identified particle measurements at large transverse momenta from p+p to Au+Au collisions at RHIC

Richard Hollis

for the STAR collaboration

UIC UNIVERSITY OF ILLINOIS AT CHICAGO

19-24 February 2007

Lake Louise Winter Institute

outline

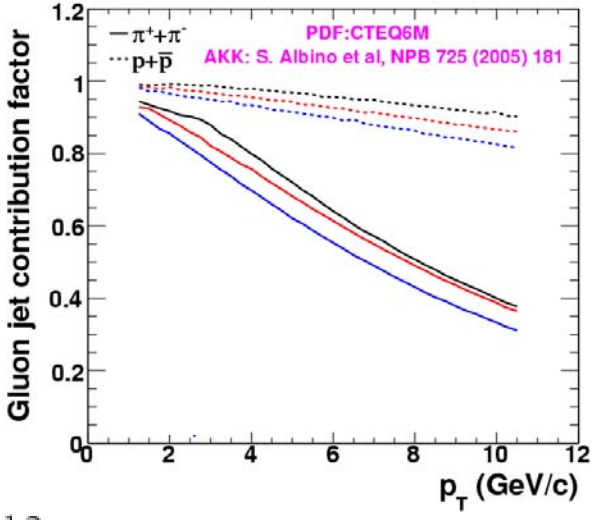
- motivation
- data analysis
- data ratios
- interpretation
- summary

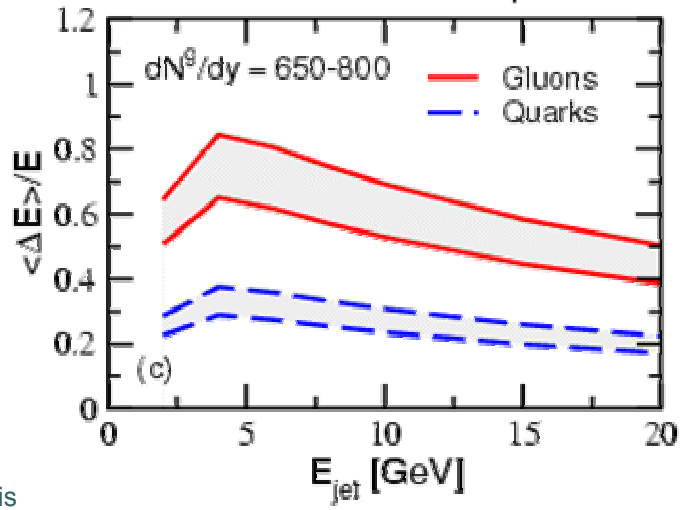
motivation

motivation:

why identify particles at high-p_T?

- why do we look at identified particles?
  - at high-p_T affords insight into gluon and quark jet production
- gluon jets produce more baryons than quark jets
- probe energy loss for quark and gluon jets
  - a difference was expected, but not seen

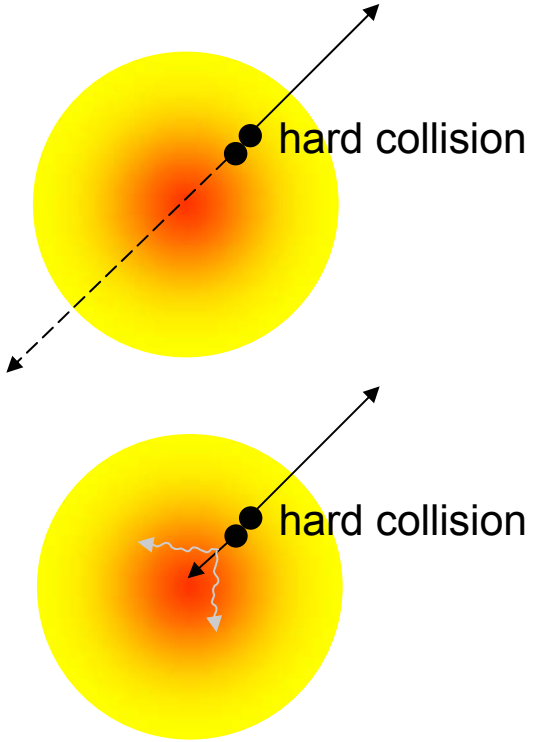




motivation:
partonic path length

- in the simplest way:

  can look at the modification of particle production due to the created medium



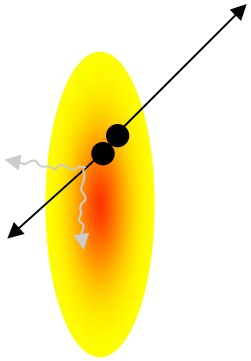
central Au+Au collisions

motivation:
partonic path length

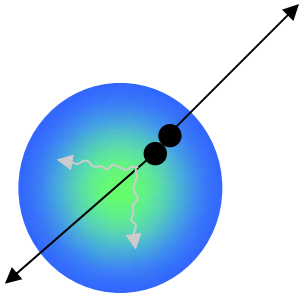
- in the simplest way:

  can look at the modification of particle production due to the created medium

- varying the collision centrality/system size varies the path length



centrality
peripheral Au+Au collision

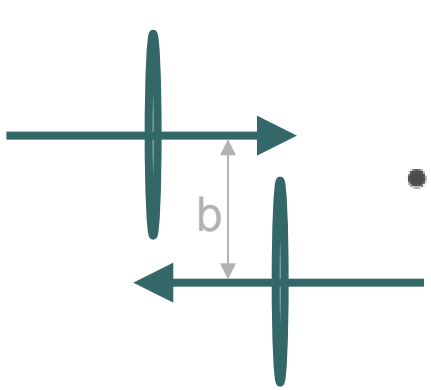


system size
central Cu+Cu collision

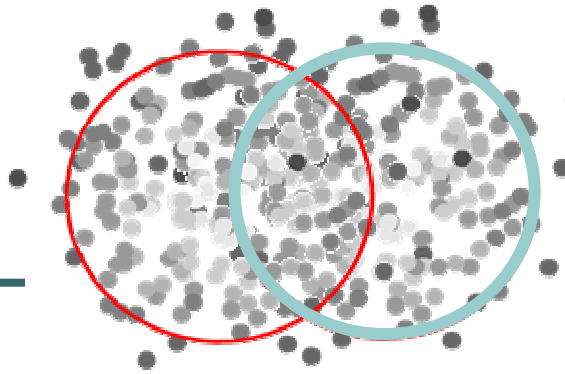
motivation:

participants and collisions

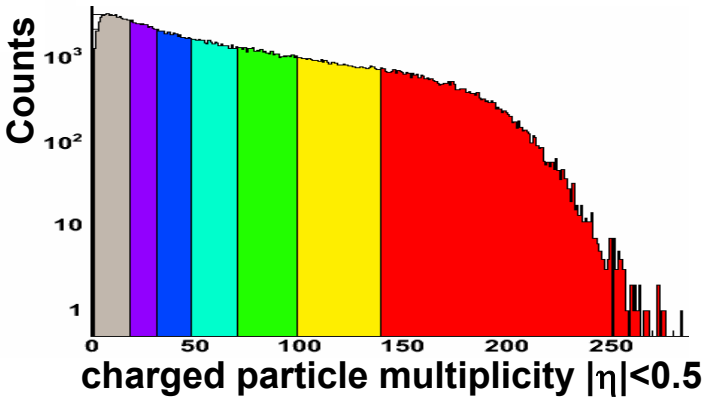
- nuclear collisions are characterized by the volume overlap
- divide data into fractional cross-section
- use models to derive quantities such as N_{part}, N_{coll}, b



side view



beam view

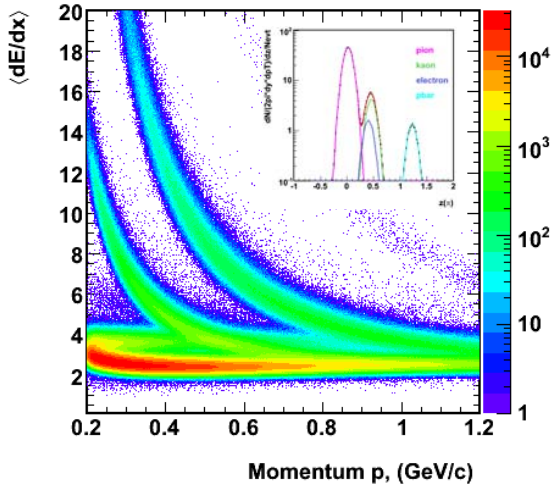


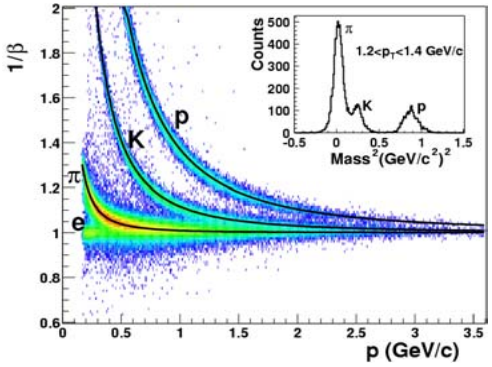
defines the “centrality” of the collision

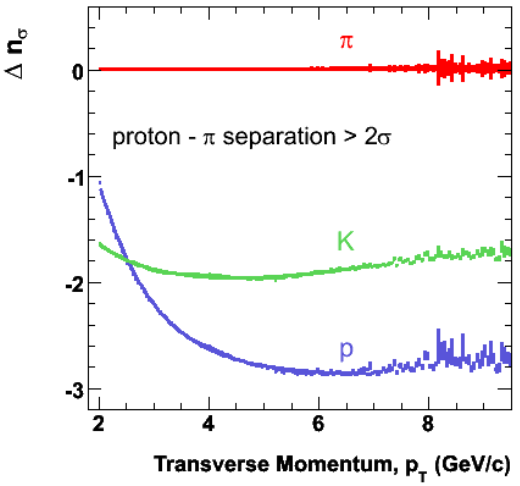
data analysis and preliminary results

data: analysis
analysis summary

- low-p_T ($0.2<p_T<1.2$)
  - energy loss in TPC
  - clear particle separation
- low- to intermediate-p_T ($0.2<p_T<3.0$)
  - TOF
  - clear particle separation
- high-p_T ($p_T>2.5$)
  - relativistic rise of energy loss in TPC
  - statistical separation



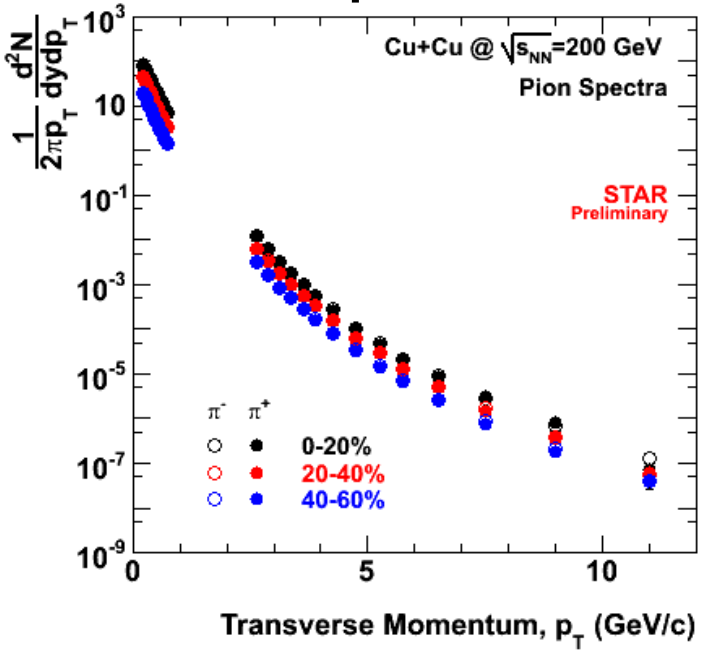




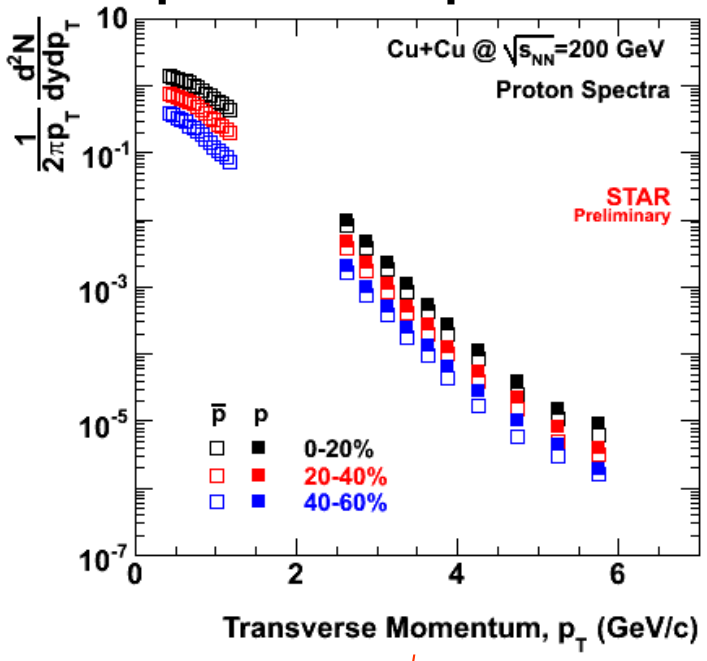
data: preliminary results

π and proton spectra

π spectra



proton spectra



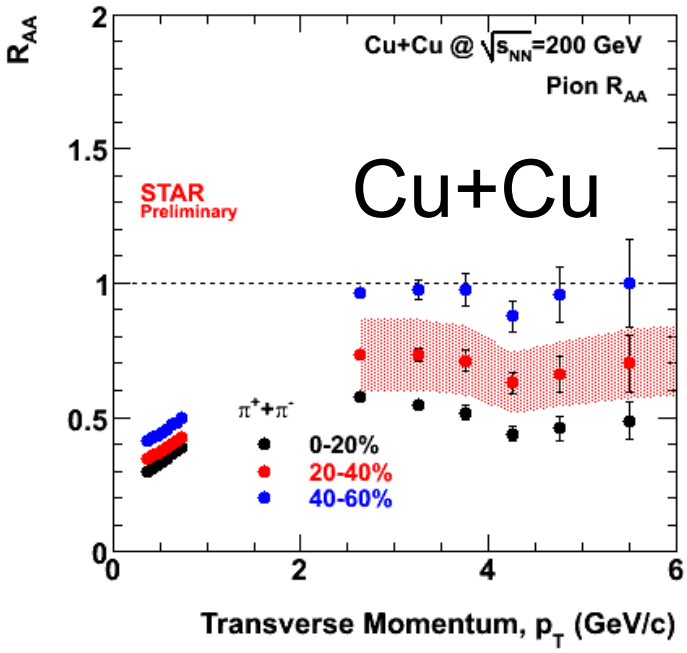
new, preliminary, data for **Cu+Cu** collisions at $\sqrt{s_{NN}}$=200GeV

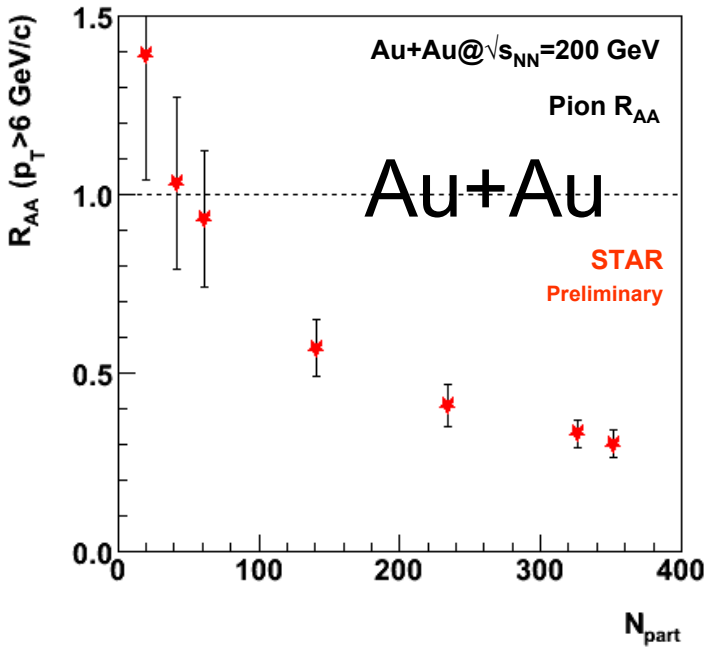
$1<p_T<2$ GeV/*c* gap to be filled by TOF - analysis underway in STAR

data: preliminary results

π nuclear modification factor

$$R_{AB} = \frac{\sigma_{NN}^{inel}}{N_{bin}^{AB}} \frac{d^2N_{AB}/dydp_T}{d^2\sigma_{pp}/dydp_T}$$





A+A collisions: suppression of produced π's at high-p_T

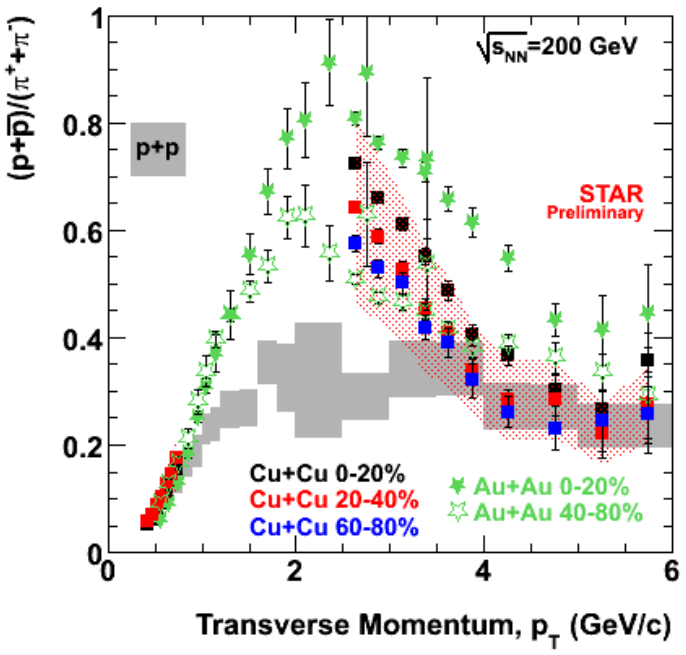
- larger suppression for more central data
- more suppression, energy loss, for increasing path length in the medium

Phys. Rev. Lett. 97 (2006) 152301
Phys. Lett. B 637 (2006) 161

data: preliminary results

baryon/meson enhancement

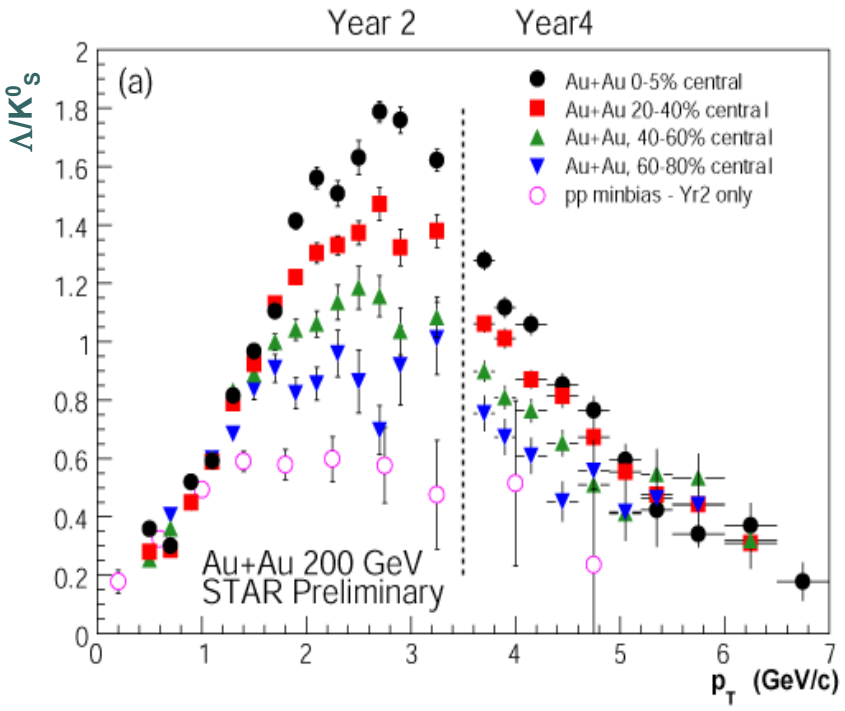
- intermediate-p_T enhancement in baryon production is observed relative to p+p data
  - maximal enhancement at p_T~2GeV/*c*
  - intermediate-p_T: strong centrality dependence
  - centrality independent for p_T>5GeV/*c* (Cu+Cu) and p_T>7GeV/*c* (Au+Au)



data: preliminary results

baryon/meson enhancement

- baryon/meson enhancement also evident in strangeness sector
  - Λ/K^0 shows the same systematic dependencies



data interpretation

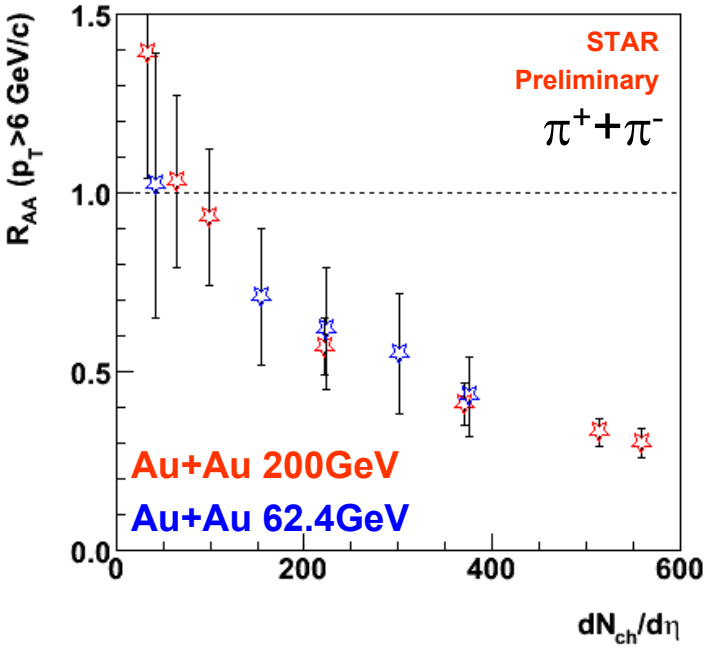
what does all this mean?

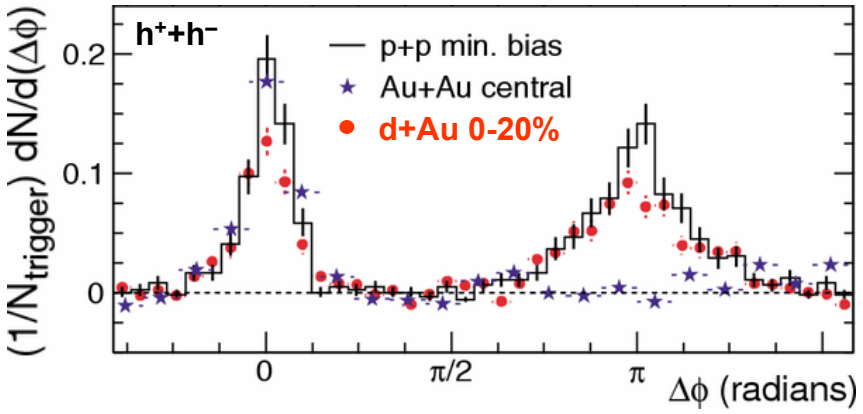
Phys. Rev. Lett. 91 (2003) 072304

data: interpretation

partonic energy loss in the medium

- strong suppression of π yields, relative to p+p collisions
  - indicative of partonic energy loss of the initial quark jet
- suppression is dependent on centrality, but independent of energy
  - at 62.4 and 200 GeV
- are gluon jets suppressed in the same way?
  - look at protons



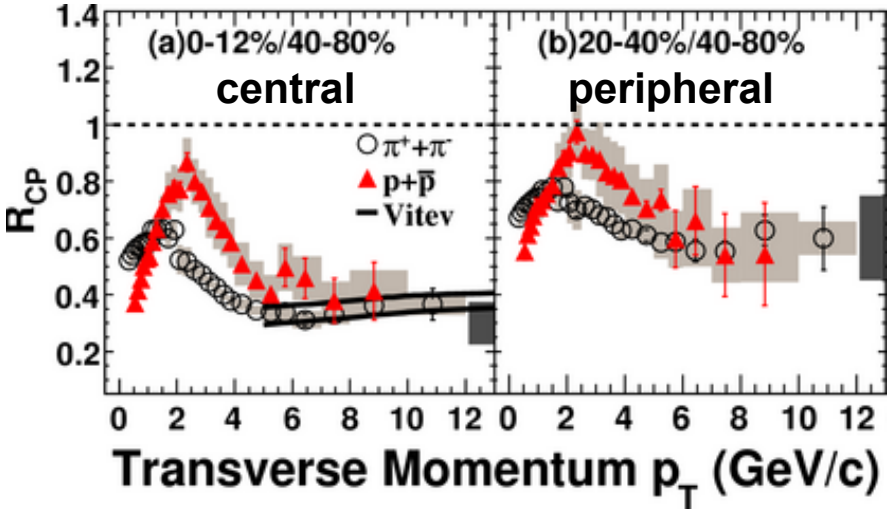


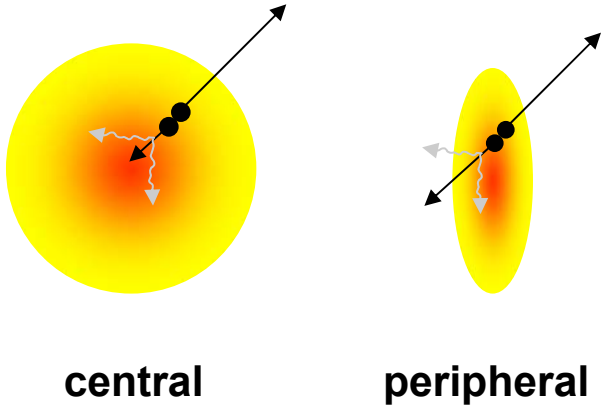
Phys. Rev. Lett. 97 (2006) 152301

data: interpretation

quark and gluon jet medium modification

- excess proton production at intermediate-p_T
- suppression is similar at high-p_T
  - energy loss is similar for quark and gluon jets





summary

- we have a systematic data sample of identified π and $p(\bar{p})$ measured at RHIC
- systematic effects are observed versus the system size of the collision
  - π suppression at large transverse momenta (R_{AA}) for larger system sizes (i.e. more central data)
  - enhanced p/π ratio at intermediate p_T
    - no enhancement at high-p_T
  - similar suppression for π and proton: indicating quark and gluon jets are subjected to the same energy losses