Resonance Production in pp Collisions at $\sqrt{s} = 13$ TeV with ALICE at the LHC

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Introduction

Resonances are short lived particles having lifetime $\sim 10^{-23}$ sec, that can be used to study the medium formed in heavy-ion collisions. Due to their short lifetimes, regeneration and rescattering [1] effects become important in heavy-ion collisions. The ratios of resonance to stable particle yields are affected by rescattering and may contain information on both the chemical freeze-out temperature and the hadronic phase of the system. The measurements in pp collisions can be used as baseline for heavy-ion collisions and provide information for tuning event generators inspired by Quantum Chromodynamics.
Measurements of K^{*0} and ϕ production in pp collisions at centre-of-mass energy $\sqrt{s} = 13$ TeV are presented. The data used in this work was collected with the ALICE detector in the year 2015 (Run II). K^{*0}/K and ϕ/K yield ratios as a function of collision energy and $(p + \bar{p})/\phi$ yield ratio as a function of transverse momentum (p_T) are presented.

Resonance reconstruction

K^{*0} and ϕ mesons are reconstructed using an invariant mass analysis of their hadronic decays. Branching ratios for $K^{*0}(\overline{K^{*0}}) \rightarrow \pi^- K^+ (\pi^+ K^-)$ and $\phi \rightarrow K^+ K^-$ are 66.66% and 48.9%, respectively. The combinatorial background is estimated using an event mixing technique [2]. The signals for K^{*0} and ϕ in various p_T intervals are obtained by subtracting the combinatorial background from the unlike charged invariant mass distribution. After combinatorial background subtraction a residual background remains which arises mainly from correlated πK or KK pairs or from misidentified particle decays. The extracted K^{*0} signal is fitted with a Breit-Wigner function [2] and the ϕ signal is fitted with a convolution of Breit-Wigner and Gaussian function [2]. Residual backgrounds for both K^{*0} and ϕ are fitted with a second-order polynomial. Invariant mass distribution of unlike-charged πK pairs from same events and mixed events in the p_T range $1.2 < p_T < 1.4$ GeV/c are shown in the top panel of Fig. 1.

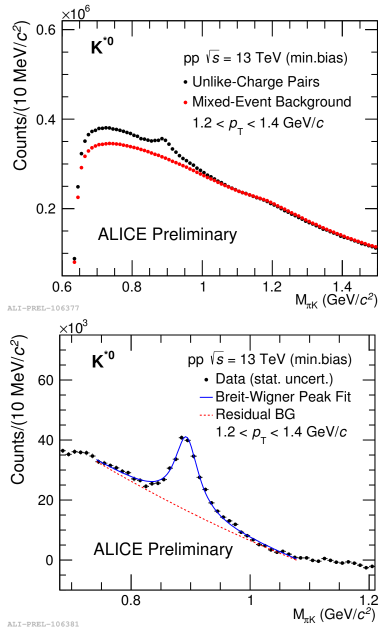

FIG. 1: Top panel: Invariant mass distribution of unlike charged πK pairs from same event (black marker) and normalized mixed event (red marker). Bottom panel: Invariant mass distribution after subtraction of the combinatorial background for K^{*0}. Blue solid line shows fitting for K^{*0} signal with residual background and red dashed line describes residual background.

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The same event and mixed event distributions are normalized in the invariant mass region of 1.1 to 1.15 GeV/c^2, which is far from the K^{*0} peak. The unlike-charged πK invariant mass distribution after combinatorial mixed event background subtraction is shown in the bottom panel of Fig. 1, where a signal can be observed on top of a residual background. Raw yields for K^{*0} and ϕ are obtained from residual background subtracted signal distributions in different p_T intervals. Raw yields are corrected with detector efficiency × acceptance and branching ratio to get the corrected p_T spectrum.

Results and discussion

The measurements for K^{*0} and ϕ mesons are done over the p_T range 0 to 15 GeV/c and 0.4 to 8 GeV/c, respectively. Total particle yields (dN/dy) are obtained by integrating the p_T spectra in the measured p_T region and estimating the yield in the unmeasured region using a Levy-Tsallis fit function [2, 3]. Figure 2 shows the K^{*0}/K (top) and ϕ/K (bottom) yield ratios as a function of $\sqrt{s}$. The results from pp collisions at $\sqrt{s}$ = 13 TeV are compared with measurements at lower energies [2, 4–6]. No significant energy dependence is observed in these particle yield ratios in pp collisions. However, K^{*0}/K yield ratios in heavy-ion collisions are found to be lower with respect to pp collisions. This decrease in K^{*0}/K yield ratios can be understood as being due to rescattering of K^{*0} decay daughters in the hadronic phase. Figure 3 shows $(p+\bar{p})/\phi$ ratios for pp, p-Pb and Pb-Pb collisions as a function of p_T. The ratios for pp collisions are similar at $\sqrt{s}$ = 7 TeV and 13 TeV. These show a decrease with increasing p_T in contrast to the measurements for p-Pb [5] and Pb-Pb [6] central collisions. This may indicate that minimum bias pp collisions do not show any hydrodynamic evolution [6].

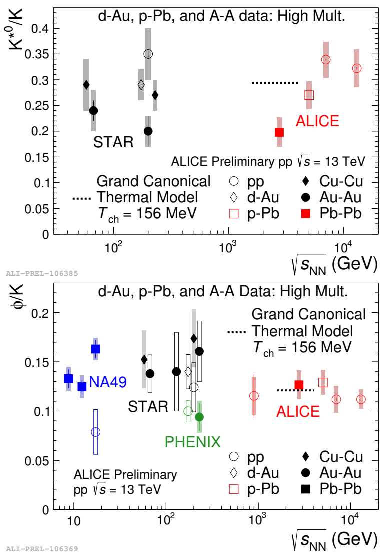

FIG. 2: Ratios of particle yields K^{*0}/K (top) and ϕ/K (bottom) as a function of $\sqrt{s}$. The results are compared with measurements at lower energies.

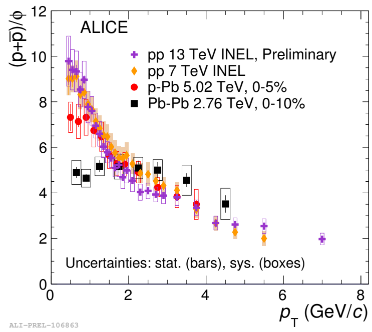

FIG. 3: $(p+\bar{p})/\phi$ ratios as a function of p_T for pp, p-Pb and Pb-Pb collisions.

Acknowledgments

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References

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