High p_T Results from PHENIX

(Swan-song of the QM-02 data)

Final results will be out in the public very soon

One last look on what's in the open since last July

Please take error bars (on preliminary data) seriously!

What is high pT?

Evolution of time, coherence length, temperature (if any) … -> transverse momentum scale

The region where incoherent parton scattering is expected to dominate
(but then the observables might be influenced by later evolution!)

Where is the transition from “soft” to “hard”?
(doesn’t have to be the same for all particles!)

Scaling from p+p to A+A
(0^{th} approx.: participants -> bulk properties, collisions -> parton level,
but then the two get intertwined…)

Multiple mechanisms, dual strategy:
- take an observable and explain its p_T/centrality dependence with a series of scenarios
- take a model and explain several observables in a p_T range

-> put all pieces in place simultaneously

A very old slide with a point

…and the point is:
- to get info on individual stages/mechanism you have to de-convolute
- the only way to do it is to start from the highest p_T
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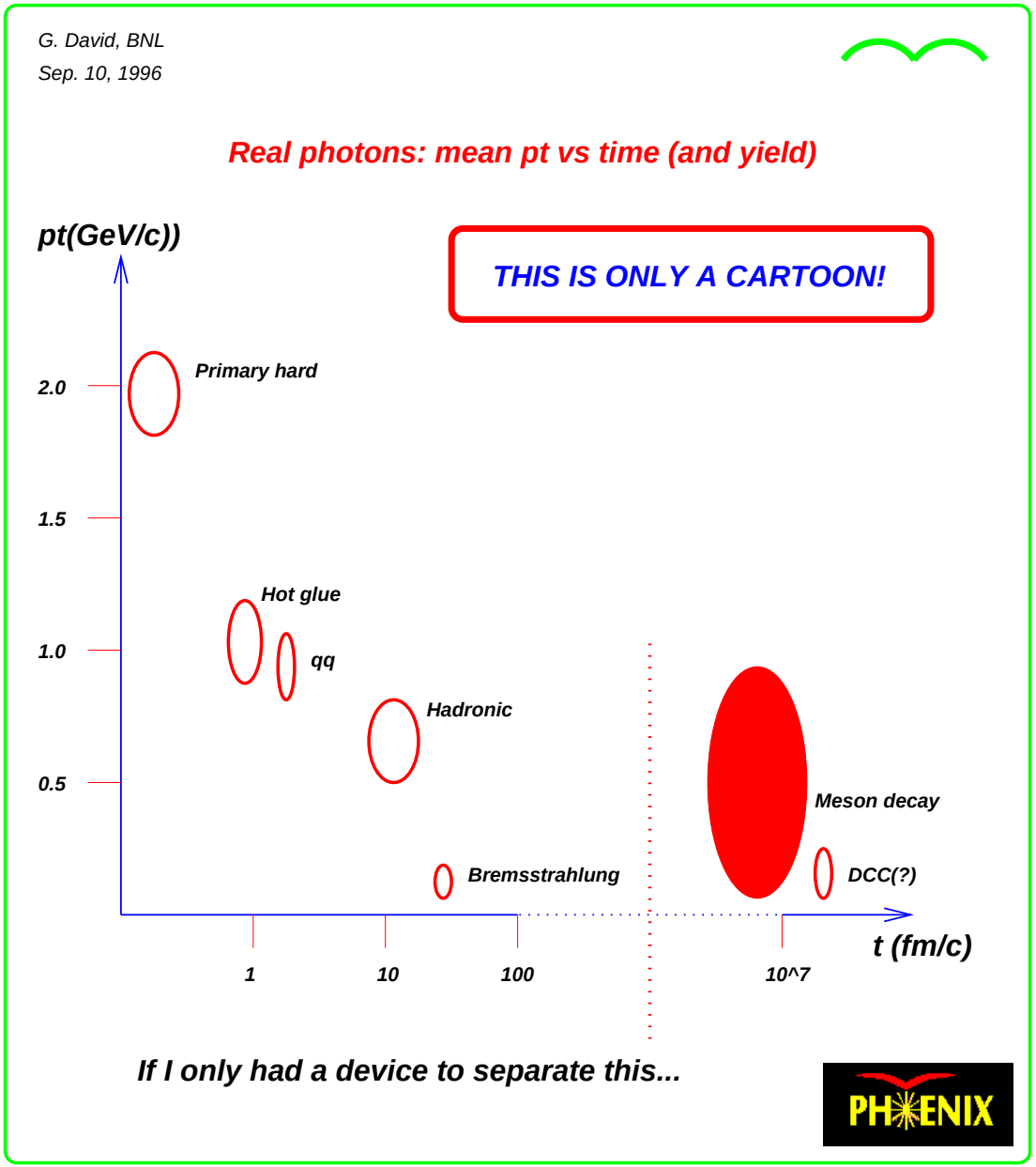
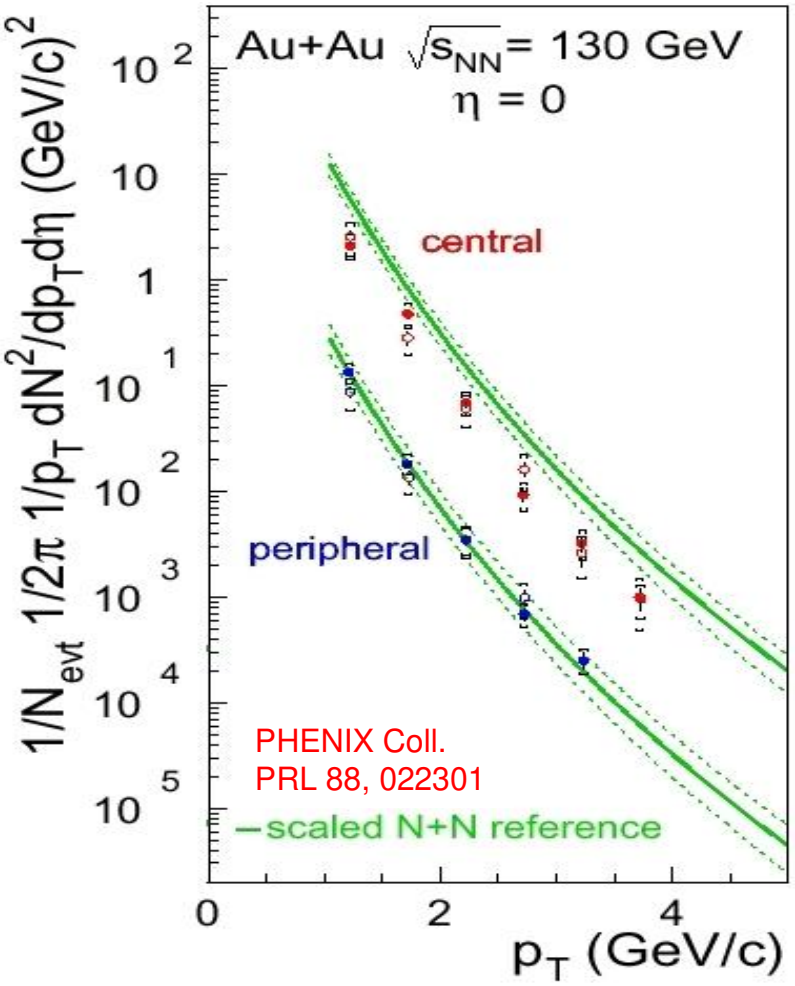


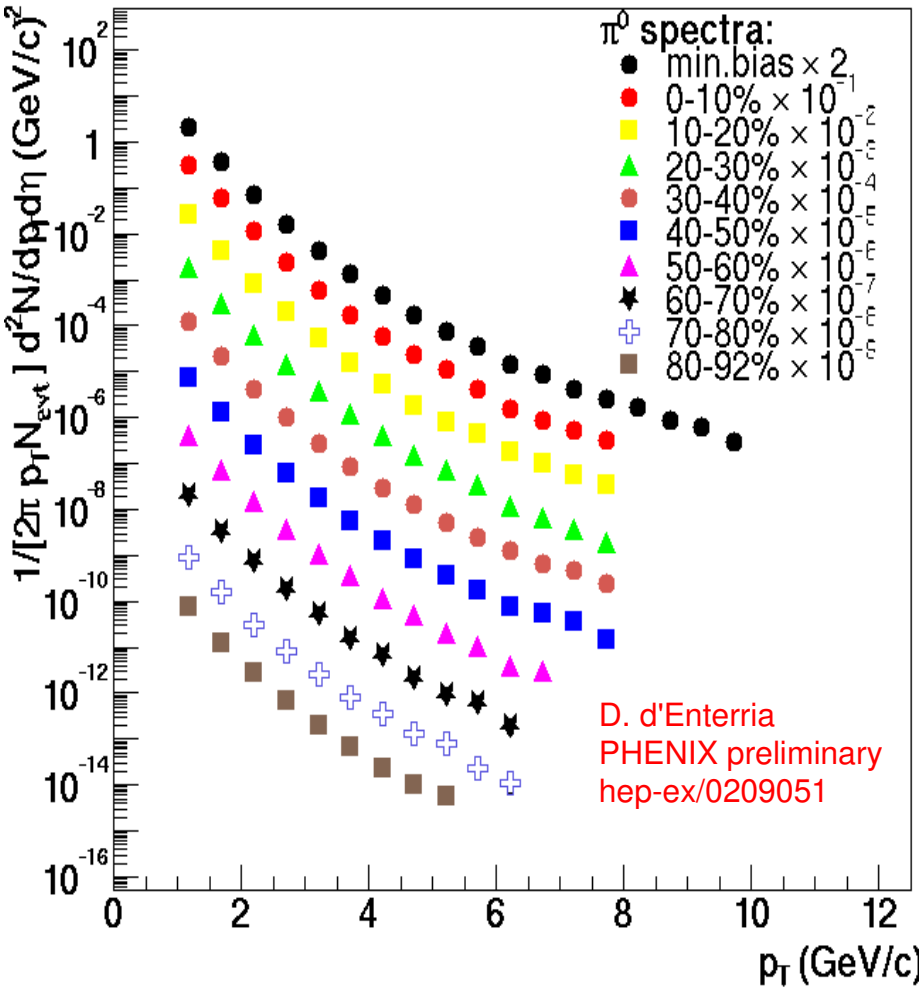
Pizeros

Year-2: increased luminosity and acceptance -> much higher p_T

Au+Au $\sqrt{s_{NN}}$ = 130 GeV



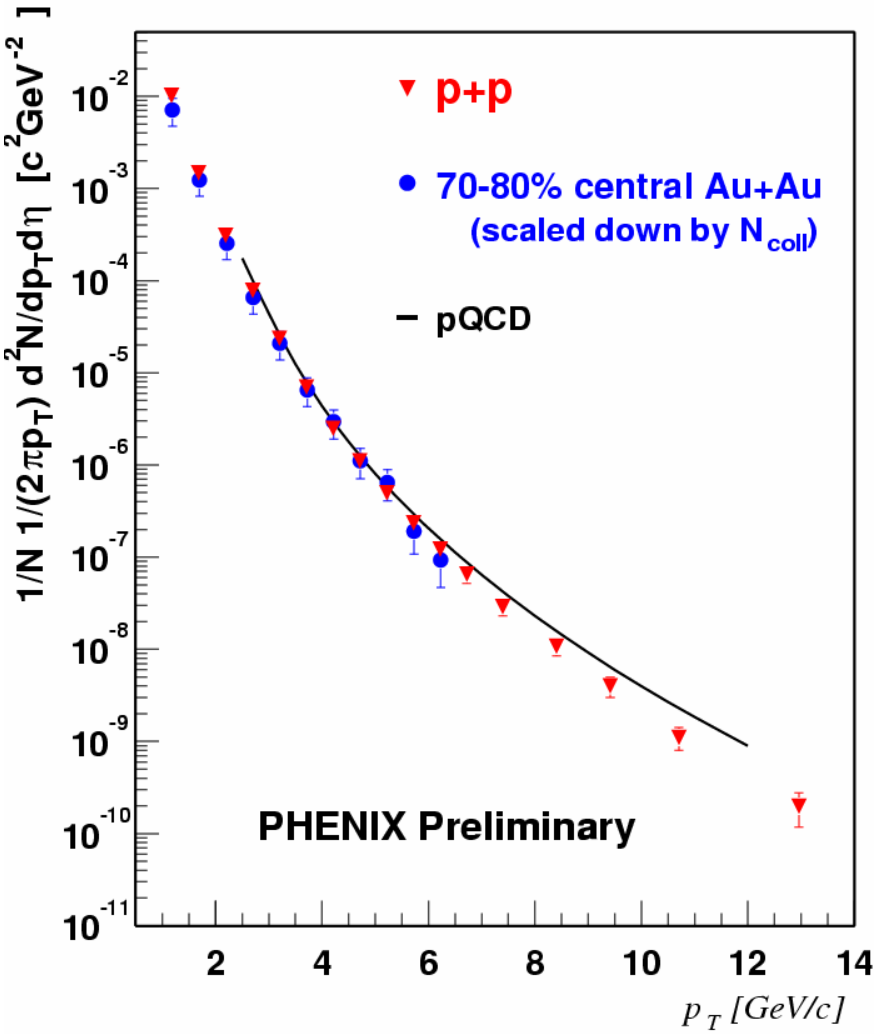
Au+Au $\sqrt{s_{NN}}$ = 200 GeV



Pizero: peripheral Au+Au, pp and a pQCD-based calculation

N_{coll} scaling works in peripheral (PHENIX p+p and 70-80% Au+Au)

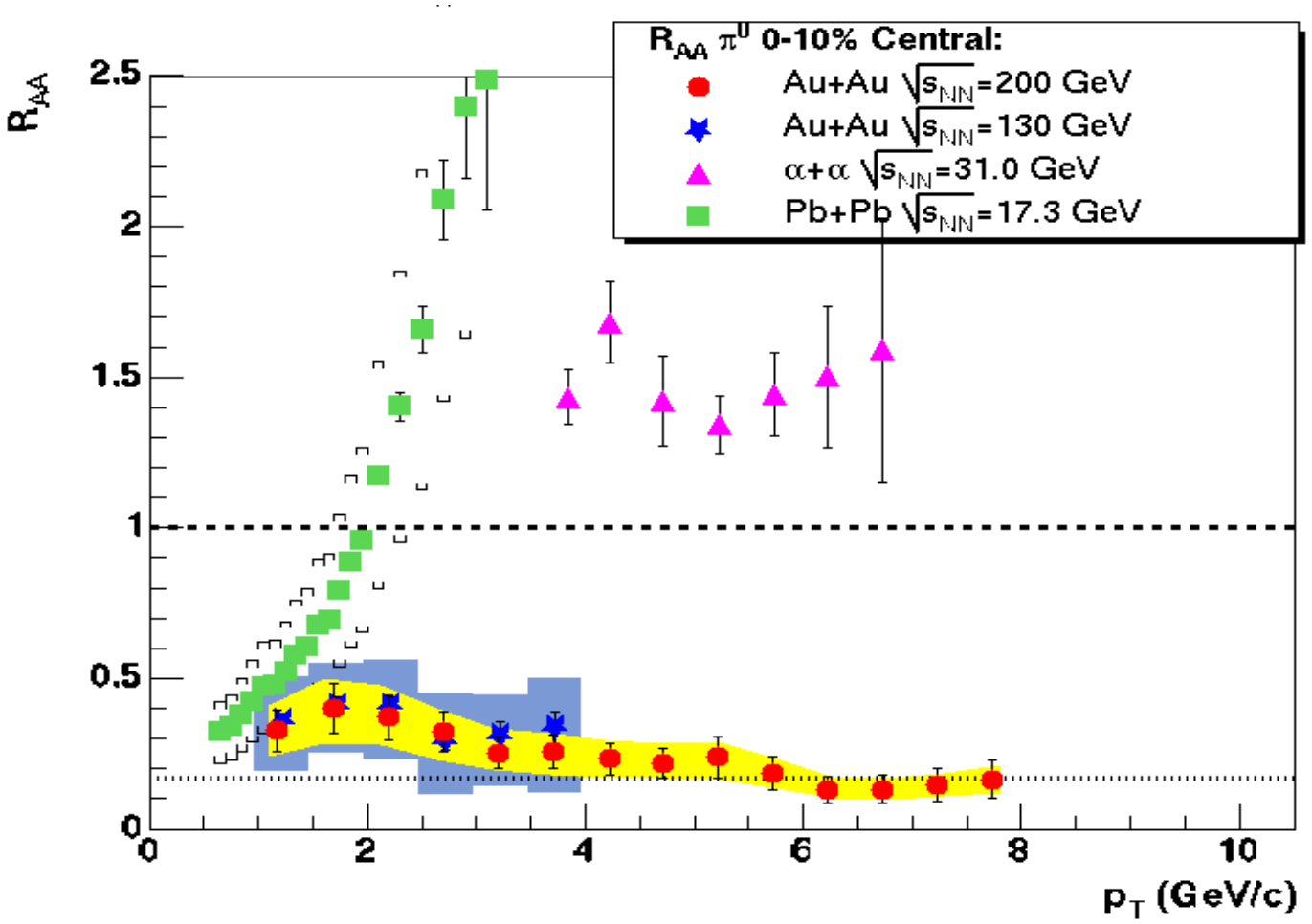
Solid curve: Y. Zhang et al, NLO pQCD and intrinsic k_T fitted for 2-6 GeV p+p
Overpredicts p+p data at higher p_T



Nuclear Modification Factor (R_{AA}) with Pizeros

$$R_{AA}(p_T) = \frac{d^2 N_{AA}/d\eta dp_T}{\langle N_{coll}\rangle\, d^2 N_{pp}/d\eta dp_T}$$

Normalize to p+p
calculate Ncoll from Glauber



From Year-1 to Year-2

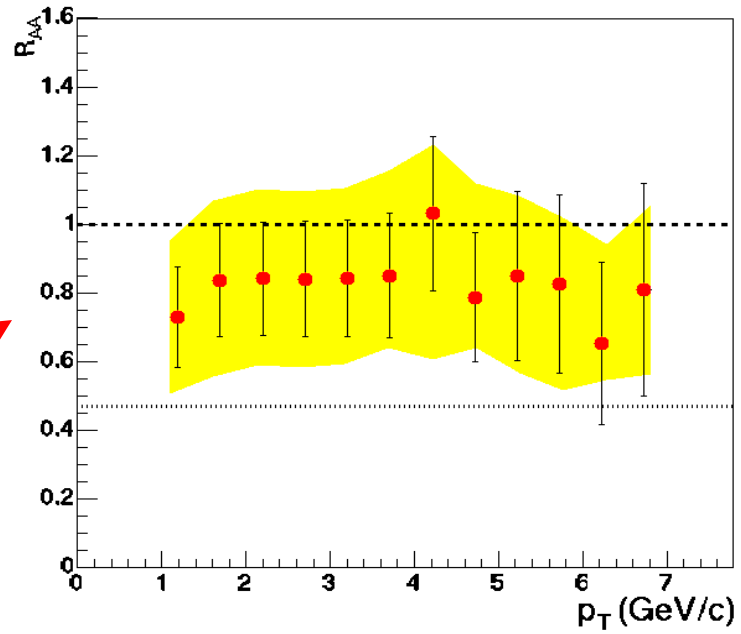
- Much smaller errors
- Much higher pT
- Own pp reference
- Consistent

Central/peripheral – a close relative to R_{AA}

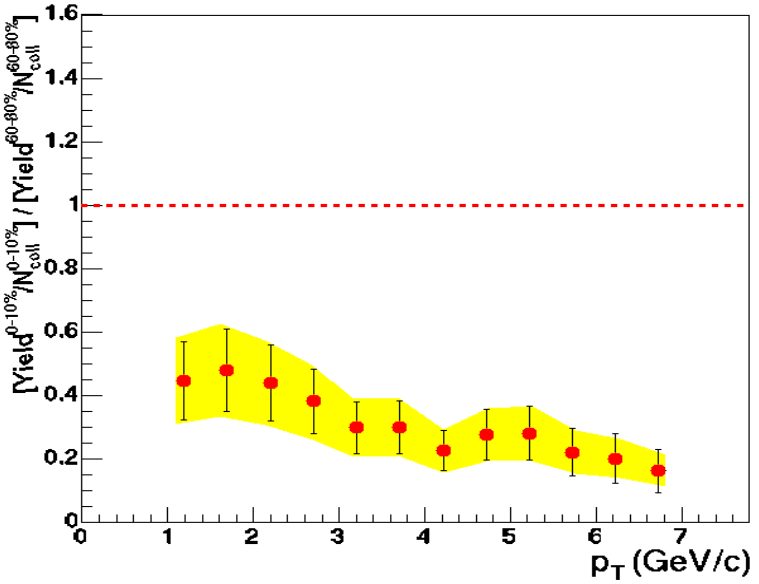
Advantage:
- pp reference not needed
- some detector systematics cancel

Disadvantage:
- very sensitive to N_{coll}

R_{AA} for peripheral (60-80%)
- consistent with N_{coll} scaling



Central(0-10%) / peripheral(60-80%)
normalized with respective N_{coll}
(very similar to R_{AA} but errors larger)



R_{AA} for pizeros compared to calculations

--- Wang dE/dx = 0

--- dE/dx =0.25 GeV/fm

•Wang: X.N. Wang, Phys. Rev. C61, 064910 (2000).

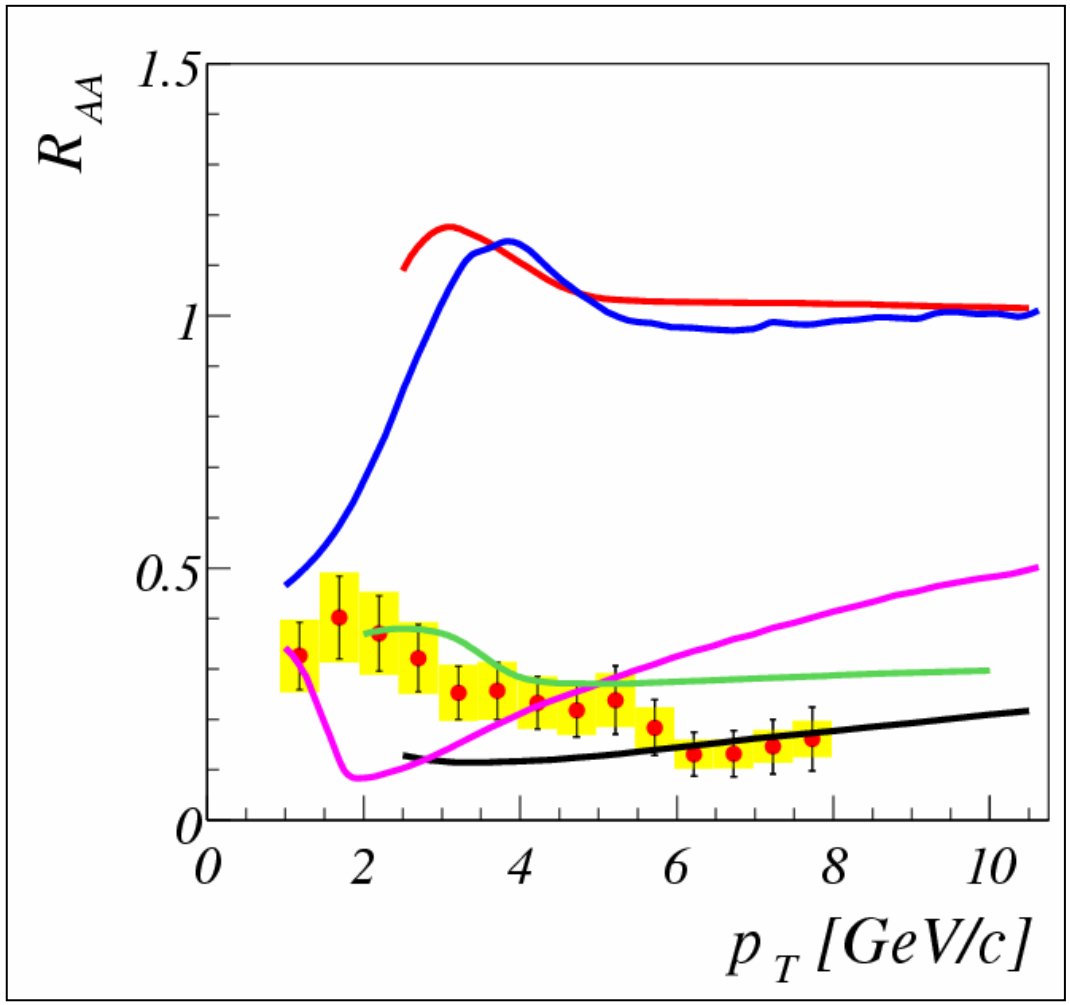
--- Levai $L/\lambda = 0$

--- $L/\lambda = 4$

•Gyulassy, Levai, Vitev: P.Levai, Nuclear Physics A698 (2002) 631.

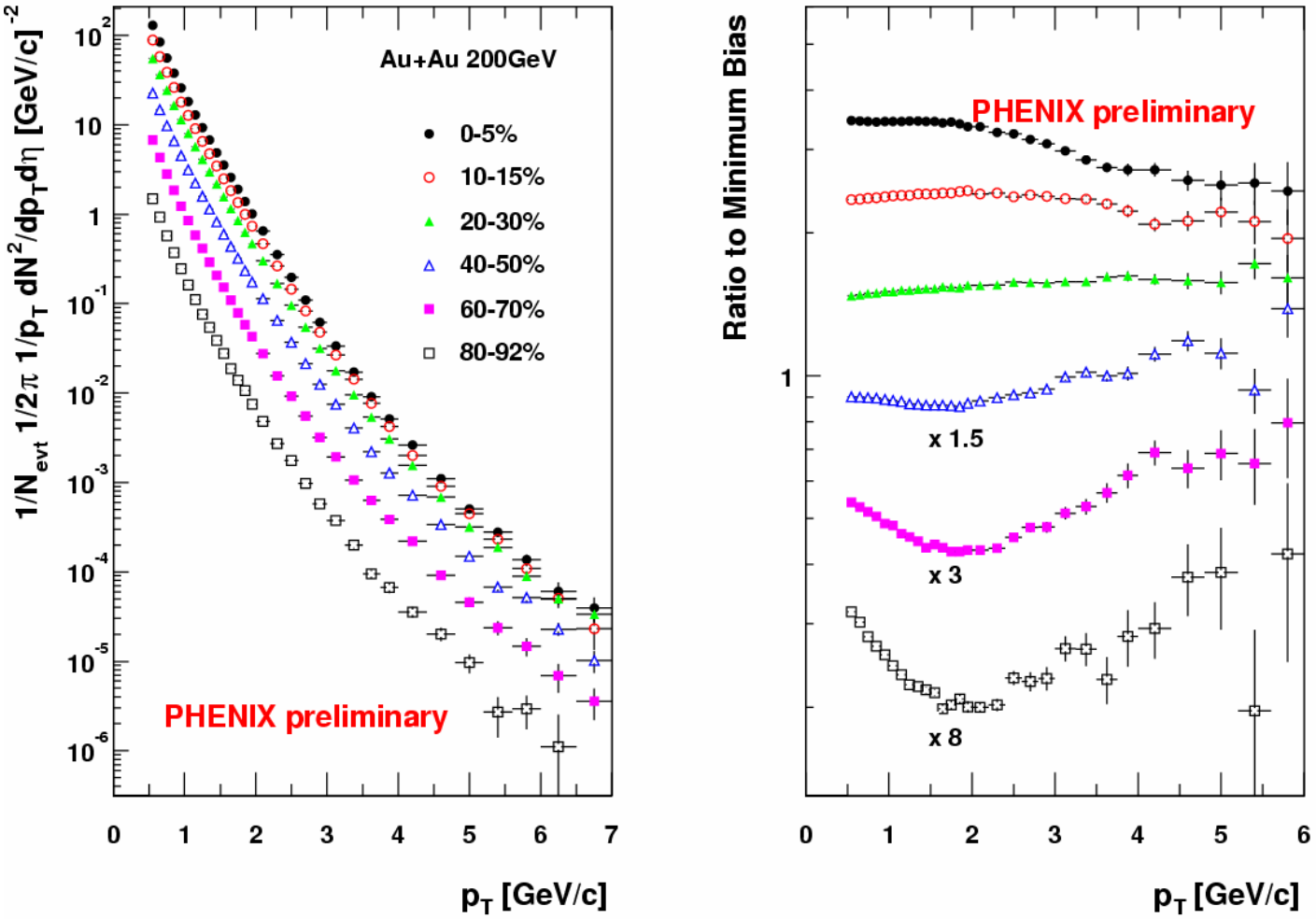
--- Vitev $dN^g/dy = 900$

•**GLV**, Nucl. Phys. B 594, p. 371 (2001) + work in preparation.

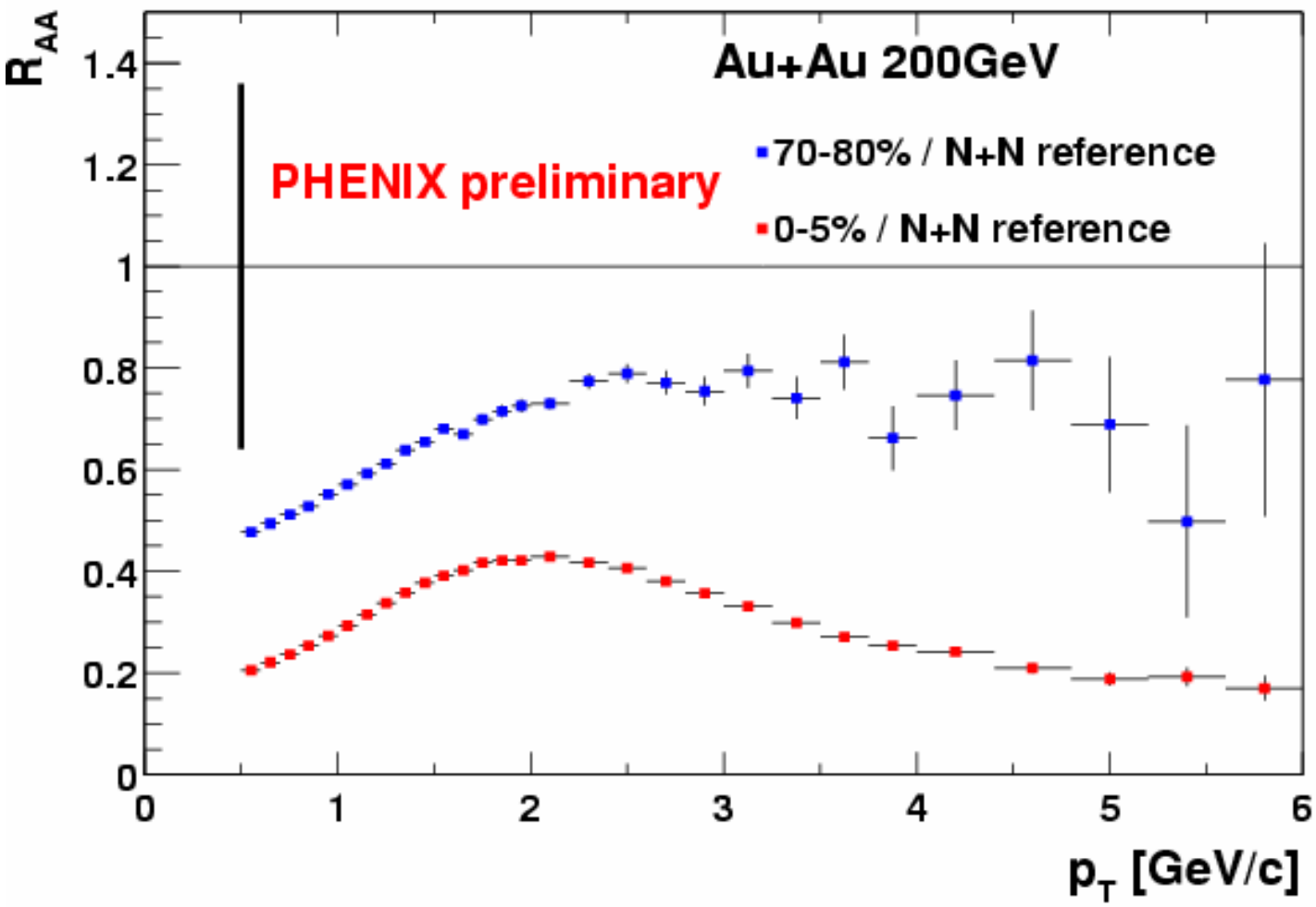


Charged particles, spectra and shapes 200 GeV

A neat way to characterize shape changes: divide each spectrum by minimum bias

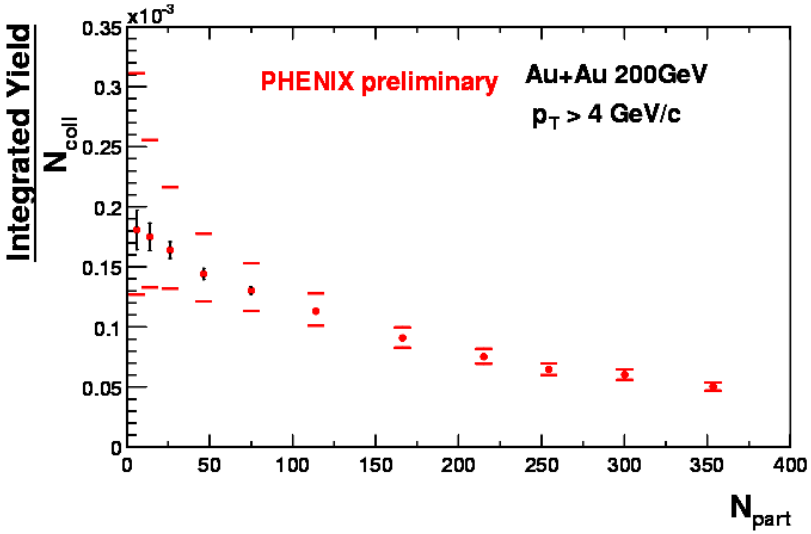


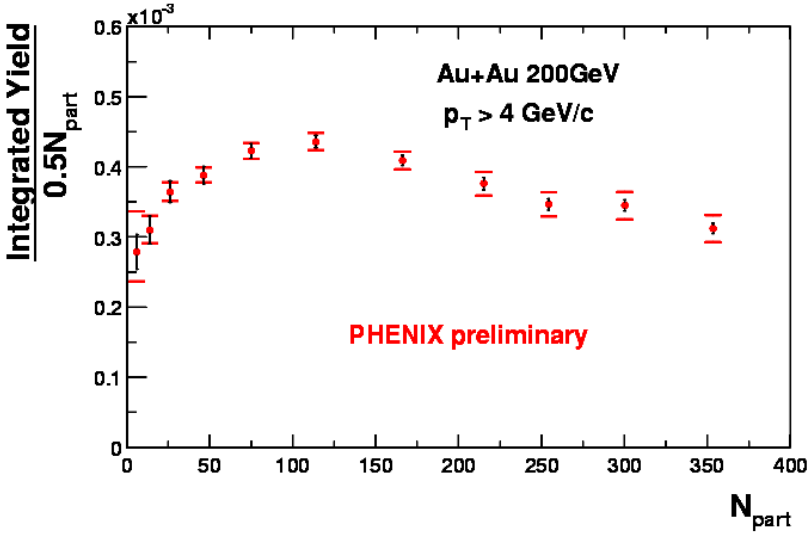
Suppression of (unidentified) charged hadrons



Centrality Dependence of the Suppression at high p_T

Charged yield / N_{coll}, N_{part} vs N_{part}

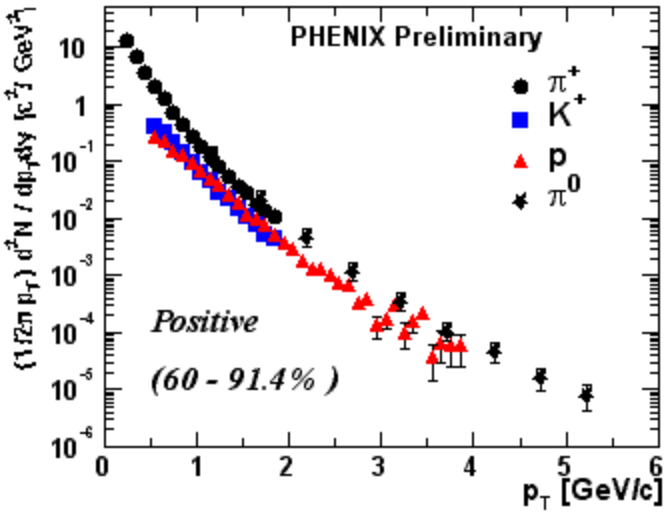


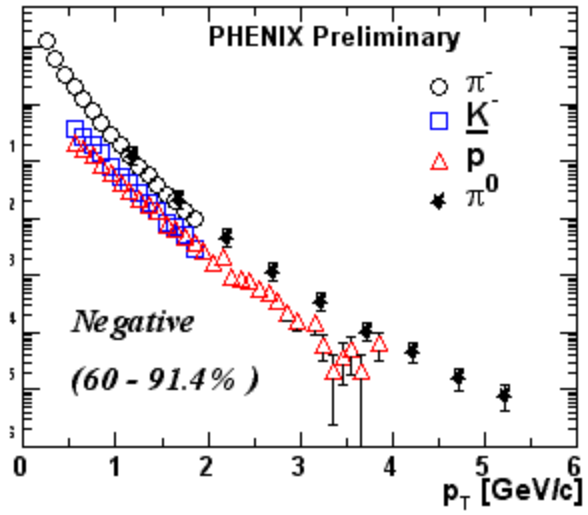


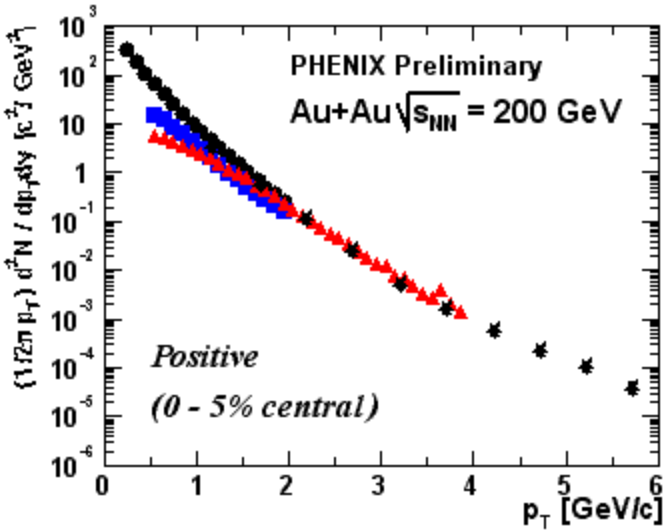
Identified hadron spectra, 200 GeV

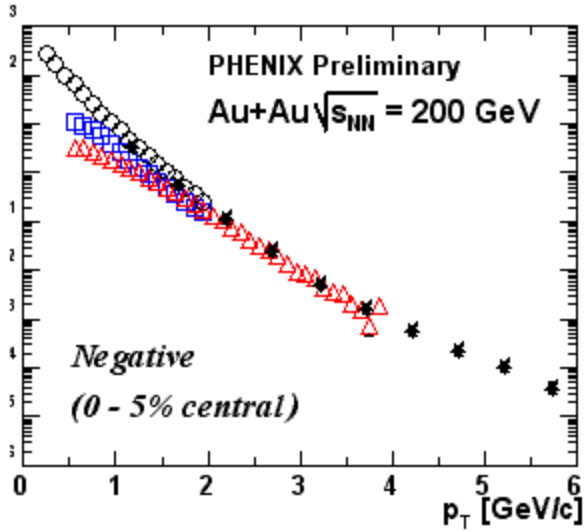
Peripheral:
- similar to pp
- pions dominate at high p_T

Central:
- slopes increase with mass
- proton and pion yields equal at 2-4 GeV/c
- low p_T modified
- antiprotons also overlap negative pions



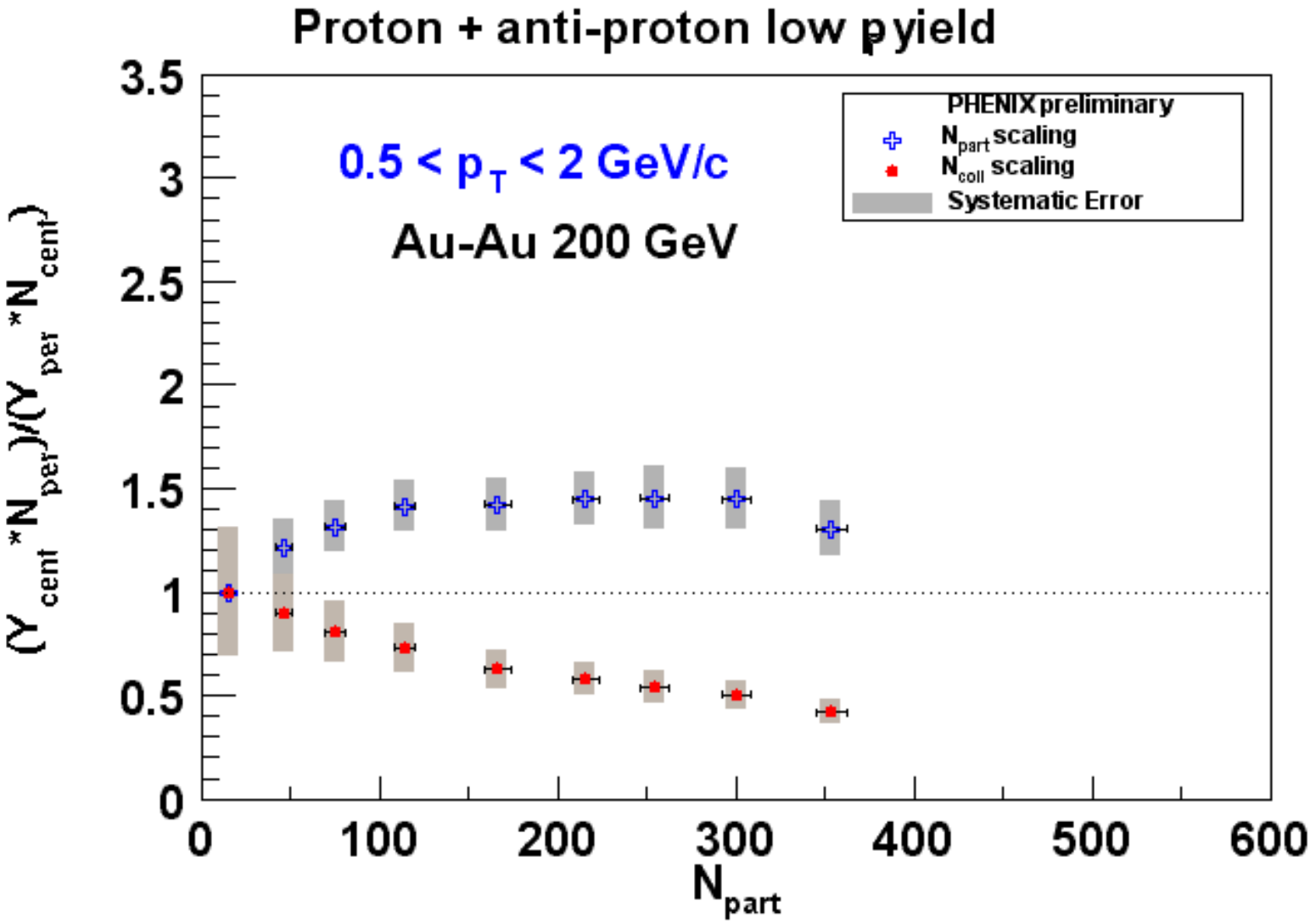






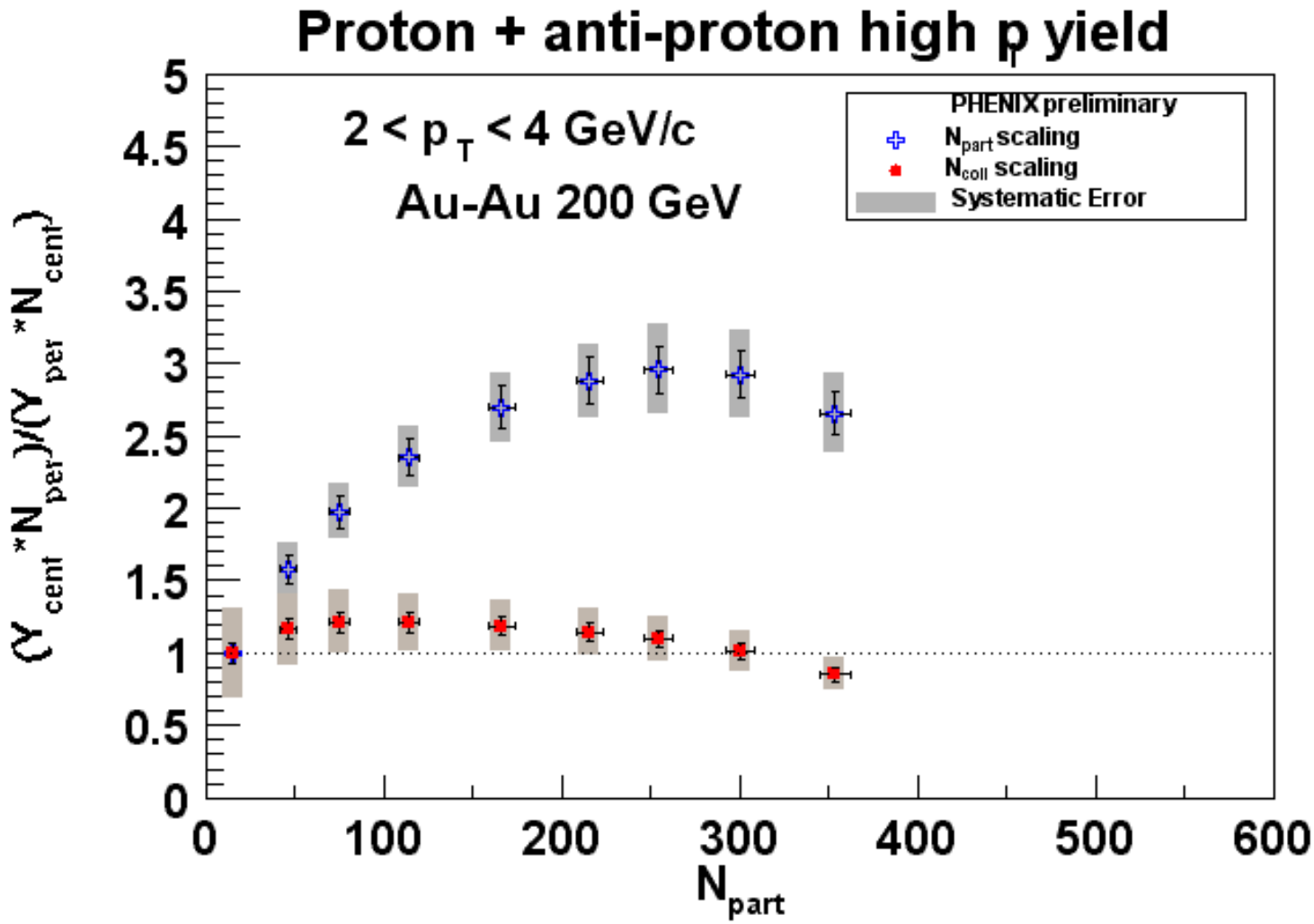
Low pT baryons (almost) scale with Npart

(Normalized to 1 at most peripheral)



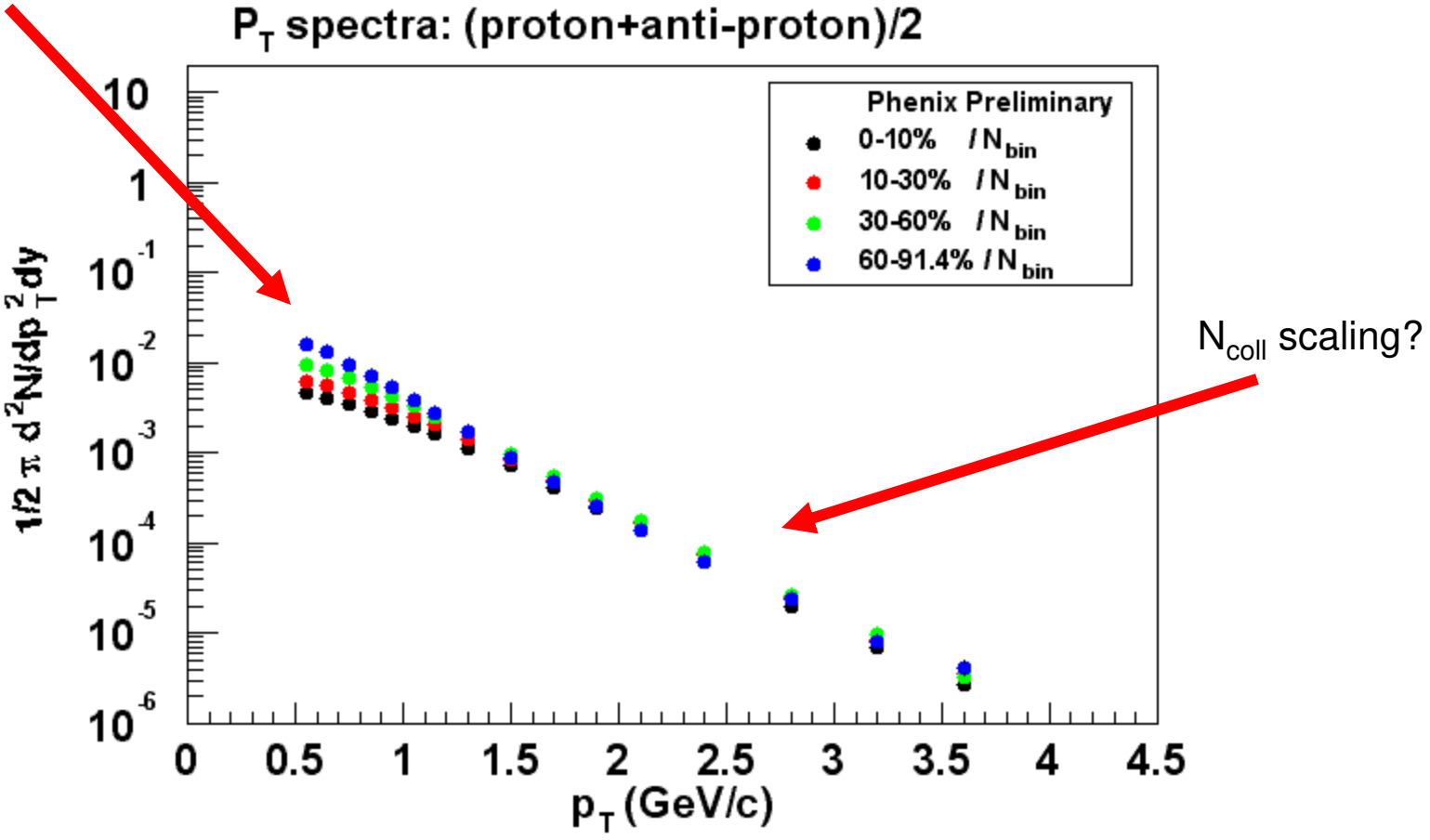
High pT baryons scale with Ncoll

(Normalized to 1 at most peripheral)



Scaling of proton – antiproton spectra

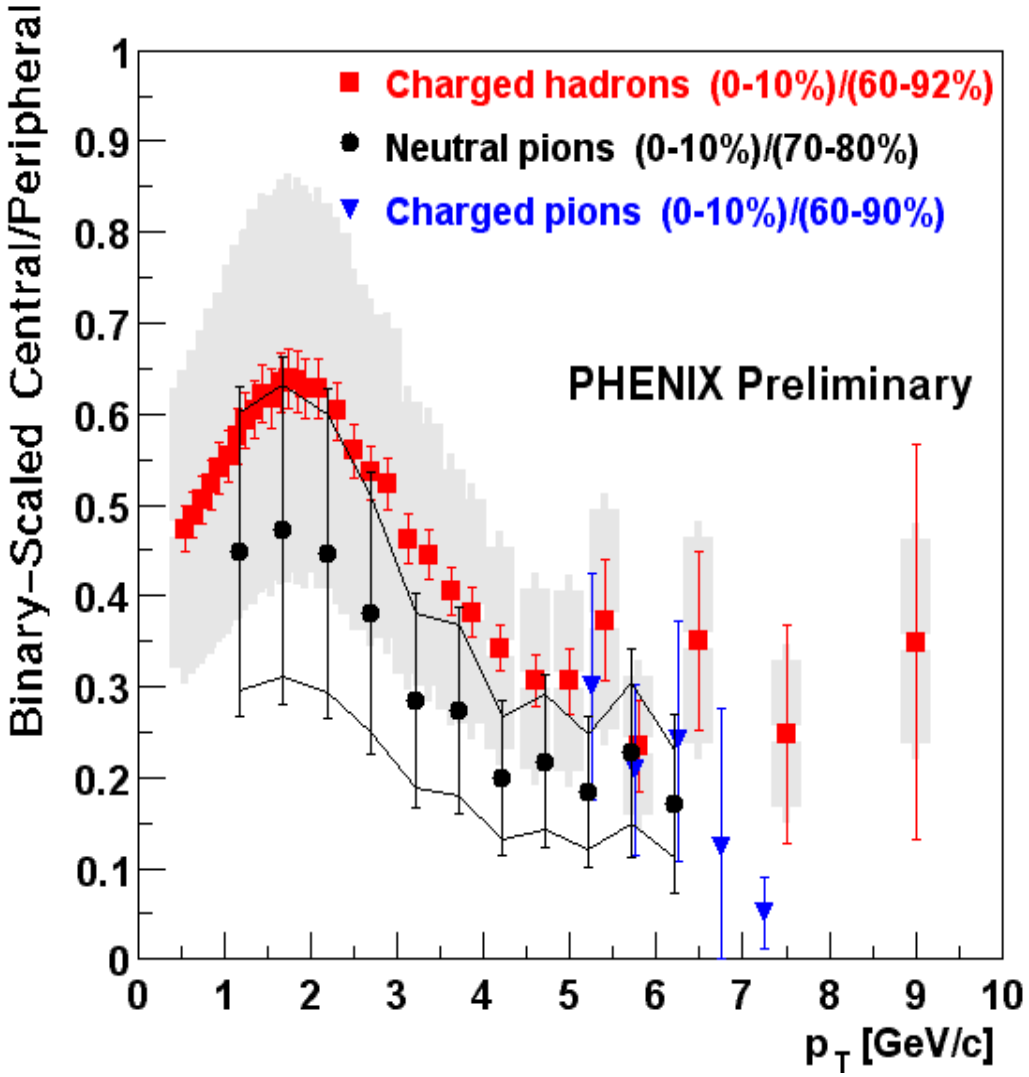
Shape change



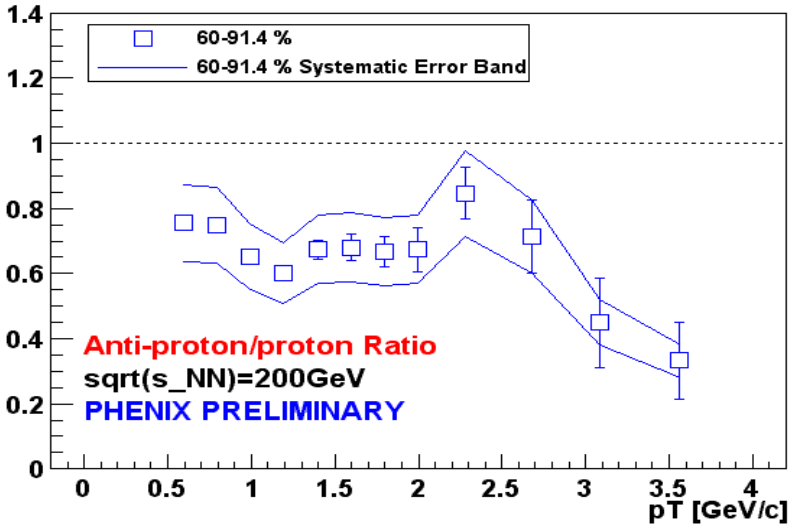
N_{coll} scaling?

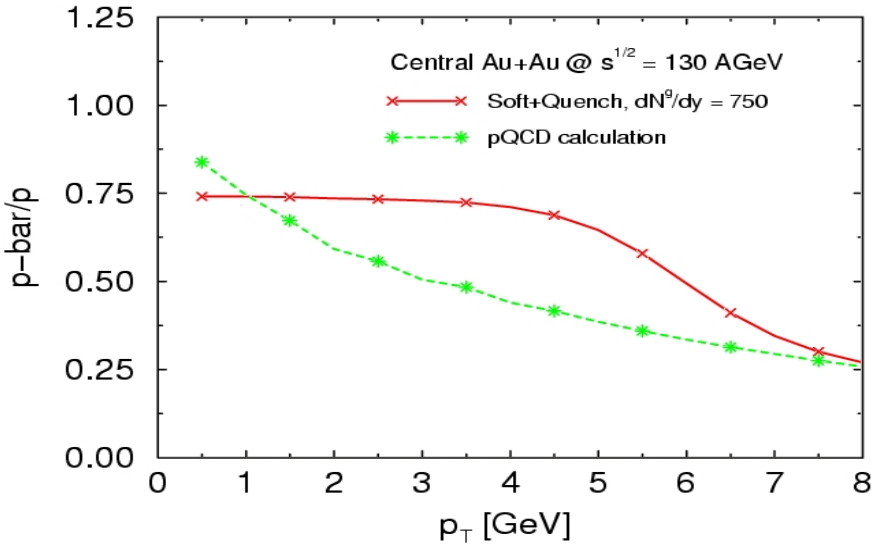
Suppression for different hadrons

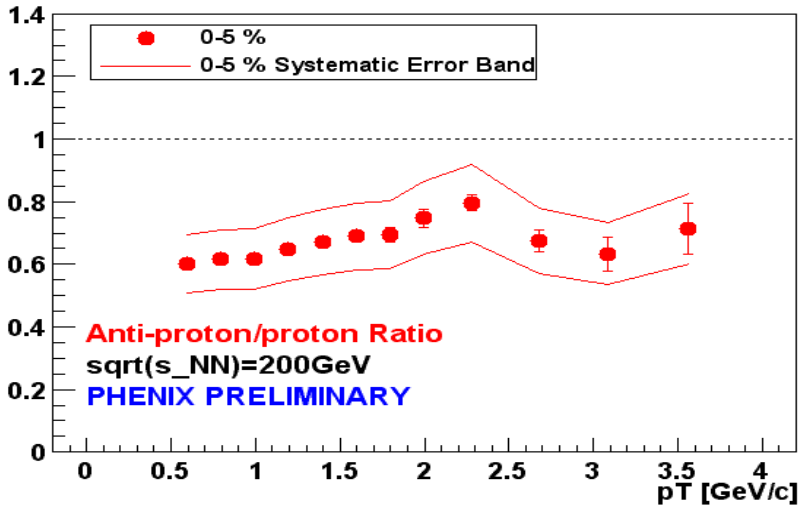
- Suppression to 9 GeV/c!
- Factor consistent for 3 independent measurements
- Difference in charged hadron ratio and neutral pion ratio accounted for by particle composition

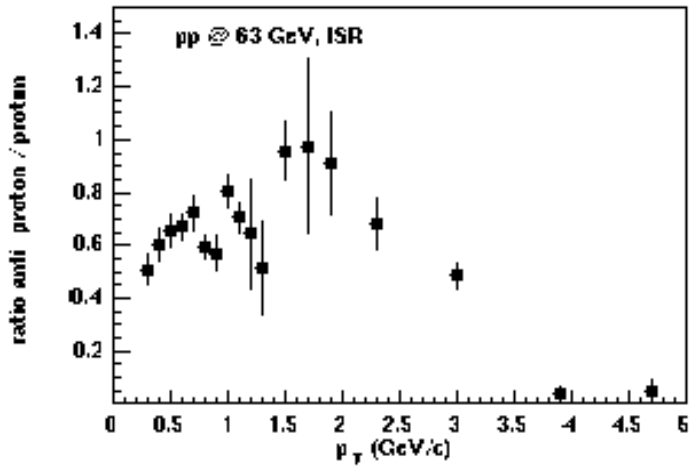


Antiproton/proton ratios – peripheral and central



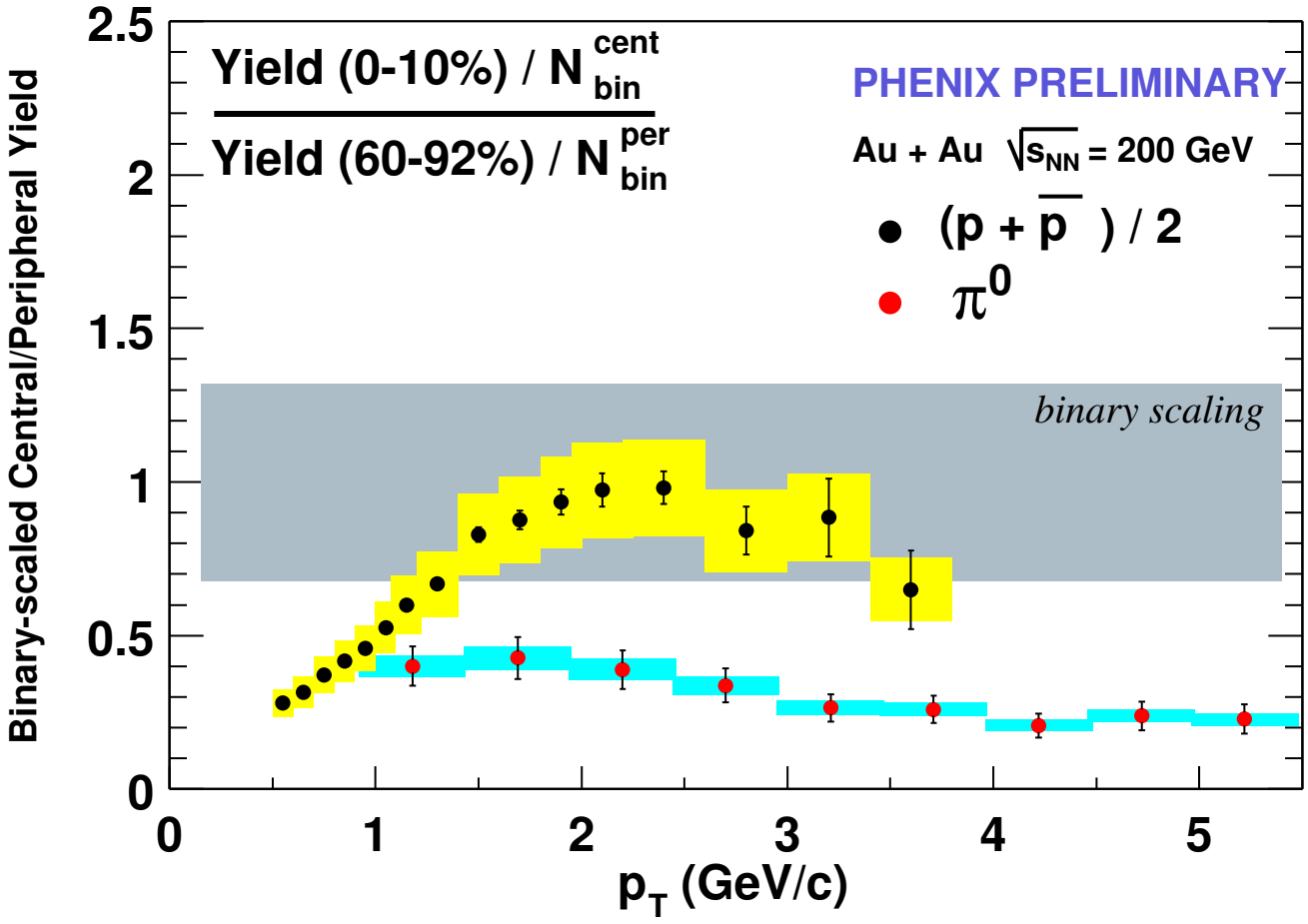






Transverse Dynamics at RHIC, Mar. 7, 2003 – G. David, BNL

A plot that almost made it to Nature



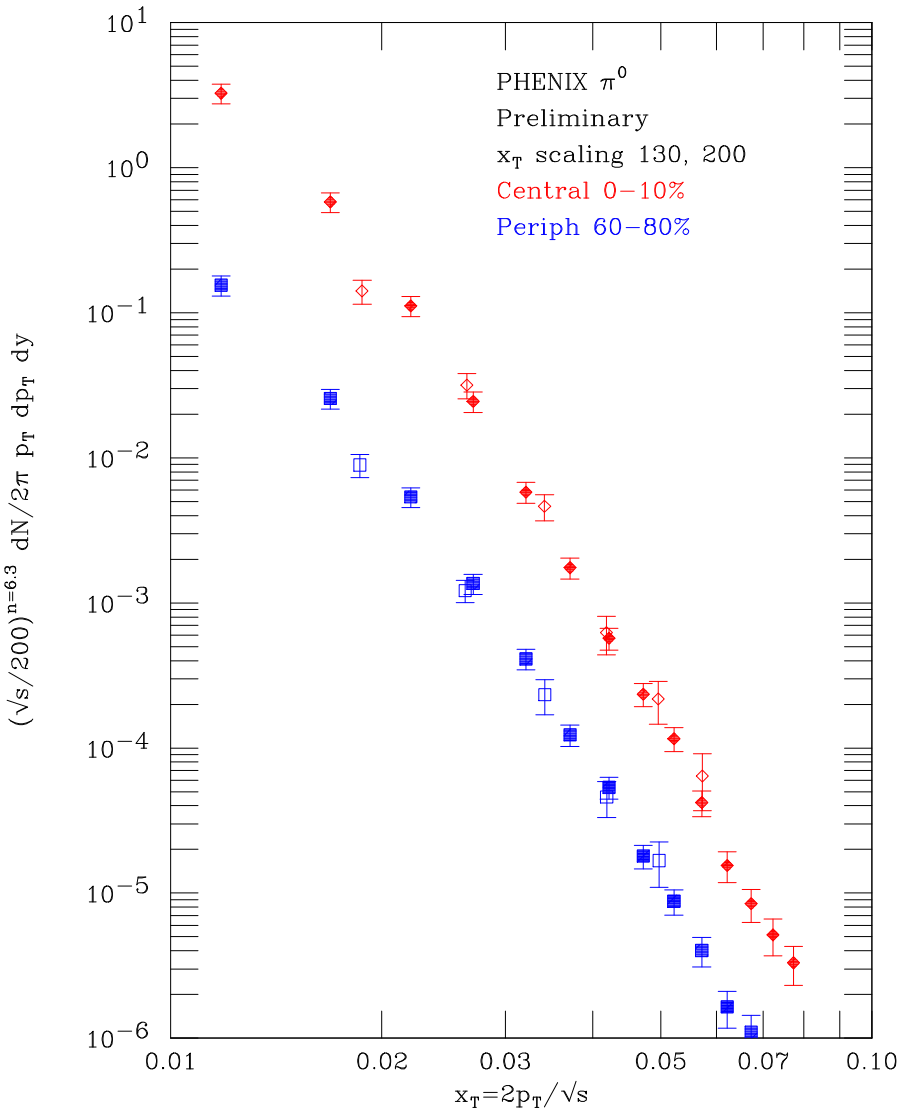
First tests of xT scaling with PHENIX 130 and 200 GeV data

Suppression of high p_T pions unambiguously established but not the mechanism(s)

If shadowing is the main reason, cross-sections at the same x_T should exhibit the same suppression

Since no p+p data at 130 GeV, compare central to peripheral for both 130 and 200 GeV

Apparent scaling at $0.025<x_T<0.06$ with scaling exponent n=6.3+-(0.7)



Conclusions