High p_T charged hadron production in Au-Au collisions at 62 GeV

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Introduction

Hadron spectra and reference

R_{AA}

Summary

Where the Jet quenching start in √s?

- **Energy loss is predicted to be proportional to the**

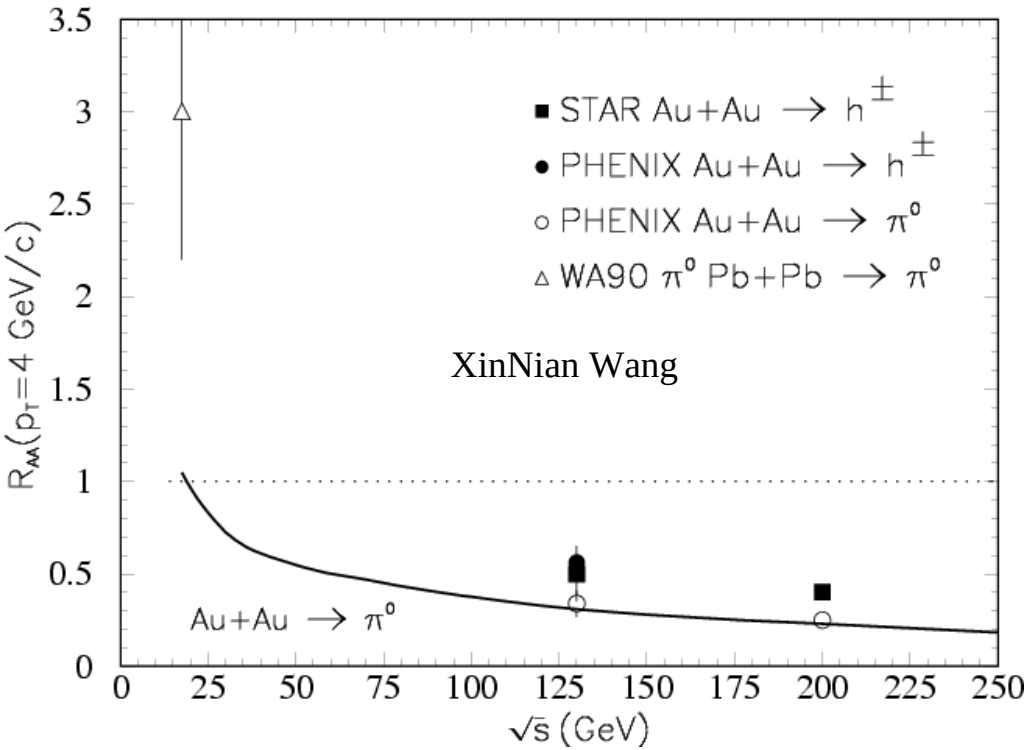
  System size and gluon Density

$$\Delta E \propto L \frac{1}{A_\perp} \frac{dN^g}{dy}$$

$$\frac{dN^g}{dy} \approx \frac{3}{2} \frac{dN^{ch}}{d\eta} \left| \frac{d\eta}{dy} \right|$$

- **By changing √s, one changes the medium density, thus change the expected amount of energy loss.**

- **Is the matter is still partonic?**

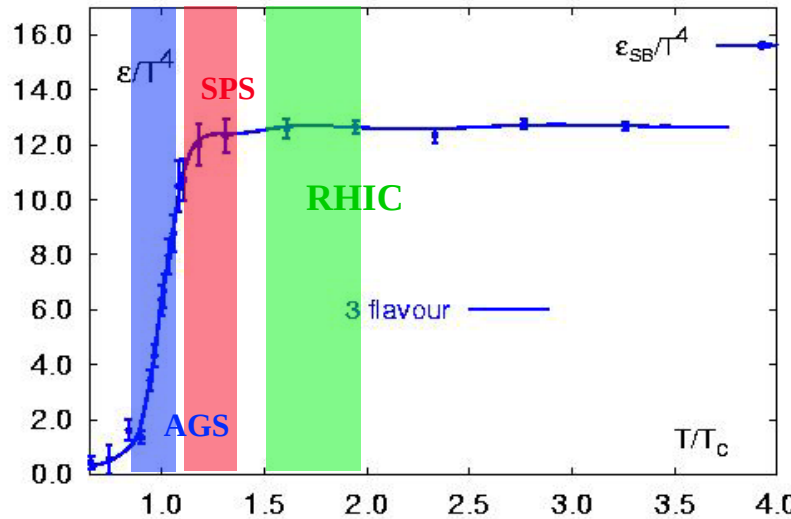


This is one of the remaining test on jet quenching theory

Also

SPS	$\varepsilon_i \sim 3$ GeV/fm^3	$T_i \sim 220$ MeV
RHIC	$\varepsilon_i \sim 5$ - 15 GeV/fm^3	$T_i \sim 250$-350 MeV

- From SPS, to RHIC, energy density only changes by factor of 3. However, the high p_T physics changes dramatically
  - A enhancement of high pT particle is seen at SPS
  - Factor of 5 suppression at RHIC.

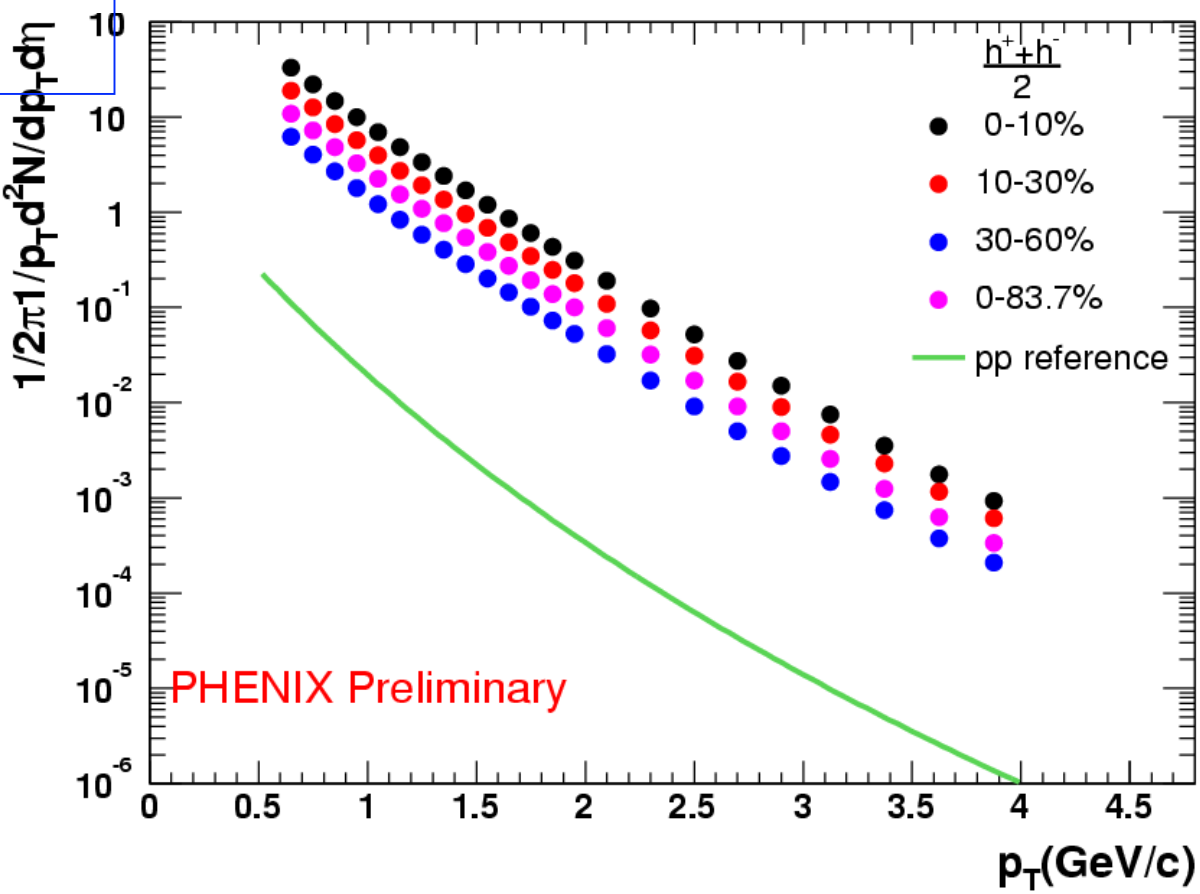


- $\sqrt{s}$ dependence of R_{AA} provide valuable information on other competing mechanisms
  - Cronin → Larger
  - Recombination → Smaller
  - Shadowing → Smaller
  - Gluon saturation → Smaller

Charged hadron and π^0 spectra @ 62 GeV

- 40 million events
- Charged data up to 4GeV/c
- Systematic uncertainty
  - ~12%

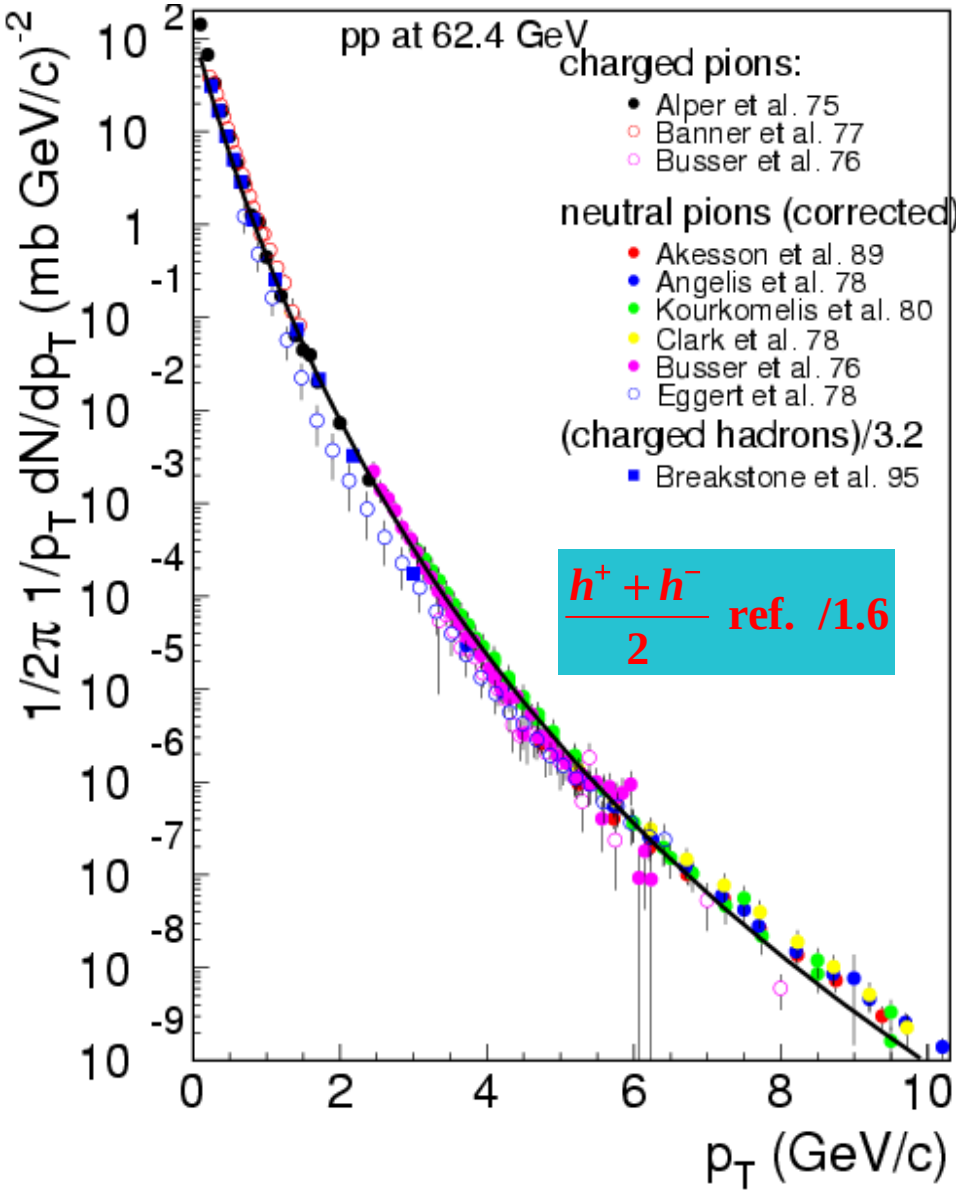
Minimum Bias, 0-10%, 10-30% and 30-60%



Charged hadron reference

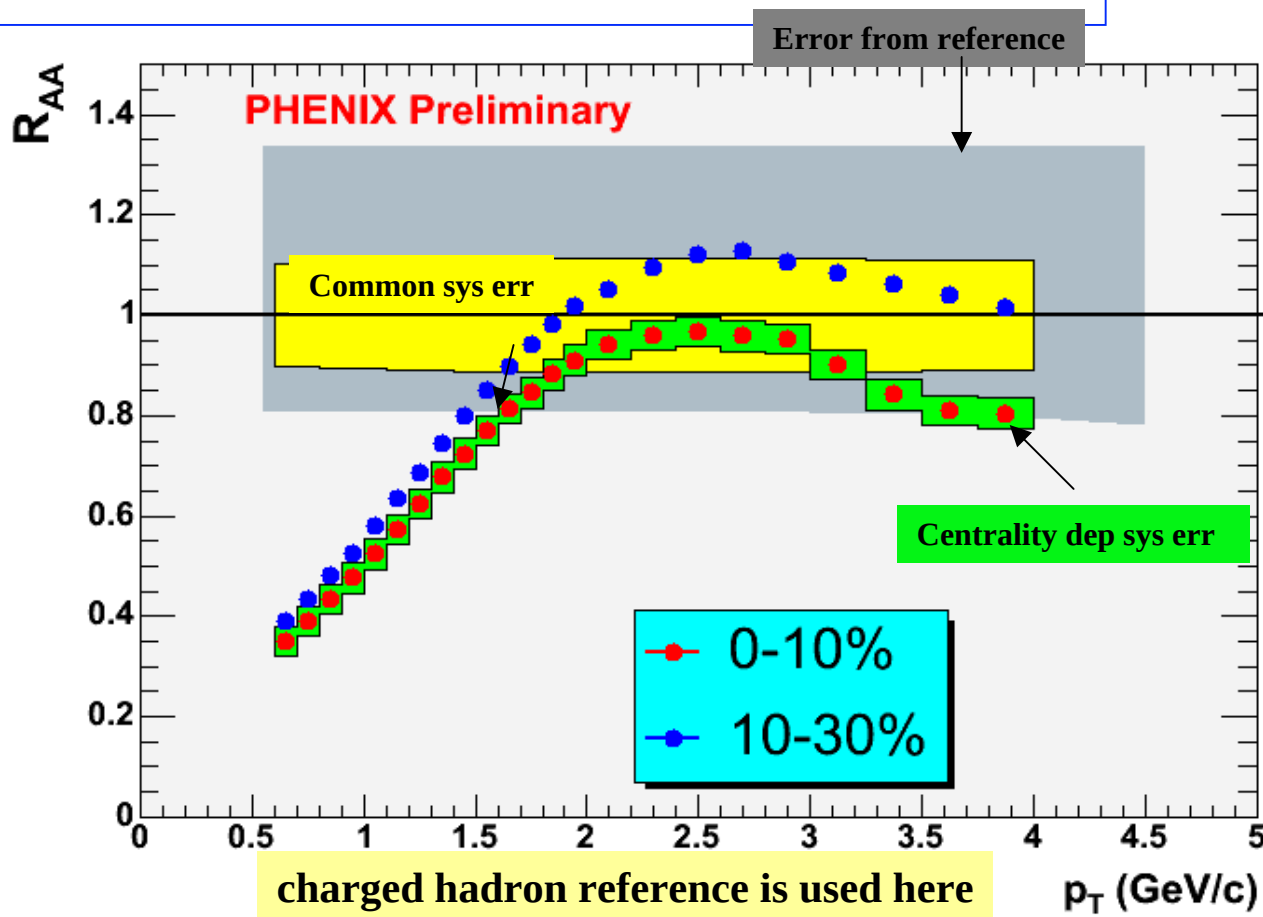
- π,k,p data from ISR are first combined to obtain charged hadron data at low √s
- Charged hadron data are then interpolated between ISR, UA1 and PHENIX to obtain the reference data at √s 62.4 GeV
- A fit using modified hagdon functional form is used to obtain parameterization for charged hadrons

- Right Fig. shows the charged reference/1.6 and compared with π^0 and Breakstone which is not used in the fit. ($(h^+ + h^-)/2\pi^0 = 1.6 \pm 0.16$ measured in ISR and RHIC)
- Charged hadron have ±25% systematic errors and the upper error increase to about 50% at 7 GeV/c



R_{AA} for charged hadron at 62GeV

- R_{AA} measurement out to 4GeV/c
- Ratio reach maximum around unity in 2-3 GeV/c then slowly goes down
- The peak position seems shift to higher in p_T for less central collision
- Strong centrality dependence in 2-4 GeV/c.



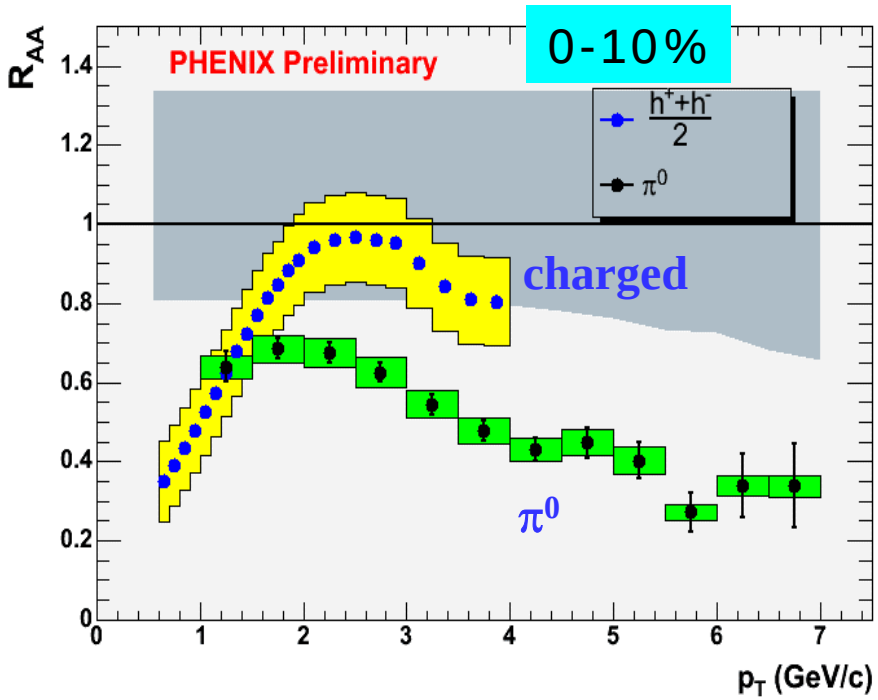
charged hadron reference is used here

charged hadron and π^0 R_{AA} compared

- **Common reference p+p→Charged+X is used**
- **π^0 yield is divided by (charged reference)/1.6**

See Stefan's talk

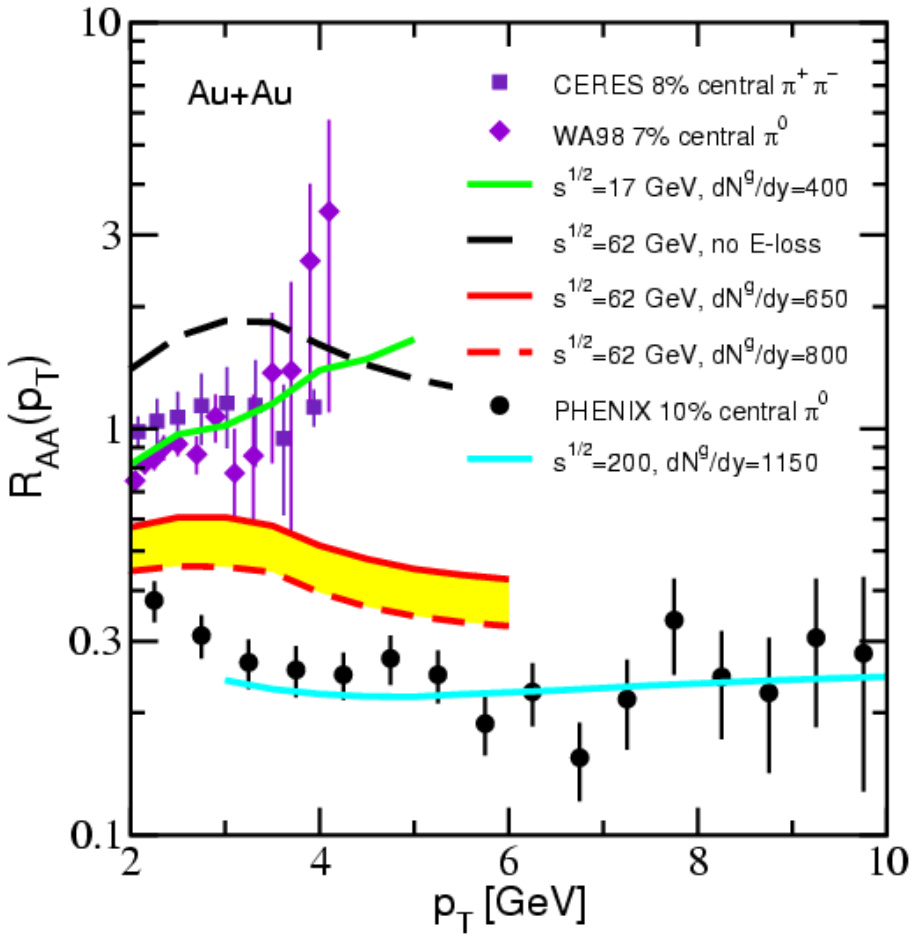
- **Discrepancy between charged and π^0 clearly persist out to 4 GeV/c or higher in p_T**
- **Large proton contribution up to at least 4GeV/c**



Jet quenching again?

- It is important to understand the strong canceling effect between enhancement (Cronin) and suppression (quenching)
- Probably energy loss dominate only at p_T>4 GeV/c
- The energy loss fluctuation need to be taken into account

- Charged hadron suppression is further complicated by other soft physics
  - Cronining effect
  - coalesce effect

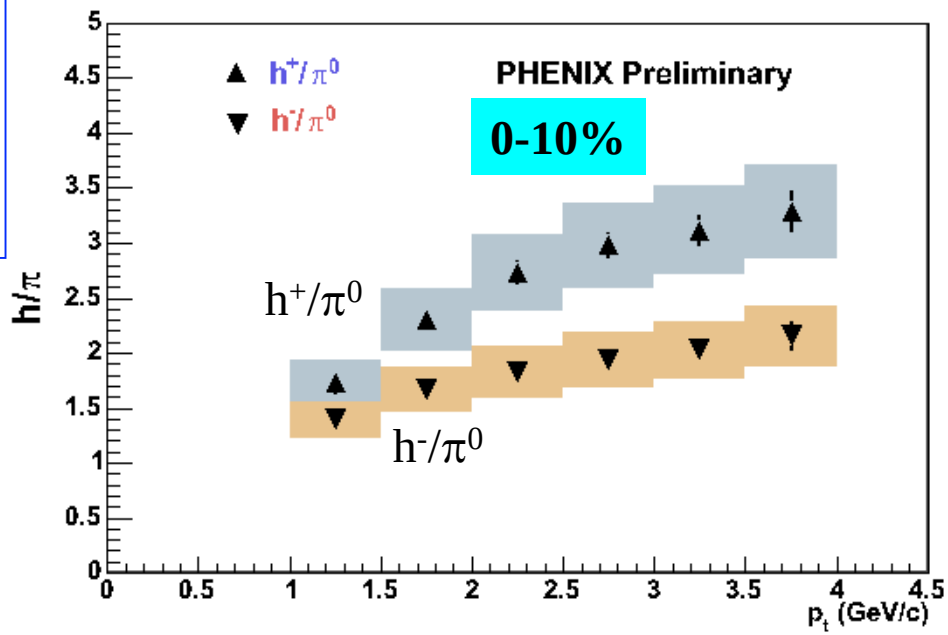


I.V., nucl-th/0404052

Charged hadrons to pion ratio

- **Difference between negative and positive hadron to pion ratios**
  - **Due to difference between anti-proton and proton yields**
  - **Consistent with proton/pion ratio**

See Tatsuya's talk



- **Ratios monotonically increase as p_T**
  - **Similar to 200GeV data if we average negative and positive hadrons**
  - **h/pi=2-3 at intermediate p_T**
  - **h/pion =1.6 in p-p collisions**

Conclusions

- **High p_T charged hadron data from Run-4 62GeV**
  - **Spectra measured to 4 GeV/c**
  - **p-p references are build from ISR data with decent systematic error**
  - **R_{AA} is around unity at p_T>2.5 GeV/c**
    R_{AA} is larger than that for π^0.
    Stronger Cronin and more protons

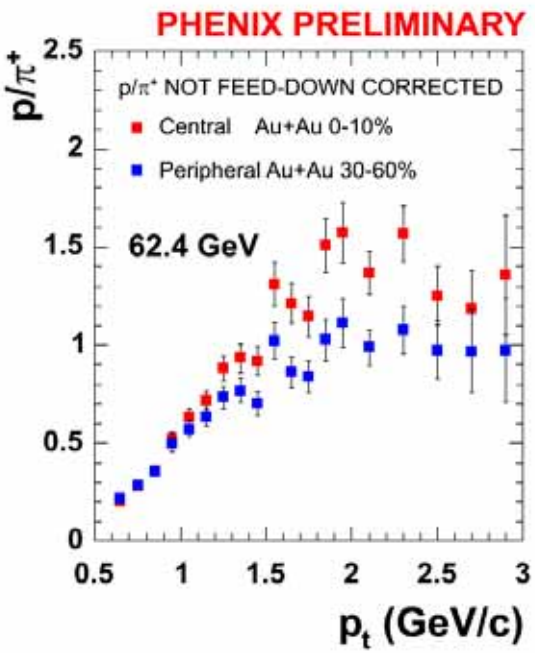
- **Charged hadron to π^0 ratio**

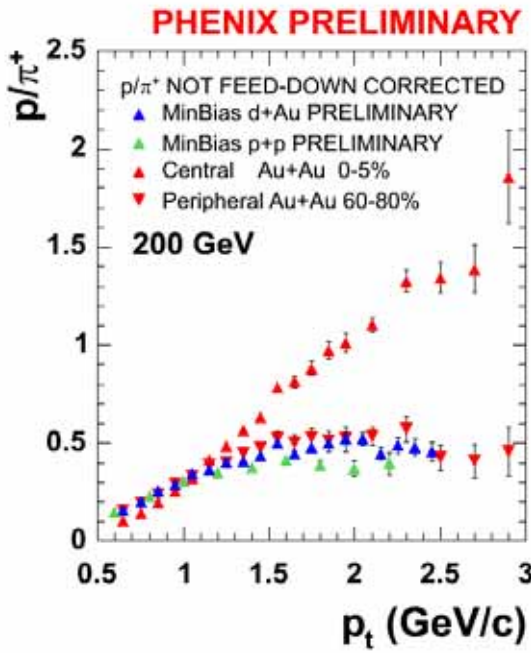
  - **Similar to 200GeV (h/pi=2-3 at intermediate p_T)**
  - **exceed the expected value of h/π=1.6**
  - **Large p/π ratio indicate large proton content similar to 200 GeV**

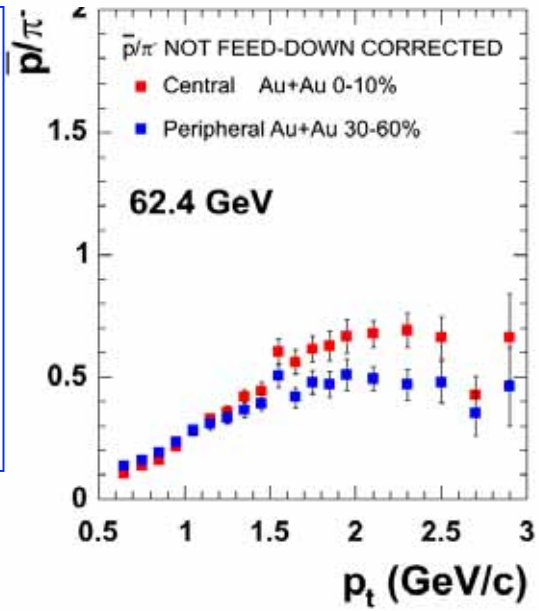
Compare with p/π ratio measured directly @ 62GeV

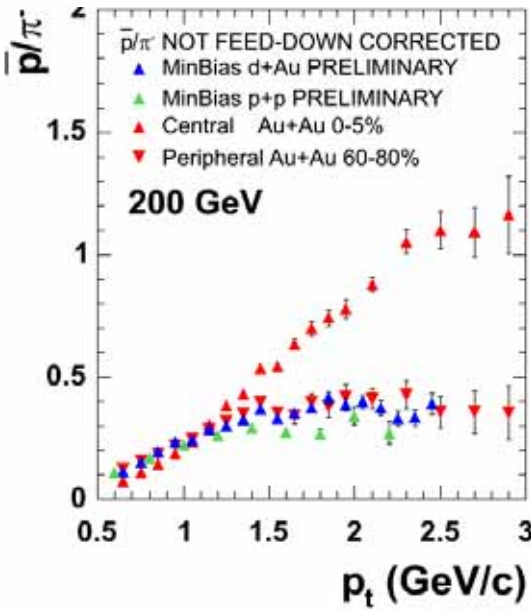
- **Large proton contribution at intermediate pT persist at √s=200,130, and 62.4 GeV**

- **Less Anti-proton in central collisions at 62GeV than 130 and 200 GeV**
  - **Reflects pbar/p ratio decrease towards smaller √s**









PHENIX set up @ 62 GeV

Trigger and Centrality

Beam-Beam Counters:BBC

$3.0<|\eta|<3.9$, $\Delta\varphi = 2\pi$

Zero-Degree Calorimeters: ZDC

$|\eta| > 6$, $|Z|=18.25$ m

Charged particle Tracking

$|\eta|<0.35$, $\Delta\varphi=\pi$

Drift Chamber :DC

R_{DC} = 2-2.4 m

Pad Chamber 1:PC1

R_{PC1} = 2.4 m

PC2, PC3 and RICH used for background rejection