Accuracy versus Precision

-

how well do our data agree?

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This talk is not all my own work

Thanks to:

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for helping me their plots, macros

What we've measured

- STAR, PHENIX,
- PHENIX and STAR, all 4 experiments

- $h^{\pm}, \pi^{+}, \pi^{-}, \pi^{0}$, p, $\bar{p}$
- K^{+}, K^{-}, K^{0}_{s}
- Λ, ,$\bar{\Lambda}$, Ξ^{+}, Ξ^{-}, Ω^{+}, Ω^{-}
- Φ, K^{*}, ρ, η, ω, $\Lambda(1520)$, Σ^{+},Σ^{-}
- real and virtual γ
- D^{0}, D^{*},NPE
- J/Ψ, Υ
- d,$\bar{d}$, He, ${}^{3}_{\Lambda}H$, ${}^{3}_{\Lambda}\bar{H}$

Where at least 2 results exist

- In p-p, Au-Au, Cu-Cu at $\sqrt{s}$ = 200 and 62 GeV
- PHENIX and STAR, all 4 experiments

- $h^{\pm}, \pi^{+}, \pi^{-}, \pi^{0}$, p, $\bar{p}$
- K^{+}, K^{-}
- Λ, ,$\bar{\Lambda}$
- Φ, , ρ
- real γ
- NPE
- J/Ψ, Υ
- d,$\bar{d}$

And where spectra overlap significantly

- In p-p, Au-Au, at $\sqrt{s}$ = 200 GeV
- PHENIX and STAR, all 4 experiments

- π^+, π^-, π^0, p, $\bar{p}$
- K^+, K^-
-
- Φ
-
- NPE

How data are compared

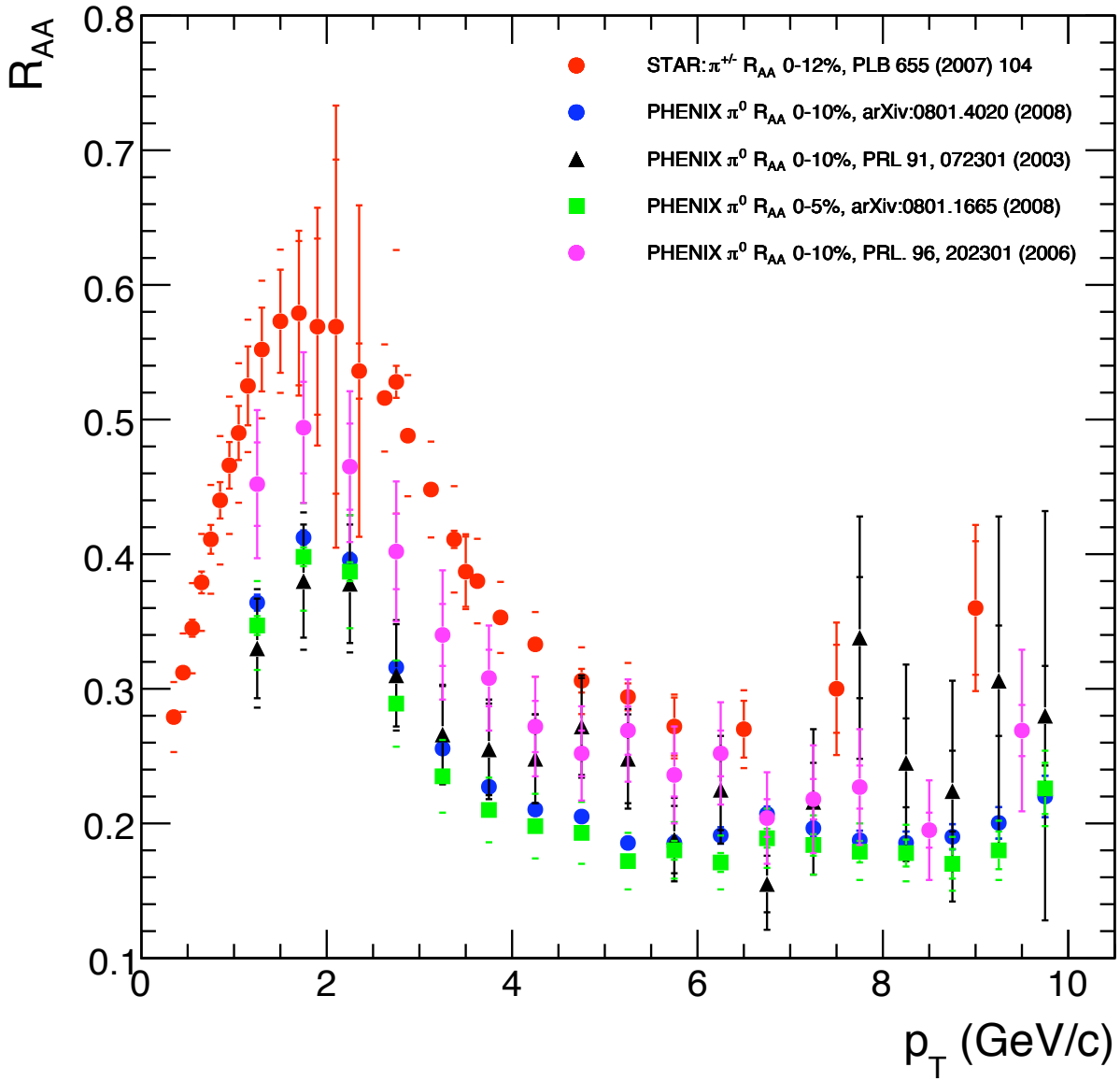
- Take the published data points
- Combine in quadrature stat and sys error (realize not strictly correct but sufficient)
- Fit data to formula: $\frac{A}{\left(e^{(-ap_T - bp_T^2)} + p_T/p_0\right)^n}$

  (don't interpret variables just good fit)
- To compare spectra divide fits, plot 95% confidence band

Data references

STAR π and protons Phys. Rev. Lett. 97, 152301
STAR low pt π, K, p Phys. Rev. Lett. 92, 112301
STAR high pt π and p in p-p Phys. Lett. B 637, 161
STAR π0 Phys. Rev. C 80 44905 (2009)
STAR NPE Phys. Rev. Lett. 98 192301 (2007)
STAR ϕ Phys. Rev. C 79 64903 (2009)
BRAHMS π and protons Phys. Rev. C 72, 014908
PHENIX charged π and protons Phys. Rev. C. 69, 034909
PHENIX π0 Phys. Rev. Lett. 101, 232301 (2008)
PHENIX π0, 2003 Phys. Rev. Lett. 91, 072301
PHENIX π0 p-p Phys. Rev. Lett. 91, 241803 (2003)
PHENIX NPE Au-Au Phys. Rev. Lett. 94, 082301 (2005)
PHENIX NPE p-p Phys. Rev. Lett. 97, 252002 (2006)
PHENIX ϕ Phys. Rev. C 72, 014903 (2005)

Where problems became evident - R_{AA} of pions

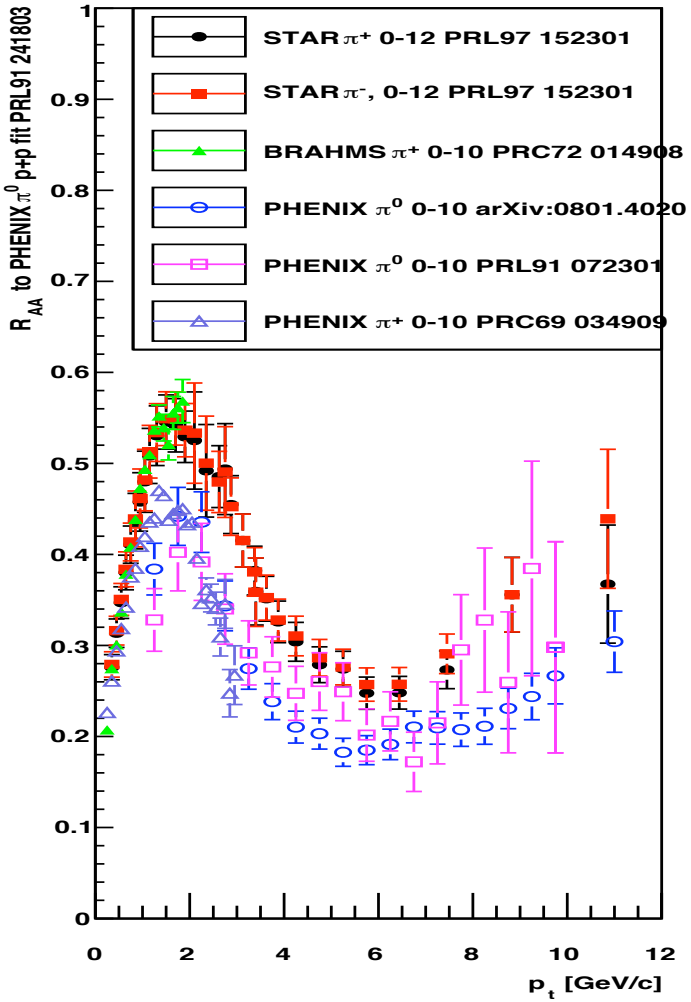


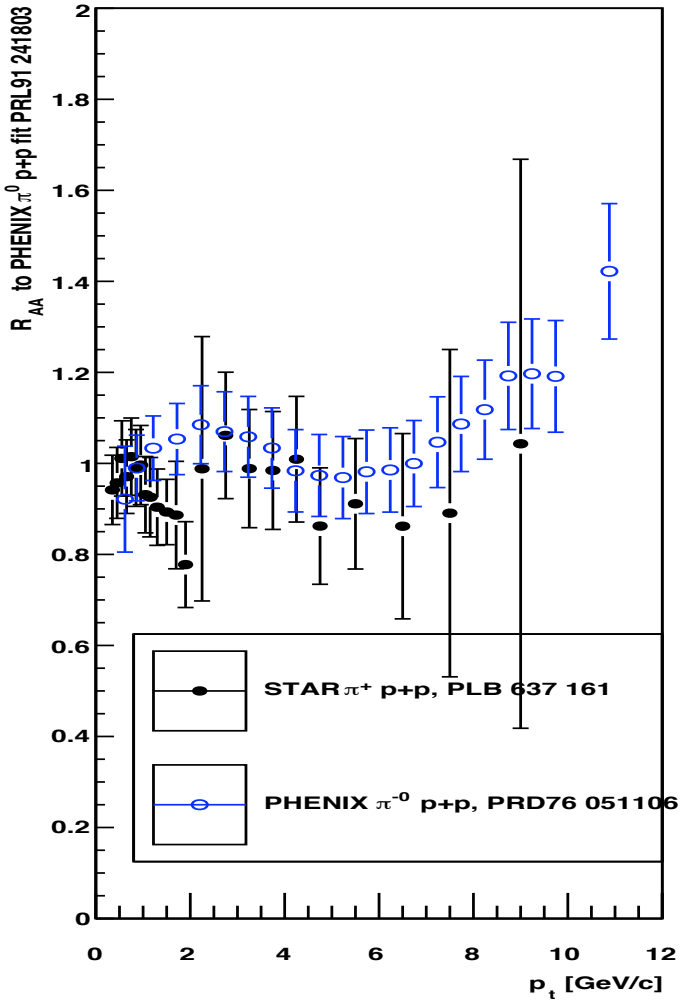
Latest/most precise PHENIX π^0 data consistently below STAR $\pi^{\pm}$ at high p_T

No longer the same "within errors"

Is it just a problem with the p-p?

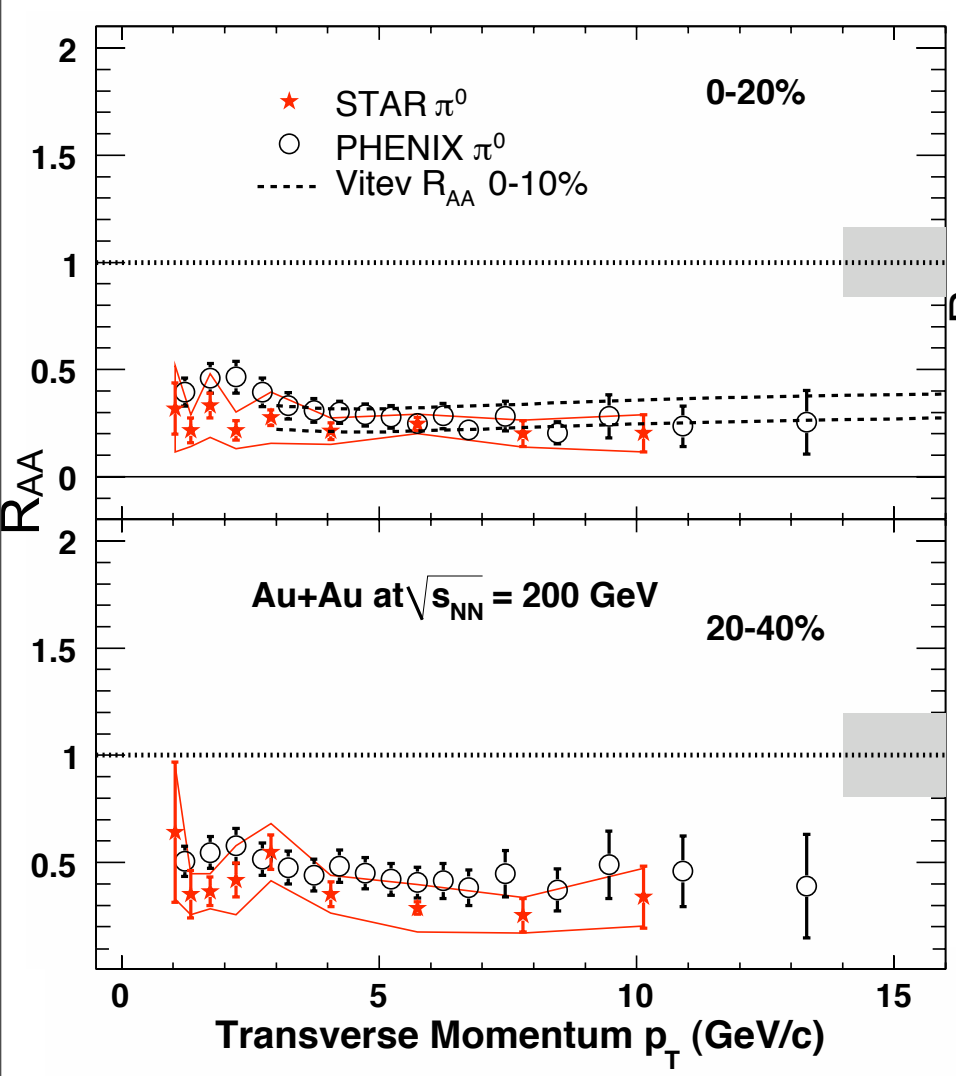
Calculate R_{AA} using common fit function to PHENIX π^0 p-p

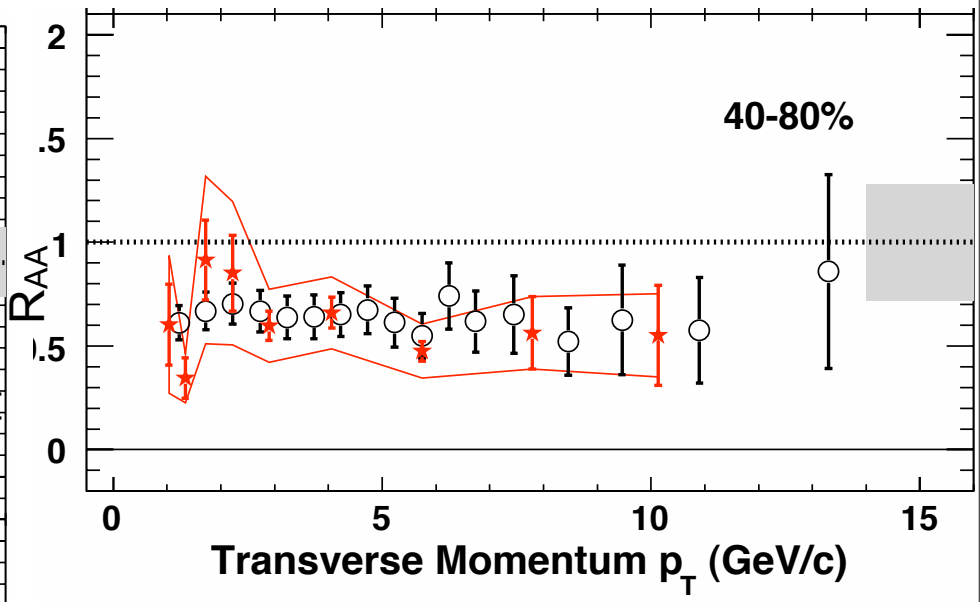




Not a great fit to the π^0 but cancels out in comparison

R_{AA} of π^0



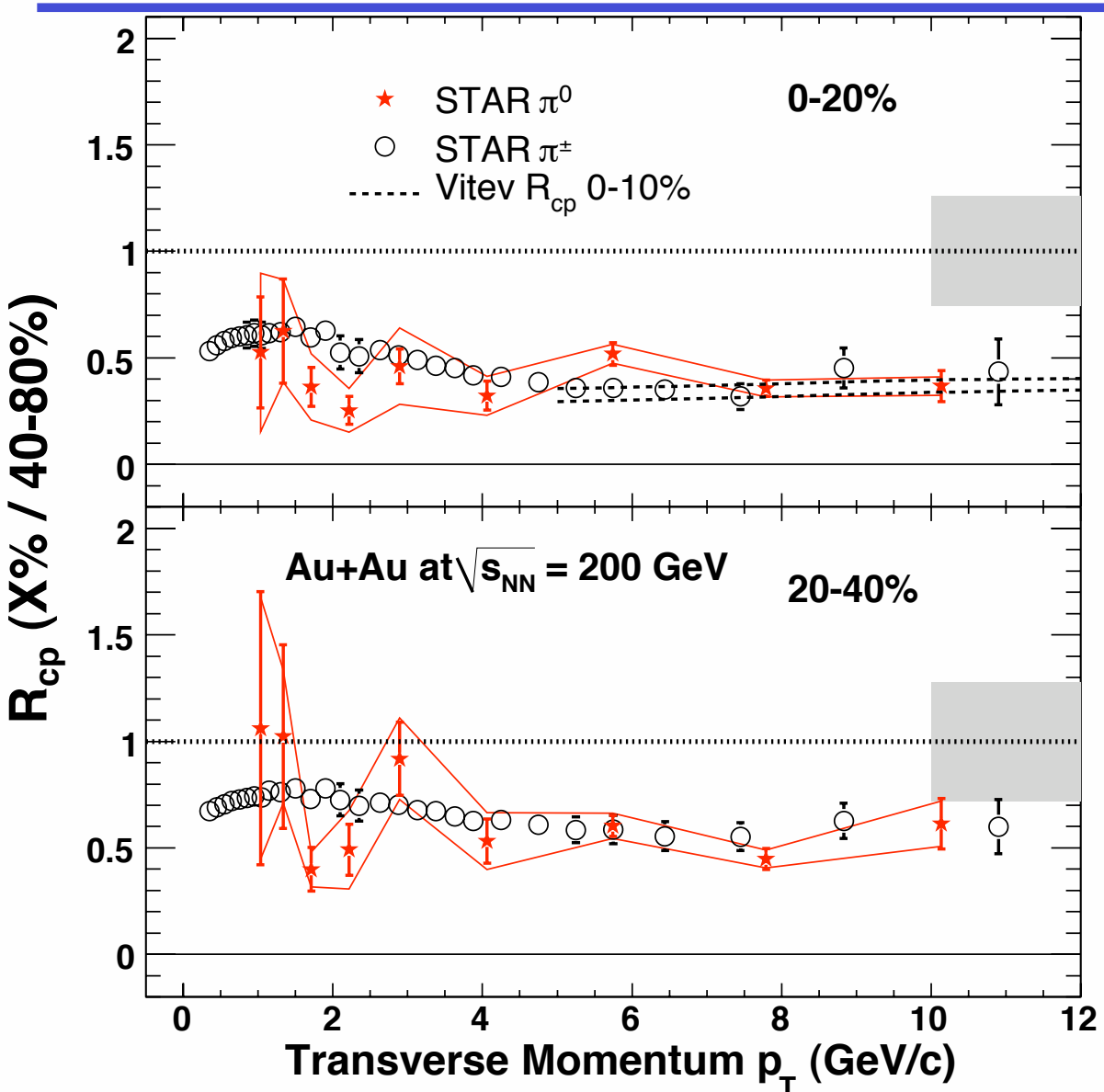


New STAR data on π^0 at first glance resolves the issue.

STAR data has large errors

Are STAR data self consistent

Difference between STAR π^0 and $\pi^{\pm}$ R_{CP}?



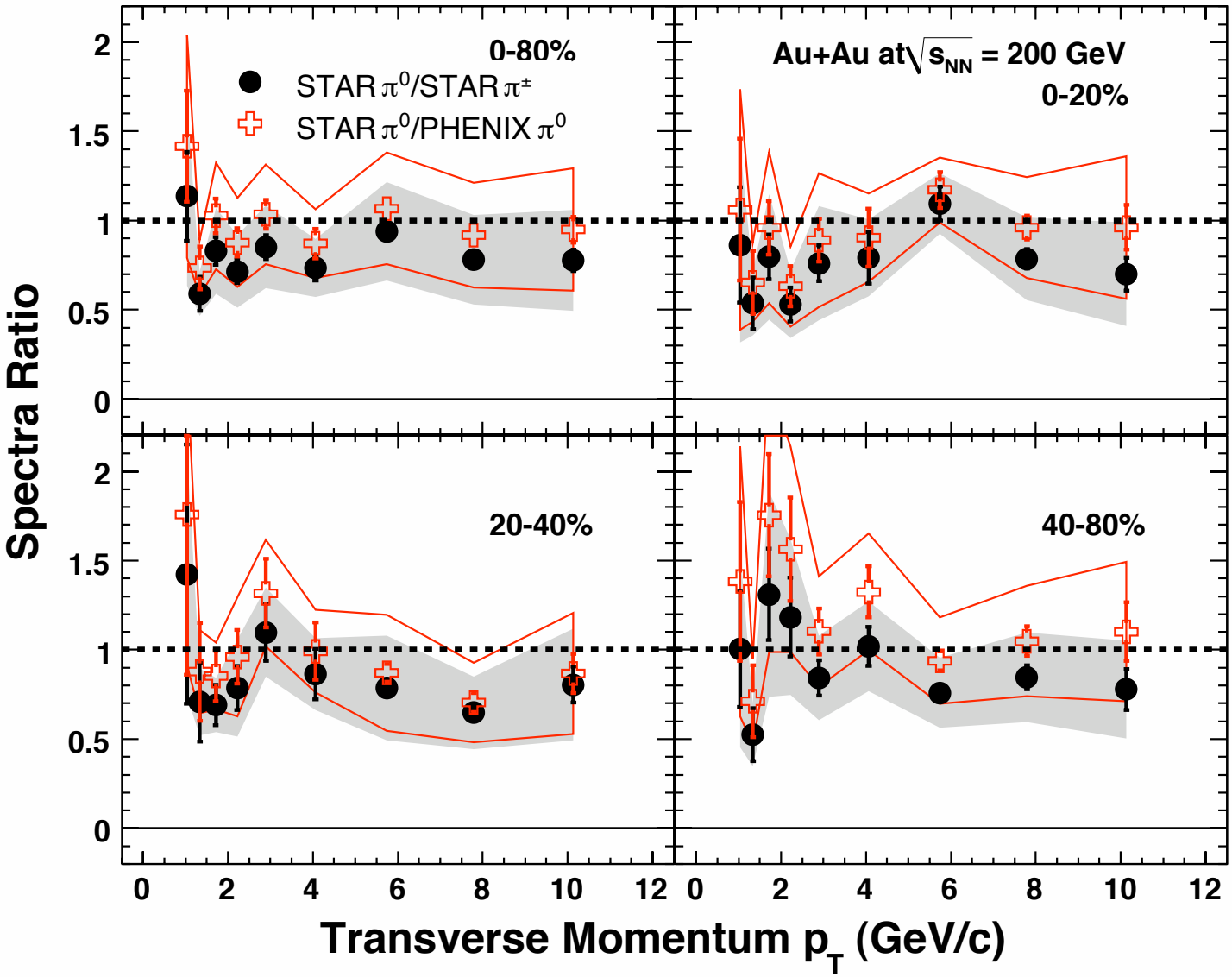
Seem to be!

How can that be?

A=B
B=C
C!=A?

Large errors cover a multitude of sins

Difference between π^0 and $\pi^{\pm}$?

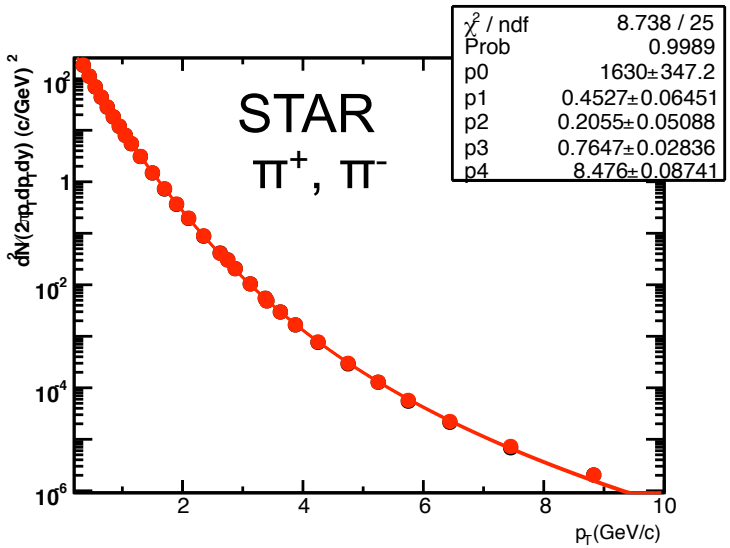


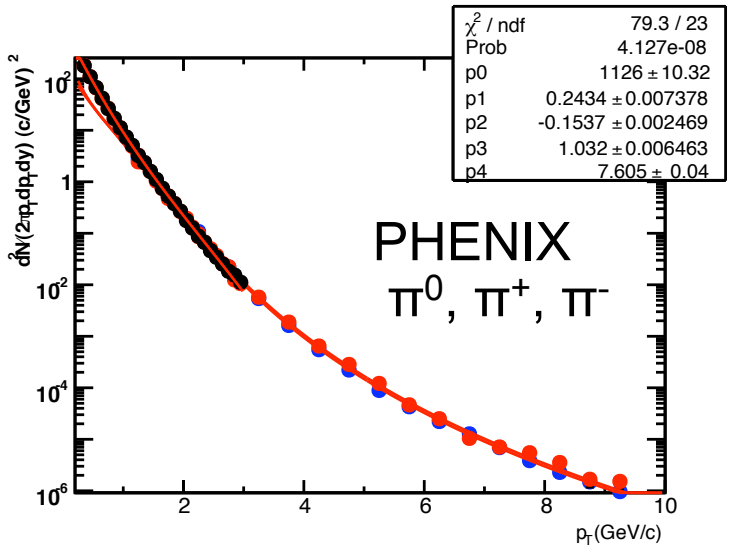
STAR $\pi^0 \lesssim$ STAR π^+

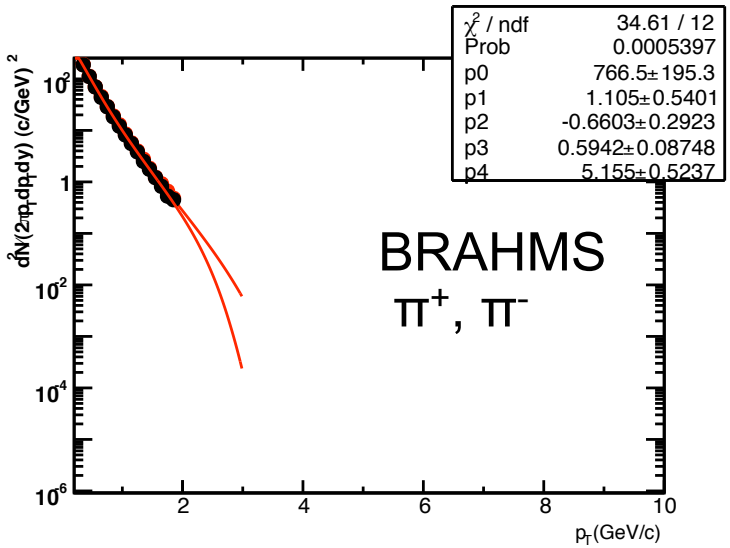
STAR $\pi^0 \gtrsim$ PHENIX π^0

STAR $\pi^+ >$ PHENIX π^0

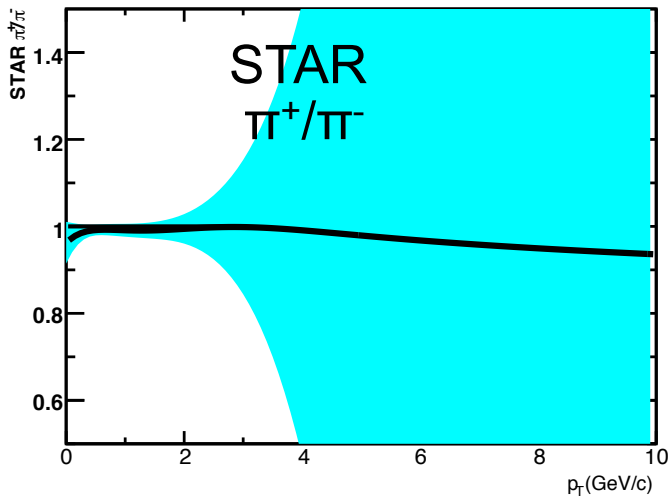
π in Au-Au 0-10%

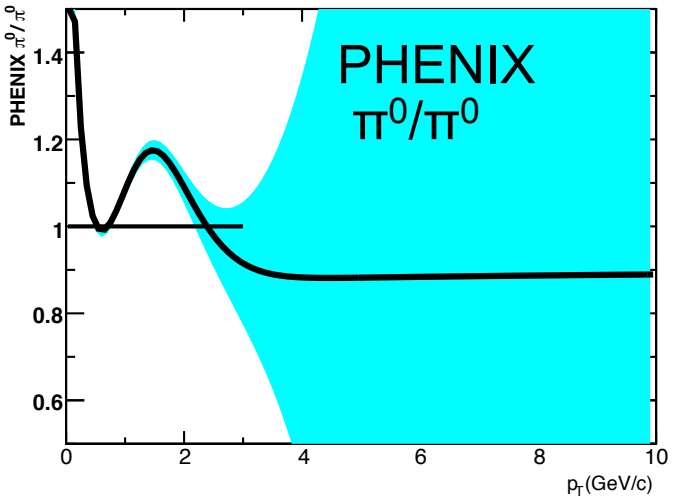

STAR
π+, π-
χ2 / ndf 8.738 / 25
Prob 0.9989
p0 1630±347.2
p1 0.4527±0.06451
p2 0.2055±0.05088
p3 0.7647±0.02836
p4 8.476±0.08741
d2N/(2πpTdpTdy) (c/GeV)2
pT(GeV/c)

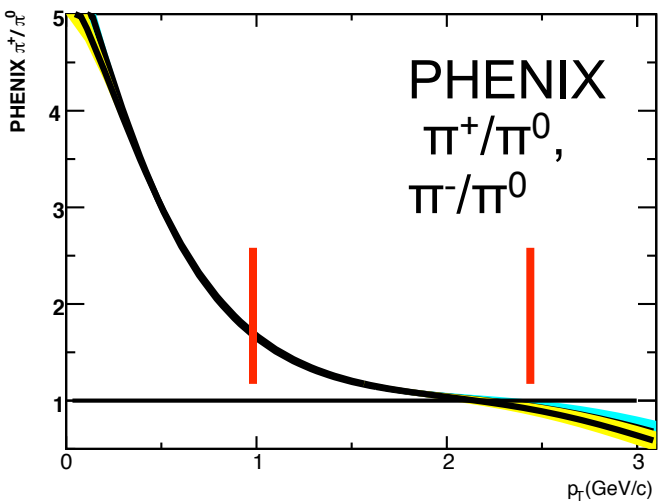

PHENIX
π0, π+, π-
χ2 / ndf 79.3 / 23
Prob 4.127e-08
p0 1126 ± 10.32
p1 0.2434 ± 0.007378
p2 -0.1537 ± 0.002469
p3 1.032 ± 0.006463
p4 7.605 ± 0.04
d2N/(2πpTdpTdy) (c/GeV)2
pT(GeV/c)

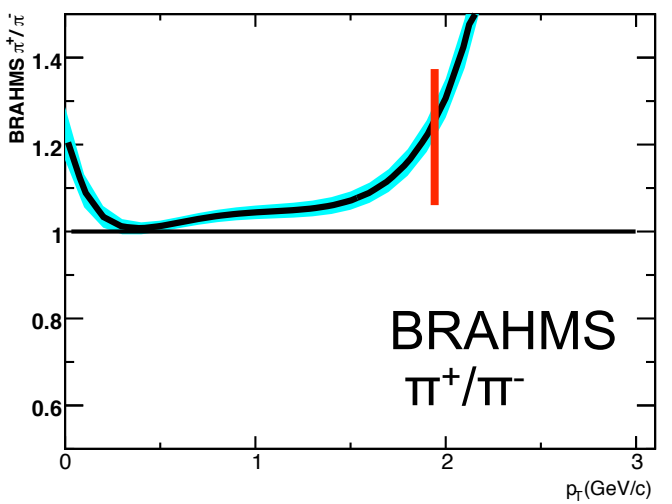

BRAHMS
π+, π-
χ2 / ndf 34.61 / 12
Prob 0.0005397
p0 766.5±195.3
p1 1.105±0.5401
p2 -0.6603±0.2923
p3 0.5942±0.08748
p4 5.155±0.5237
d2N/(2πpTdpTdy) (c/GeV)2
pT(GeV/c)

π in Au-Au 0-10% - Self consistency



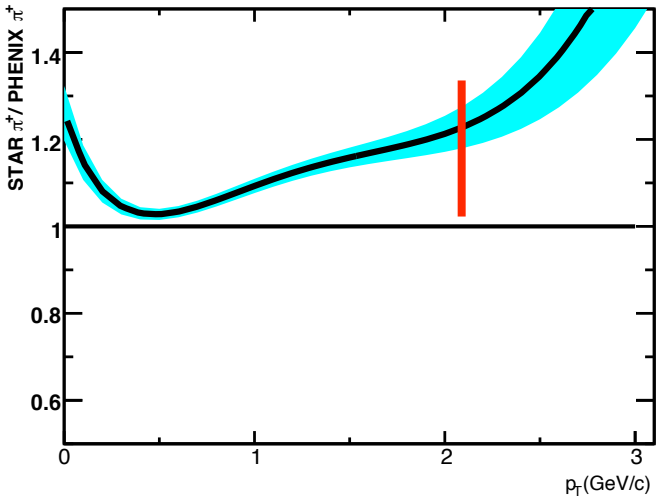


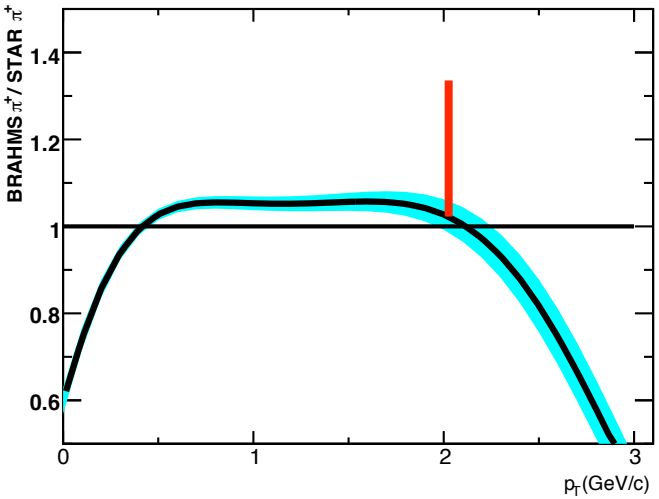


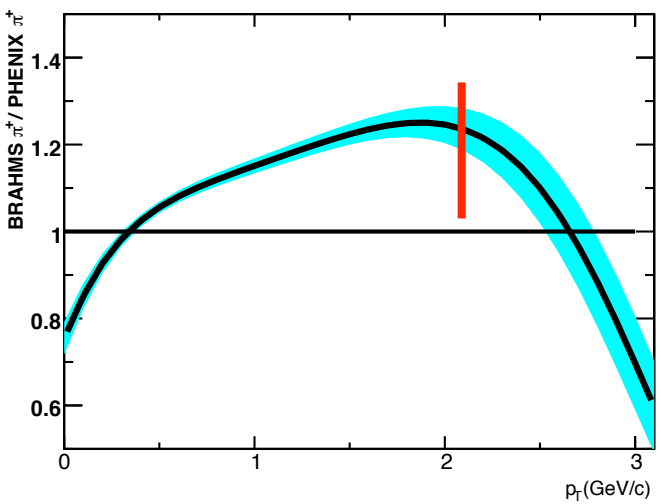


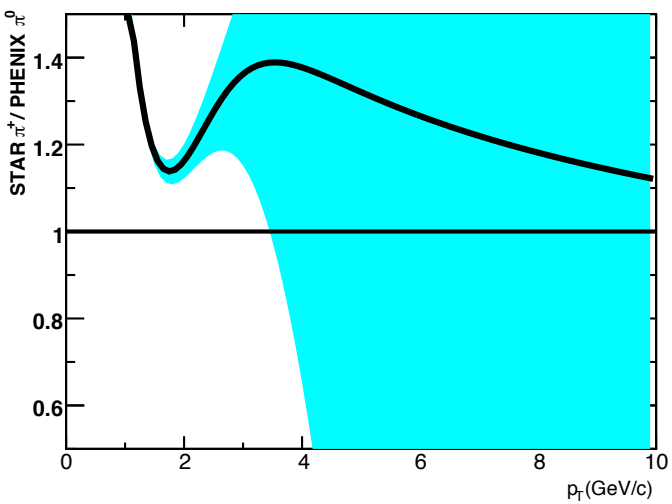
PHENIX consistency needs more detailed check

π in Au-Au 0-10% - Comparison

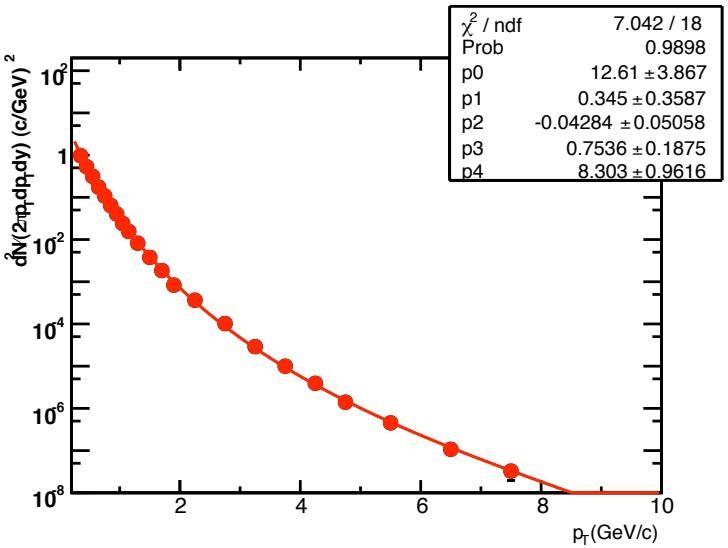


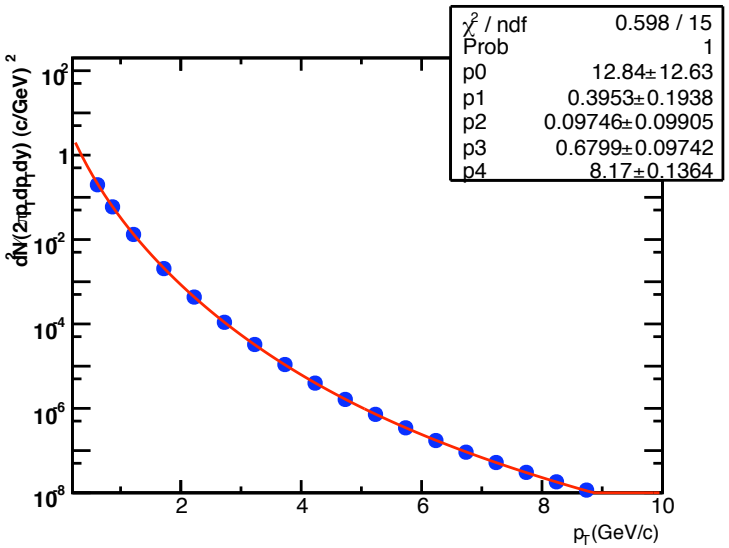


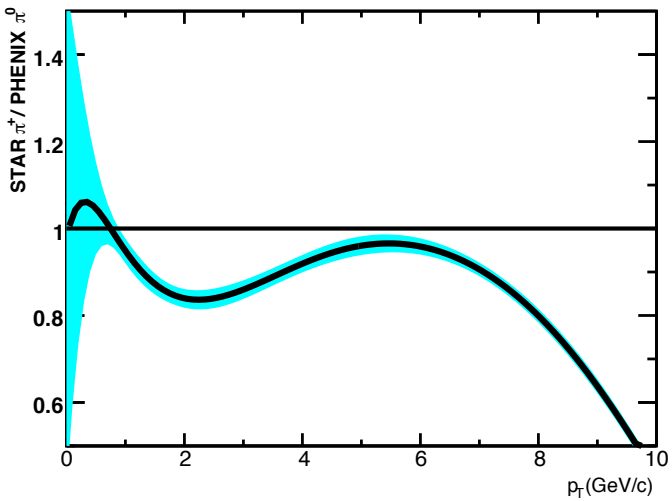




π in p-p - Comparison

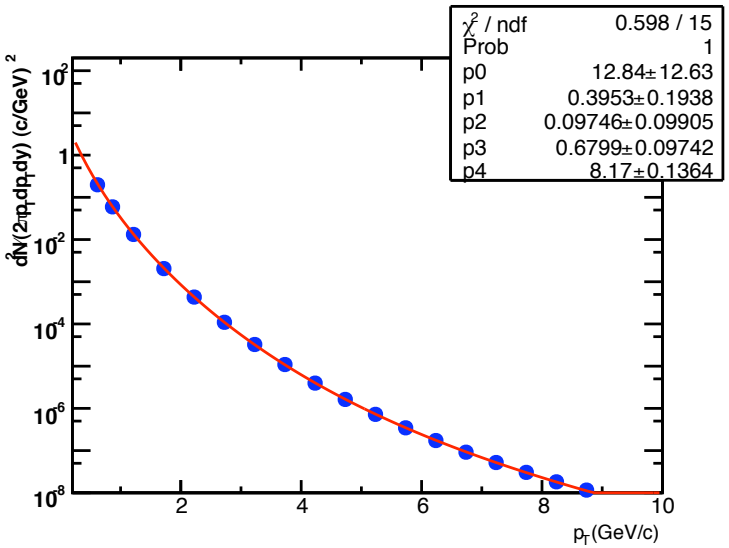


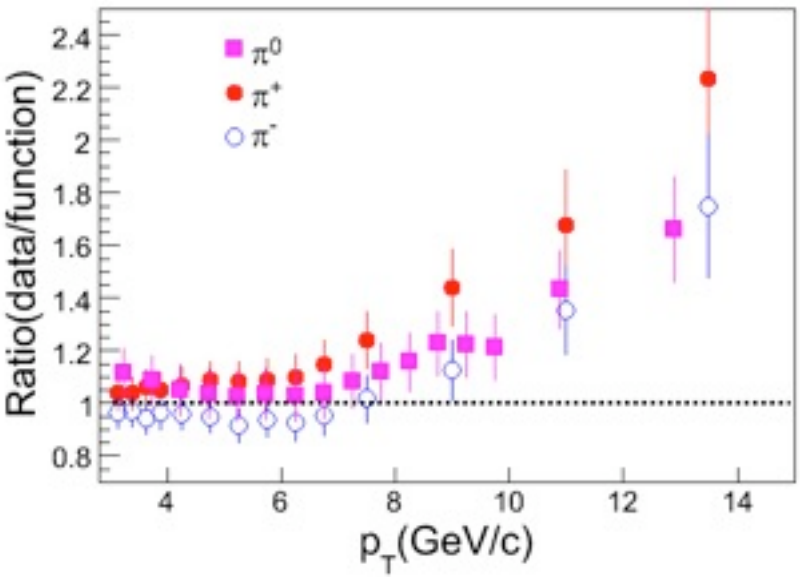


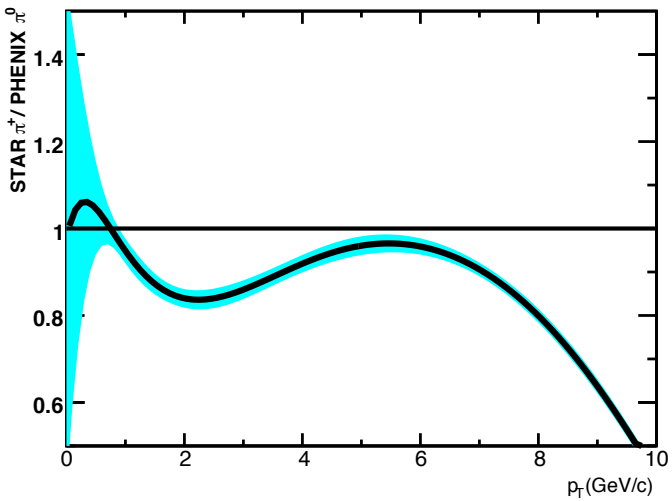


π in p-p - Comparison

- STAR $\pi^{\pm}$, PHENIX π^0 compared to a Tsalis fit
- New STAR data from run without SVT not published - presented at QM09







Proton spectra - the feed-down correction

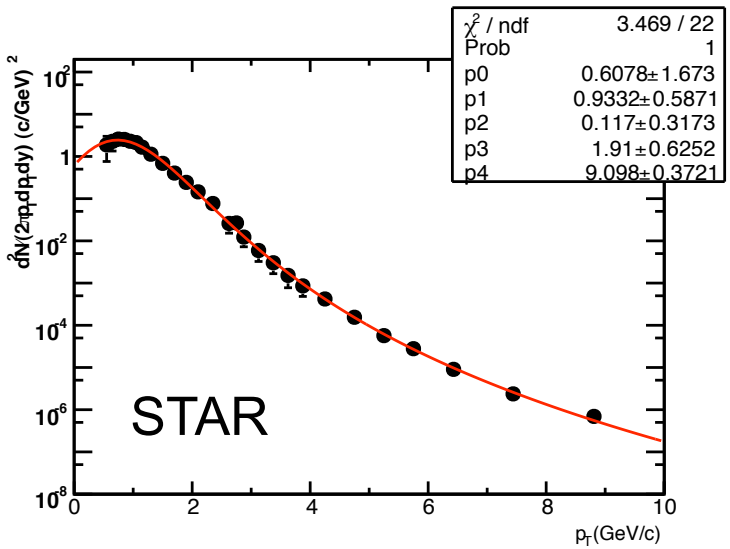
- STAR - hyperon feed-down of Λ and Σ^+ - use measured Λ spectra, $\Sigma^+/\Lambda = 0.35$ independent of p_T

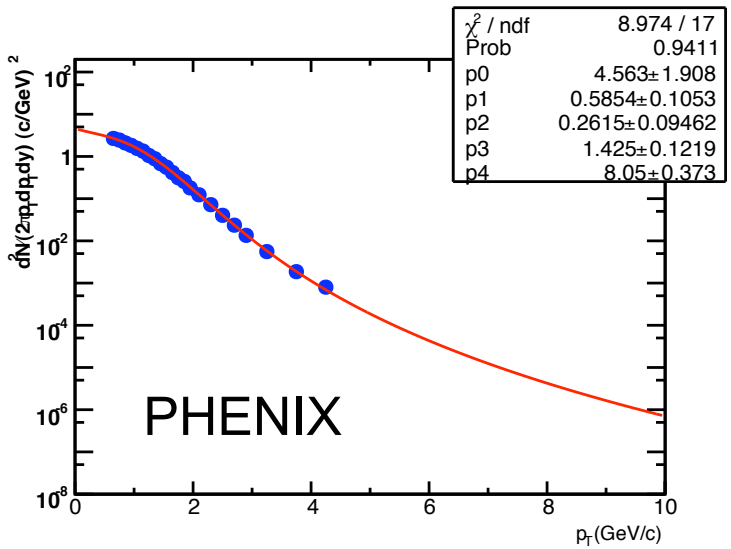
- PHENIX - HIJING tunes to measured ratio of Λ/p, including p_T dependence, in 130 GeV. Σ^+ correction not applied

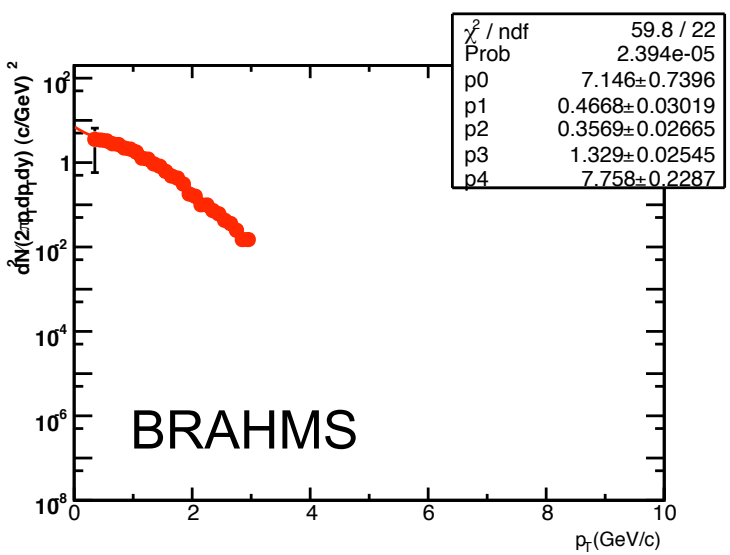
- BRAHMS - Use p_T independent ratio of $N(\Lambda) = 0.89N(p)$ from 130 GeV data

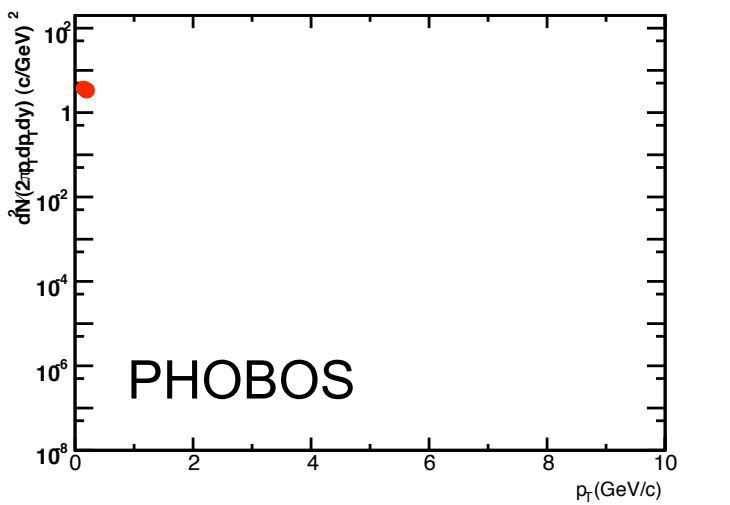
- From this would expect STAR > PHENIX ~ BRAHMS

Feed-down corrected protons - Au-Au 0-10%

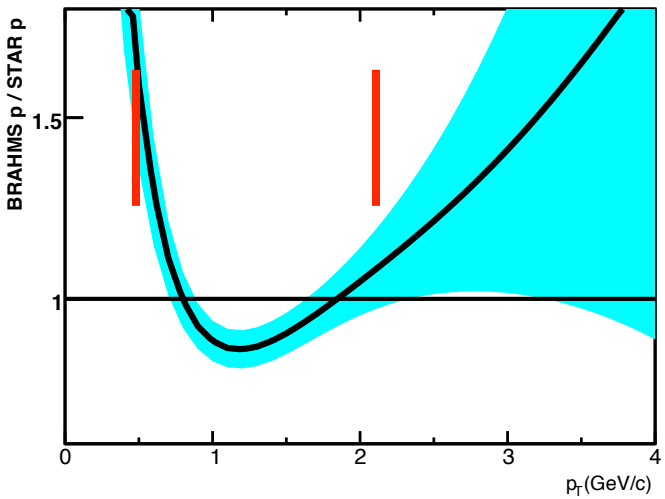


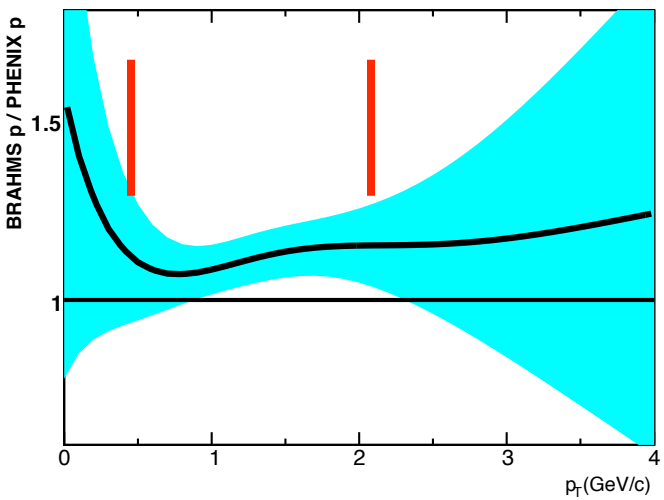


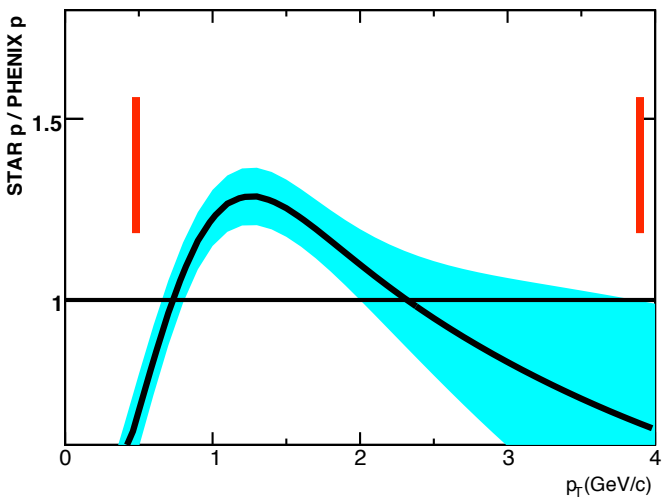




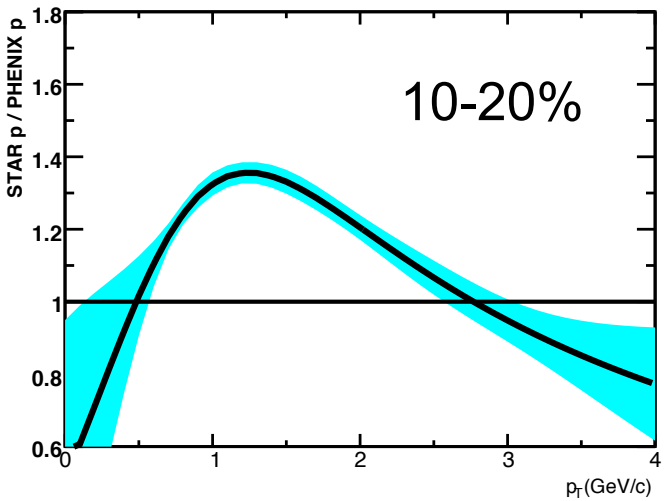
Feed-down corrected protons - Au-Au 0-10%

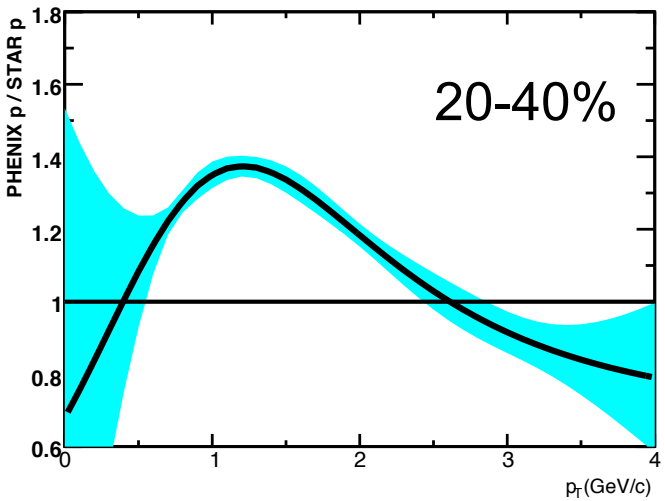




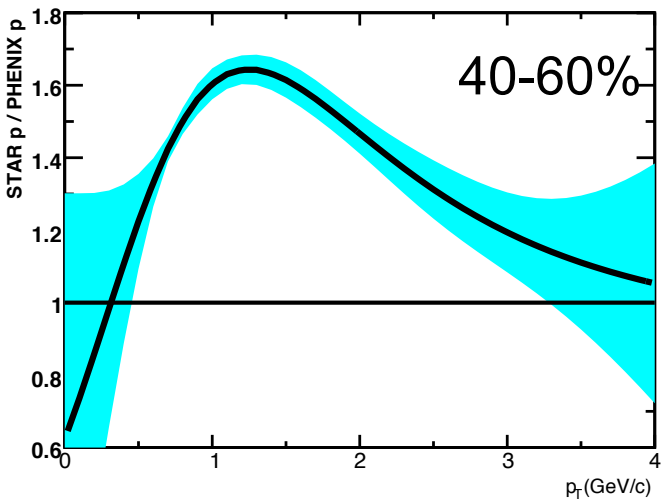


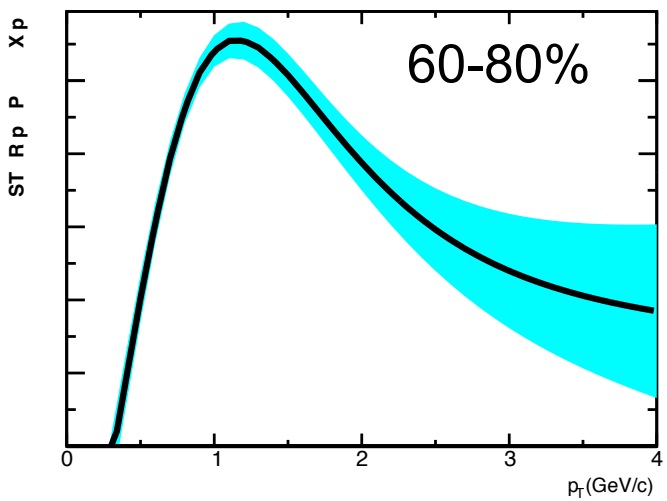
Feed-down corrected protons - Au-Au



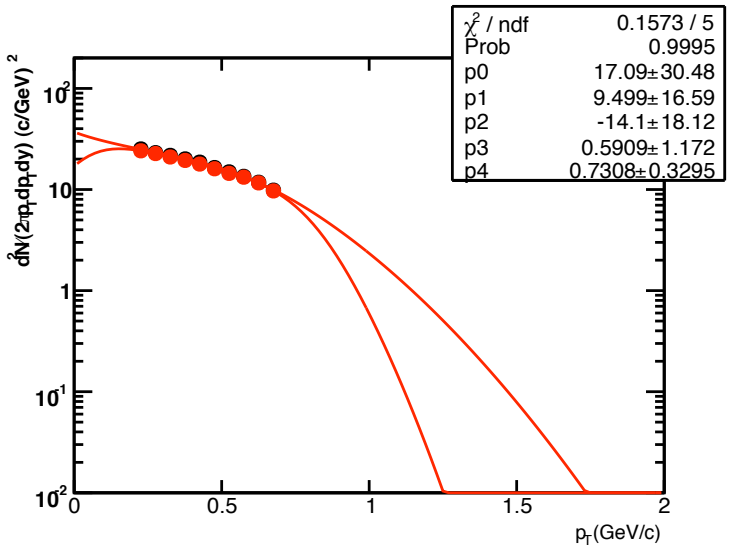


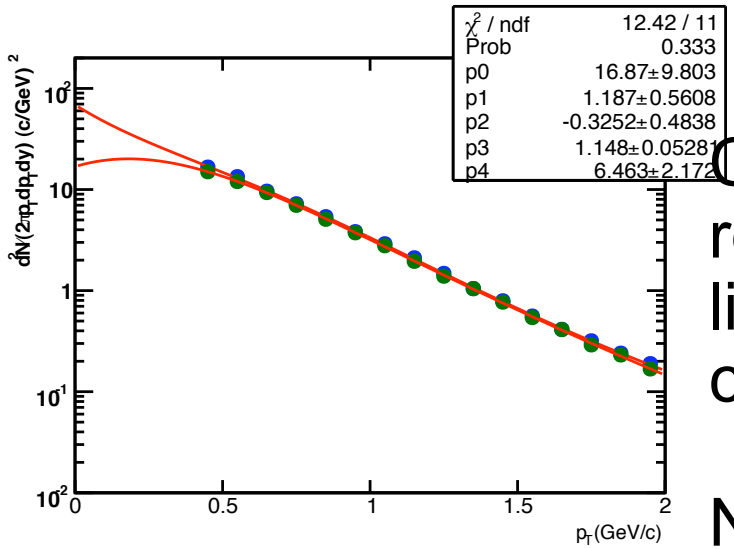
Clear centrality trend difference



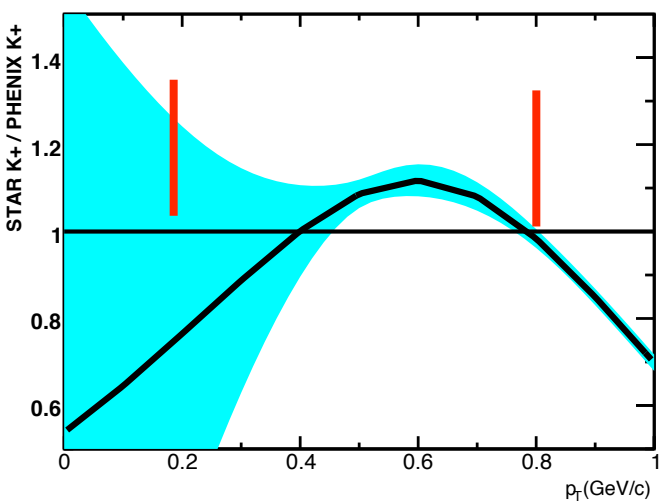


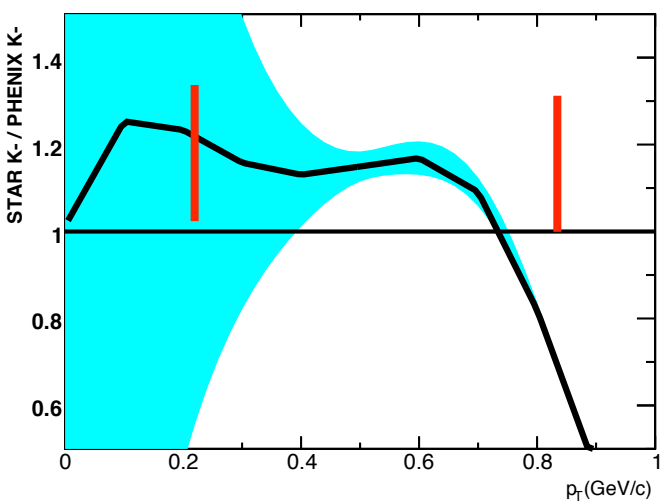
$K^{\pm}$ Au-Au 0-10% - STAR/PHENIX





Careful p_T range of bottom plots != to top

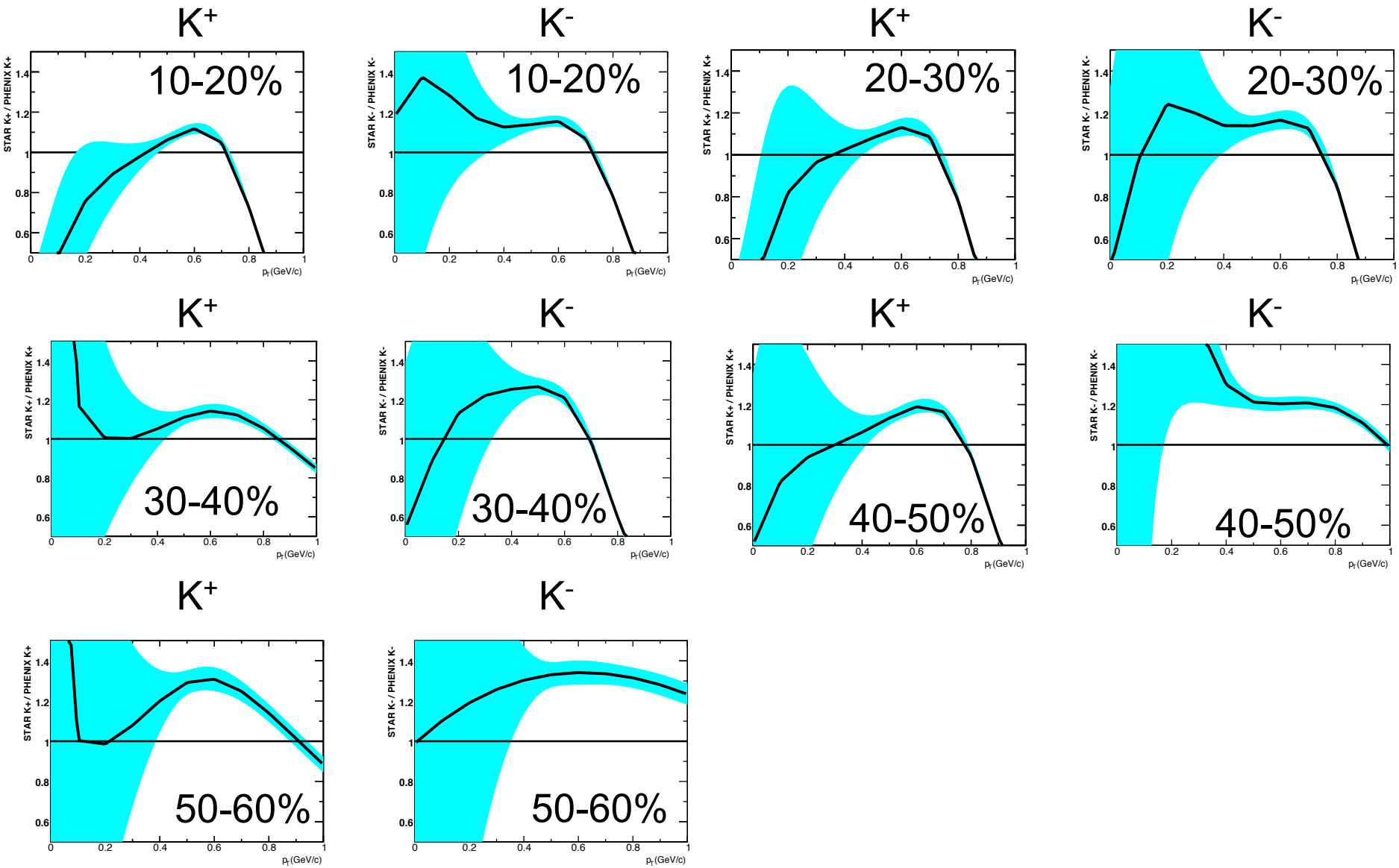




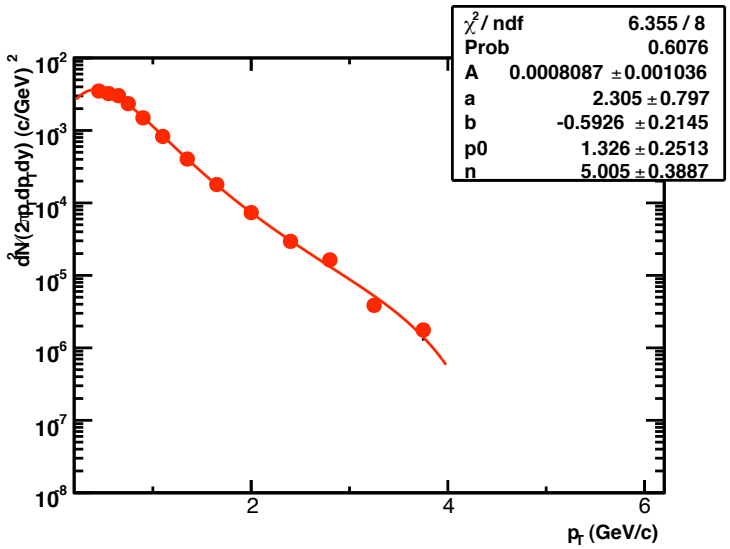
Comparison restricted by limited mtm coverage.

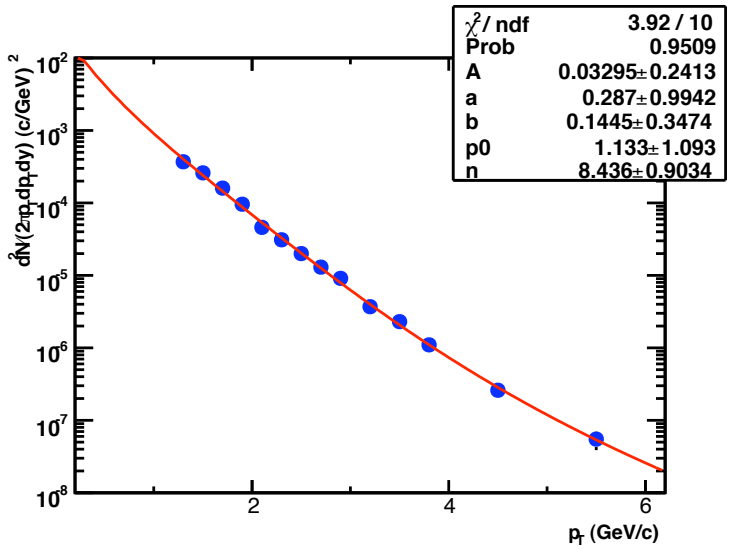
New data on high p_T $K^{\pm}$ but not compared here. Starts at p_T> PHENIX

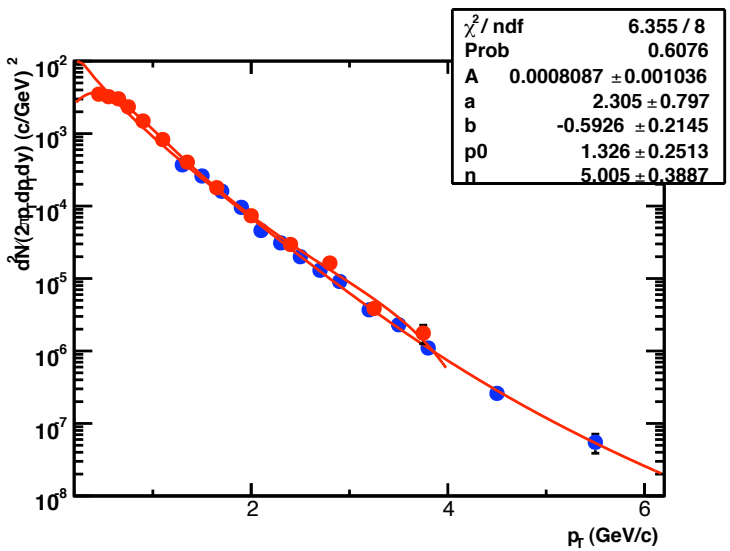
$K^{\pm}$ in Au-Au - STAR/PHENIX

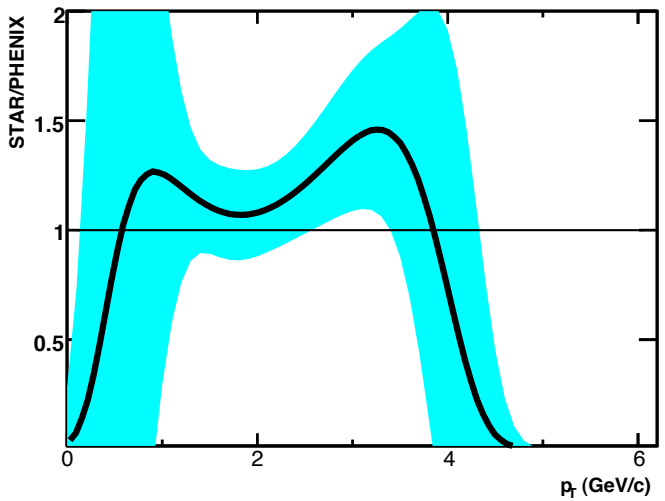


ϕ in p-p - STAR/PHENIX

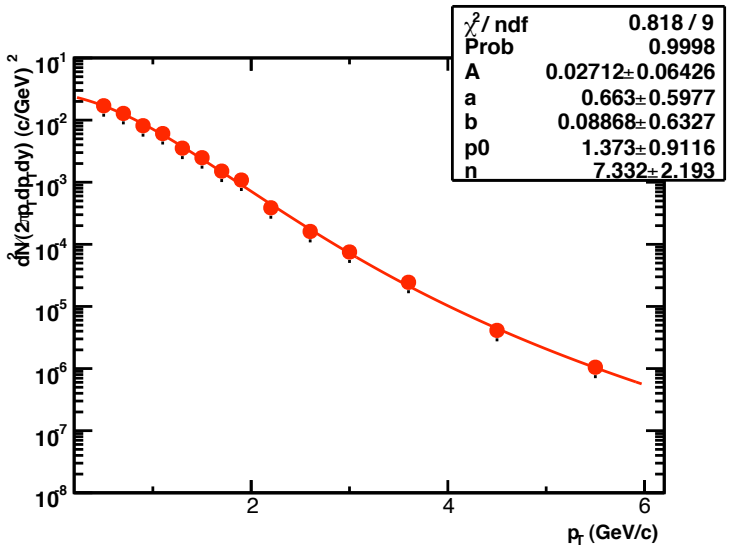


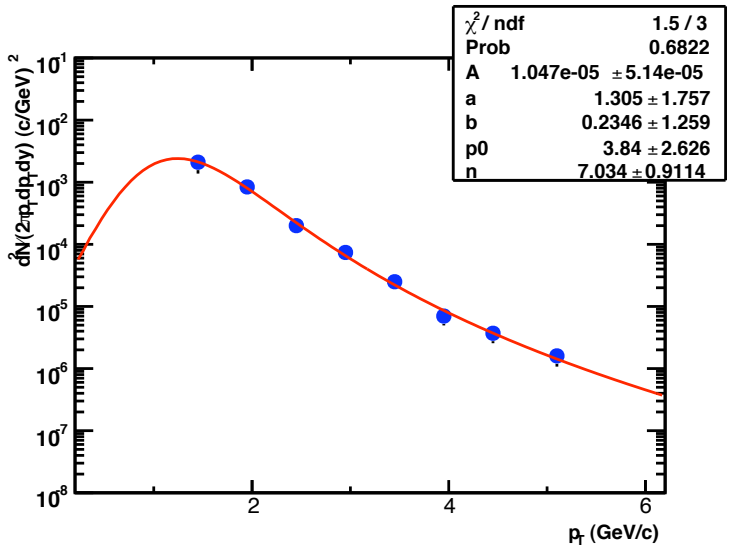


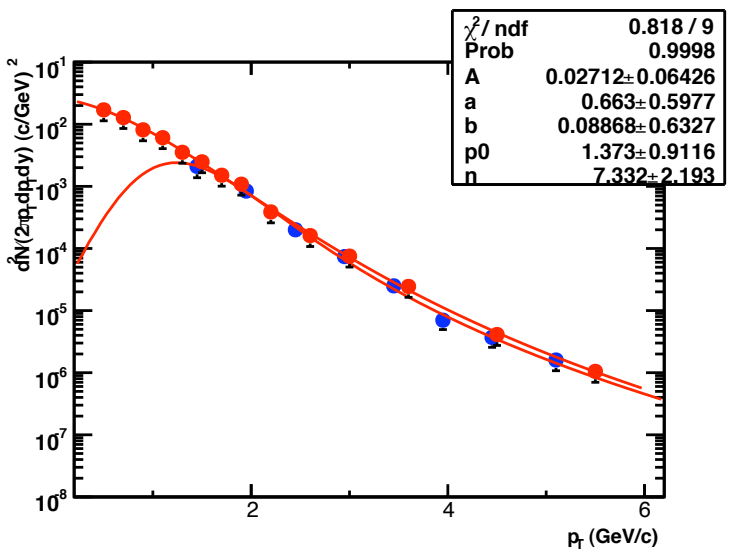


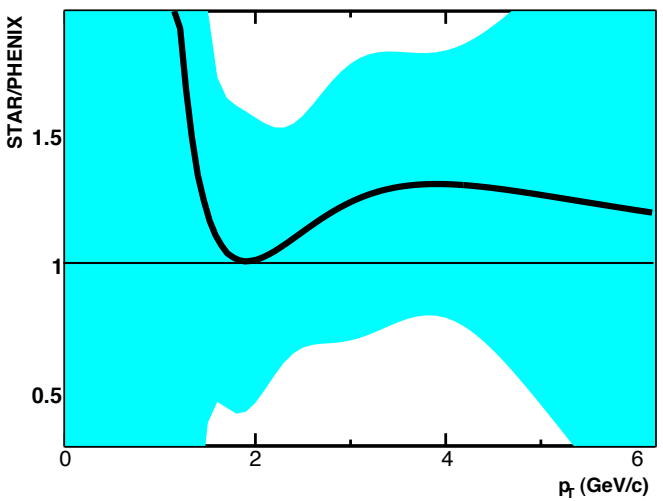


ϕ in Min-bias d-Au - STAR/PHENIX

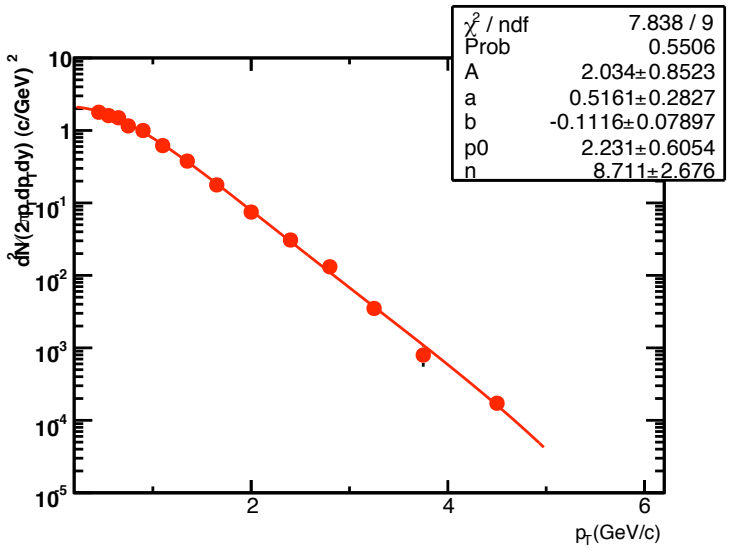


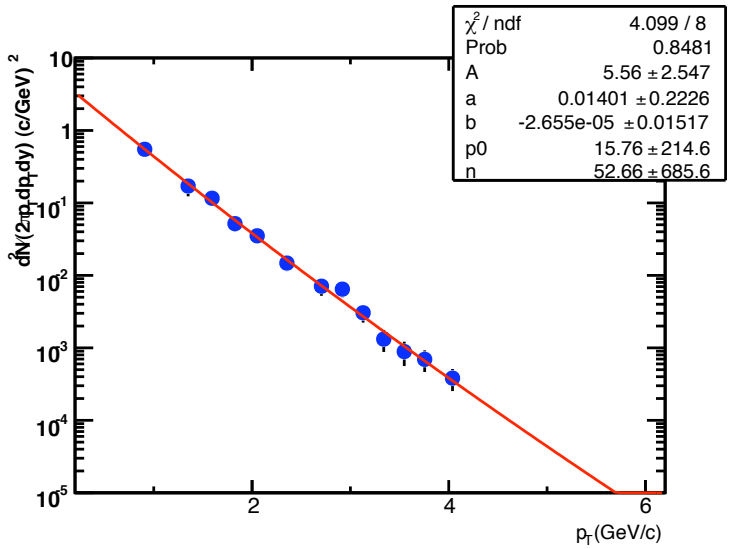


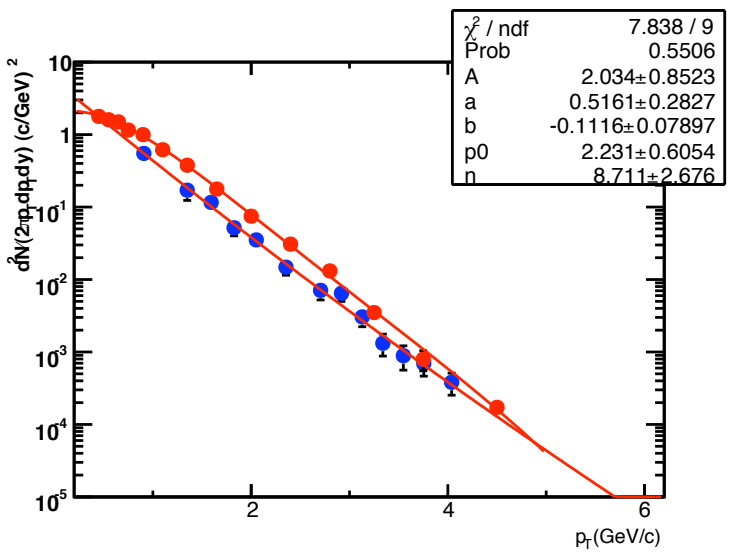


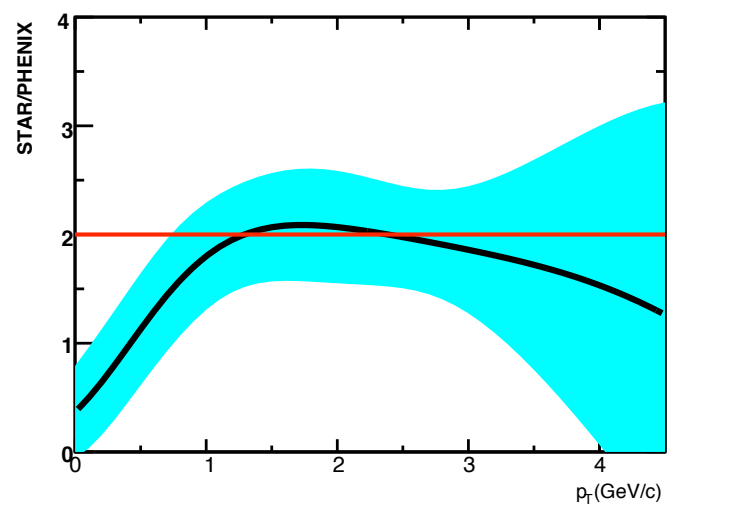


ϕ in 0-10% Au-Au - STAR/PHENIX

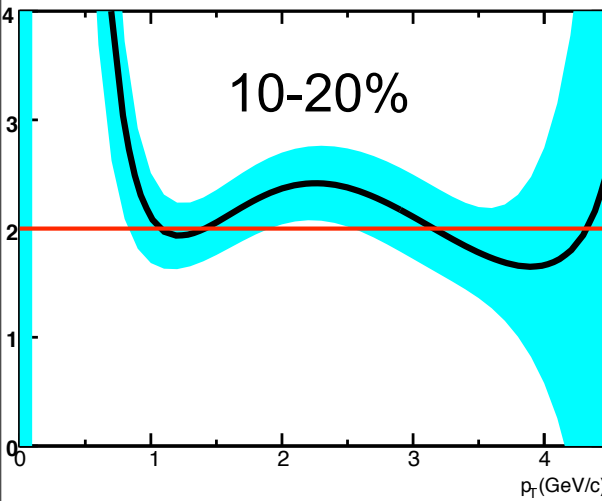


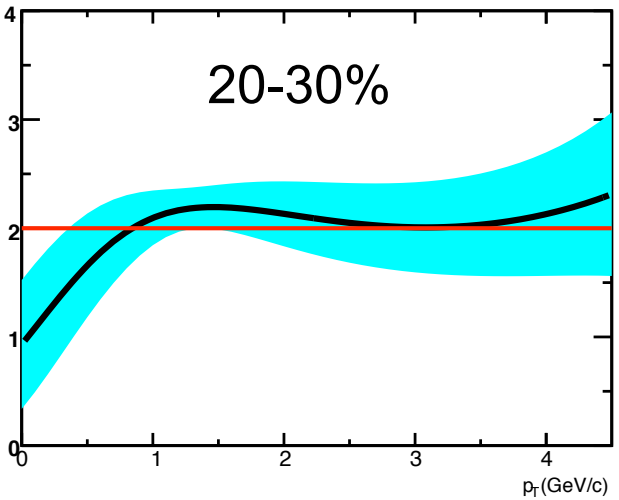


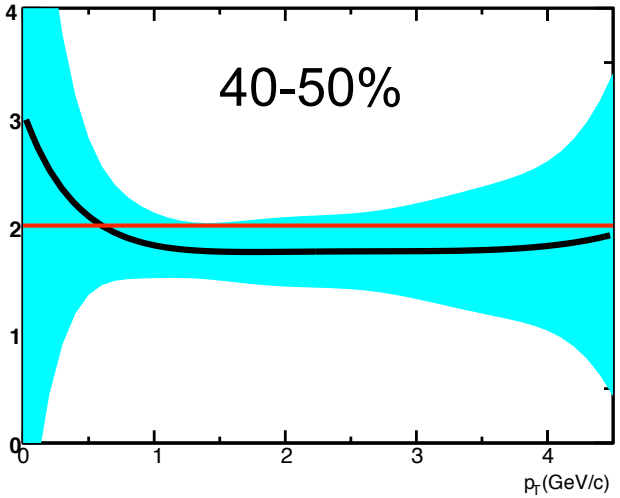


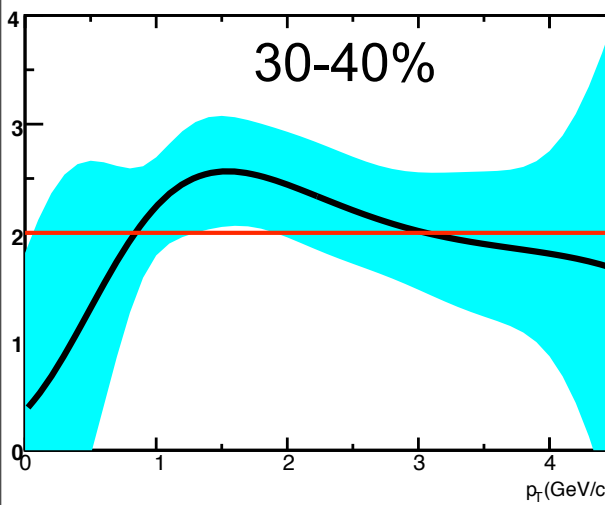


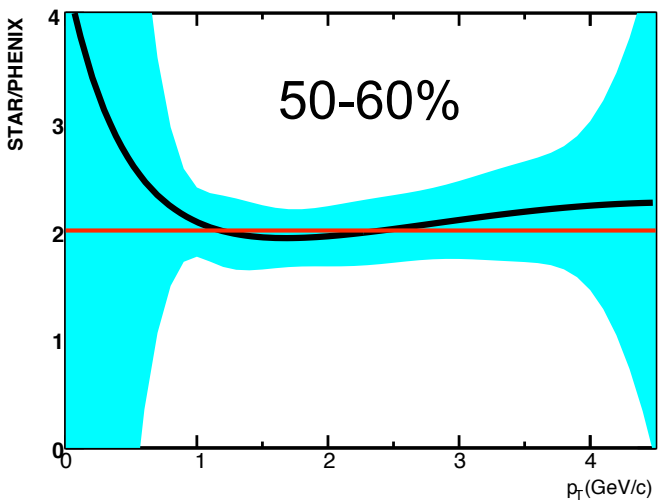
ϕ in Au-Au - STAR/PHENIX











- Factor 2 difference for all centralities
- flat as f^n p_T

Issues checked

Significant offset only Au-Au data :
BG estimate? - STAR and PHENIX checked STAR data, levels what you would estimate from single particle yields + PID range of STAR

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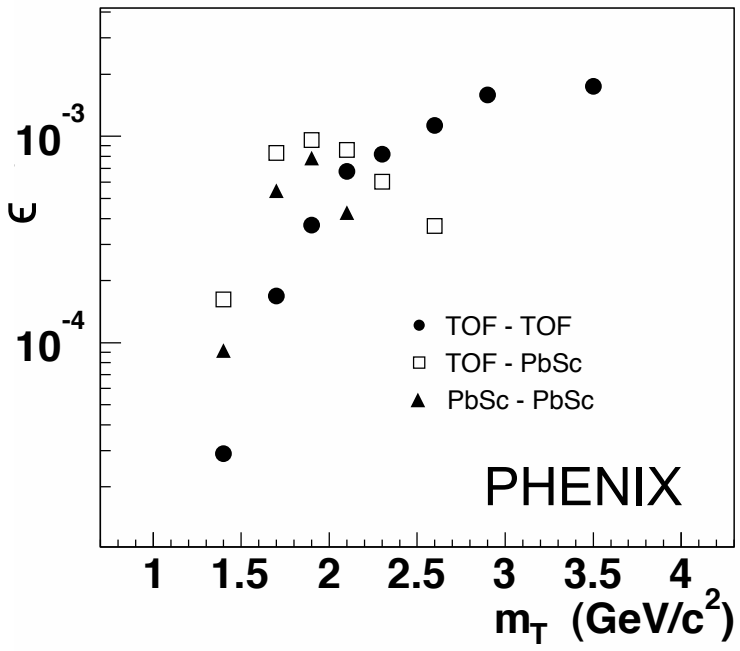
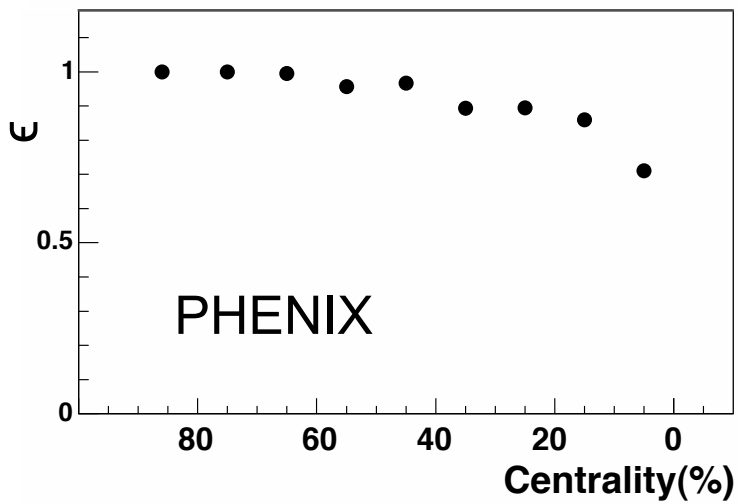
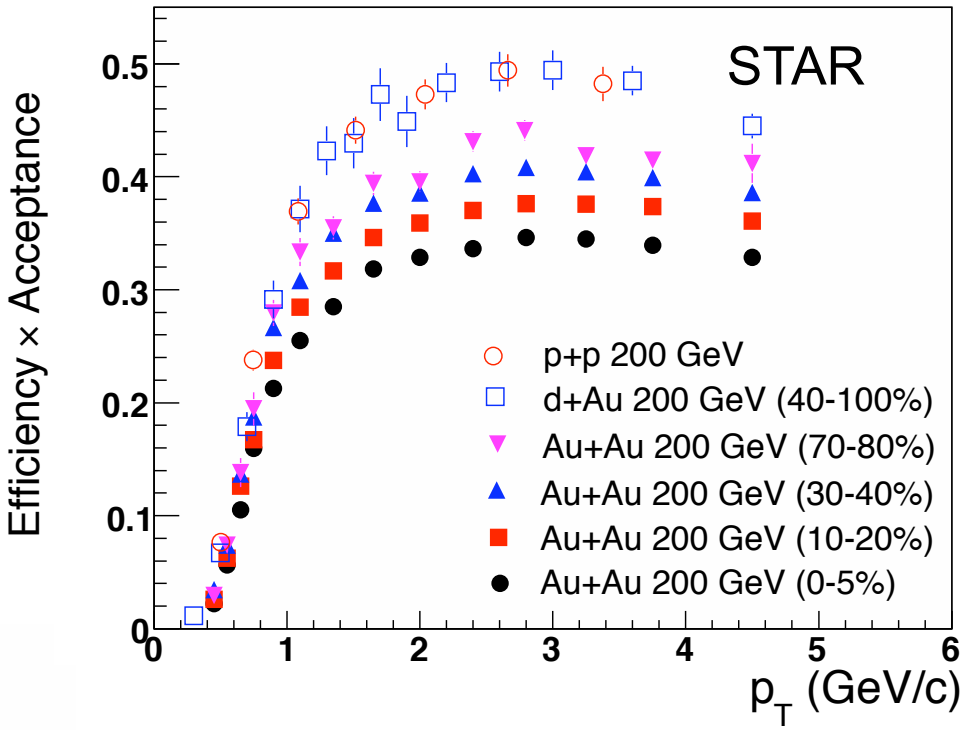
Effic.?

ϕ effic calculations







STAR: ~single ϵ^2 X accept
- can't be factor 2 higher

PHENIX: steep f^n of p_T
- surprising if make flat offset

Issues checked

Significant offset only Au-Au data :

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STAR effic.?

Seems unlikely

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Mass peak fit functions?

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STAR effic.?

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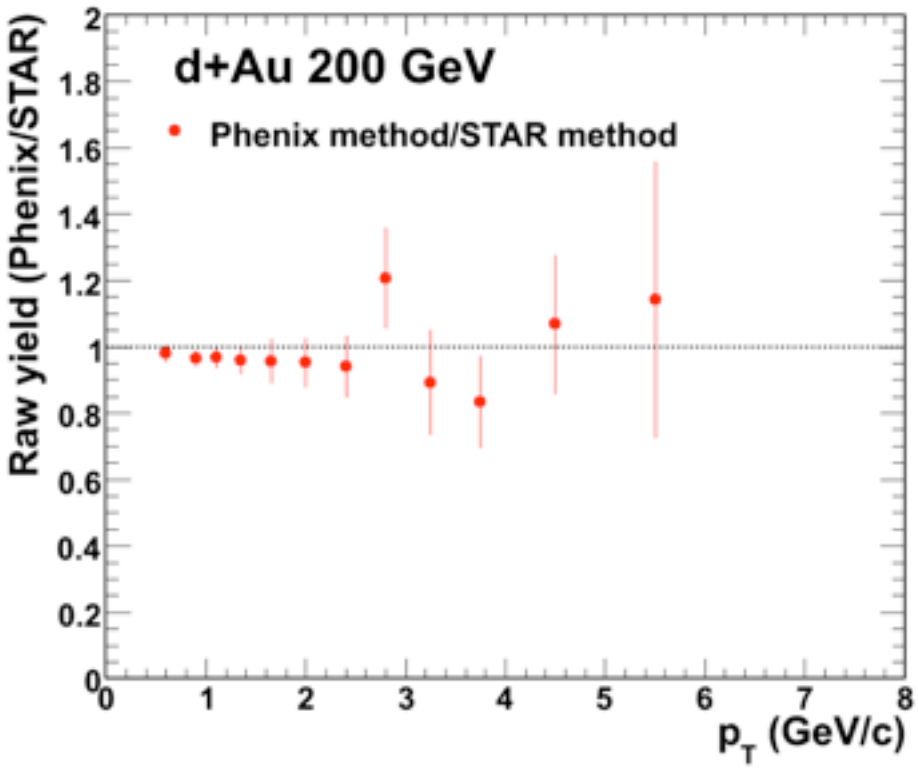
Mass peak fit functions?



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Significant offset only Au-Au data :

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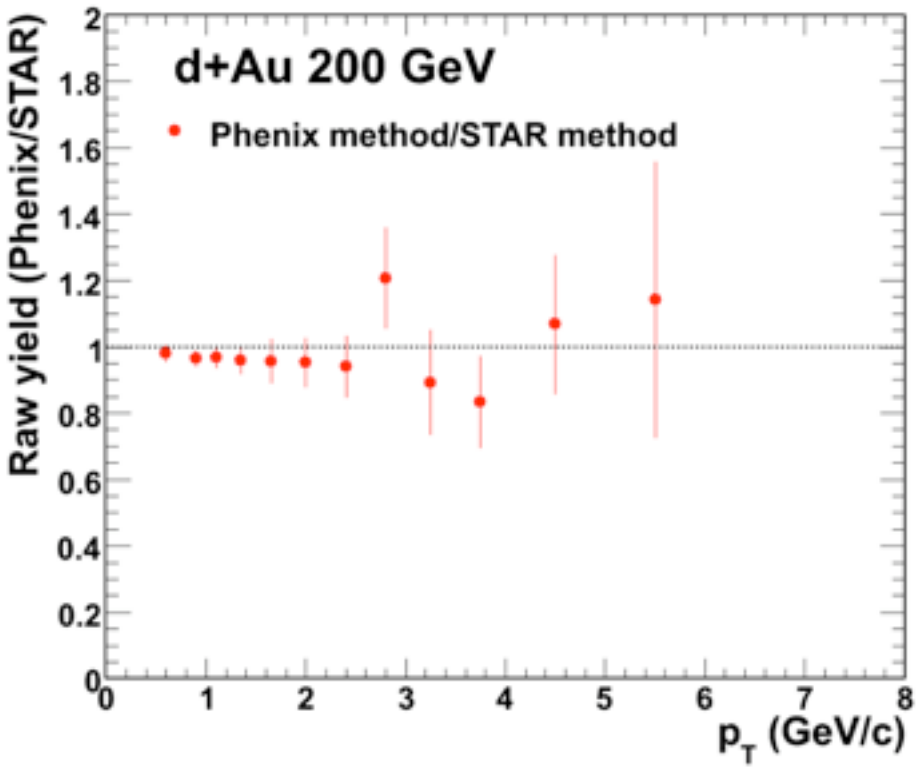
STAR effic.?

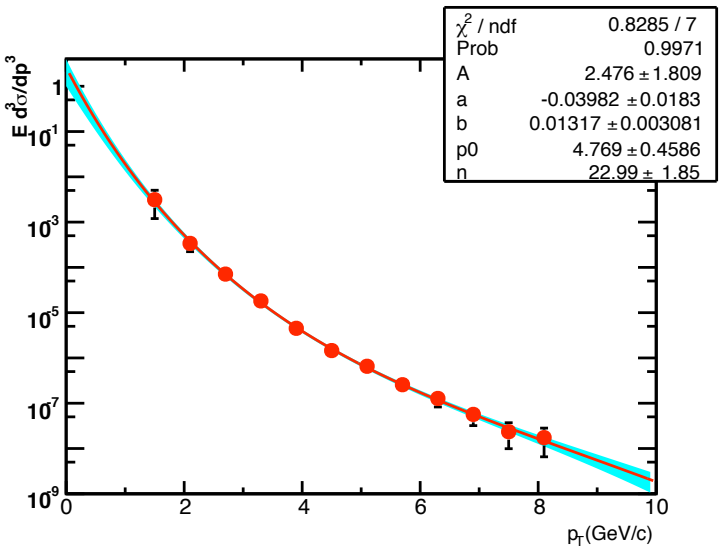
Seems unlikely

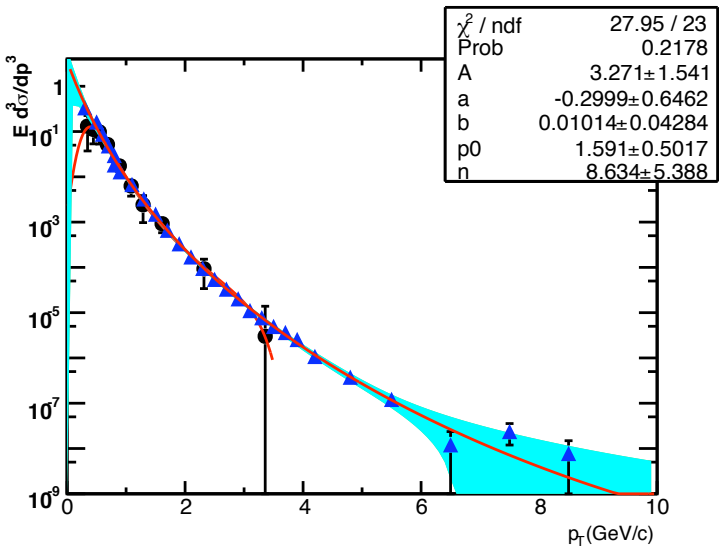
Mass peak fit functions?

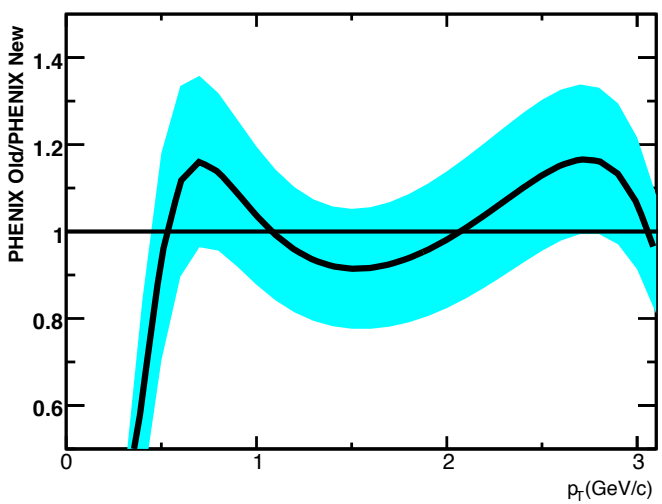
Only minor effect

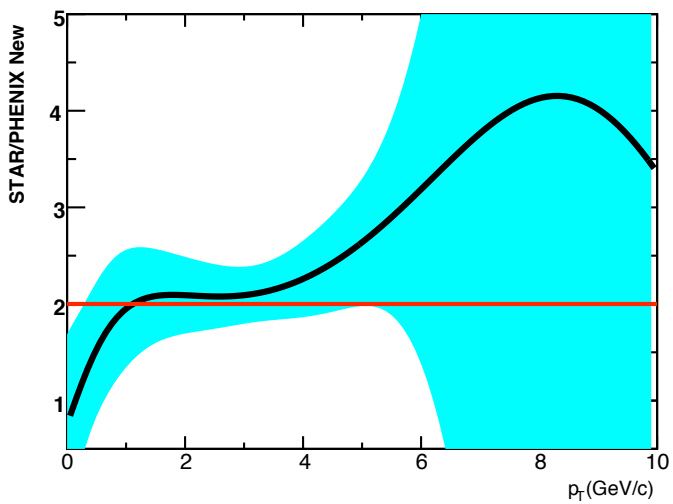


npe Au-Au 0-10% Central -

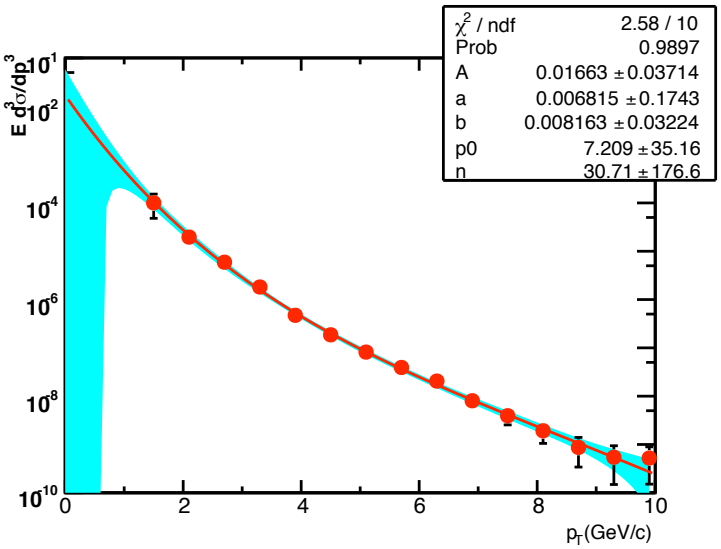


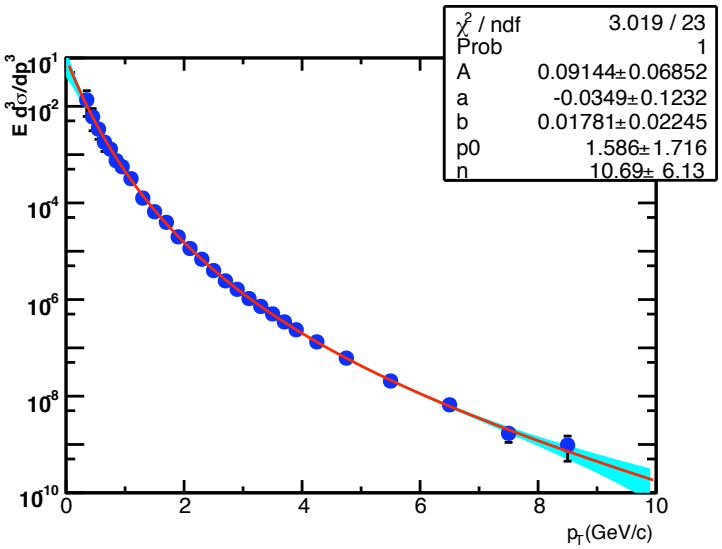


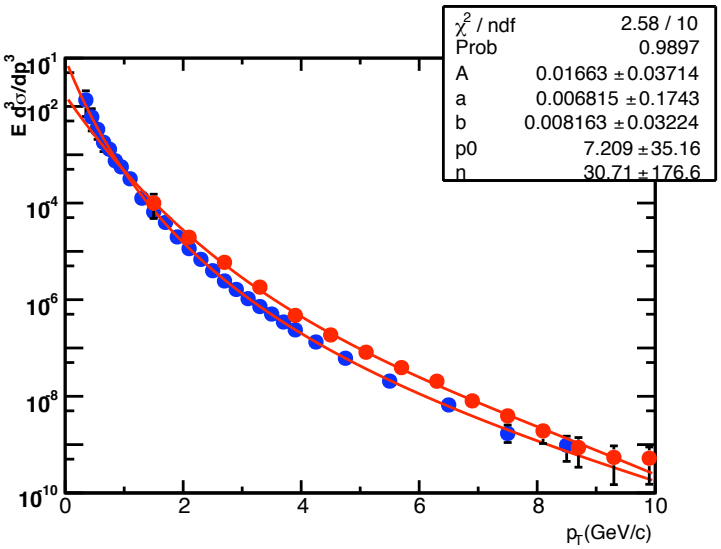


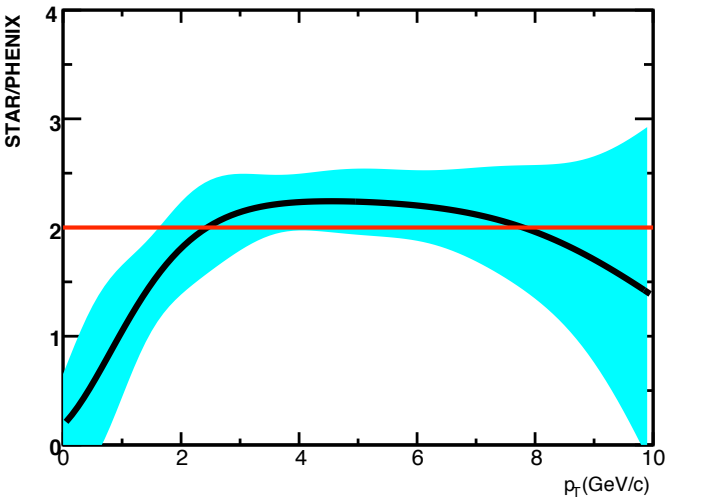


npe min-bias p-p - STAR/PHENIX









Summary

- Clearly issues with compatibility of data now (stat.) errors are small
- At best our data is 20% accuracy if you assume all experiments are correct
- Not one over arching issue
- ϕ in Au-Au as big a problem as the NPE

Summary

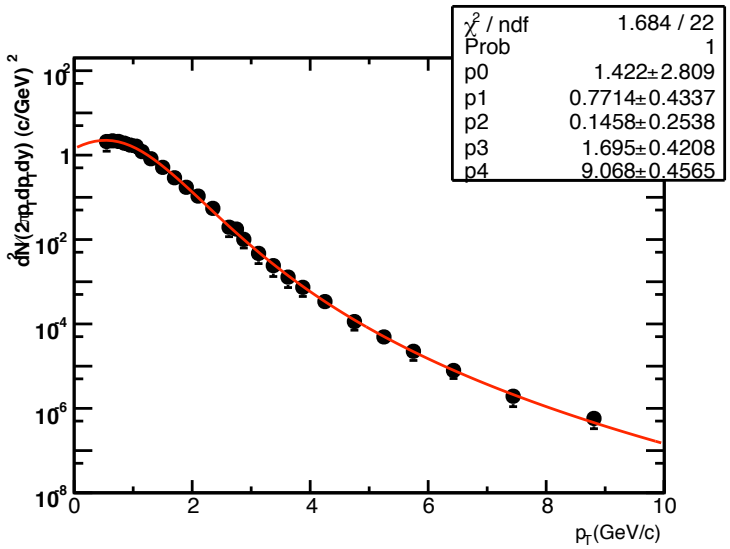
- Clearly issues with compatibility of data now (stat.) errors are small
- At best our data is 20% accuracy if you assume all experiments are correct
- Not one over arching issue
- ϕ in Au-Au as big a problem as the NPE

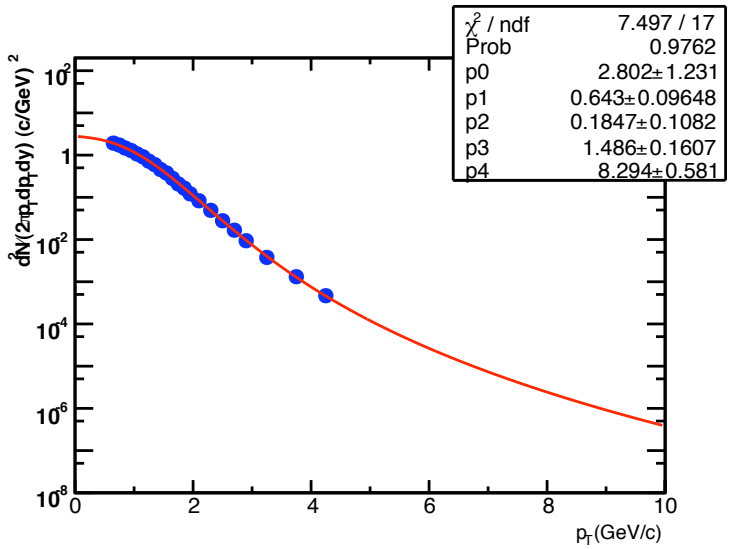
Can we PLEASE try and come up with a common format for our data tables.

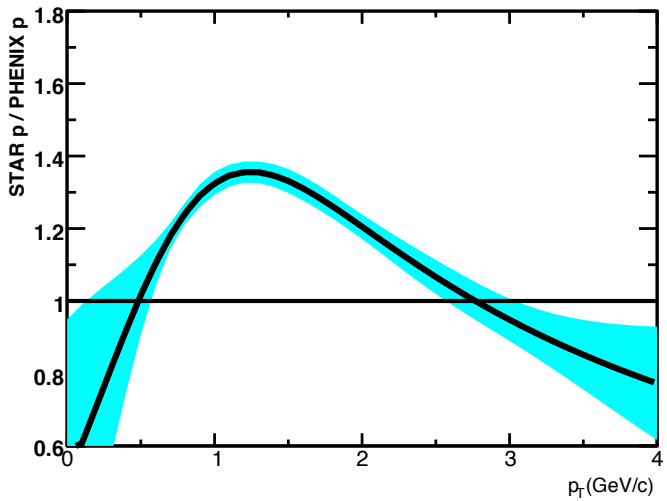
We want people to use our data!! Found essentially all possible variations including root files, + missing data

Getting almost impossible to find in the long lists of publications

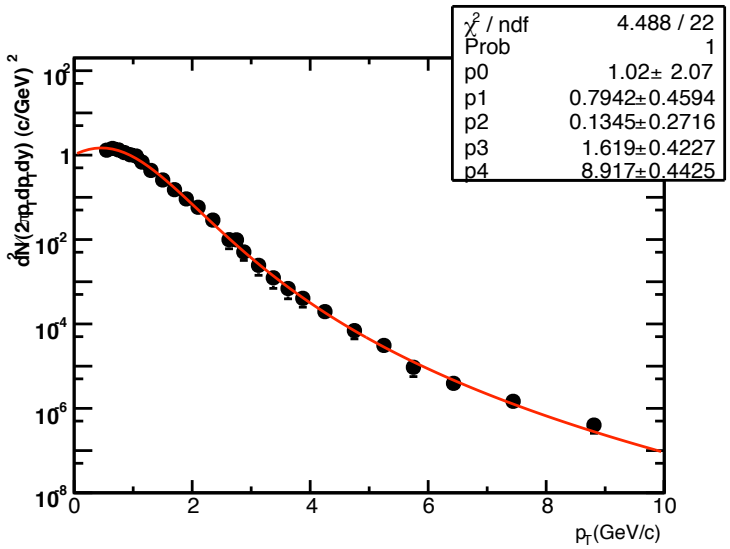
Feed-down corrected protons - Au-Au 10-20%

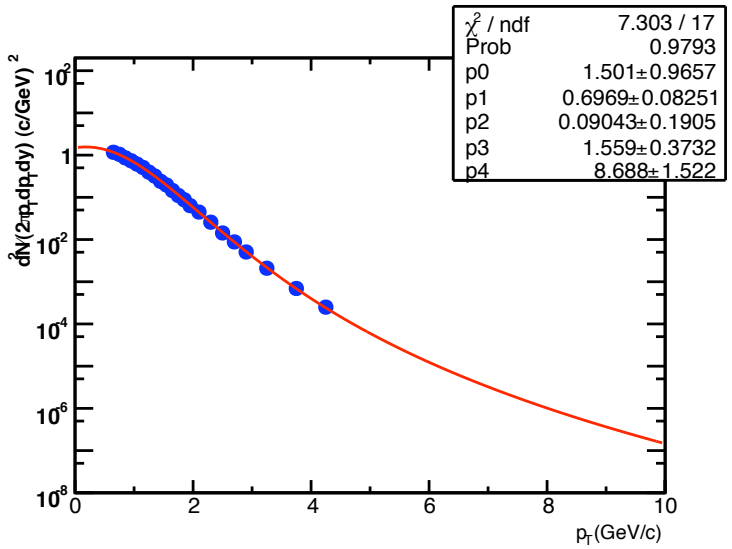


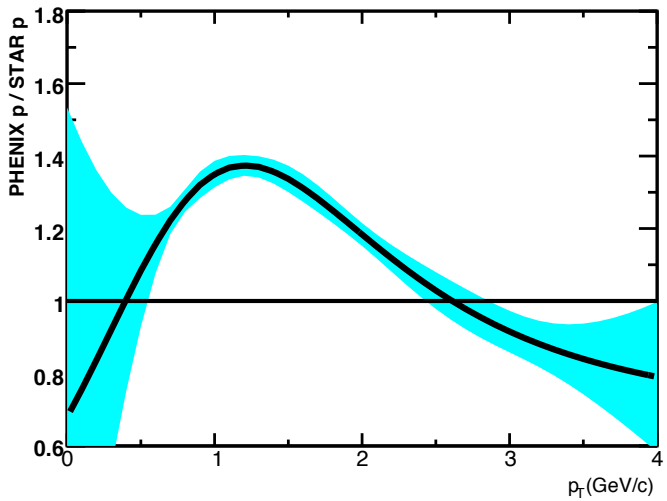




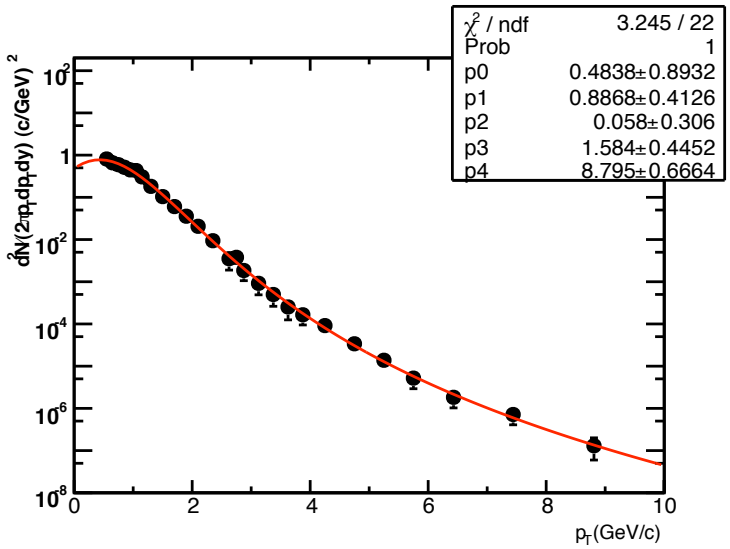
Feed-down corrected protons - Au-Au 20-40%

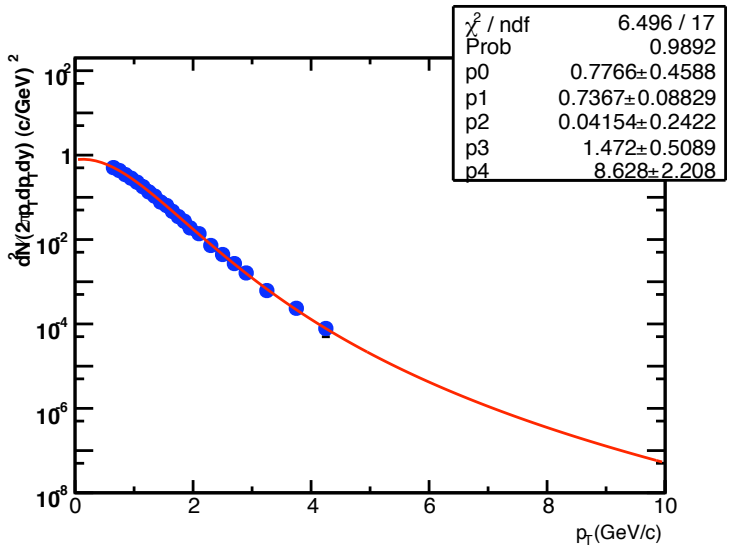


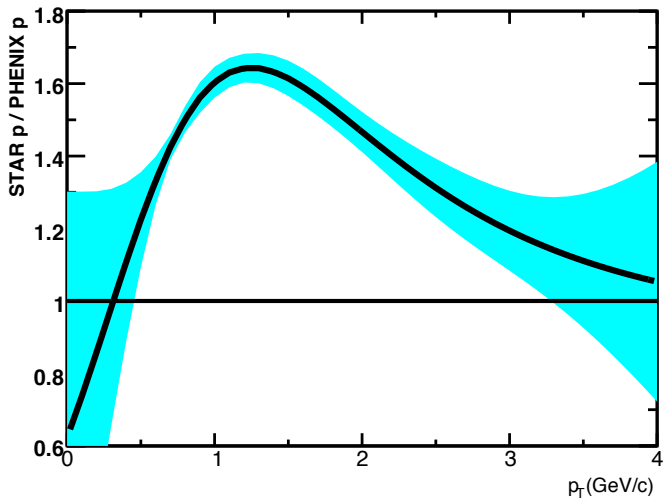




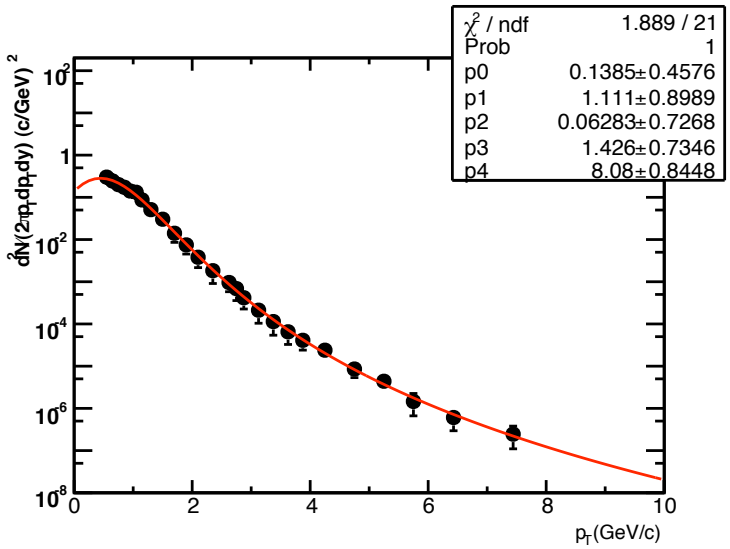
Feed-down corrected protons - Au-Au 40-60%

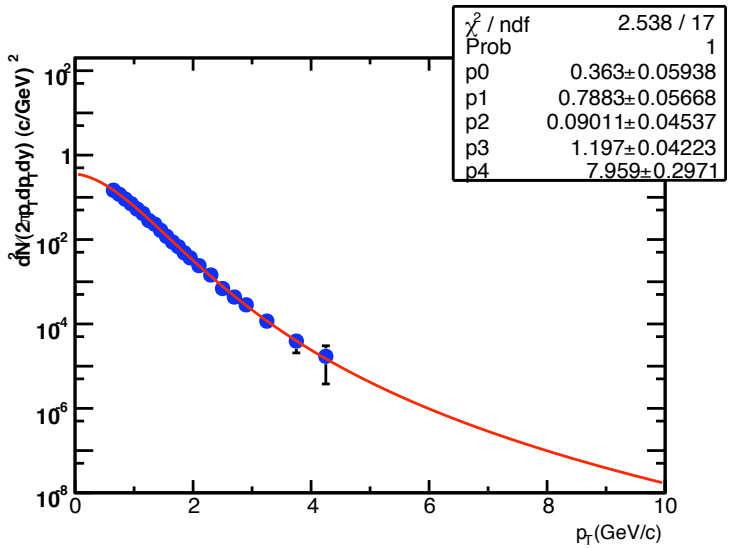


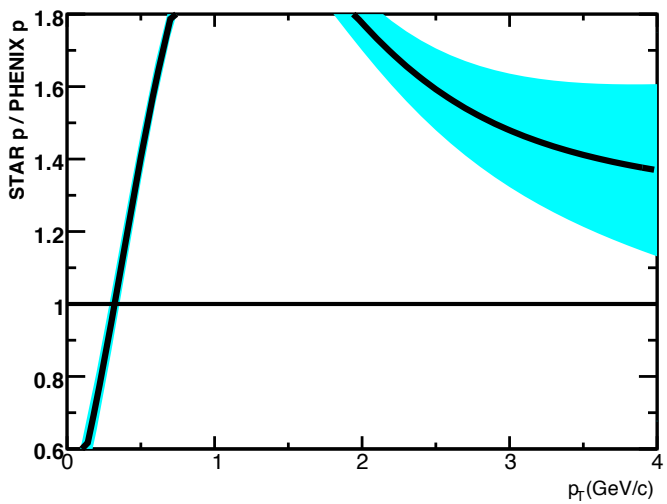




Feed-down corrected protons - Au-Au 60-80%







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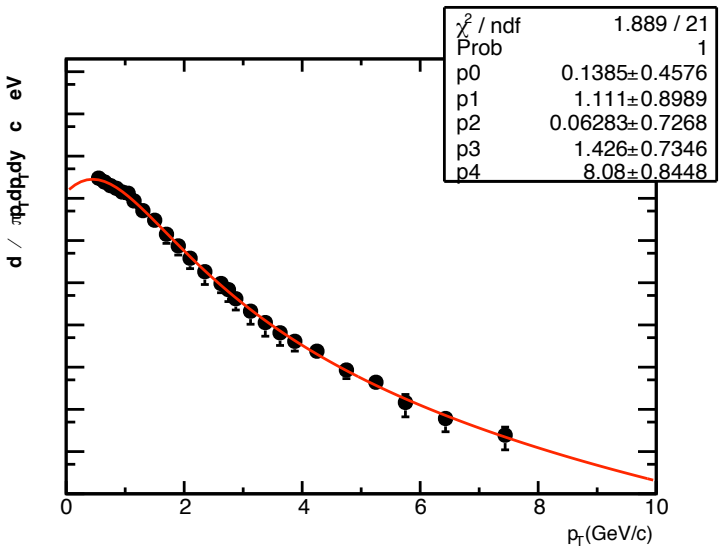

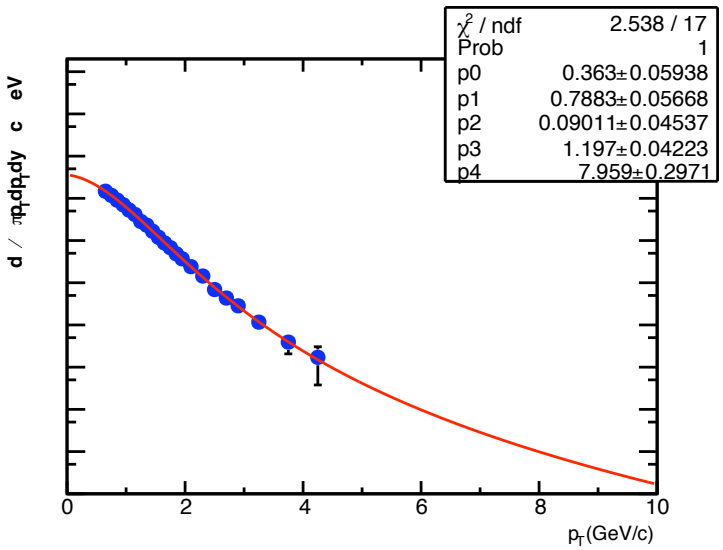

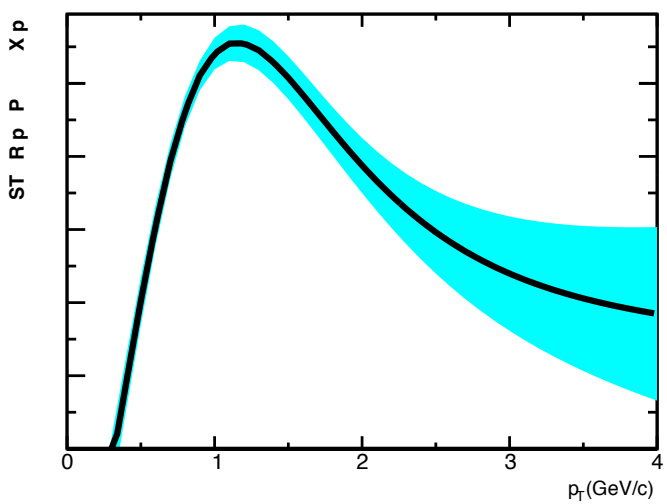

R_{AA} published vs R_{AA} from fit