K^* meson production in $p+p$ and d+Au collisions at $\sqrt{s}_{NN}$ = 200 GeV with PHENIX experiment at RHIC

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Introduction

Resonances having very short life time (∼few fm/c) provide unique capabilities to probe the hadron production mechanisms and the collision dynamics in heavy ion collisions. To isolate phenomena related to the dense and hot medium created in such collisions and to understand cold nuclear matter effects, it is important to measure particle production in smaller collision systems like $p+p$ and d+A. Comparison of the mass, width for K^* in p+p, d+Au and heavy ion collisions will give information on the interaction taking place in quark gluon plasma or hadronic matter. Measuring the K^* yields from intermediate transverse momentum (p_T) ($2 < p_T$ GeV/$c < 5$) to high p_T ($p_T > 5$ GeV/c), one can study multiple re-scattering of partons in the initial state, parton energy loss and quark recombination processes, which will help in understanding different suppression patterns for meson and baryons [1–3].

We report the measurement of the K^* in $p+p$ and d+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV via its hadronic decay ($K^*(892) \to \pi K$) with the PHENIX detector, which is one of the major detectors at Relativistic Heavy Ion Collider (RHIC), BNL to search for Quark Gluon Plasma (QGP). The techniques used for the measurement of the K^* spectrum in $p+p$ collisions are established and used to get the K^* signal in d+Au collisions. The K^* is studied at intermediate to high p_T regions from 0.9 to 8 GeV/c.

Analysis

The data presented here were taken during 2005 for p+p and during 2008 for d+Au RHIC run. The K^{*0} and $\overline{K}^{*0}$ are obtained by invariant mass reconstruction from their daughter track (K, π) combinations and subtracting the combinatorial backgrounds obtained from mixed-event technique. Figure 1. shows the K^* invariant mass spectra for p+p collisions at $\sqrt{s}$ = 200 GeV for a particular p_T bin (2.3 $< p_T$ GeV/$c < 2.6$). The K^* invariant mass spectra for d+Au collisions for a particular p_T bin ($2.1 < p_T$ GeV/$c < 2.3$) is shown in Fig. 2. In both p+p and d+Au the signal is fitted with the relativistic Breit-Wigner function plus a second order polynomial function that represents the residual background. The uncorrected yields obtained in each p_T bins were corrected for the detector acceptance and efficiency. The corrected $(K^{*0} + \overline{K}^{*0})/2$ yields as a function of p_T for p+p collisions is shown in Fig. 3. A Tsallis function was used to extract the K^{*0} yields per unit of rapidity. The

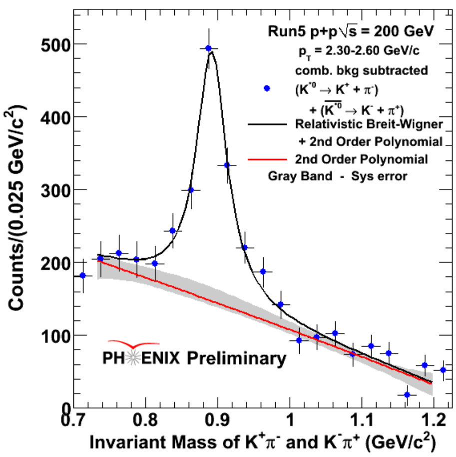

FIG. 1: The mixed-event background subtracted Kπ invariant mass spectra in p+p collisions ar $\sqrt{s}$ = 200 GeV for a particular p_T (2.3 - 2.6) bin.

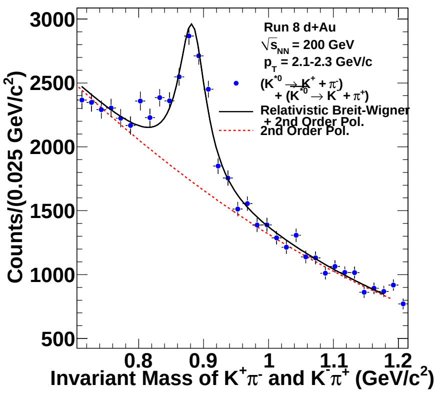

FIG. 2: The mixed-event background subtracted Kπ invariant mass spectra in minimum bias d+Au collisions ar $\sqrt{s_{NN}} = 200$ GeV for a particular p_T (2.3 - 2.6) bin.

Tsallis function is defined as:

$$\frac{1}{2\pi p_T}\frac{d^2N}{dp_T dy} = \frac{1}{2\pi}\frac{dN}{dy}\times$$
$$\frac{(n-1)(n-2)}{nT + m_0(n-1)(nT+m_0)} \left(\frac{nT+m_T}{nT+m_0}\right)^{-n}, \quad (1)$$

where, dN/dy is the multiplicity of K^* production at mid-rapidity, T is the inverse slope parameter, n is a measure of the amount of fluctuations and m_T is the transverse mass $= \sqrt{p_T^2 + m_{K^{*0}}^2}$, $m_{K^{*0}}$ is K^{*0} mass taken to be 0.896 GeV/c^2.

The STAR experiment measured the K^* production upto $p_T \sim 3.5$ GeV/c, whereas the present results extend the measurement range upto 8 GeV/c. These results are used to study hadronic matter effects at intermediate and high p_T and set a baseline for study of QGP signals in heavy ion collisions.

Conclusion

We have measured the K^{*0} signal in both p+p and d+Au collisions with PHENIX detector at $\sqrt{s_{NN}} = 200$ GeV from intermediate to high p_T up to 8 GeV/c range. The PHENIX preliminary invariant p_T-spectra for p+p collisions has been reported. The PHENIX preliminary invariant p_T-spectra and the nuclear modification factor (R_{dAu}) will be obtained in d+Au collisions upto high p_T to study the cold matter effects. The results and status of d+Au analysis will also be presented.

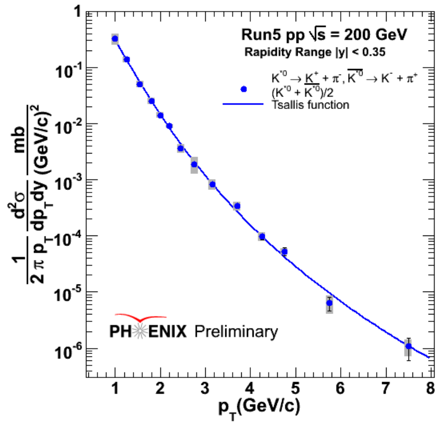

FIG. 3: The corrected $(K^{*0} + \overline{K}^{*0})/2$ invariant yields as a function of p_T for p+p at $\sqrt{s} = 200$ GeV. The statistical and systematic errors are also depicted in the figure. The solid line is Tsallis function fit to the data.

References

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