Strange baryon production in Au+Au collisions at $\sqrt{s_{NN}} = 19.6$ GeV from STAR

Sameer Aslam (for the STAR Collaboration)[1*]

[1]Department of Physics, Indian Institute Of Technology Patna
[*]1821ph11@iitp.ac.in

July 21, 2023

Abstract

At very high temperatures and nearly zero baryon densities, experiments are concentrated on the study of the properties of the deconfined QCD matter. At moderate temperatures and high baryon densities, investigations are focused on the search for structures in the QCD phase diagram such as the critical end point, the predicted first order phase transition between hadronic and partonic matter and the chiral phase transition. Strangeness production has been suggested as a sensitive probe to the early dynamics of the deconfined matter created in heavy-ion collisions. The data taken during 2010 and 2011 in Beam Energy Scan (BES) phase-I indicated potential changes in the medium properties for $\sqrt{s_{NN}} \leq 19.6$ GeV. However, no definite conclusions can be drawn due to the limited precision of those data. Since 2018, STAR has conducted the BES phase-II program and accumulated high statistics Au+Au collision data at various energies ($\sqrt{s_{NN}}$) below 27 GeV. The production of Λ from Au+Au collisions at $\sqrt{s_{NN}} = 19.6$ GeV will be presented in this talk. The P_T spectra, nuclear modification factors, and particle ratios will also be reported.

1 Introduction

The early production of strange baryons such as $\Lambda(\overline{\Lambda})$ in heavy-ion collisions provides valuable insight into the properties of the medium created in these collisions [1]. Measurements from the RHIC Beam Energy Scan (BES) program phase-I have already shown hints for increasing dominance of hadronic interactions and the turn-off of the signatures of quark-gluon plasma at low energies [2]. The BES-II program, with high statistics samples and detector upgrades, allows us to improve the measurements in the energy range of $\sqrt{s_{NN}} \leq 27$ GeV. In particular, the upgrade of the inner sectors of the Time Projection Chamber (iTPC) [3] provides a wider rapidity coverage, lower transverse momentum (p_T) cutoff, and better momentum and the ionization energy loss (dE/dx) resolution. The improved acceptance of the iTPC at low p_T and the enhanced tracking efficiency are of particular interest for the reconstruction of strange and multi-strange baryons. The lower p_T cutoff will allow the reduction of systematic uncertainties arising from extrapolation.

2 Discussion

To study the tracking efficiency, embedding data are used in the STAR experiment where simulated particles are embedded into real events and passed through the STAR detector environment simulated by the GEANT package [4]. The acceptance and reconstruction efficiency of Λ and $\overline{\Lambda}$ are calculated by diving the number of reconstructed Monte Carlo (MC) $\Lambda(\overline{\Lambda})$ by that of input MC ones. Figure 1 shows the acceptance $\times$ reconstruction efficiencies of Λ and $\overline{\Lambda}$ plotted against p_T (in GeV/c) in the most central (0-5%) Au+Au collisions at mid-rapidity ($|y| < 0.5$). The iTPC upgrade significantly improves the reconstruction efficiency towards the low p_T region.

3 Conclusion

The total detection efficiencies of Λ and $\overline{\Lambda}$ at mid-rapidity ($|y| < 0.5$) in Au+Au collisions at $\sqrt{s_{NN}} = 19.6$ GeV (BES-II) are presented. Thanks to the iTPC, the total detection efficiencies of Λ and $\overline{\Lambda}$ increases by a significant amount towards the low p_T region in comparision to the previous BES-I analysis.

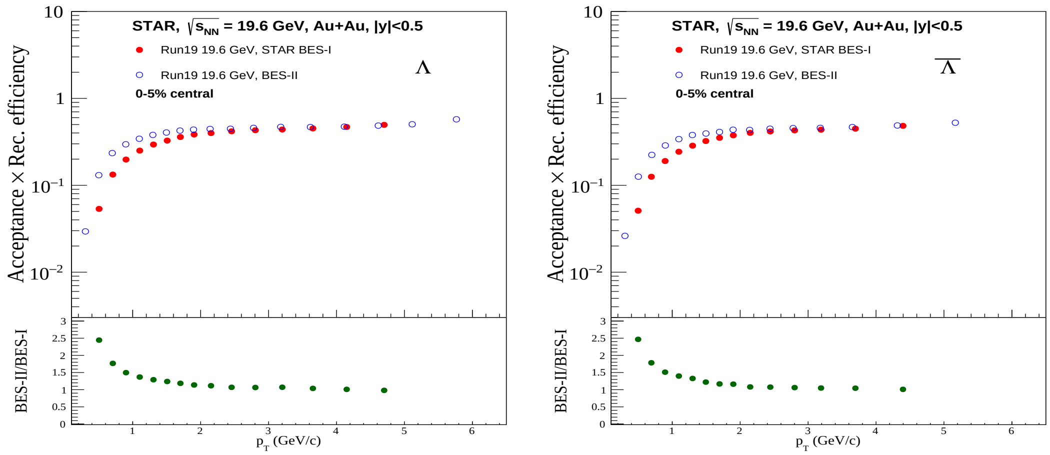

Figure 1: The acceptance × reconstruction efficiencies of Λ (left panel) and $\overline{\Lambda}$ (right panel) at mid-rapidity ($|y| < 0.5$) in 0-5% most central Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6 GeV. The open circles in both panels represent acceptance × reconstruction efficiencies of $\Lambda(\overline{\Lambda})$ from BES-II analysis and the solid red circles represent the acceptance × reconstruction efficiencies of $\Lambda(\overline{\Lambda})$ from BES-I analysis [2]. The selection cuts in BES-I and BES-II are the same.

References

[1] Rafelski et al. Phys. Rev. Lett., American Physical Society, 1982, 48, 1066-1069

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

[3] STAR Collaboration, Technical Design Report for the iTPC Upgrade STAR Note, 2015, 644

[4] V. Fine and P. Nevski, Proc. CHEP 2000, 143 (2000)