Multiplicity dependence of resonance production in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE

Sourav Kundu (for the ALICE Collaboration)*
National Institute of Science Education and Research, HBNI, Jatni-752050, INDIA

Introduction

Resonances are short lived particles having lifetimes $\sim 10^{-23}$ s and can be used to study the properties of the hadronic phase in heavy-ion collisions. In fact, in central Pb-Pb collisions, where the lifetime of the hadronic phase is similar to that of resonances, regeneration and rescattering [1] effects become important. At the LHC, the pseudo-rapidity densities at mid rapidity ($\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$) of final state charged particles in pp and p-Pb collisions are comparable with semi-peripheral Au-Au collisions at RHIC energies and peripheral Pb-Pb collisions at LHC energies [2–4]. Recent measurements in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV [5] and pp collisions at $\sqrt{s}$ = 7 TeV show a decreasing trend in K^{*0}/K ratio as a function of $\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$, similar to heavy-ion collisions. Multiplicity-dependent studies in pp and p-Pb collisions are therefore interesting as they allow to probe the possbile presence of hadronic medium effects on final state observables even in pp and p-Pb collisions. A study of the multiplicity dependence of ϕ meson production is important in the context of the study of strangeness production, since ϕ is an $\mathrm{s\bar{s}}$ pair and its net strangeness content is 0 and we do not know if it behaves like a S = 0 particle or a S = 2 particle. Therefore, a multiplicity-differential study of ϕ meson production is advocated by many theorists in order to provide an input for the tuning of MC generators.

In this contribution we present the recent measurements of K^{*0} and ϕ meson production as a function of $\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$ in pp collisions at $\sqrt{s}$ = 13 TeV. Transverse momentum (p_{T}) integrated particle yields ($\mathrm{d}N/\mathrm{d}y$) are shown as a function of $\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$. These results are compared with the measurements from p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV [5] and pp collisions at $\sqrt{s}$ = 7 TeV. We also present the resonance to stable particle ratios (K^{*0}/K and ϕ/K) and compare the results with the measurements from p-Pb and Pb-Pb collisions.

Analysis details

These analyses are based on a data sample of ∼43M minimum bias triggered events collected by ALICE in 2015. All events in which at least one charged particle has been detected within $|\eta|$ <1.0 are considered for this analysis. Events are divided into classes depending on the multiplicity in the V0 detectors. These are two plastic scintillator detectors, V0A and V0C, placed in the pseudorapidity ranges 2.8 < η < 5.1 and -3.7 < η < -1.7, covering the full azimuthal angle. Charged particle multiplicity is then measured at midrapidity for each class. The whole data sample has been divided into ten event multiplicity classes (denoted as I-X), where I and X correspond to highest and lowest V0M multiplicity event classes, respectively.

K^{*0} and ϕ mesons are reconstructed using an invariant mass analysis of their hadronic decays. Branching ratios for $\mathrm{K}^{*0}(\mathrm{\bar{K}}^{*0}) \rightarrow \mathrm{K}^{+}\pi^{-}$ ($\mathrm{K}^{-}\pi^{+}$) and $\phi \rightarrow \mathrm{K}^{+}\pi^{-}$ are 66.66% and 48.9%, respectively.

Results

The measurements of K^{*0} and ϕ mesons are performed at mid rapidity ($|y| < 0.5$) over the p_{T} ranges 0 to 15 GeV/c and 0.4 to 8 GeV/c, respectively. $\mathrm{d}N/\mathrm{d}y$ is obtained by integrating the p_{T} spectrum in the measured p_{T} region and estimating the yield in the unmeasured region using a Levy-Tsallis fit function [6, 7].

*Electronic address: sourav.kundu@cern.ch

Figure 1 shows $p_{\rm T}$ spectra of K^{*0} in different V0M multiplicity classes along with their ratios to the corresponding spectrum in minimum bias collisions. Ratios suggest that the $p_{\rm T}$ spectrum gets harder with increasing multiplicity. Figure 2 shows dN/dy of K^{*0} as a

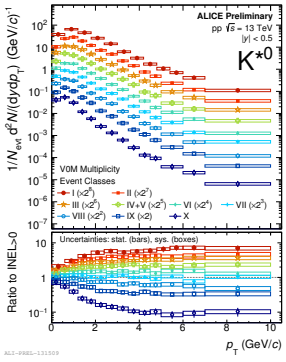

FIG. 1: Top panel: $p_{\rm T}$ spectra of K^{*0} in different V0M multiplicity classes. Bottom panel: Ratio of $p_{\rm T}$ spectra in different multiplicity classes to minimum bias $p_{\rm T}$ spectrum.

function of $\langle {\rm d}N_{\rm ch}/{\rm d}\eta \rangle$. The results are compared with the measurements from p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV [5] and pp collisions at $\sqrt{s} = 7$ TeV. The measurements for all different collisions are consistent with each other at similar mulitplicities and fall on a single line, which suggests that the particle production is independent of collision system and collision energy and mainly driven by $\langle {\rm d}N_{\rm ch}/{\rm d}\eta \rangle$. $p_{\rm T}$ integrated K^{*0}/K and ϕ/K ratios as a func-

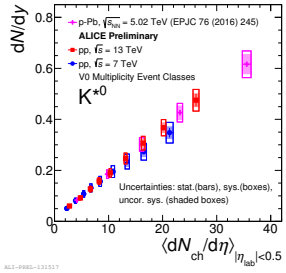

FIG. 2: dN/dy of K^{*0} as a function of $\langle {\rm d}N_{\rm ch}/{\rm d}\eta \rangle$ in pp collisions at $\sqrt{s} = 13$, 7 TeV and p-Pb collisions at $\sqrt{s} = 5.02$ TeV [5].

tion of $\langle {\rm d}N_{\rm ch}/{\rm d}\eta \rangle^{1/3}$ in pp, p-Pb and Pb-Pb collisions are shown in Fig. 3. A smooth evolution is observed for these ratios as a function of $\langle {\rm d}N_{\rm ch}/{\rm d}\eta \rangle^{1/3}$, from low multiplicity pp to central Pb-Pb collisions. The results from pp collisions at $\sqrt{s} = 13$ TeV are consistent with the measurements from p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV [5]. The ϕ/K ratio is nearly flat across all systems and multiplicities. On the other hand, the K^{*0}/K ratio shows a decreasing trend with increasing multiplicity in all three systems. This decrease in the K^{*0}/K yield ratios in central Pb-Pb collisions can be understood as being due to rescattering of K^{*0} decay daughters in the hadronic phase.

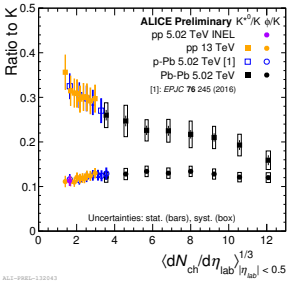

FIG. 3: K^{*0}/K and ϕ/K ratios as a function of $\langle {\rm d}N_{\rm ch}/{\rm d}\eta \rangle^{1/3}$ in pp, p-Pb, and Pb-Pb collisions.

Acknowledgments

Sourav Kundu acknowledges financial support by the DAE, DST of the Government of India.

References

[1] M. Bleicher, J. Aichelin, Phys. Lett. B 81, 530 (2002).
[2] J. Adam et al., Eur. Phys. J. C 77 (2017) 33.
[3] J. Adam et al., Phys. Rev. C 91(6), 064905 (2015).
[4] K. Aamodt et al., Phys. Rev. Lett. 106, 032301 (2011).
[5] J. Adam et al., Eur. Phys. J. C 76, 245 (2016).
[6] B. Abelev et al., Eur. Phys. J. C 72, 2183 (2012).
[7] C. Tsallis J. Stat. Phys. 52, 479 (1988).