# Hadronic resonance production in ALICE

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## Introduction

Hadronic resonances are useful to understand the hadronic phase created in heavy-ion collisions at ultrarelativistic energies [1]. At the Large Hadron Collider (LHC) energies resonances with lifetimes (∼10 femtoseconds) similar to the duration of the fireball at the Large Hadron Collider (LHC) energies, possess the sensitivity to the competing dynamics of rescattering and regeneration. These dynamics have the capacity to either diminish in the final state or enhance the resonance yields.

Traditionally, it was believed that the conditions necessary for the formation of the quark-gluon plasma (QGP) would only be achieved in the context of heavy-ion collisions. Data from smaller systems, such as proton-proton (pp) and proton-lead (p–Pb) collisions, were primarily collected for comparative purpose. However, recent investigations into high-multiplicity events within pp and p–Pb collisions at the LHC have unveiled patterns reminiscent of phenomena traditionally observed in nucleus-nucleus (AA) collisions.

To understand the phenomenon at high multiplicity , investigation with respect to transverse spherocity [2] were done. Transverse spherocity helps us distinguishing hard events and soft events based on event topology. In hard events, particles are produced with significant transverse momenta, often resulting in a more anisotropic $p_{\mathrm{T}}$ distributions. In soft events, particles are produced with relatively low transverse momenta, which can lead to a more isotropic $p_{\mathrm{T}}$ distribution. Therefore hard events tend to have a lower transverse spherocity value whereas soft events tend to have a higher transverse spherocity value.

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## Methodology

ALICE, a prominent component of the Large Hadron Collider (LHC) at CERN, is a formidable experimental setup. A comprehensive description of the ALICE apparatus and its performance can be found in [3]. Notably, several key sub-detectors play pivotal roles in the analysis of resonances. These include the Inner Tracking System (ITS), the Time Projection Chamber (TPC), the Time-Of-Flight detector (TOF), and the V0A and V0C scintillators. The ITS and the TPC assume crucial roles in primary vertex determination, particle tracking, and particle identification (PID) via the measurement of specific energy loss. Meanwhile, the TOF detector specializes in PID by precisely measuring the particle time of flight. The V0A ($2.8 < \eta < 5.1$) and V0C ($-3.7 < \eta < -1.7$) hodoscopes contribute significantly by providing event triggering and selection based on the charged-particle multiplicity at forward rapidities.

The process of resonance reconstruction unfolds by first identifying the decay products of the resonances. Subsequently, the invariant mass of these products is calculated. To discern the signal from the background, the shape of the uncorrelated background is estimated using techniques such as event-mixing or like-sign/unlike-sign methodology.

Following the subtraction of combinatorial background contributions, the resulting invariant mass distribution undergoes further analysis. This includes fitting the distribution with a polynomial function to describe any remaining background components and employing a Breit-Wigner, Voigtian, or Gaussian function to characterize the signal. Corrective factors are then applied to the raw yields, accounting for elements such as geometrical acceptance, detector efficiency, branching ratio, trigger selection efficiency, and signal-loss factors, all contributing to a refined estimate of the final yields.

## Results and discussion

ALICE has measured the production at mid-rapidity ($|y| < 0.5$) of a large set of hadronic resonances in several collision systems at different LHC energies. The latest results from the multiplicity ($\langle dN_{ch}/d\eta \rangle_{|\eta|<0.5}$) dependent analysis and transverse spherocity dependent analysis of $\Lambda(1520)$ in pp collisions at $\sqrt{s} = 13$ TeV are discussed here.
Figure 1 shows the $p_{\mathrm{T}}$-spectra of $\Lambda(1520)$ and $\Lambda(1520)/\Lambda$ ratio with respect to transverse spherocity and in the measured $\mathrm{p}_T$ classes. We didn't observe any significance difference between isotropic and jetty classes.

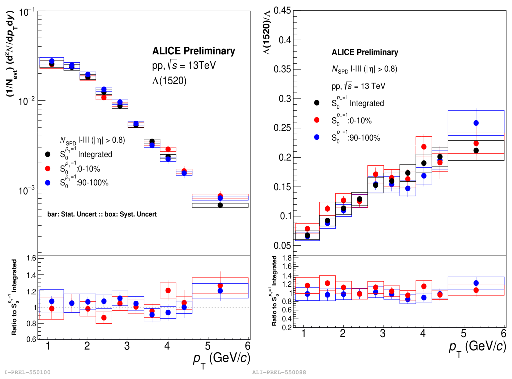


FIG. 1: Left plot: $p_{\mathrm{T}}$ spectra of $\Lambda(1520)$; right plot: $p_{\mathrm{T}}$ differential $\Lambda(1520)/\Lambda$ ratio as a function of spherocity in pp collisions.

Figure 2 shows the $\Lambda(1520)$ $p_{\mathrm{T}}$-integrated yields and $\langle p_{\mathrm{T}} \rangle$ as a function of the charged particle density and both tells about hardening with increasing multiplicity irrespective of center of mass energies.

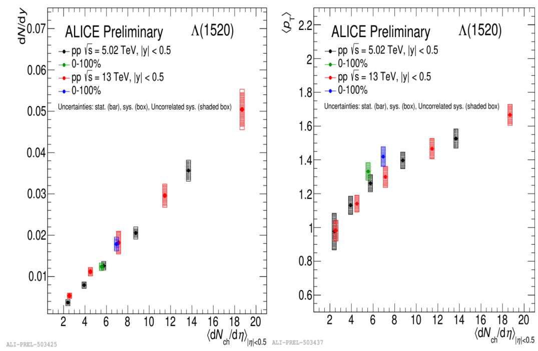


FIG. 2: $p_{\mathrm{T}}$ integrated yield and mean $p_{\mathrm{T}}$ as a function of charged particle multiplicity in pp collisions.


## Acknowledgments

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## References


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