Measurements of K_S^0 production at $\sqrt{s_{NN}}$ = 7.7 GeV and $\Omega(\bar{\Omega})$ production at $\sqrt{s_{NN}}$ = 14.6, 19.6 GeV in Au+Au collisions

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Abstract

One main motivation of the Beam Energy Scan (BES) program at RHIC is to search for the QCD critical point and the onset of deconfinement. Strangeness production has been suggested as a sensitive probe to the early dynamics of the deconfined matter created in heavy-ion collisions due to small hadronic cross sections.

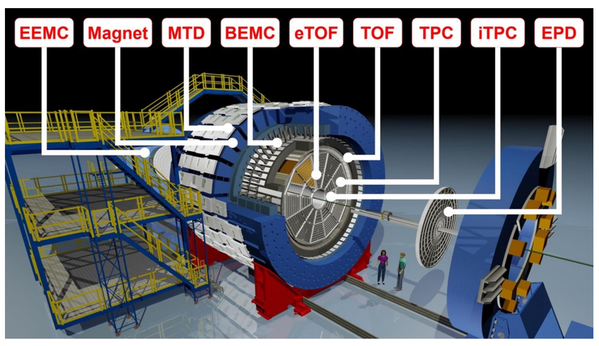
During BES-II, STAR has accumulated high statistics data in Au+Au collisions, which can help reduce the uncertainties in the strange hadron measurements, in particular for the multi-strange hadrons. In this poster, we present new STAR measurements of K_S^0 production at $\sqrt{s_{NN}}$ = 7.7 GeV and $\Omega(\bar{\Omega})$ production in Au+Au collisions at $\sqrt{s_{NN}}$ = 14.6, 19.6 GeV from BES-II, including transverse-momentum and rapidity spectra, nuclear modification factors. New insights on the collision dynamics is discussed.

Motivation

- Rapidity density of strange baryons may give insight on the baryon stopping mechanism
- Precise measurement of $\Omega(\bar{\Omega})$ — baryon with only strange quarks — production with larger statistics and upgraded detector
- Update Ω/ϕ ratio as a function of p_{T} to test the recombination model

STAR detector and particle reconstruction

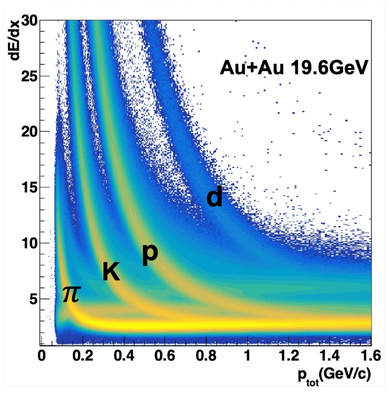
- Large and uniform acceptance
- Excellent particle identification

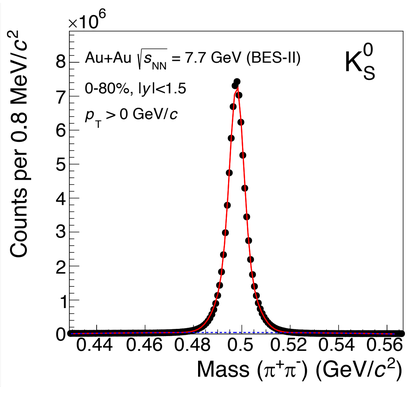


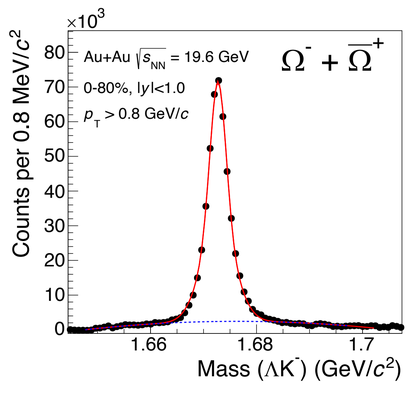
iTPC (STAR Inner Sector TPC) :

- Larger rapidity coverage — |η| from 1.0 to 1.5
- Better PID — improved dE/dx resolution
- Lower p_{T} limit — from 120 to 60 MeV/c

- Particle identification with dE/dx
- π, K, p are used to reconstruct the strange particles
- Large number of strange particles allow multi-differential measurements

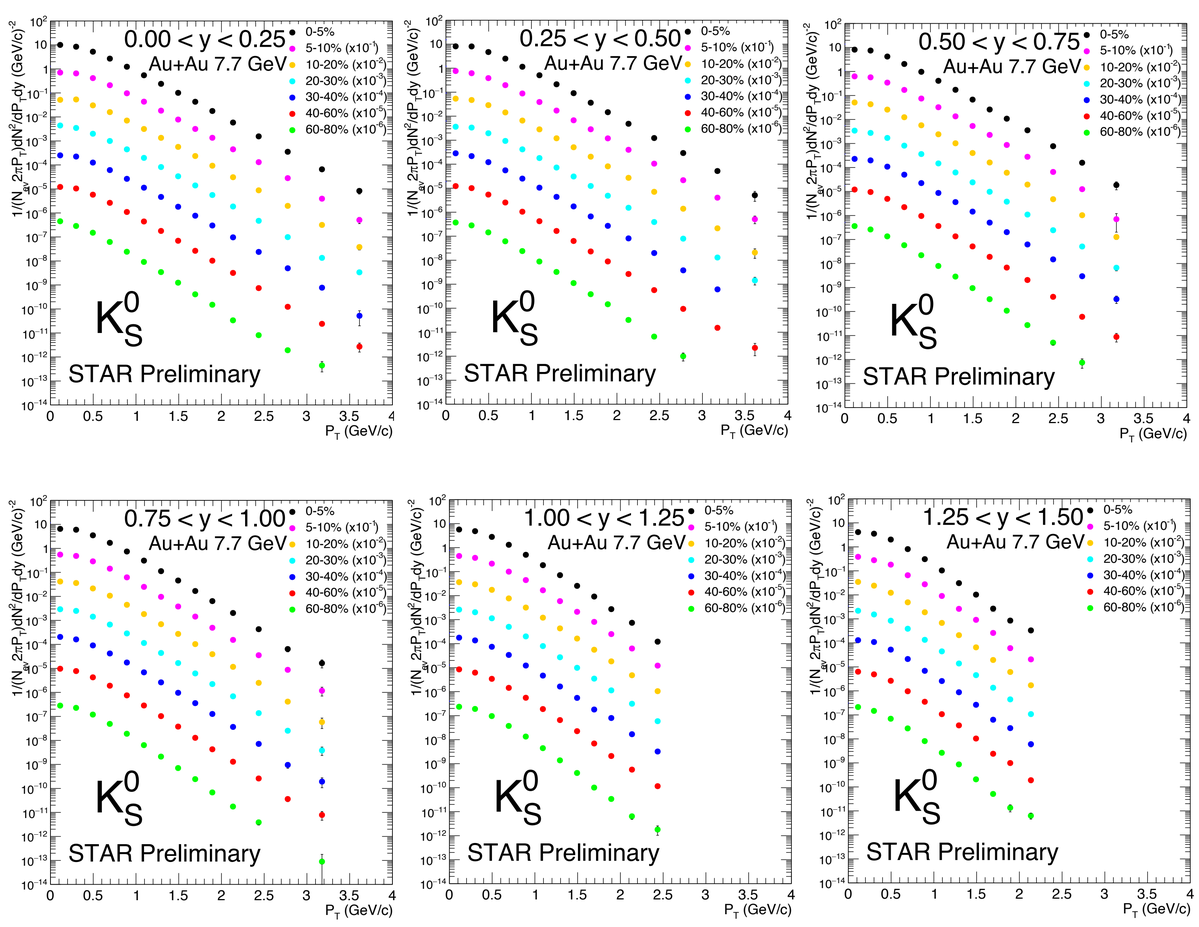






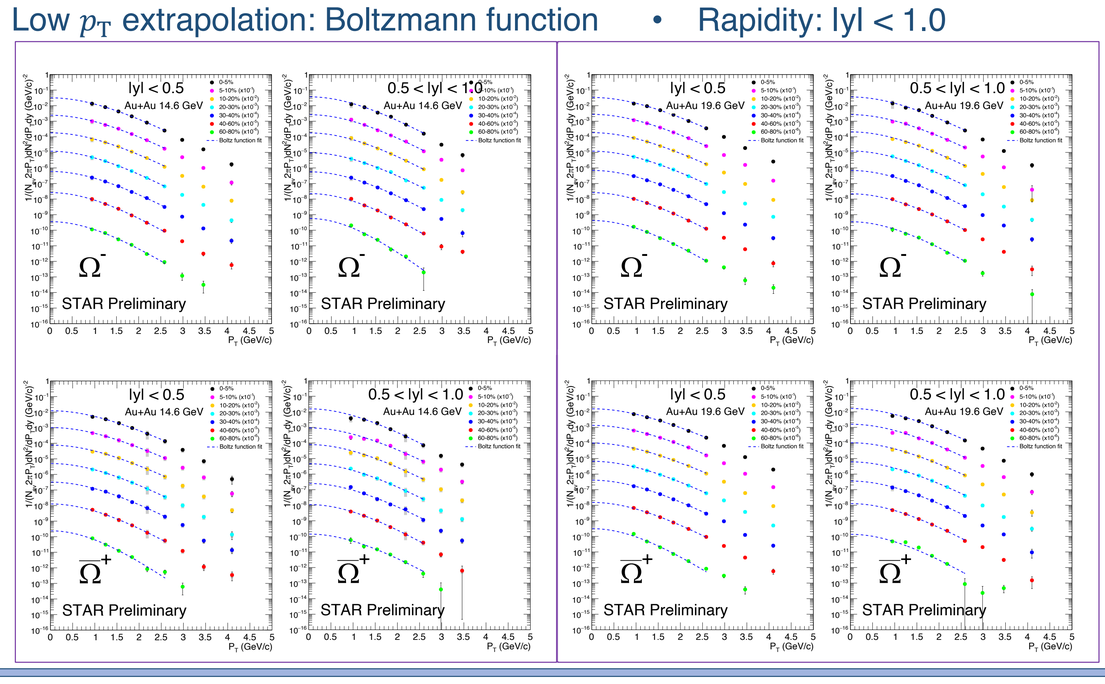
p_T Spectra of K_S^0 in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7 GeV

- Measured down to p_{T} = 0, no need for extrapolation to obtain dN/dy
- Rapidity: |y| < 1.5
- Measurement range of BES-I: p_{T} > 0.2 GeV/c, |y| < 0.5



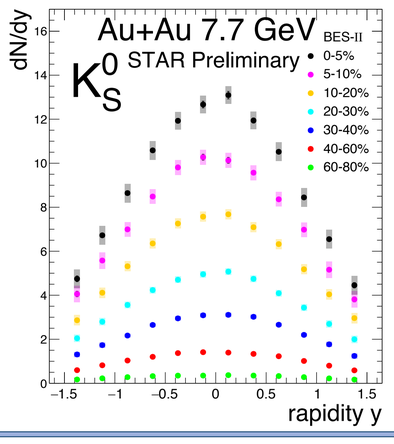
p_T Spectra of $\Omega(\bar{\Omega})$ in Au+Au collisions at $\sqrt{s_{NN}}$ = 14.6 and 19.6 GeV

- Low p_{T} extrapolation: Boltzmann function
- Rapidity: |y| < 1.0



Rapidity spectra of K_S^0 at $\sqrt{s_{NN}}$ = 7.7 GeV

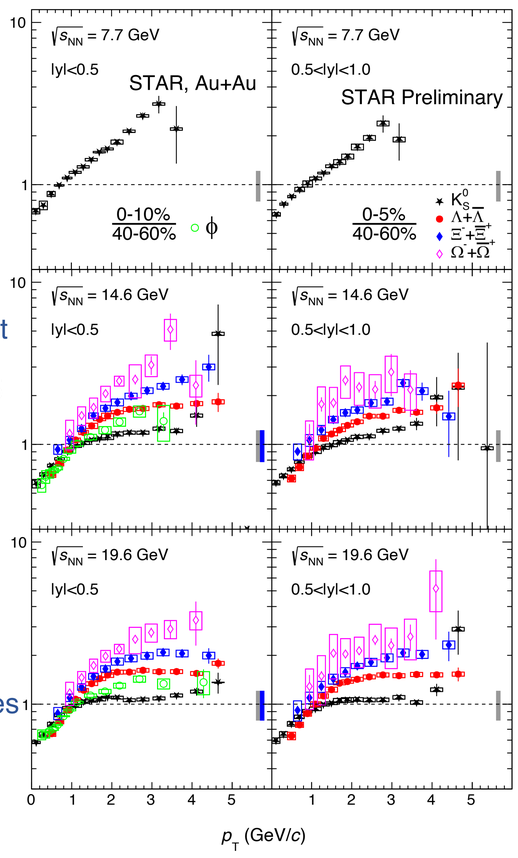
- Precise strangeness measurements with extended p_{T} and rapidity
- Rapidity spectra of mesons (K_S^0) are Gaussian-like distributions
- The dN/dy yield at forward rapidity and backward rapidity are consistent within error



Nuclear modification factor

$$R_{\mathrm{CP}} = \frac{[(dN/dp_T)/\langle N_{\mathrm{coll}}\rangle]_{\mathrm{central}}}{[(dN/dp_T)/\langle N_{\mathrm{coll}}\rangle]_{\mathrm{peripheral}}}$$

- R_{CP} of K_S^0 increases with decreasing collision energies at p_{T} > 2 GeV/c:
  - ✓ Partonic energy loss effect is less important
  - ✓ Cold nuclear matter effects are more important
- R_{CP} tends to be flat and larger than unity at p_{T} > 2 GeV/c:
  - ✓ Quark coalescence
  - ✓ Radial flow
- Stronger enhancement for Ω compared to Ξ, Λ and K_S^0:
  - ✓ A proposed signature for QGP formation: stronger enhancement for multi-strange particles
- R_{CP} shows minor rapidity dependence



Summary

- Precise strangeness measurements with extended p_{T} and rapidity at $\sqrt{s_{NN}}$ = 7.7, 14.6 and 19.6 GeV
- Rapidity spectra of mesons (K_S^0) are Gaussian-like distributions
- Nuclear modification factor indicates the strangeness enhancement at $\sqrt{s_{NN}}$ = 14.6 and 19.6 GeV, consistent with QGP formation

Outlook

- Strangeness measurements from 3.2 to 14.6 GeV in BES-II are on-going

Supported in part by the U.S. DEPARTMENT OF ENERGY | Office of Science

Strangeness in Quark Matter
3-7 June 2024, Strasbourg, France

Tsinghua University

The STAR Collaboration
https://drupal.star.bnl.gov/STAR/presentations