Strangeness Production in Fixed-Target Au+Au collisions at $\sqrt{s_{NN}}$ = 7.2 GeV from STAR

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Abstract

Strangeness production is considered a sensitive probe to the properties of the medium created in heavy-ion collisions. The RHIC Beam Energy Scan Program (BES) is designed to investigate the QCD phase diagram and search for a potential QCD critical point. The BES-II program covers a wide energy range from $\sqrt{s_{NN}}$ =3 to 54.4 GeV. Of particular interest is the high baryon density region which can be explored through production of strange hadrons (K^0_s, Λ) at lower energies from the fixed target program. Such studies can also help understand their production mechanism in high baryon density medium. In this poster, we will report measurements of strange particle (K^0_s, Λ) production in Au+Au collisions at $\sqrt{s_{NN}}$= 7.2 GeV. The data were taken in 2018 by the STAR experiment with the fixed target configuration. Analysis status of the K^0_s and Λ measurements in this dataset will be discussed.

Motivation

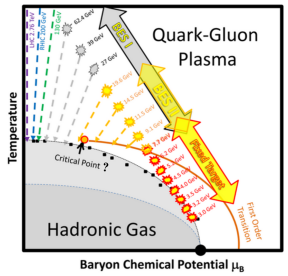
The Fixed-Target Program expands the range of the RHIC Beam Energy Scan (BES) to higher values of μ_B (baryon chemical potential).

- **Search for disappearance of QGP signatures.**
- **Search for evidence of a first order phase transition.[1]**
- **Search for critical point.**

Why Fixed-Target program?

- STAR Fixed-Target Program extends the collision energy range in BES II to lower energies than what is feasible at RHIC with colliding beams.
- Data from $\sqrt{s_{NN}}$ < 7 GeV could help determine evidences of phase transitions or criticality at lower energies.

B. Kimelman, Quark Matter (2022)



Strange hadrons (K^0_s, Λ) are excellent probe for identifying the phase boundary and the onset of deconfinement.[2]

Particle Reconstruction

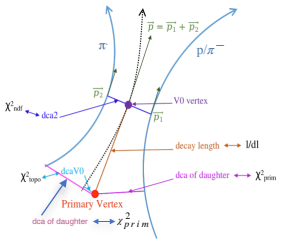
KFParticle: Reconstruction package for short-lived particles.

$K^0_s \rightarrow \pi^- \pi^+$
BR:(69.05 ± 0.05) %
cτ = 2.68 cm

$\Lambda \rightarrow p\,\pi^-$
BR:(64.1 ± 0.05) %
cτ = 7.89 cm

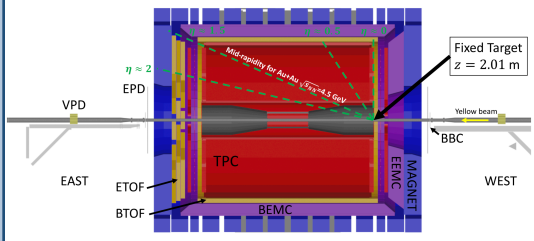
Cuts Applied

- χ^2_{prim} > 10 (daughter A)
- χ^2_{prim} > 10 (daughter B)
- χ^2_{topo} < 5
- χ^2_{ndf} < 5
- l/dl > 5



https://drupal.star.bnl.gov/STAR/book/export/html/39875

Overview of The STAR Detector



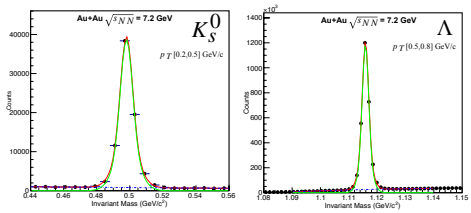
Gold Target

- 250 μm foil.
- 2 cm below the nominal beam axis.
- 2 m from centre of STAR.

The main objective of the STAR detector is to study the formation and characteristics of quark gluon plasma (QGP)

D. Cebra, annual APS meet, virtual

Invariant Mass Distributions



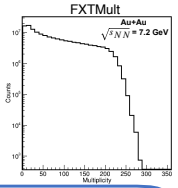
$$a_0 + a_1 m^1 + a_2 m^2 + \frac{Y_1}{\sqrt{2\pi}\,\sigma_1} \exp \frac{(-(m-m_0)^2)}{2\sigma_1^2} + \frac{Y_2}{\sqrt{2\pi}\,\sigma_2} \exp \frac{(-(m-m_0)^2)}{2\sigma_2^2}$$

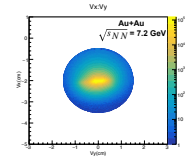
- Red line : Double gaussian + 2^{nd}order polynomial (signal+background)
- Blue line : 2^{nd} order polynomial (background)
- Green line : double gaussian (signal)

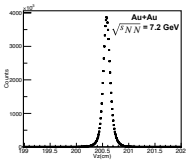
Data Set and Event Selection

Data set

- Au+Au @ $\sqrt{s_{NN}}$ = 7.2Gev
- Events Analysed ~ 148 million
- Particles Studied: K^0_s , Λ







Event Cuts

- 198 < V_Z < 202 cm
- V_r < 2 cm

Track Cuts

- nHits > 15
- nHitsFit/nHitsPoss > 0.52

Summary and Outlook

- **Presented invariant mass distributions for strange particles (K^0_S, Λ).**
- **Efficiency study is ongoing.**
- **Working on corrected spectra to obtain dN/dy, $\langle p_T \rangle$ and nuclear modification factor.**

References:

[1] Adamczyk L et al. 2014 Phys. Rev. Lett. 112 162301

[2] STAR, J. Adam et al. 2020 Phys. Rev. C 102 034909

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