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APS physics

Strange Hadron Production in d+Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV Using the STAR Detector

STAR

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Outline :

- Motivation
- Overview of the STAR Detector
- Data Set and Particle Identification
- Analysis Technique
- Results
    - Ratios of Particle Yield (dN/dy)
    - Rapidity Asymmetry
- Summary

Motivation : Rapidity Asymmetry :

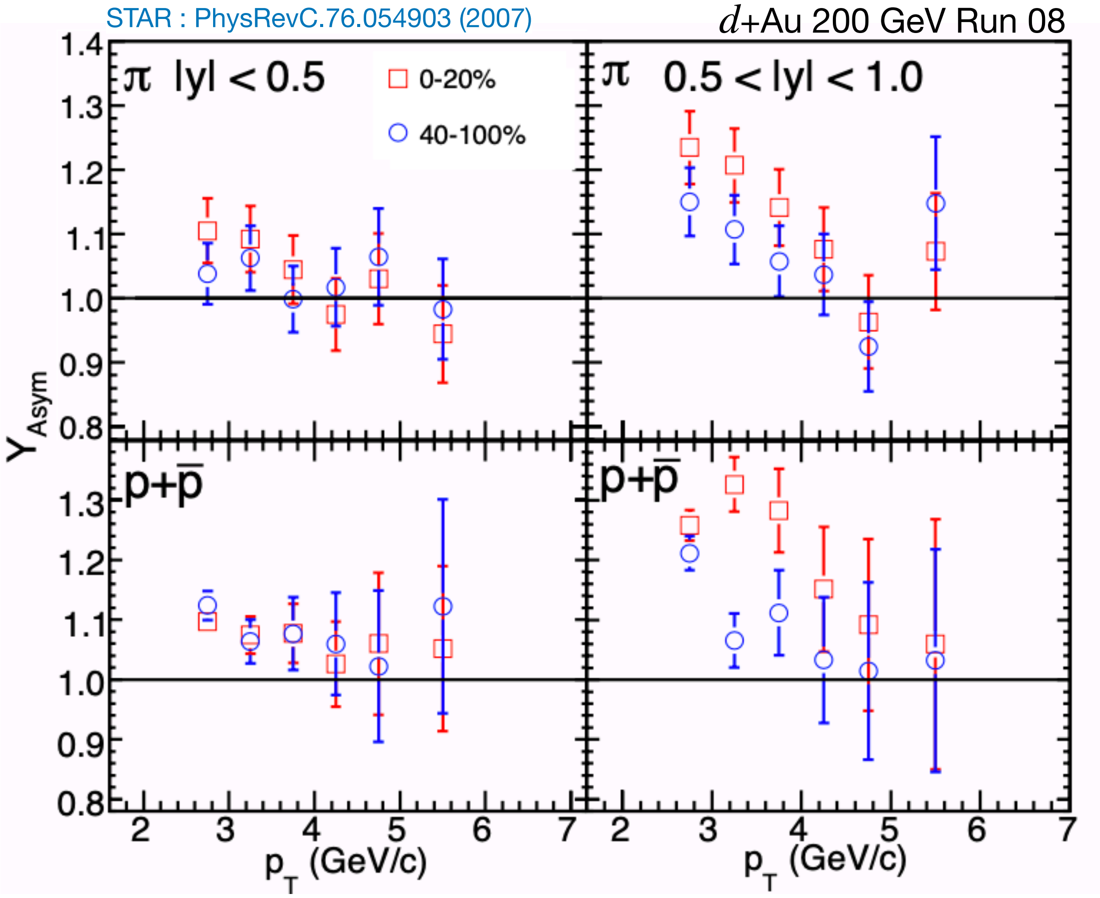
$$Y_{asym}(p_T) = \frac{d^2N(p_T)/dy_{CM}dp_T|_{y_{CM}\in[-b,-a]}}{d^2N(p_T)/dy_{CM}dp_T|_{y_{CM}\in[a,b]}}.$$

Au going side - backward rapidity & d going side - forward rapidity

- Comparative study of particle production in backward and forward rapidities in asymmetric systems like d+Au, p+Au etc. can be done using Y_{asym}.
- Unique tool to study contributions from nuclear effects (nuclear shadowing, multiple scattering etc.) to particle production.

STAR : PhysRevC.76.054903 (2007)

d+Au 200 GeV Run 08



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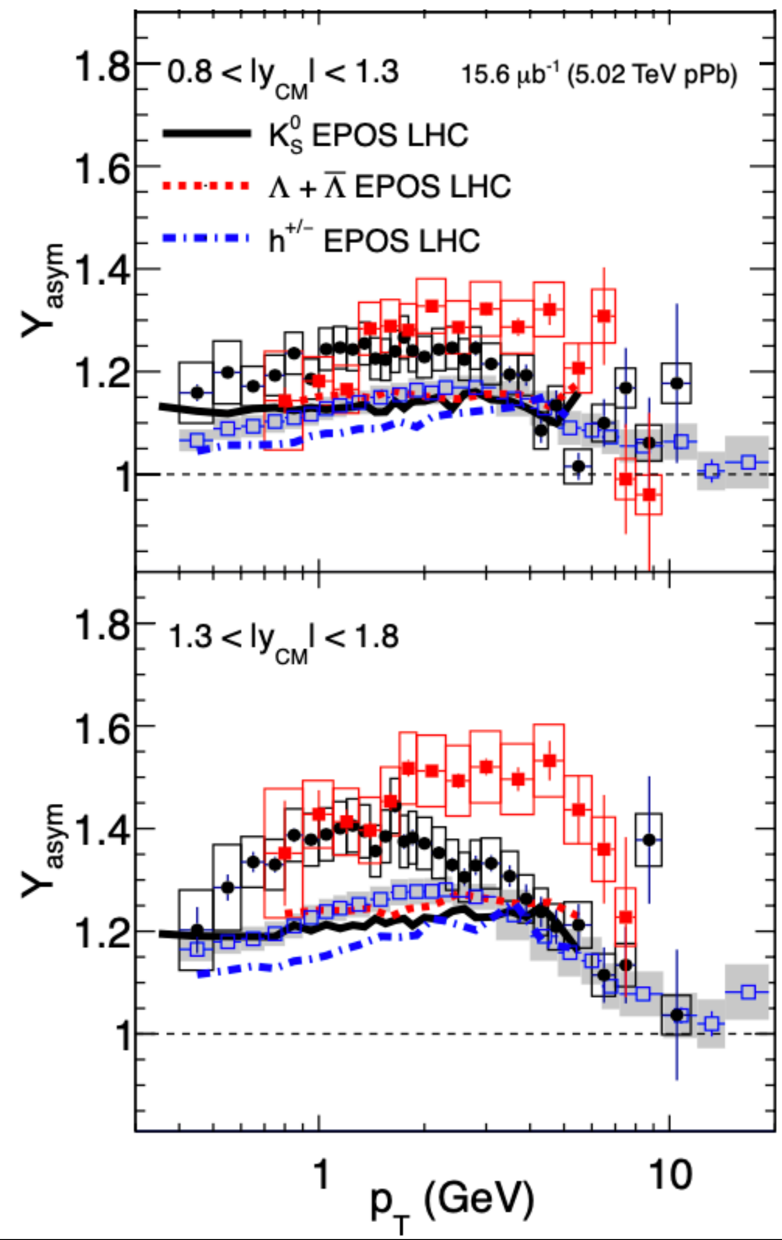
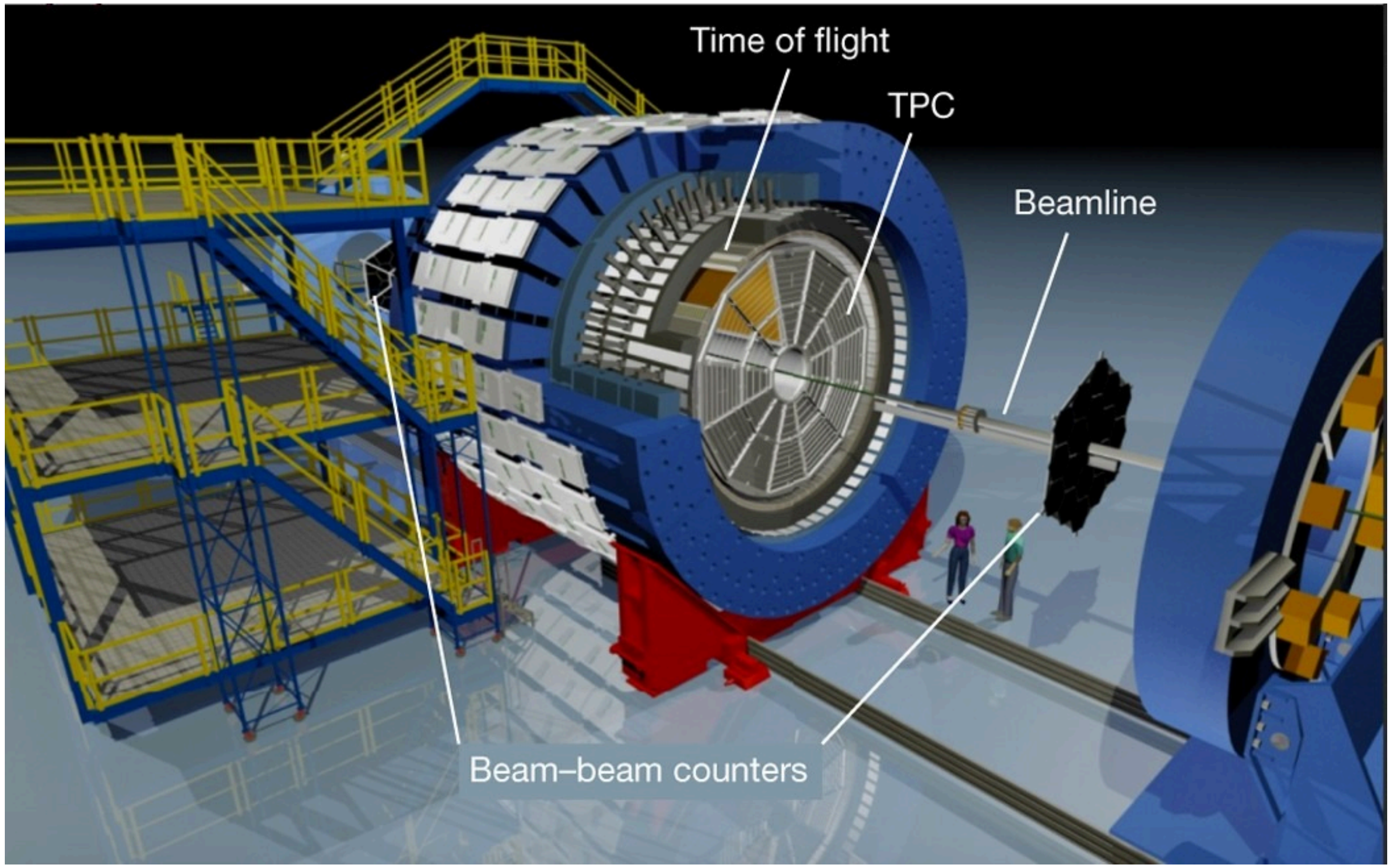


- At low p_T - $Y_{asym} > 1$ ➡ presence of nuclear effects
- At high p_T - Y_{asym} is consistent with unity.
- Deviations are higher for higher rapidity.

We want to look for Y_{asym} for K_S^0 in d+Au collisions at 200 GeV

Overview of STAR Detector :

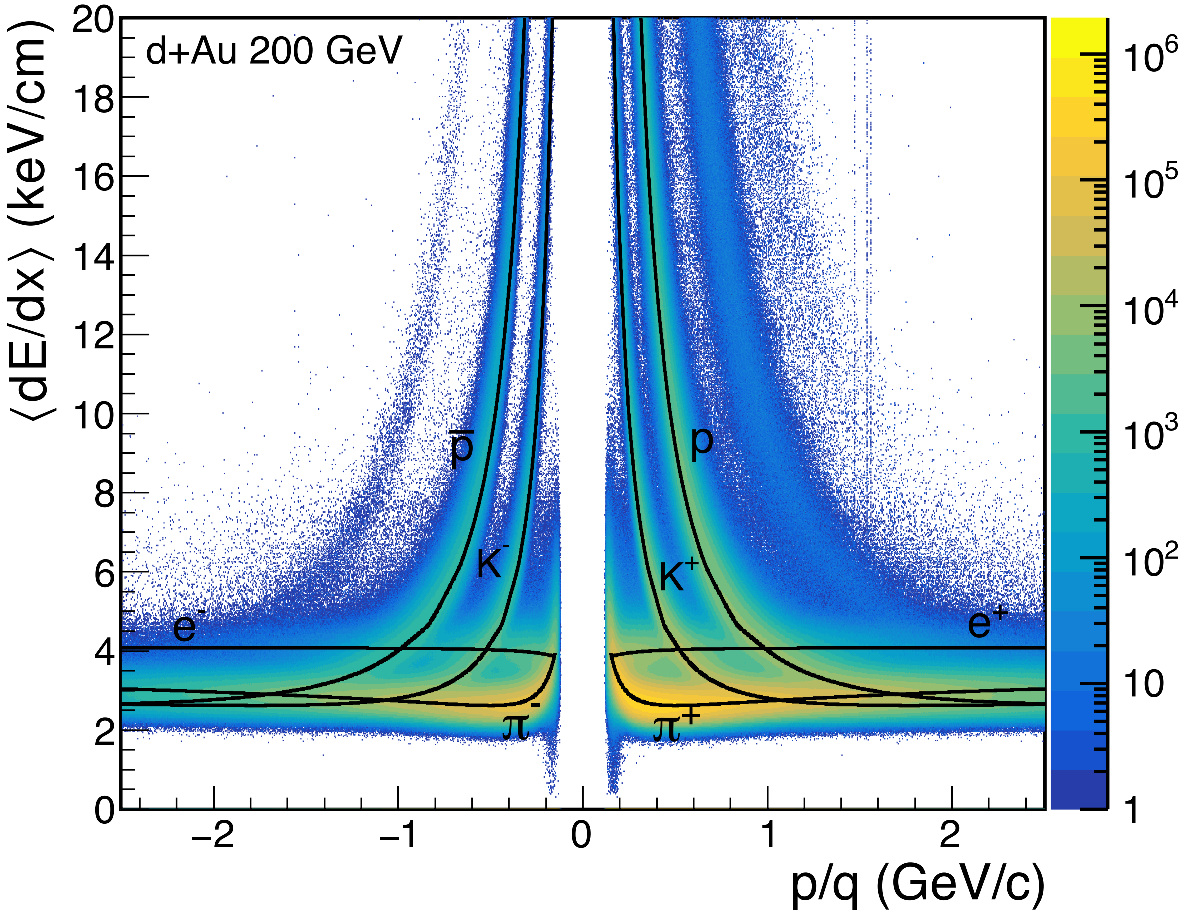


- Main goal of STAR experiment is to study the formation and characteristics of quark gluon plasma (QGP)

- The Solenoidal Tracker At RHIC (STAR) consists of several subdetectors :
  - **Tracking :** Time Projection Chamber ($|\eta| < 1.0$)
  - **Particle Identification :** Time Projection Chamber and Time of Flight ($|\eta| < 1.0$)

Data Set and Particle Identification :

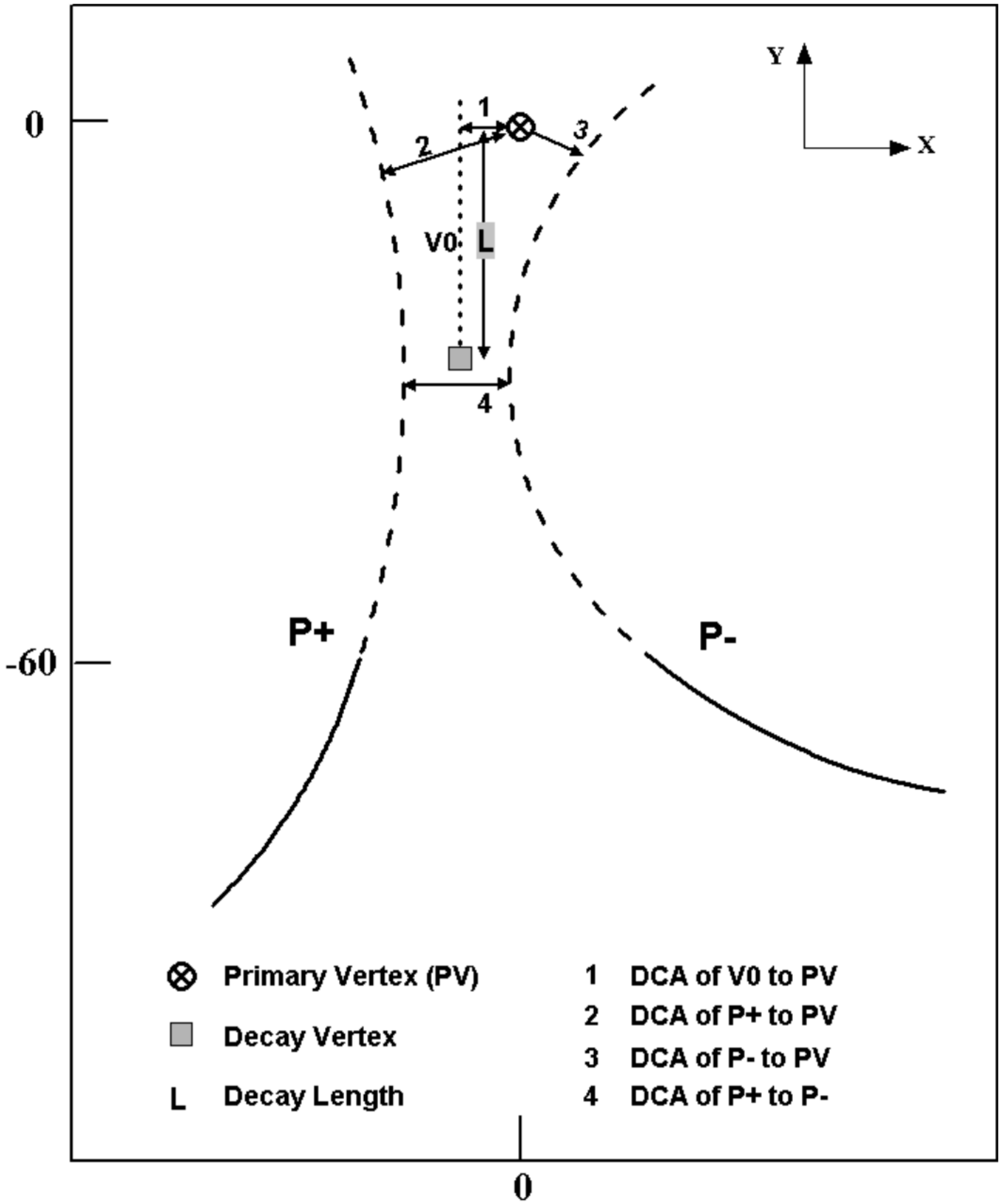
- Collision : d+Au 200 GeV
- Events analyzed ~100M
- Particles studied : K_S^0
- Collision centrality : minimum bias
- Rapidities studied :
    - Midrapidity :
      |y| <0.5
    - Backward rapidities :
      -0.8 < y <0.4, -0.4 < y <0
    - Forward rapidities :
      0 < y <0.4, 0.4 < y < 0.8



- Particle identification is done via <dE/dx> measured in TPC

$$Z = \log \frac{\langle dE/dX \rangle_{measure}}{\langle dE/dX \rangle_{Bichsel}},\ n\sigma_p = \frac{Z}{\sigma_p}$$

K_S^0 Reconstruction :



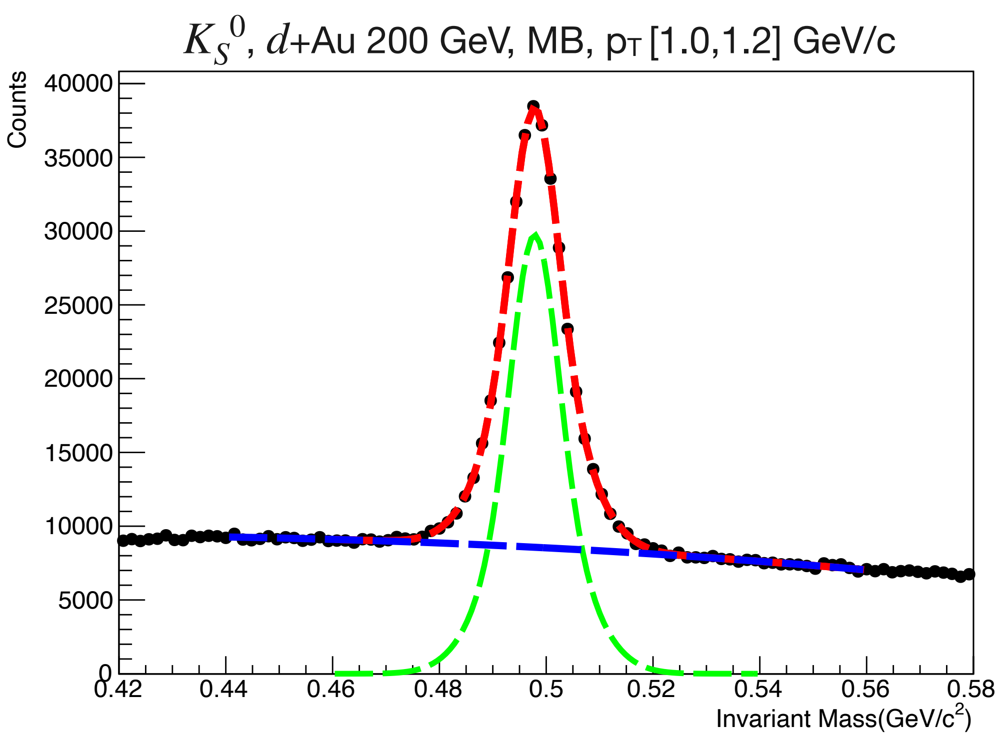
$K_s^0 \rightarrow \pi^+\pi^-$, $c\tau$ = 2.68 cm.

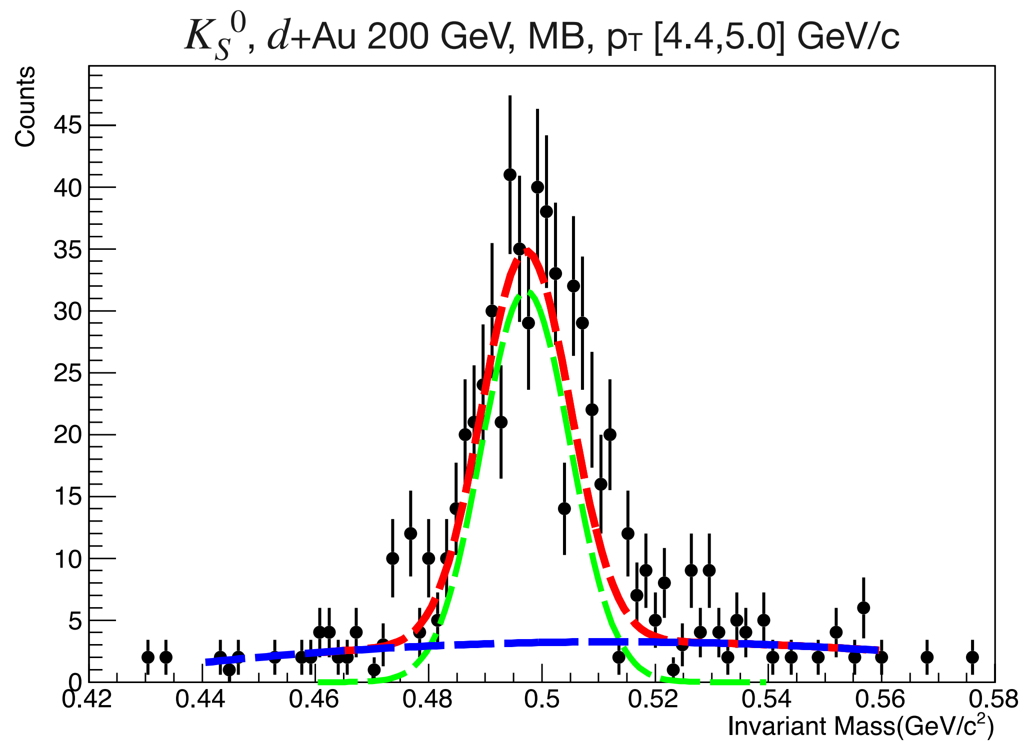
Branching Ratio : 69.2%

- Cuts on daughters :
  - Number of hits in TPC >15
  - Pion identification using TPC
- V0 reconstruction cuts :
  - DCA of P+ to P- <= 0.8 cm
  - DCA of V0 to PV < 0.8 cm
  - DCA of pion to PV > 0.7 cm
  - Decay length >= 2.5 cm

https://drupal.star.bnl.gov/STAR/files/startheses/2005/jiang_hai.pdf

Invariant Mass Distributions :



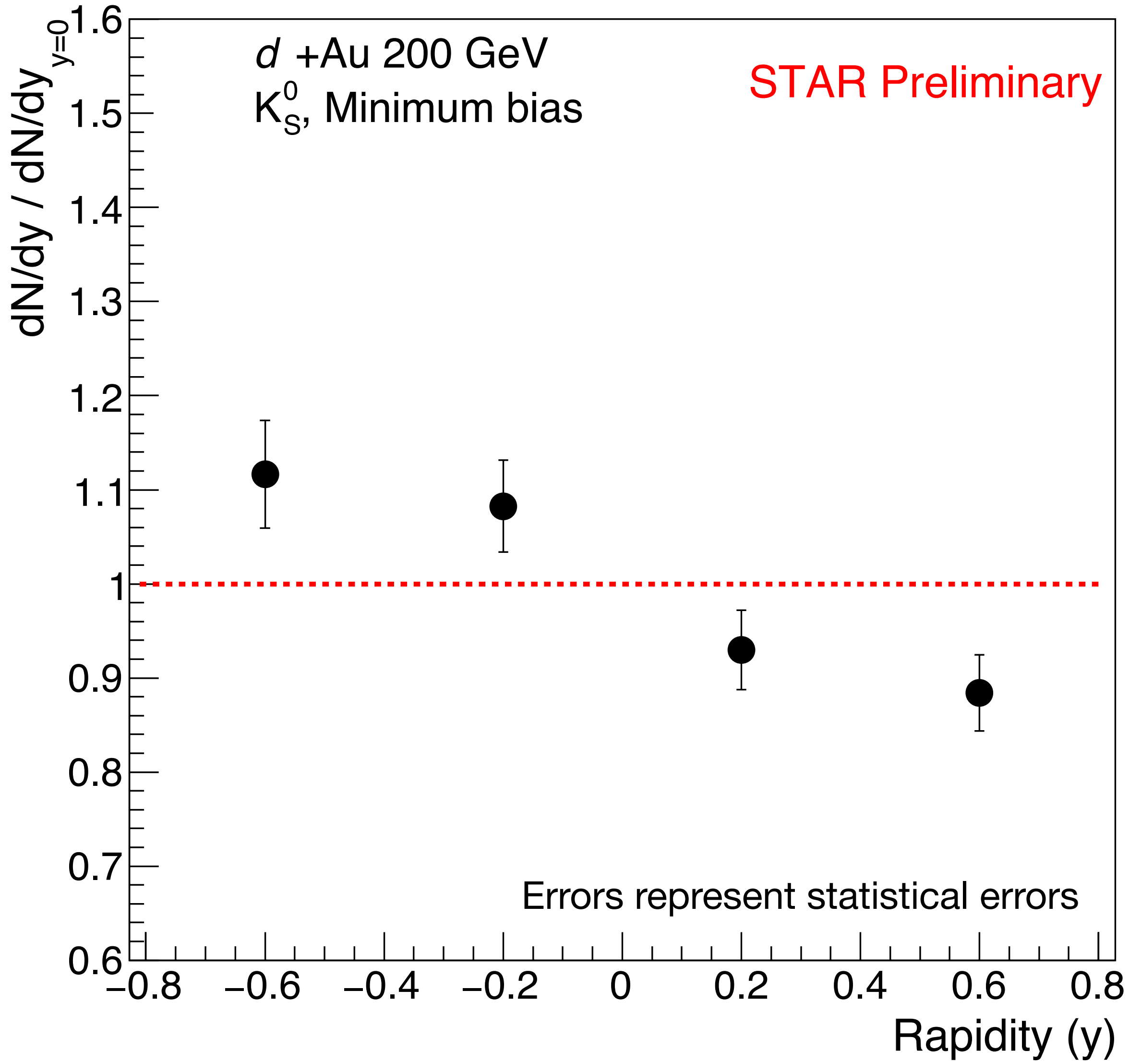


- Red line : double Gaussian + 2nd order polynomial (signal+background)
- Blue line : 2nd order polynomial (background)
- Green line : double Gaussian (signal)

Invariant mass distributions are fitted using function :

$$a_0 + a_1 x + a_2 x^2 + \frac{Y_1}{\sqrt{2\pi\sigma_1}} \exp\left(\frac{-(m-m_0)^2}{2\sigma_1^2}\right) + \frac{Y_2}{\sqrt{2\pi\sigma_2}} \exp\left(\frac{-(m-m_0)^2}{2\sigma_2^2}\right)$$

Ratio of dN/dy at Various Rapidities w.r.t. that at Midrapidity (|y| <0.5):



dN/dy values at various rapidities are obtained from measured spectra.

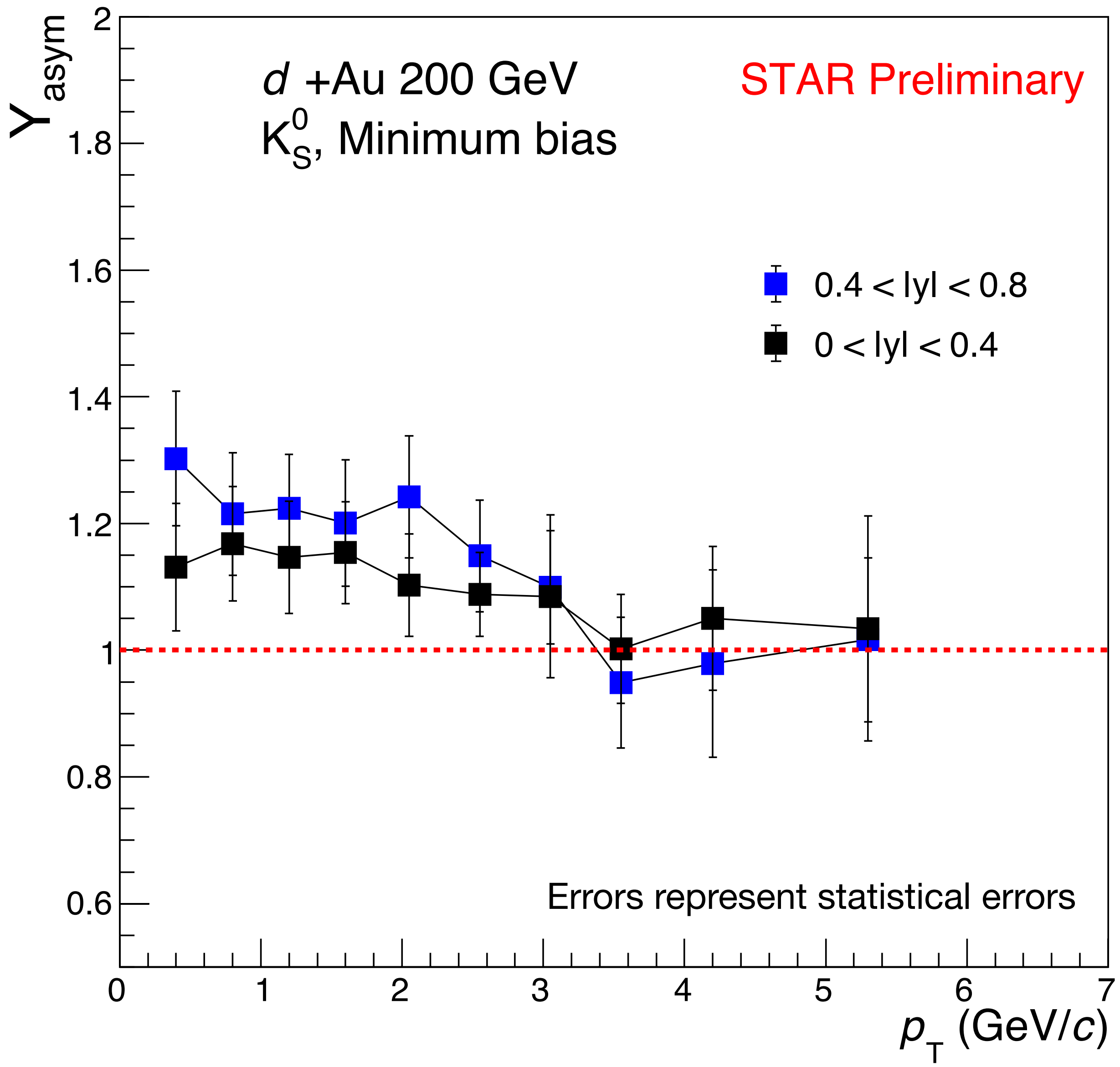
Au going side - backward rapidity

d going side - forward rapidity

- Ratio of $(\mathrm{d}N/\mathrm{d}y)/(\mathrm{d}N/\mathrm{d}y)_{y=0}$ decreases with rapidity.

Rapidity Asymmetry :

$$Y_{\text{asym}}(p_T) = \frac{d^2N(p_T)/dy_{CM}dp_T|_{y_{CM}\in[-b,-a]}}{d^2N(p_T)/dy_{CM}dp_T|_{y_{CM}\in[a,b]}}.$$



- $Y_{asym} > 1$ is observed at low p_T
  - Signifies the presence of nuclear effects.
- Consistent with unity at high p_T.
- More prominent for higher rapidity interval ($0.4 < |y| < 0.8$).

For low p_T (0- 2.0 GeV/c), deviations from unity are :

Rapidity interval	Deviation
0 < |y| < 0.4	3.4σ
0.4 < |y| < 0.8	4.8σ

Summary :

- Studied K^0_s production for different rapidity intervals (midrapidity, $|y|<0.5$) & ($|y|<0.4$, $0.4<|y|<0.8$) in minimum bias d+Au collisions at RHIC.
- Ratio of dN/dy at various rapidities with respect to that at midrapidity shows decreasing trend for the range $-0.8 < y < 0.8$.
- $Y_{asym} > 1$ is observed at low p_T and is more pronounced at more forward rapidity regions.

Thank You!