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Charged particle multiplicity dependence of K*(892)$^{\pm}$ production in pp collisions at $\sqrt{s} = 13\ \mathrm{TeV}$ with ALICE

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INTRODUCTION AND MOTIVATION

- **Resonances** are ideal probes to characterize the system formed in heavy-ion collisions at ultrarelativistic energies

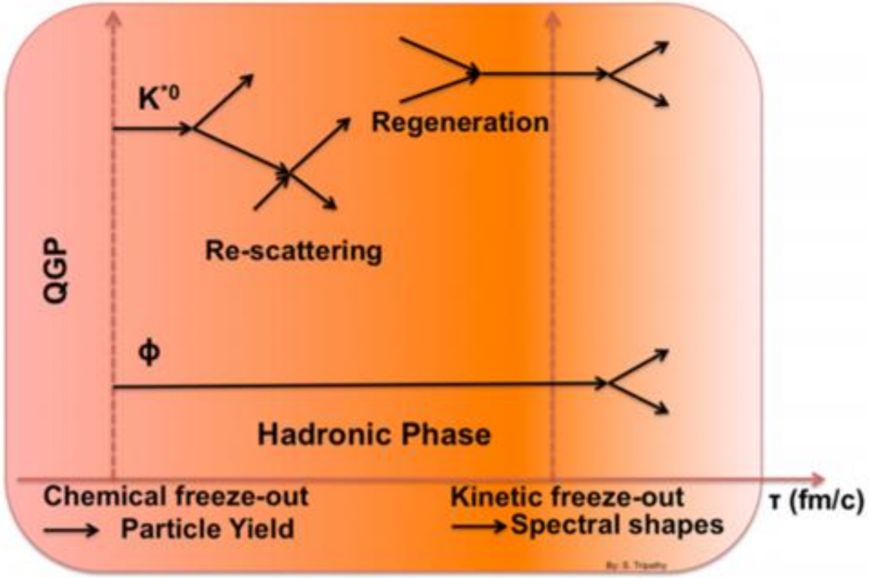
- **$K^{*\pm}$ resonance** is particularly interesting because of its **very short lifetime** (~ 4 fm/c), comparable to the one of the hadronic phase → it may be **sensitive** to the competing **rescattering** and **regeneration** mechanisms

- **Small** collision systems:
  - ➢ used as a **baseline** for heavy-ion collisions
  - ➢ **Recent results** on resonance production show the onset of phenomena **typical of heavy-ion collisions**, like collective behaviour and suppression of the yield ratios of resonances to stable particles

- **K^{*0}** multiplicity dependent analysis in **pp** collisions at **13 TeV** [1] shows **a hint of suppression** for **K^{*0}/K** with increasing multiplicity → **hadronic phase even for small systems?**

- Inclusive analysis of **$K^{*\pm}$** production in pp collisions [2] **shows lower systematic uncertainties** on $K^{*\pm}$ measurement **than K^{*0}** due to the different strategies used for K^0_S and $K^\pm$ identification in ALICE

  → $K^{*\pm}$ measurements can complement previous K^{*0} results **with smaller systematic uncertainties**



K^{*0}

Regeneration

Re-scattering

QGP

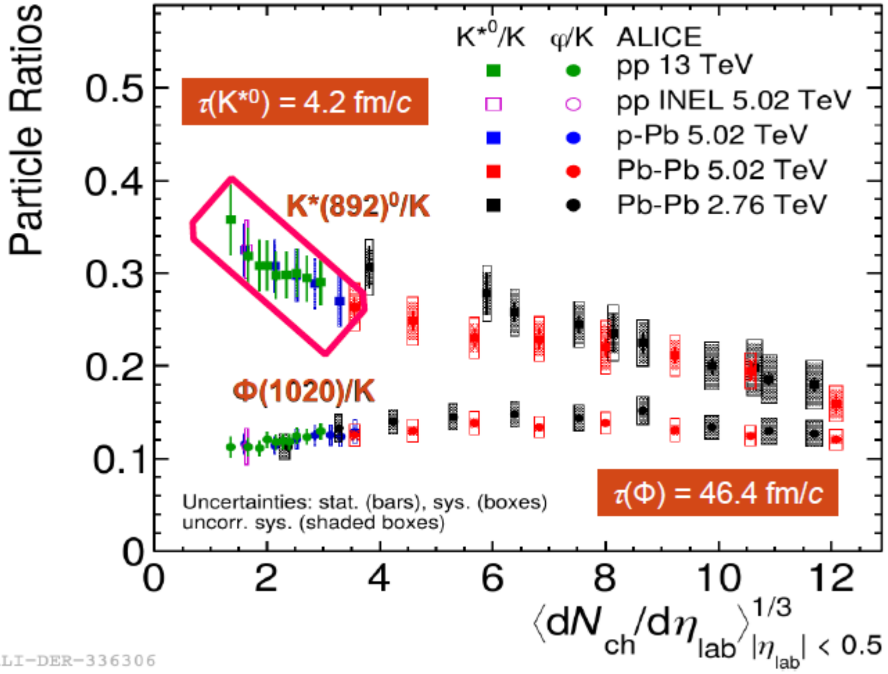
ϕ

Hadronic Phase

Chemical freeze-out → Particle Yield

Kinetic freeze-out → Spectral shapes

τ (fm/c)



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[1] Phys. Lett. B 807 (2020) 135501

[2] Phys. Lett. B 828 (2022) 137013

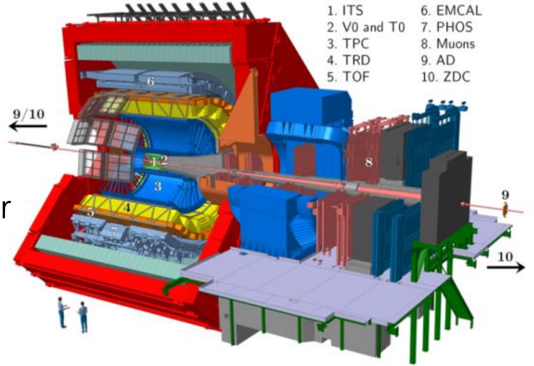
$K^{*\pm}$ RESONANCE RECONSTRUCTION

Used sub-detectors:

ITS – Tracker / Trigger / Vertexer

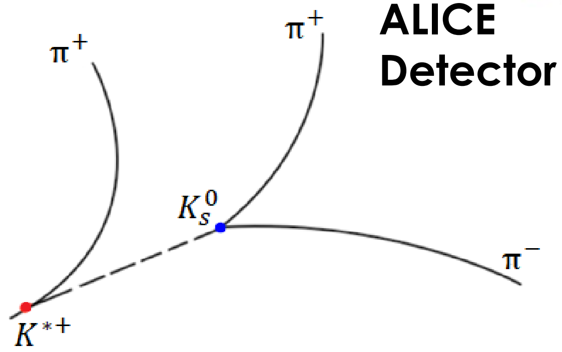
TPC – Tracker / PID (dE/dx)

V0 – Trigger / Multiplicity estimator



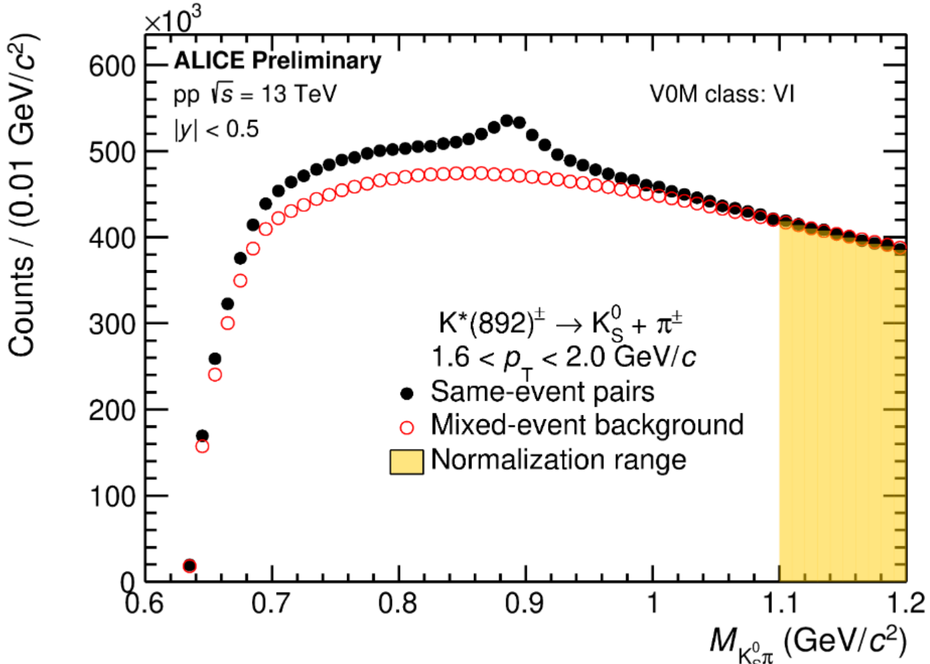
ALICE Detector

- Signal reconstructed via **invariant mass distribution** of the decay daughters: $K^{*\pm} \rightarrow \pi^{\pm} + K^0_S$; K^0_S identified via $K^0_S \rightarrow \pi^+ + \pi^-$, and $\pi^{\pm}$ via dE/dx in the TPC
- **Uncorrelated background** estimated via event mixing technique
- After the uncorrelated background subtraction, the remaining distribution is fitted with a **NR Breit-Wigner** + **residual backgroud** (expol) function F_{BG}:



$$\frac{A}{2\pi}\frac{\Gamma_0}{(M_{K\pi}-M_0)^2+\frac{\Gamma_0^2}{4}}+F_{BG}$$

$$F_{BG}(M_{K\pi}) = [M_{K\pi}-(m_\pi+m_K)]^n exp(A+BM_{K\pi}+CM_{K\pi}^2)$$



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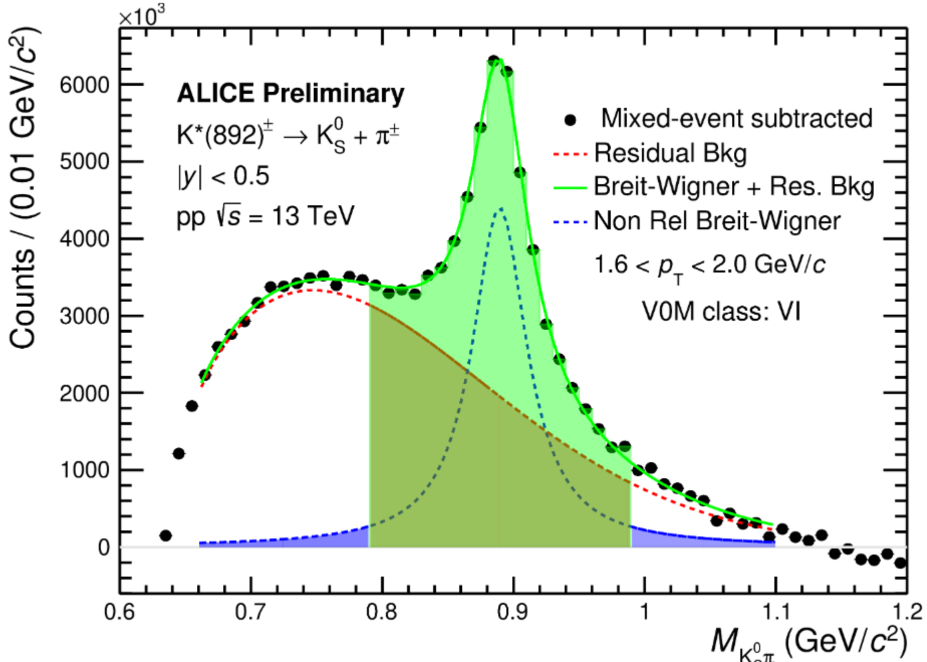

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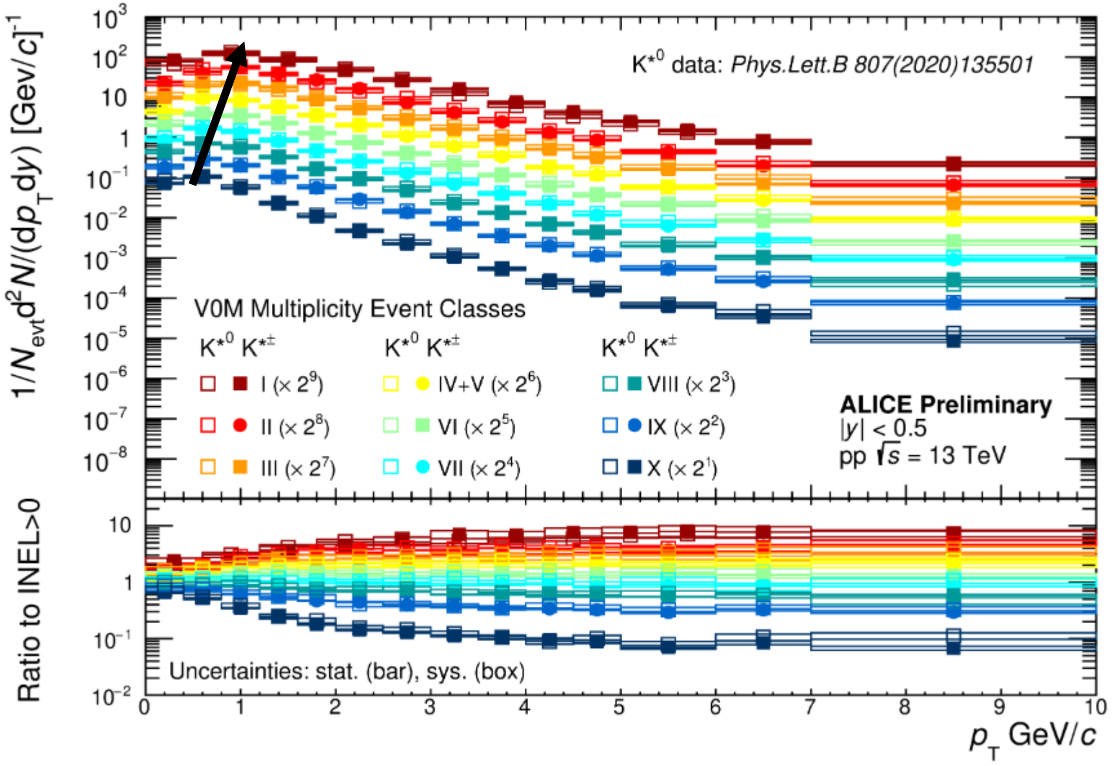
$K^{*\pm}$ p_T SPECTRA, $\langle p_t \rangle$, AND dN/dy



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Comparable results for $K^{*\pm}$ and K^{*0} with **lower systematic uncertainties** for $K^{*\pm}$ measurements

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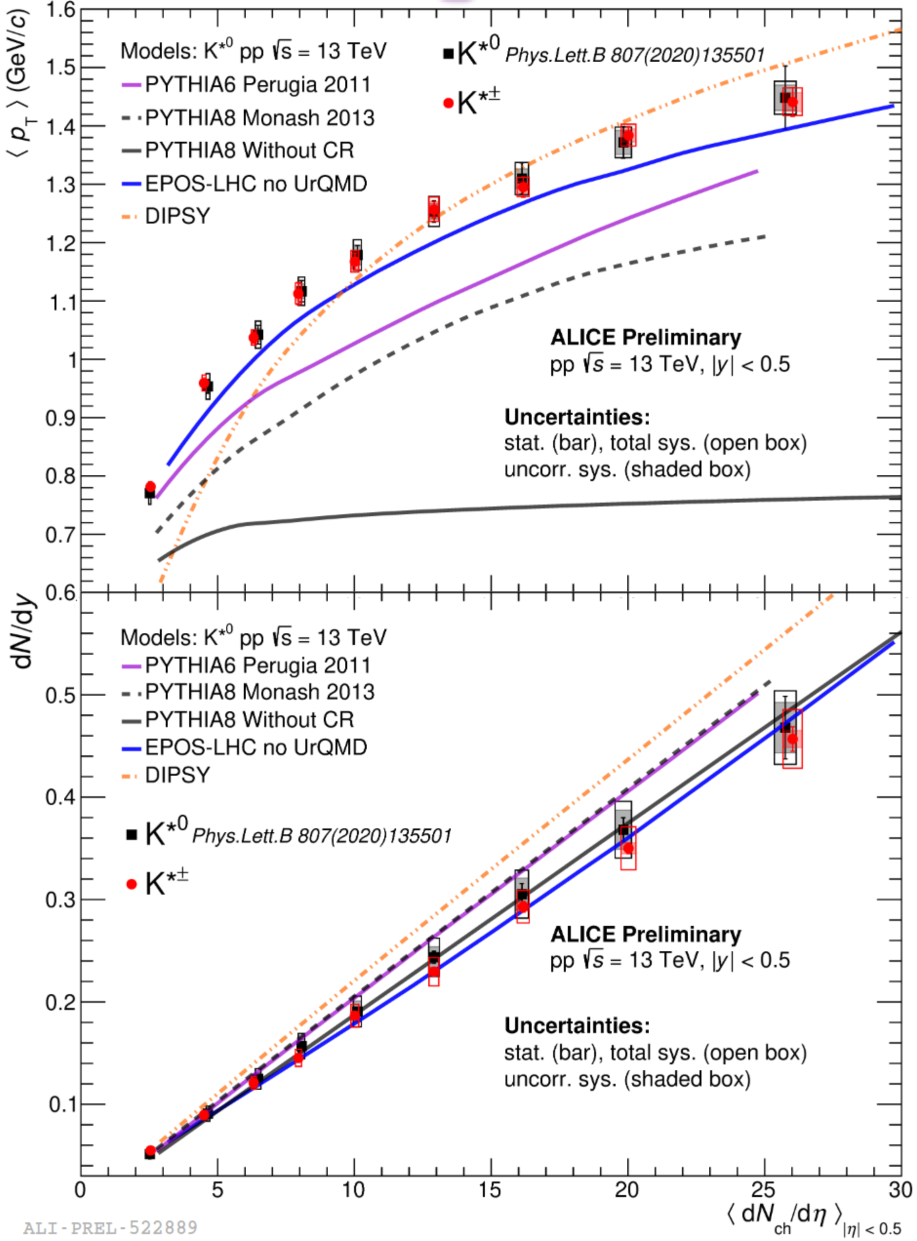

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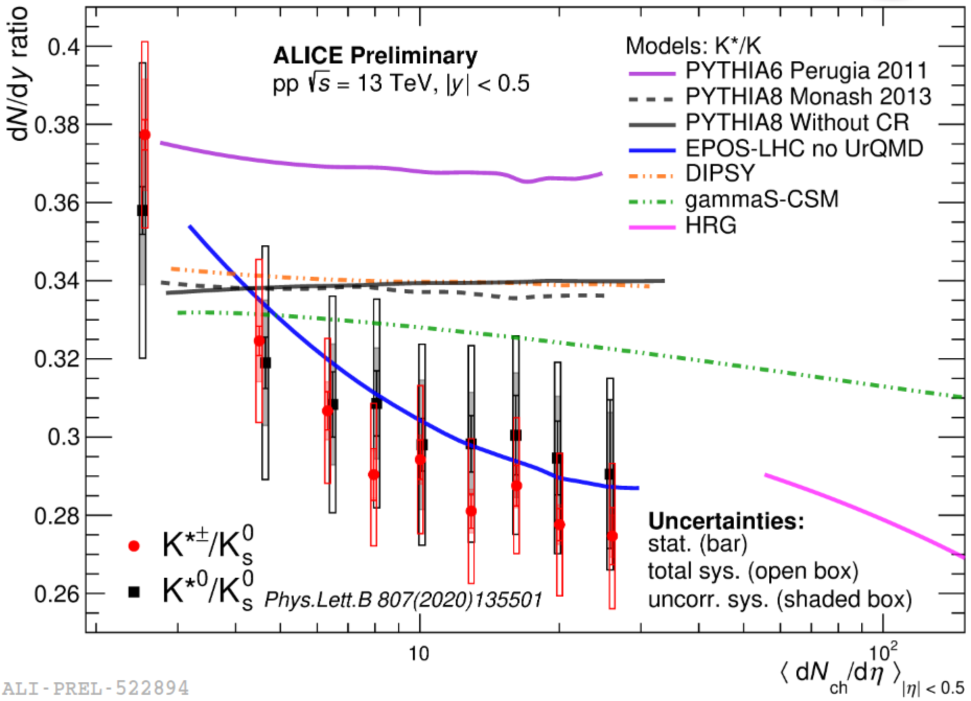
- p_T spectra **get harder** with increasing multiplicity and **maximum shifts** towards higher p_T → **flow-like** effect
- **Lower panel:** ratios of p_T spectra to INEL>0 For p_T < 5 GeV/c spectra increase from low to high multiplicity classes. Same spectral shape for p_T > 5 GeV/c → Process dominant at low p_T
- Among all the model predictions, **EPOS-LHC** [3] gives the best agreement with measured data, although slightly underestimates $\langle p_T \rangle$ values

[3] Phys. Rev. C 92, 034906 (2015)

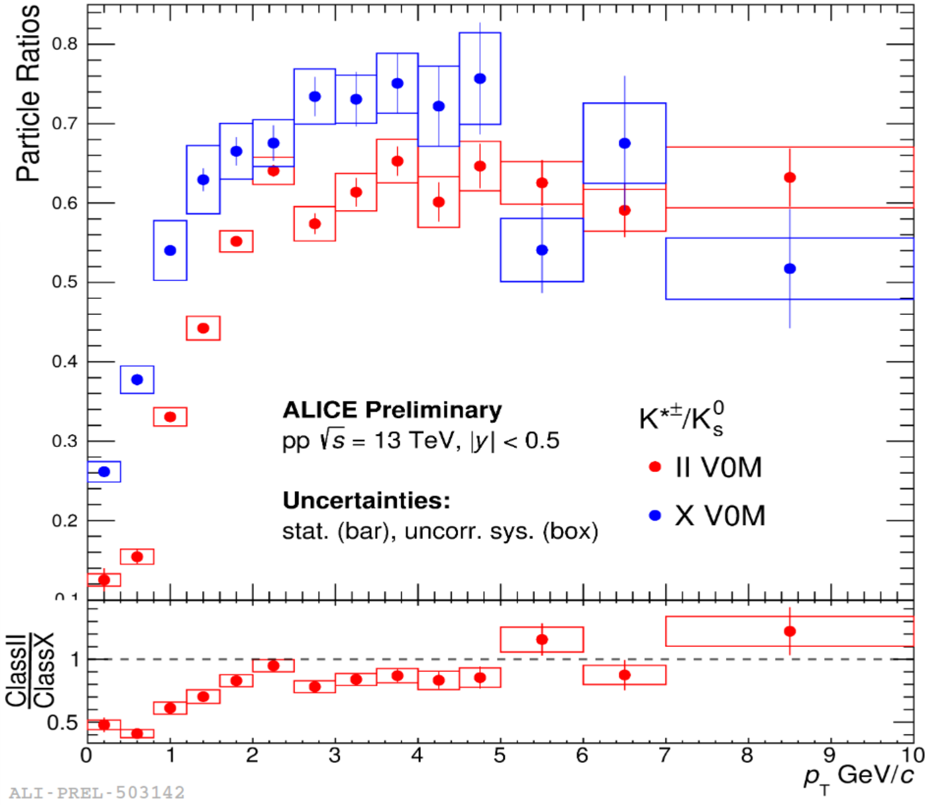
RATIO OF PARTICLE YIELDS: $K^{*\pm}/K^0_S$



- $K^{*\pm}/K^0_S$ **trend** in pp collisions at $\sqrt{s}$ = 13 TeV **confirms** the K^{*0}/K^0_S **suppression** even **accounting for the systematic uncertainties**

EPOS-LHC: same treatment for pp, p–A, and A–A collisions → formation of two different regions: core (high density) and corona (low density)

It is able to reproduce the decreasing trend without UrQMD → is suppression actually due to rescattering? Must also consider core/corona effects



- Low p_T particles are mainly affected by rescattering effects during the hadronic phase
- **Important** $K^{*\pm}/K^0_S$ **suppression** for $p_T < 2.5$ GeV/c
- Results consistent with those obtained for K^{*0} and with the hypothesis of rescattering effects

SUMMARY

Preliminary results on $K^{*\pm}$ measurements show the typical onset of **collective-like phenomena** (hardening of the p_T spectra) → possible **hadronic phase** (suppression of $K^{*\pm}/K^0_S$) or **mini-plasma** formation (core) in **small systems** too?

Thank you for your attention