High-p<sub>T</sub> azimuthal correlations of neutral strange baryons and mesons in STAR at RHIC

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Abstract. We present results on two-particle azimuthal correlations of high-p<sub>T</sub> neutral strange baryons (Λ, ¯Λ) and mesons (K<sub>0</sub><sup>S</sup>) associated with non-identified charged particles in d+Au and Au+Au collisions at √s<sub>NN</sub> = 200 GeV. In particular, we discuss properties of the near-side yield of associated charged particles as a function of centrality, transverse momentum and z<sub>T</sub>, as well as possible baryon/meson and particle/antiparticle differences. The results are compared to the proton and pion triggered correlations and to fragmentation and recombination models.

Keywords: identified correlations, high-p<sub>T</sub> processes, neutral strange baryons and mesons
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INTRODUCTION

Partonic energy loss is predicted to be a sensitive probe of the matter created in high energy heavy-ion collisions because its magnitude depends strongly on the color charge density of the medium traversed. Partons originating from hard scattering of quarks or gluons from the colliding nuclei fragment into jets. As a direct measurement of jets in nuclear collisions is difficult due to the high multiplicities of emitted particles, azimuthal correlations of particles with large transverse momentum (p<sub>T</sub>) are commonly used to study jet related processes. Identified two-particle correlations are expected to provide additional information on jet quenching, as well as the baryon-meson puzzle and particle production mechanisms at RHIC energies. In this paper, we discuss properties of the near-side associated yield of charged particles for identified strange baryon (Λ, ¯Λ) and meson (K<sub>0</sub><sup>S</sup>) trigger particles.

DATA ANALYSIS

The analysis presented in this paper is based on d+Au and Au+Au collisions at √s<sub>NN</sub> = 200 GeV, measured by the STAR experiment. STAR is a multi-purpose spectrometer comprised of several detectors inside a large solenoidal magnet with a magnetic field of 0.5 T. In this analysis, we use both charged particle tracks measured by the Time Projection Chamber (TPC) with full azimuthal coverage, together with Λ, ¯Λ and K<sub>0</sub><sup>S</sup> particles reconstructed by a topological analysis from their decay products.

In the azimuthal correlations presented here, we distinguish several trigger particle species (charged particles, Λ, ¯Λ, and K<sub>0</sub><sup>S</sup>) while the associated particles are always charged particles with p<sub>T</sub> = (1–2) GeV/c. The measured azimuthal distributions are normalized to the number of trigger particles and corrected for the reconstruction efficiency.
FIGURE 1. Near-side associated charged particle yield as a function of the transverse momentum of the trigger particle, $p_T^{\text{trigger}}$, in d+Au (a) and central Au+Au collisions (b) at $\sqrt{s_{NN}} = 200$ GeV. The data points for baryons are offset by 50 MeV/c for a better view.

of associated charged particles which, in the $p_T$ range studied, varies from 70-84% depending on centrality. The data are fit with two Gaussians on top of a flat background in d+Au and elliptic flow modulated background in Au+Au collisions, respectively. The yield of associated particles is calculated as the area under the Gaussian peak. The uncertainties in the elliptic flow subtraction result in about a 30% systematic error on the extracted associated yield.

RESULTS

Fig. 1 shows the near-side associated yield of charged particles with $p_T = (1–2)$ GeV/c as a function of the transverse momentum of the trigger particle, $p_T^{\text{trigger}}$. The near-side yield in central Au+Au collisions is about 3-4 times larger than in d+Au collisions, independent of trigger species and $p_T^{\text{trigger}}$. To look for possible baryon/meson differences, we have included in Fig. 1 the results for $\pi^+\pi^-$ (95% purity) and $p+\bar{p}$ (50% purity) trigger particles which are identified by the relativistic rise of ionization energy loss in the TPC [1]. Although the near-side yield does not show any significant difference between trigger particle species in either collision system, there is a hint of a trend of a baryon/meson splitting in Au+Au collisions which is not apparent in the d+Au data.

Next, we discuss the centrality dependence of the near-side associated yield. In order to make a comparison with a parton recombination model [2], we have calculated the ratio of the near-side yield in central (0-10%) to peripheral (40-80%) Au+Au collisions for $p_T^{\text{trigger}} = 3–6$ GeV/c. The ratio decreases from about 3 at $p_T^{\text{associated}} = 1$ GeV/c to 2 at $p_T^{\text{associated}} = 3$ GeV/c (cf. Fig. 2a). This behavior, as well as the large magnitude of the ratio, is in line with the model expectations and points toward a significant role of thermal-shower recombination in Au+Au collisions [2]. However, as long range pseudo-rapidity correlations play a significant role in Au+Au collisions for $p_T < 3$ GeV/c [3] and they are not included in the model, this agreement is only qualitative. Again, there
FIGURE 2. The ratio of near-side associated charged particle yield in central (0-10%) and peripheral (40-80%) Au+Au collisions as a function of $p_T^{\text{associated}}$ (a). $z_T$ dependence of near-side charged particle associated yield in central Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. The data points for baryons are offseted by 50 MeV/$c$ for a better view (b).

is a hint of a trend of a baryon/meson splitting although the errors are quite large.

The near-side associated yield can be connected to fragmentation. It was proposed to study charged hadron-triggered fragmentation functions expressed in terms of the variable $z_T = \frac{p_T^{\text{associated}}}{p_T^{\text{trigger}}}$, an approximation of the commonly used variable $z = \frac{p_T}{p_T^{\text{parton}}}$. Here, we go one step further and present identified hadron-triggered fragmentation functions. Fig. 2(b) shows the fragmentation functions for $p_T^{\text{trigger}} = 3 - 6$ GeV/$c$ in central Au+Au collisions. In the $p_T$ range studied, the spectral shape is similar for various trigger particle species within the statistical errors.

CONCLUSIONS

We have reported results on near-side associated yield of charged particles for charged hadron and neutral strange baryon/meson trigger particles. There is a large increase of the near-side yield from d+Au towards central Au+Au collisions where thermal-shower recombination dominates. However, in the $p_T$ range studied we do not observe any appreciable baryon/meson or particle/antiparticle differences in either collision system, although there is a hint of a trend of baryon/meson difference in Au+Au collisions. Ongoing studies with larger statistics will allow access to a higher $p_T$ range which, in combination with a study of long range pseudo-rapidity correlations for strange trigger particles, will bring new insights into this problem.

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