# Multiplicity dependence of strangeness production in proton-proton collision at √s = 5.02 TeV with ALICE at the LHC

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## Physics motivation

**Strange hadron production:** key tool for understanding hadronization and thermalization in Quark-Gluon Plasma (QGP) :

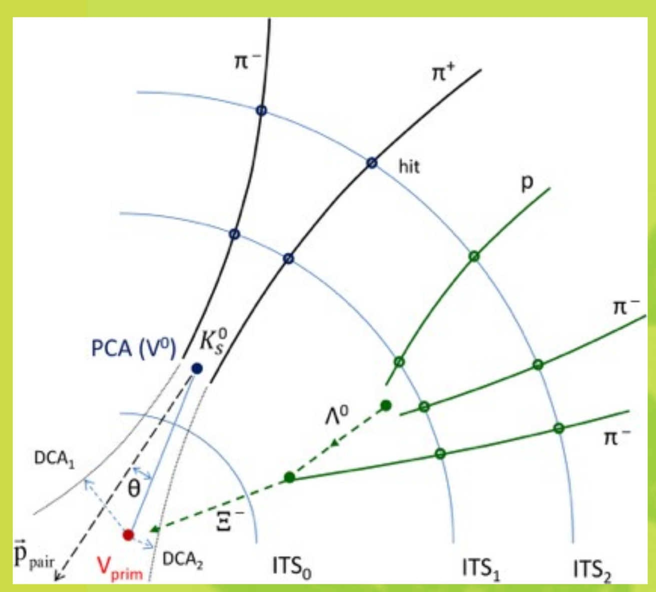
- soft probe originally proposed as a signature of QGP formation in heavy-ion collisions (HI) [1]
- several similarities observed recently between HI and high multiplicity pp collisions

**Hadrochemistry in pp collisions :**

- benchmark for HI physics
- can shed light on the dynamics of small collisions systems
- collected data at √s = 0.9, 2.76, 5.02, 7, 8, 13 TeV

## Identification of (multi-)strange baryons

- Kinematical and geometrical criteria are used to reconstruct candidates




- **V0** is a generic neutral particle decaying weakly into a pair of charged particles.
- **Cascade** is a generic charged particle decaying weakly into a V0 plus a charged particle.

$K^0_S \to \pi^+ + \pi^-$ BR : 69.2 %

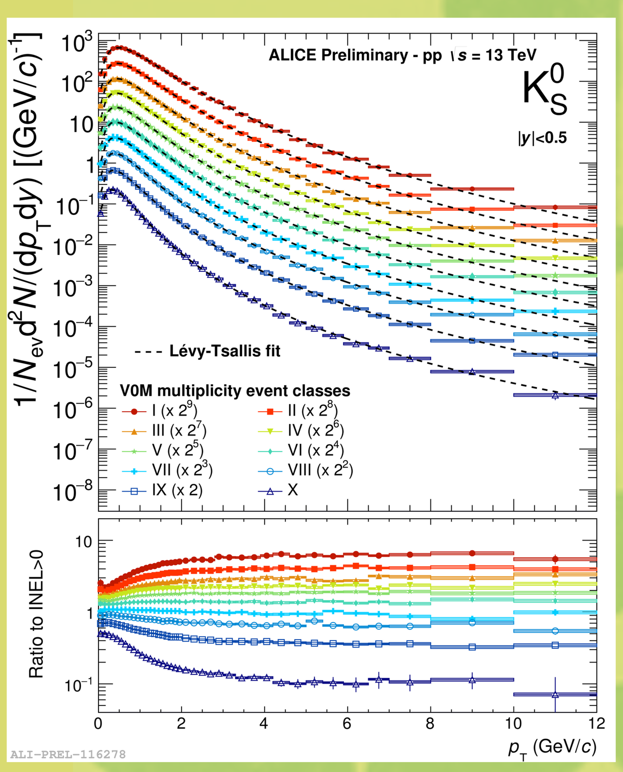
$\Xi^- \to \Lambda + \pi^-$ BR : 99.9 %

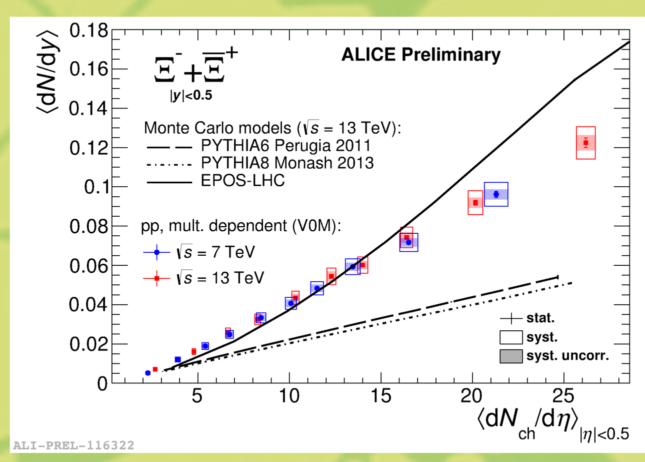
$\Lambda \to p + \pi^-$ BR : 63.9 %

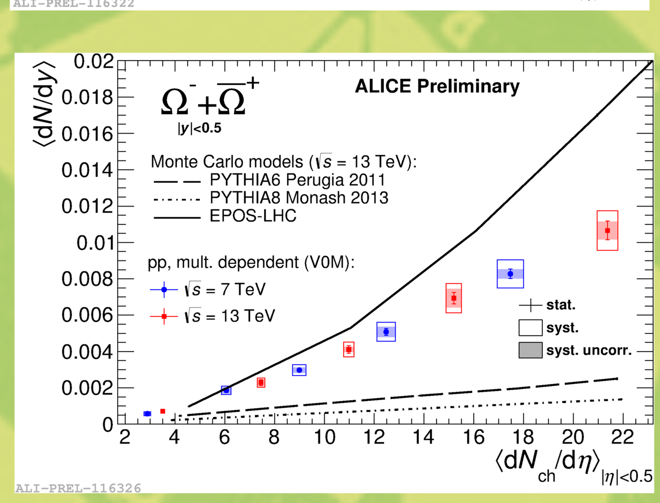
$\Omega \to \Lambda + K^-$ BR : 67.8 %

Data sample under study :
**pp:** about 118×10⁷ minimum bias collisions at √s = 5.02 TeV taken in 2017

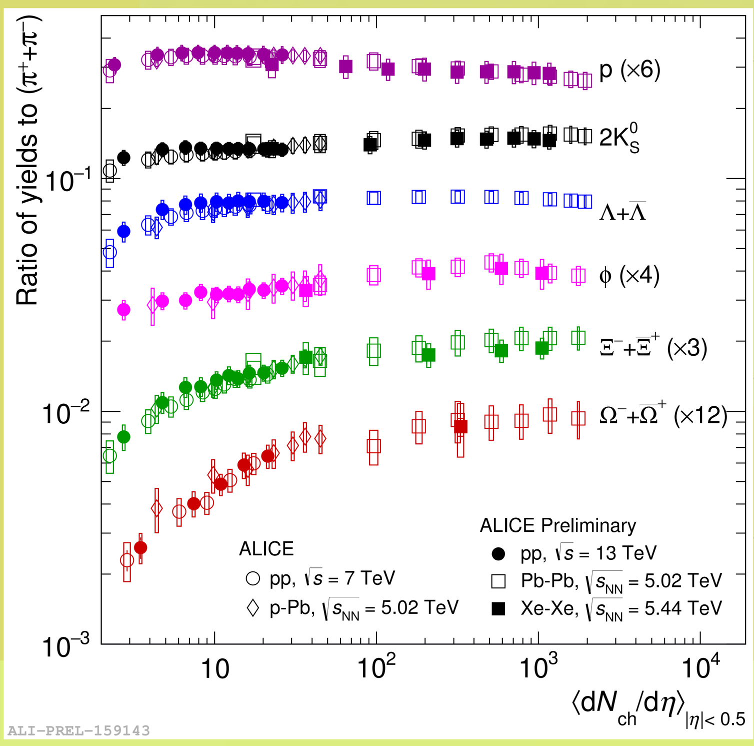
## Hadrochemistry



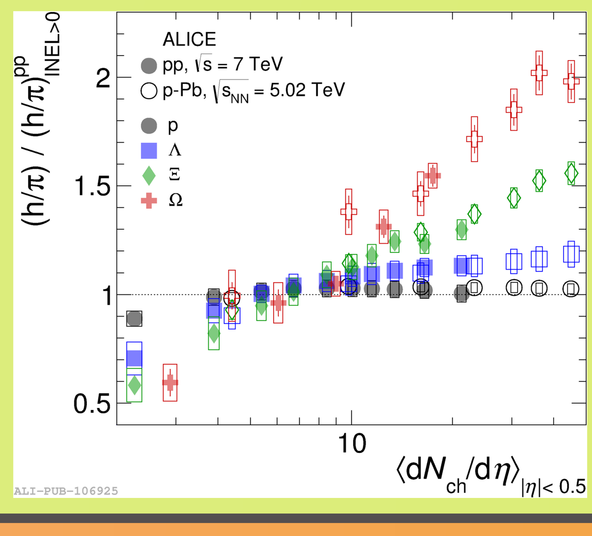




- The $p_T$ **spectra** became harder as the multiplicity increases
- Possible interpretation: particle emission from a **collectively expanding system**
- **Yields** in minimum bias pp collisions at different energies follow the same trend



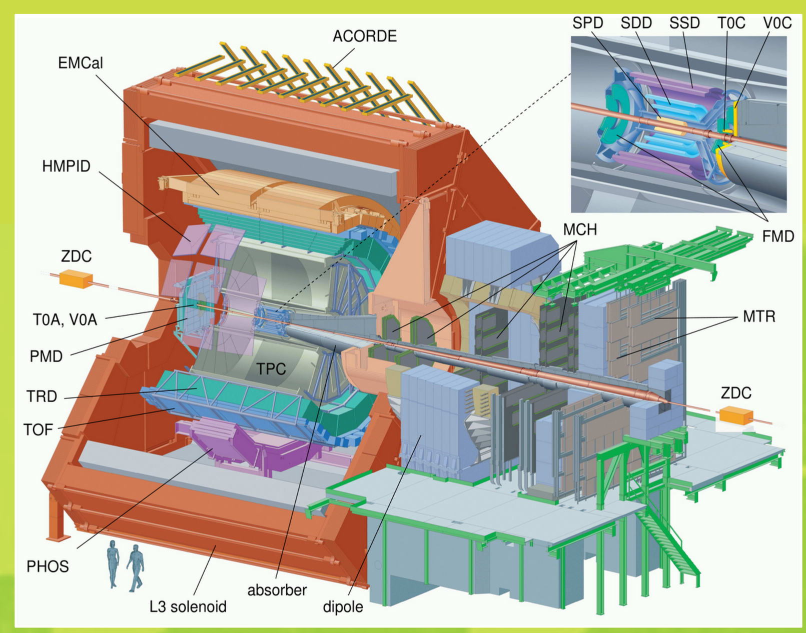

- $p_T$**-integrated yield ratios to pions show enhancement [4]** from low multiplicity pp to central Pb-Pb collisions
- Smooth evolution between pp, p-Pb and Pb-Pb collisions
- Yields ratios show for all particles a saturation in central Pb-Pb collisions

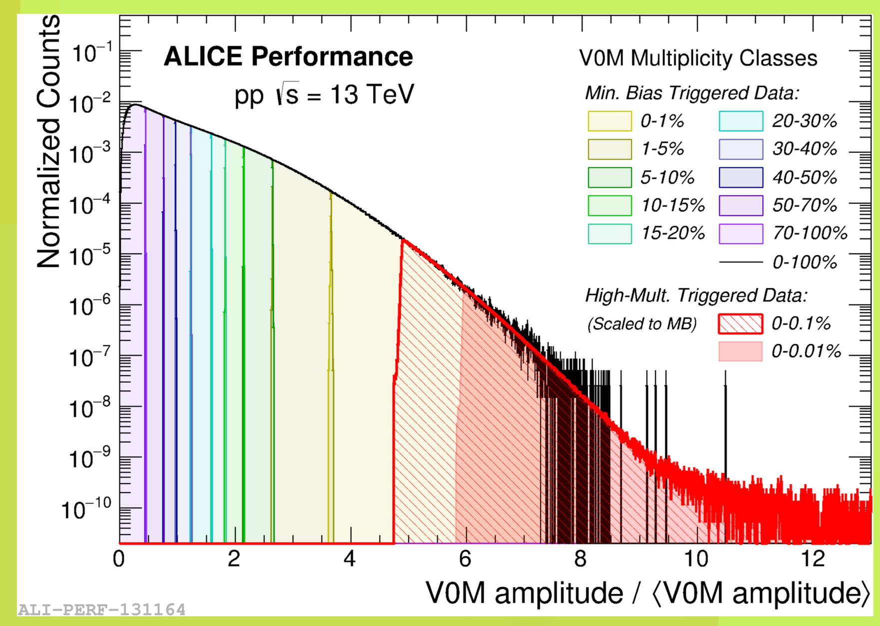
- Slope increases with increasing **strangeness content** in pp and p-Pb collisions




## ALICE at the LHC

More details about the detector can be found in [2]




**ITS** ($|\eta| < 0.9$)
6 layers of silicon detectors
-triggering
-tracking and (secondary) vertexing
-PID (dE/dx)

**TPC** ($|\eta| < 0.9$)
Gas-filled detector mainly used for:
-tracking and vertexing
-PID (dE/dx)
Momentum measurement
0.1 GeV/c < $p_T$ < 100 GeV/c

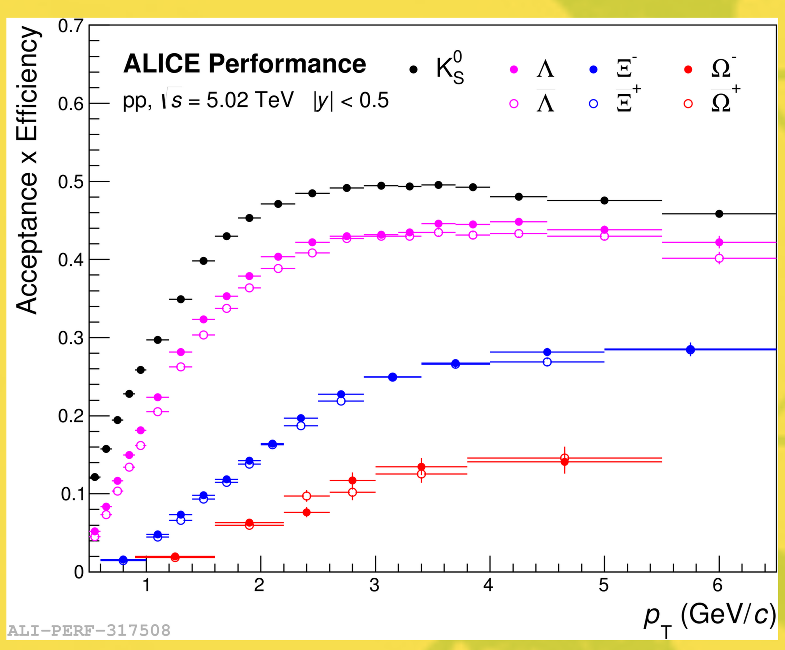
**V0A** (2.8< η <5.1) **and V0C** (-3.7< η <-1.7)
Forward-rapidity arrays of scintillators
-triggering,
beam gas rejection, **multiplicity estimator**

**TOF** ($|\eta| < 0.9$)
Made by MRPCs
-PID
-pile-up rejection

**Multiplicity estimation:**

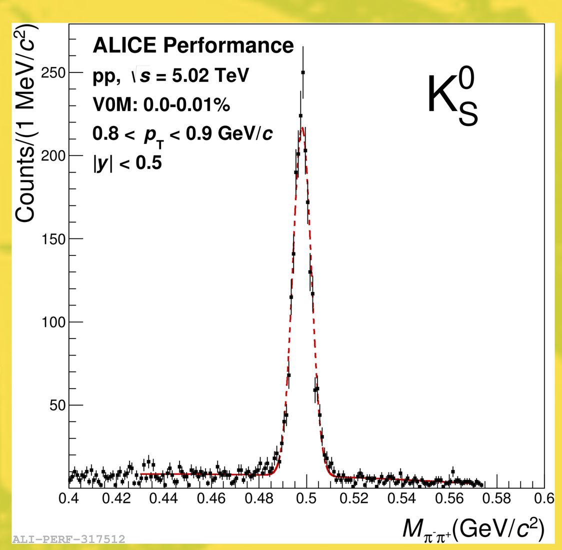
- data sample divided in V0M (V0A and V0C) amplitude classes
- **multiplicity** is the measurement of the average number of primary charged particles at central rapidity for each V0M amplitude class

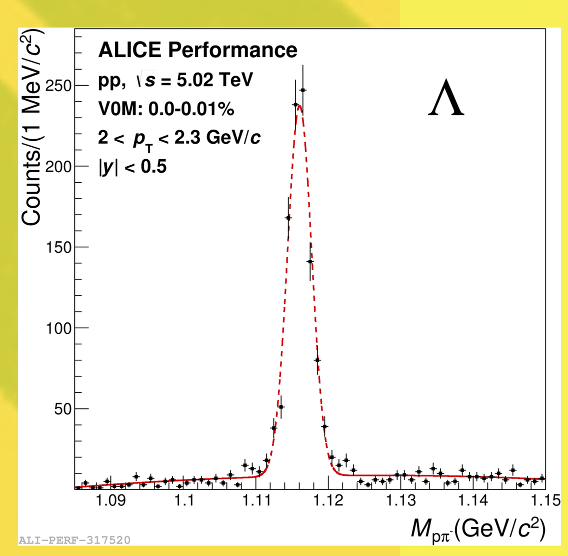
## Particle reconstruction in pp collisions @ 5.02 TeV

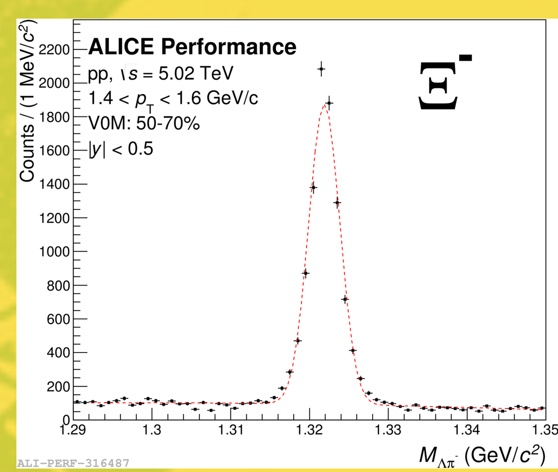


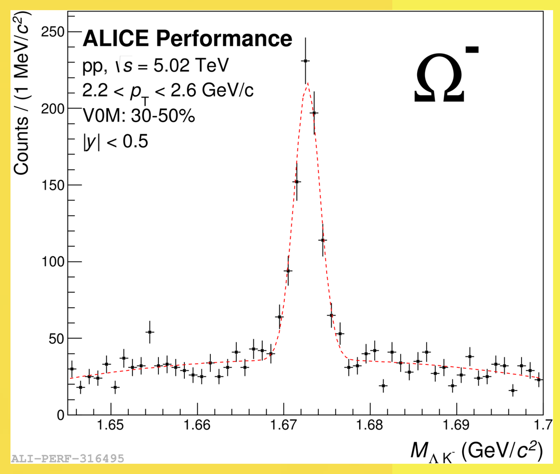

- **Detector acceptance times efficiency** dependence on $p_T$ was estimating with QCD-inspired MC models, namely PYTHIA8 with Geant3 transport [3]

- **Invariant mass distributions** for **V0s** and **Cascades** reconstructed for selected $p_T$ and multiplicity bins
- **Clear signal** observed for all strange hadrons in minimum bias data sample
- The invariant mass spectra are fitted by a **polynomial+gaussian fuction** to determine **mean** and **width** of the peak
- The **highest multiplicity** class reached for certain particles :
  - ***V0s*** : 0-0.01% ~ 24.43 $\langle dN_{ch}/d\eta \rangle_{|\eta|<0.5}$
  - Ξ : 0-0.1% ~ 21.89 $\langle dN_{ch}/d\eta \rangle_{|\eta|<0.5}$
  - Ω: 0-1% ~ 18.45 $\langle dN_{ch}/d\eta \rangle_{|\eta|<0.5}$




## Conclusions

- Particle yields driven by $\langle dN_{ch}/d\eta \rangle$ regardless of the collisions energy and system
- Strangeness enhancement more important for particles with higher strangeness content
- First look to the pp data sample collected at 5.02 TeV is promising. Finalization of these results with high statistics will come soon

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[1] J. Rafelski and B. Müller, PRL48, 1066 (1982);
[2] The ALICE Collaboration et. al. 2008 JINST 3 S08002;
[3] P. Skands, S. Carraza, J. Rojo, 1434-6052, (2014);
[4] ALICE Collaboration, Nature Physics 13, 535–539 (2017)

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