

High p_T Spectra of Identified Particles Produced in Pb+Pb Collisions at 158A GeV Beam Energy

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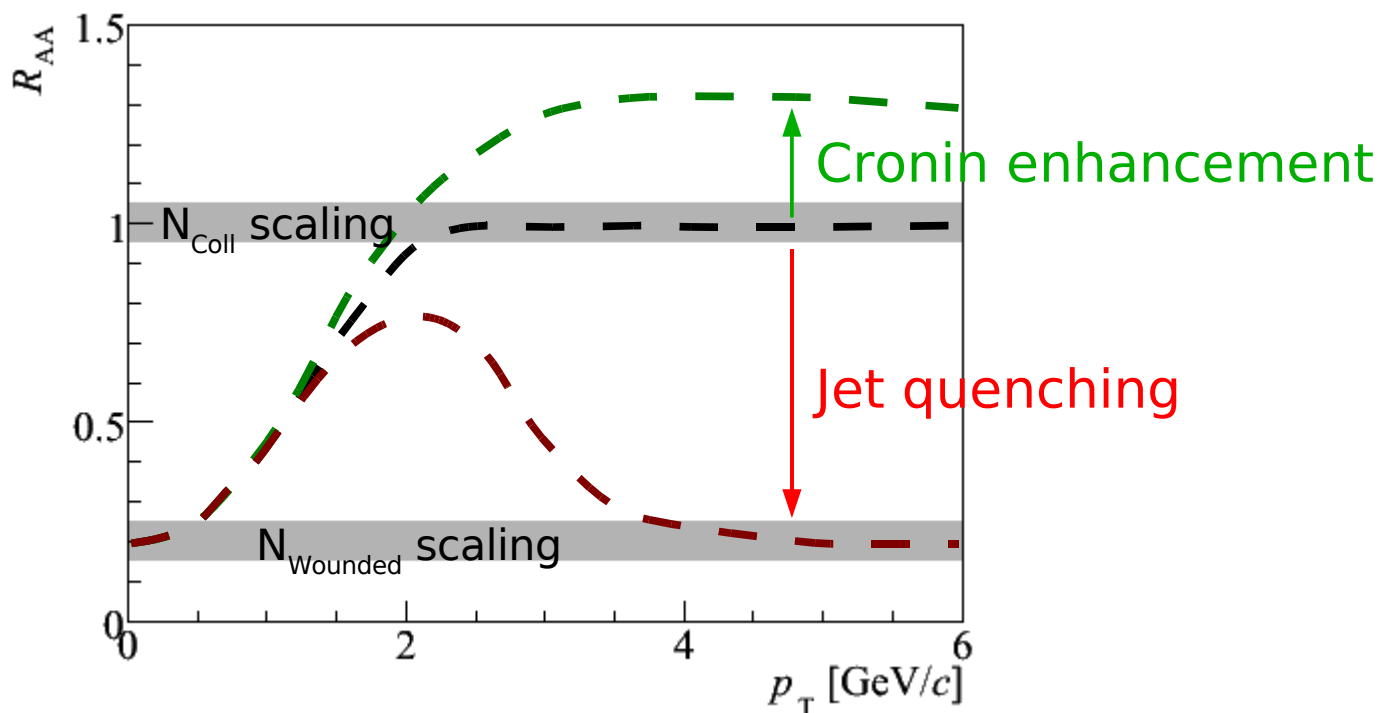
and András László (MTA-KFKI Budapest)



for the  collaboration

How does the transition between soft and hard physics look like?

Sketch of nuclear modification factor R_{AA} for Au+Au collisions:

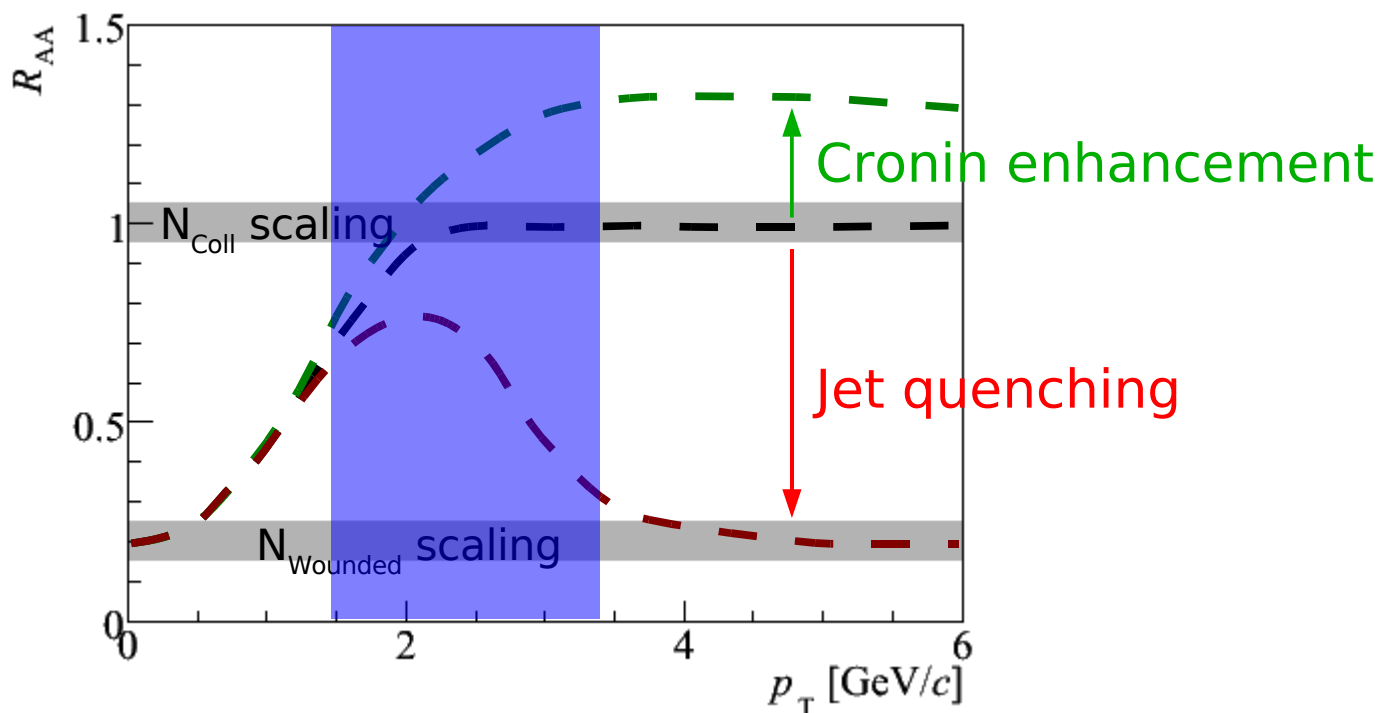


Interplay of different effects modifies shape of spectra at high p_T

→ **1** Nuclear modification factor R_{CP}

How does the transition between soft and hard physics look like?

Sketch of nuclear modification factor R_{AA} for Au+Au collisions:



Interplay of different effects modifies shape of spectra at high p_T

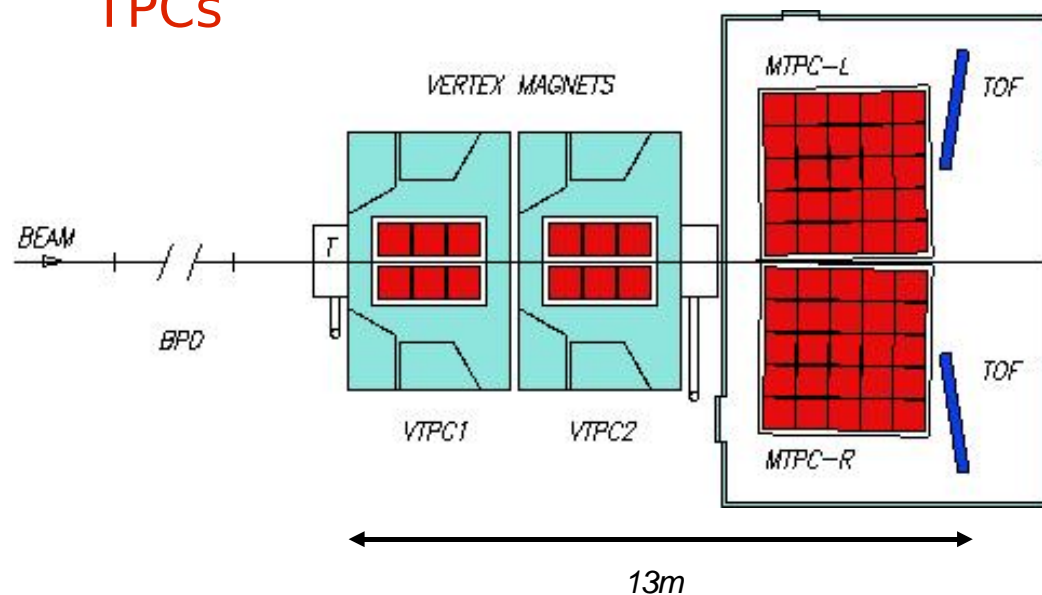
→ **1** Nuclear modification factor R_{CP}

hadronization mechanisms at intermediate p_T

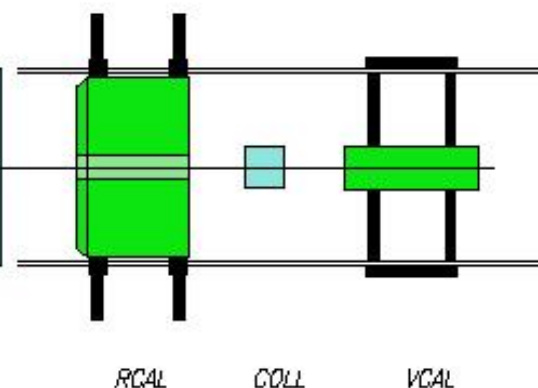
→ **2** Baryon / meson ratios

► The NA49 experiment

Particle identification:
TPCs



Centrality determination:
Veto calorimeter



► Analysis procedure

- Charged hadrons
- Neutral strange hadrons

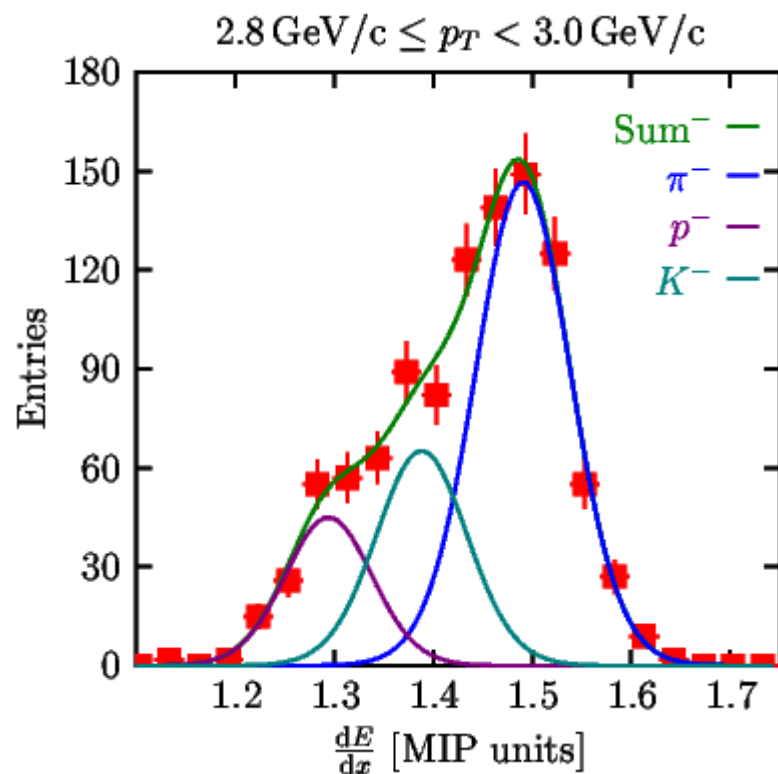
► Preliminary results:

- 1 Nuclear modification factor R_{CP}
 - 2 Baryon / meson ratios
- for Pb+Pb collisions @ 158A GeV

Particle identification at high p_T (Pb+Pb collisions @ 158A GeV)

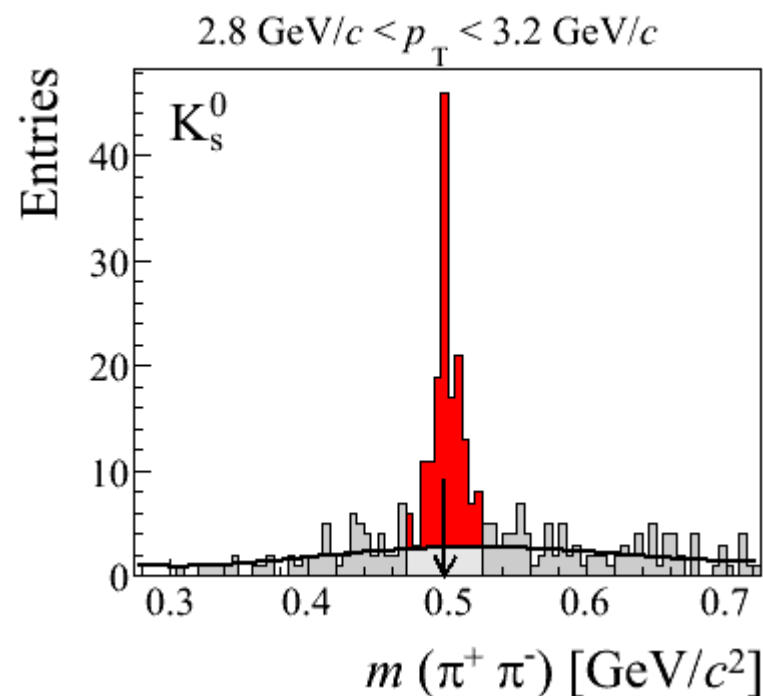
Charged hadrons:

Fit to energy loss (dE/dx) spectra



Neutral strange hadrons:

Invariant mass fit



The preliminary results are

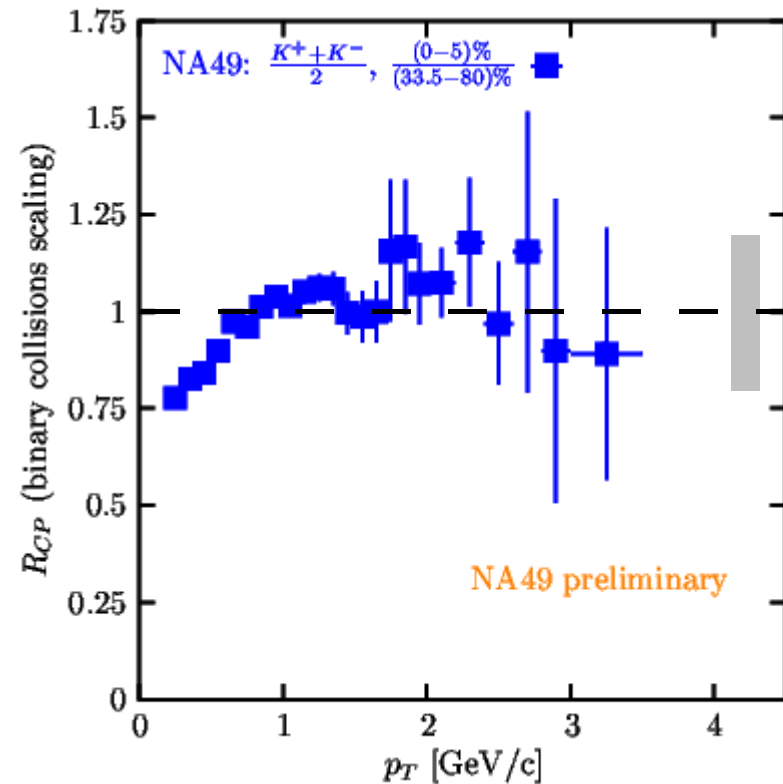
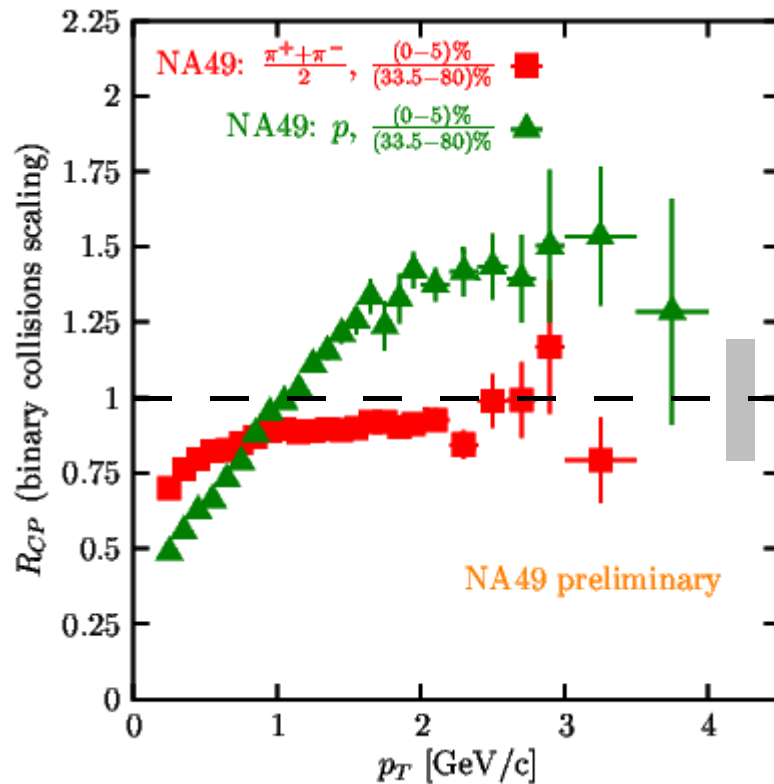
corrected for

- ▶ geometrical acceptance
- ▶ tracking and reconstruction efficiency

not yet corrected for

- ▶ K^\pm and π^\pm decay
- ▶ feeddown

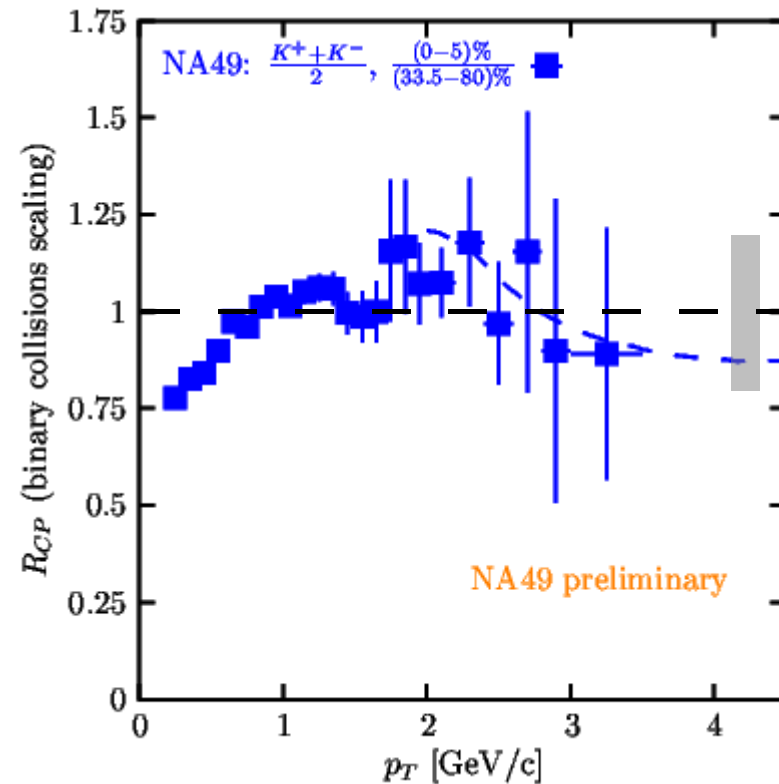
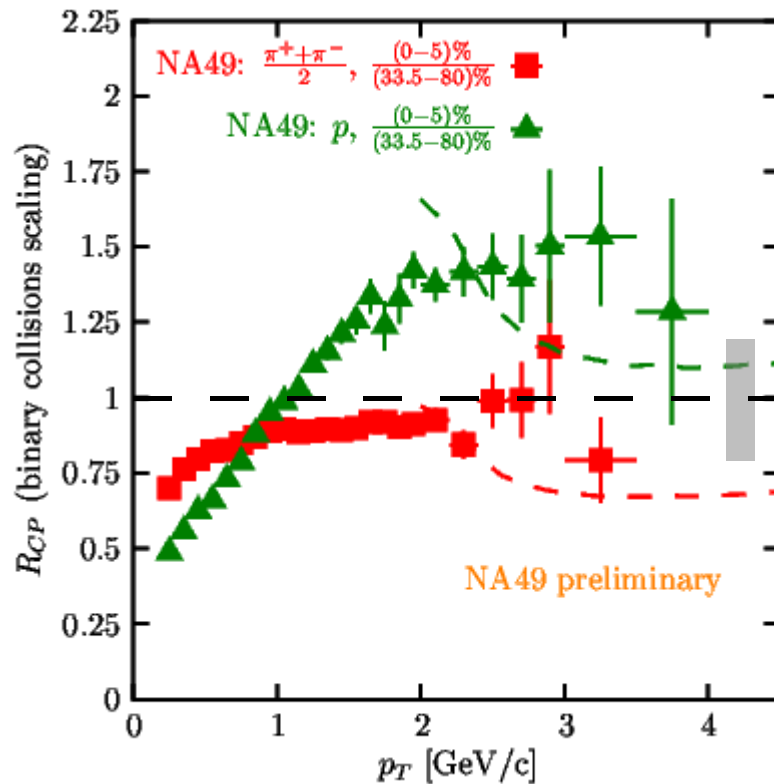
→ systematic biases $\leq 10\%$



- ▶ No indication for Cronin enhancement for pions and kaons
- ▶ $R_{CP}(\pi) < R_{CP}(K) < R_{CP}(p)$
- ▶ Enhancement for protons

$$R_{CP} = \frac{\langle N_{Coll} \rangle^{Per.} \left(\frac{d^2 N}{d p_T d y} \right)^{Cen.}}{\langle N_{Coll} \rangle^{Cen.} \left(\frac{d^2 N}{d p_T d y} \right)^{Per.}}$$

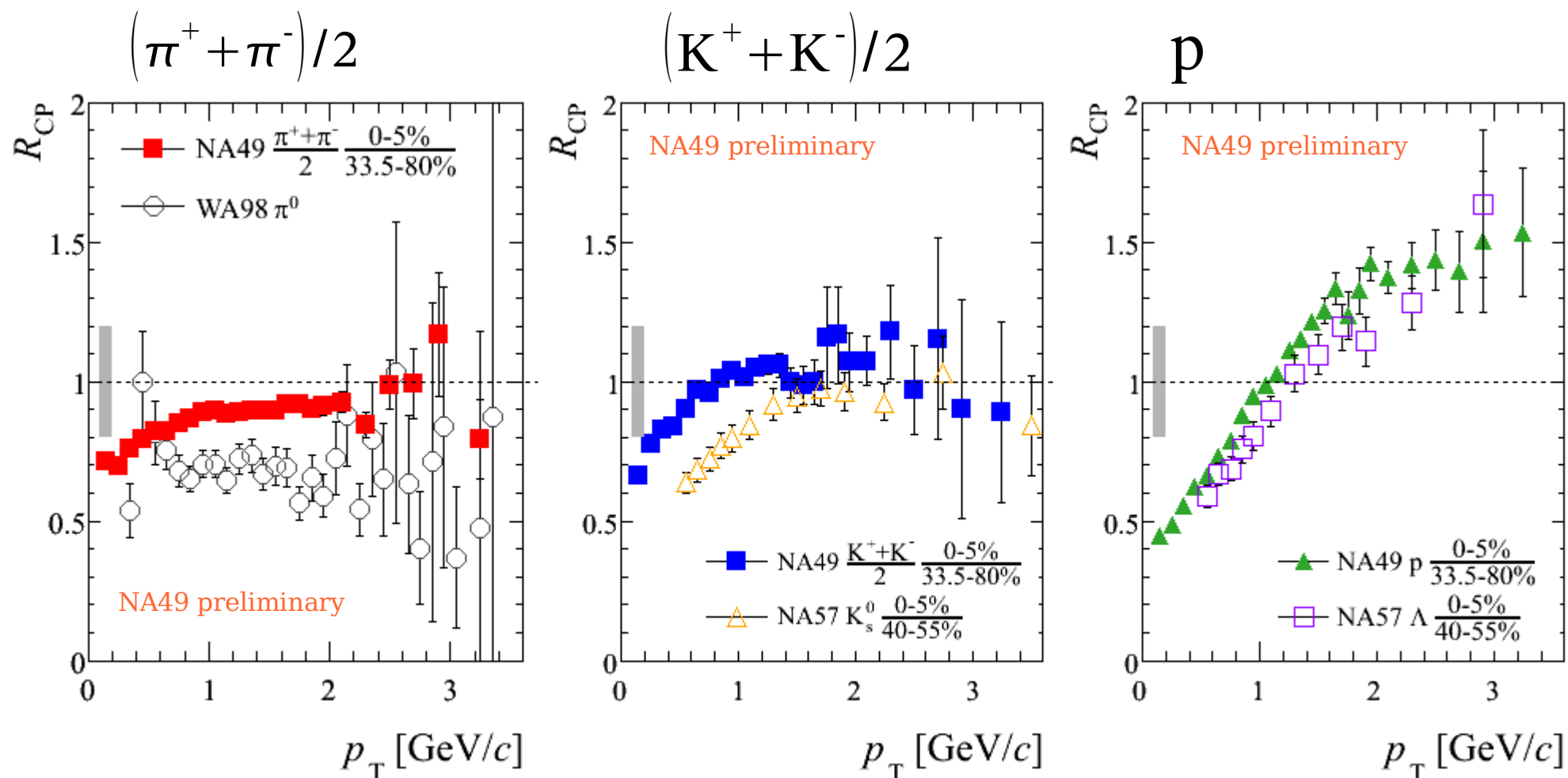
Shaded bands indicate uncertainty in N_{Coll} determination: 20%



Dashed lines: pQCD calculations including jet quenching
 (Wang, PL B 595, 165, 2004 and private communication)

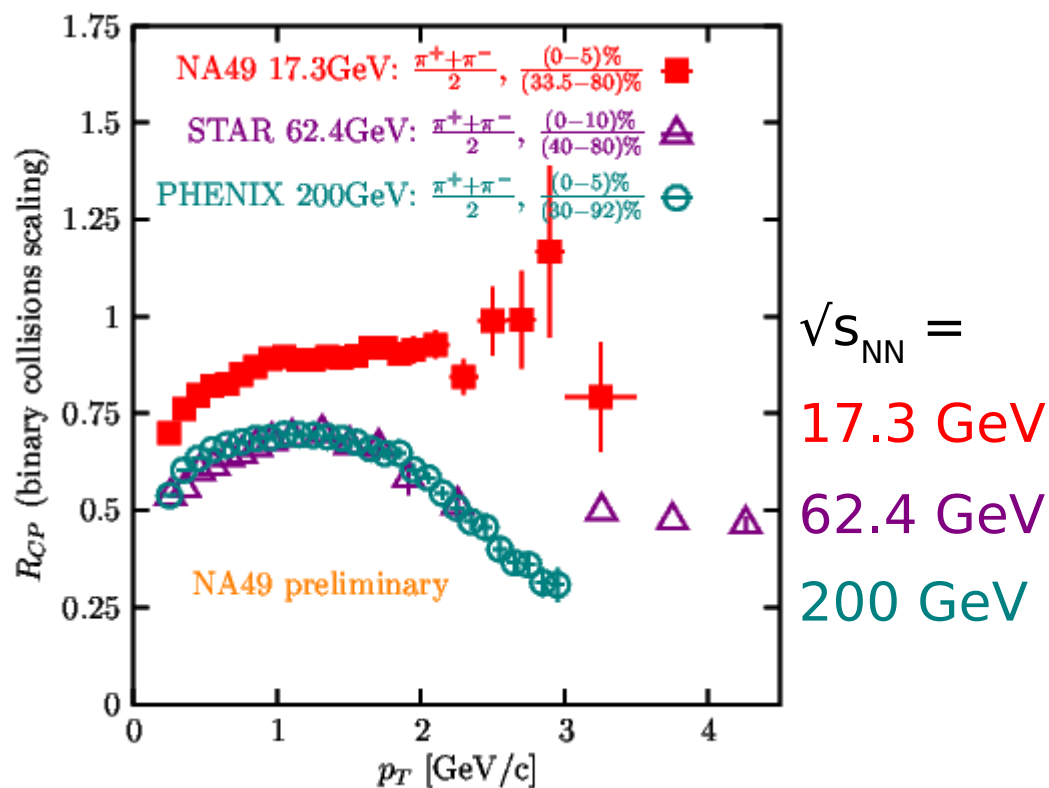
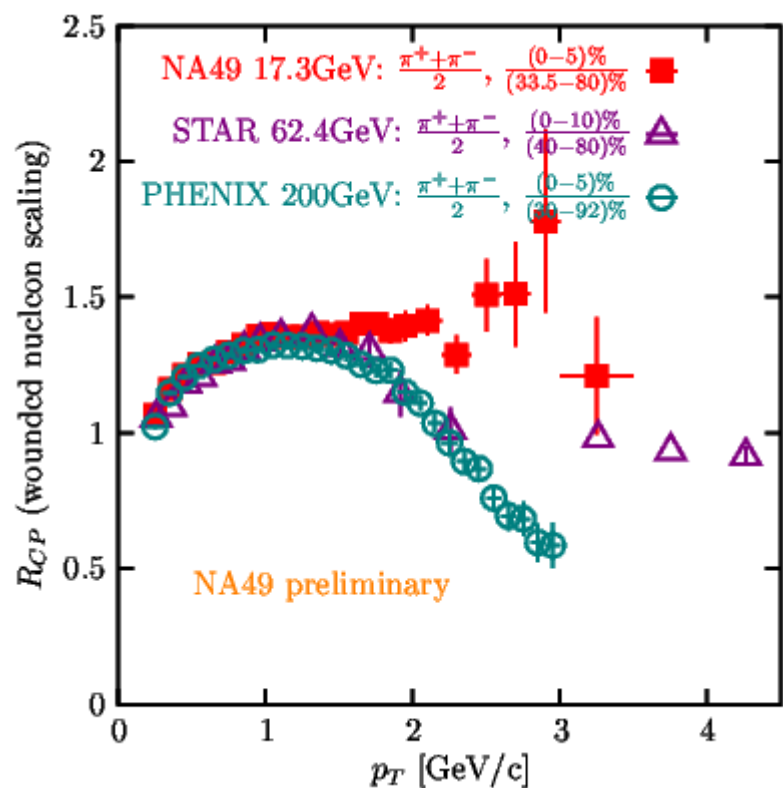
- Predictions consistent within errors with NA49 measurements

Shaded bands indicate uncertainty in N_{Coll} determination: 20%



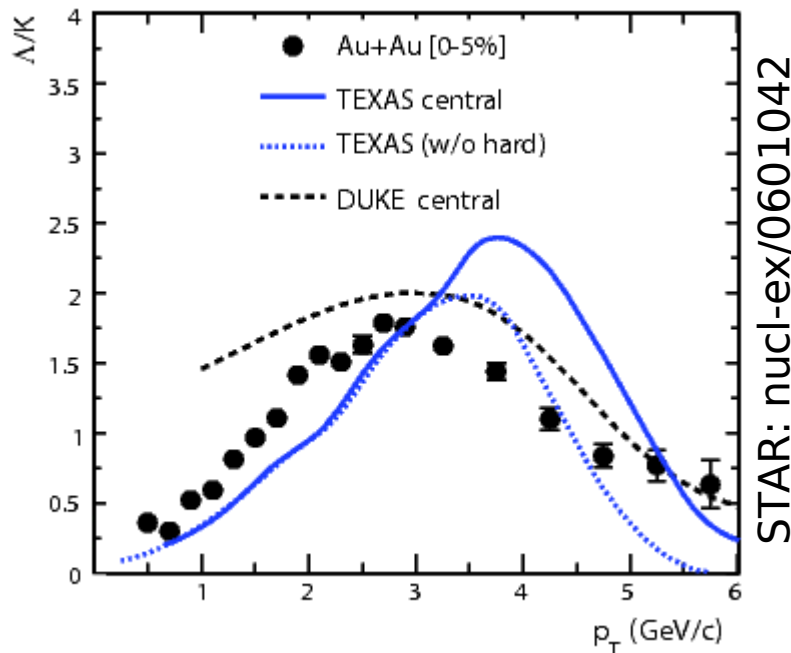
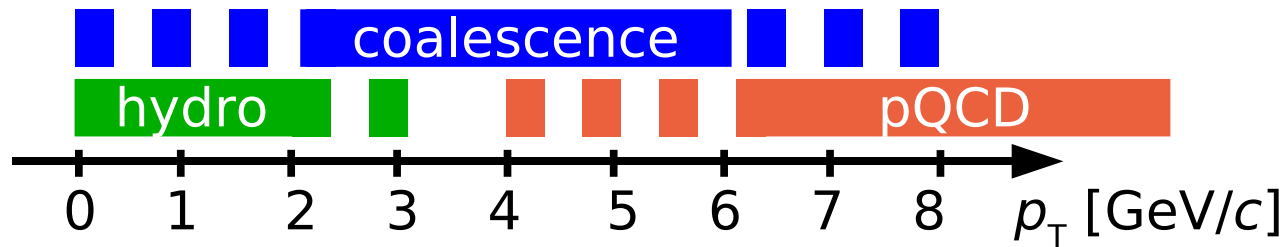
- Consistency between experiments at SPS (within large systematic errors)

WA98: EPJ C 23: 225, 2002; NA57: PL B 623, 17, 2005



- ▶ R_{CP} (wounded nucleon scaling) is energy independent for $p_T < 1.5$ GeV/c
- ▶ R_{CP} seems to decrease with increasing energy at $p_T \simeq 3$ GeV/c for both scalings

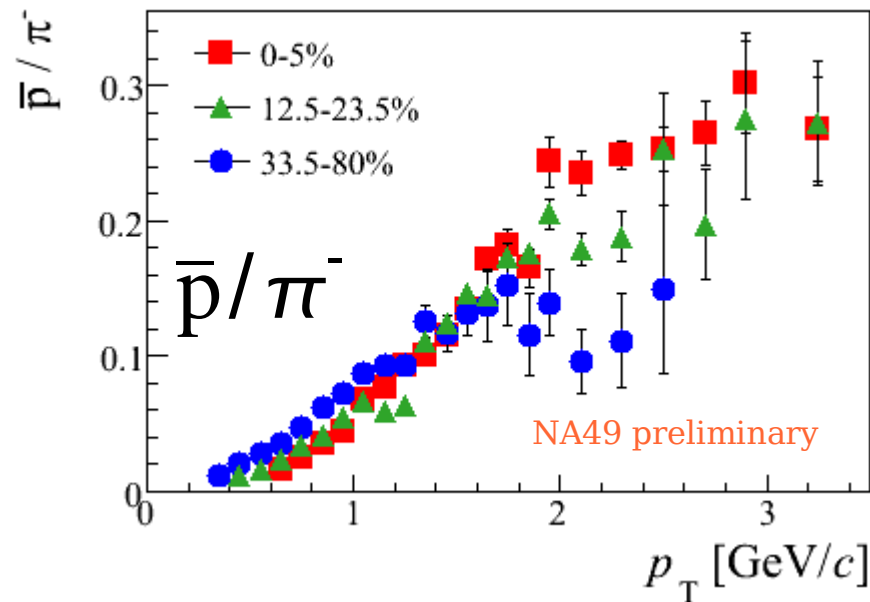
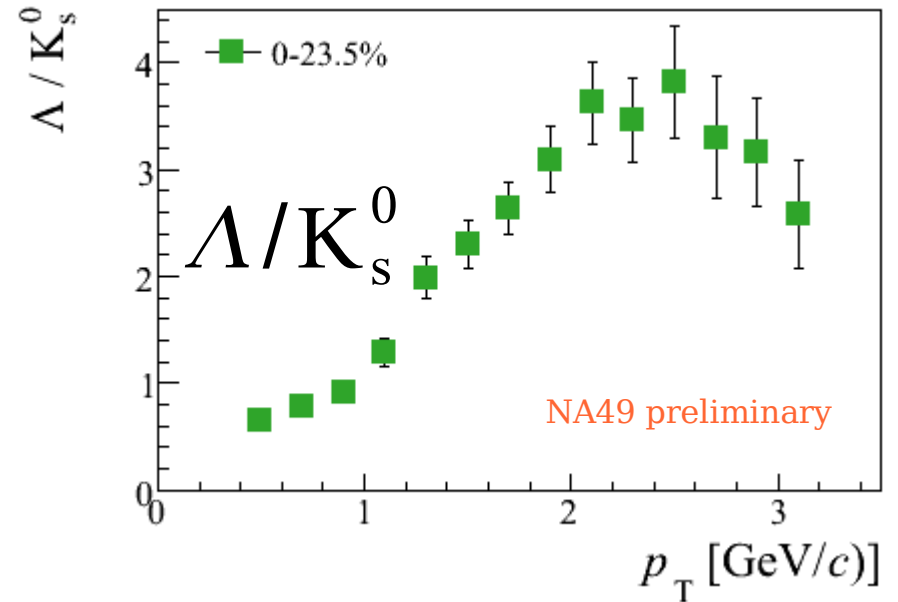
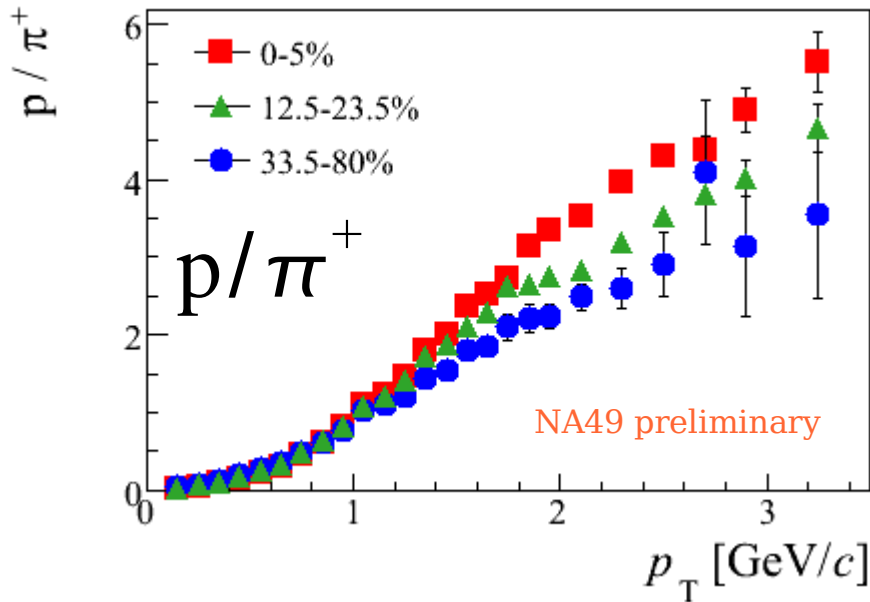
How does the transition between soft and hard physics look like?



- ▶ Large baryon / meson ratios at intermediate p_T in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV
- ▶ Can qualitatively be explained by *quark coalescence models*

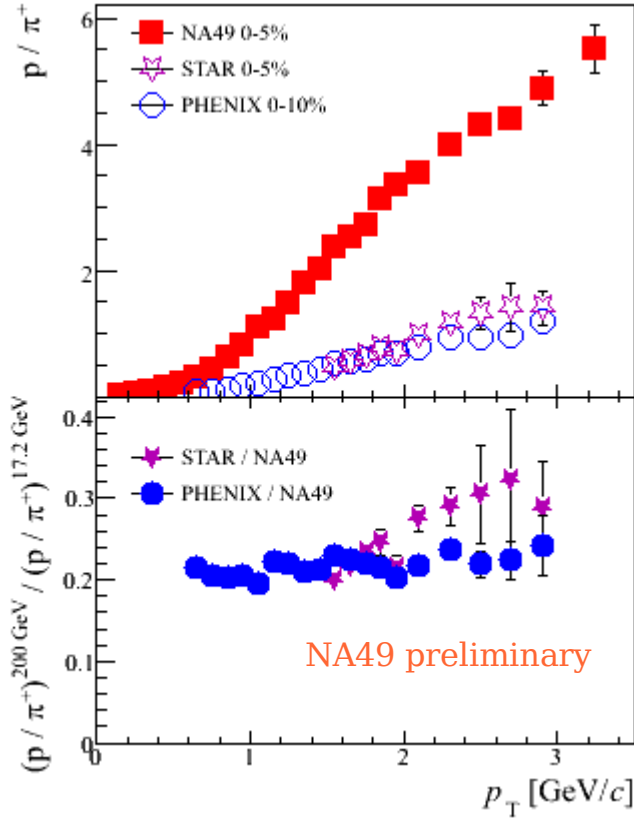
→ Energy dependence?

No coalescence model calculations available for $\sqrt{s_{NN}} = 17.3$ GeV yet

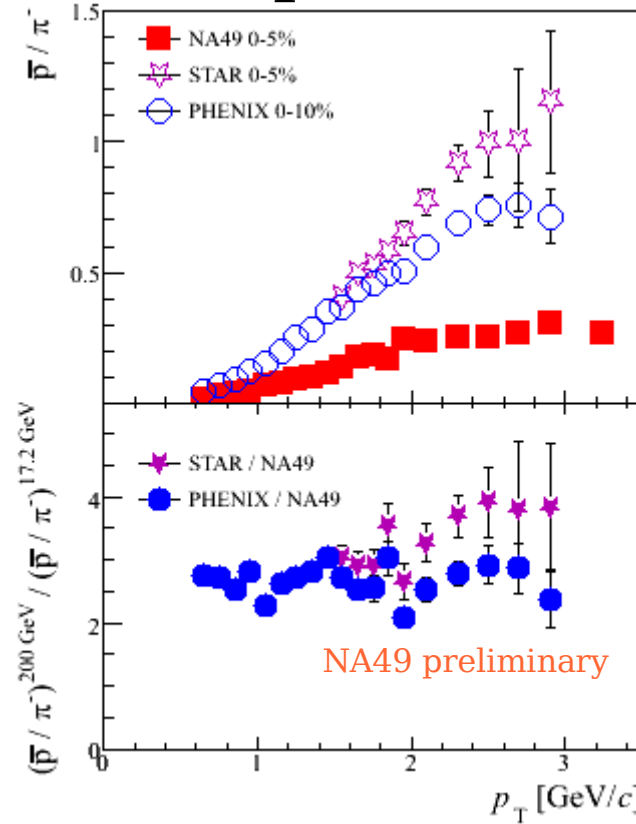


- ▶ Increase with p_T and centrality
- ▶ Tendency to saturate at high p_T ?

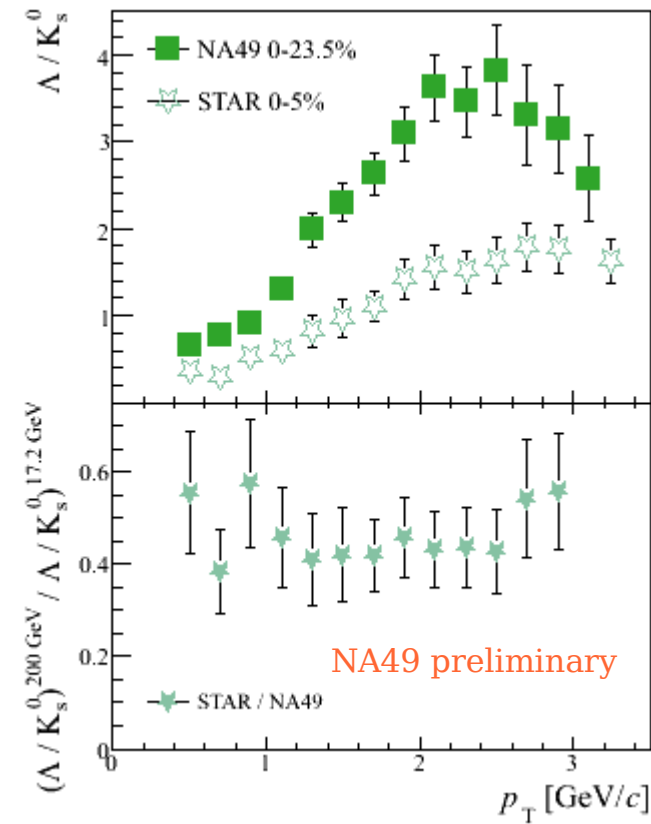
p/π^+



\bar{p}/π^-



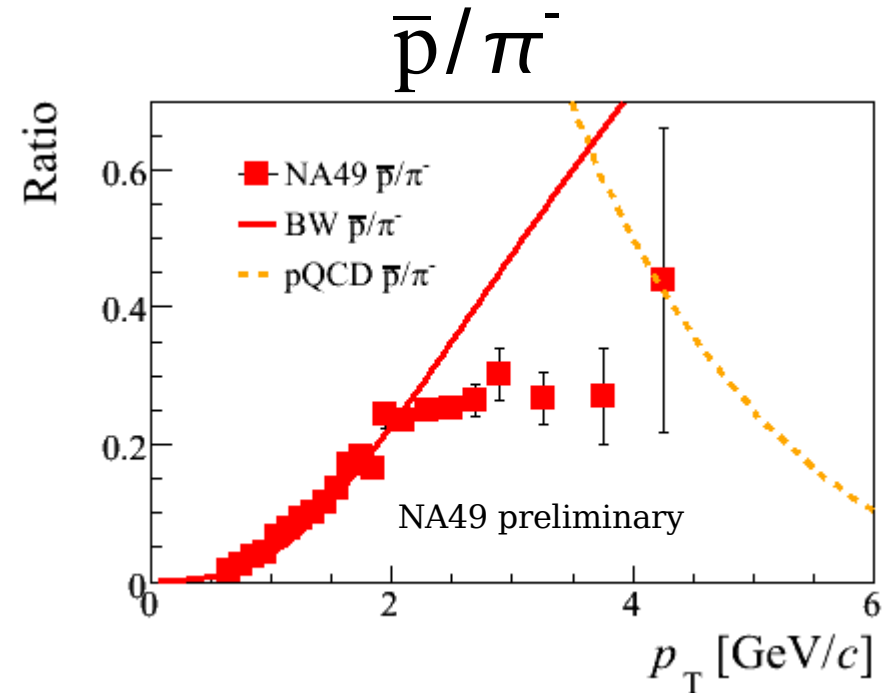
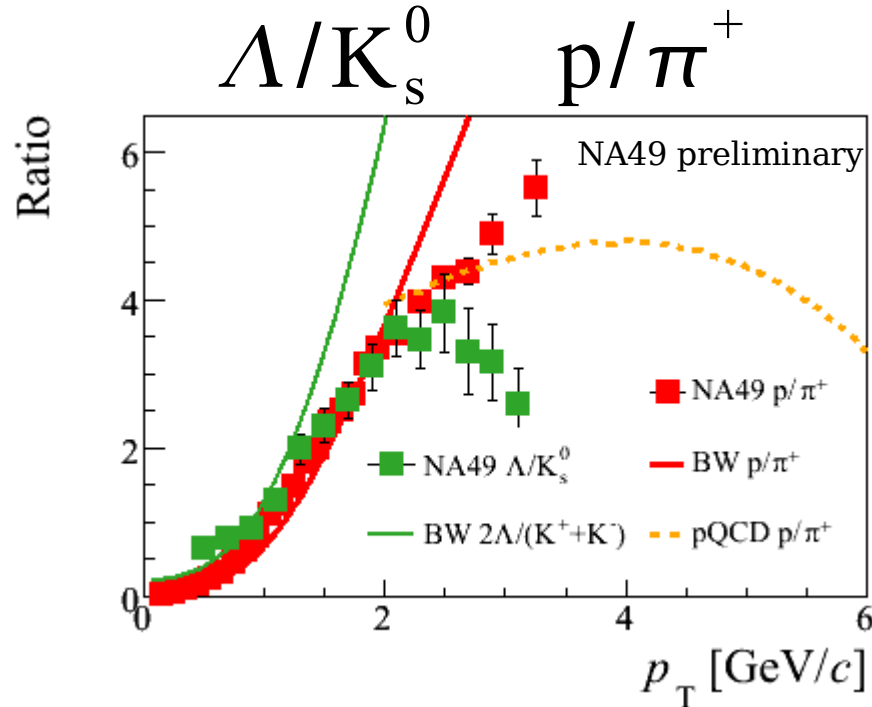
Λ/K_s^0



► The shape of baryon / meson ratios seems to be energy independent

PHENIX: Phys. Rev. C 69, 034909 (2004); STAR: nucl-ex/0601042

Pb+Pb @ 158A GeV



- ▶ Blast wave fit overpredicts data at $p_T > 2.0$ GeV/c
- ▶ How to describe data at higher p_T ?
- ▶ No predictions of coalescence models exist for SPS energy yet

BW: Retière, Lisa, PR C 70, 044907, 2004

pQCD: Wang, PL B 595, 165, 2004 and private communication

- ▶ New results on high p_T hadron production in Pb+Pb collisions @ 158A GeV

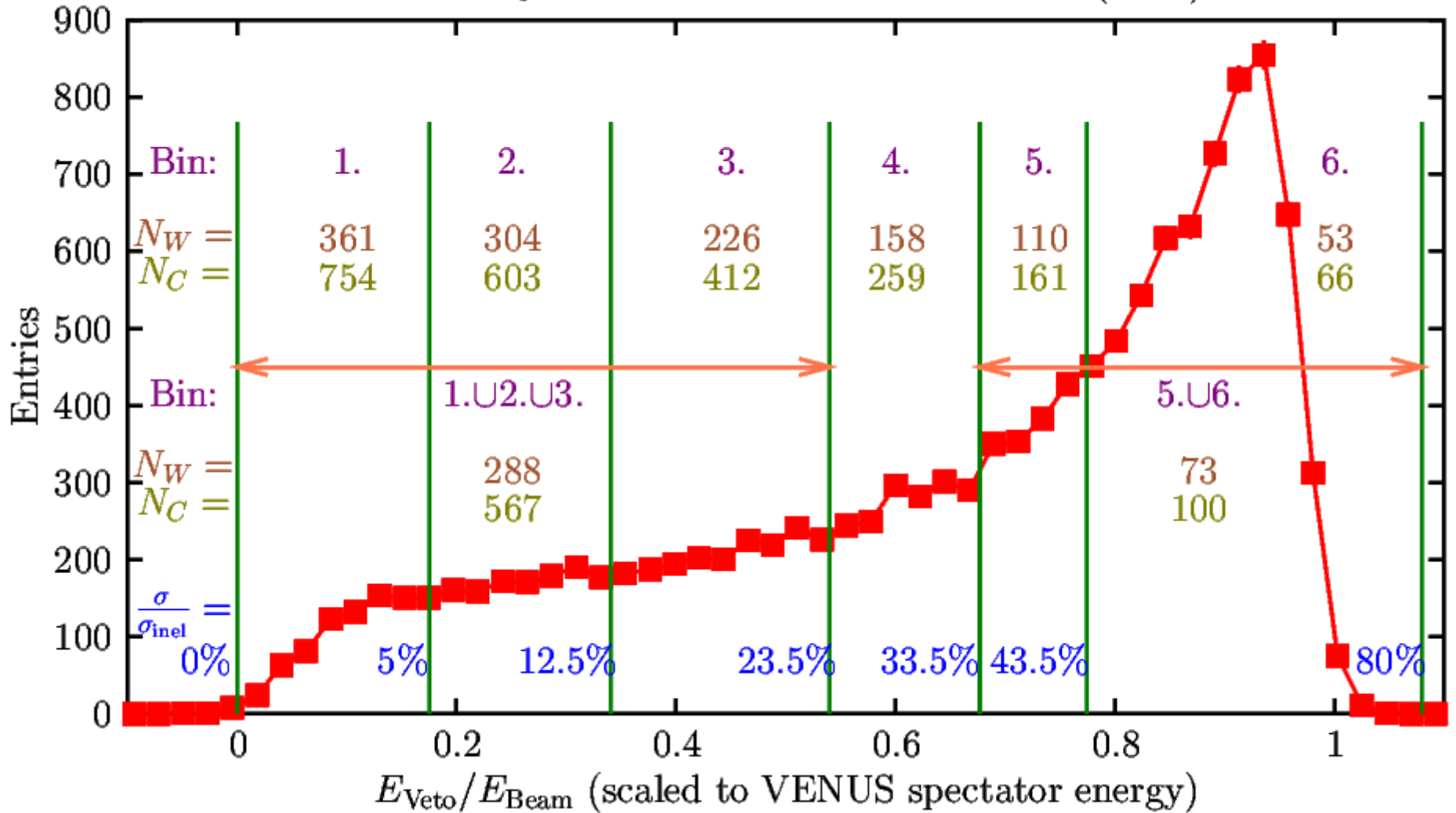
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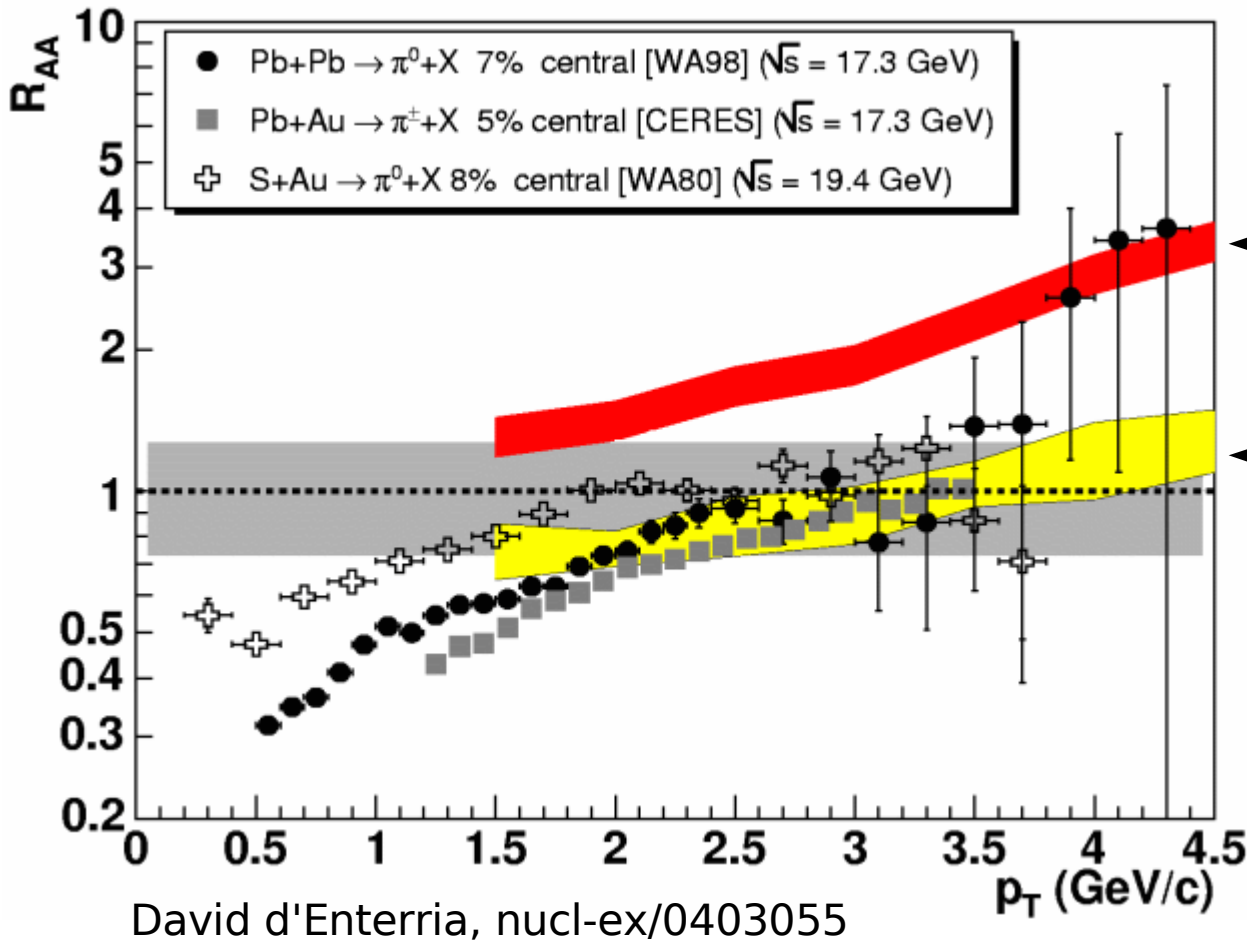
- ▶ R_{CP} results from three SPS experiments (WA98, NA57, NA49) agree within a large systematic error
- ▶ Results are consistent with a jet quenching model

2

- ▶ Baryon / meson ratios increase with p_T
- ▶ The shape of this increase is energy independent
- ▶ Blast wave fit overpredicts data at $p_T > 2.0$ GeV/c
- ▶ Can this domain be described by coalescence models?

Centrality selection with Veto Calorimeter (ZDC)





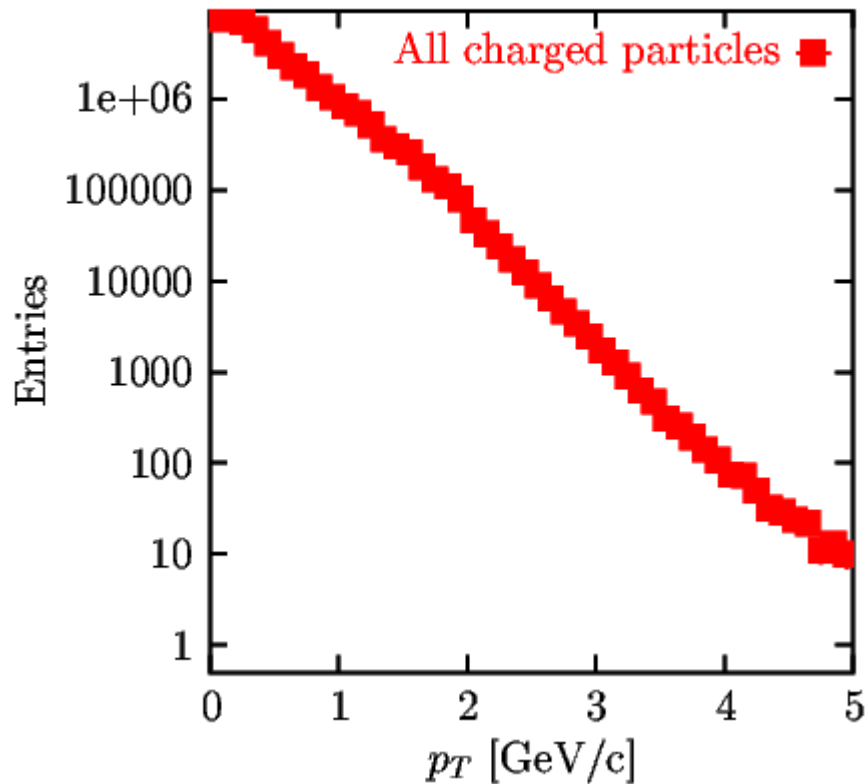
theoretical calculations, considering:

- Cronin effect, shadowing
- Cronin effect, shadowing, + final-state parton energy loss

(Vitev, Gyulassy
PRL 89 (2002) 252301)

Reach of statistics

Uncorrected spectrum, (0-5)%



momentum resolution

$$\frac{\sigma_p}{p^2} \approx 10^{-4} \frac{1}{\text{GeV}/c}$$

dE/dx resolution: 3 – 6%