ρ^0 Resonance Production in Cu+Cu and Au+Au Collisions at $\sqrt{s}_{NN} = 200$ and 62.4 GeV at RHIC in STAR

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Introduction

Relativistic heavy ion collisions offer an unique oportunity to study nuclear matter in states of high temparature and energy density. Under these conditions, it is expected that nuclear matter will go through a phase transition to a plasma of quarks and gluons (QGP)[1]. The study of hadronic resonances having extremely short lifetimes (∼few fm/c), comparable with the lifetime of the hot and dense medium created in relativistic heavy ion collisions has the unique characteristics to probe the hadrons production and the collision dynamics through their daughter particles rescattering and regeneration effects at extreme conditions [2]. Measurement of the mass, yield, and transverse momentum distributions of resonances can provide information about the dynamics of heavy ion collisions and their in-medium effects [3]. The ρ^0 vector meson is one among such resonances which plays an important role in the particle production and interaction dynamics in relativistic heavy ion collisions.

Experiement

The STAR (Solenoidal Tracker At RHIC) detector at RHIC in Brookhaven National Laboratory (BNL) is a large acceptance collider detector which measures primarily hadronic observables. The main tracking device within STAR is the time projection chamber (TPC) located inside a solenoidal magnetic field [4]. TPC provides particle identification for charged particles by measuring their ionization energy loss (dE/dx).

Data Analysis and Results

The hadronic decay channel of $\rho^0(770) \rightarrow \pi^+ + \pi^-$ is studied using the STAR detector. The data presented here were taken during 2004 and 2005 RHIC runs. The ρ^0 signal is reconstructed by calculating the invariant mass of each $\pi^+\pi^-$ pair in an event and then the background is calculated using the like-sign technique i.e. the geometric mean of the invariant mass distributions obtained from uncorrelated $\pi^+\pi^+$ and $\pi^-\pi^-$ pairs from the same event. The $\pi^+\pi^-$ invariant mass distribution after background subtraction and fitted with a cocktail function is shown in Fig. 1. The raw yields, masses for each transverse momentum bins are obtained for ρ^0 by fitting the background subtracted invariant mass spectra to a p-wave Breit-Wigner function [6] multiplied by the phase space factor. The ρ^0 mas shift as a function of p_T will be presented. The ρ^0 corrected invariant yields for various centralities in $Cu + Cu$ collisions is shown in Fig. 2. The ρ^0 transverse momentum spectra, integrated yield, mean p_T in $Cu + Cu$ and $Au + Au$ for different centralities in both 200 and 62.4 GeV will be discussed. The par-

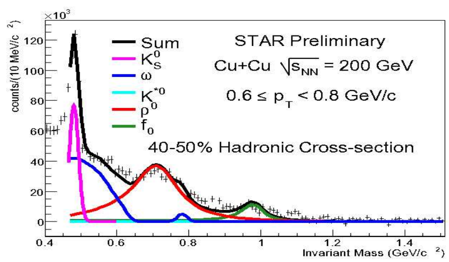

FIG. 1: The raw $\pi^+\pi^-$ invariant mass distribution after substraction of the like-sign background distribution for 40-50% hadronic cross-section in $Cu + Cu$ 200 GeV collisions.

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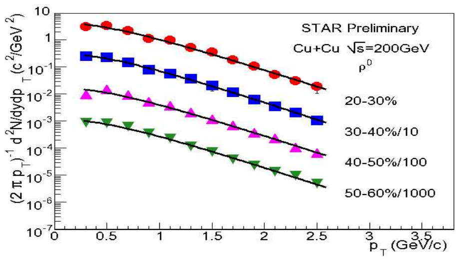

FIG. 2: The p_T distributions at $|y| < 0.5$ for different centrality bins in $Cu + Cu$ collisions at 200 GeV.

ticle ratios in different collision systems give information about the decay daughter particles rescattering and regeneration effects [3]. The ρ^0/π^- ratio compaired with K^*/K^- ratio will be discussed for different collision systems. Fig. 3 shows the ratios of yields of ρ^0 and K^* to their corresponding stable particles π^- and K^- respectively.

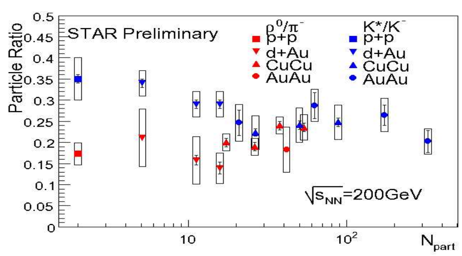

FIG. 3: The ρ^0/π^- ratios compaired with K^*/K^- ratios for various centralities in different collision systems.

The nuclear modification factors (R_{CuCu}, R_{CP}) are used to study the nuclear effects of matter on particle production. We have calculated the ρ^0 nuclear modification factor [5] as a function of transverse momentum in different collision cross-sections at $\sqrt{s}_{NN}$ = 200 GeV in $Cu + Cu$ system. The results will be discussed in the meeting.

The ρ^0 elliptic flow(v_2) has a special importance in relativistic heavy ion collisions that potentially provides information on the

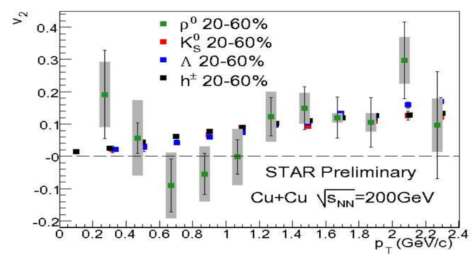

FIG. 4: The ρ^0 v_2 as a function of p_T along with K^*, Λ and charged hadrons v_2 for 20-60% hadronic cross-section.

ρ^0 production mechanism. The ρ^0 v_2 vs. p_T in $Cu + Cu$ 200 GeV is shown in the Fig. 4. We have measured a non zero amount of ρ^0 v_2 first time in STAR using the 200 GeV $Cu + Cu$ data for 20-60% hadronic cross-section.

References

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