K^{*0} resonance production in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV

Subhash Singha (for ALICE collaboration) [1*]
Variable Energy Cyclotron Centre, Kolkata 700064, INDIA

Introduction:

The production of resonances in heavy-ion collision is expected to be sensitive to the properties of strongly interacting matter produced in these collisions. The resonance production may be affected by the onset of deconfined phase of quarks and gluons called the quark gluon plasma (QGP). The Large Hadron Collider (LHC) at CERN can provide collisions of heavy nuclei at center of mass energies up to 5.5 TeV per nucleon. The resonance like $K^{*0}(896)$ meson is of particular interest because it has a small lifetime (4 fm/c) compared to the one of the fireball. So the characteristic properties of K^{*0} such as its mass, width and yield could be modified [1]. Due to short lifetime, decay particles of resonances may undergo rescattering and regeneration effects. Since the resonance K^{*0} contains a strange quark, it may provide some information regarding the strangeness enhancement for the system. The recent measurements by STAR experiment [2] at $\sqrt{s_{NN}}$ = 200 GeV suggest that the rescattering of K^{*0} decay products is dominant over the K^{*0} generation. It will be interesting to study the effect of rescattering, regeneration and strangeness at LHC energies.

1. Analysis and Results:

We will present the status of the study of K^{*0} meson mass, width and yield in Pb-Pb collision at center of mass energy 2.76 TeV per nucleon using the ALICE (A Large Ion Collider Experiment) detector at LHC. The K^{*0} production is measured through the hadronic decay channel ($K^{*0} \rightarrow \pi^- K^+$ and $\bar{K^{*0}} \rightarrow \pi^+ K^-$) at midrapidity ($-0.5 < y < 0.5$) in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV for different collision centralities. Pions and kaons are identified using the Time Projection Chamber(TPC) and the Time Of Flight(TOF) detectors in ALICE. The K^{*0} signal is obtained by reconstructing the invariant mass of pions and kaons. The background is estimated through mixed event technique. The signal is obtained by subtracting the combinatorial background from the kaon - pion invariant mass distribution. The extracted signal is fitted using a Breit-Wigner plus a linear residual background function.

$$\frac{\Gamma_0}{(M(K\pi) - M_0)^2 + \frac{\Gamma_0^2}{4}} + AM(K\pi) + B \quad (1)$$

where M_0 and Γ_0 are the mass and width of the K^{*0}; A and B are the intercept and slope for the linear residual background. Figure 1 shows the $K\pi$ invariant mass distribution over the p_T range 2.0 GeV/c to 2.5 GeV/c for Pb-Pb collisions (0 to 20 % centrality) at $\sqrt{s_{NN}}$ = 2.76 TeV after the mixed event background subtraction. The solid line indicates the function given in equation 1. The dashed line corresponds to the residual background only.

From the fitting, mass and width of K^{*0} are obtained. The variation of mass and width for different p_T in two centralities of 0 to 20 % and 60 to 80 % are shown in figure 2.

The measured mass and width is compared with the results from Monte Carlo HIJING [3] model calculations after full propagation in the simulated detector. The mass and width are close to PDG value except at low values of p_T. The observed mass shift at low p_T includes contributions due to the energy loss of the decay particles in detector. This effect is

*Electronic address: `subhash.singha@vecc.gov.in`

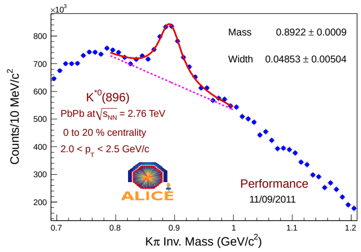

FIG. 1: The mixed event background subtracted $K\pi$ pair invariant mass distribution over the range 2.0 GeV/c $< p_T <$ 2.5 GeV/c for Pb-Pb collisions (0 to 20 % centrality) at $\sqrt{s_{NN}}$ = 2.76 TeV. The solid line corresponds to a Breit-Wigner + Linear function. The dashed line is the linear function corresponding to the residual background.

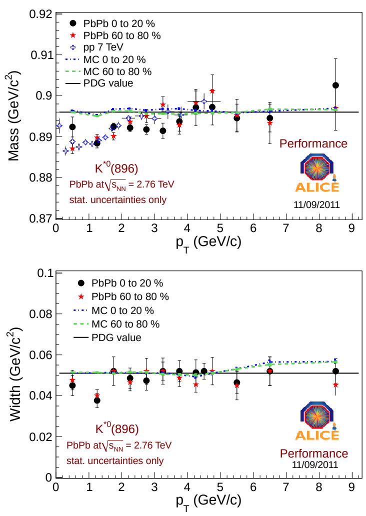

FIG. 2: K^{*0} mass and width as a function of p_T for Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV. Open symbols refer to mass as a function of p_T for *pp* collision at $\sqrt{s_{NN}}$ = 7 TeV The black line represents the PDG value 896.0 MeV/c^2 and 50.3 MeV/c^2 for mass and width respectively. The errors shown are statistical only.

not accounted in the analysis yet. The observed K^{*0} mass in Pb-Pb collisions is also compared to corresponding values in *pp* collisions at $\sqrt{s_{NN}}$ = 7 TeV. The mass and width as a function of p_T are similar for Pb-Pb 0 to 20 %, 60 to 80 % and *pp* collisions.

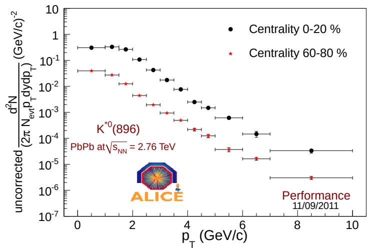

FIG. 3: Uncorrected p_T spectra at midrapidity of K^{*0} for two centralities in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV. The errors shown are statistical only.

The raw yields are computed from the full integral of the fitted Breit-Wigner function. The yield as a function of p_T for different centralities will soon be estimated. Figure 3 shows the raw yield as a function of p_T for two centralities of 0 to 20 % and 60 to 80 % cross section. This will permit to extract the temperature parameter and the mean p_T for this reaction, giving us important information about the K^{*0} resonance production at LHC energies. The systematic errors on the signal extraction will be estimated by different methods for background subtraction (mixed event and like-sign techniques), the residual background functions (e.g. linear, nonlinear and exponential), particle identification and selection criteria.

References

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