Insight into $K^*(892)^0$ production in pp collisions as a function of collision energy, event-topology and multiplicity with ALICE at the LHC

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Physics Motivation:

- Short-lived particles $\rightarrow$ life-times are comparable to the hadronic phase of the medium produced in the high-energy collisions

- Regeneration and re-scattering processes in hadronic phase $\rightarrow$ Affect resonance yields and transverse momentum ($p_T$) spectra shape

- Good probes to verify the presence of hadronic phase and study its properties

- Resonance study in small systems:
  - Multiplicity dependence: bridge the gap between minimum bias pp and peripheral heavy-ion collisions
  - Event shape observable: disentangle soft and hard dominated QCD processes
A Large Ion Collider Experiment (ALICE)

- Tracking is performed with Inner Tracking System (ITS) and Time Projection Chamber (TPC)
- PID exploits $dE/dx$ in the TPC and Time Of Flight (TOF)
- Multiplicity selection and pile-up rejection thanks to forward scintillator arrays (V0)

Event shapes are characterised using **transverse spherocity ($p_T$ unweighted)**.

$$S_0^{p_T=1} = \frac{\pi^2}{4} \left( \frac{\sum_i |\vec{p}_{Ti} \times \hat{n}|}{\sum_i |\vec{p}_{Ti}|} \right)^2$$

- $S_0 \to 0$ (jetty limit) (Dominated by hard QCD processes)
- $S_0 \to 1$ (isotropic limit) (Dominated by soft QCD processes)

where $\hat{n}$ is a two-dimensional unit vector in the transverse plane, chosen in a way so that $S_0$ is minimized.
**K*⁺⁻ Reconstruction**

- \( K* \rightarrow \pi^\pm K^\mp \) (BR 66%) channel with invariant mass study
- Uncorrelated background subtracted using event-mixing technique
- After subtraction: fit with Breit-Wigner (signal) + 2nd order polynomial (residual background) function

**Results: transverse momentum \((p_T)\) spectra**

- Evolution of the spectral shape with multiplicity for \( p_T < 5 \) GeV/c consistent with the presence of radial flow
- For \( p_T > 5 \) GeV/c no multiplicity evolution
- Flat \( p_T \) ratio of \( S_0 \)-selected to MB event classes

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Results: particle ratios

- No strong energy dependence of the K*0/K ratio in pp collisions
- Results for pp and p–Pb collisions consistent at similar multiplicities
- Highest multiplicity in small systems consistent with Pb–Pb results
- Hint of suppression of K*0/K ratios as a function of charged particle multiplicity is observed \(\rightarrow\) possible presence of the hadronic phase in high-multiplicity pp collisions

Summary

- Hardening of \(p_T\) spectra with charged particle multiplicity in pp collisions
- \(p_T\) spectra as a function of transverse spherocity classes show flat ratio to MB
- K*0 production is independent of collision system and energy for a given multiplicity value
- No strong energy dependence for multiplicity dependent K*0/K ratio in pp collisions
- Hint of suppression of K*0 as a function of charged particle multiplicity observed in small collision systems \(\rightarrow\) hint of possible formation of hadron gas phase in high-multiplicity pp collisions

*Thank you for your attention!!*