Strangeness production in Au+Au collisions at $\sqrt{s_{NN}}$ = 14.6, 19.6, 200 GeV with STAR

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Abstract

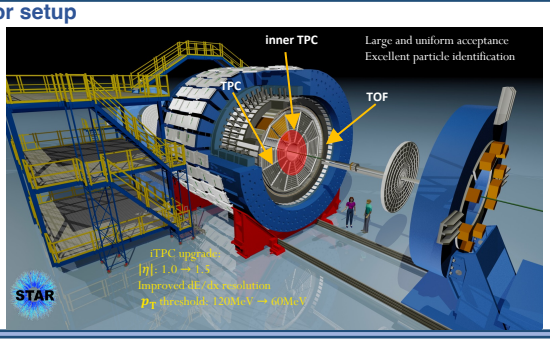
Strangeness production has been suggested as a sensitive probe to the early dynamics of the deconfined matter created in heavy-ion collisions. Benefiting from the iTPC upgrade, the strangeness measurements are now extended from mid-rapidity ($|y| < 0.5$, BES-I) to a larger rapidity range ($|y| < 1.0$, BES-II), which may help us understand the baryon stopping mechanism.

In this poster, we report new measurements of strange hadron (K_s^0, Λ, $\overline{\Lambda}$, Ξ, $\overline{\Xi}$, ϕ) production in Au+Au collisions at $\sqrt{s_{NN}}$ = 14.6 and 19.6 GeV from STAR BES-II and $\Omega(\overline{\Omega})$ production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV, including rapidity spectra, nuclear modification factors R_{CP} and the multi-strange baryon-to-meson ratio $\Omega(sss)/\phi(s\bar{s})$.

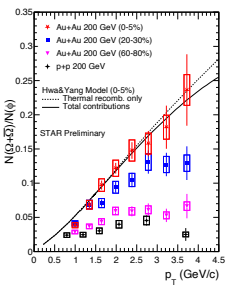
Motivation

- Strangeness production is suggested as a sensitive probe to the early dynamics of the medium created.
- Strange baryon-to-meson ratio can be utilized to understand hadronization mechanism.
- Rapidity density of (anti-)strange baryons may give insight on the baryon stopping mechanism.
- $R_{CP}\left(\frac{[(dN/dp_T)/<N_{coll}>]_{central}}{[(dN/dp_T)/<N_{coll}>]_{peripheral}}\right)$: Study the nuclear medium effects in the reaction process.

Detector setup



$\Omega(sss)/\phi(s\bar{s})$ ratio at $\sqrt{s_{NN}}$ = 200 GeV

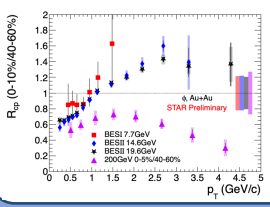


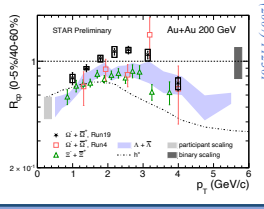
- In central collisions, good agreement between data and recombination model calculations.
- ✓ Mainly produced through quark recombination.
- ✓ Significant Ω enhancement over ϕ is observed.
- At intermediate p_T, ratio increases gradually with increasing system size.

Au+Au 200 GeV ϕ: STAR, Phys. Rev. Lett. 99(2007) 112301
p+p 200GeV ϕ: STAR, Phys. Rev. C 79(2009) 064903
Theory: Phys. Rev. C, 2007, 75: 054904

Nuclear modification factor (R_{CP})

- ➢ Energy dependence of R_{CP} for ϕ.
- $R_{CP} < 1$ for higher p_T at $\sqrt{s_{NN}}$ = 200 GeV → Partonic energy loss in the QGP medium.
- $R_{CP} > 1$ for higher p_T at $\sqrt{s_{NN}}$ = 19.6 GeV and lower energies → Cronin-type interactions, radial flow and/or coalescence hadronization.
- ➢ R_{CP} of strange hadrons at $\sqrt{s_{NN}}$ = 200 GeV.
- R_{CP} of Ω follows the same trend in p_T as that of Λ and Ξ, as expected from recombination model.
- The higher R_{CP} of Ω implies the faster increase of Ω yields with the increasing centrality.



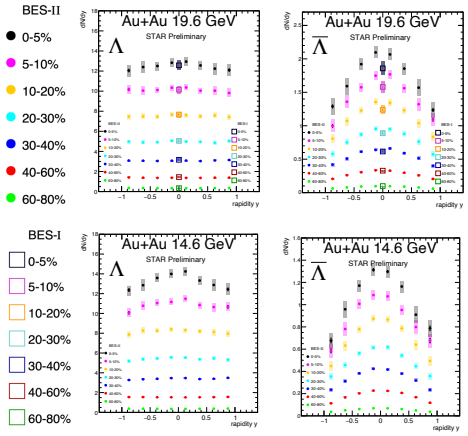


Ω + Ω Run4 & Ξ + Ξ : STAR, Phys. Rev. Lett. 98 (2007) 062301
Λ + Λ : STAR, Phys. Rev. Lett. 92 (2004) 052302
h±(charged hadrons): STAR, Phys. Rev. Lett. 91 (2003) 172302
φ 200 GeV: Phys. Rev. Lett. 99 (2007) 112301

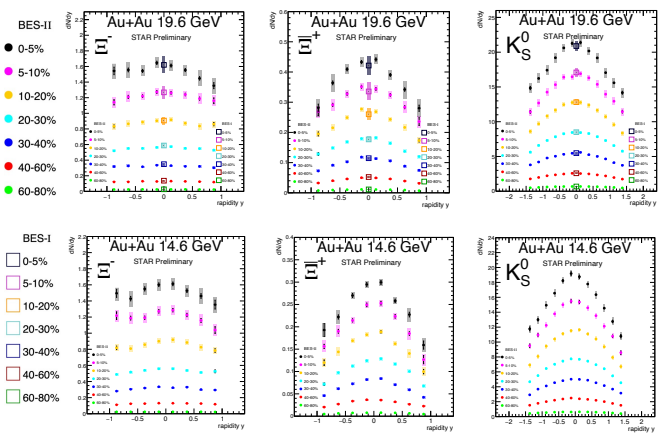
Rapidity spectra of $\Lambda(\overline{\Lambda})$ at $\sqrt{s_{NN}}$ = 19.6 and 14.6 GeV

- $\overline{\Lambda}$ shows Gaussian-like distribution.
- Λ yields are higher than $\overline{\Lambda}$ but with much broader rapidity distributions.
- ✓ Extra contributions from stopped baryons.
- Similar trends observed by NA49.

NA49, PRC 78, 034918 (2008)



Rapidity spectra of K_s^0, Ξ, and $\overline{\Xi}$ at $\sqrt{s_{NN}}$ = 19.6 and 14.6 GeV.



- K_s^0 and $\overline{\Xi}$ show Gaussian-like distributions.
- Ξ yields are higher than $\overline{\Xi}$ but with much broader rapidity distributions.

Summary

- Ω measurements at $\sqrt{s_{NN}}$ = 200 GeV indicates a smooth trend in strangeness enhancement from small to large systems.
- Nuclear modification factor (R_{CP}) shows possible nuclear medium effect in the reaction process.
- Baryons have higher yields and wider rapidity distributions than their anti-baryons at $\sqrt{s_{NN}}$ = 14.6 and 19.6 GeV → extra contributions from stopped baryons.

Outlook

- Strangeness measurements from 3.2 to 14.6 GeV in BES-II will probe the onset of deconfinement.

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

Tsinghua University

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