Study of Cronin effect and nuclear modification of strange particles in d-Au and Au-Au collisions at 200 GeV in PHENIX

Dmitri Kotchetkov

(University of California at Riverside)

for PHENIX Collaboration

Quark Matter'04, Oakland, January 16th, 2004.

Strangeness at PHENIX

Motivations:

- ✓ Strange particles as a tool to quantify the effects of medium modification
- ✓ Strangeness observables to look into initial (gluon saturation) or final state (quark recombination, flow)
- ✓ Effects of strangeness on energy loss

PHENIX ongoing analyses:

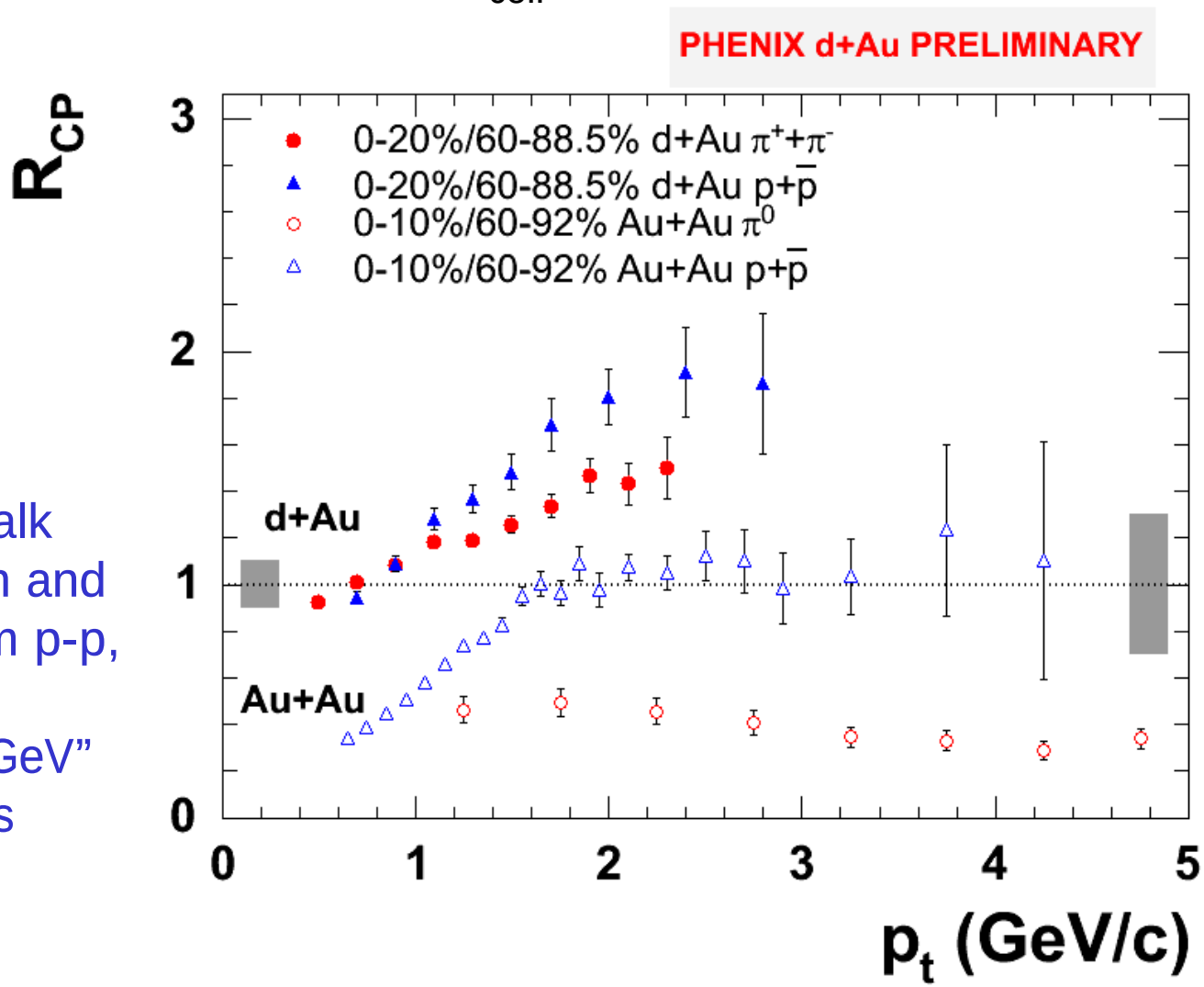
single K^+, K^-

$K^0_S \to \pi^+\pi^-$ $\quad$ $\Lambda \to p\pi^-$ $\quad$ $\overline{\Lambda} \to p^-\pi^+$

$\phi \to K^+K^-$ $\quad$ $\phi \to e^+e^-$

Nuclear enhancement and suppression

$$R_{CP} = \frac{\text{Yield(central)} / < N_{coll}\,(\text{central}) >}{\text{Yield(peripheral)} / < N_{coll}\,(\text{peripheral}) >}$$



Parallel Session talk "π/K/p production and Cronin effect from p-p, d-Au and Au-Au collisions at 200 GeV" by Felix Matathias

Mesons vs. baryons or heavier vs. lighter?

In central Au-Au collisions:

- ✓ No suppression of protons at $P_t > 2.0$ GeV
- ✓ Suppression of π^0 up to measurement limits (~10 GeV)

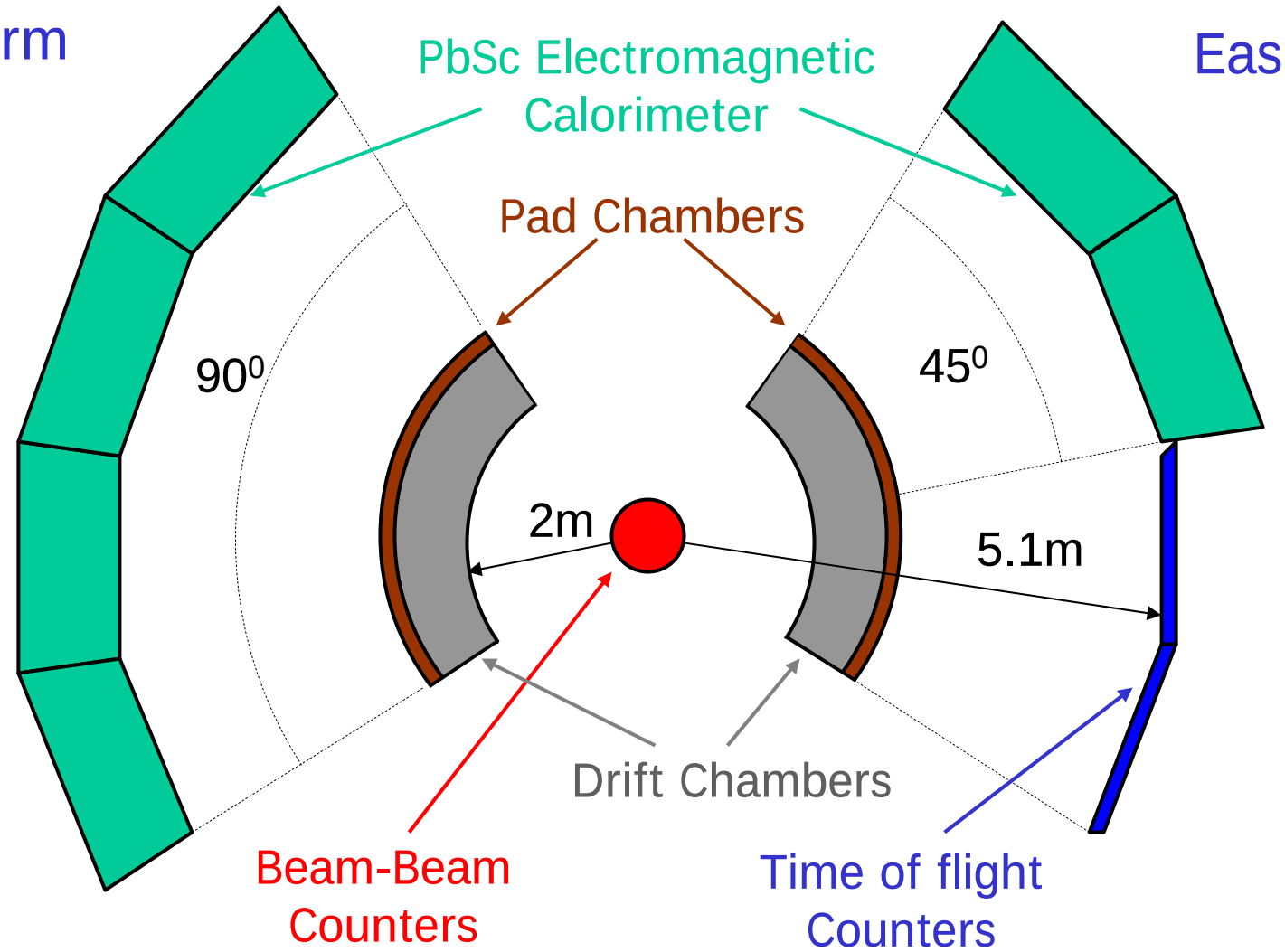
In central d-Au collisions:

- ✓ Nuclear enhancement (Cronin) is larger for protons

How strangeness affects nuclear modification?

- ✓ Effect of strange quarks on R_{cp}
- ✓ Strange baryons and antibaryons vs. strange mesons (number of quarks)
- ✓ Mass dependence of R_{cp} among strange particles

Detectors

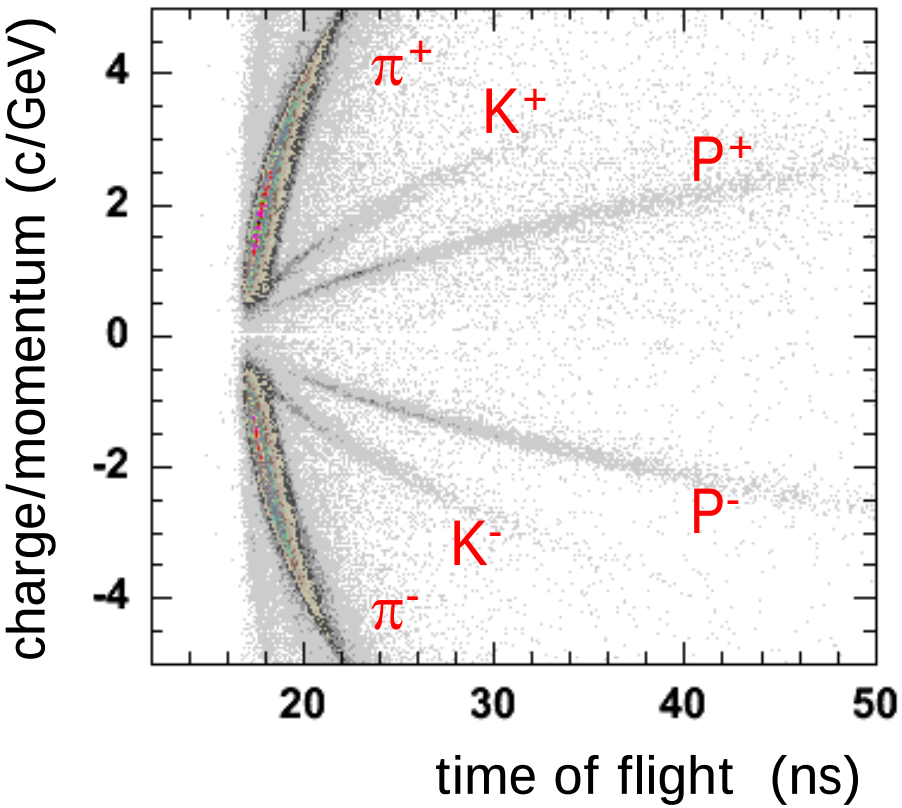


⊗ Beam direction

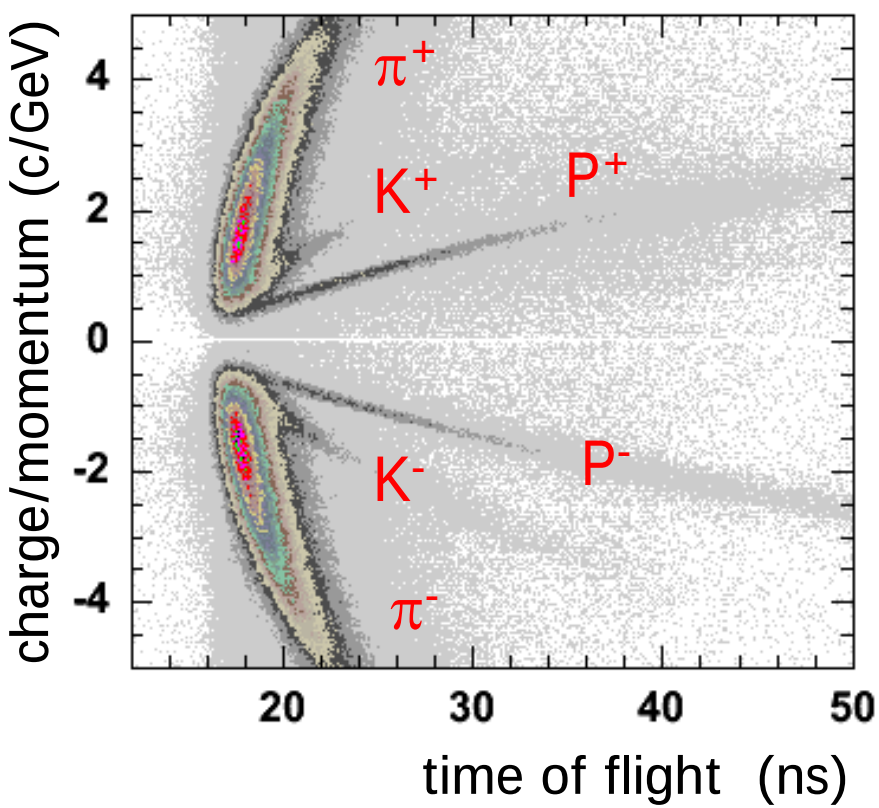
$\eta = -0.35 \ldots +0.35$

Hadron's time of flight

In Time of flight Counters (TOF):



In Electromagnetic Calorimeter (EMC):



time of flight resolution:

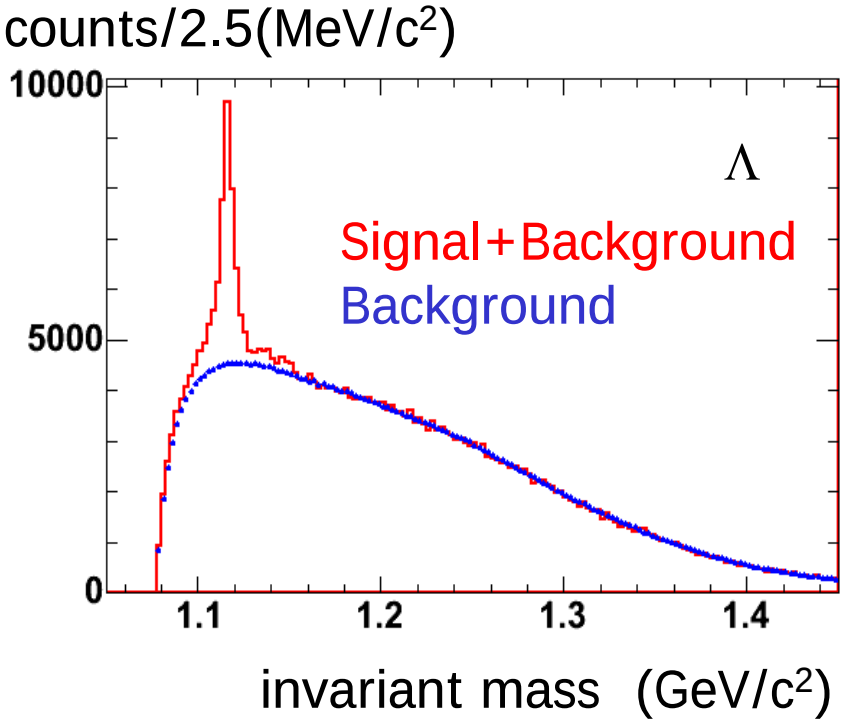
TOF: 115 ps

EMC: 700 ps (average)
function of energy of a cluster

Λ reconstruction

- ✓ high asymmetry of decay
- ✓ mean P of π from Λ decay equals 0.3 GeV
- ✓ detect protons in high resolution TOF (up to 3 GeV)
- ✓ reconstruct protons into pairs with any hadron detected either in TOF or EMC
- ✓ event mixing technique to build a combinatorial background

pπ invariant mass from d-Au collisions



Λ:
S/B = 1/5

$$\frac{S}{\sqrt{S+B}} = 65$$

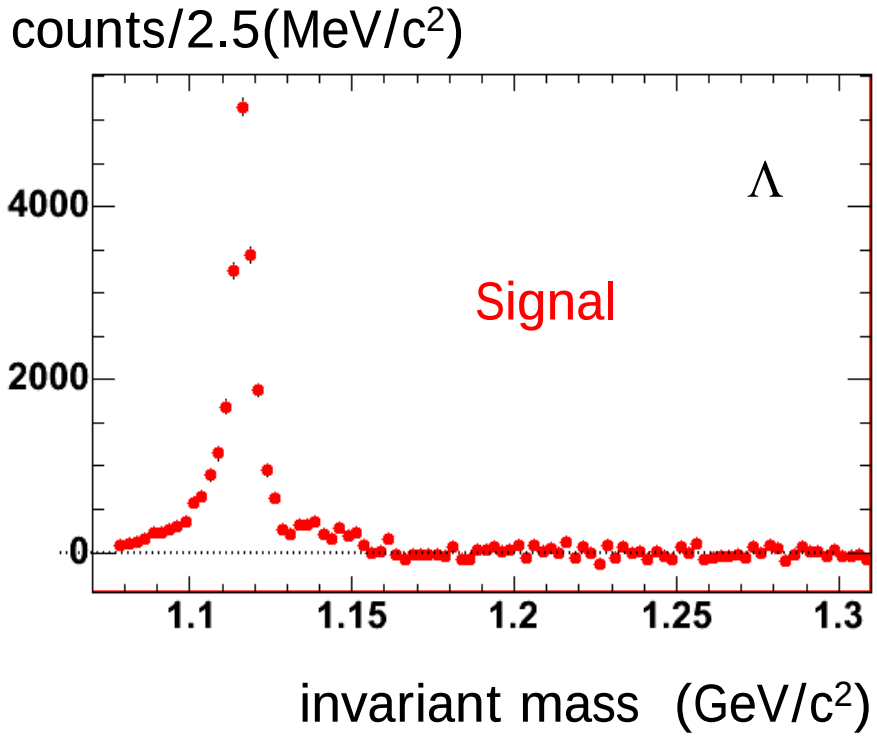
Λ–bar:
S/B = 1/4

$$\frac{S}{\sqrt{S+B}} = 43$$

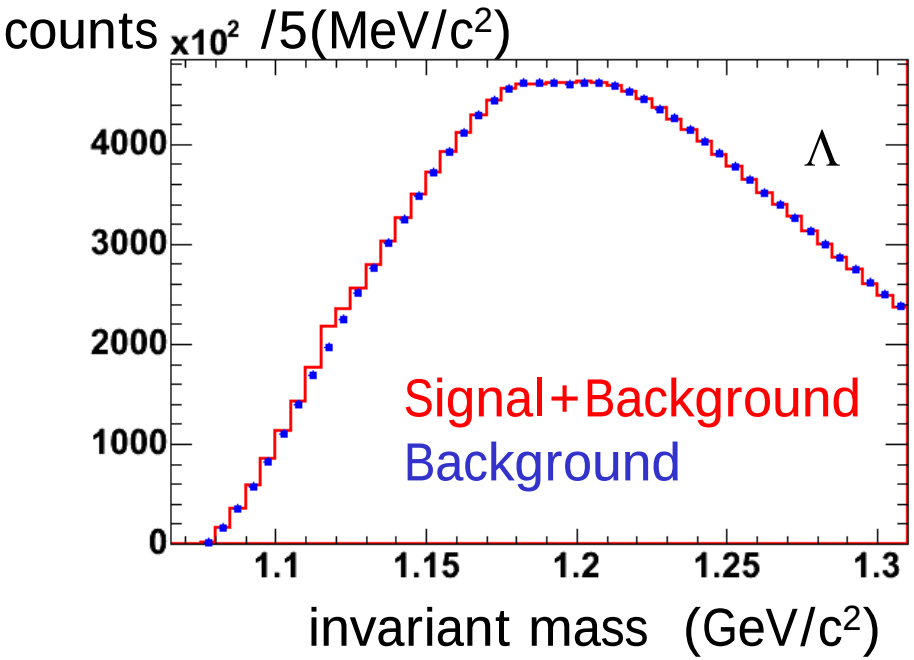
From
63 x 10^6 minimum bias d-Au collisions:

Λ:
Counts = 24395+/-373(stat)

Λ–bar:
Counts = 9744+/-229(stat)



pπ invariant mass from Au-Au collisions



Λ:
S/B = 1/33

$$\frac{S}{\sqrt{S+B}} = 43$$

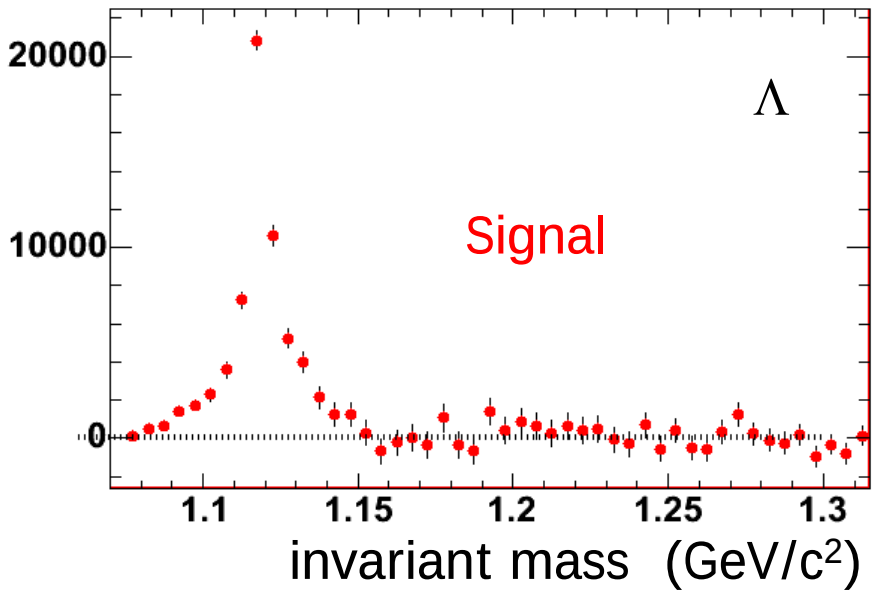
Λ–bar:
S/B = 1/33

$$\frac{S}{\sqrt{S+B}} = 38$$

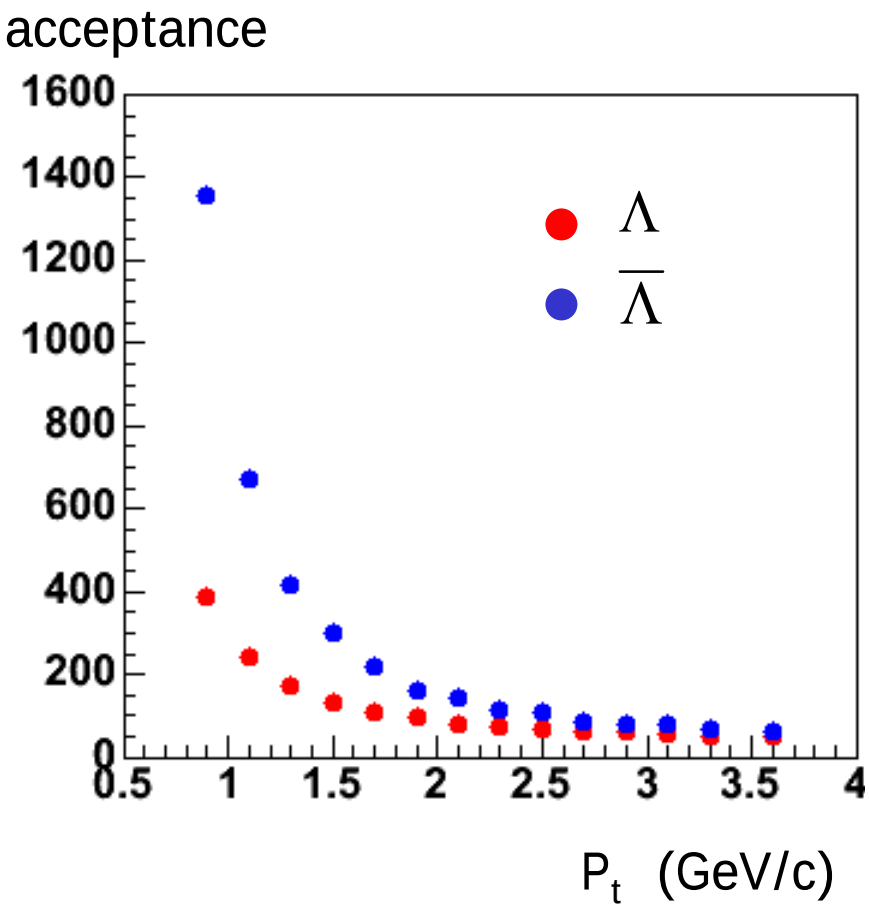
From
20 x 10^6 minimum bias Au-Au collisions:

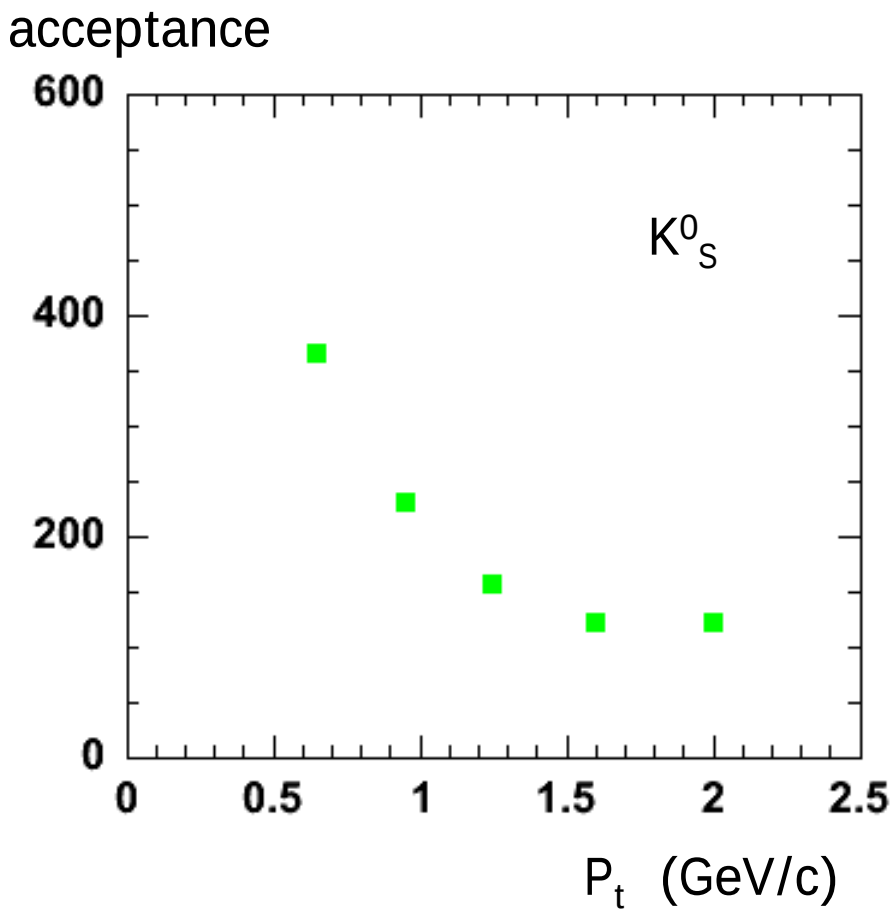
Λ:
Counts = 62786+/-1580(stat)

Λ–bar:
Counts = 48377+/-1358(stat)



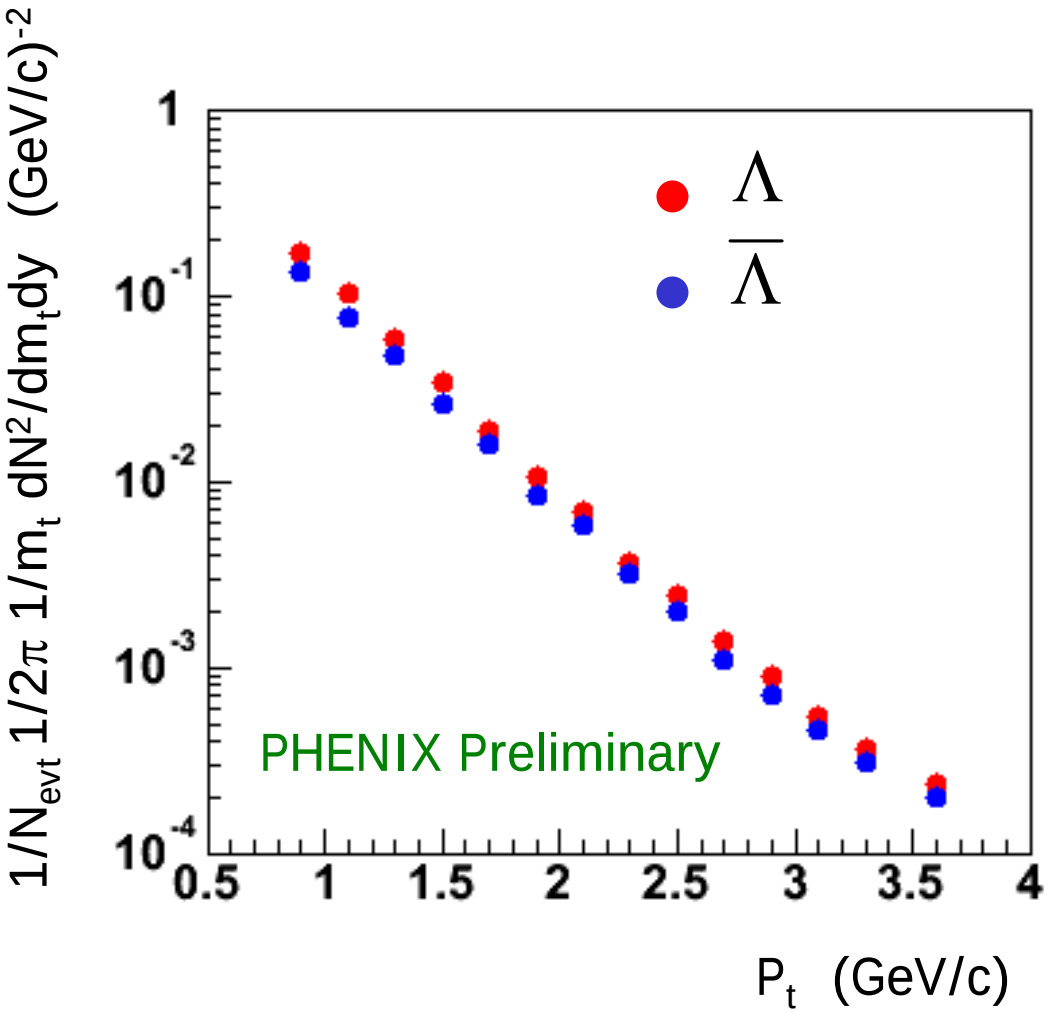
Detector acceptance normalization





- ✓ Single particle generator (K^0_S, Λ, e t.c.)
- ✓ Simulation of PHENIX detector response
- ✓ Extract particle yields as for real data

Λ and Λ-bar P_t spectra in d-Au Minimum bias collisions at 200 GeV



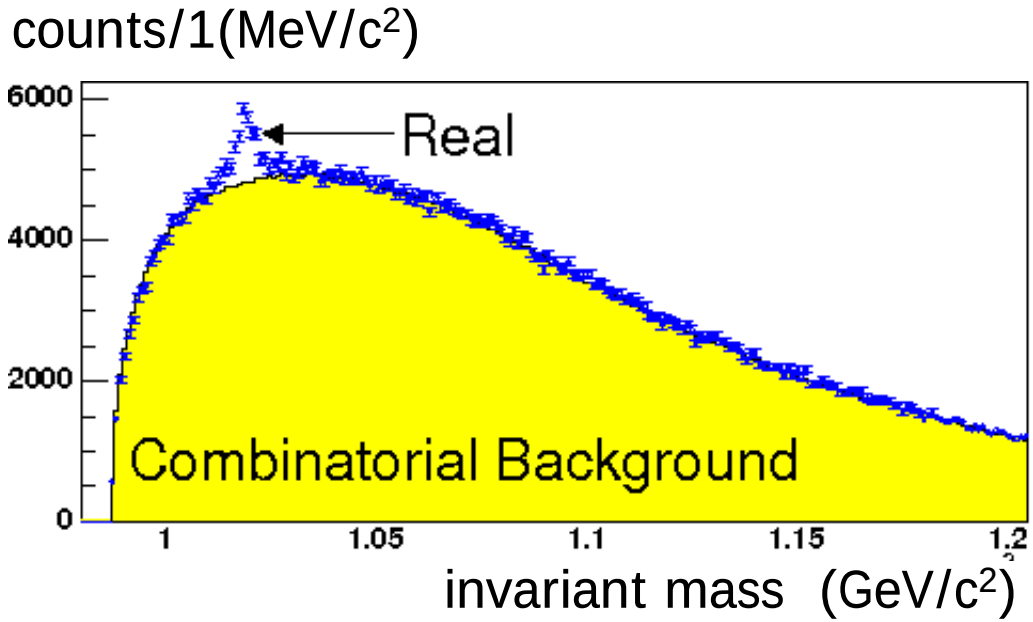
Poster Strangeness 5
Arkadij Taranenko

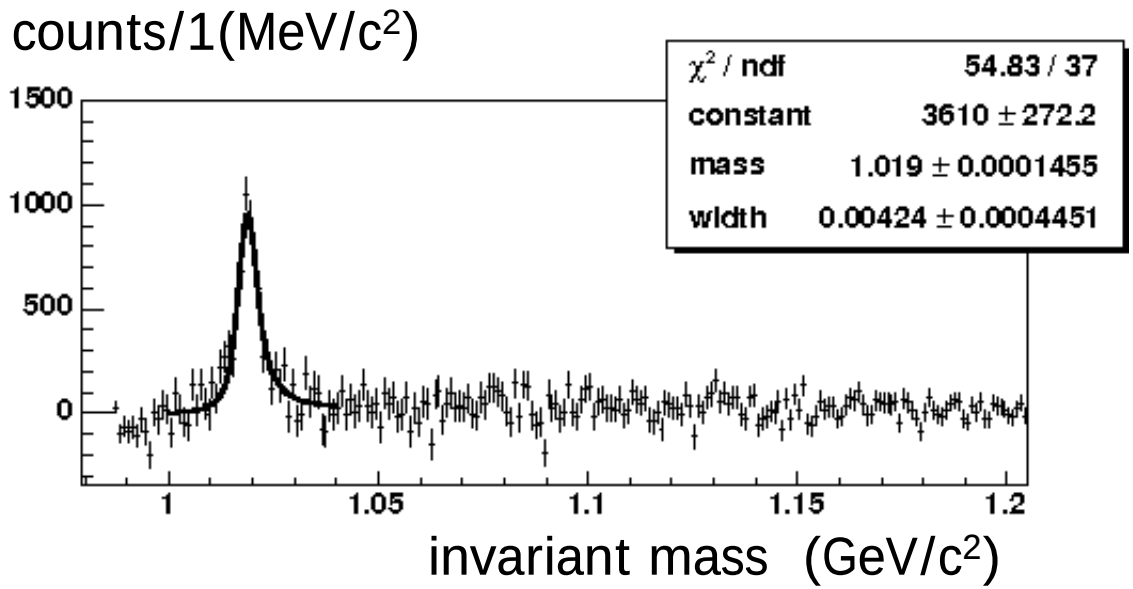
Only statistical errors are shown

ϕ reconstruction

- ✓ ϕ -> K+K- channel
- ✓ identify kaons either in TOF or EMC
- ✓ event mixing technique to build a combinatorial background

K^+K^- invariant mass from Au-Au collisions





From
19 x 10^6 minimum bias
Au-Au collisions:

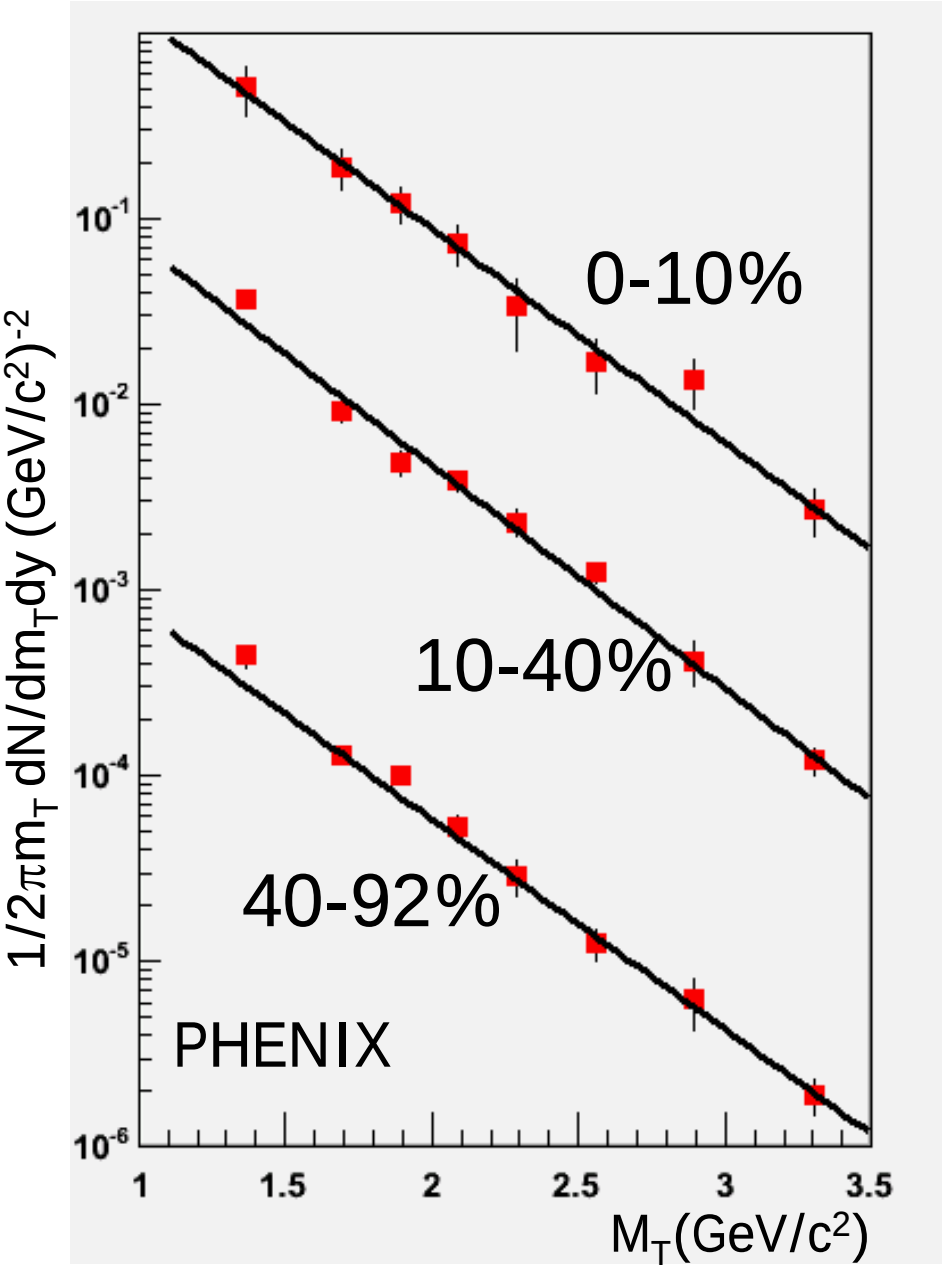
ϕ:
Counts = 5560+/-240(stat)

S/B = 1/8.5

Posters:
Strangeness 14
by Charles Maguire

Flow 7 by Debsankar Mukhopadhyay

ϕ m_t spectra in Au-Au collisions at 200 GeV



$\phi \rightarrow K^+K^-$

Minimum bias events

dN/dy=1.34±0.09(stat) ±0.20(syst)

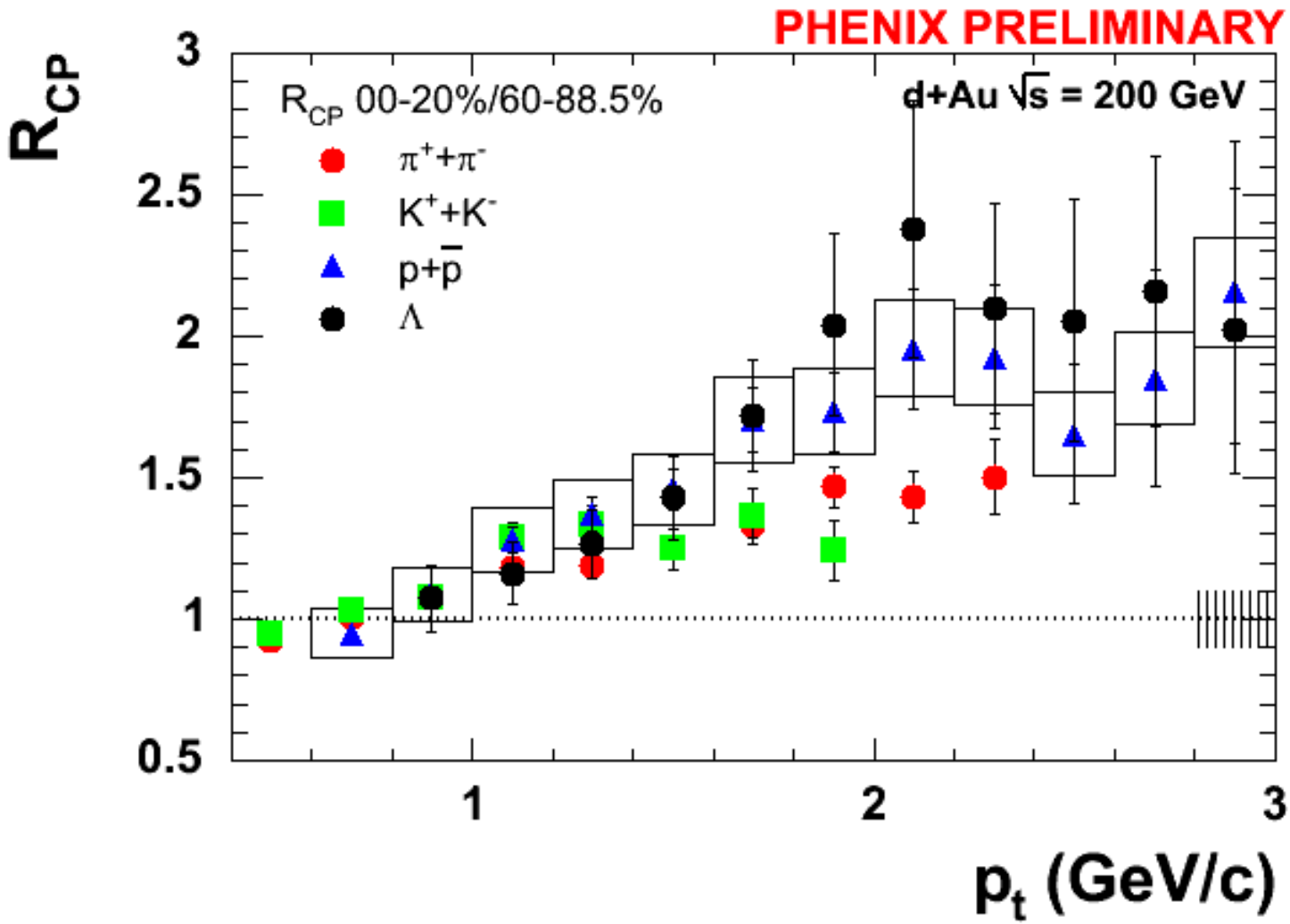
T=366 ±11(stat) ±18(syst) MeV

0-10% on correct scale, others offset by factors of 10

Parallel Session talk “Light vector mesons (ϕ) in d-Au collisions in PHENIX”
by Richard Seto

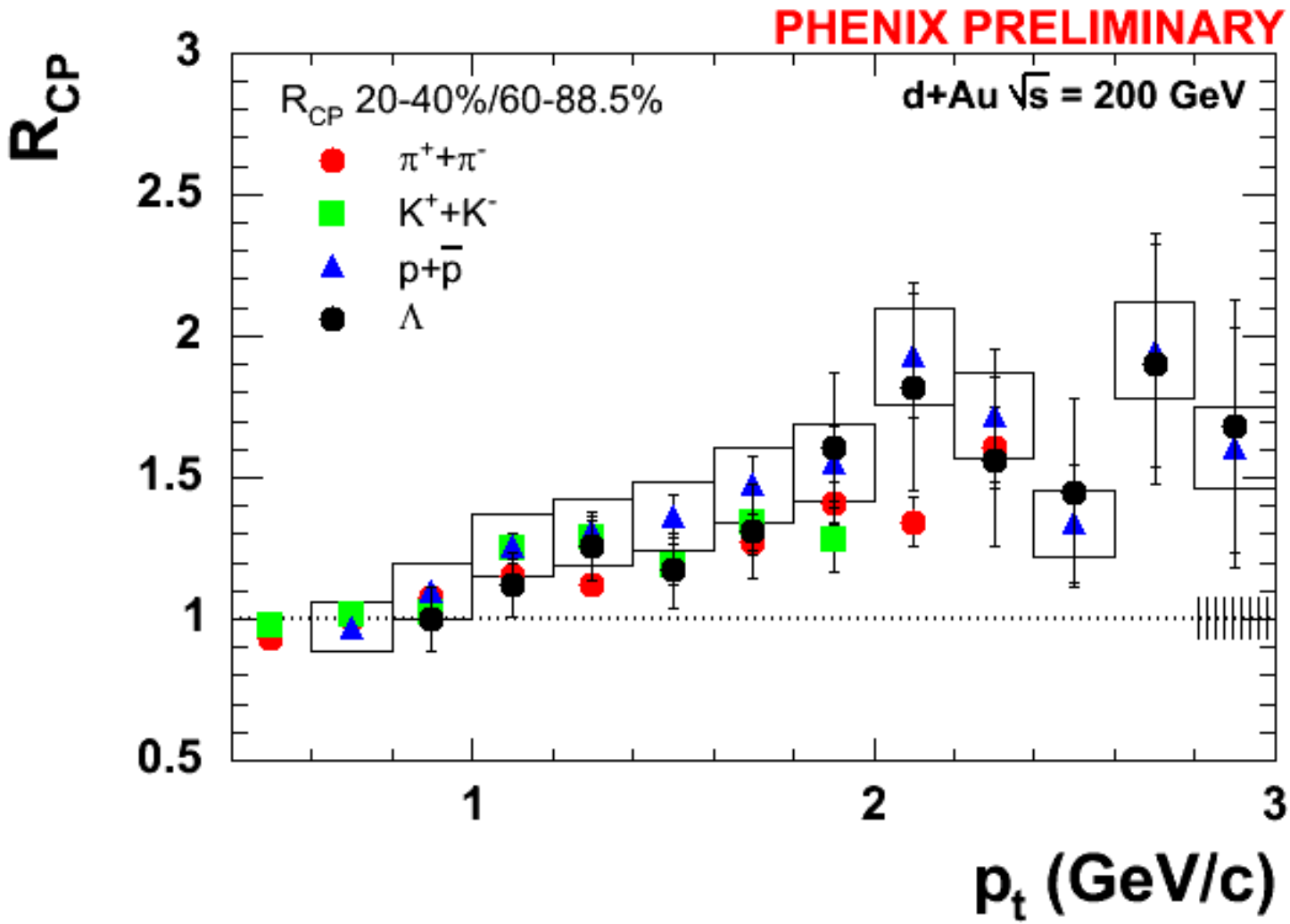
Cronin effect in d-Au collisions

R_{cp} of identified hadrons (0-20% d-Au central collisions) at 200 GeV



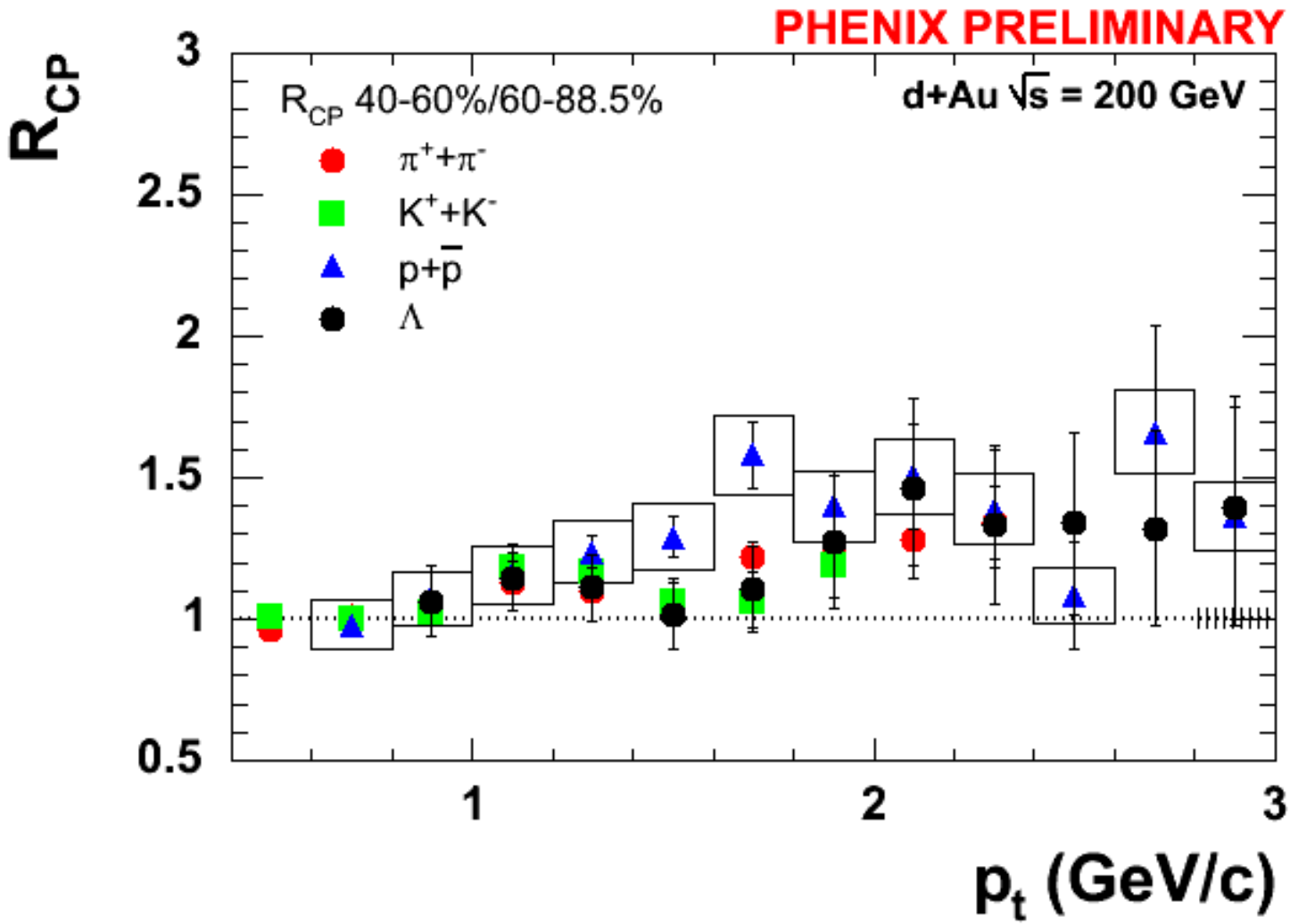
Only statistical errors shown for Λ

R_{cp} of identified hadrons (20-40% d-Au central collisions) at 200 GeV



Λ's R_{cp} modification is very similar to one of the proton

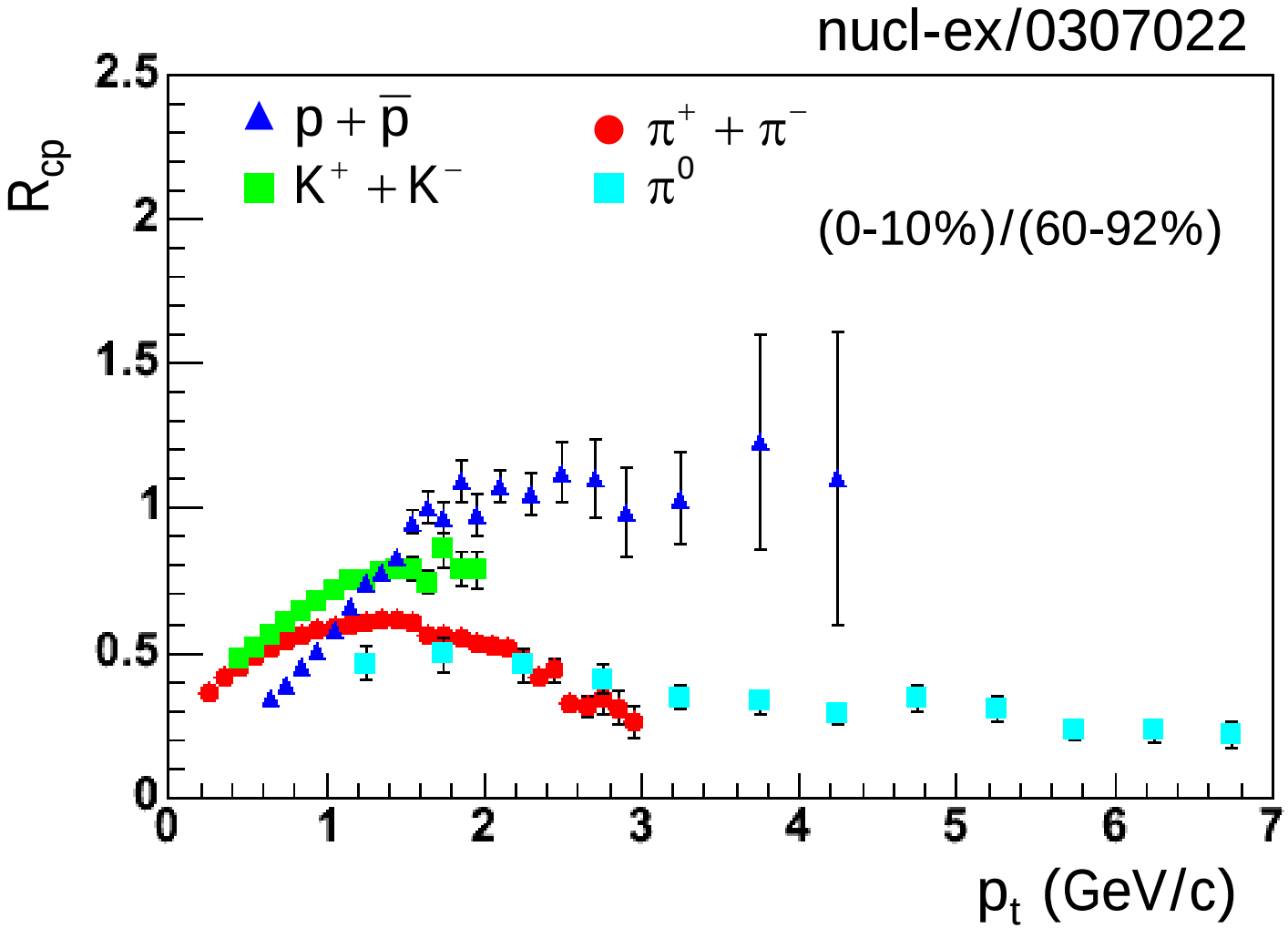
R_{cp} of identified hadrons (40-60% d-Au central collisions) at 200 GeV



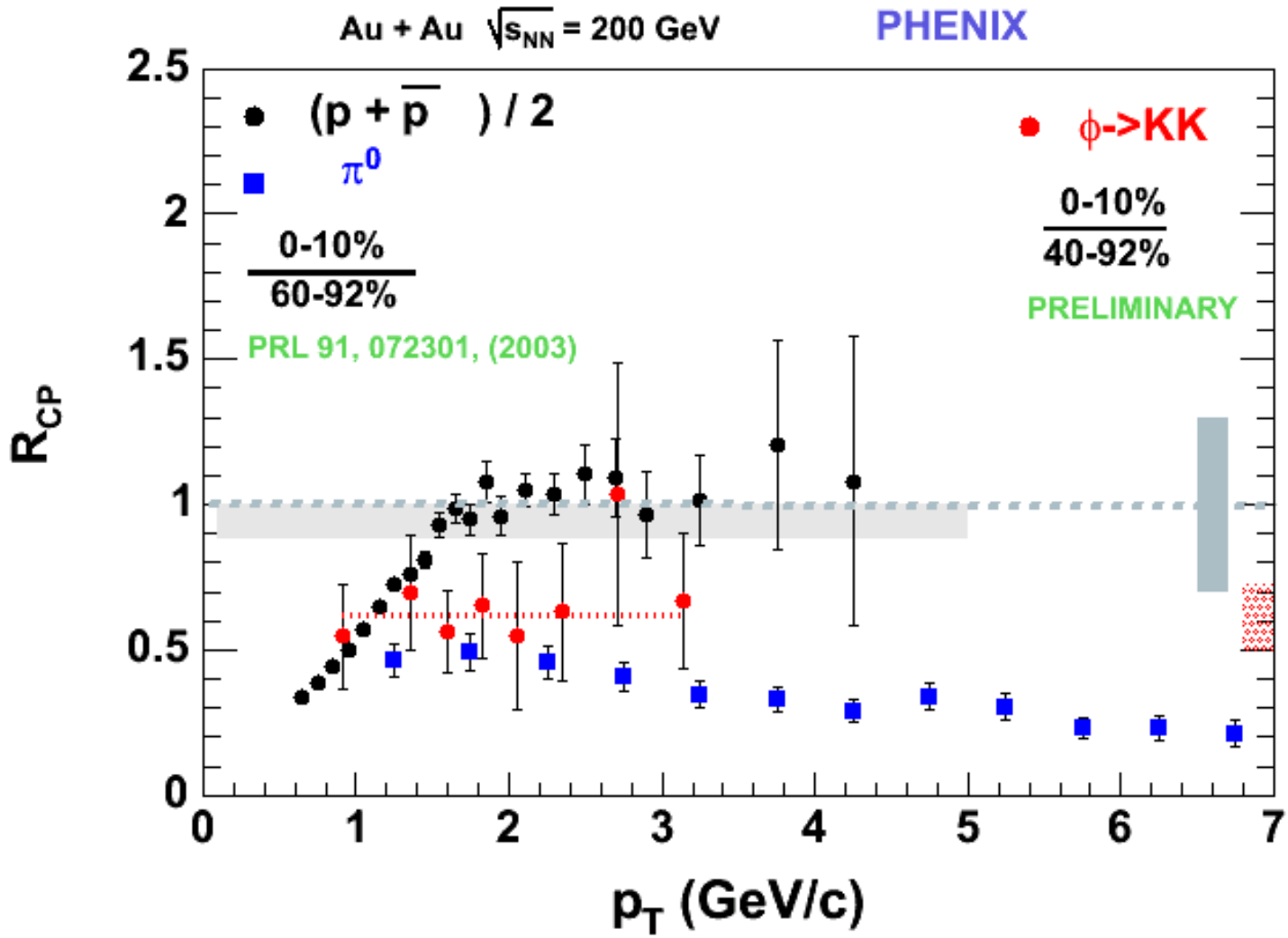
Mass of Λ is close to one of a proton

Nuclear modification in Au-Au collisions

R_{cp} of identified hadrons (0-10% Au-Au central collisions) at 200 GeV



R_{cp} of ϕ (0-10% Au-Au central collisions) at 200 GeV



Mass of ϕ is close to one of a proton

Summary

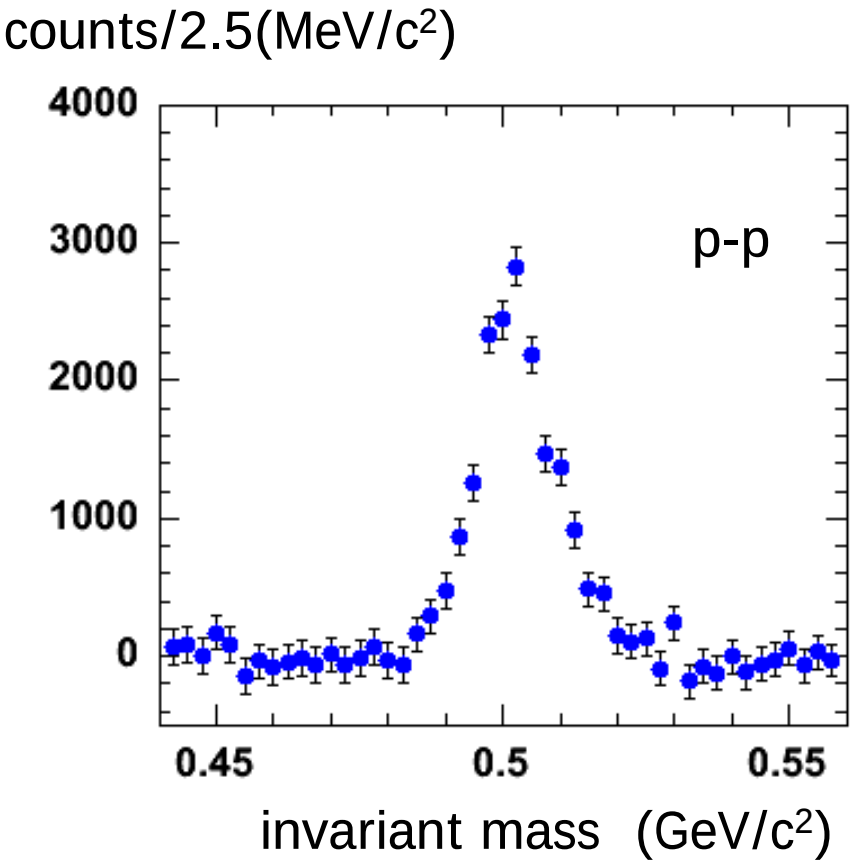
Are differences in R_{cp} attributable to mass or quark number?

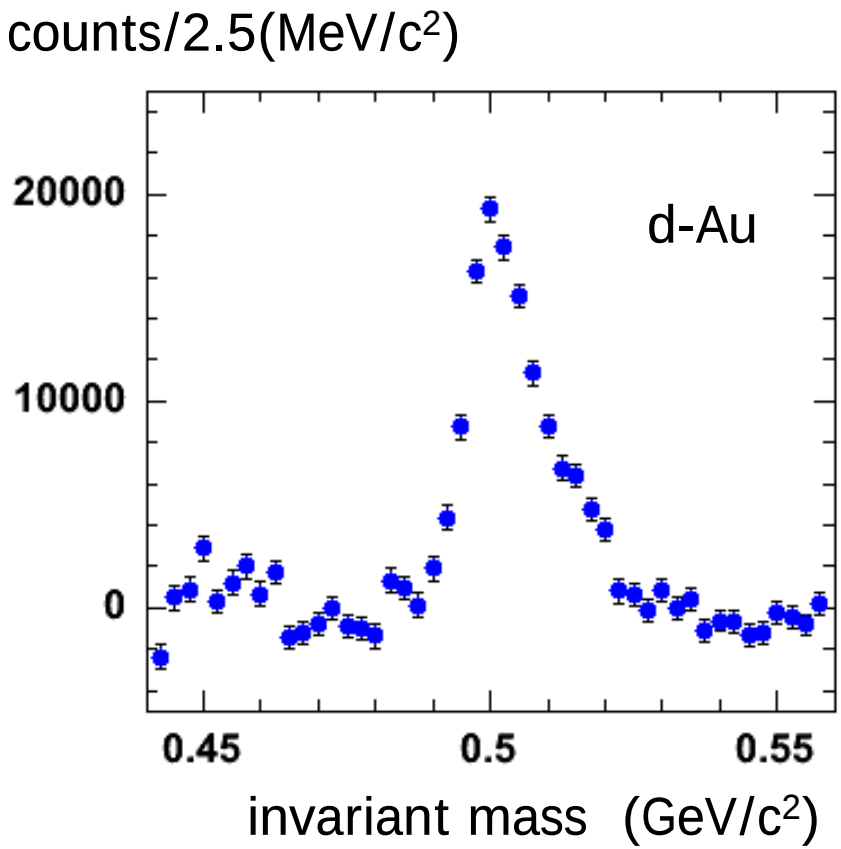
- ✓ There is no evidence for mass dependence of R_{cp}
- ✓ Strangeness seems to have no effect on R_{cp}
- ✓ There is a difference in R_{cp} for mesons and baryons (see STAR results of Λ's R_{cp} in Au-Au)

Outlook

- ✓ R_{cp} results from K^0_S and from Λ (Au-Au)
- ✓ Analysis of multi-strange baryons (Ξ^0, Ξ^+, Ξ^-, Ω^- and others)

Extracted K^0_S signal





From
48.85 x 10^6 minimum bias p-p collisions: Counts = 16630+/-605(stat)
62.20 x 10^6 minimum bias d-Au collisions: Counts = 116397+/-2627(stat)