Measurement of the net-kaon net-Ξ correlations in pp, p–Pb and Pb–Pb collisions with ALICE

Mario Ciacco, on behalf of the ALICE Collaboration

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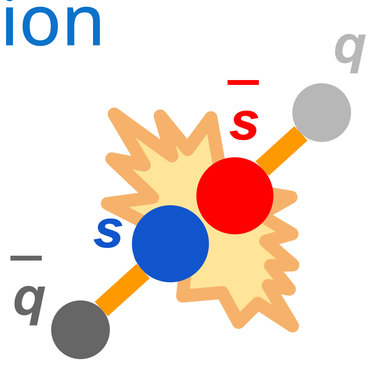
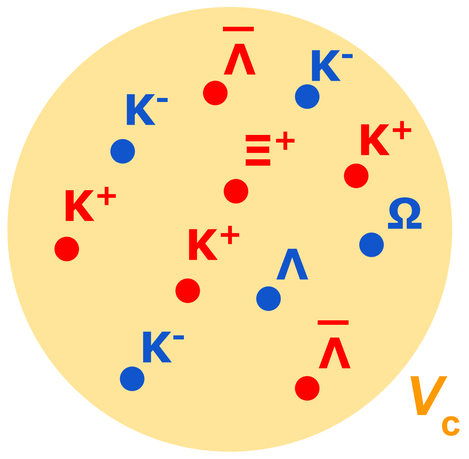
Hadronisation and strangeness conservation

- String fragmentation [1]
  - short-range rapidity correlations
  - mostly correlation of unlike-sign charges



- Canonical statistical hadronisation (CSM) [2]
  - thermalised hadronic system with long-range rapidity correlations
  - symmetry of like- and unlike-sign correlations



Event-by-event observables

- Cumulants κ_i

$$\kappa_1 = \langle n \rangle \qquad \rightarrow \text{average}$$
$$\kappa_{11}(m,n) = \langle (m - \langle m \rangle)(n - \langle n \rangle) \rangle$$
$$\kappa_2 = \langle (n - \langle n \rangle)^2 \rangle \qquad \rightarrow \text{(co)variance}$$

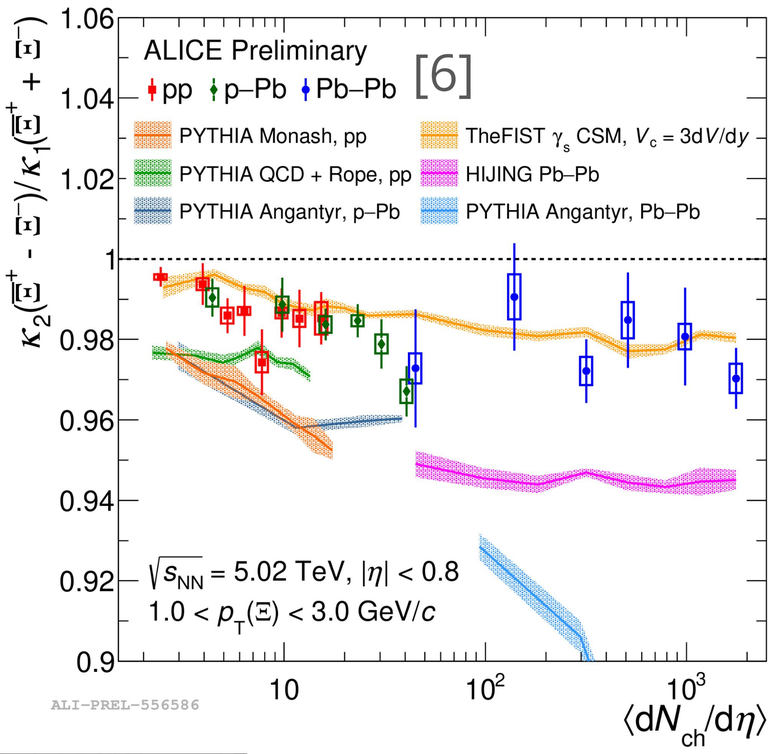
- Correlation ρ

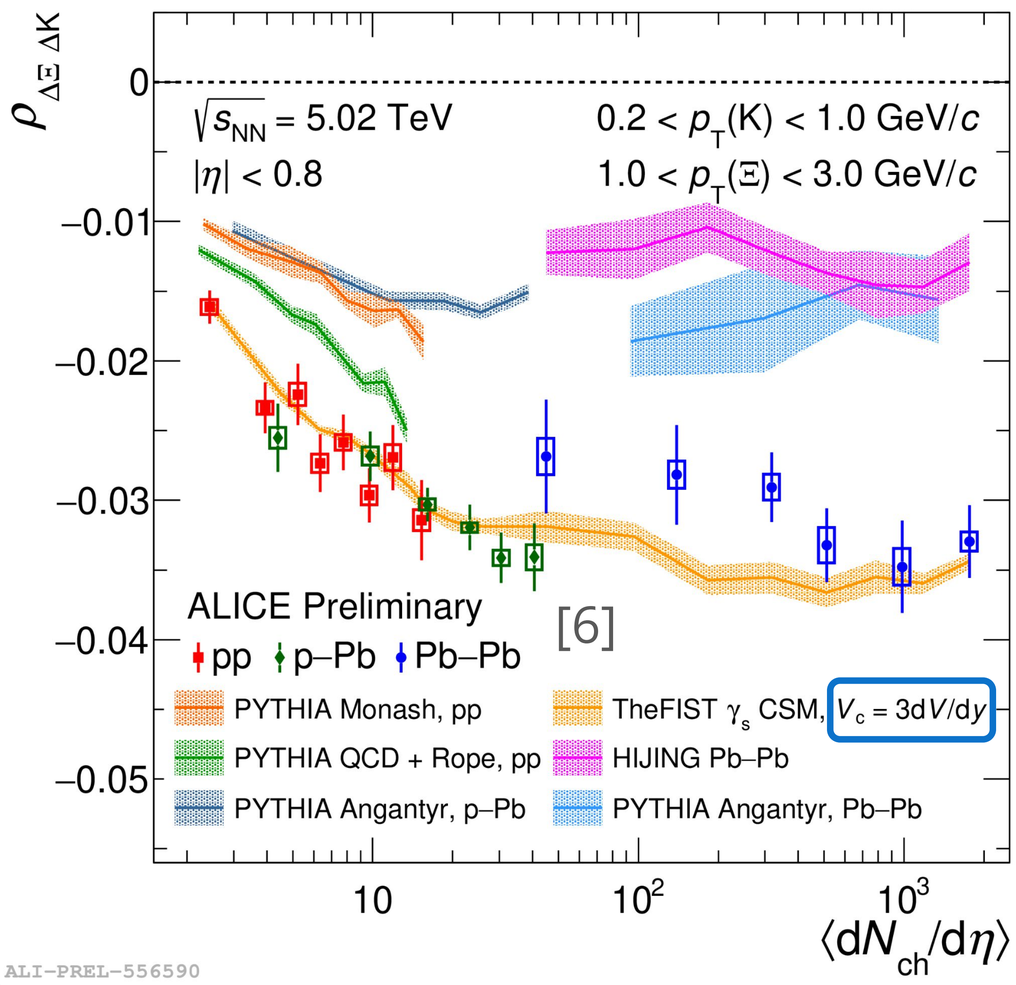
$$\rho(m,n) = \frac{\kappa_{11}(m,n)}{\sqrt{\kappa_2(m)\kappa_2(n)}}$$

- Net-particle number Δn
  - at the LHC, $\mu_B \sim 0$ [3] → matter balances antimatter → cancellation of the effect of volume fluctuations [4]

Results

- Second-to-first order cumulant ratio of net-Ξ
  - sensitive to unlike-sign strangeness correlation
  - smooth evolution across multiplicity
  - indication of longer-range rapidity correlations → ~3 units of rapidity compared to ~1 unit of rapidity for string fragmentation

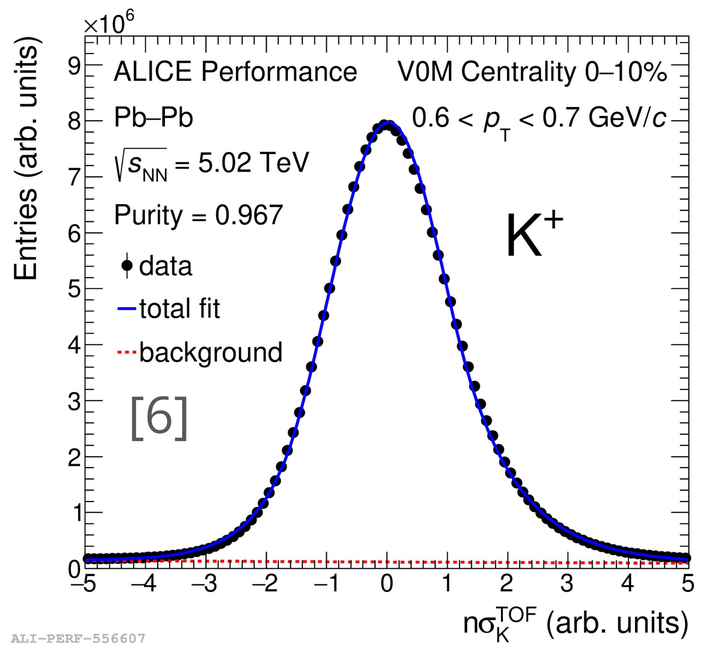




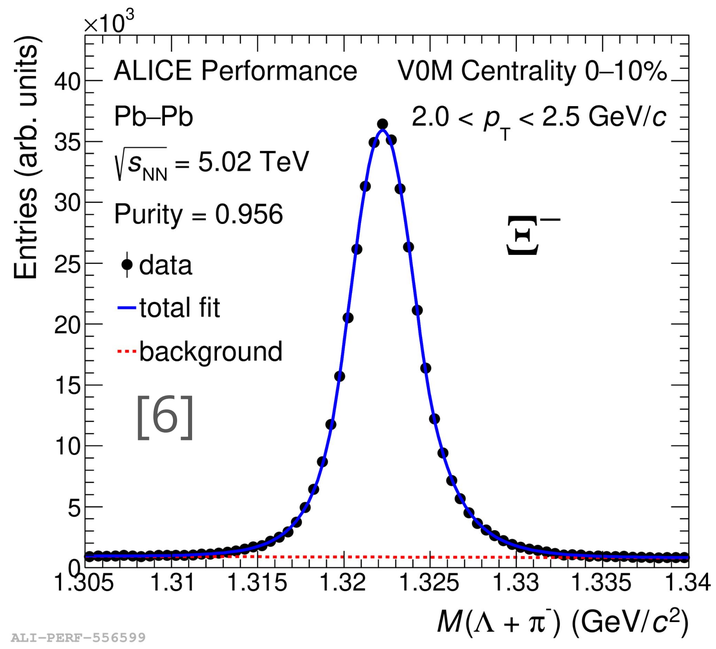
- Net-Ξ–net-kaon correlation
  - sensitive to like- and unlike-sign correlations
  - results are consistent with CSM, $V_c \sim 3\,dV/dy$
  - indication of a significant *ss* correlation
  - Pythia 8 + Rope hadronisation reproduces yields but fails to describe fluctuations

Candidate selection

- Charged kaons
  - d*E*/d*x* with Time Projection Chamber
  - velocity with Time-of-Flight detector



- Charged Ξ baryons
  - cascade decay
  $\Xi^- \rightarrow (\Lambda \rightarrow p + \pi^-) + \pi^- + cc$
  - selection based on Boosted Decision Trees [5]



References

[1] T. Sjostrand et al., arXiv:2203.11601 [hep-ph]
[2] V.Vovchenko et al., Phys. Rev. C 100, 054906 (2019)
[3] A. Rustamov et al., Nucl. Phys. A 960 (2017) 114-130
[4] ALICE Collaboration, arXiv:2311.13332 [nucl-ex]
[5] Chen et al., (2016) arXiv:1603.02754 [cs.LG]
[6] ALICE Collaboration, ALICE-PUBLIC-2023-003 (2023)