High-p_T Strange Particle Spectra and Correlations in STAR

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Abstract

We present results on strange particle production in p+p, d+Au and Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. We discuss the nuclear modification factors (R_{CP}) and ratios of particle yields in order to investigate the range of anomalous baryon production. The medium modification of the fragmentation process is further explored by studying azimuthal correlations at intermediate-p_T for K^0_S, Λ and $\bar{\Lambda}$ trigger particles. The results are compared to fragmentation and recombination models.

The observed suppression of inclusive p_T spectra of identified particles in central Au+Au collisions with respect to p+p (R_{AA}) and peripheral Au+Au collisions (R_{CP}) [1,2], together with enhanced *baryon/meson* ratios [3], show that in the intermediate-p_T range of 2-6 GeV/c, baryons and mesons behave differently than in p+p collisions. This indicates that jet fragmentation is not a dominant source of particle production and parton recombination and coalescence models have been suggested as alternative mechanisms [4,5,6,7]. In addition, studies of two-particle correlations of charged particles in Au+Au revealed the presence of additional long-range pseudo-rapidity correlations on the near-side (commonly referred to as the *ridge*) [8]. These are absent in p+p and d+Au collisions.

The wealth of data collected by the STAR experiment in p+p, d+Au and Au+Au collisions at $\sqrt{s_{NN}}$ =200 GeV allows a detailed study of strangeness production up to high p_T. In this paper, we discuss the behaviour of strange baryon/meson ratios and identified particle R_{CP} in order to investigate the range of the baryon anomaly. We further explore the medium modification of the fragmentation process by studying two particle azimuthal correlations at intermediate-p_T using strange trigger particles (K^0_S, Λ, $\bar{\Lambda}$) associated with unidentified charged particles.

Figure 1(a) shows the Λ/K^0_S ratio for various centralities in Au+Au collisions. The high statistics Year 4 data significantly increase the reach in p_T and we

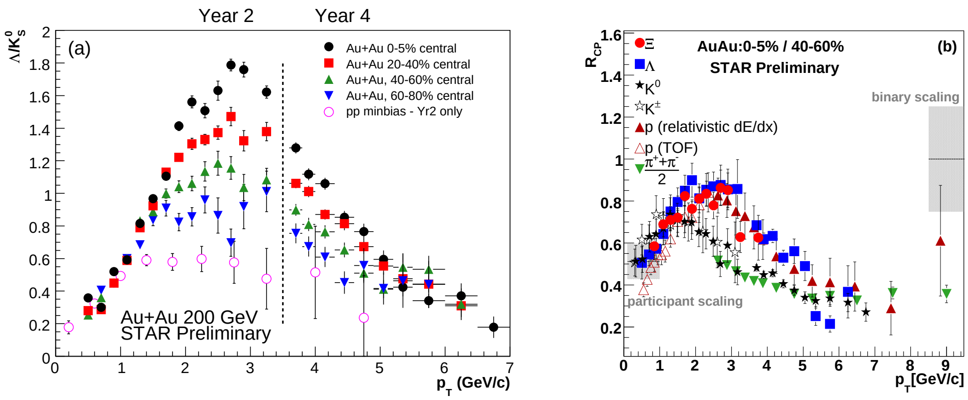

Fig. 1. (a) Λ/K^0_S ratio as a function of p_T in p+p and for different centralitites in Au+Au collisions. (b) R_{CP} of strange and non-strange particles in Au+Au collisions.

observe that by $p_T = 6$ GeV/c, the ratio becomes similar for all centralities and is consistent with that in p+p. Similarly, the R_{CP} of identified particles (Fig. 1(b)), demonstrates that in the intermediate-p_T region mesons have smaller R_{CP} than baryons, but above $p_T = 6$ GeV/c, they both show the same suppression. Recombination/coalescence models predict a turn-over in the Λ/K^0_S ratio, however its exact position and shape of the distribution are not reproduced well [4,5,6,7]. The model combining soft particle production at low p_T with a leading order pQCD at high p_T incorporating gluonic baryon junctions and GLV formalism [9] predicts the turn-over in the ratio as well, but also fails to describe its position and shape in detail [10].

In the following paragraphs we discuss properties of the near-side azimuthal correlations using identified strange trigger particles (Λ, $\bar{\Lambda}$, and K^0_S) associated with charged particles. The azimuthal distributions, normalized to the number of trigger particles, are corrected for the reconstruction efficiency of associated particles and elliptic flow. The near-side yield of associated particles is calculated as the area under the Gaussian peak obtained from the fit. We study separately the jet and ridge contributions to the near-side yield by analyzing the correlations in two $\Delta\eta$ windows: $\Delta\eta < 0.5$ containing both jet and ridge contributions, and $\Delta\eta > 0.5$ containing the ridge-like correlations.

Comparing d+Au and Au+Au collisions, we observe an increase of the near-side yields by a factor of 3-4 going from d+Au to central Au+Au collisions. While the jet yield is independent of centrality, the ridge yield is responsible for the strong increase of the total near-side yield (not shown here, see [11]). No significant baryon/meson or particle/anti-particle differences are observed.
Next, we study the dependence of the near-side yield on the transverse momentum of the trigger particle, $p_T^{trigger}$, shown in Figure 2. While the ridge yield increases with $p_T^{trigger}$ and flattens off for $p_T^{trigger} > 3.0$ GeV/c, the jet yield keeps increasing with $p_T^{trigger}$. The jet yield for Λ triggers is systematically below that of charged and K^0_S triggers. Two effects could possibly explain

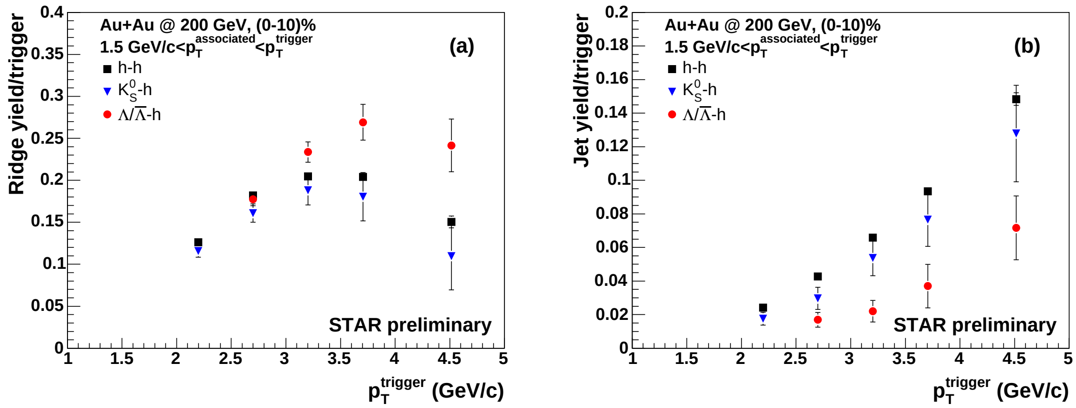

Fig. 2. Dependence of the ridge yield (a) and jet yield (b) on $p_T^{trigger}$ for various trigger species in central (0-10%) Au+Au collisions.

this difference: (1) the heavier baryon takes away more energy than the meson and thus less energy is available for the associated particle production, (2) an artificial track merging affects more Λ than K_S^0 and charged particles resulting in a lower associated yield. Both effects are currently under investigation.

Fig. 3(a) shows the invariant p_T distribution of associated charged particles on the near side in central Au+Au collisions for $p_T^{trigger}$ = 3-6 GeV/c. We have fit the data with an exponential function $Ae^{-p_T/T}$ and extracted the inverse slope T. The jet spectrum has $T \sim 520$ MeV and is on average 80 MeV harder than the jet+ridge spectrum with $T \sim 440$ MeV. In order to make a comparison with the parton recombination model [12], we have calculated a central-to-peripheral ratio of the near-side yields in Au+Au as shown in

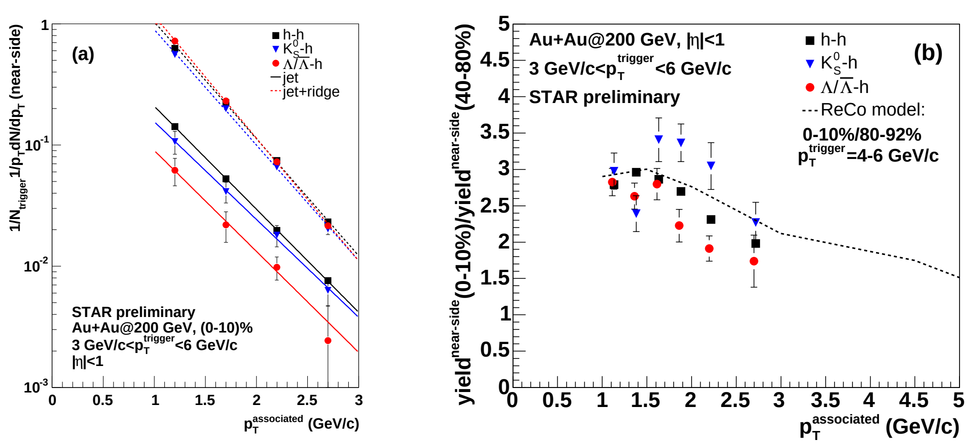

Fig. 3. (a) Invariant p_T distribution of associated charged particles on the near side in central Au+Au collisions. (b) The central-to-peripheral ratio of the near-side yield in Au+Au collisions as a function of $p_T^{associated}$. The dashed line is from [12].

Figure 3(b). The ratio is about 3 at $p_T^{associated} = 1$ GeV/c and decreases with $p_T^{associated}$. Although the calculation has been done for charged pions, our results qualitatively agree with the model and point toward a significant role of thermal-shower recombination in central Au+Au collisions. To draw any quantitative conlusions, the calculation should be done for the same centrality, $p_T^{trigger}$ selection and reproduce properties of the $\Delta\eta$ correlations.

In summary, we have reported recent results on strangeness production at intermediate-p_T at RHIC. The strange baryon/meson ratios and identified particle R_{CP} show that the anomalous baryon production is limited to p_T =2-6 GeV/c and above $p_T > 6$ GeV/c both baryons and mesons behave similarly. Two-particle correlations with identified strange trigger particles reveal a strong contribution from the long-range pseudo-rapidity correlations at near-side. Ongoing studies using identified associated particles will help to constrain the origin of these correlations. The central-to-peripheral ratio of the near-side yields and its decrease with $p_T^{associated}$ is in a qualitative agreement with the recombination model. The crucial test of this model will be correlations with multiply-strange trigger particles (Ξ, Ω) which are under investigation.

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