PROCEEDINGS OF SCIENCE

Multiplicity-dependent study of $\Lambda(1520)$ resonance production in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV with ALICE

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The measurement of the $\Lambda(1520)$ (mass = 1520 MeV/c^2) resonance production at midrapidity ($|y| < 0.5$) in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV as a function of charged-particle multiplicity is presented. The hadronic decay channel $\Lambda(1520) \rightarrow pK^-$($\overline{\Lambda}(1520) \rightarrow \overline{p}K^+$) with branching ratio BR = 22.5 ± 0.5% is used to reconstruct $\Lambda(1520)$. It has a lifetime of around 13 fm/c, which lies between the lifetimes of K^* and ϕ resonances. The multiplicity-dependent measurement of the $\Lambda(1520)/\Lambda$ ratio for pp collisions can serve as a baseline for heavy-ion collisions.

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1. Introduction

Hadronic resonances are short-lived particles having a lifetime comparable to that of a quark–gluon plasma (QGP) fireball created in heavy ion collisions. In ultrarelativistic heavy-ion collisions, they are useful tools for analysing the hadronic phase. The yields of long-lived hadrons remain constant between the chemical and kinetic freeze-out. Resonance particles may experience pseudo-elastic rescattering or regeneration effects that have an impact on their yields and transverse momenta as a result of interactions with hadrons [1]. Regeneration increases the resonance yield whereas rescattering reduces the reconstructible yield with respect to the production at chemical freeze-out.

The yields of stable particles compared to those of hadronic resonances may reveal information of the hadronic phase. The transverse-momentum spectra, the integrated yields ($\mathrm{d}N/\mathrm{d}y$), the mean transverse-momentum ($\langle p_{\mathrm{T}} \rangle$), the $\Lambda(1520)/\Lambda$ yield ratio and the multiplicity dependence of $\Lambda(1520)$ production as a function of the charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV measured by ALICE are presented.

2. Analysis Procedure

The results presented here were acquired by analysing the data from ALICE [2]. The details on the performance of the ALICE detector can be found in [3]. Vertex finding and tracking are performed using the Inner Tracking System (ITS) and Time Projection Chamber (TPC). The TPC is also used for particle identification (PID). For the PID of relatively high momentum particles, the Time-Of-Flight (TOF) detector is employed. A reconstructed primary vertex must be within 10 cm of the interaction point along the beam direction in order to select good events.

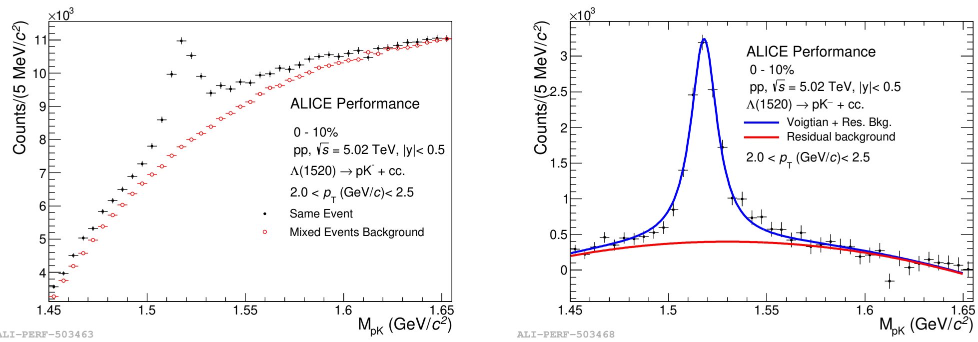

Figure 1: The pK invariant mass distribution before (left panel) and after (right panel) subtracting the normalized mixed-event background distribution.

The $\Lambda(1520)$ production has been measured by invariant mass reconstruction of its decay daughters in the hadronic decay channel: $\Lambda(1520) \rightarrow pK^{-}(\overline{\Lambda(1520)} \rightarrow \overline{p}K^{+})$. The invariant mass distribution of all primary proton and kaon candidate pairs are built and the estimated combinatorial background calculated using the mixed-event technique is subtracted. A Voigtian function is used to fit the signal from the invariant mass distribution after background subtraction, along with a second order polynomial for the residual background. The invariant mass distribution is shown in Fig. 1. Then the fully corrected p_{T}-spectra are obtained.

3. Results

The p_{T} spectra of Λ(1520) for five V0 multiplicity classes (0–10%, 10–30%, 30–50%, 50–70%, 70–100%) are shown in Fig. 2. The ratio to the 0-100% multiplicity class is shown in the bottom panel. A hardening of the p_{T} spectra with the increasing multiplicity classes is observed, as found for other resonances in pp, p–Pb, and Pb–Pb collisions [1, 6].

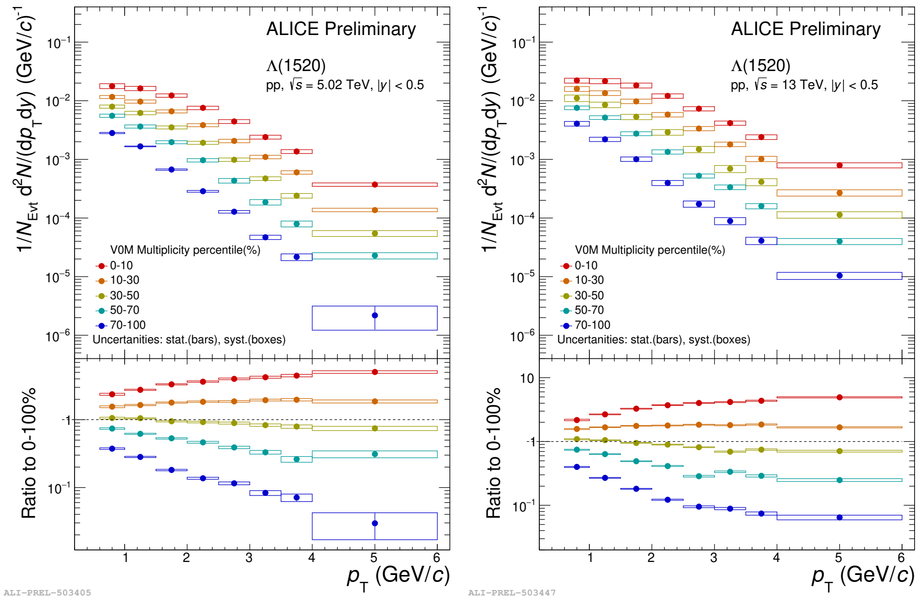

Figure 2: Λ(1520) p_{T} spectra for different multiplicity classes in mid rapidity pp collisions at $\sqrt{s}$ = 5.02 TeV (left panel) and 13 TeV (right panel) . Bars show statistical errors and boxes show the systematic errors.

To obtain the integrated yields and average transverse momentum, the p_{T}-spectra are fitted with a *Lvy*–Tsallis function. The dN/dy and $\langle p_{\mathrm{T}}\rangle$ of Λ(1520) have been calculated as functions of the final state charged-particle multiplicity as shown in Fig. 3. Both of these increase with multiplicity and are independent of the collisions system and energy for a fixed multiplicity .

The Figure 4 displays the yield ratio of Λ(1520)/Λ as a function of charged particle multiplicity in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV (left panel). The comparison of this ratio with other systems and energies [4, 5] is shown in the right panel.

The Λ(1520)/Λ ratio is found to decrease with increasing multiplicity in Pb–Pb collisions. No suppression is observed in small collision systems, i.e. in pp and p–Pb collisions, where the ratio is flat within uncertainties. We observe that the Λ(1520)/Λ ratio in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV is almost flat within uncertainty and irrespective of multiplicity.

4. Conclusion

The recent results on the measurement of baryonic resonance Λ(1520) in pp collisions at $\sqrt{s}$ = 5.02 TeV and 13 TeV obtained by ALICE detector have been presented. Both dN/dy and $\langle p_{\mathrm{T}}\rangle$ increase with multiplicity and are independent of collision systems and energies at a given multiplicity . The Λ(1520)/Λ ratio is flat as a function of charged particle multiplicity in pp collisions. Further the result will be compared with the EPOS model prediction.

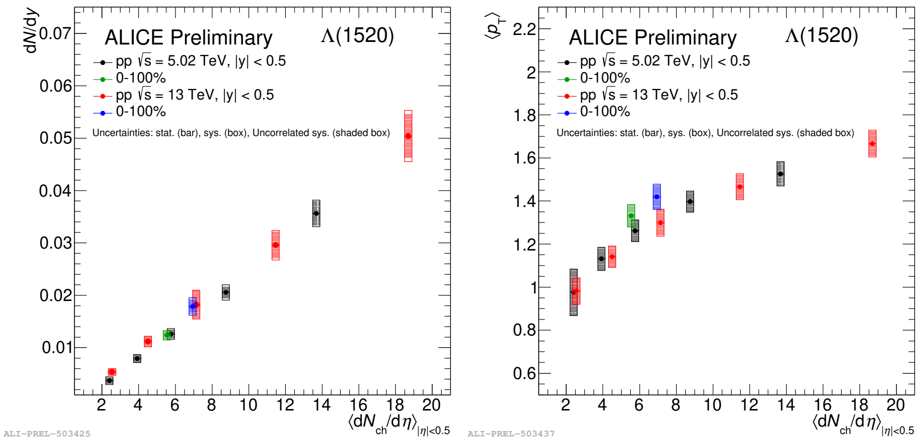

Figure 3: Integrated yield (left panel) and mean transverse momentum (right panel) of Λ(1520) as a function of charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 5.02 TeV and 13 TeV in various multiplicity classes. The statistical, systematics and uncorrelated errors are shown by bars, boxes, and shaded boxes respectively.

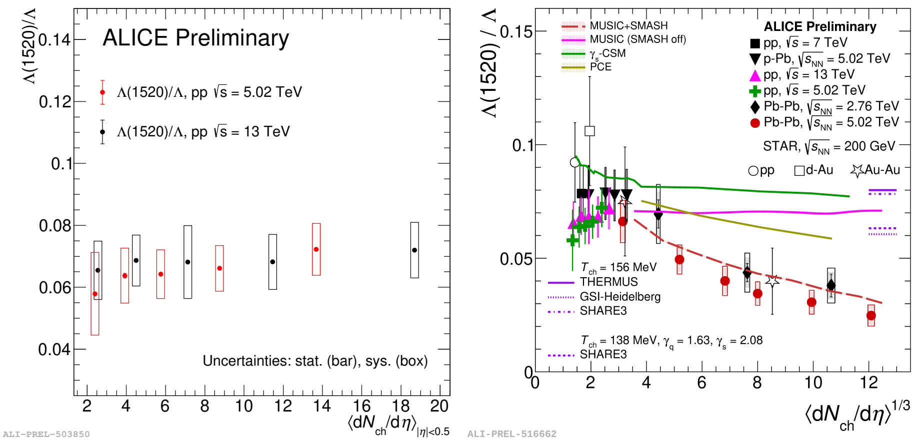

Figure 4: Λ(1520)/Λ ratio as a function of charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV (left panel) compared with previous measurements (right panel).

References

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