Rapidity and centrality dependence of the K/π ratios in Au+Au collisions at 62.4 GeV

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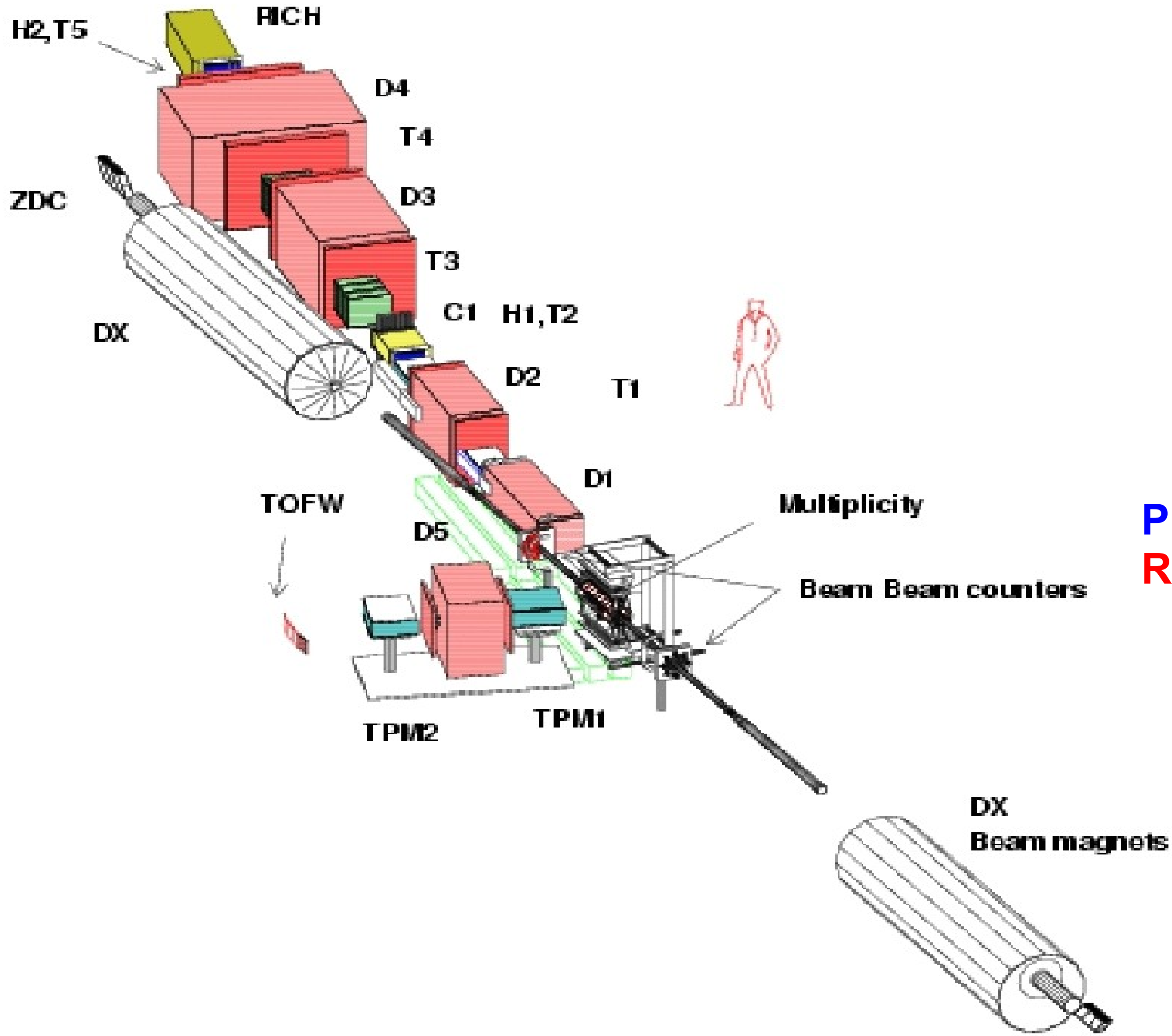
Strange Quark Matter, Beijing, 6 october 2008

Outline

- Experimental setup and analysis issues
- Models employed for comparison
- Rapidity dependence of yields and ratios in central Au+Au collisions at 62.4 GeV
- Results from non-central collisions
- Discussions
- Summary

BRAHMS setup



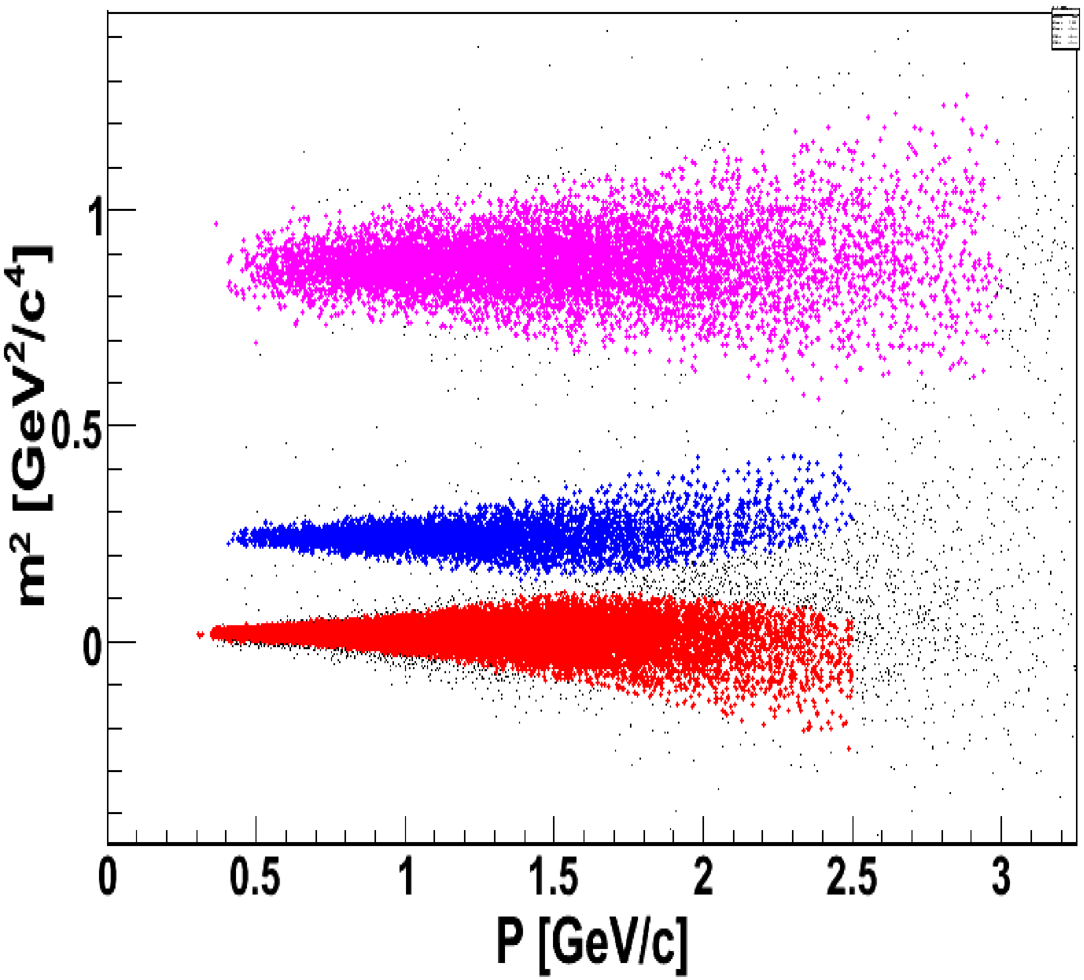
Colliding systems studied:
Au+Au
d+Au
p+p
Cu+Cu
Energies:
200, 130, 62.4 GeV

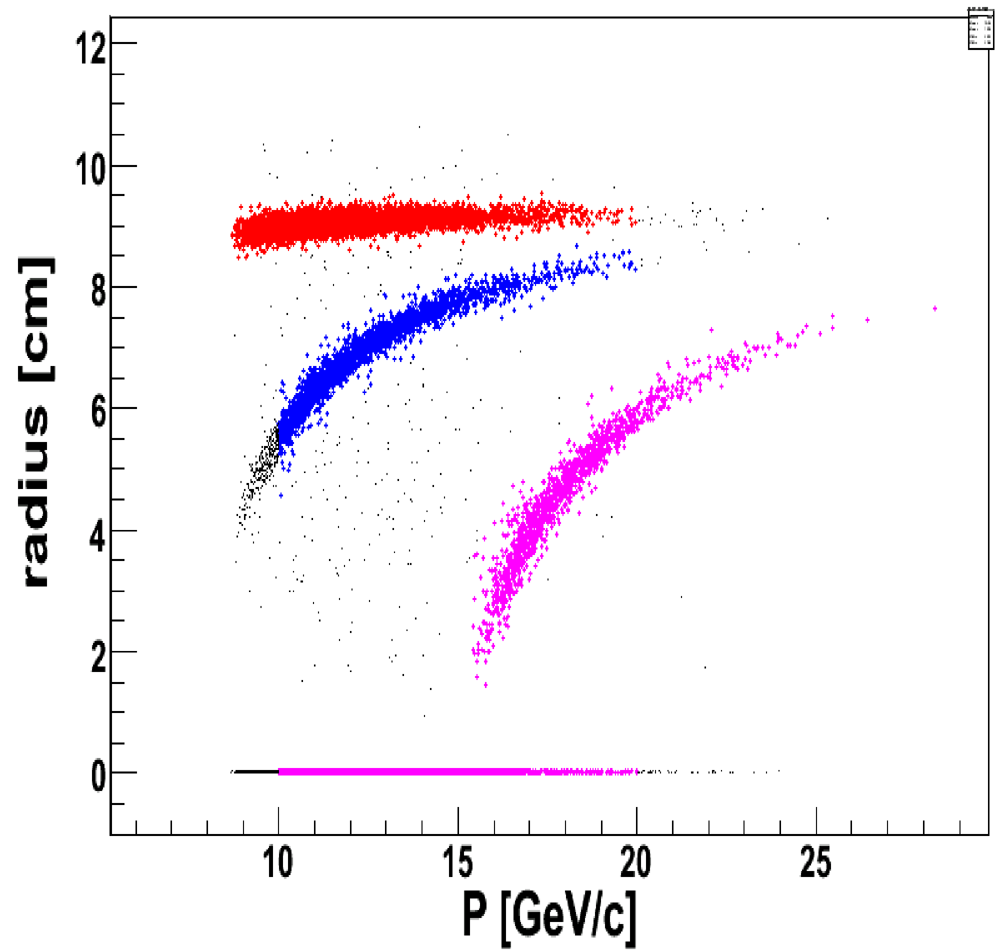
Physical observables of interest:
R_{AA}, R_{cp}, yields, v_2, particle ratios

Most important:
The rapidity dependence of these observables

M.Adamczyk et al., BRAHMS Collaboration, Nucl. Instr. and Meth. A499 (2003) 437

BRAHMS PID





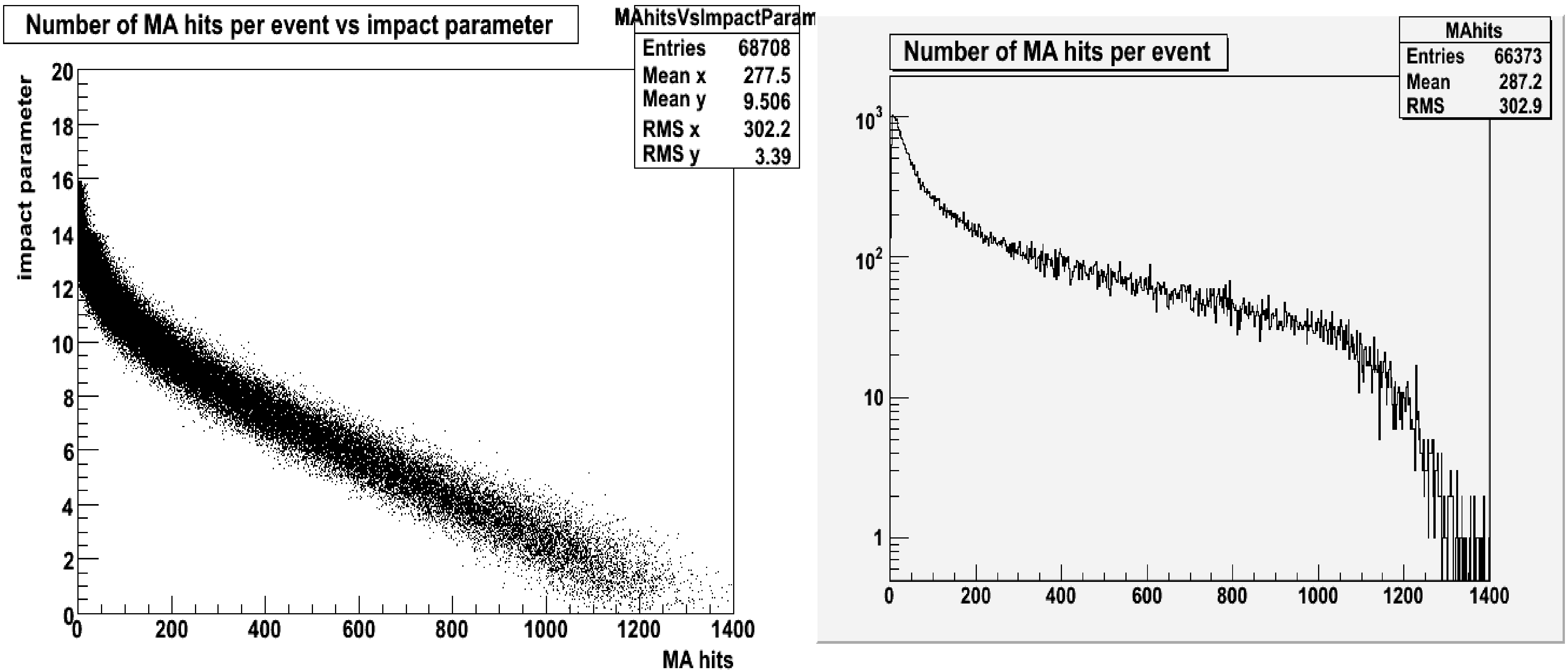
The time of flight detectors at mid-rapidity ensure good pion/kaon/proton separation up to ~3 GeV/c

RICH at forward rapidity separates pions and kaons up to ~25GeV and protons up to ~30 GeV

Models employed for comparison with the data

- AMPT v1.11 B.Zhang et al., (2000), Z.-w. Lin et al. (2002)
  - **(A Multiphase Transport model)** includes both partonic and hadronic interactions
  - Initial space-time information for partons and strings → HIJING
  - Minijet parton scattering using the parton cascade model ZPC
  - String fragmentation → Lund model
  - The hadronic cascade treated via ART
- UrQMD v2.3 S.A.Bass et al. (1998), M.Bleicher et al. (1999)
  - **(Ultra relativistic Quantum Molecular Dynamics)** is a microscopic transport model
  - The main mechanism is color strings excitation and their subsequent fragmentation into hadrons followed by a hadronic cascade
  - In the latest version UrQMD includes PYTHIA for high pt generation.

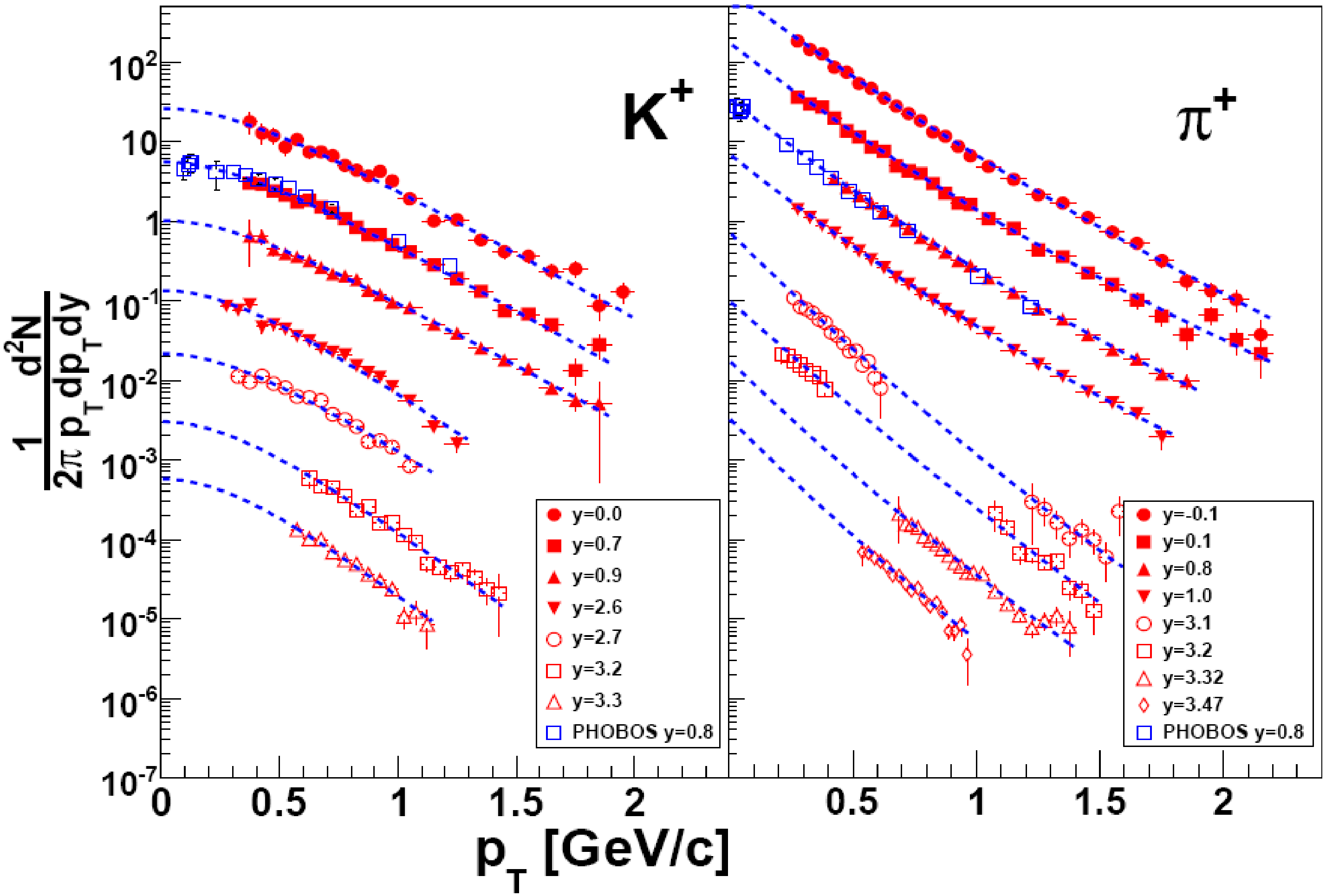
Centrality selection in the models



The Multiplicity Array (MA) response for the simulated events.

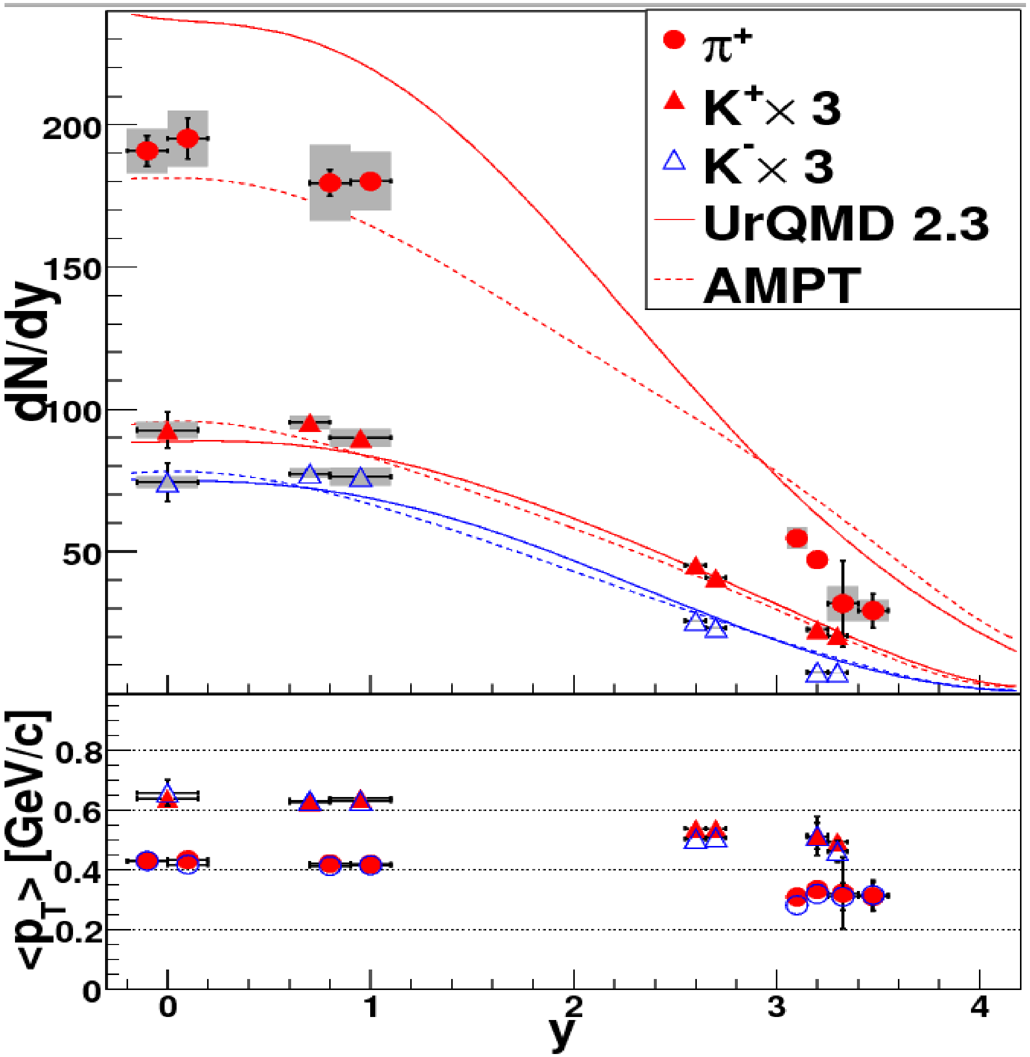
We simulate the number of hits in our centrality detector for every event generated by the models and apply the same cuts on multiplicity as for the experimental data.

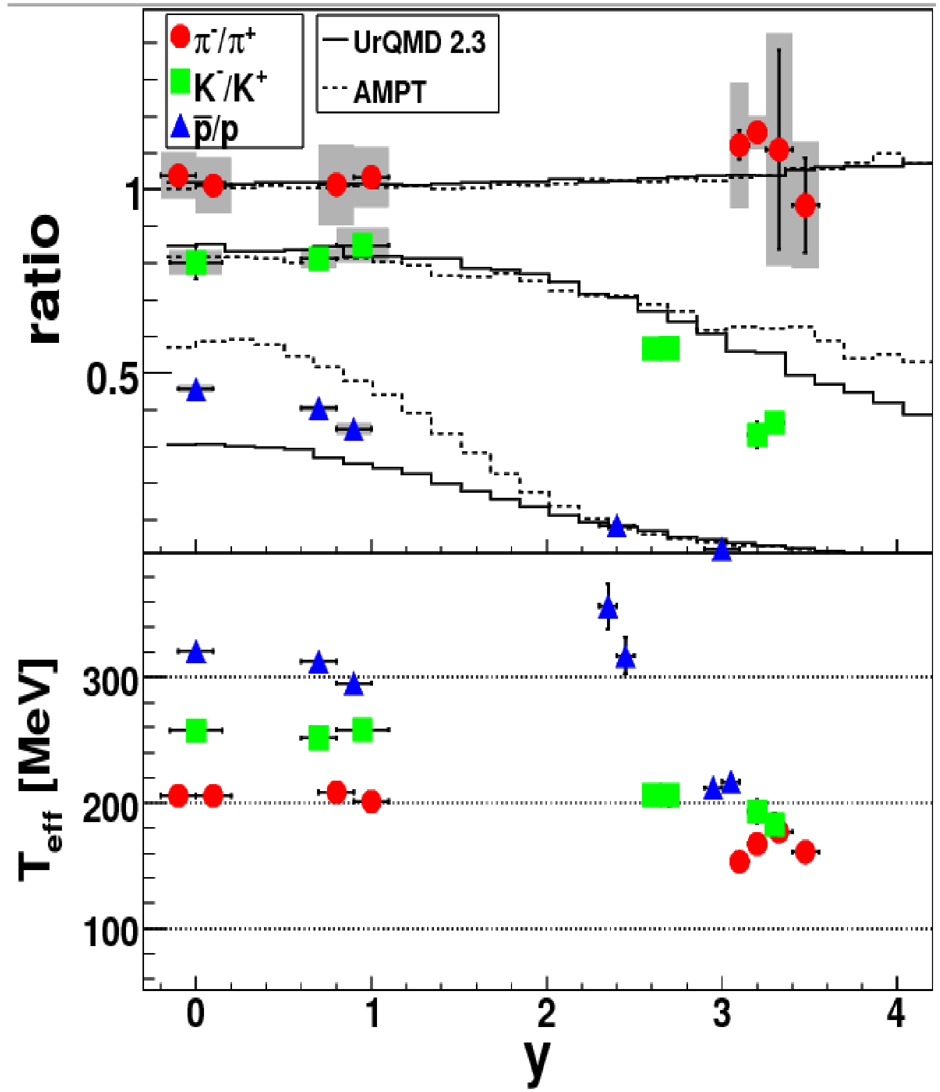
The invariant spectra and fitting



The pion spectra was fitted best with power law functions, while the kaons were fitted with mt exponential functions. The yields were extracted as parameters from the fit functions.

Rapidity dependence of integrated yields in 0-10% central Au+Au collisions at 62.4 GeV

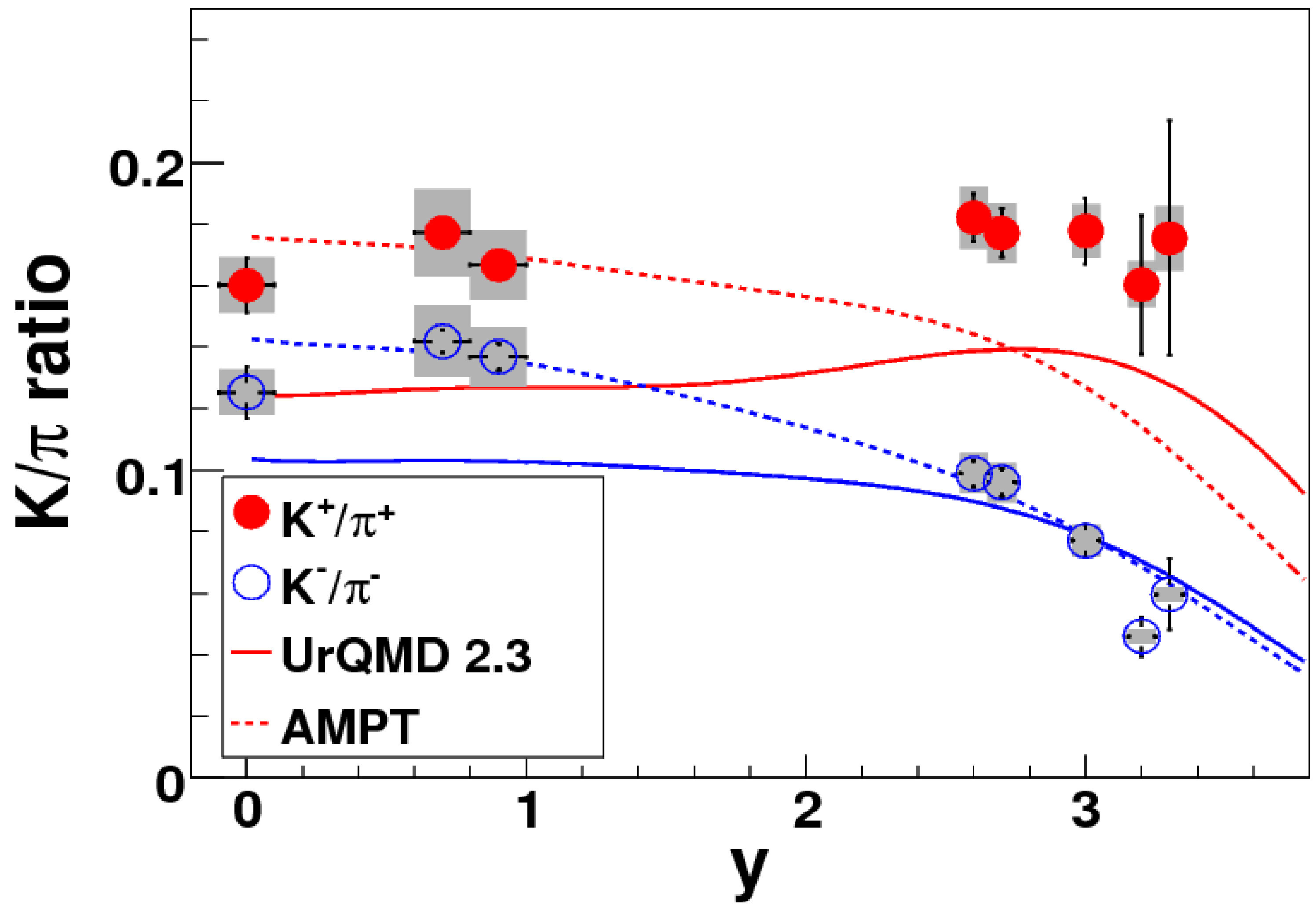




<pt> and effective temperatures drop at forward rapidity

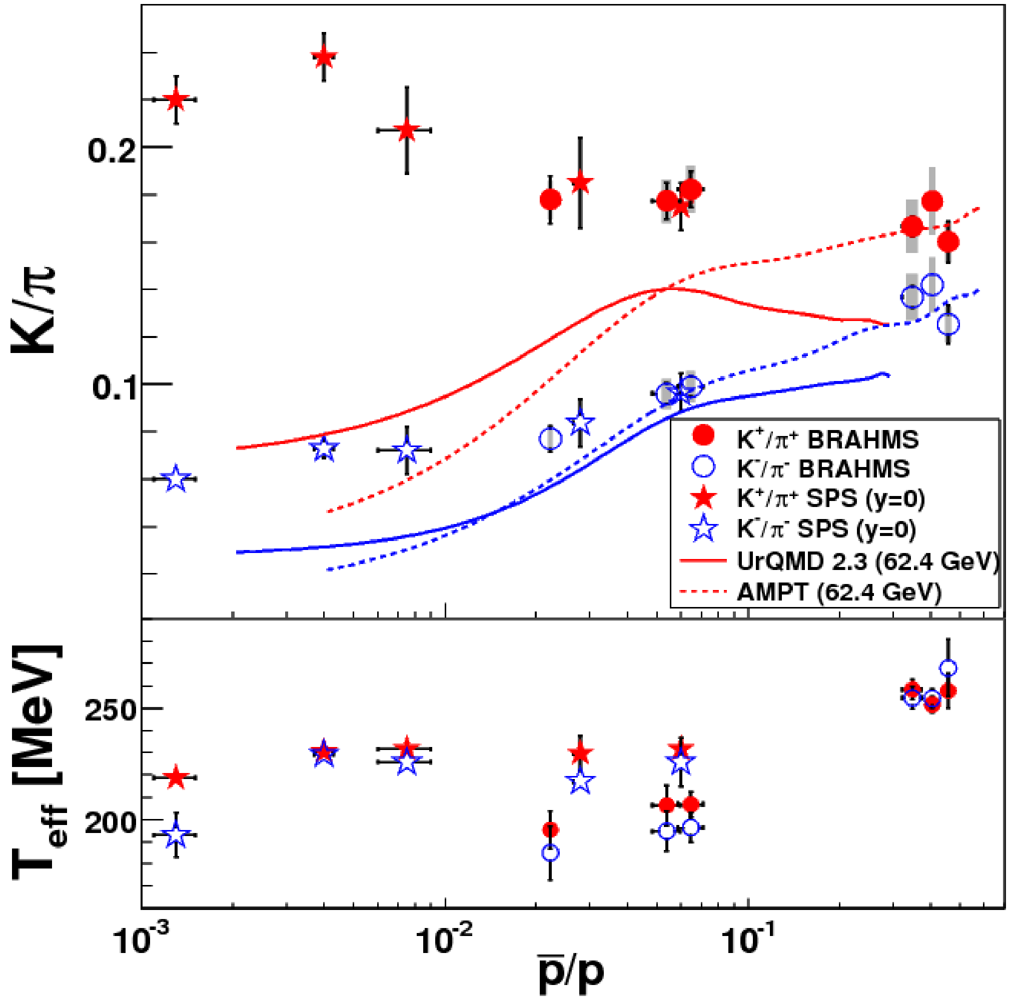
anti-p/p = 0.47 at y=0
anti-p/p = 0.023 at y=3.0

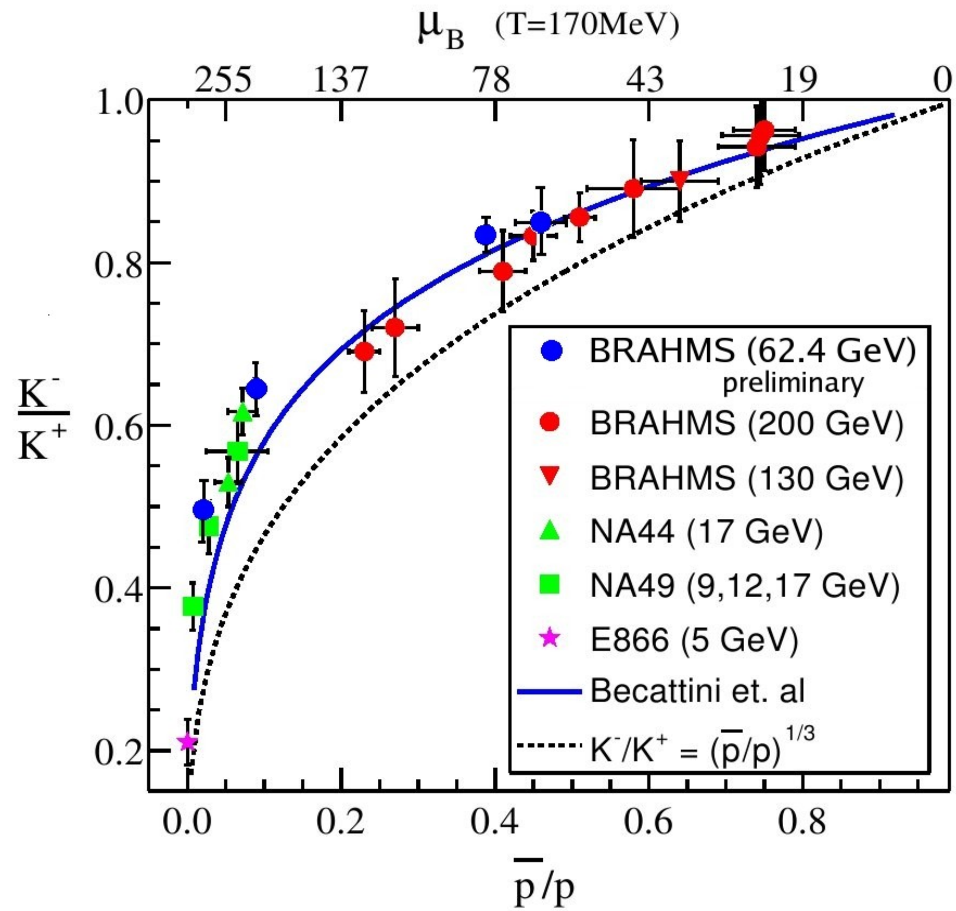
K/pi ratios vs y in central Au+Au at 62.4 GeV



Models seems not to explain the absolute value of K+/pi+ ratio at forward rapidity. However UrQMD seems to qualitatively reproduce the trend of the data.

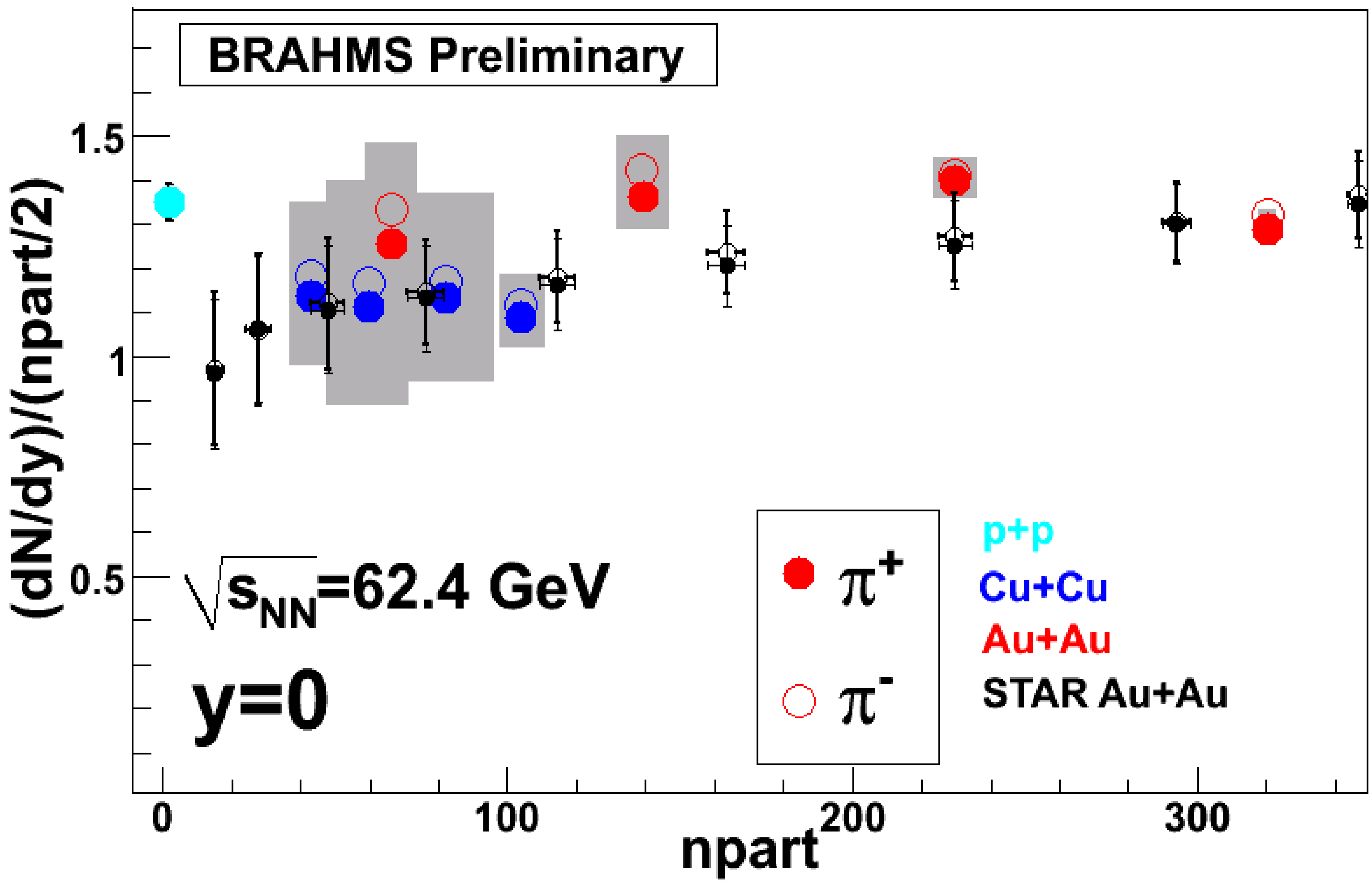
Relative abundancies dependence on baryo-chemical potential





The model calculations in the left figure are made only at 62.4 GeV.
The effective temperatures are extracted using mt exponentials.

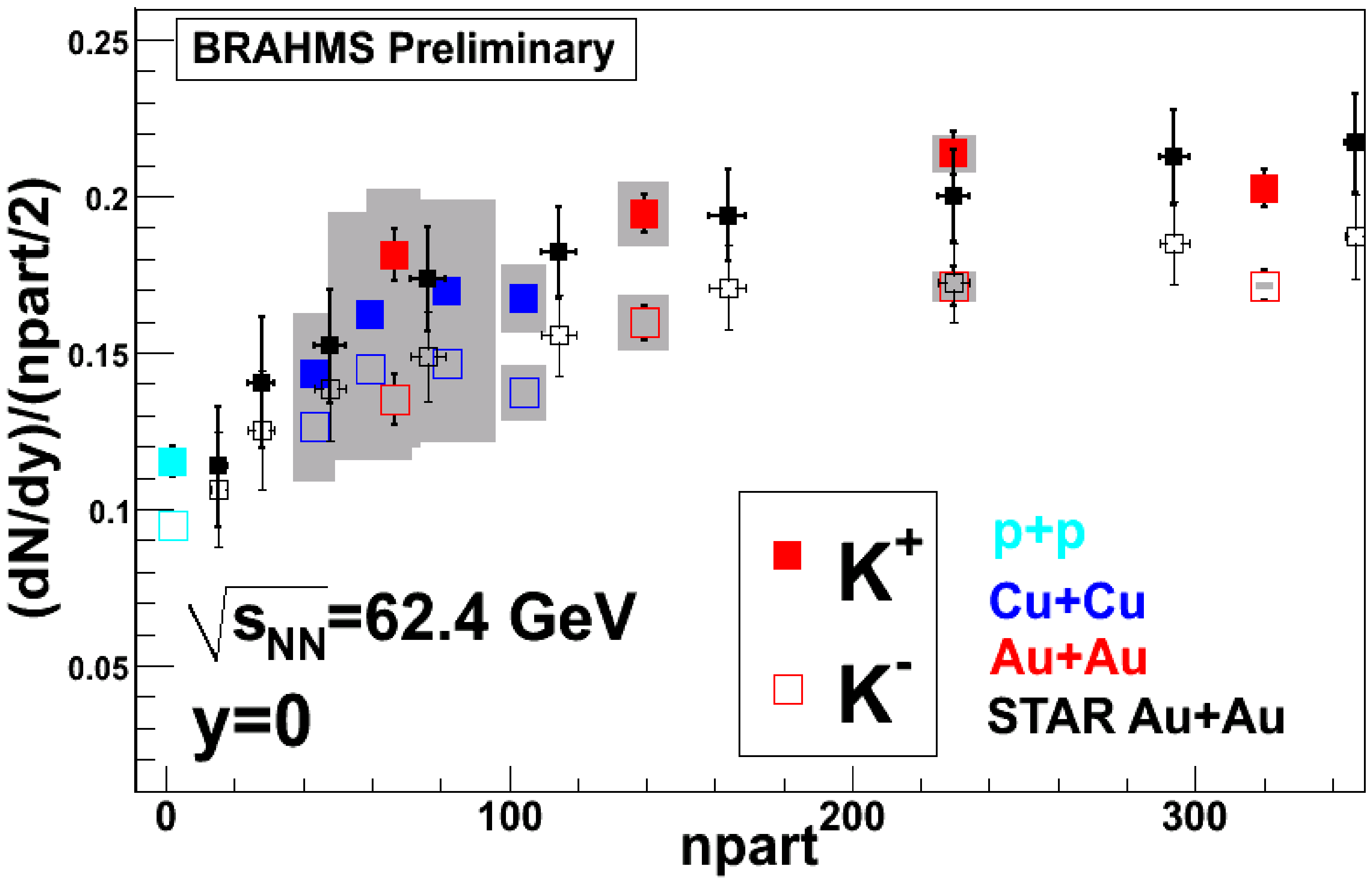
Centrality dependence of yields at mid-rapidity



STAR points are from hep-ex/0808.2041

For comparison we use here the same set of npart obtained trough a MC Glauber model (see STAR paper)

Centrality dependence of yields at mid-rapidity



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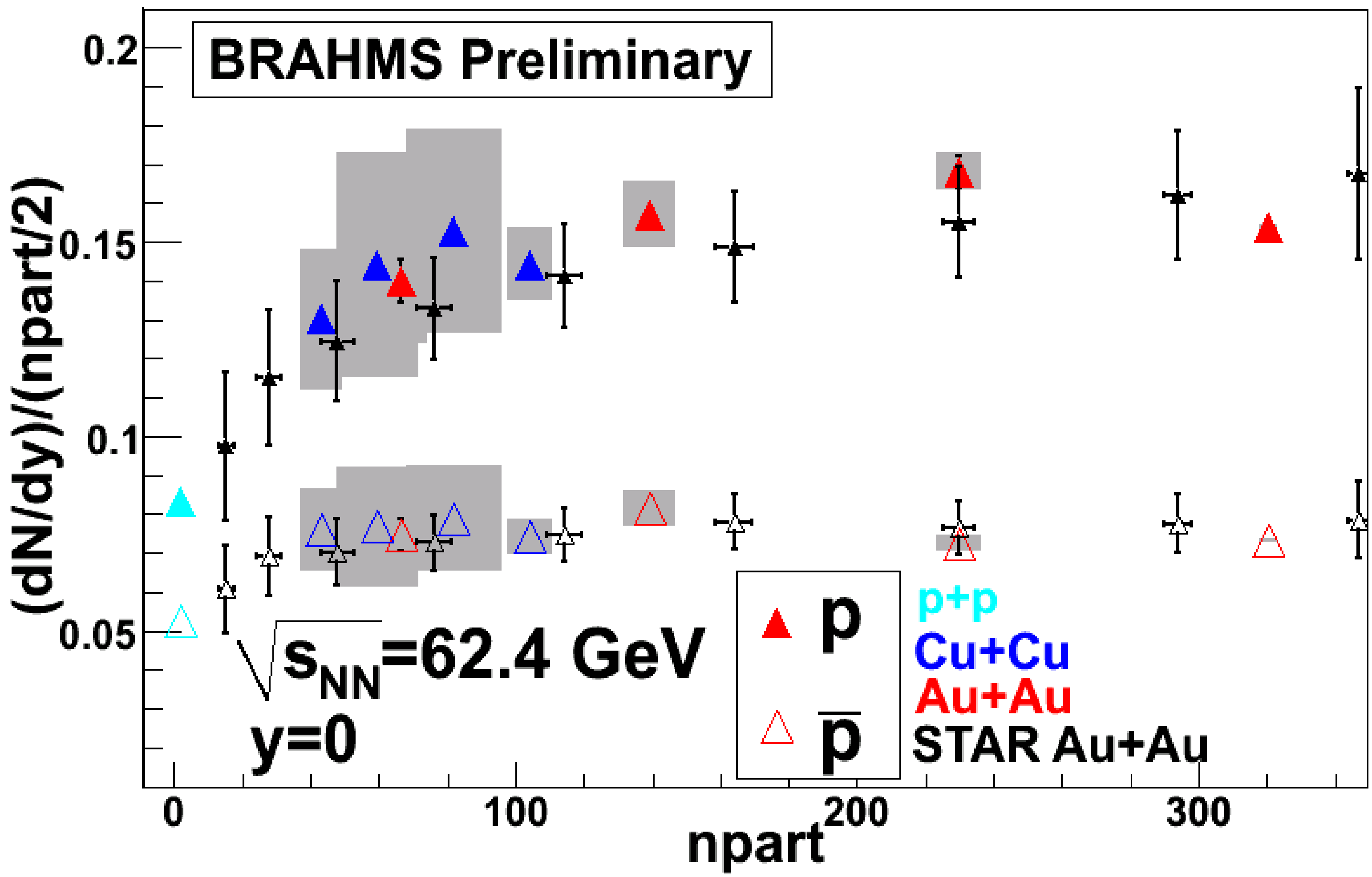
Centrality dependence of yields at mid-rapidity



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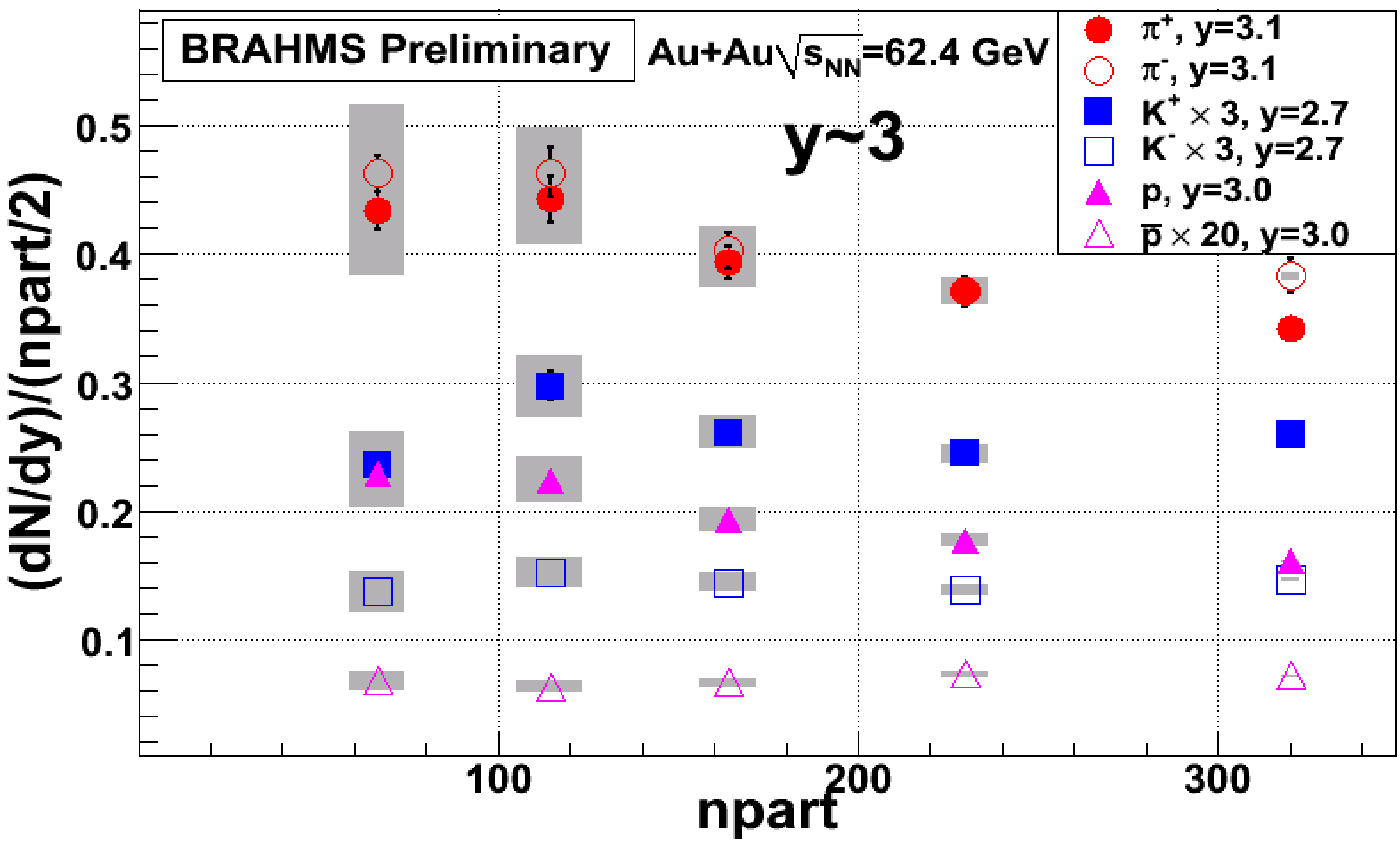
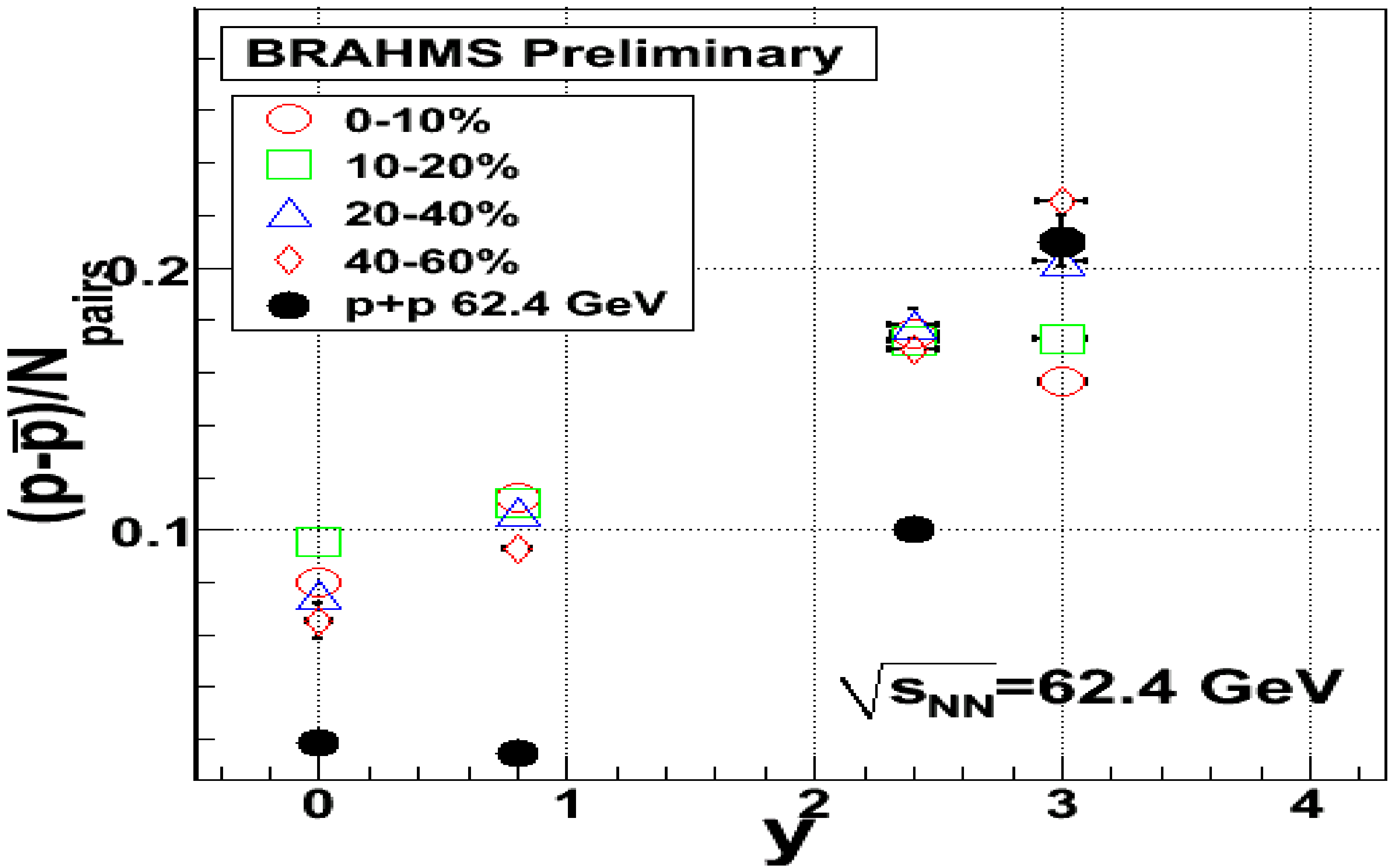
Centrality dependence of yields at y~3



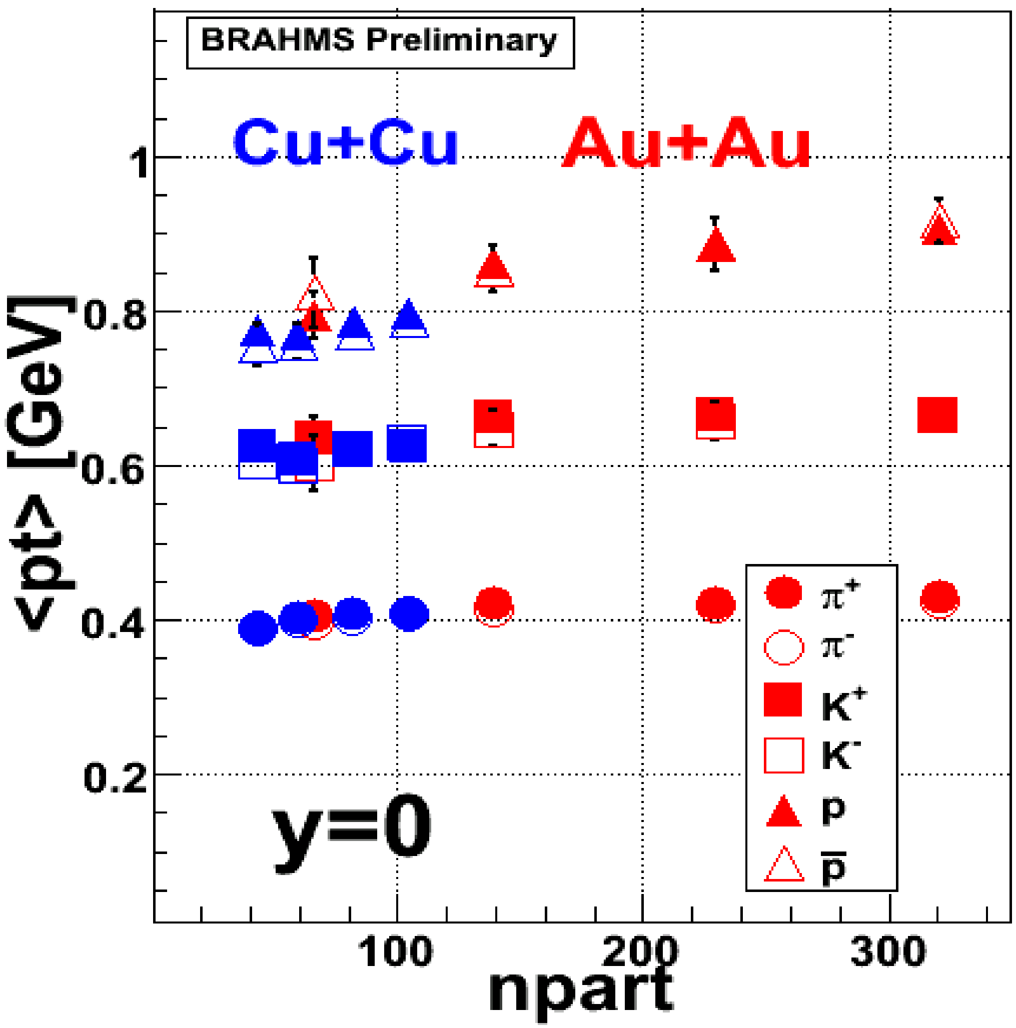
We observe an increase of pions and protons in the more peripheral bins

Net-protons versus rapidity and centrality

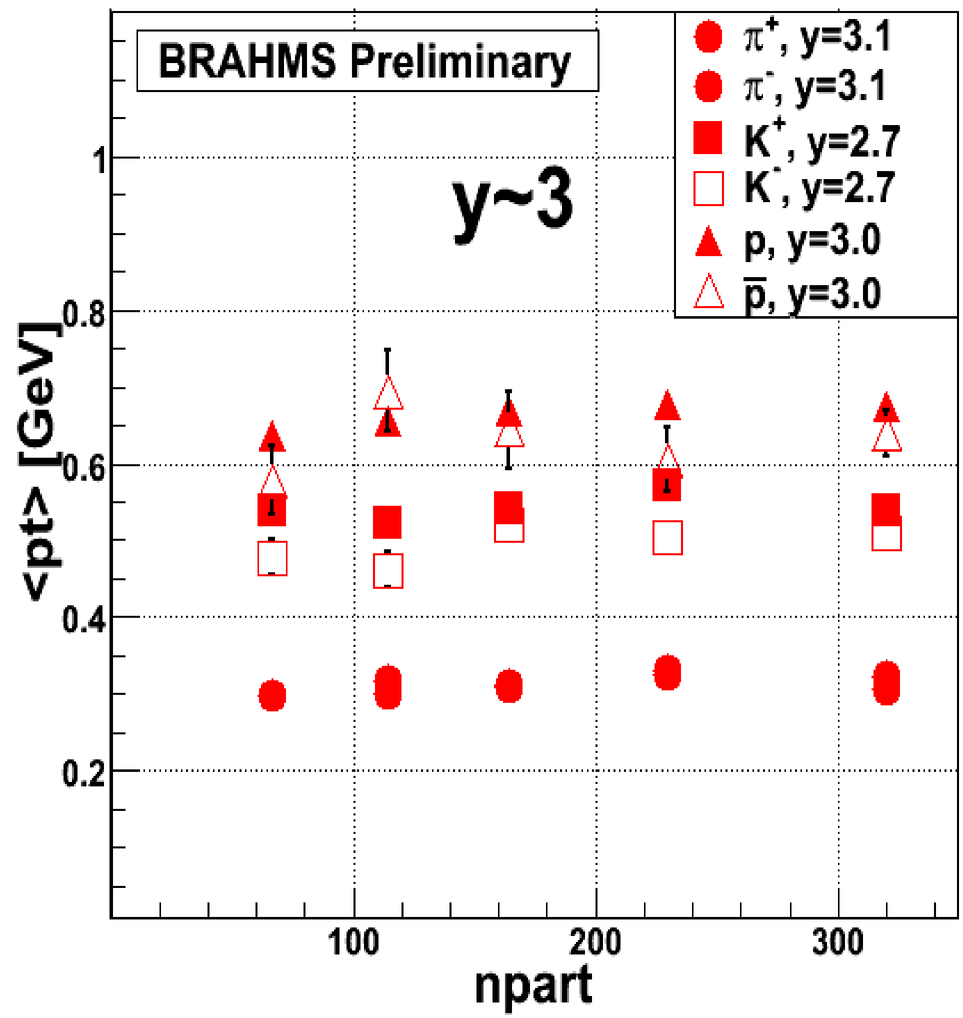


The fragmentation peak is shifting towards higher rapidities in less central collisions.

Average pt dependence on centrality and rapidity

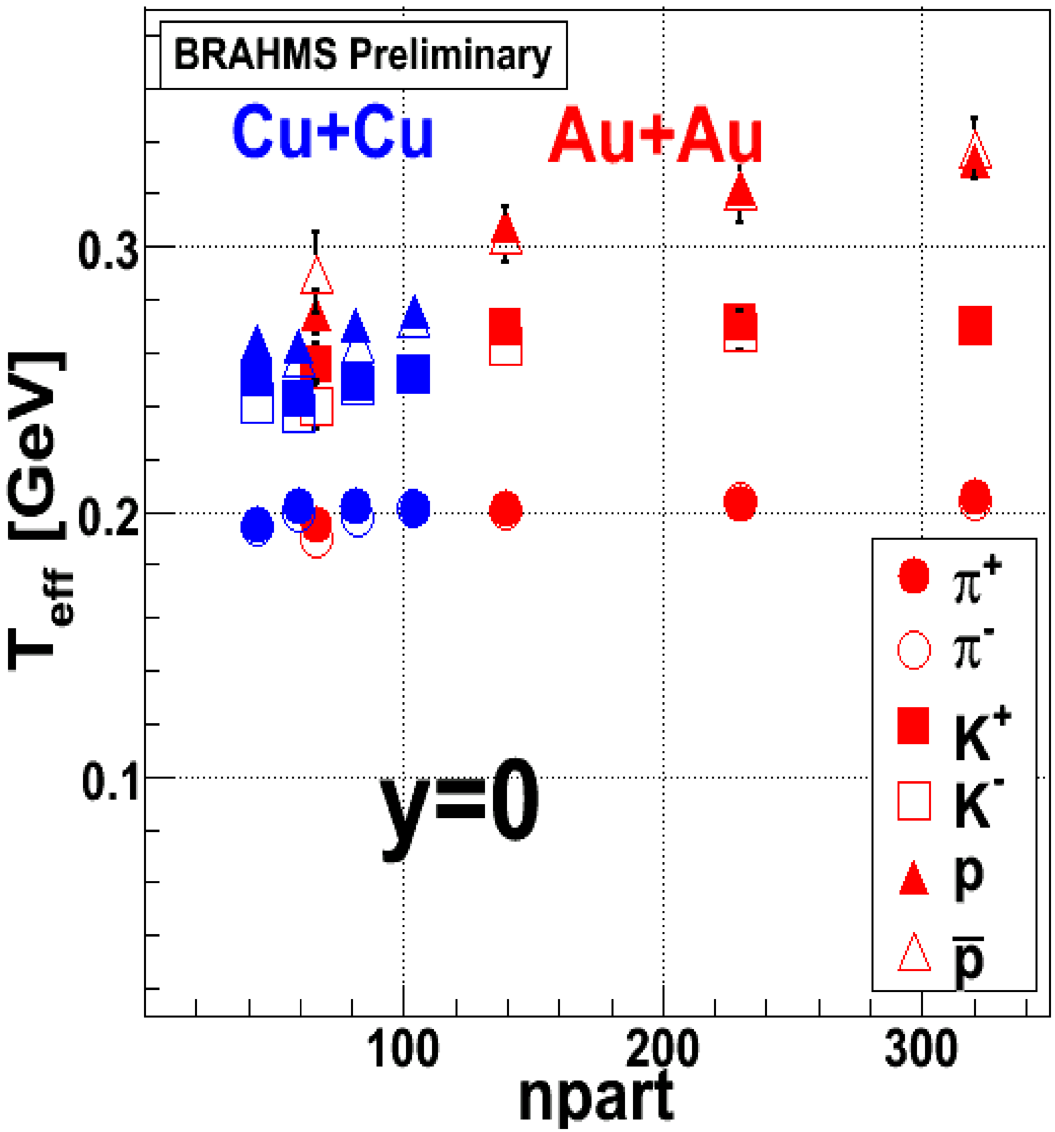


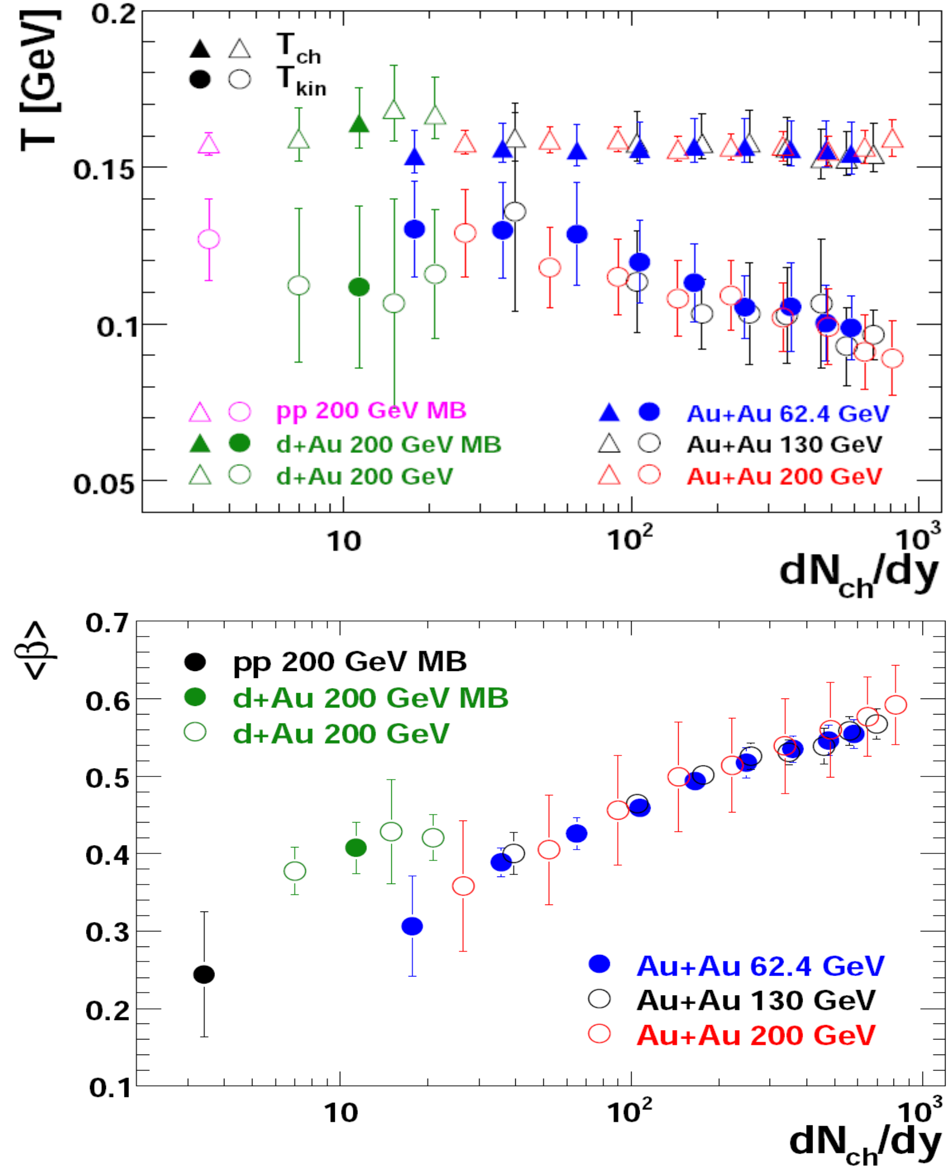
Stronger decrease in <pt> for heavier particles



No visible <pt> dependence on centrality at forward rapidity.

Effective temperatures

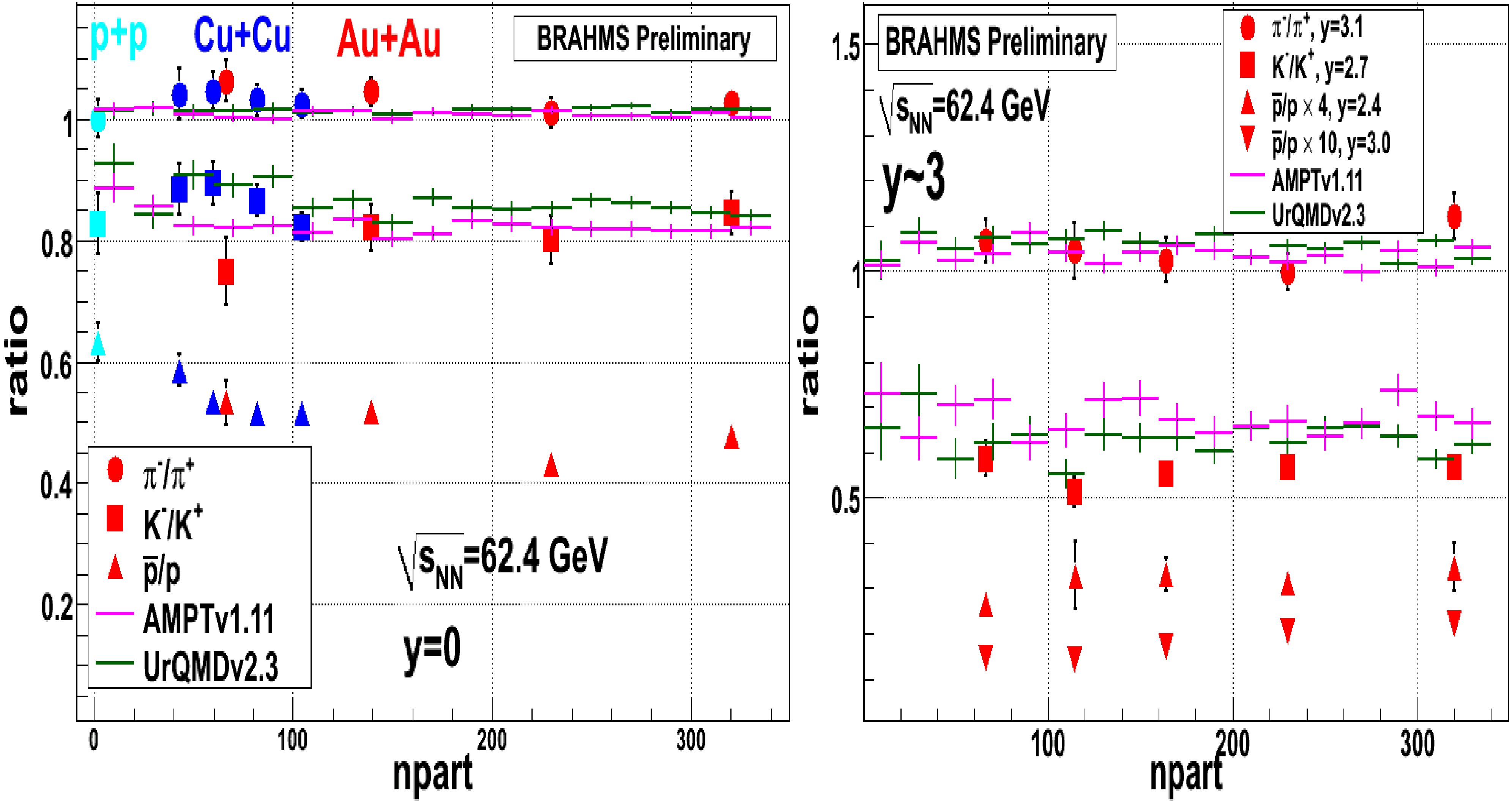




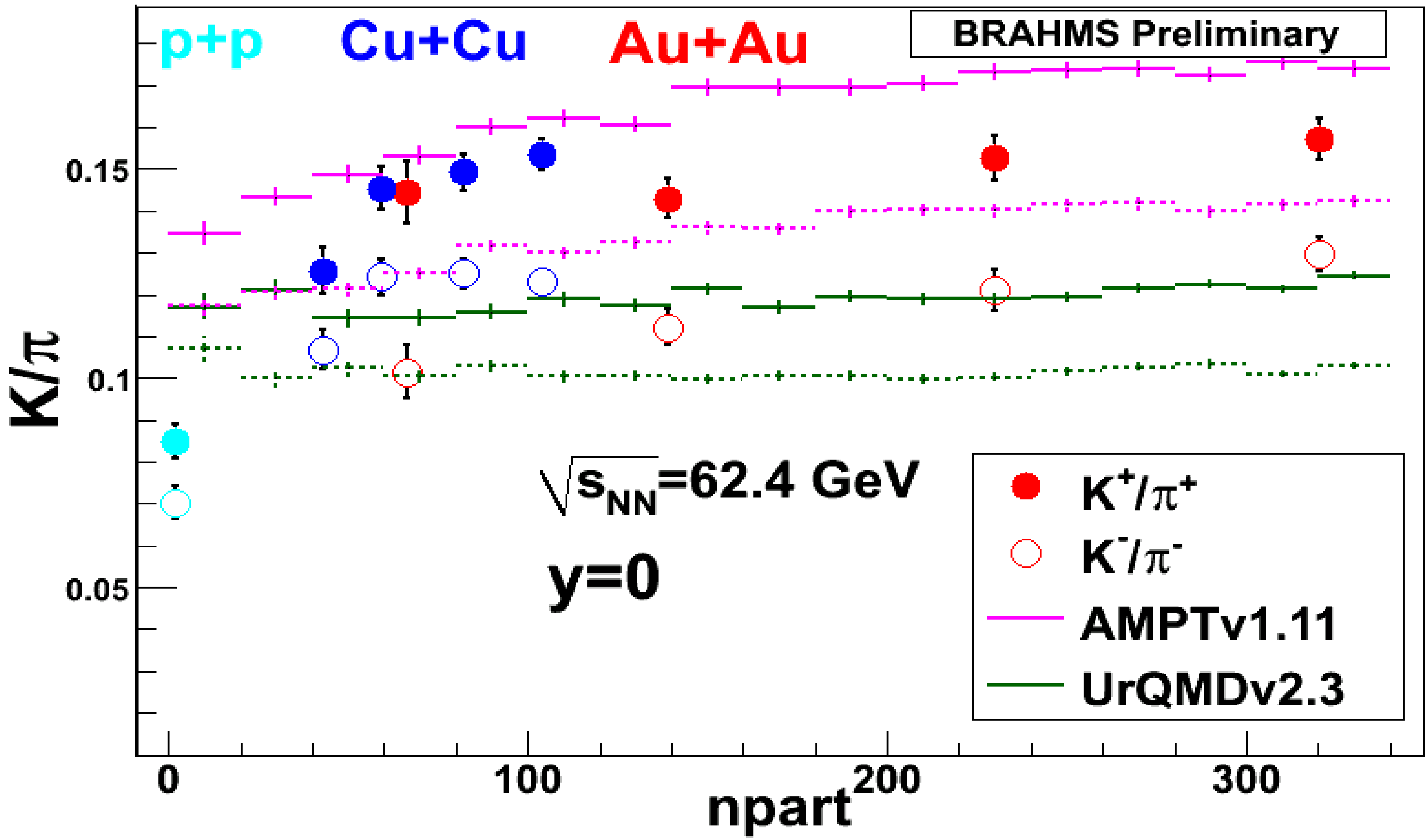
Pion effective temperatures are obtained by fitting the spectra below 1 GeV/c with mt exponentials

STAR Collaboration, hep-ex/0808.2041

Anti-particle/particle ratios dependence on centrality

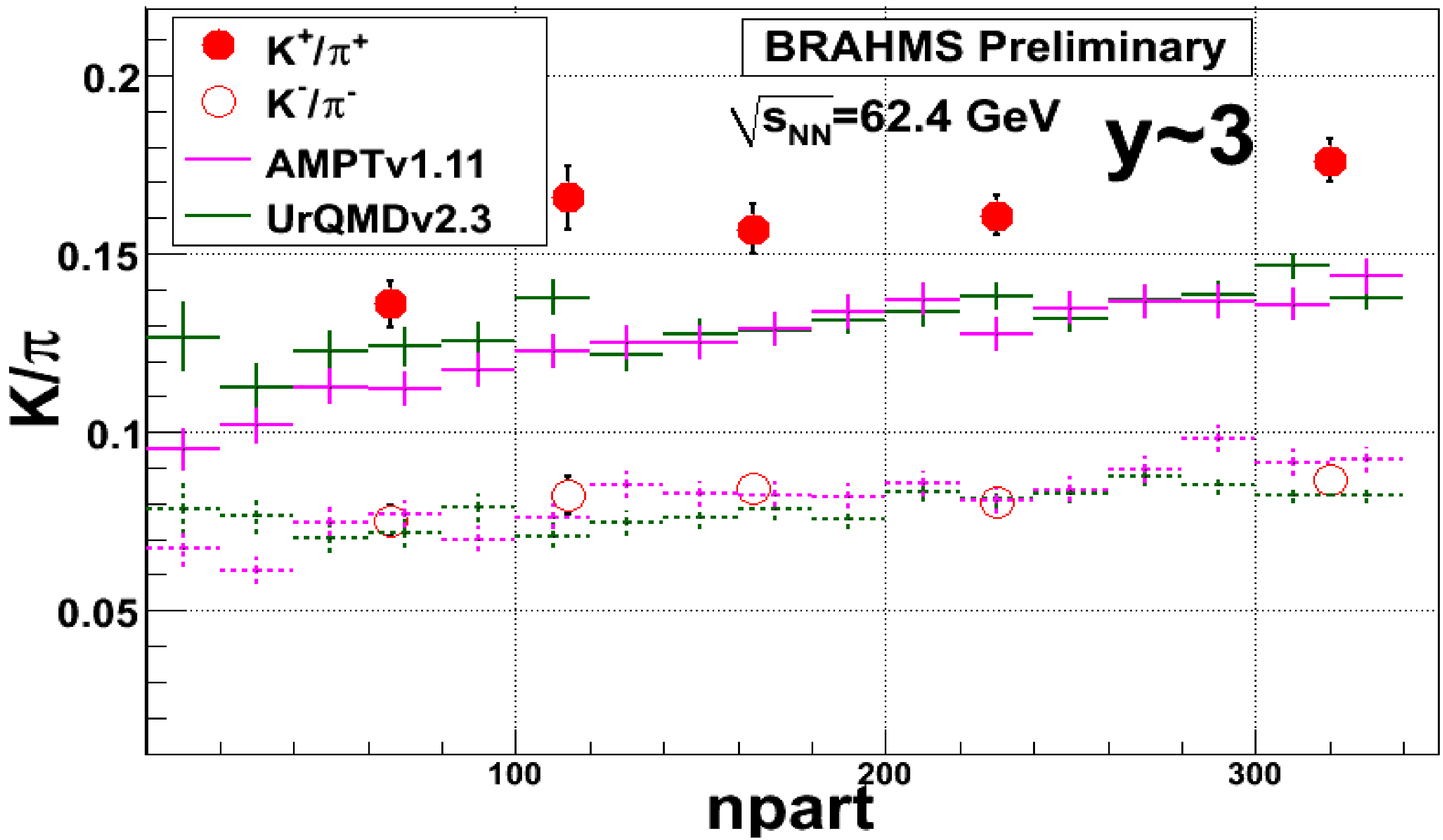


K/pi ratios y=0



K/pi ratios drop as the system becomes smaller.

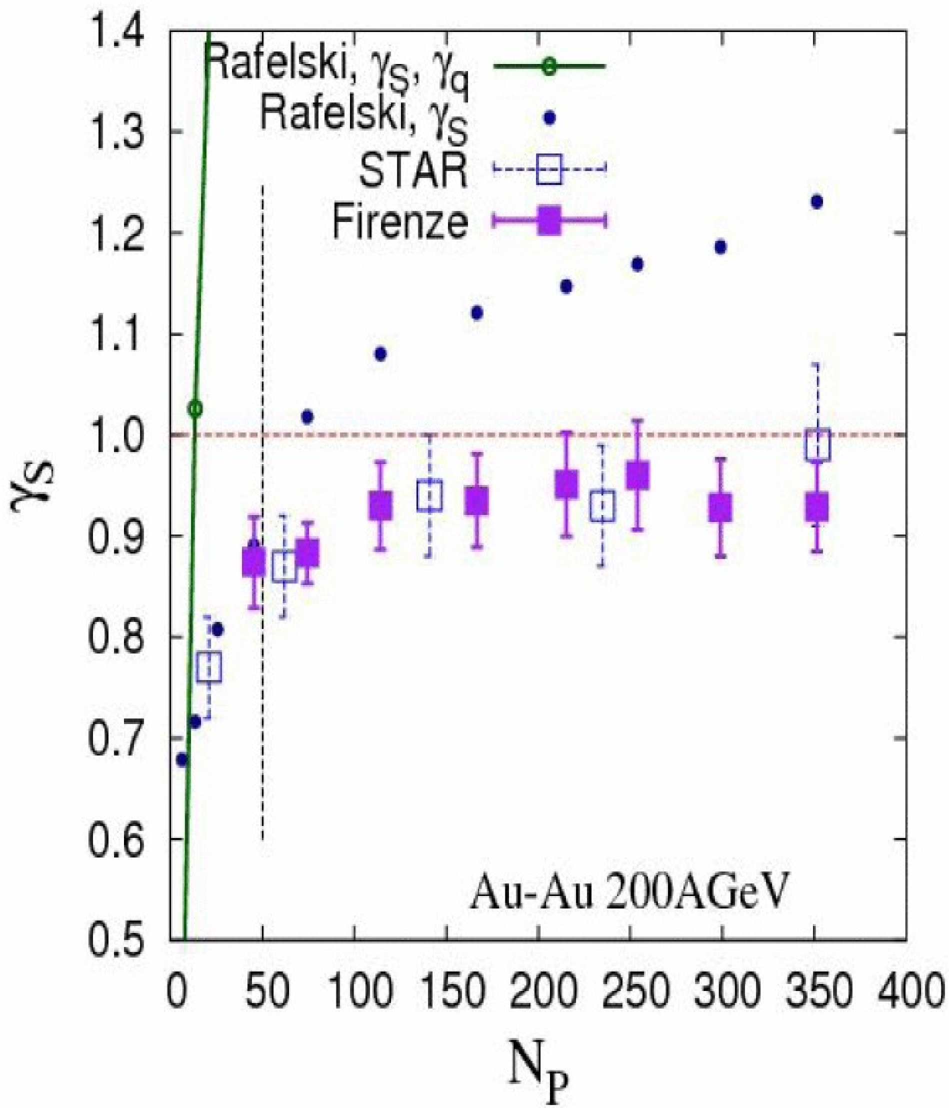
K/pi ratios y=2.7



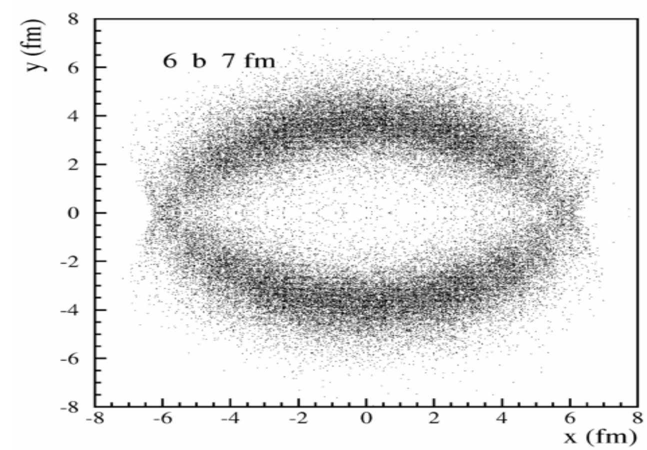
K/pi ratio seems to drop also at forward rapidity.

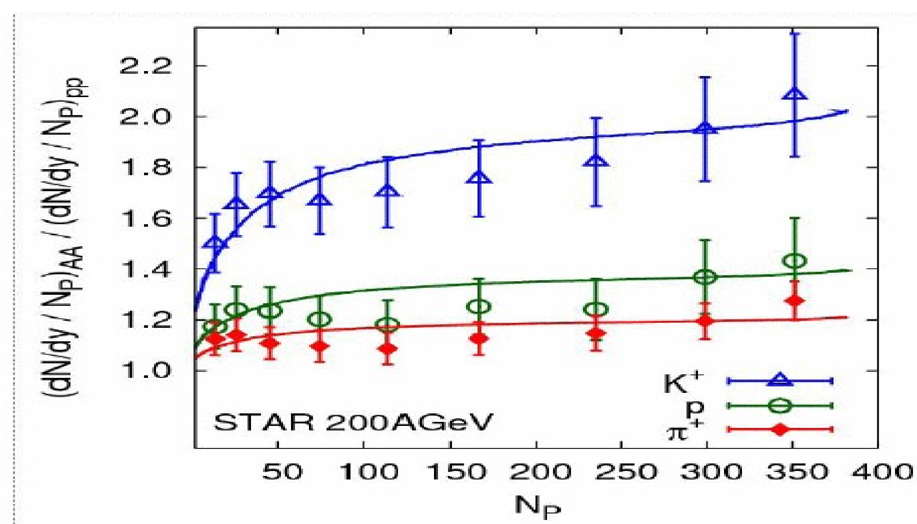
Explanations

Chemical non-equilibrium, canonical suppresion



Core-corona models: J.Manninen, F.Becattini (2005)





Summary

- We measured rapidity and centrality dependent yields of identified particles in Au+Au, Cu+Cu and p+p collisions at 62.4 GeV
- The K/pi and K-/K+ ratios measured at forward rapidity in Au+Au collisions at 62.4 GeV seem to have a common dependence, on the anti-p/p ratio, with the same ratios measured at SPS energies at mid-rapidity.
- The K/pi ratios at mid-rapidity were found to decrease with decreasing system size. This feature is posibly explained by chemical non-equilibrium and core-corona type of models.