Identified charged particle spectra in $p+p$ collisions at $\sqrt{s}$ = 62.4 GeV at RHIC

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Introduction

The comparison of transverse momentum spectra of the charged particles in $p+p$ collisions with those in heavy-ion collisions offers the opportunity to investigate the properties of the high-density color-deconfined state of strongly interacting matter known as Quark Gluon Plasma (QGP), which is expected to be formed in high-energy collisions of heavy nuclei. While the $A+A$ collisions probe the material science of nuclear matter, the $p+p$ collisions more directly probe the hadronization. It is important to study the bulk production of particles as a function of both p_T and particle species. The low-p_T particle production, and species composition provide crucial input for modeling of hadronic interactions and the hadronization process in high-energy collisions [1].

Experiment and Analysis

The data presented here is from $\sim$ 2 million minimum-bias triggered $p+p$ collisions at $\sqrt{s}$ = 62.4 GeV taken with the STAR (Solenoidal Tracker At RHIC) detector at Relativistic Heavy Ion Collider (RHIC) in the year 2006. The Time Projection Chamber (TPC) detector was used for tracking and identification of charged particles. Particle identification in the TPC is based on the specific ionization energy loss of charged particles in the TPC's gas volume. Figure 1 shows the ionization energy loss (dE/dx) of charged particle tracks as a function of momentum measured by the TPC at midrapidity ($\mid y \mid$ <0.3). Figure 2 shows the $n\sigma_i$ distribution of K^+, where the

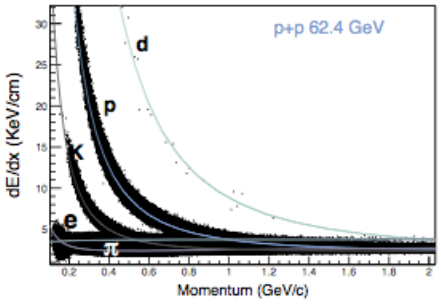

FIG. 1: Particle identification by ionization energy loss in STAR's Time Projection Chamber. Different curves shown in the plot corresponds to the theoretical values of dE/dx for the corresponding particles.

expected value of $n\sigma_i$ variable is around zero. The variable $n\sigma_i$ can be defined as:

$$n\sigma_i = \frac{1}{\sigma} ln \left(\frac{< dE/dx >}{< dE/dx >_i^{BB}} \right) \qquad (1)$$

where σ is the $< dE/dx >$ resolution of the TPC, which is a function of track length in the TPC [2] and $< dE/dx >_i^{BB}$ is the Bethe-Bloch expectation of $< dE/dx >$ for the given particle type i (i = π, K, p) [3, 4].

To extract the raw particle yield of a given particle type, the $n\sigma_i$ distribution are simultaneously fitted with multiple Gaussian functions, as shown in the Fig. 2.

Results and Summary

In this contribution, we will present measurements of transverse momentum spectra for $\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$ in $p+p$ collisions at $\sqrt{s}$ = 62.4 GeV from the STAR experiment at the RHIC. The results are measured at

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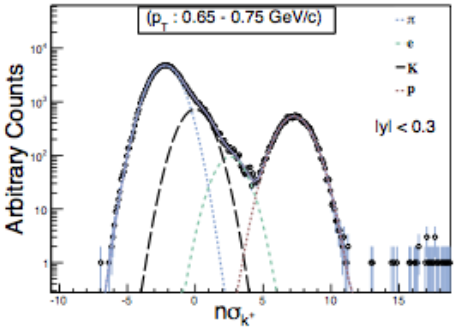

FIG. 2: The $n\sigma_{K^+}$ distribution for the minimum-bias $p + p$ collisions at 62.4 GeV. The plot is shown for the p_T bin 0.65 - 0.75 GeV/c. Errors shown are statistical only. The curves represent the Gaussian fits to $n\sigma_{K^+}$ distribution, with individual peaks plotted separately.

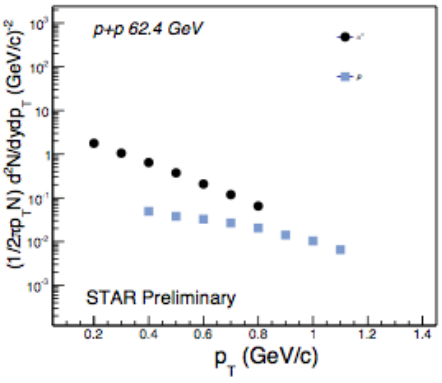

FIG. 3: Transverse Momentum distribution of π^+ and p at midrapidity region. The errors involved are only statistical and their sizes are smaller than the sizes of the symbols used.

midrapidity in the range $\mid y \mid < 0.3$. The uncertainties shown in all the results are only statistical. The raw yield obtained by using $n\sigma_i$ method for the charged hadrons is measured at the low momentum region (0.15 to 1.15 GeV/c). The results presented in this contribution corresponds to efficiency and energy-loss corrections obtained from multi-

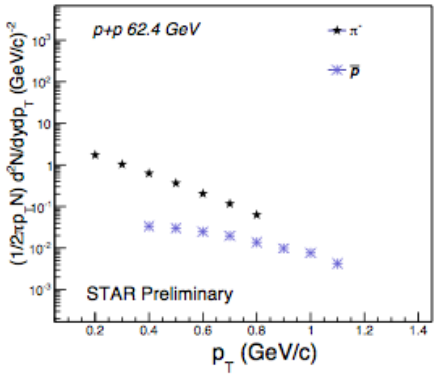

FIG. 4: Transverse Momentum distribution of π^- and $\bar{p}$ at midrapidity region. The errors involved are only statistical and their sizes are smaller than the sizes of the symbols used.

step embedding Monte Carlo technique for pions, kaons, protons and anti protons. In addition to this, the raw proton yield will be corrected for background contamination arising mainly from the interaction of produced hadrons with the beam pipe and the detector material, which is estimated from the global DCA (Distance of Closest Approach) distribution of protons. The feed-down as well as background corrections for the pions are not included in this study.

Figure 3 shows the efficiency and energy-loss corrected transverse momentum spectra for π^+ along with the p spectra which has the background correction implemented in addition to efficiency and energy-loss corrections, where as the Fig. 4 shows the efficiency and energy-loss corrected transverse momentum spectra for π^- and $\bar{p}$.

References

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