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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9th Edition of the Large Hadron Collider Physics Conference

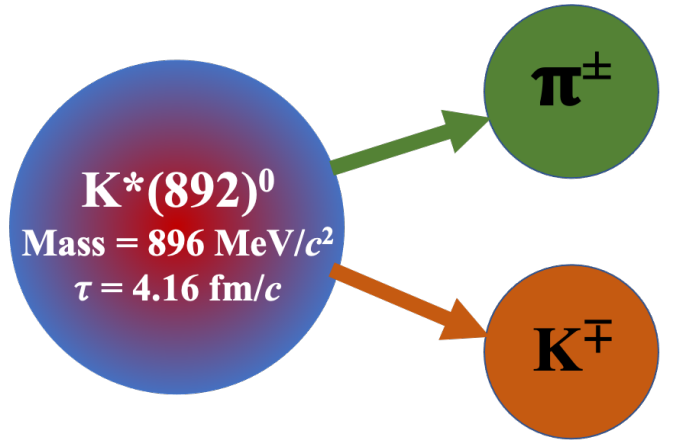
Physics Motivation:

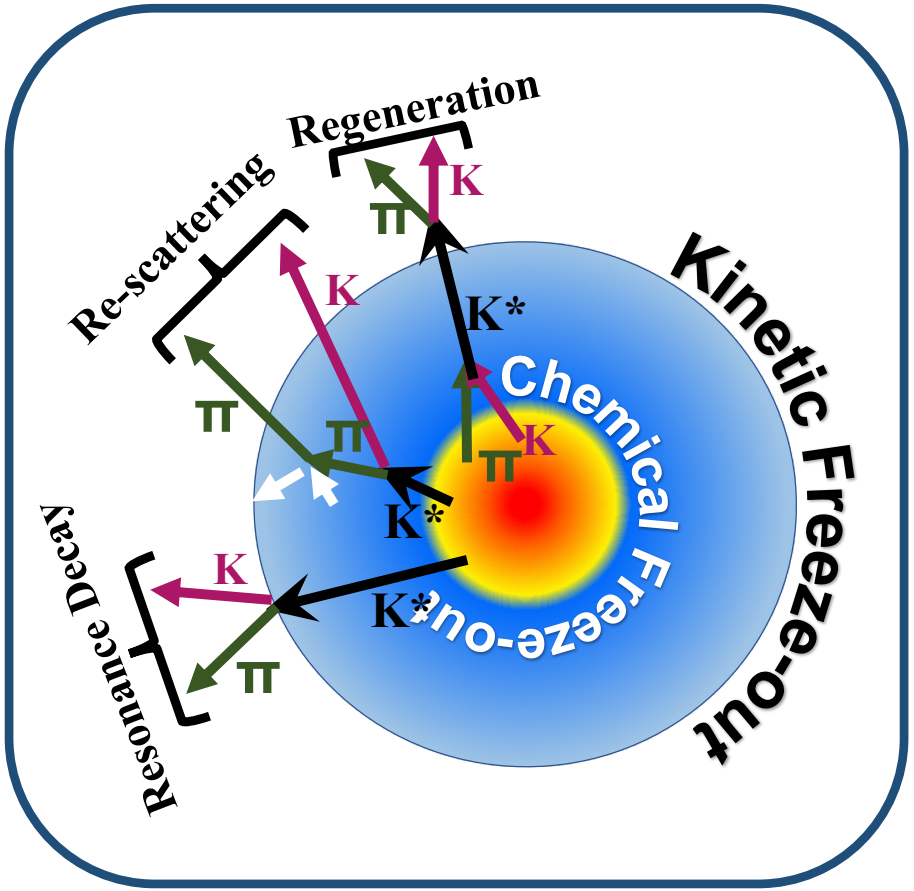
- Short-lived particles → life-times are comparable to the hadronic phase of the medium produced in the high-energy collisions

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

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

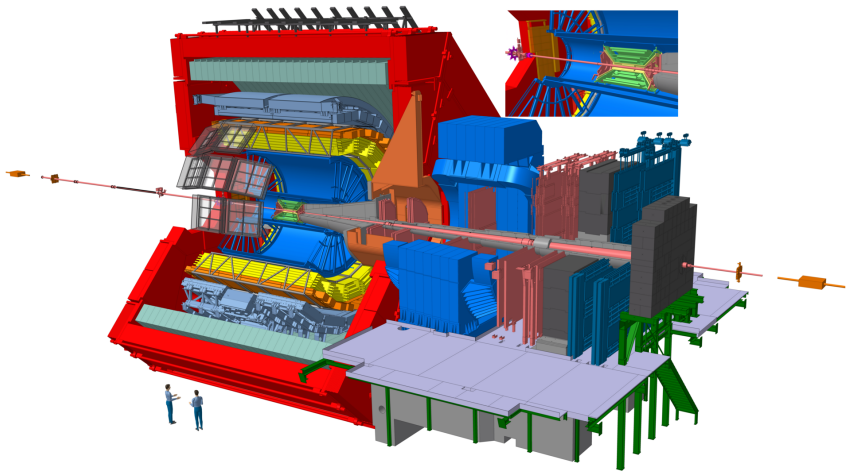
- Resonance study in small systems:
  - Multiplicity dependence: bridge the gap between minimum bias pp and peripheral heavy-ion collisions
  - Event shape observable: disentangle soft and hard dominated QCD processes





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)



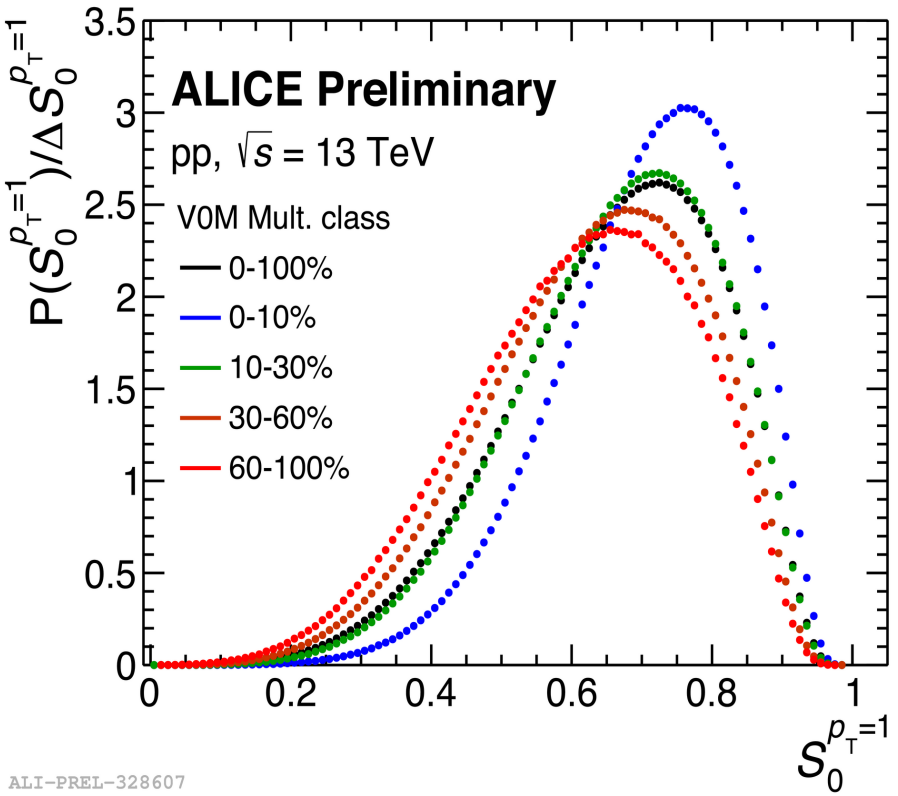
Transverse spherocity

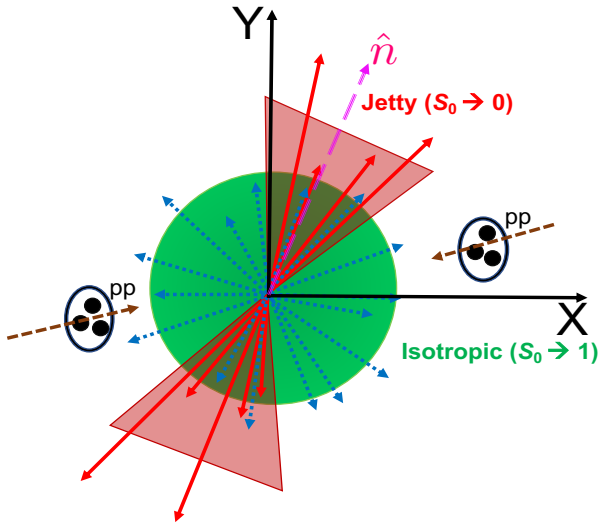
Event shapes are characterised using **transverse spherocity** (p_T unweighted).

$$S_0^{p_T=1} = \frac{\pi^2}{4}\left(\frac{\sum_i |\vec{p_{T}}_i \times \hat{n}|}{\sum_i |\vec{p_{T}}_i|}\right)^2$$

$S_0 \rightarrow 0$ (jetty limit)
(Dominated by hard QCD processes)
$S_0 \rightarrow 1$ (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.

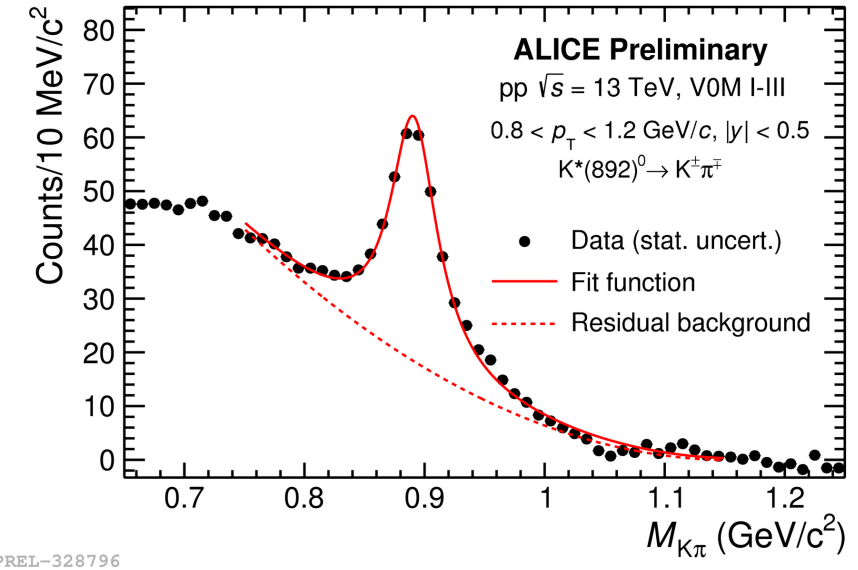




High multiplicity: dominated by isotropic events
Low multiplicity: dominated by jetty events

K^{*0} Reconstruction

- $K^{*0} \rightarrow \pi^{\pm}K^{\mp}$ (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



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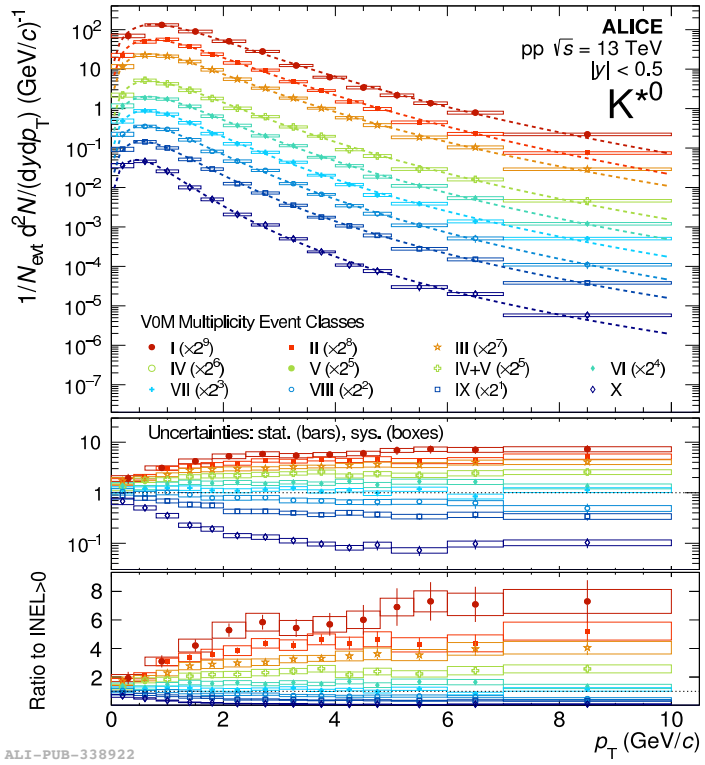
Results: transverse momentum (p_T) spectra



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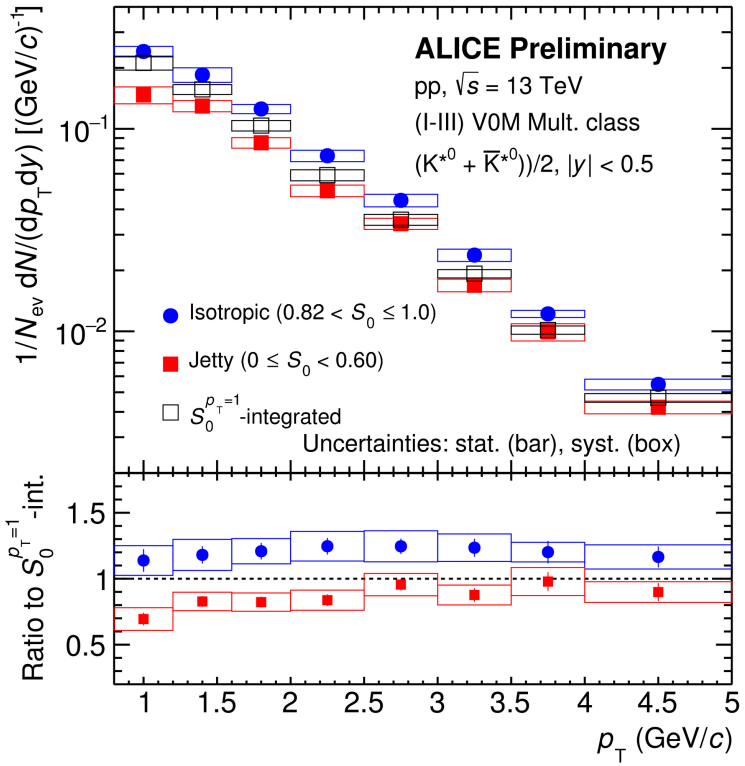
Phys. Lett. B 807, 135501 (2020)



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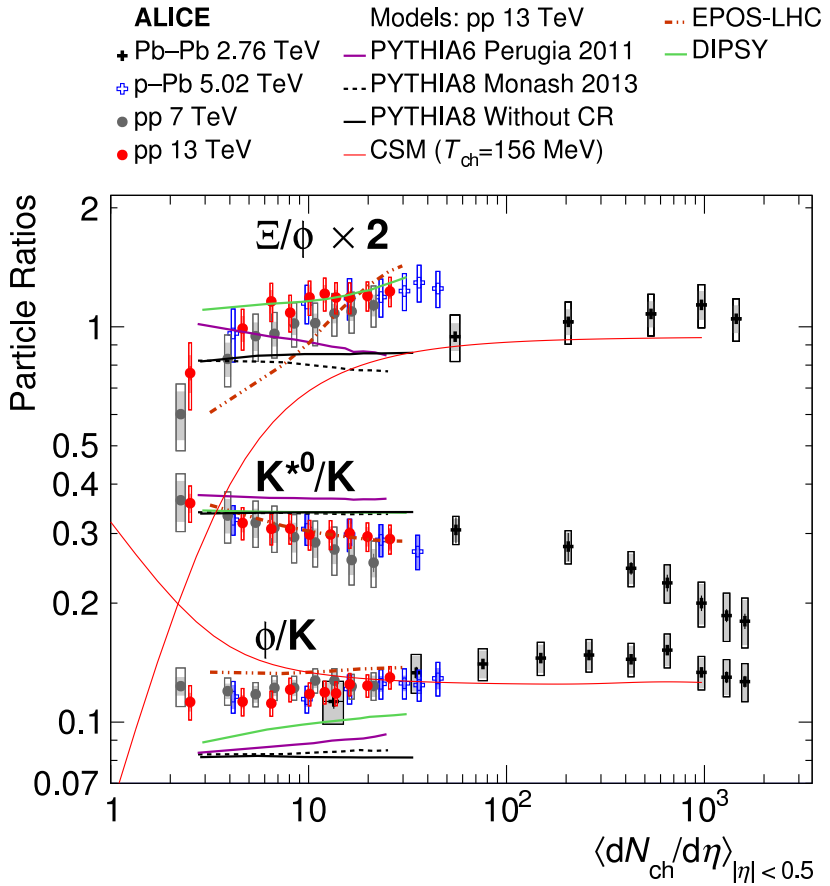
- Evolution of the spectral shape with multiplicity for p_T < 5 GeV/c consistent with the presence of radial flow
- For p_T > 5 GeV/c no multiplicity evolution
- Flat p_T ratio of S_0-selected to MB event classes

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 → *possible presence of the hadronic phase in high-multiplicity pp collisions*



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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
  → hint of possible formation of hadron gas phase in high-multiplicity pp collisions

Thank you for your attention!!