Strangeness Production at RHIC

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The STAR Collaboration

Brazil: Universidade de Sao Paolo

China: IHEP - Beijing, IPP - Wuhan

England: University of Birmingham

France: Institut de Recherches Subatomiques Strasbourg, SUBATECH - Nantes

Germany: Max Planck Institute – Munich
University of Frankfurt

Poland: Warsaw University, Warsaw University of Technology

Spokesperson: John Harris

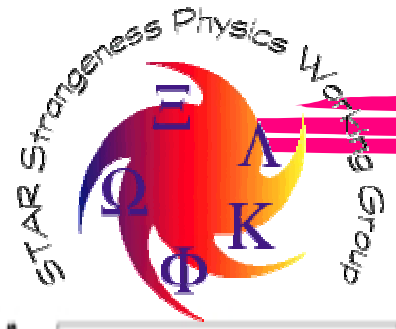
Institutions: 36
Collaborators: 415
Students: ~50

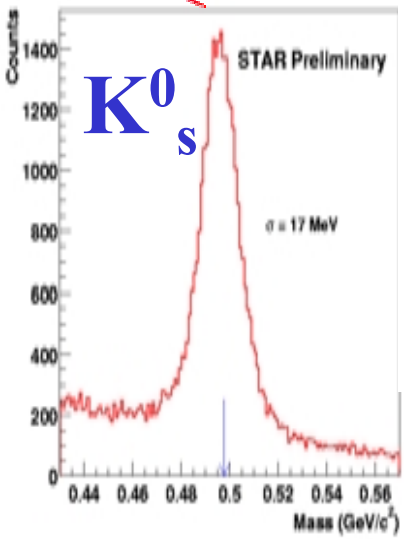
Russia: MEPHI – Moscow, LPP/LHE JINR–Dubna, IHEP-Protvino

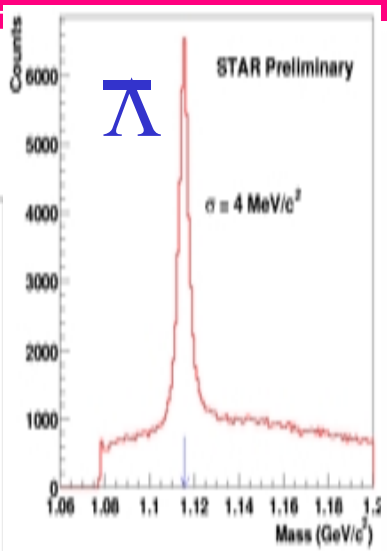
U.S. Labs: Argonne, Berkeley, Brookhaven National Labs

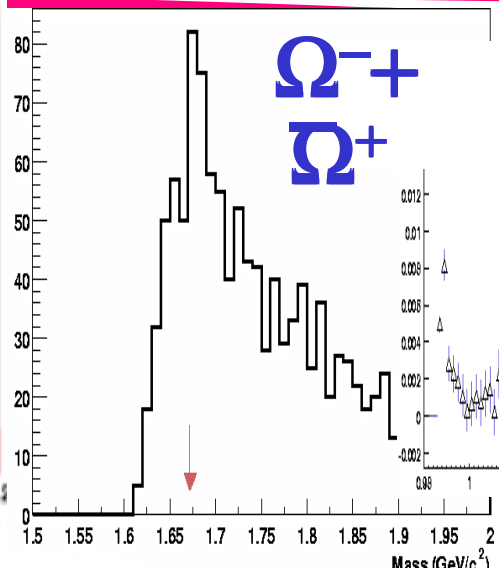
U.S. Universities:
Arkansas, UC Berkeley, UC Davis, UCLA, Carnegie Mellon, Creighton, Indiana, Kent State, MSU, CCNY, Ohio State, Penn State, Purdue,Rice, Texas A&M, UT Austin, Washington, Wayne State, Yale

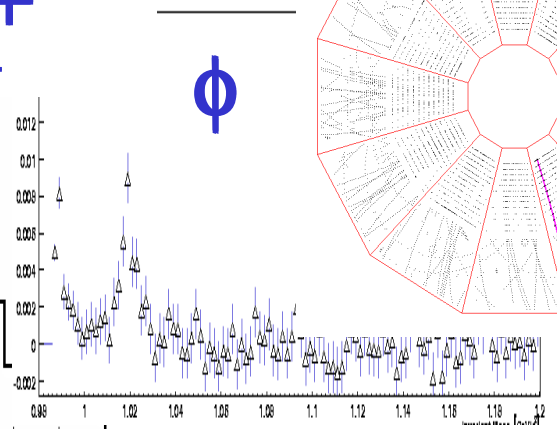
STAR STRANGENESS! *(Preliminary)*

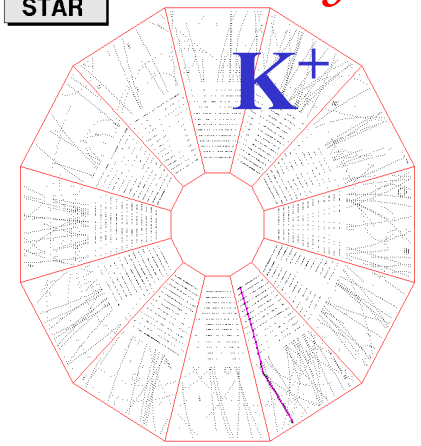


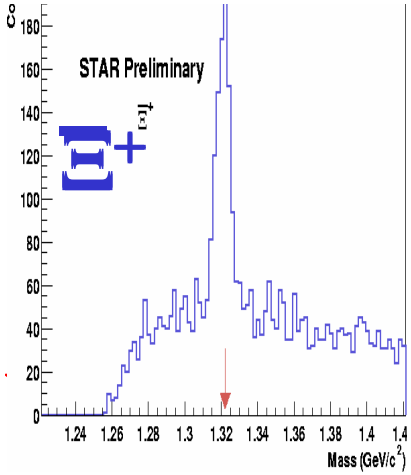


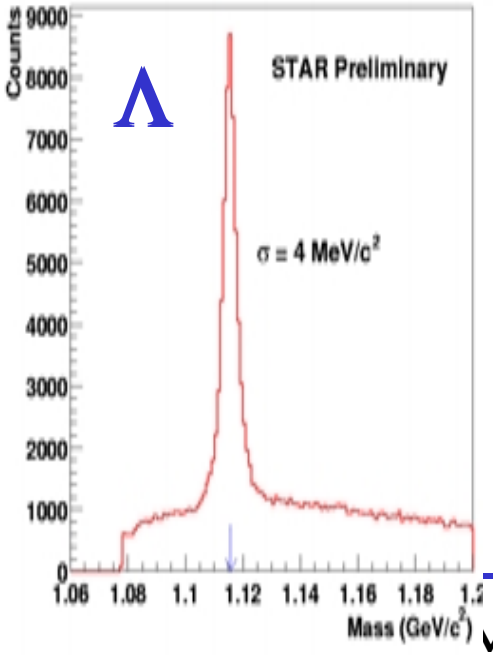


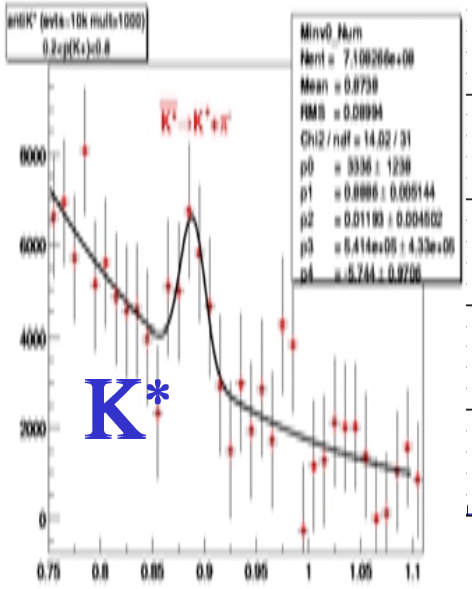


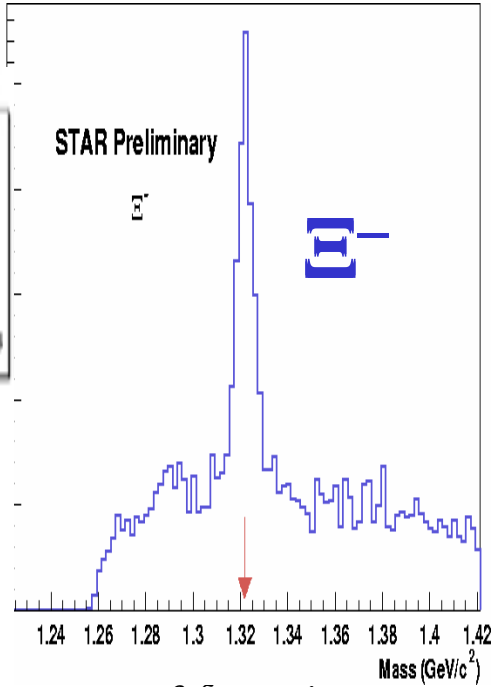












Helen Caines

Introduction

Chemical content

– Yields (K^+, K^-)

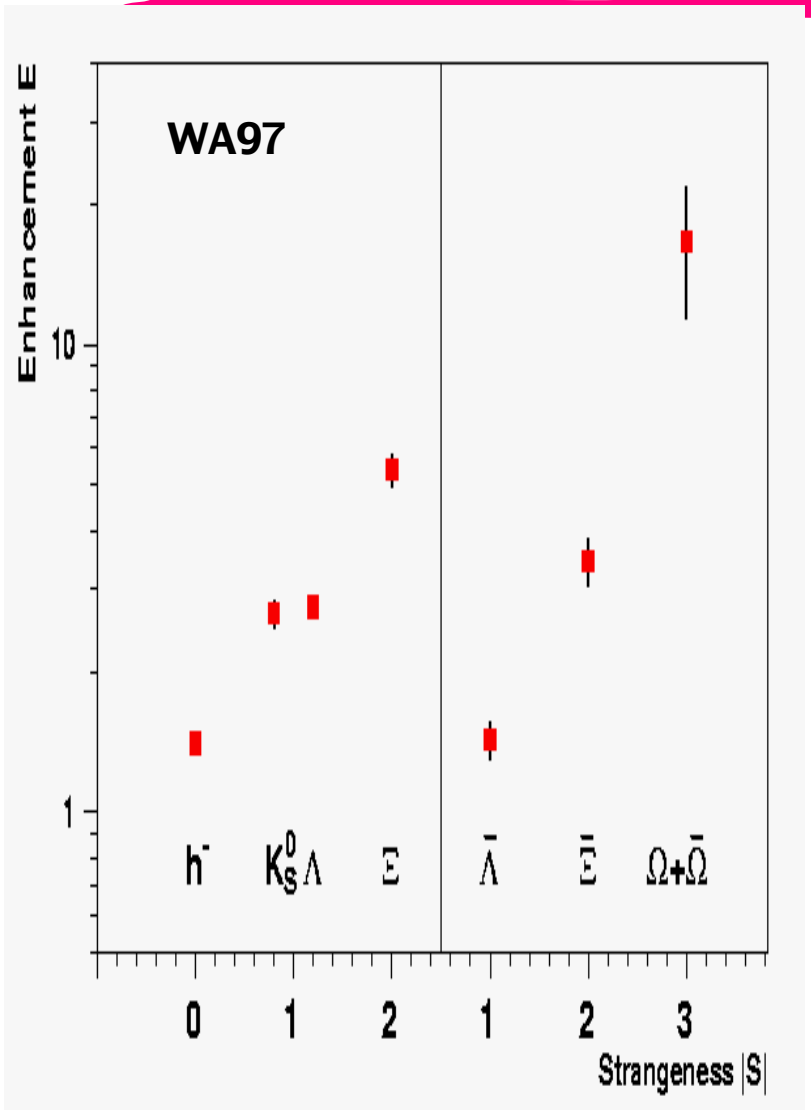
Flow – How much and when does it start?

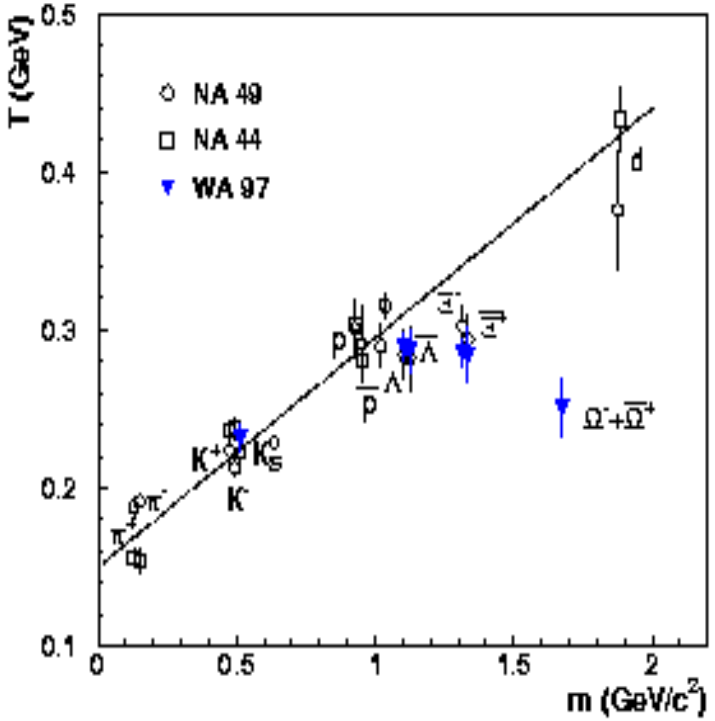
When is Strangeness Produced – Resonances

Chemical Freeze–out – Ratios ($\bar{\Lambda}/\Lambda$, Ξ^+/Ξ^-, K^+/K^-, K/π)

Thermal Freeze–out – Radii and Inverse slopes (K^+,K^-)

Previous Strangeness Highlights





Multi– Strange Particles appear to

freeze out at a cooler temperature/ earlier or have less flow

STAR Pertinent Facts

Field:

0.25 T (Half Nominal value)

(slightly worse resolution at higher p, lower pt acceptance)

TPC:

Inner Radius – 50cm

(p_t>75 MeV/c)

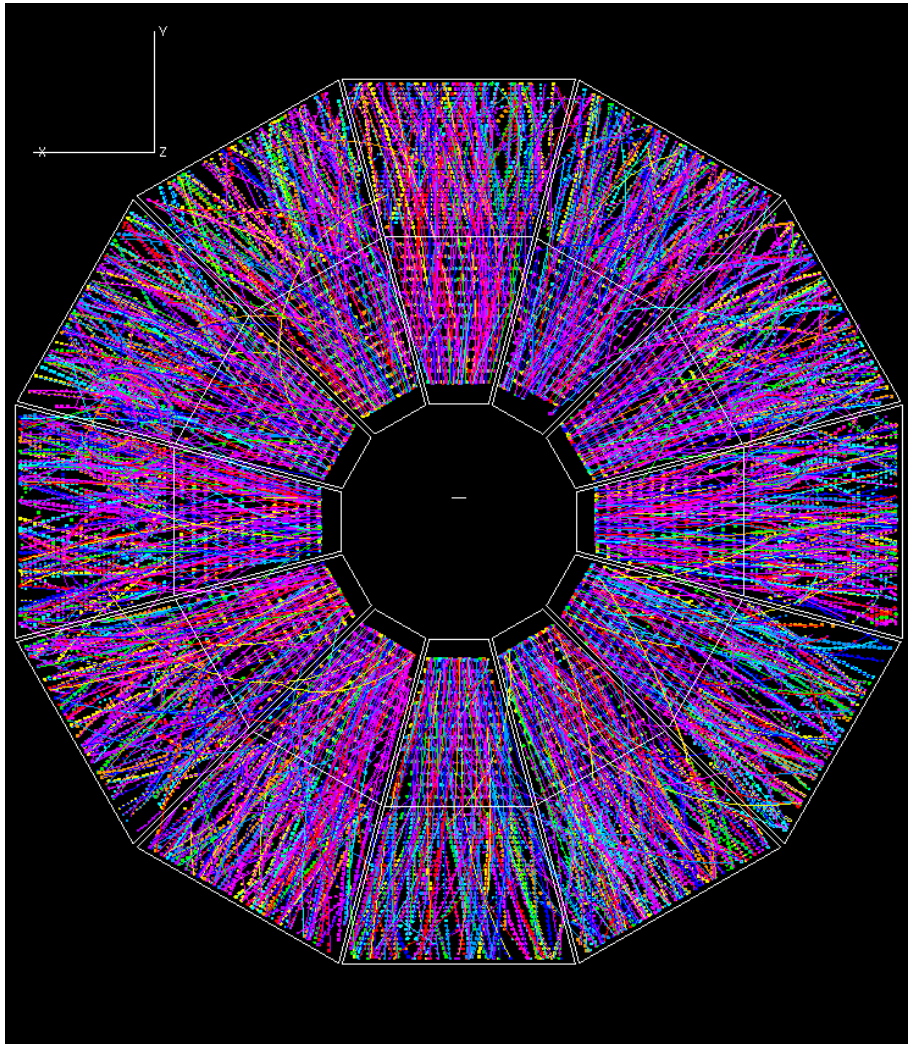
Length – ± 200cm

(−1.5< η < 1.5)

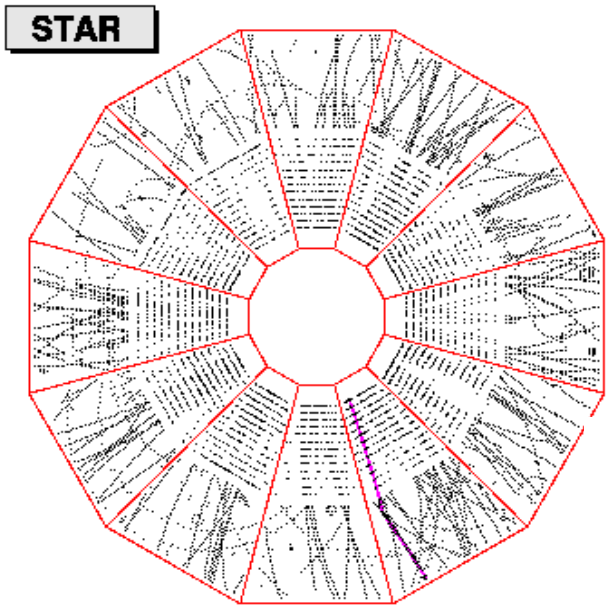
Events:

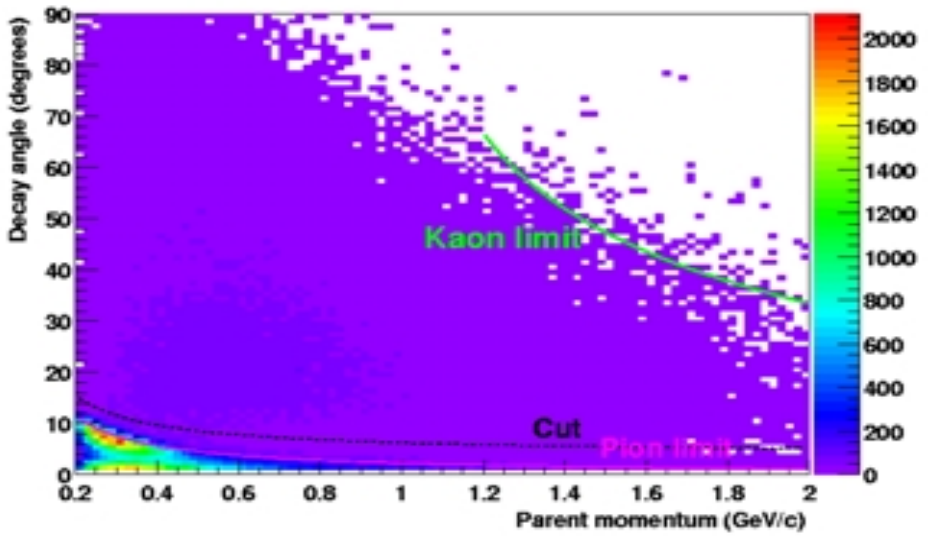
~300,000 "Central" Events –top 8% multiplicity

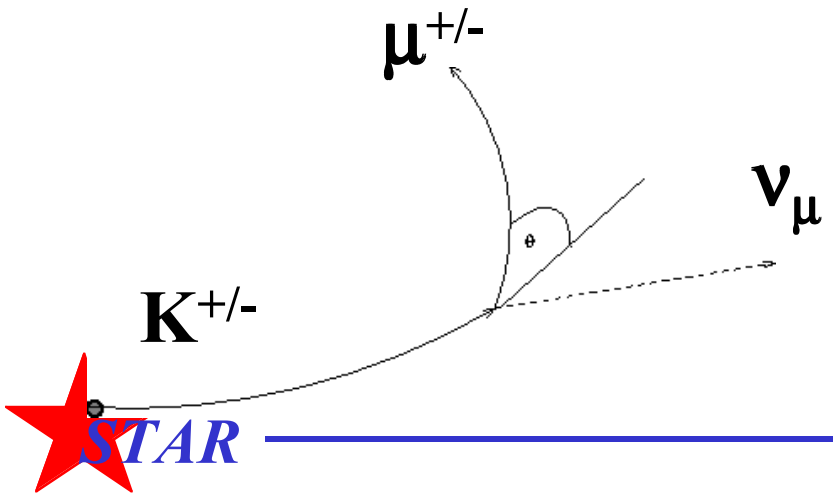
~160,000 "Min-bias" Events



High P_t K^+ & K^- Identification Via "Kinks"







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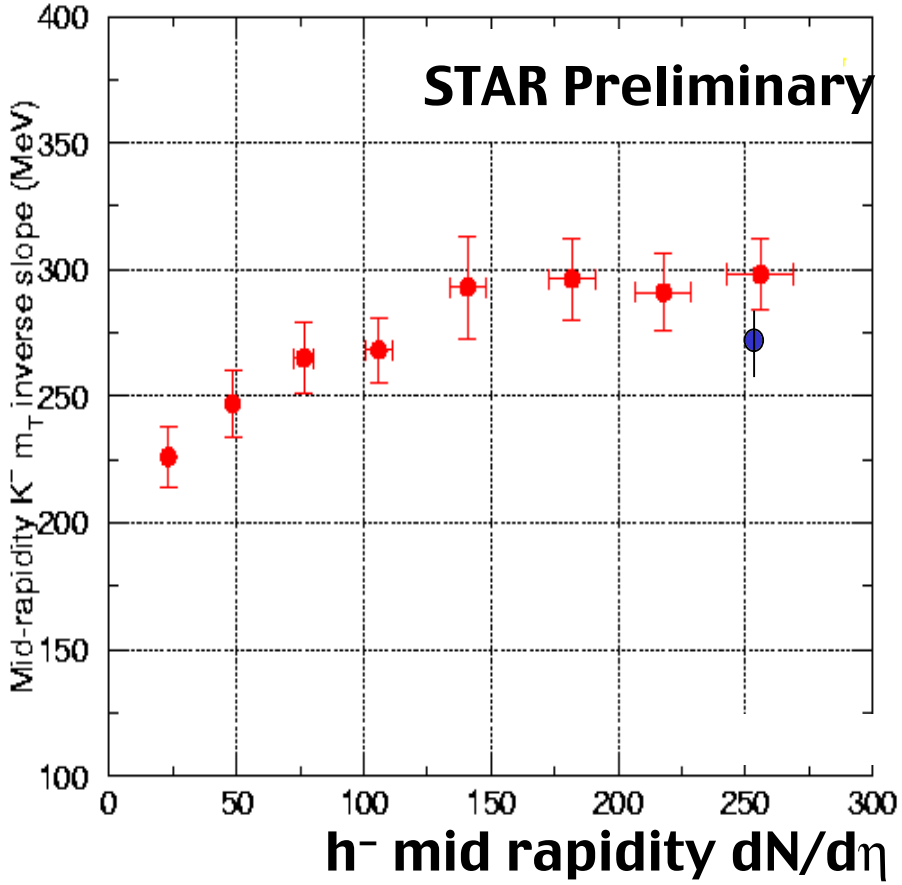
“Kink” m_t Distributions

K^- Inverse Slope Results

- Kink
- dE/dx

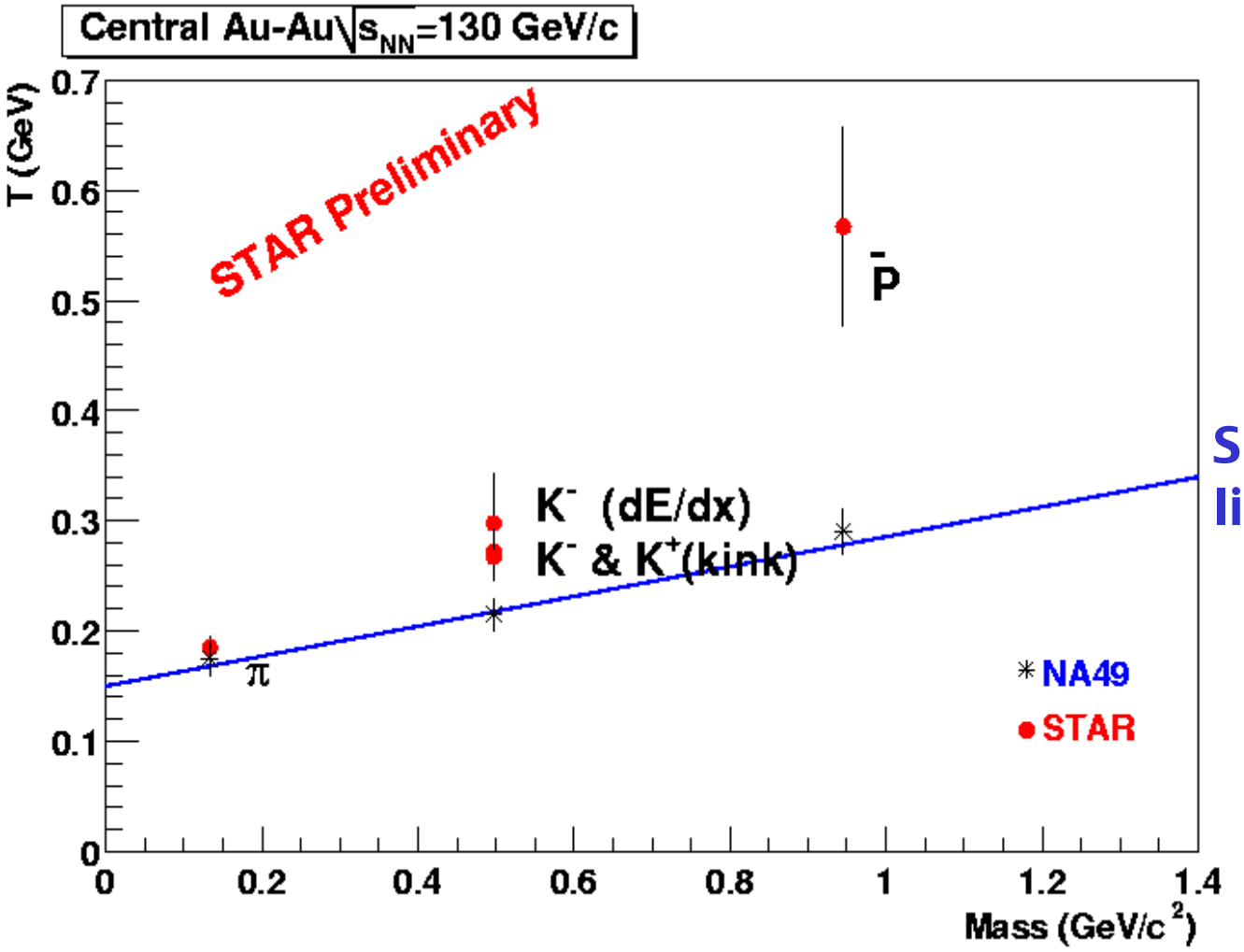


“Kink” Rapidity Distribution

Mid-y K^+ dN/dy =
35 ±3(stat.)±5(sys.)

Mid-y K^- dN/dy =
30±3(stat.)±4(sys.)

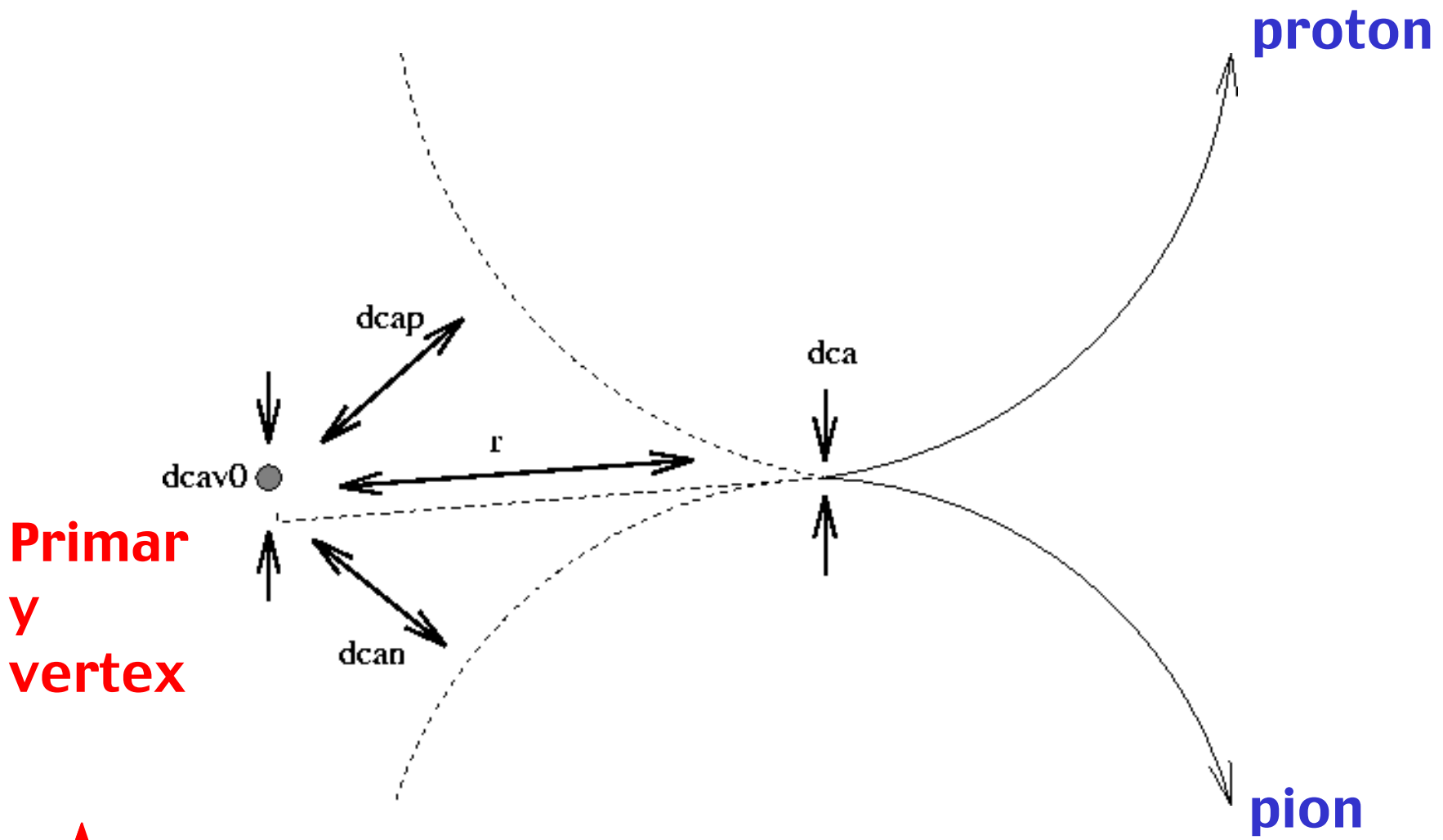
STAR's T vs Mass



SPS line

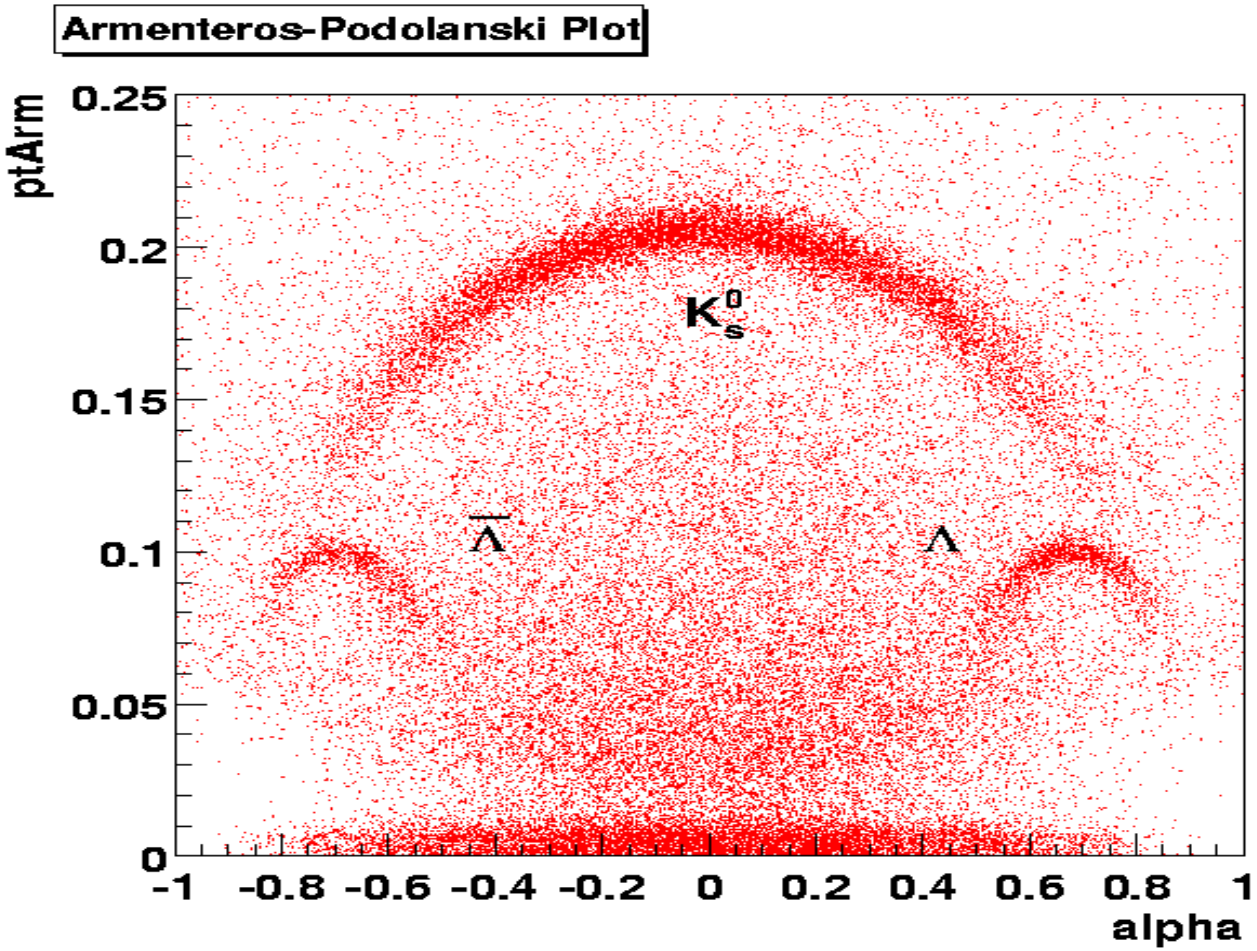
- Indication of larger transverse flow at RHIC.
- Light strange mesons seem to flow with non-strange particles

Finding V0s



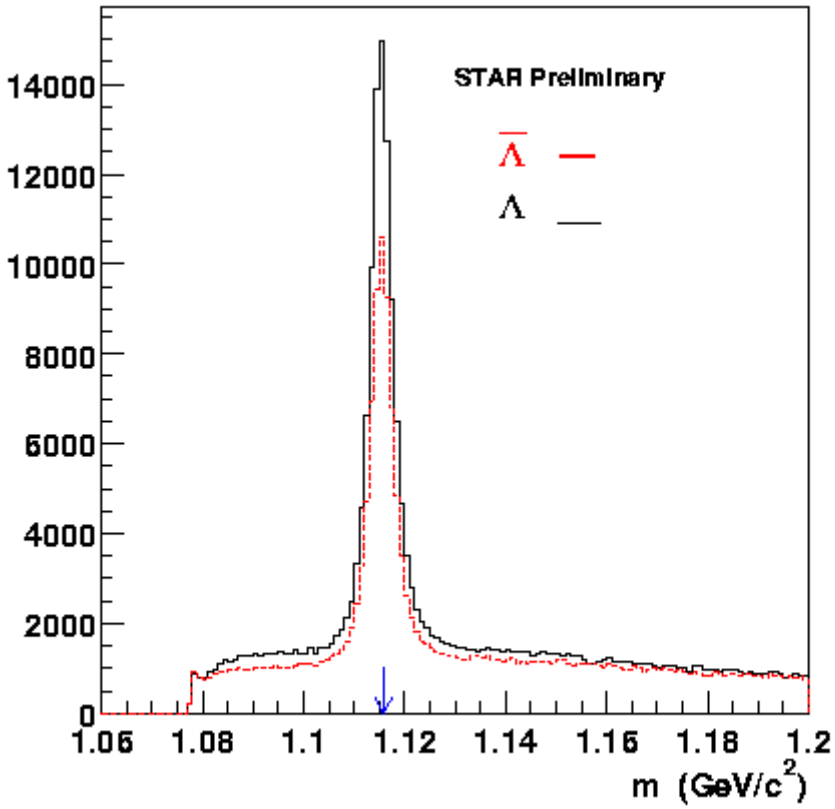
In case you thought it was easy...

After e



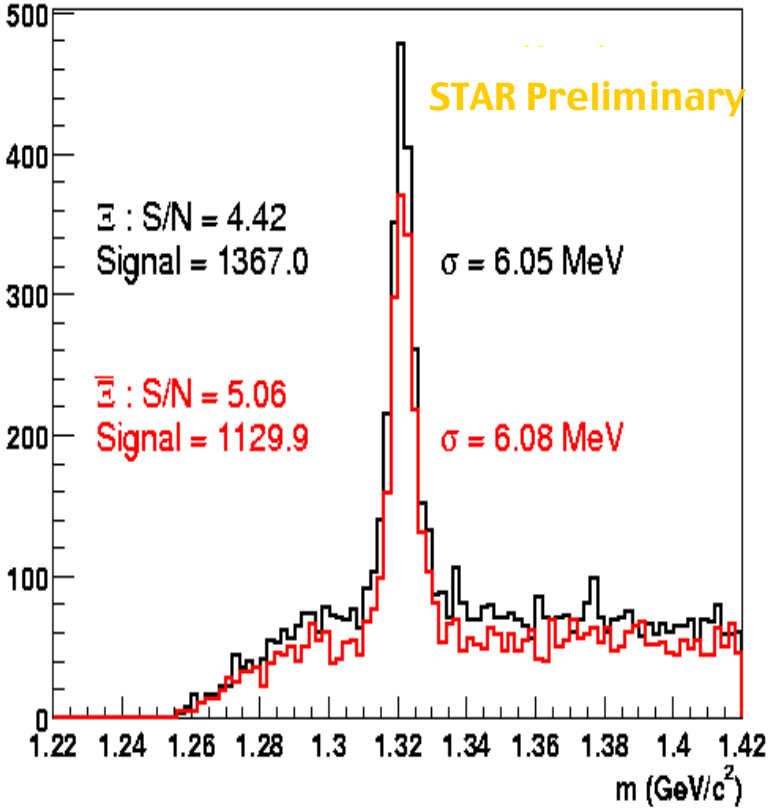
Strange Baryon Ratios

Reconstruct:
~0.84 Λ/ev, ~ 0.61 $\bar{\Lambda}$/ev



Ratio = 0.73 ± 0.03 (stat)

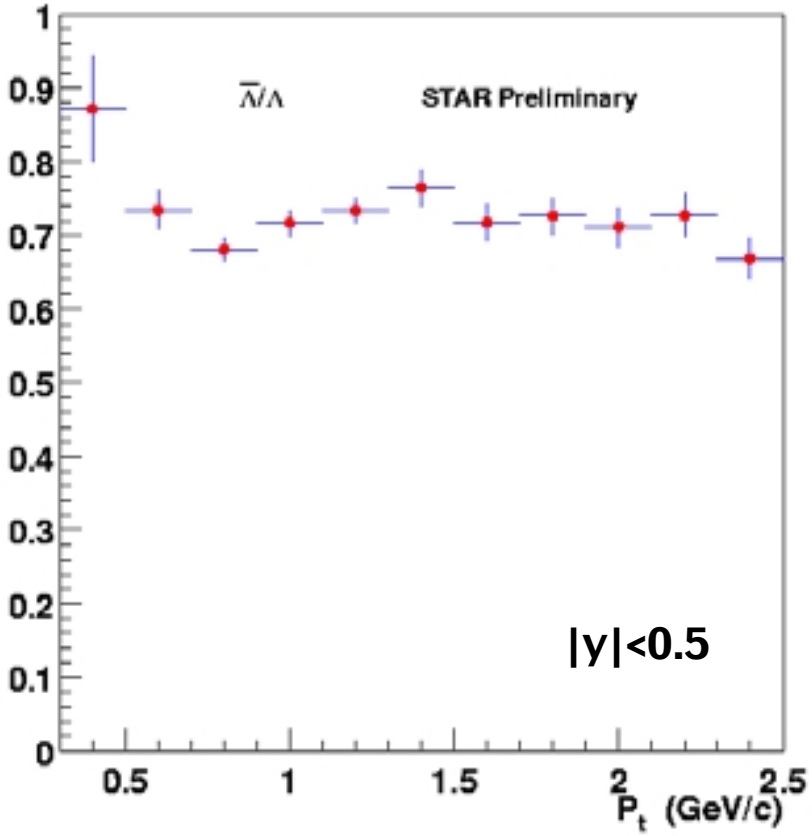
Reconstruct:
~0.006 Ξ^-/ev. ~0.005 $\bar{\Xi}^+$/ev

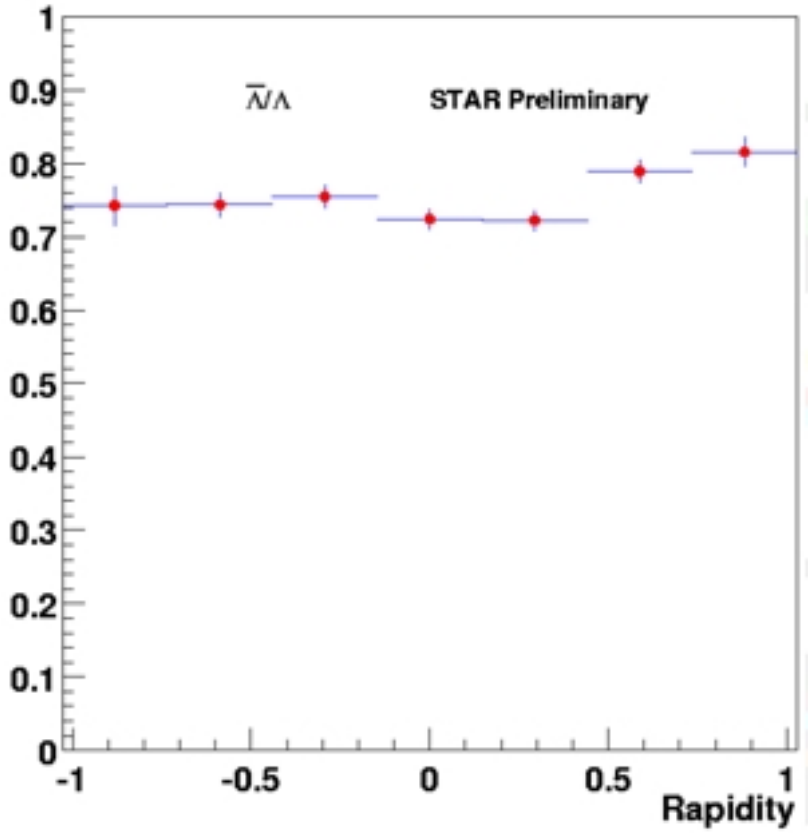


Ratio = 0.82 ± 0.08 (stat)

Preliminary $\bar{\Lambda}/\Lambda$ Ratio

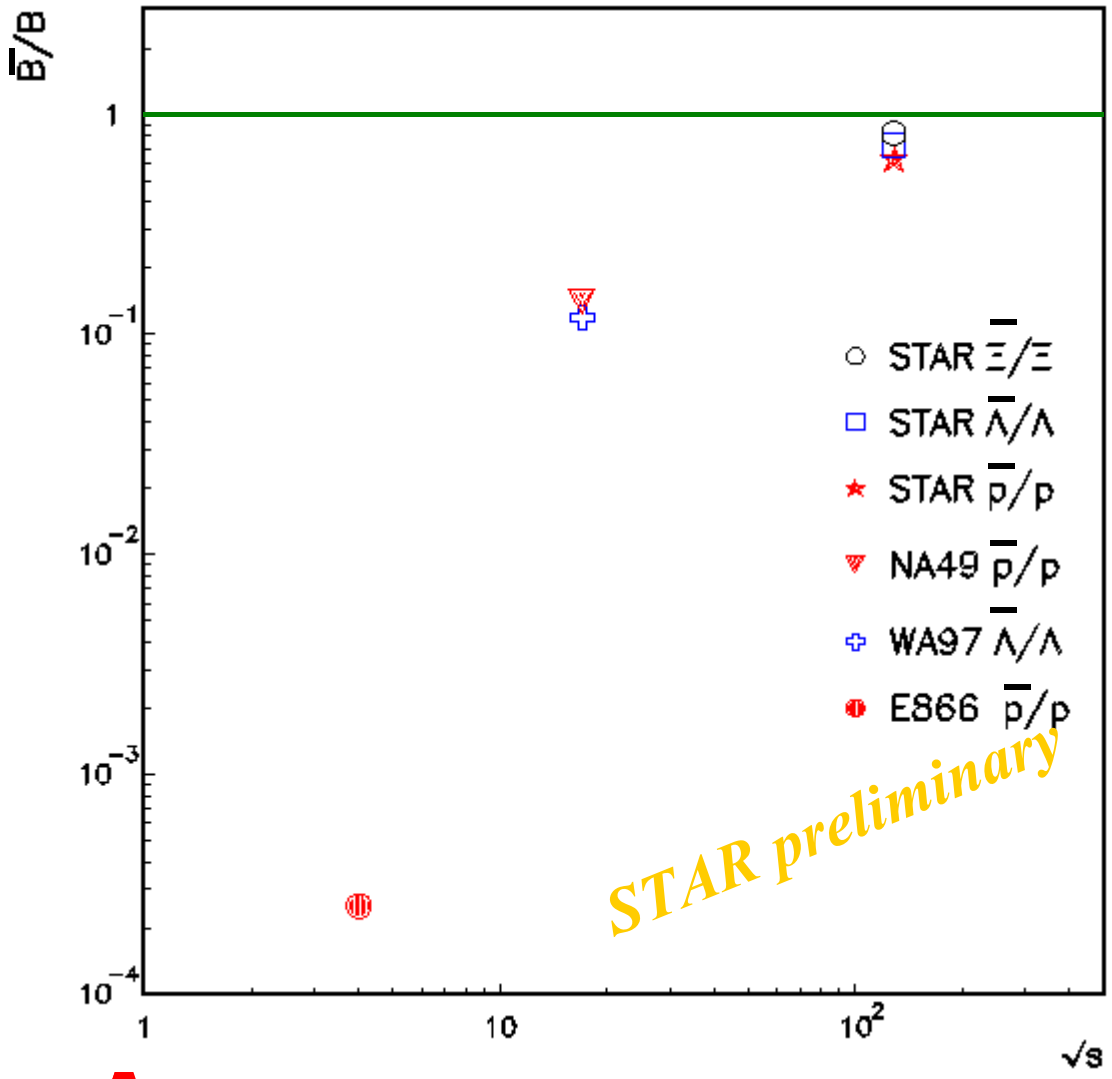
Central events





Ratio is flat as a function of p_t and y

Towards a Baryon-Free Region



Preliminary:

$\bar{p}/p = 0.6 \pm 0.02$ (stat.) ± 0.06 (sys.)

$\bar{\Lambda}/\Lambda = 0.73 \pm 0.03$ (stat.)

$\bar{\Xi}^+/\Xi^- = 0.82 \pm 0.08$ (stat.)

Λ and $\bar{\Lambda}$ from Mixed Event Studies

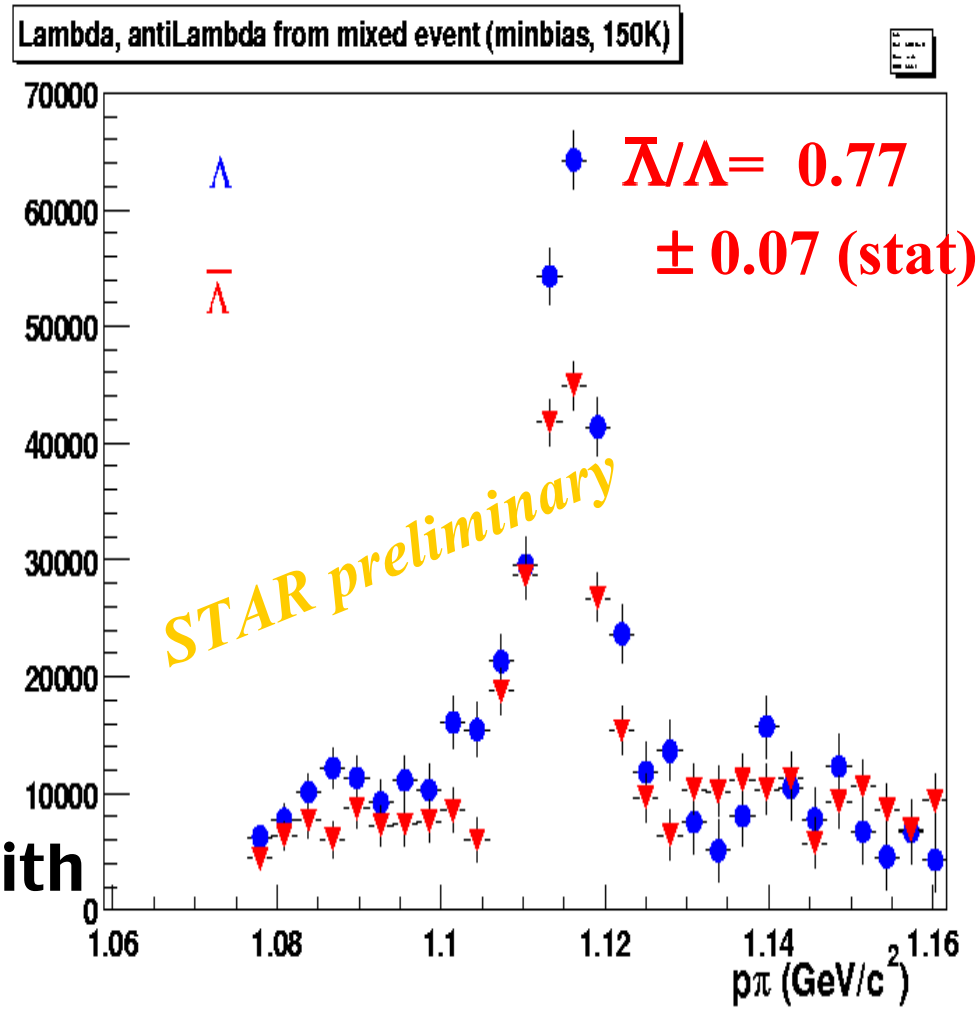
Good cross-check with standard V0 analysis.

Low p_t measurement where there is no V0 analysis

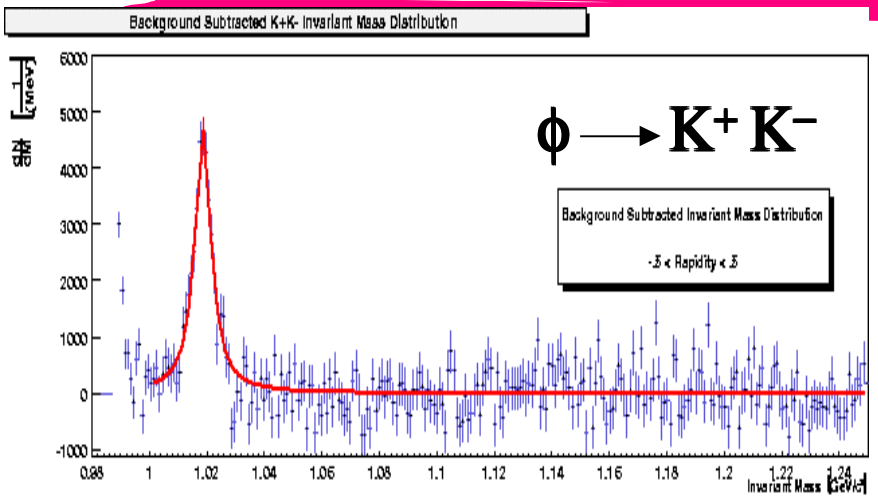
High efficiency (yields are ~10X V0 analysis yields)

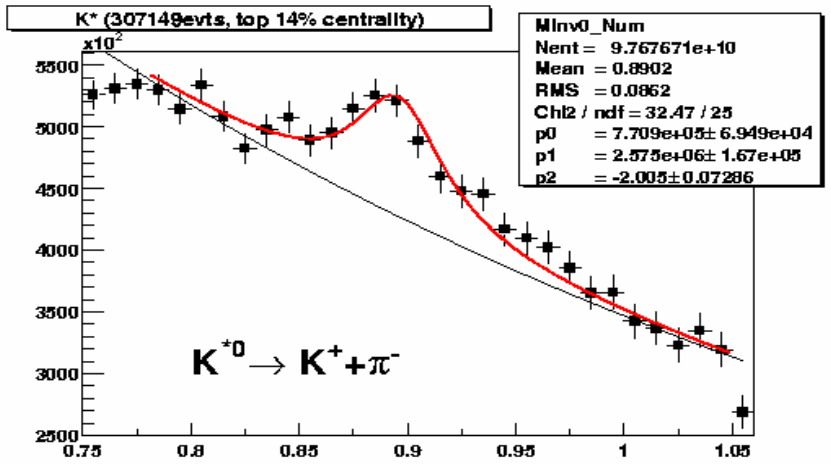
Background determined by mixed event

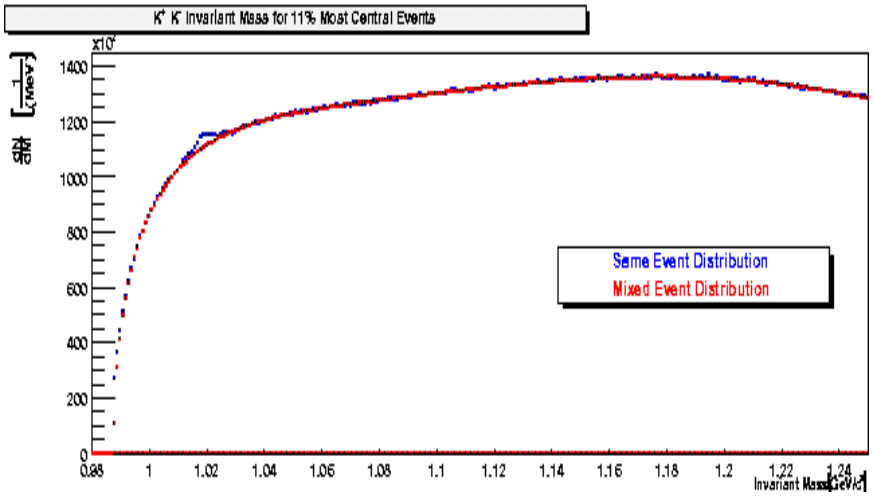
The ratio is in agreement with "standard" analysis

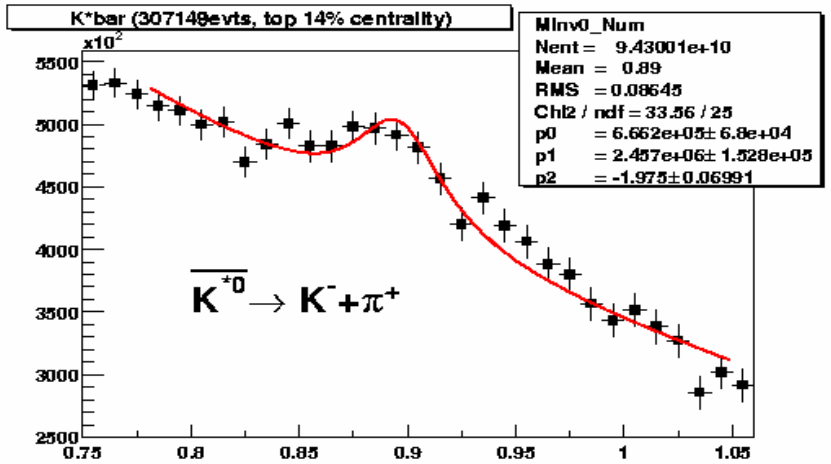


The Resonances



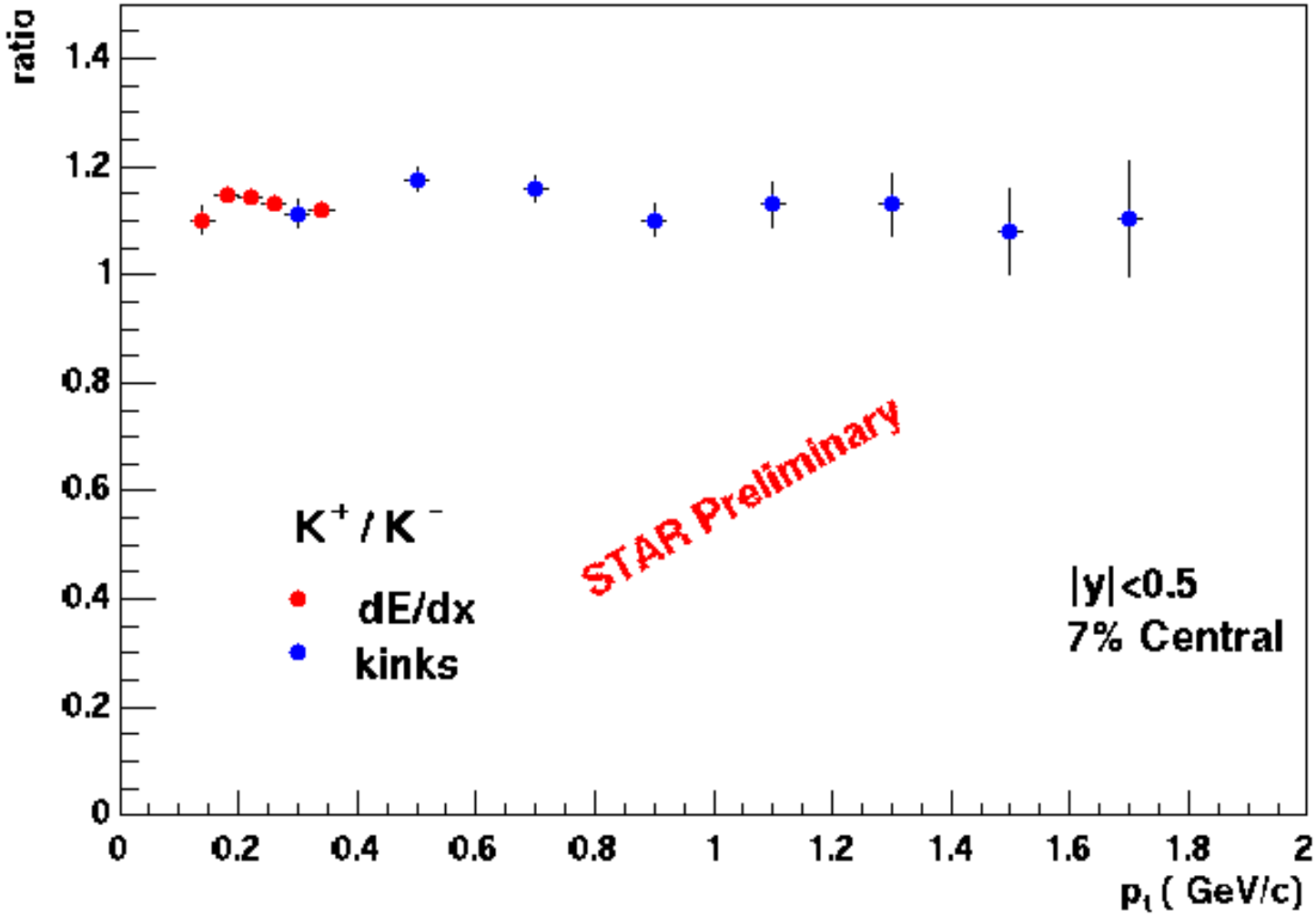




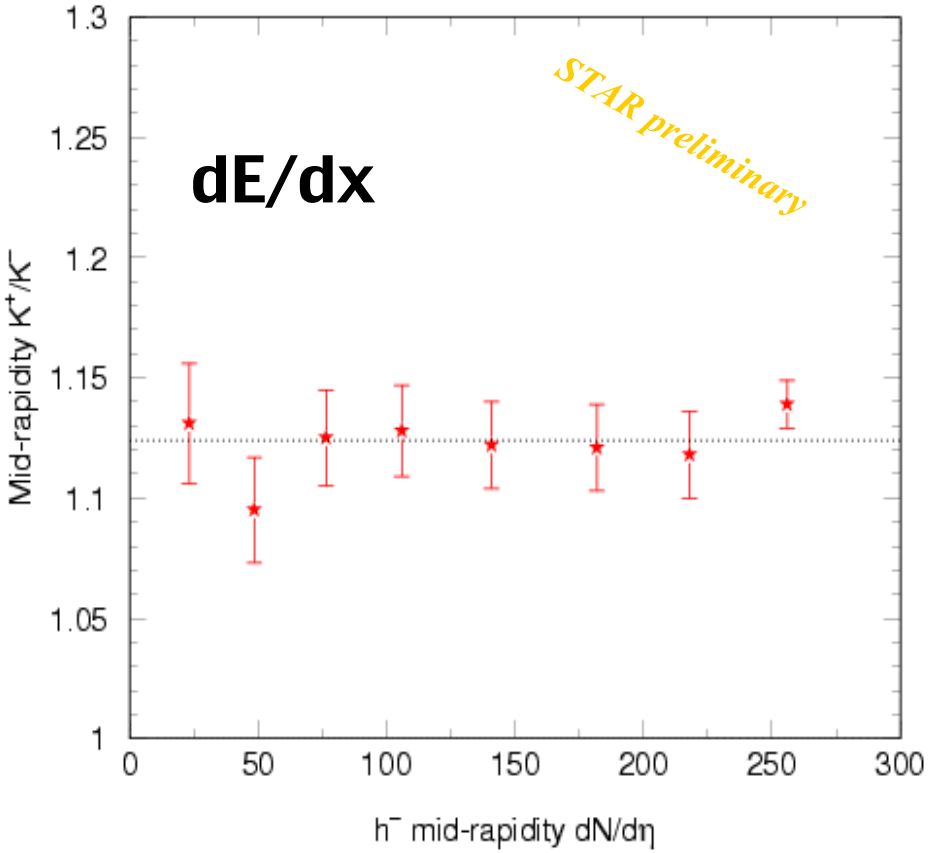


See talk by Z. Xu

K^+/K^- vs p_t


ratio
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
p_t (GeV/c)
K^+ / K^-
dE/dx
kinks
STAR Preliminary
|y|<0.5
7% Central

K^+/K^- Ratio – N_{ch}

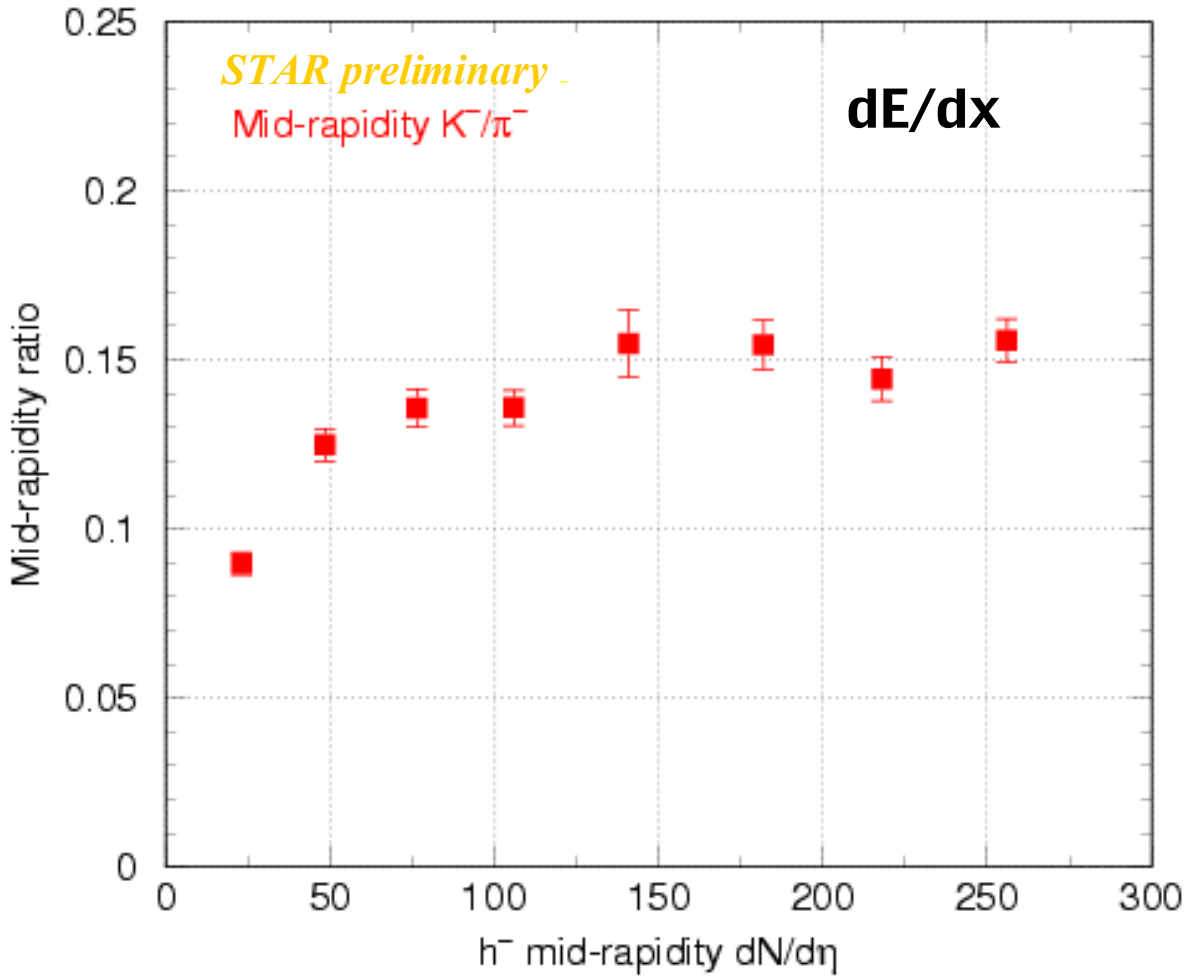


STAR preliminary

Kinks

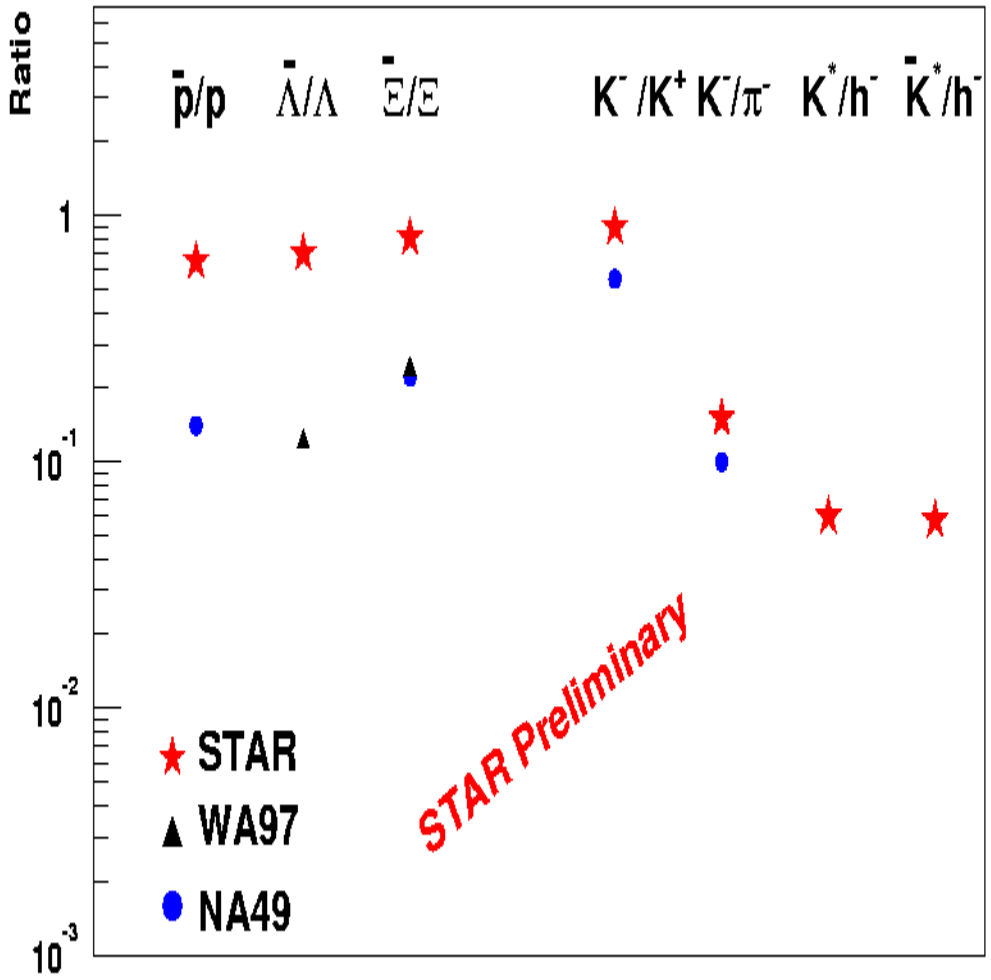
- K^+/K^-= 1.12±0.01(stat.)± 0.06(sys.) (dE/dx). (The kink method is systematically higher.)
- K^+/K^- constant over measured centrality.

K^-/π^- Ratio



K^-/π^- ratio is enhanced by almost a factor of 2 in central collisions compared to peripheral collisions

Comparing to SPS – Central Mid-y



$\bar{p}/p$ = 0.6 ± 0.02 (stat.) ± 0.06 (sys.)

$\bar{\Lambda}/\Lambda$ = 0.73 ± 0.03 (stat.)

$\bar{\Xi}^+/\Xi^-$ = 0.82 ± 0.08 (stat.)

K^-/K^+(kink) = 0.87 ± 0.02(stat.) ± 0.05(sys.)

K^-/K^+(dE/dx) = 0.89±0.008 (stat.)± 0.05 (sys.)

K^-/π^- = 0.15 ± 0.02 (stat.)

K^*/h^- = 0.06 ± 0.06 (stat.)± 0.01 (sys.)

$\bar{K}^*/h^-$ = 0.058 ± 0.06 (stat.)± 0.01 (sys.)

Conclusion

- Kaon Inverse slope ~270MeV, Mid-rapidity dN/dy ~30
- The K mesons' thermal freeze-out along with the p and π appear to indicate more radial flow than at the SPS
- All shown ratios show no large trends as functions of y or p_t
- K^+/K^- is flat as function of centrality
- K^-/π^- ratio increases by ~ factor 2 from peripheral to central events
- Even at RHIC energies the mid-y region not baryon free

Future: Finish correcting K^0_s, Λ, Ξ, ϕ and K^* results

For More STAR Strangeness Information See

Talks:

- Particle Ratios from Au–Au Collisions at $\sqrt{s_{NN}}$=130 GeV – H. Huang
- Resonance Studies at STAR – Z. Xu

Posters:

- Calculating the reconstruction efficiency of singly strange hadrons in the STAR TPC – M. Lamont
- Kaon reconstruction via one-prong decays in the STAR TPC – W. Deng
- Multiply strange baryon production in Au–Au collisions at $\sqrt{s_{NN}}$=130 GeV – C. Lansdell
- Strange Particle Correlation Studies with the STAR detector – T. Humanic