First results of the K*(892)± production in pp collisions at √s = 13 TeV with ALICE at LHC

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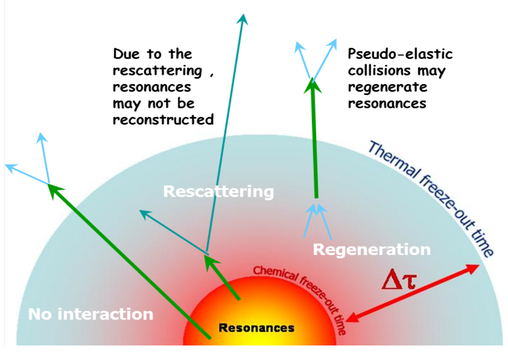
Motivation



- The lifetime of the hadronic resonances (~10^{-23} s) is of the same order of magnitude as that of the fireball formed in ultra-relativistic heavy-ion collisions.
- Relative particle abundances are determined at the chemical freeze-out. However (pseudo-) elastic re-scattering and regeneration processes occurring in the late hadronic phase can affect the measured resonance yields. These yield modifications can be used to estimate the lifetime of the hadronic phase.

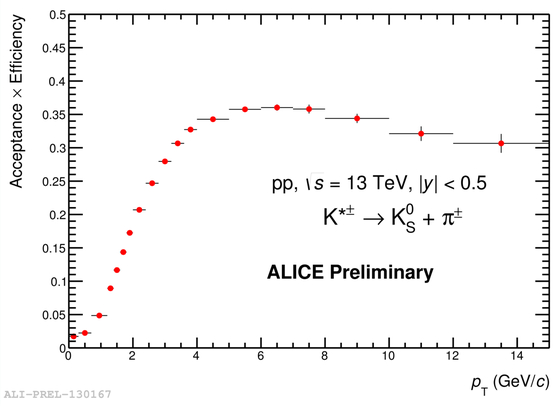
Resonance production in pp collisions is a baseline for heavy-ion collisions and helps in:

- Understanding hadron production processes
- Constraining theoretical models (PYTHIA, PHOJET, EPOS-LHC etc.)
- Studying strangeness production if strange resonances are measured

K*± is a strange resonance with a short lifetime (~ 4 fm/c) is thus very suitable to characterize the hadronic phase in Pb-Pb collisions. It is of interest to compare it with K*0 measurement in the same collision system.

Particle	Mass (MeV/c²)	Width (MeV/c²)	Decay (BR)
K*0	895.81 ± 0.19	47.4 ± 0.6	$K^{\pm} + \pi^{\mp}$ (0.66)
K*±	891.66 ± 0.26	50.8 ± 0.9	$\pi^{\pm} + K^0_S$ (0.33) $K^0_S \to \pi^+\pi^-$

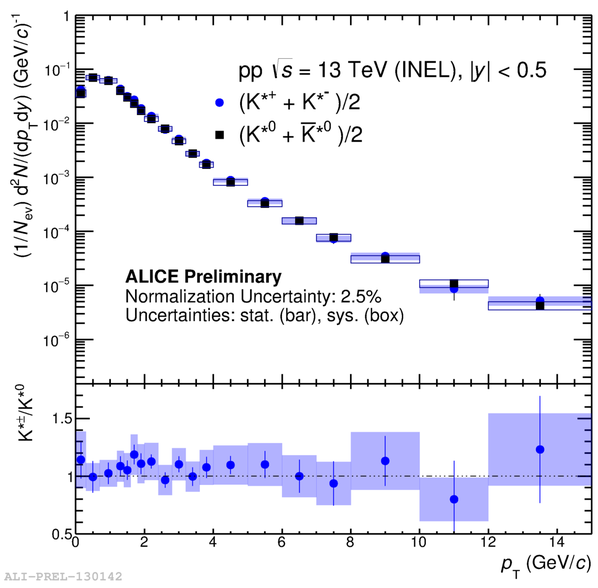
Acceptance x Efficiency



Acceptance x Efficiency is estimated from Monte-Carlo simulations (PYTHIA6-Perugia 2011 [1], PYTHIA8-Monash 2013 [2], EPOS-LHC [3]) as:

$$\epsilon = \frac{Reconstructed\ K^{*\pm} \to K^0_S + \pi^{\pm}}{Generated\ K^{*\pm} \to K^0_S + \pi^{\pm}}$$

p_T spectrum and K*/K ratios

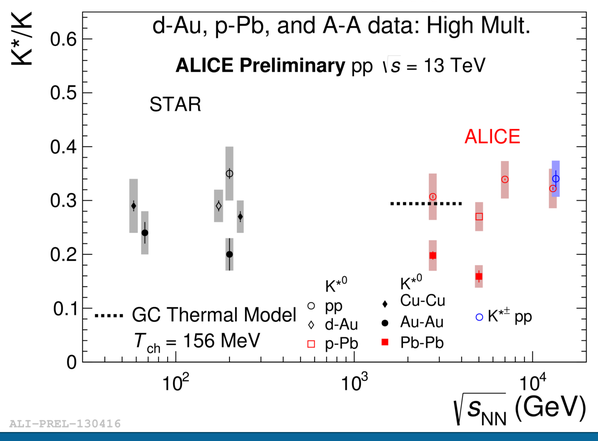


Top: K*0 p_T spectrum (black) and K*± p_T spectrum (blue) . Bottom: Ratio K*±/K*0

- **p_T spectra of K*± and K*0 in inelastic pp collisions at √s = 13 TeV** are consistent within uncertainties.

- K*±/K and K*0/K ratios are consistent within uncertainties.
- No significant energy dependence is observed in pp collisions
- K*0/K ratios are suppressed in central heavy-ion collisions with respect to pp collisions, due to dominant elastic re-scattering effects in the hadronic phase.

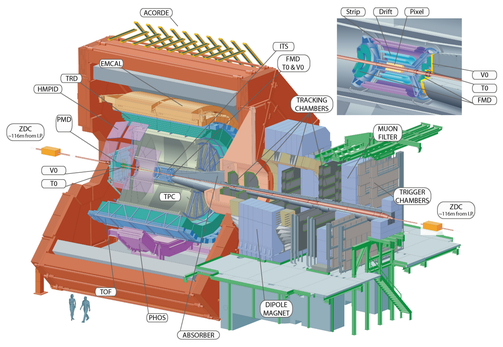
K*/K ratio vs. $\sqrt{s_{NN}}$ [5,6,7]



ALICE at LHC

ALICE central barrel

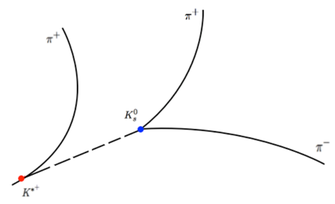
$|\eta| < 0.9$ and $p_T > 0.15$ GeV/c.



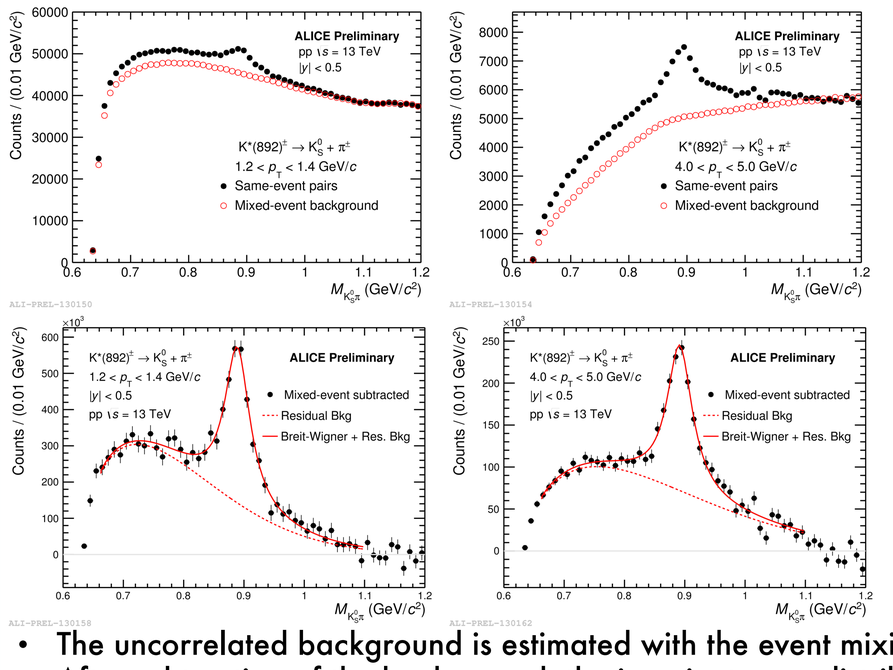
Schematic drawing of the ALICE detector at LHC

Detectors used for this analysis:

- **Inner Tracking System (ITS)**
  - Tracking and Vertexing
- **Time Projection Chamber (TPC)**
  - Main Tracking Device
  - Momentum measurement
  - Particle Identification: $\pi^{\pm}$ by dE/dx measurement, K^0_S through its weak decay topology



Signal extraction



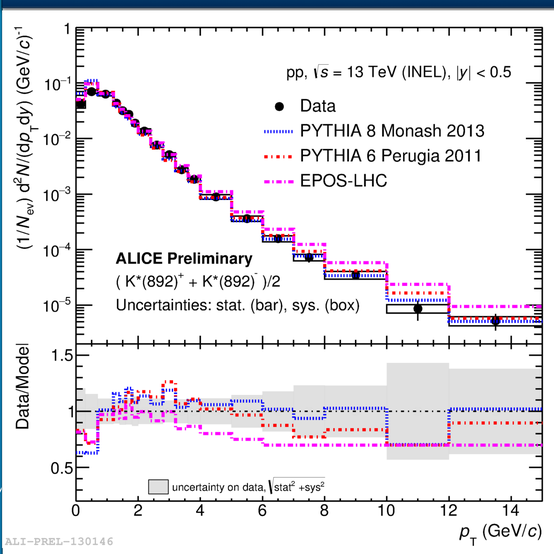
Top: Pair invariant mass distribution from the same event and from mixed events
Bottom: Background subtracted $K^0_S\ \pi$ pair invariant mass distribution

- The uncorrelated background is estimated with the event mixing technique.
- After subtraction of the background, the invariant mass distribution is fitted with a non-relativistic Breit –Wigner plus a function to shape the residual background (F_{BG}):

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

where $F_{BG}(M_{K\pi}) = [M_{K\pi} - (m_\pi + m_K)]^n \exp(A + BM_{K\pi} + CM^2_{K\pi})$ [4]

Model comparison



Top: K*± p_T INEL spectra at √s = 13 TeV compared with different models
Bottom: Model predictions/ Measured spectrum

- **Inelastic K*± p_T spectrum in pp collisions at √s = 13 TeV compared to PYTHIA6- Perugia 2011 [1], PYTHIA8-Monash 2013 [2] and EPOS-LHC [3] model prediction**
- PYTHIA8 and PYTHIA6 overestimate the production at p_T < 1 GeV/c but agree with the results for higher p_T
- EPOS-LHC overestimates the production at high p_T

Summary

- Measured p_T spectrum, yield , <p_T> and K*±/K ratio for K*± at √s = 13 TeV.
- K*± in agreement with K*0 measurement at the same collision energy
- p_T spectrum compared to PYTHIA6, PYTHIA8, EPOS-LHC predictions. Rather good agreement with PYTHIA6 and PYTHIA8 for p_T > 1 GeV/c

References

1) T. Sjostrand *et al.* , JHEP 05 (2006) 026
2) T. Sjostrand *et al.* comp. Phys. Comm. 178 (2008) 852
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