Enhancement of strange and multi-strange hadron production in pp and p-Pb collisions at the LHC

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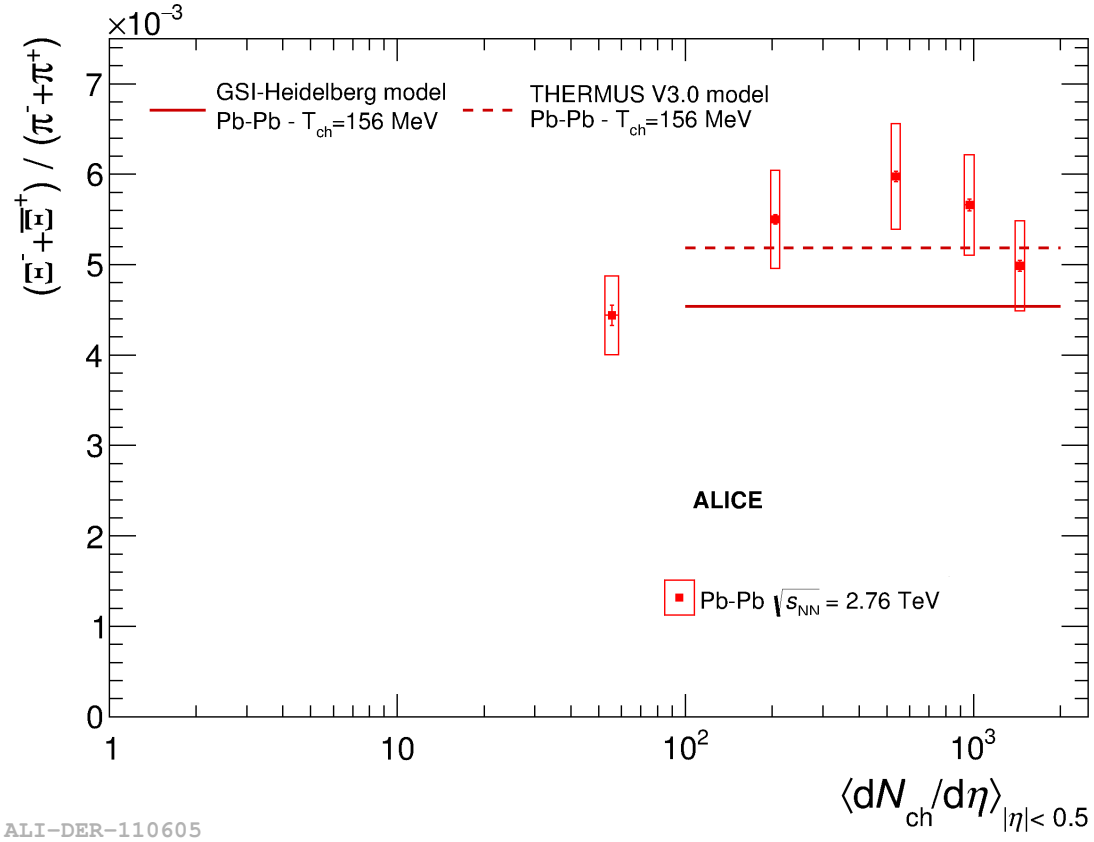
Outline of the talk

- **Introduction and motivation**
- **The ALICE detector setup**
- **Results: transverse momentum spectra and yields of K^0_s, Λ, Ξ, and Ω**
- **Comparison to models**
- **Summary and conclusions**

ALICE

Introduction and Motivation



- Strangeness production: one of the first proposed signatures of QGP formation in heavy ion collisions.
  (Phys. Rev. Lett. 48,(1982) 1066)

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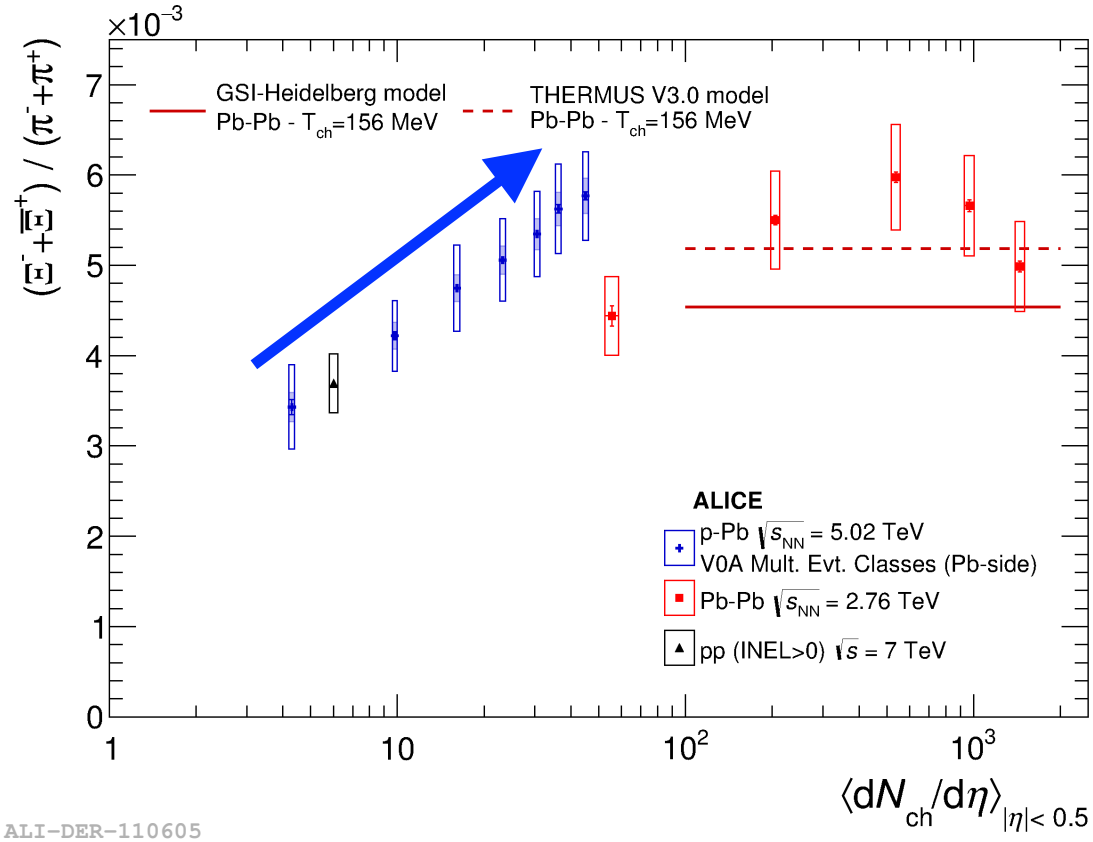

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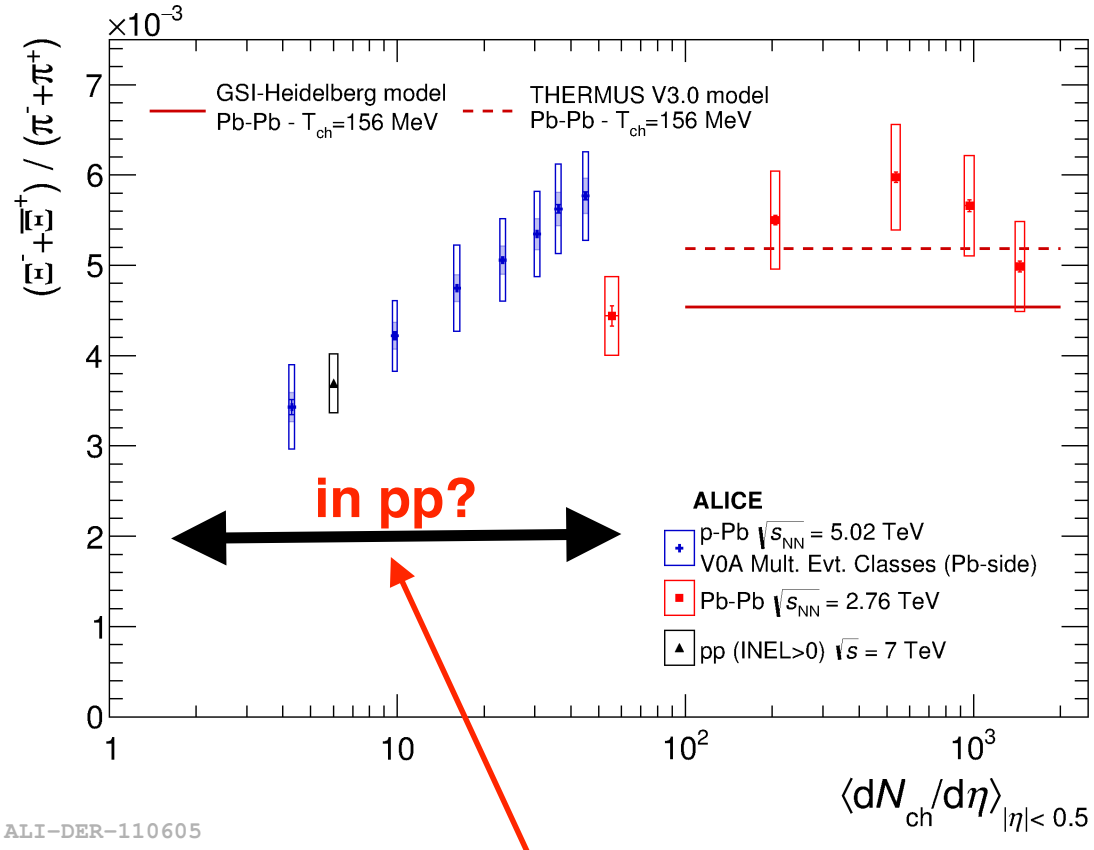

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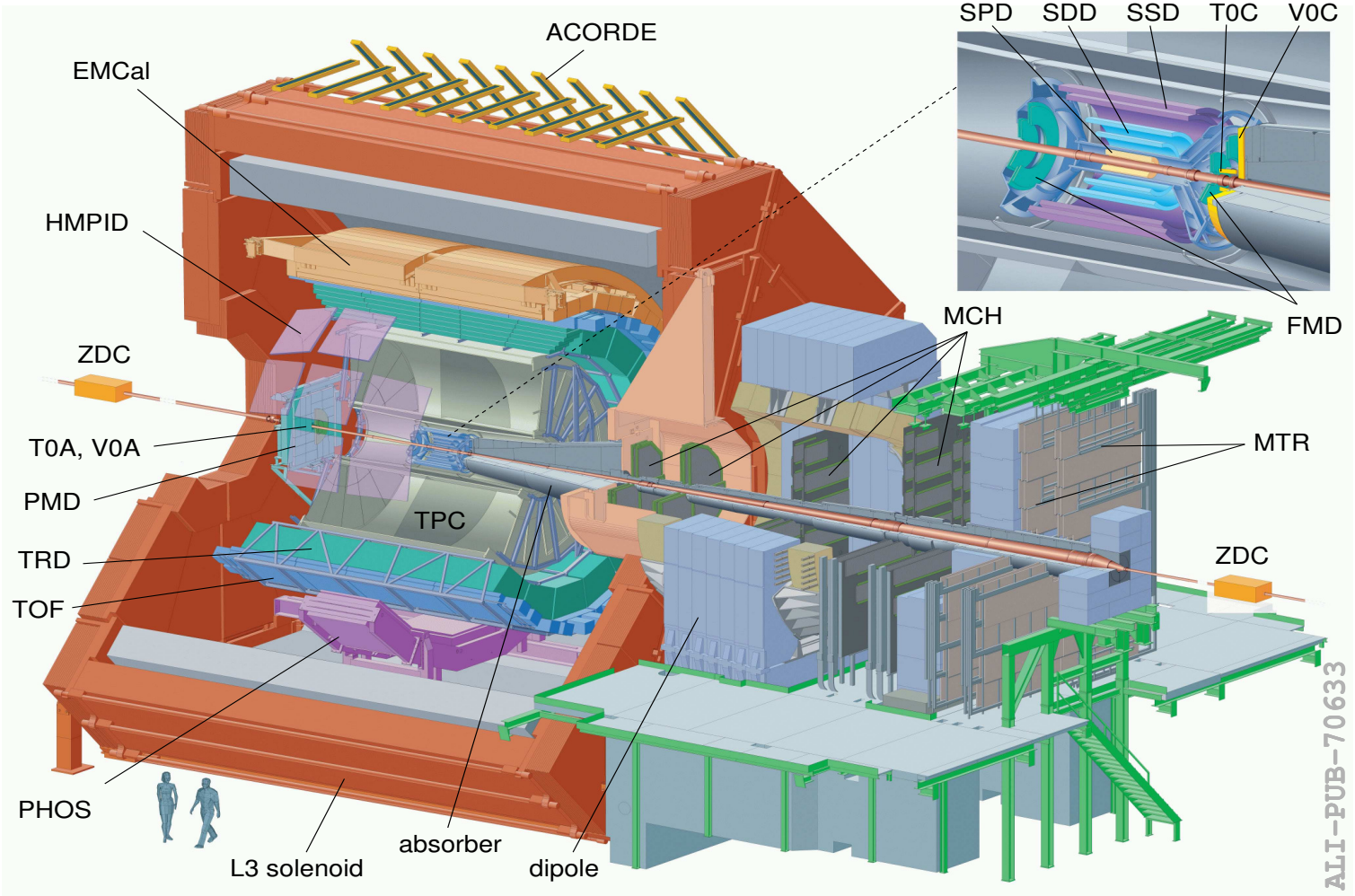
What is the multiplicity dependence of strangenss production?

The ALICE Detector at LHC



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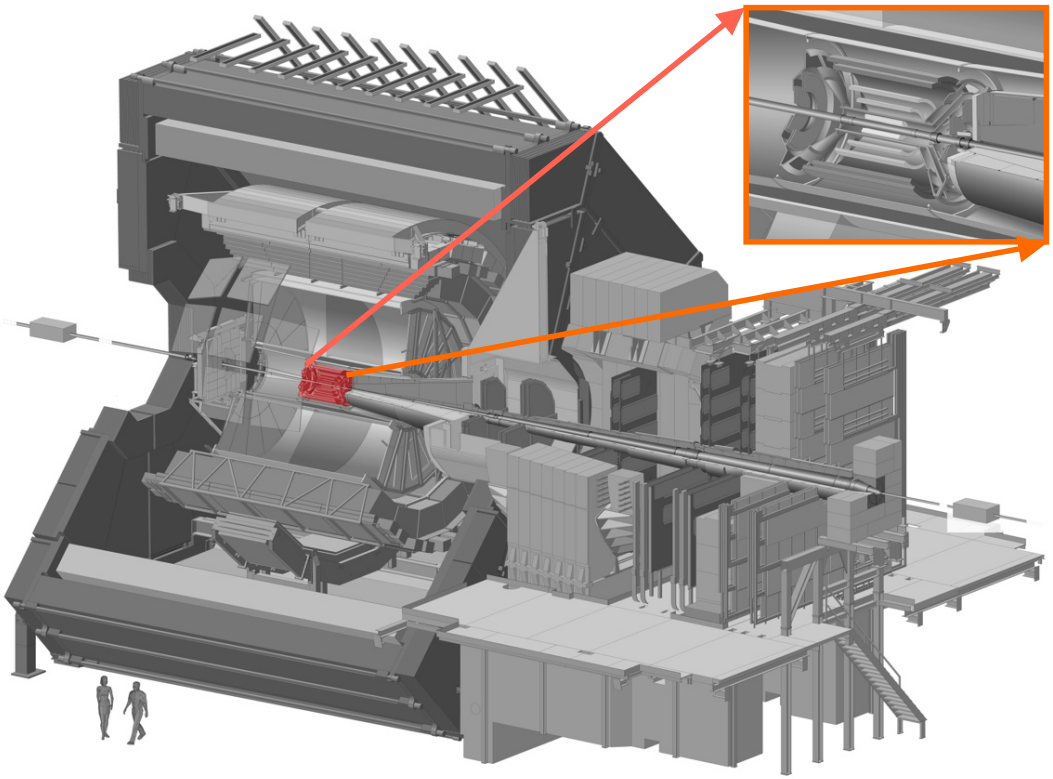
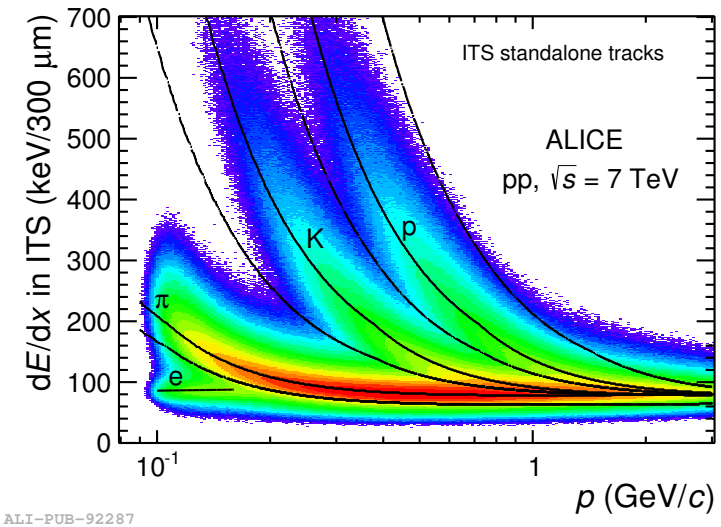


Inner Tracking System (ITS) $|\eta| < 0.9$

- Six layers of silicon detectors.
- Tracking, Vertexing, triggering and PID of p, K, π etc. using dE/dx.



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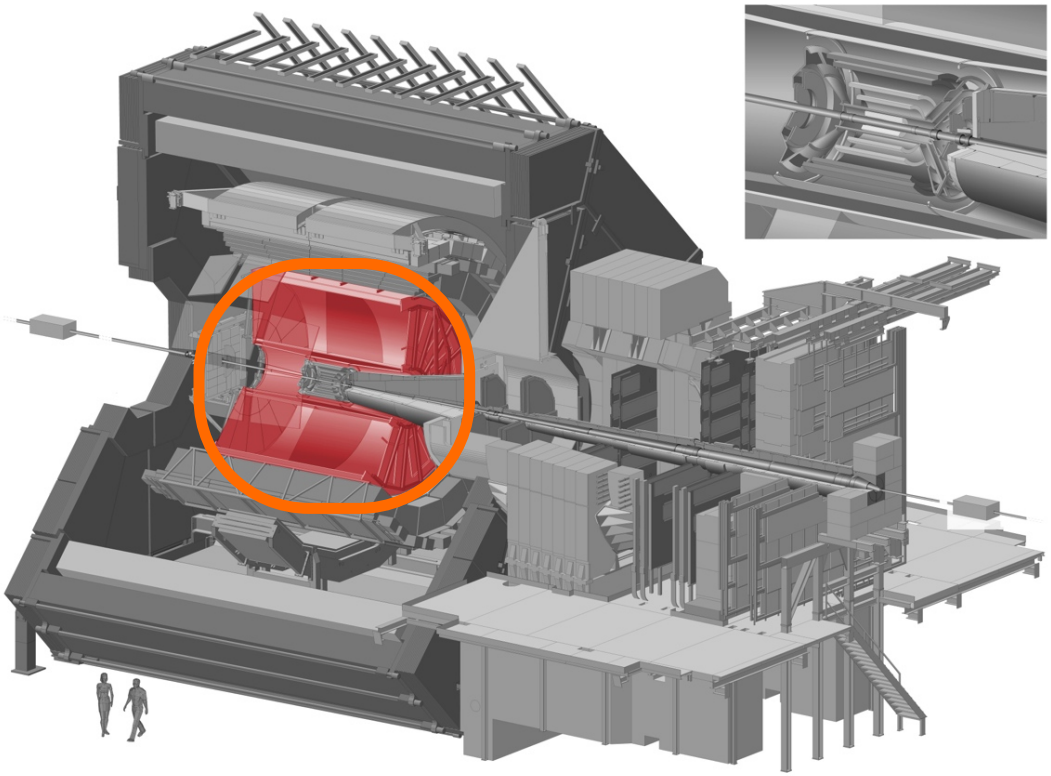
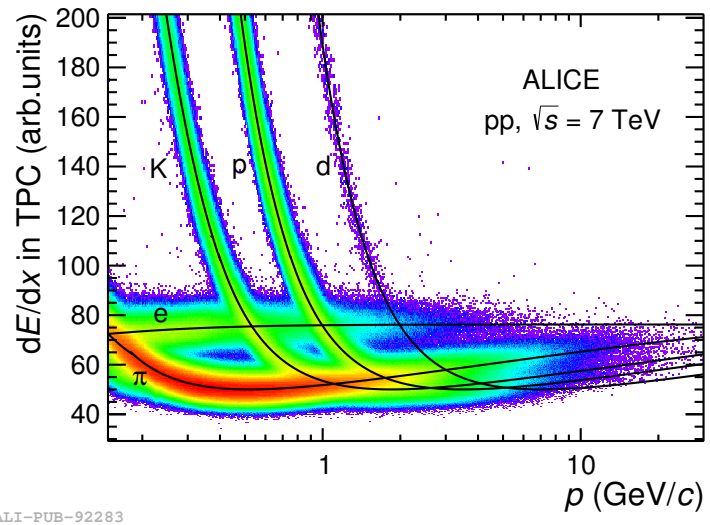
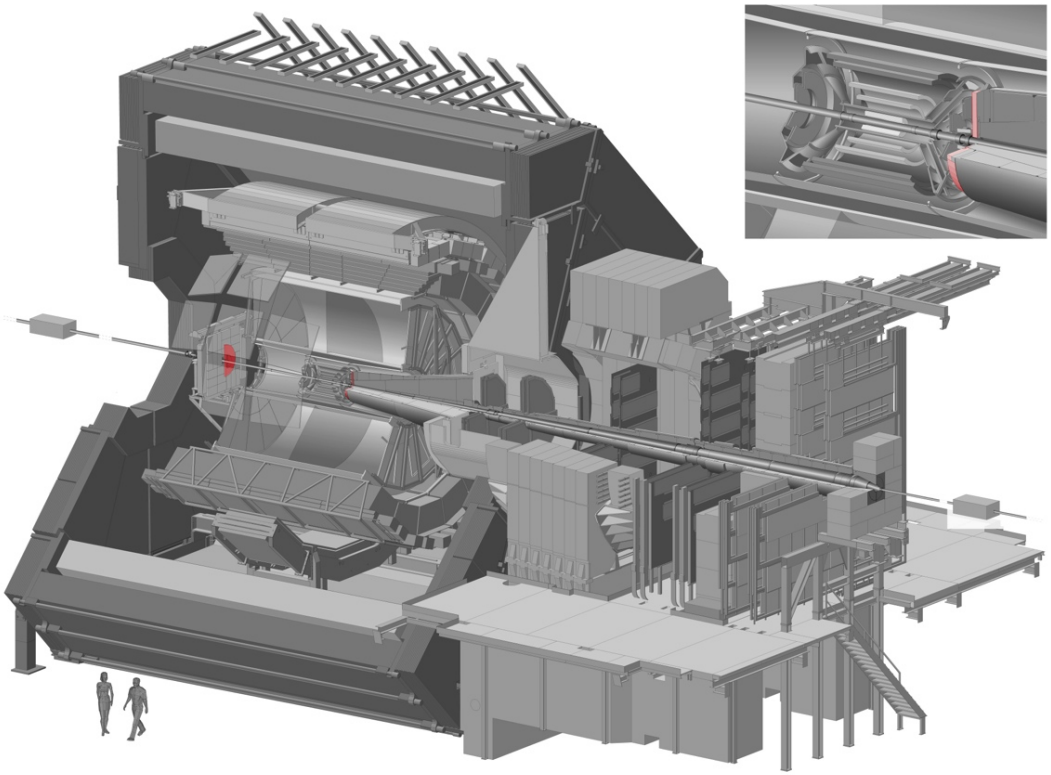


Time Projection Chamber (TPC) $|\eta| < 0.9$

- Ionization Chamber filled with Ar-CO_2 gas mixture
- Tracking, Vertexing, and PID of p, K, π etc. using dE/dx.

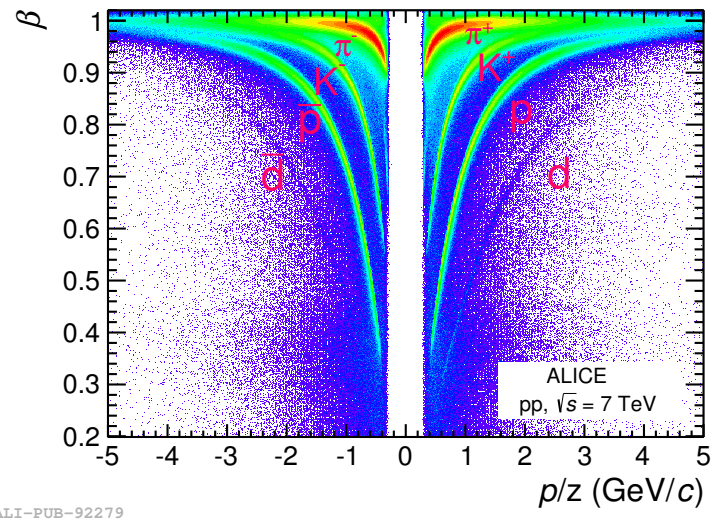


The ALICE Detector at LHC



Time of Flight (TOF) $|\eta| < 0.9$

- Multi-gap resistive plate chambers
- Particle identification using velocity measurements



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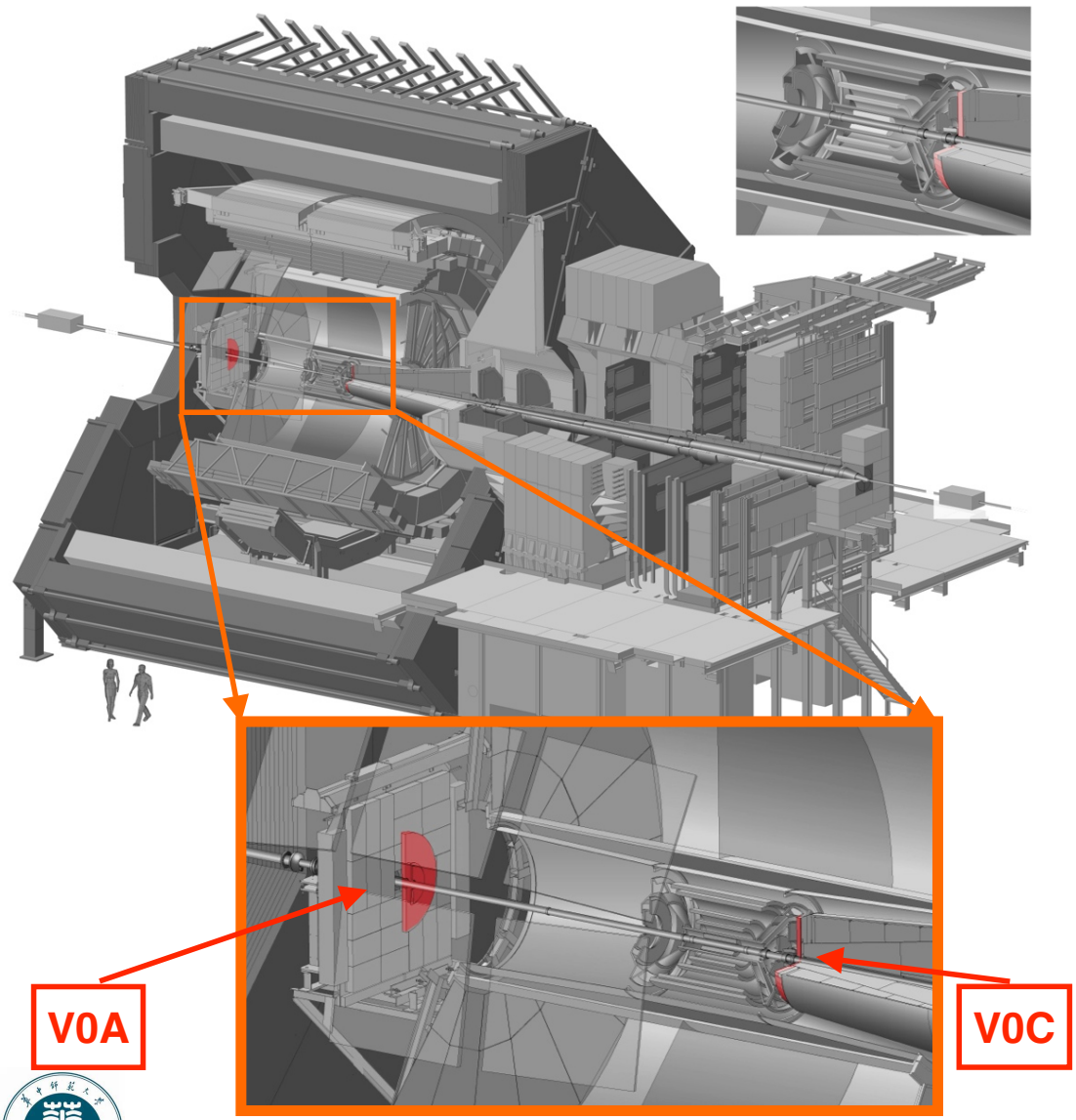
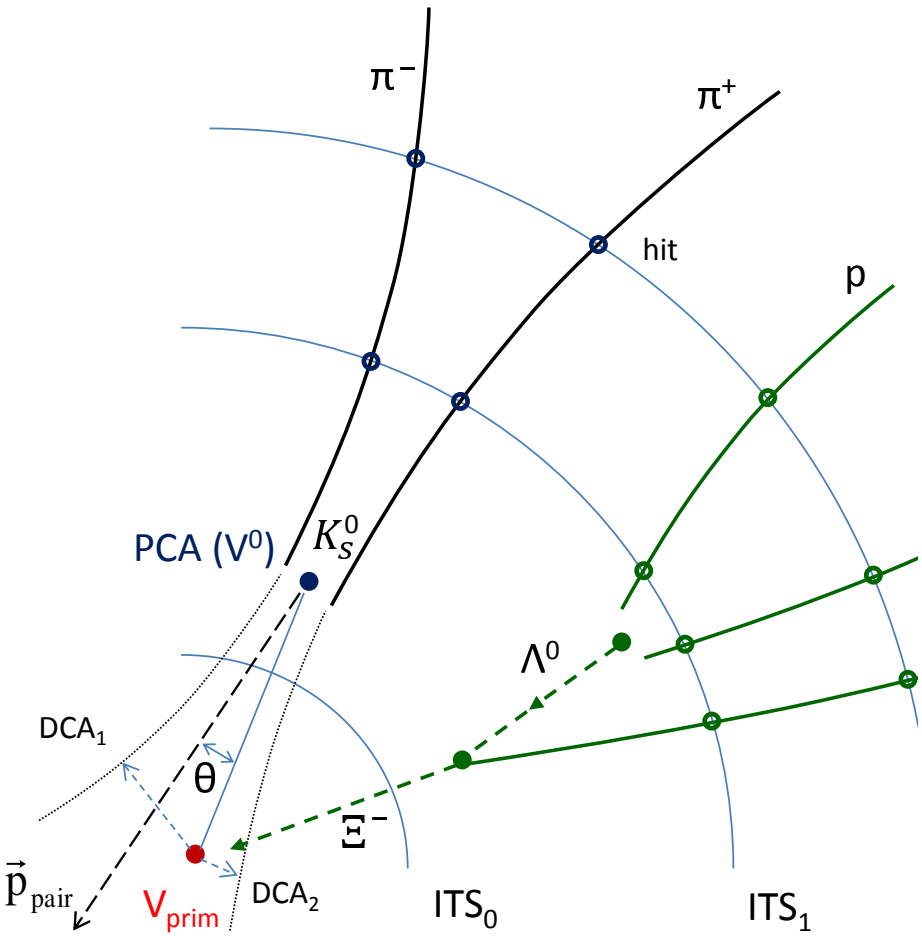
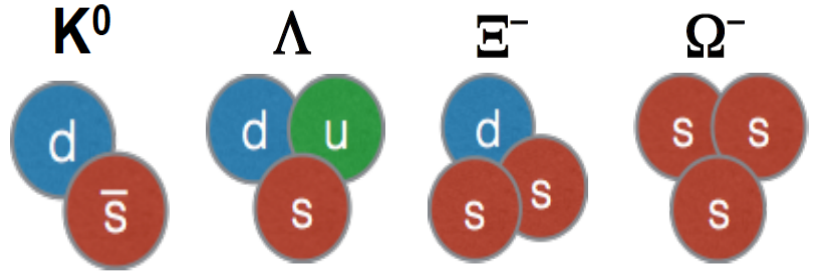


Forward Scintillators

- V0A ($2.8 < \eta < 5.1$)
  V0C ($-3.7 < \eta < -1.7$)
- Triggering and background rejection (beam gas etc.)
- Forward multiplicity estimator (V0M): total charge deposited in V0A and V0C scintillators
- Average multiplicity density $\langle dN_{ch}/d\eta \rangle$ is estimated as total primary charged tracks in $|\eta| < 0.5$

Strange and Multi-strange hadron reconstruction

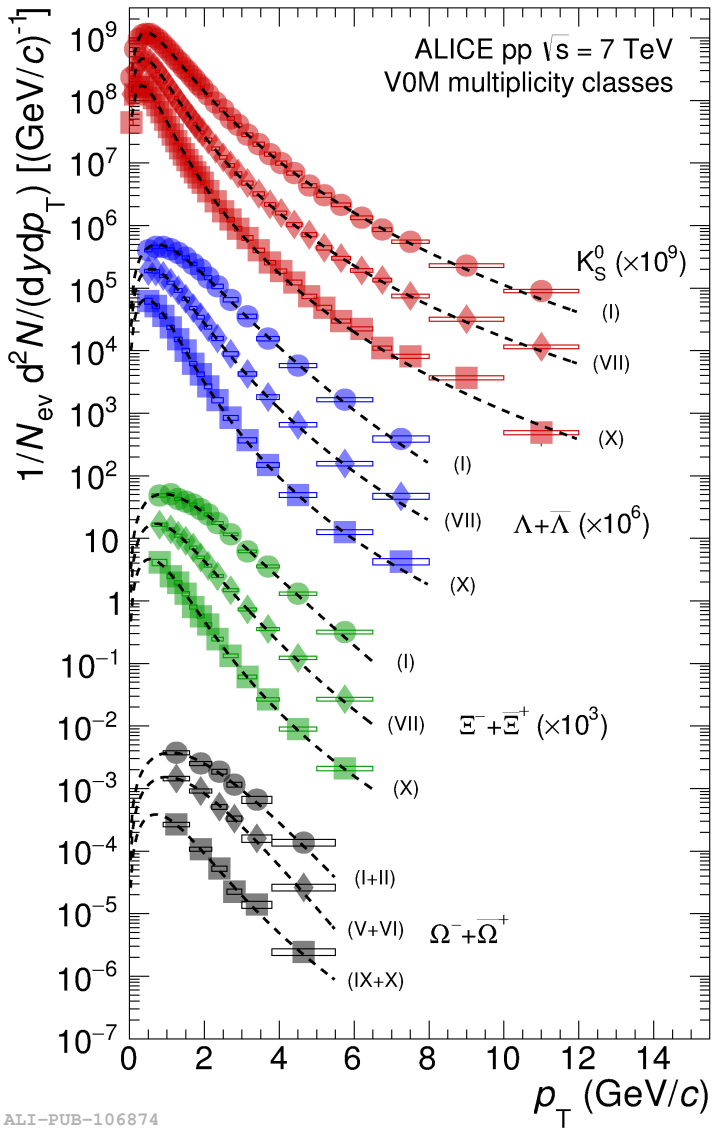




- $K_s^0 \longrightarrow \pi^+ + \pi^-$ (B.R. 69.2 %)
- $\Lambda \longrightarrow p + \pi^-$ (B.R. 63.9 %)
- $\Xi^- \longrightarrow \Lambda + \pi^-$ (B.R. 99.9 %)
- $\Omega^- \longrightarrow \Lambda + K^-$ (B.R. 67.8 %)

- Charged tracks reconstructed using ITS+TPC
- TPC PID to identify decay products
- Reconstruct invariant mass

Transverse Momentum Spectrum (pp)

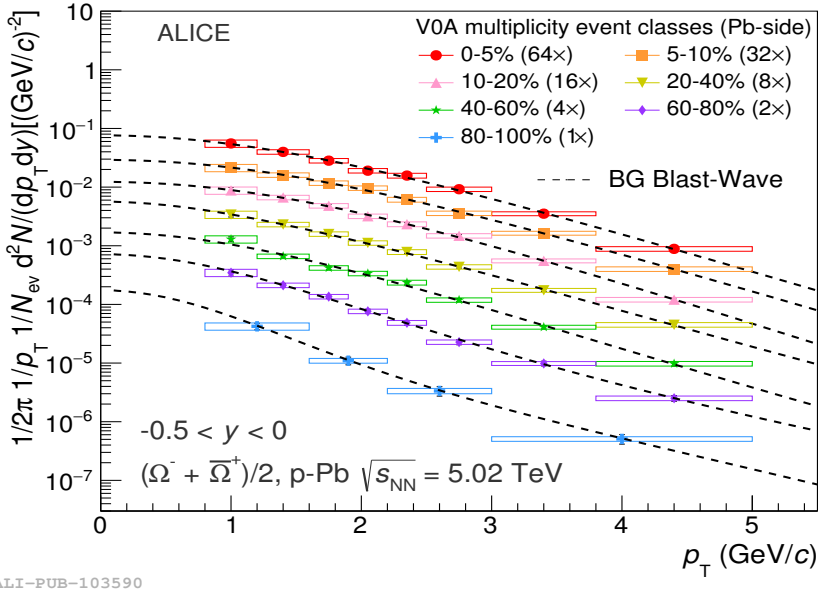


- Spectral shape harder in high multiplicity than low-multiplicity events classes

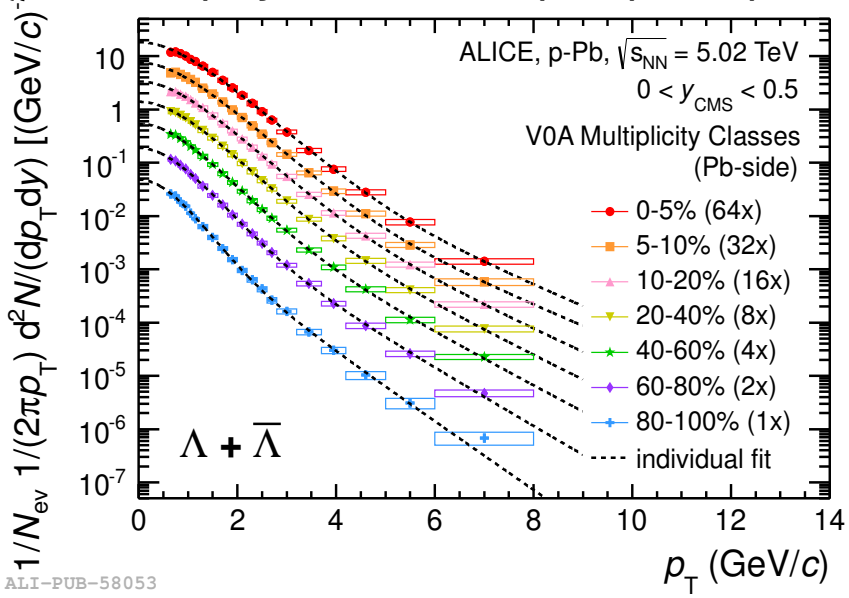
(arXiv:1606.07424)

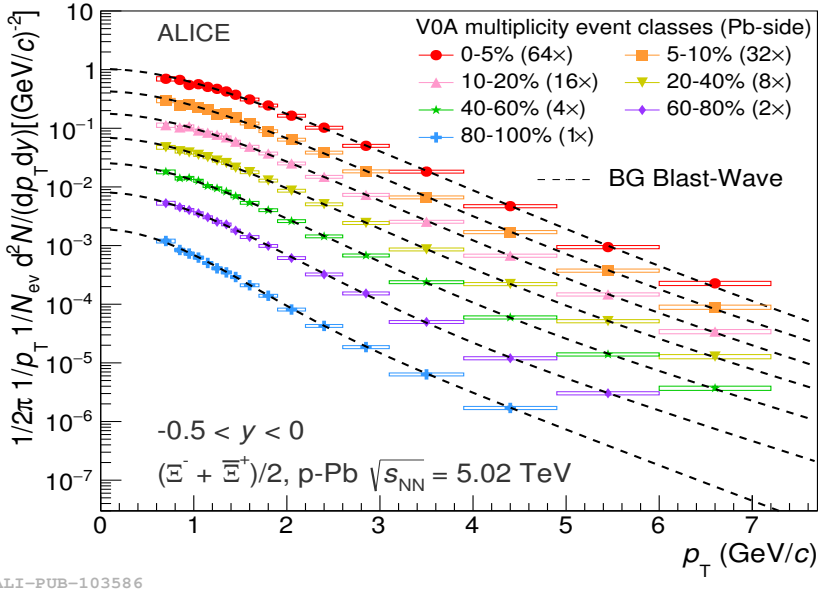
Transverse Momentum Spectrum (p-Pb)

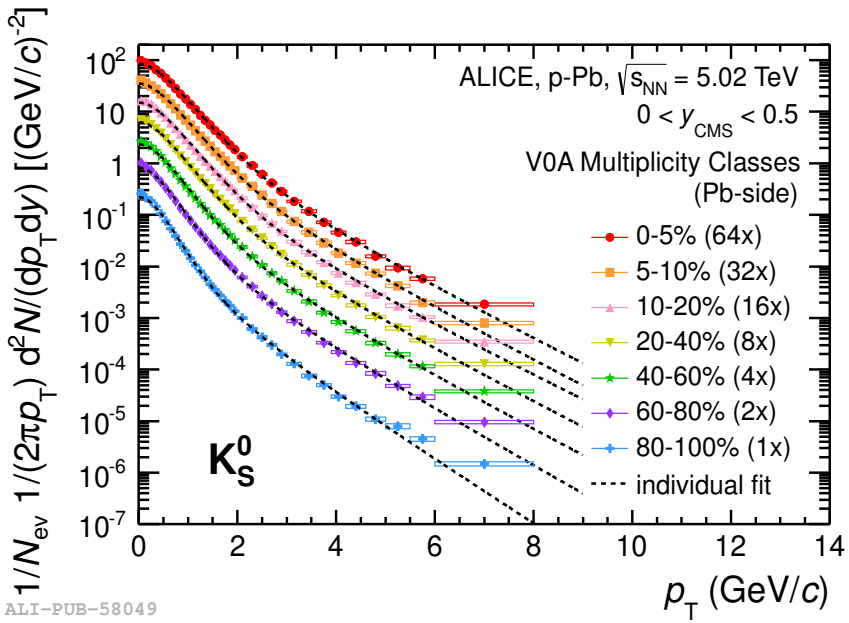
(Phys. Lett. B 758, (2016) 389-401)



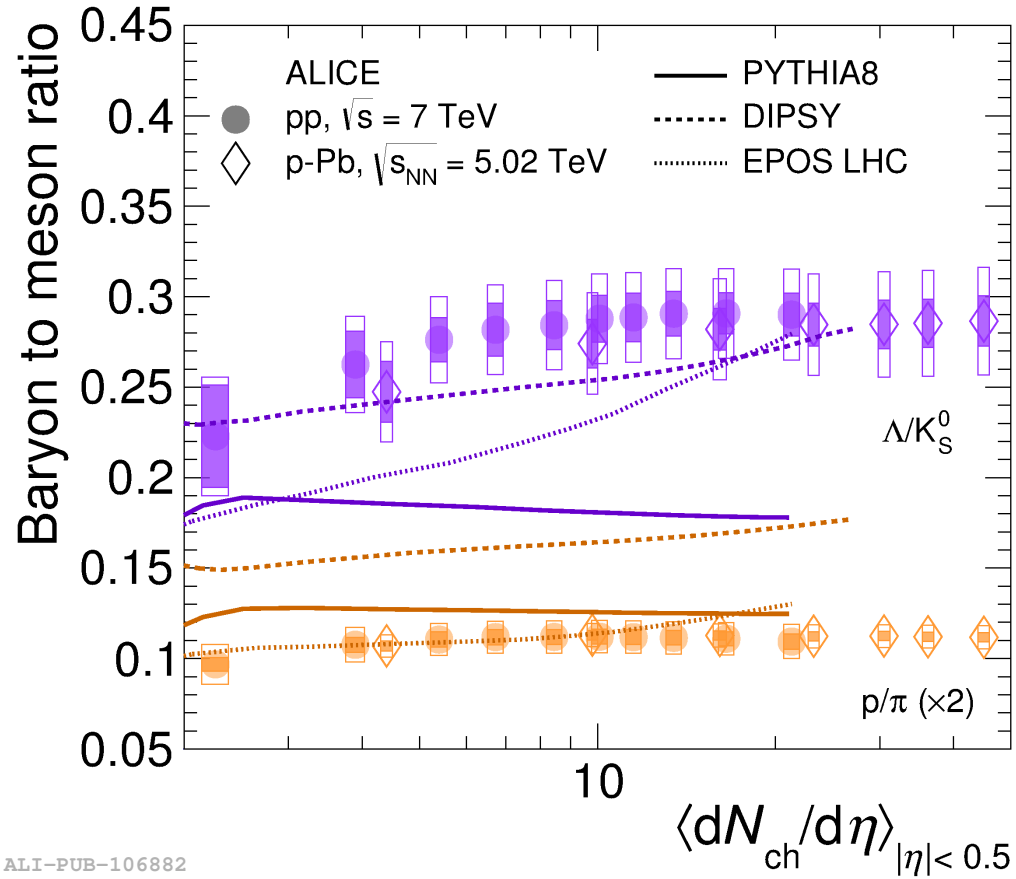
(Phys. Lett. B 728, (2014) 25-38)





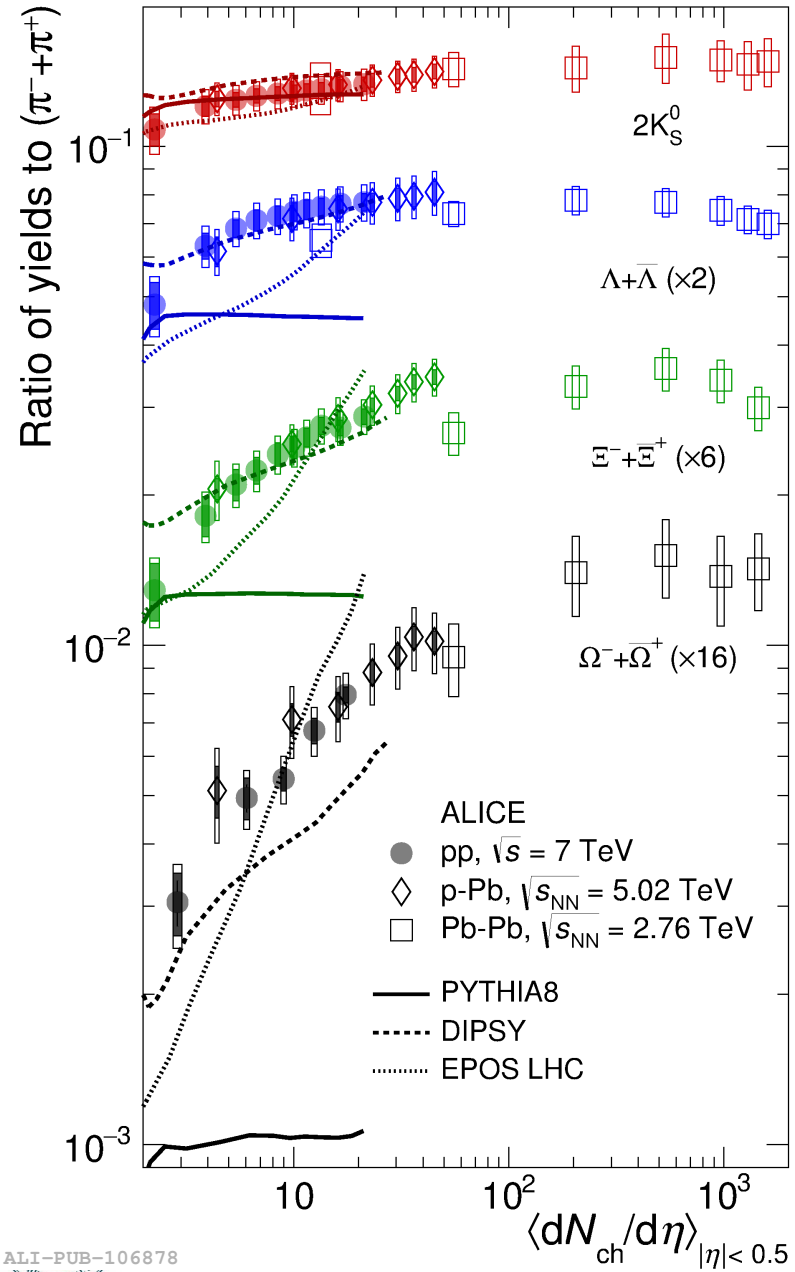


Baryon to Meson Ratio in pp and p-Pb



- The Λ/K^0_s and p/π ratio are compatible between pp and p-Pb
- No significant multiplicity dependence of p/π ratio.

Strangeness Enhancement in pp and p-Pb



ALI-PUB-106878

- Significant enhancement of strange & multi-strange particle production
- Similar trend is observed in p-Pb collisions
- Particle ratios reach values that are similar to those observed in Pb-Pb collisions
- Strangeness enhancement increases with the strangeness content in hadrons
- No MC models describes the data satisfactorily

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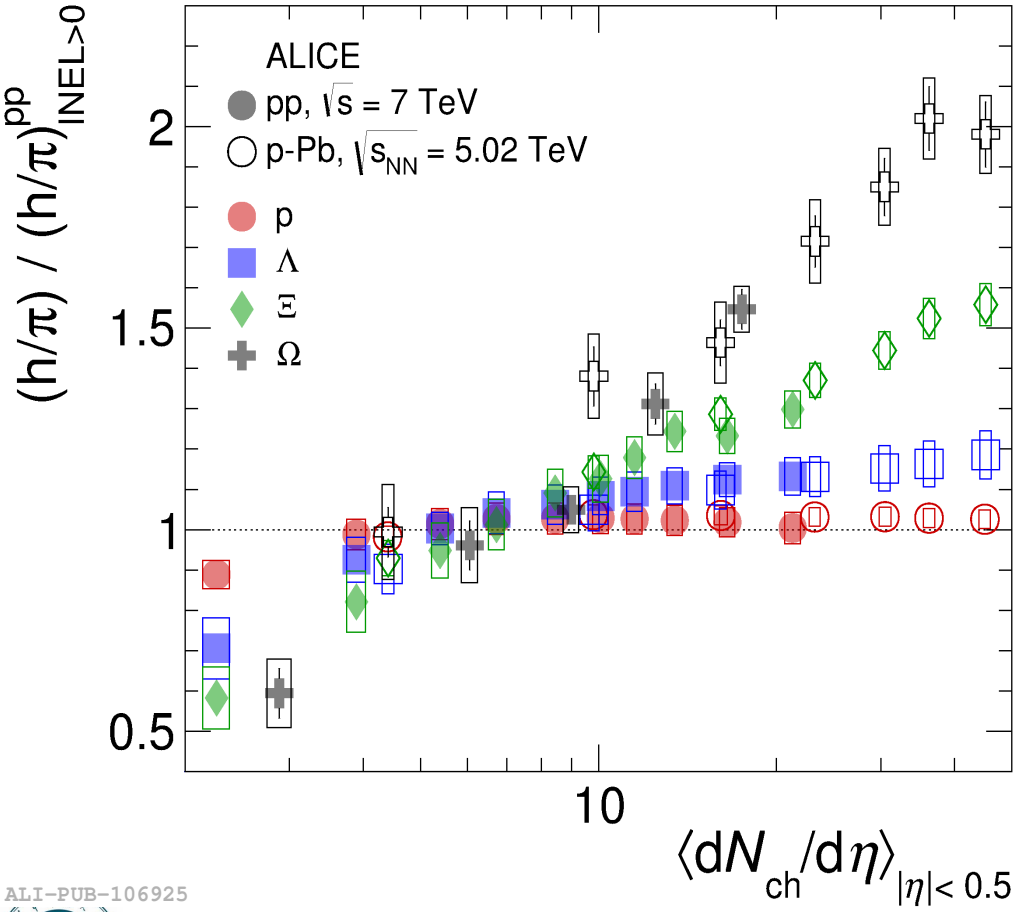
Multiplicity dependence in pp

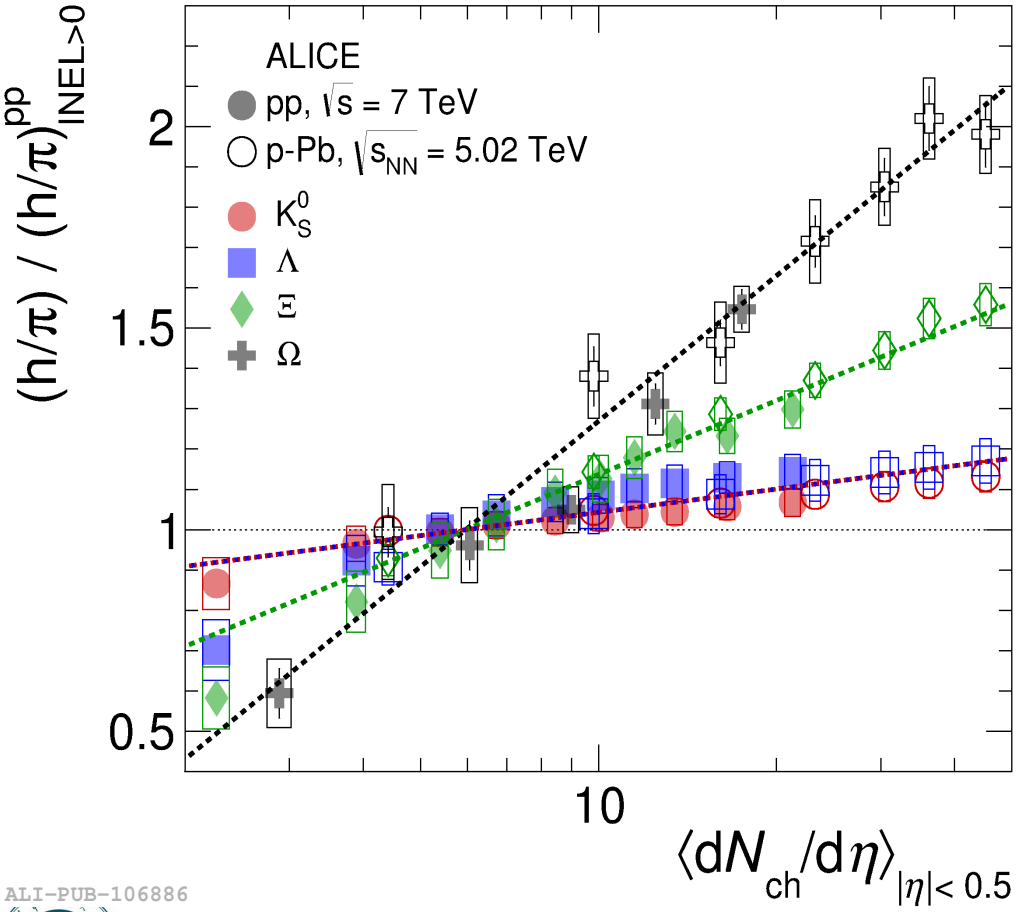
- Yield ratios normalized to pp INEL > 0 (reduced syst. uncert.)
- The p/π ratio is consistent with unity.



ALI-PUB-106925

Multiplicity dependence in pp

- Yield ratios normalized to pp INEL > 0 (reduced syst. uncert.)
- The p/π ratio is consistent with unity.



- Multiplicity dependence on strangeness described as:

$$\frac{(h/\pi)}{(h/\pi)^{pp}_{INEL>0}} = 1 + a\, S^b \log\left[\frac{\langle dN_{ch}/d\eta\rangle}{\langle dN_{ch}/d\eta\rangle^{pp}_{INEL>0}}\right]$$

parameter b = 1.67 $\pm$ 0.09

ALI-PUB-106886

Summary and Outlook

- First observation of a multiplicity dependence of strangeness production in pp collisions at 7 TeV.
- Integrated baryon to meson ratio is consistent between pp and p-Pb and no significant enhancement in proton to pion ratio.
- An enhanced production of strange and multi-strange particles has been observed in high-multiplicity pp collisions and this enhancement is stronger for higher strangeness.
- None of the tested MC models fully describe these observations.

THANK YOU FOR YOUR KIND ATTENTION!

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