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

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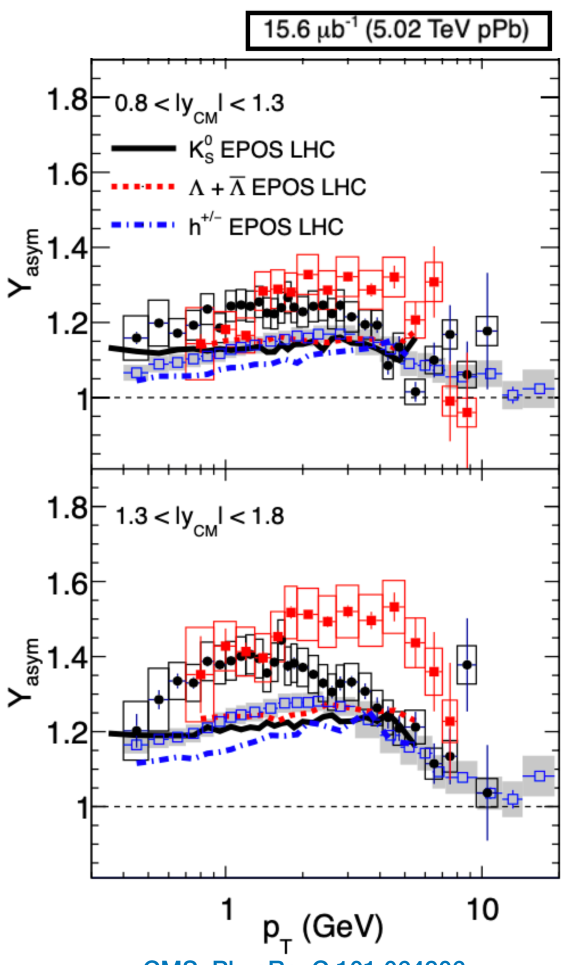
I. Motivation : Rapidity Asymmetry

Y_{asym} is defined as the ratio of particle production in backward and forward rapidity.

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

Au going side - backward rapidity with interval [-b,-a]
d going side - forward rapidity with interval [a,b]

- 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 nuclear effects (nuclear shadowing, multiple scattering etc.) on particle production.



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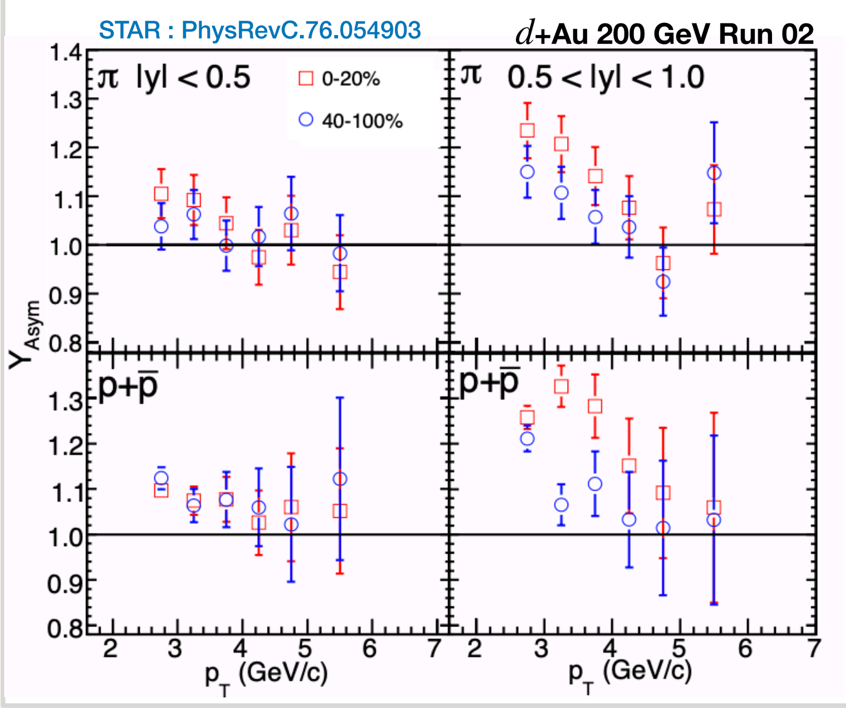
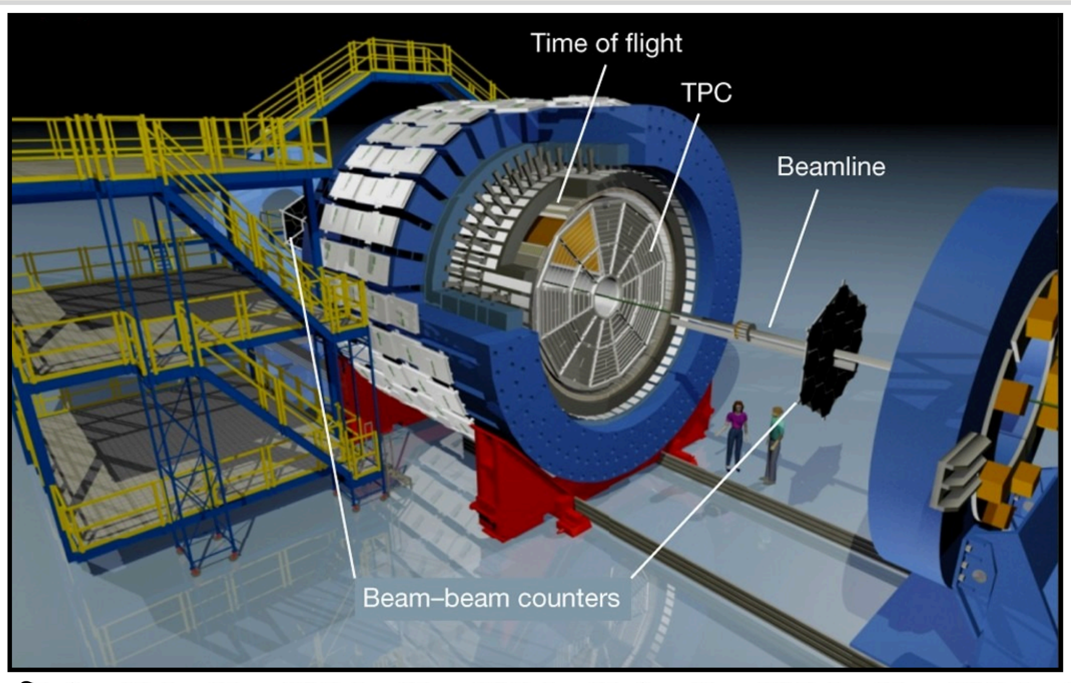


- At low p_T - Y_{asym} >1 ⟹ presence of nuclear effects
- At high p_T - Y_{asym} is consistent with unity.
- Deviations are larger for higher rapidity.

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

II. Overview of the STAR Detector

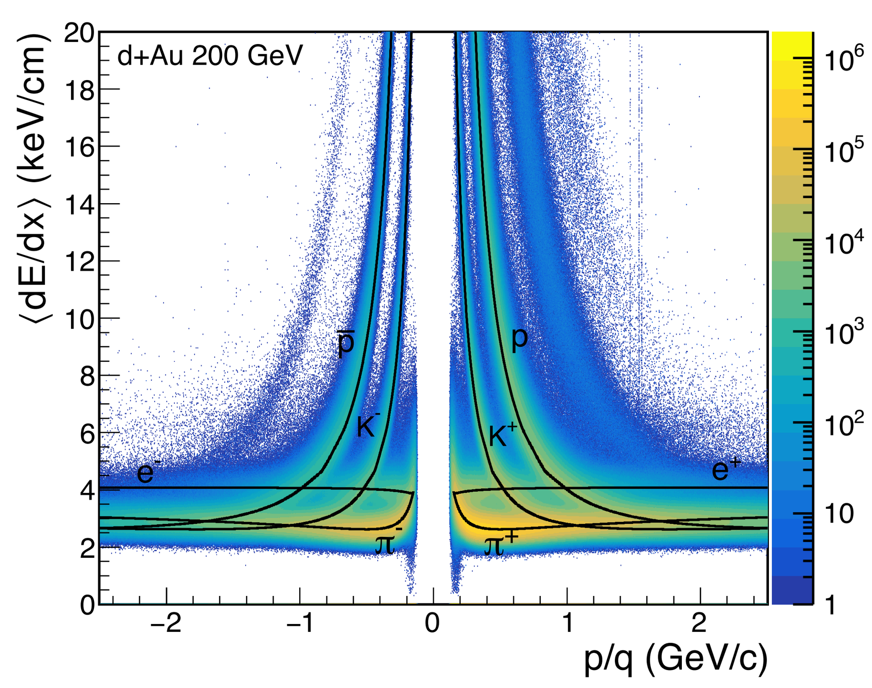


Main goal of STAR experiment is to study the formation and characteristics of Quark-Gluon Plasma (QGP)

- 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)

III. Data Set and Particle Identification

- Collision : d+Au 200 GeV
- Events analyzed : ~100M
- Particle 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

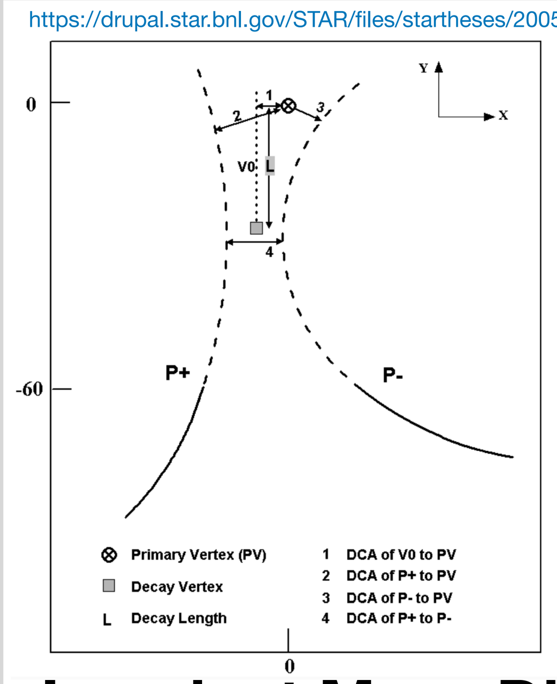


- Particle identification is done via <dE/dx> measured in TPC

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

IV. Analysis Technique

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



$K_s^0 \rightarrow \pi^+ + \pi^-$, $c\tau$ = 2.68 cm
Branching Ratio : 69.2 %

Cuts on daughters :

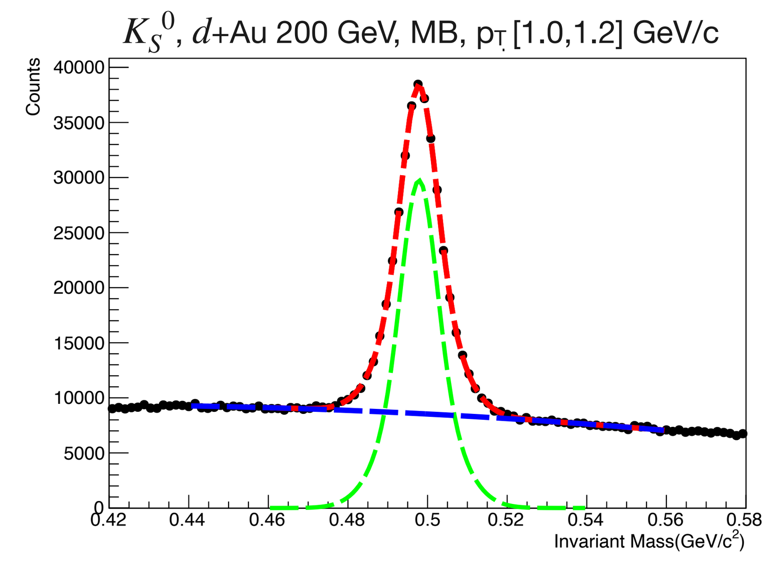
- Number of hits in TPC > 15
- Pion identification using TPC

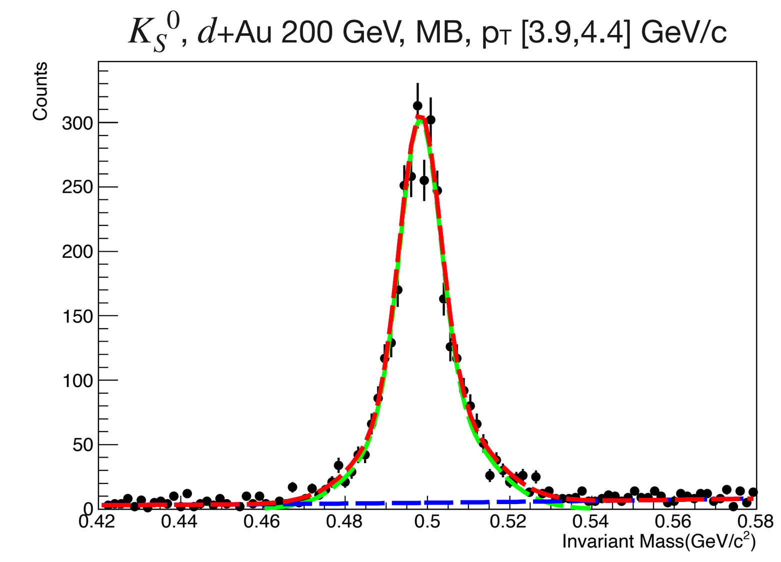
*PV means Primary Vertex

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

Invariant Mass Distributions :





- Invariant mass distributions are fitted using function :

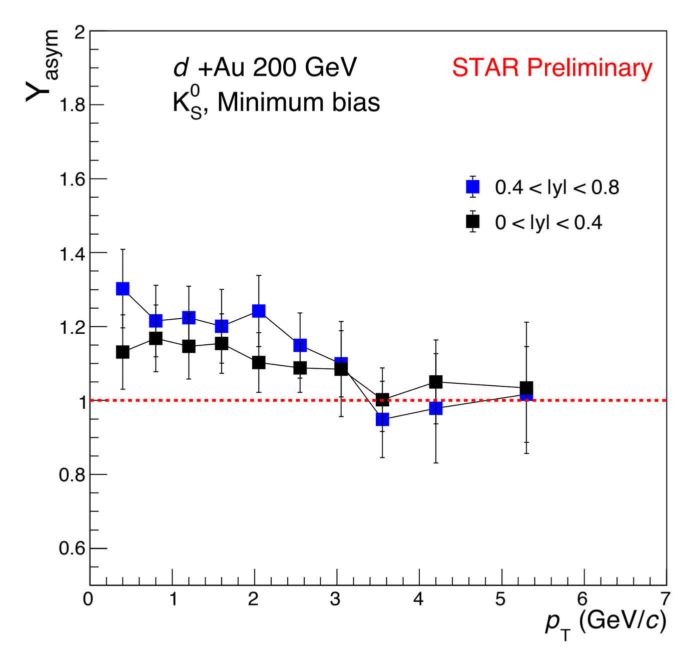
$$a_0 + a_1x + a_2x^2 + \frac{Y_1}{\sqrt{2\pi}\sigma_1}\exp\left(\frac{-(m-m_0)^2}{2\sigma_1^2}\right) + \frac{Y_2}{\sqrt{2\pi}\sigma_2}\exp\left(\frac{-(m-m_0)^2}{2\sigma_2^2}\right)$$

Raw yields are extracted and corrected for efficiency and acceptance

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

V. Results

(I) Rapidity Asymmetry :

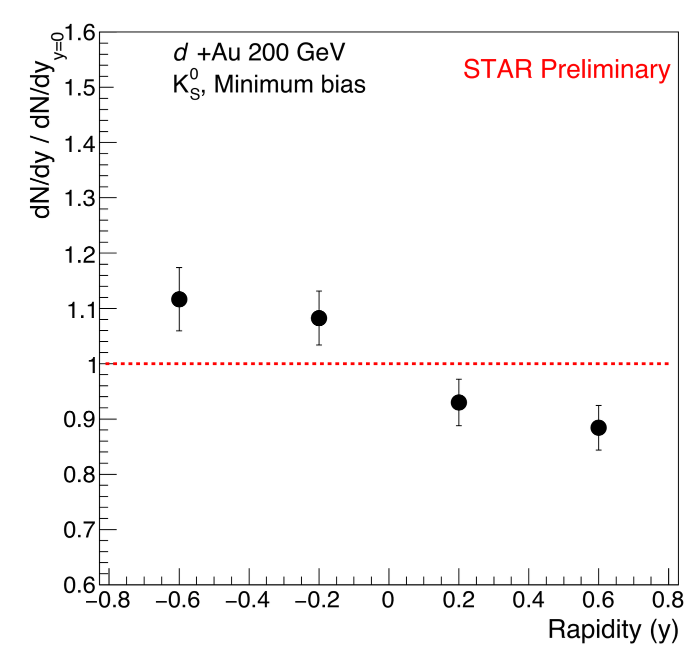


- Y_{asym} > 1 is observed at low p_T
  - Signifies the presence of nuclear effects.
- Consistent with unity at high p_T.
- More prominent for higher rapidity interval (0.4 < |y| <0.8).

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

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



dN/dy values within various rapidity intervals are obtained from measured transverse momentum distributions.

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

- Ratio of $(dN/dy)/(dN/dy)_{y=0}$ decreases with rapidity.

VI. Summary

- Presented 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.
- Y_{asym} >1 is observed at low p_T and is more pronounced for higher rapidity.
- Ratio of dN/dy at various rapidities with respect to midrapidity shows decreasing trend for the range -0.8 < y < 0.8.

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