Strange meson measurement in Cu+Cu system at $\sqrt{s_{NN}}$ = 200 GeV in PHENIX

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Introduction

The mesons containing strange quarks are one of the most interesting probes of hot and dense matter produced in heavy ion collisions. In central nucleus-nucleus collisions, the yield of high p_T hadrons (which come from jets) is suppressed in comparison to that in $p+p$ collisions scaled with the number of binary collisions $N_{\rm coll}$ [1]. The suppression is due to energy loss of high energy partons produced in initial hard scattering processes as they traverse the plasma and these data are crucial for a quantitative understanding of the energy loss mechanism [2]. At intermediate p_T ($2 < p_T$ (GeV/c) < 5), mesons containing light quarks (π, η, ω) exhibit the largest suppression, whereas baryons show very little, or no suppression [3]. Other processes, such as strong radial flow [4] recombination effects [5] are invoked to explain the differences between mesons and baryons in intermediate p_T range.

Measurements of other particles containing heavier quarks provide additional constraints to the models of parton energy loss and recombination. Experimental measurements are important to find out if strange particles are suppressed at high p_T similarly to light mesons and if flow or recombination mechanisms boost strange hadron production at intermediate p_T.

This paper presents PHENIX results on the measurements of nuclear modification factors of K^0_S and K^{*0} mesons in Cu+Cu collisions at $\sqrt{s_{NN}} = 200\,\text{GeV}$ as a function of p_T and centrality and are compared with those of ϕ and π^0.

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PHENIX Detector

A detailed description of the PHENIX detector can be found elsewhere [6]. The analysis was performed using the two central arm spectrometers of PHENIX, each covering $\Delta\phi = \pi/2$ in azimuth at mid-rapidity $|\eta| < 0.35$. The central arm spectrometer consists of the Drift Chambers (DC), three layers of Pad Chambers (PC), Ring Imaging Čerenkov (RICH), Time of Flight (TOF) and Electro-Magnetic Calorimeter (EMCal). The global event information is provided by the Beam Beam Counters (BBC), which are used for event triggering, collision time determination and to measure the vertex position along the beam axis. The Drift Chamber and first layer of Pad Chambers (PC1) form the inner tracking system, whereas PC2 and PC3 form outer tracker. The Time Of Flight (TOF) is a dedicated detector to identify the charged hadrons; pions, kaons and protons. The EMCal uses lead-scintillator (PbSc) and lead-glass (PbGl) technology, measures the position and energy of electrons and photons. It also provides a trigger on rare events with high momentum photons. It was used for data taking for K^0_S analysis.

Results and Discussions

The K^0_S and K^{*0} mesons are reconstructed via $K^0_S \to \pi^0(\to \gamma\gamma)\pi^0(\to \gamma\gamma)$ and $K^{*0} \to K^{\pm}\pi^{\mp}$ modes using different analysis techniques.

Medium effects are quantified by the nuclear modification factor, which is defined as

$$R_{\rm CuCu} = \frac{d^2N_{\rm CuCu}/dydp_T}{N_{\rm coll}/\sigma^{inel}_{pp} \times d^2\sigma_{pp}/dydp_T}, \quad (1)$$

where $d^2N_{CuCu}/dydp_T$ is the yield of particles in Cu+Cu collision system, $N_{\rm coll}$ is the num-

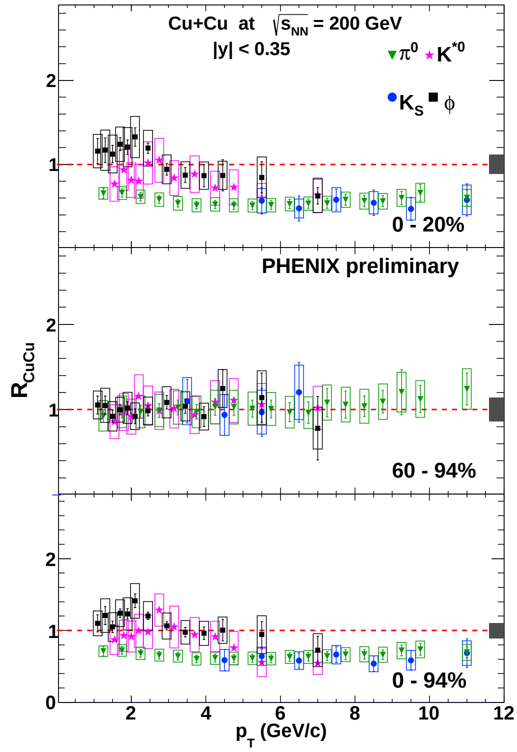

FIG. 1: Nuclear Modification factors for K^{*0}, K^0_S, ϕ, and π^0 in Cu+Cu system at $\sqrt{s_{NN}} = 200$ GeV for most central (0 - 20%), most peripheral (60 - 94%) and Minimum Bias collisions.

ber of binary collisions in the centrality bin under consideration calculated using Glauber formalism, $d^2\sigma_{pp}/dydp_T$ is the cross-section of the particle of interest in $p+p$ collision and σ^{inel}_{pp} is the total inelastic cross section in $p+p$ which is 42.2 mb. In the presence of hot medium produced in heavy ion collisions, jets are suppressed which results in $R_{\rm CuCu} < 1$ at high p_T. The quark recombination process from quark gluon matter can make > 1 at intermediate p_T which is also thought to be responsible for meson baryon difference.

Figure 1 shows $R_{\rm CuCu}$ for K^0_S, K^{*0} and ϕ [7] along with π^0 [8], for Minimum Bias, most central (0-20%) and most peripheral (60-94%) collisions. At high p_T, K^{*0} suppression is consistent with that of K^0_S within uncertainties and at intermediate p_T it is less suppressed than other light mesons like π^0. In the most peripheral collisions, R_{CuCu} is ~ 1 within uncertainties for all p_T. The R_{CuCu} for K^{*0} and ϕ are consistent within error bars in all p_T range for all centralities. At high p_T the suppression of all the strange mesons are consistent with the suppression of π^0 within error bars.

Conclusions

We presented the measurements of nuclear modification factors of strange hadrons in Cu+Cu system at $\sqrt{s_{NN}} = 200\,$GeV. The measurements of K^0_S cover high p_T range upto 13 GeV/c whereas the K^{*0} covers intermediate and high p_T range upto 8 GeV/c. The K^0_S and K^{*0} mesons are suppressed at high $p_T > 4$ GeV/c in the most central collisions which disappears when one moves to peripheral collisions. The suppression of K^0_S and K^{*0} are consistent with light mesons at high p_T. At intermediate p_T, K^{*0} are less suppressed as compared to light mesons. The behavior of nuclear modification factor of K^{*0} is similar to that of ϕ. The suppression due to jet quenching is similar for all mesons irrespective of their constituents.

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