Probing the hadronic phase of large hadronizing system through the study of the Λ(1520) resonance with ALICE at the LHC

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Importance of resonance measurements in heavy-ion collisions

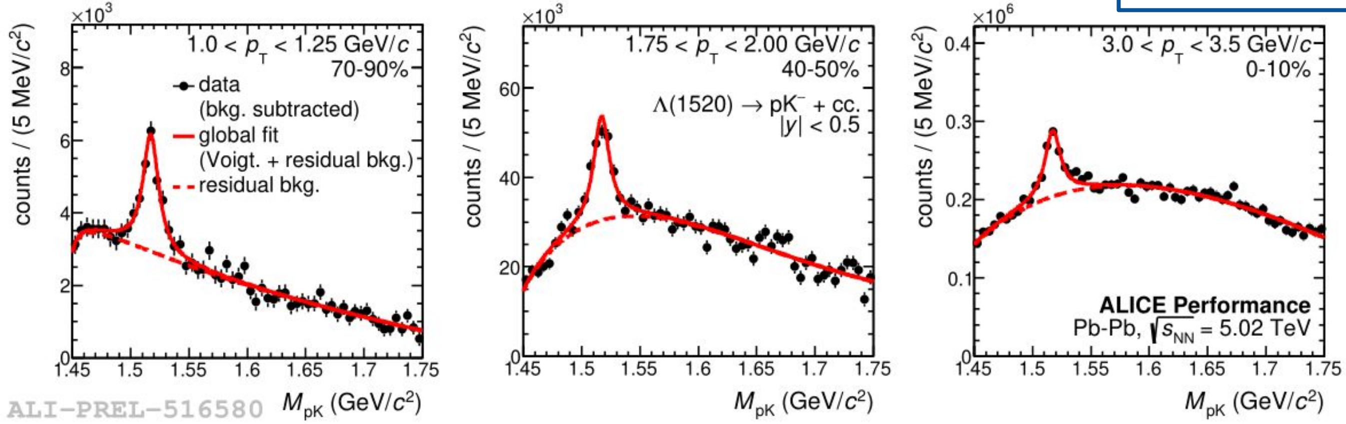
- A **Quark Gluon Plasma** (QGP) state is created in high energy heavy-ion collisions. As the system expands, it cools down and transitions back to hadronic matter. **After hadronisation, the system continues to expand** until all interactions cease (kinetic freeze-out).

- **Due to their short lifetimes** (τ ~ few fm/c), resonances **can decay within the hadronic medium** which in turn can alter their final measuredyields due to re-scattering of decay products.

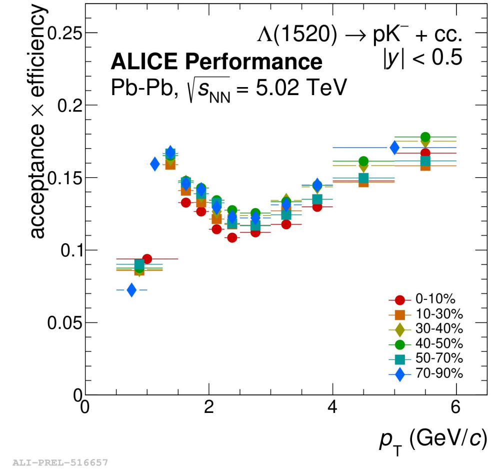
Resonance Lifetime (fm/c): ρ (1.3) < K* (4.2) < Σ* (5.5-5.0) < Λ* (12.6) < Ξ* (21.7) < Φ (46.2)

Λ(1520) signal and efficiency

Λ(1520) → p + K (B.R. = 22.5%± 0.05%)
Lifetime = 12.6 fm/*c* , Quark content = uds

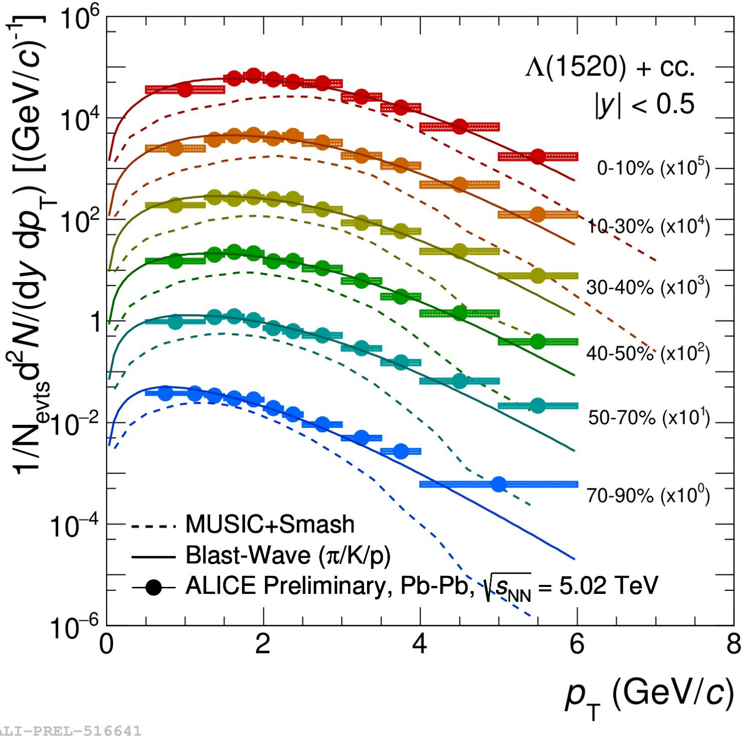


The production of Λ(1520) measured by the ALICE Experiment in **Pb-Pb collisions** at $\sqrt{s_{NN}}$ = **5.02 TeV** with **full run-2 data sample** is presented



- The signal extraction from the **invariant-mass analysis in the Λ (1520) → pK⁻** and charge conjugate **decay channel**.
- The p_T-differential yield is extracted with a combined fit (voigtian signal + residual background) and corrected for the detector acceptance and reconstruction efficiency

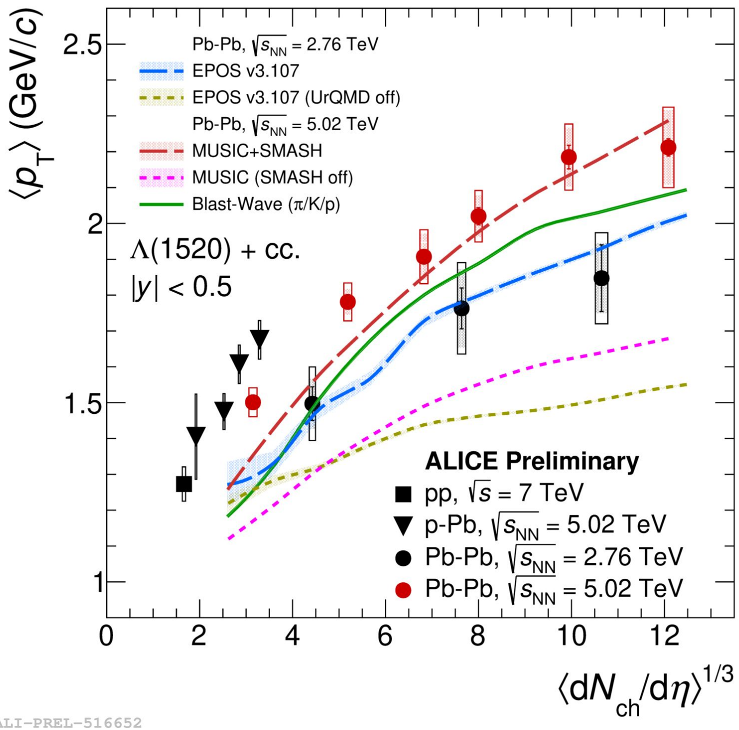
p_T-spectrum



- The Λ(1520) + cc. **p_T-differential yield measured at mid-rapidity** (|y| < 0.5) in the six centrality classes is shown
- The spectral shapes are compared with Blast-Wave[1] and **MUSIC hydrodynamic model** [2] with **SMASH afterburner** from Pb-Pb@5.02 TeV predictions
- The **spectral shapes are in agreement** with the **Blast-Wave** [2] (parameters obtained from π/K/p fits) and close to **MUSIC with SMASH afterburner** prediction at low p_T while diverge at high p_T
- **MUSIC slightly underestimates the data** with possible explanation that this model underestimates overall strangeness production at mid-rapidity

[1]ALICE: Phys.Rev.C 101 (2020)
[2]MUSIC:arXiv:2105.07539

$<p_T>$ results



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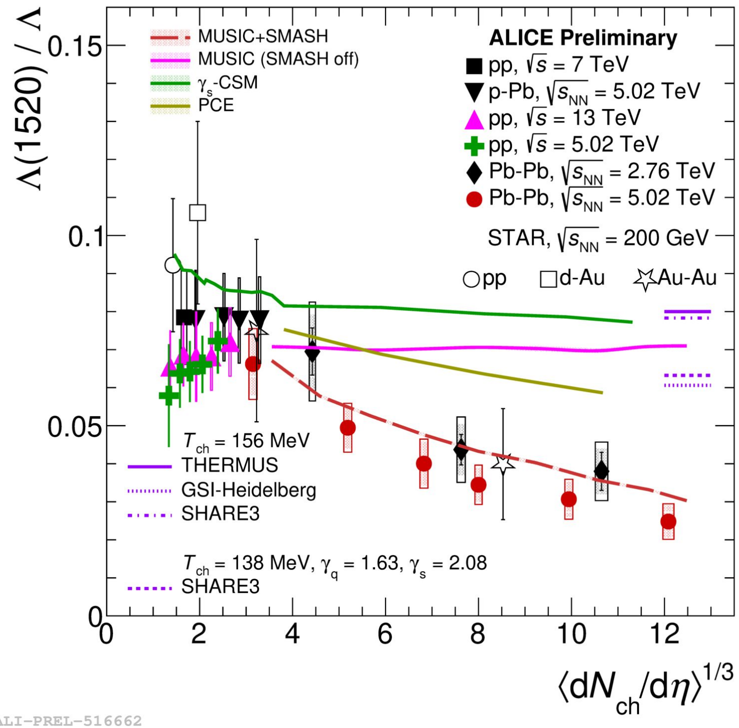
- The $<p_T>$ **increases from peripheral to central collisions** (~47% higher in 0-10% than 70-90% centrality values)
  → **higher than Pb-Pb 2.76 TeV [3] values**
  → higher than Blast-wave model (πK/p) [2] and EPOS3 (with UrQMD) model [4] predictions at 2.76 TeV
  → But EPOS3 fails to predicts data if UrQMD is off

- **Predictions from MUSIC+SMASH afterburner** [2] predictions are consistent with data in central collisions but underestimates in peripheral collisions, overall **better agreement with the data**

- When SMASH is turned off, the $<p_T>$ is underestimated

[3] ALICE: Phys. Rev. C 99, 024905
[4] EPOS3: *10.1103/PhysRevC.93.014911*

Particle ratio



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- The **p_T-integrated Λ(1520)/Λ yield ratio** is shown
  → the ratio is **suppressed in central collisions (0-10%)** if compared to the values observed in peripheral collisions, p-Pb, pp collisions and predictions from statistical hadronisation models
  →**62.55% lower than 70-90% peripheral Pb-Pb at 7.1σ level**
  → 60% lower than thermal model predictions [5,6,7,8,9]
  → **follows published PbPb@2.76 suppression trend** [3]
  →Higher precision and wider multiplicity coverage

- **MUSIC with SMASH afterburner** [2]
  →**reproduce the multiplicity suppression trend**, better agreement

- **MUSIC without SMASH**
  → first ever prediction without a afterburner, gives a flat curve
  → matching to peripheral 70-90% Pb-Pb collisions and near to the pp values

- These measurements with **highest multiplicity and improved accuracy** further confirm the existence of a **hadronic phase lasting enough** to cause a significant reduction of the reconstructible yield of short lived resonances

[5] **PCE:***Phys.Rev.C 102 (2020) 2, 024909*
[6] **CSM:***Phys.Rev.C 100 (2019) 5, 054906*
[7] *Wheaton et al., J.Phys. G 31 (2005) S1069*
[8] *Andronic et al., Nucl.Phys. A 772 (2006) 167*
[9] *Petran et al., Comput.P.Comm. 185 (2014) 2056*