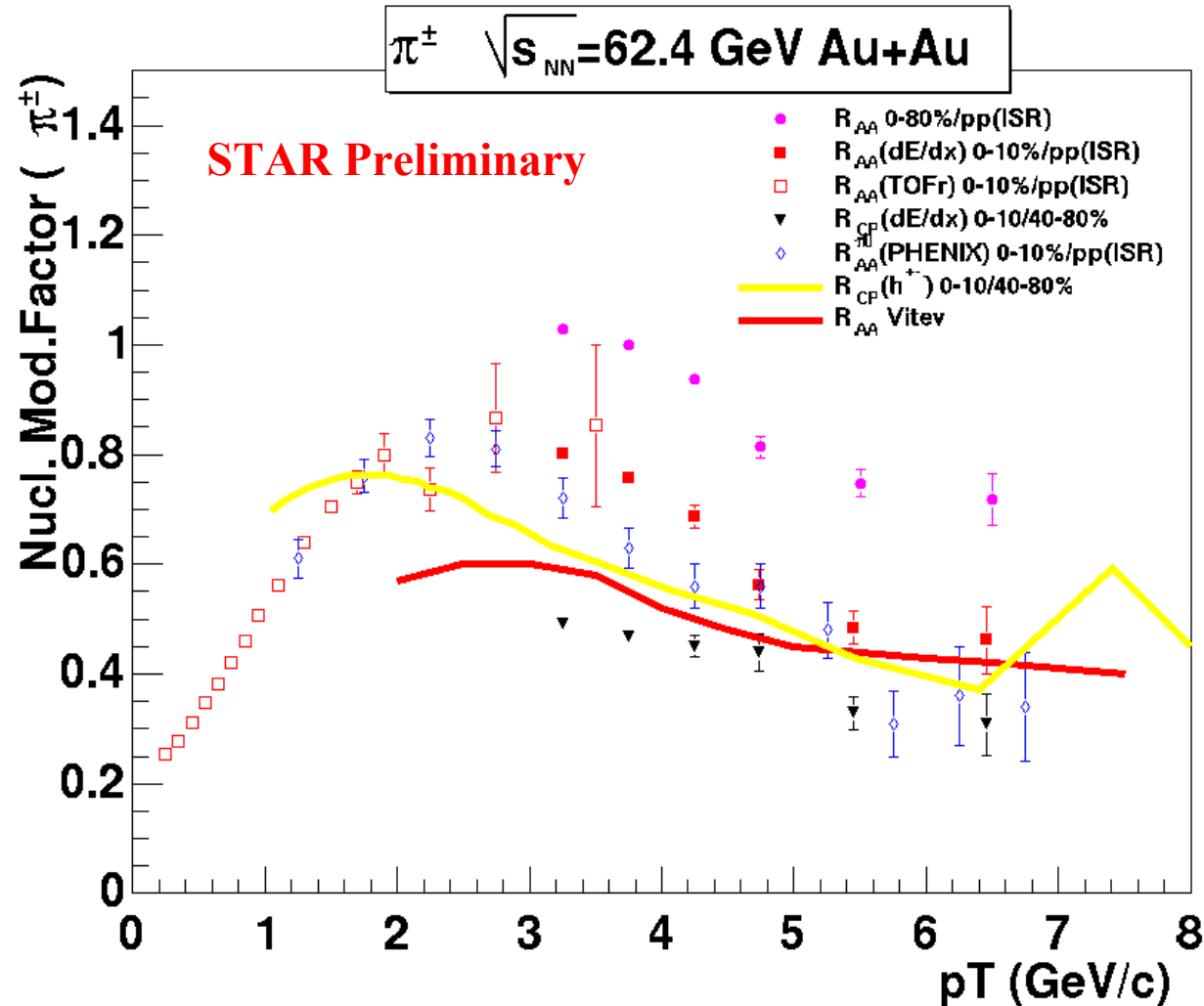
# Higher $\eta$

pt (3.5,4.0)  $\pi^\pm$  distribution in minbias ( $0.5 < |\eta| < 0.9$ )



Better  $dE/dx$  resolution: longer track, shorter drift distance

# $\pi^\pm$ Nucl. Mod. Factor



- $R_{CP} h^\pm$  20% higher than  $\pi^\pm$   $pT=3-4 \text{ GeV/c}$  consistent with  $h/\pi$  ratio
- Vitev prediction at  $dN/dy=650$
- TOFR agrees with  $dE/dx \pi^\pm$
- ISR pp parametrization same as PHENIX
- Estimated Syst. Error: 5-10%

# Conclusions

- Charged pion identification at high  $p_T$  can be done with STAR TPC (+TOF)
- At 62.4 GeV Au+Au,  $h/\pi$  ratios depend on charge, centrality and  $p_T$ 
  - Central collisions: decrease with  $p_T$  to approach peripheral value (at  $p_T=6-7\text{ GeV}/c$ )
  - Central Collisions:  $(h^+/\pi^+)-(h^-/\pi^-)\sim 1$  ( $p_T=3\text{ GeV}/c$ )
- $R_{CP}$  of  $h$  and  $\pi$  different by  $<\sim 20\%$
- Study  $\eta$  dependence around mid-rapidity
- More to come!!!