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

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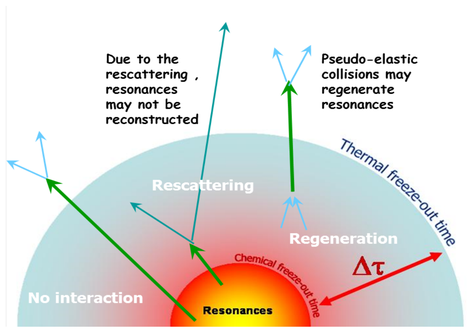
Motivation



- 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.
- A suppression of about 40% has been observed in **K*0** in Pb-Pb collisions at 2.76 TeV and 5 TeV. Similar suppression is expected for **K*±** due to similarity of the systems

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

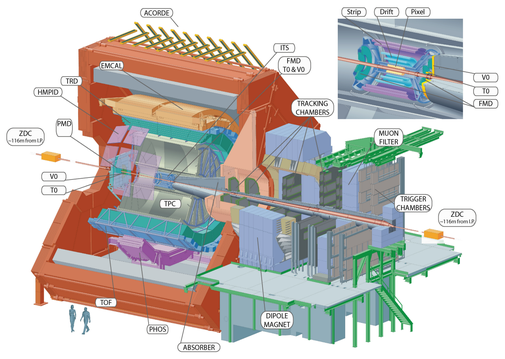
- Understanding hadron production processes
- Constraining theoretical models (PYTHIA, PHOJET, EPOS-LHC etc.)
- Studying strangeness production if strange resonances are measured

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. pp measurements are the first step in this study.

Particle	Mass (MeV/c^2)	Width (MeV/c^2)	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) $K^0_S \rightarrow \pi^+\pi^-$

ALICE at LHC

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



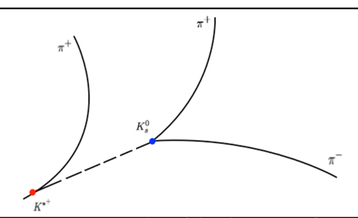
Schematic drawing of the ALICE detector at LHC

Detectors used for this analysis:

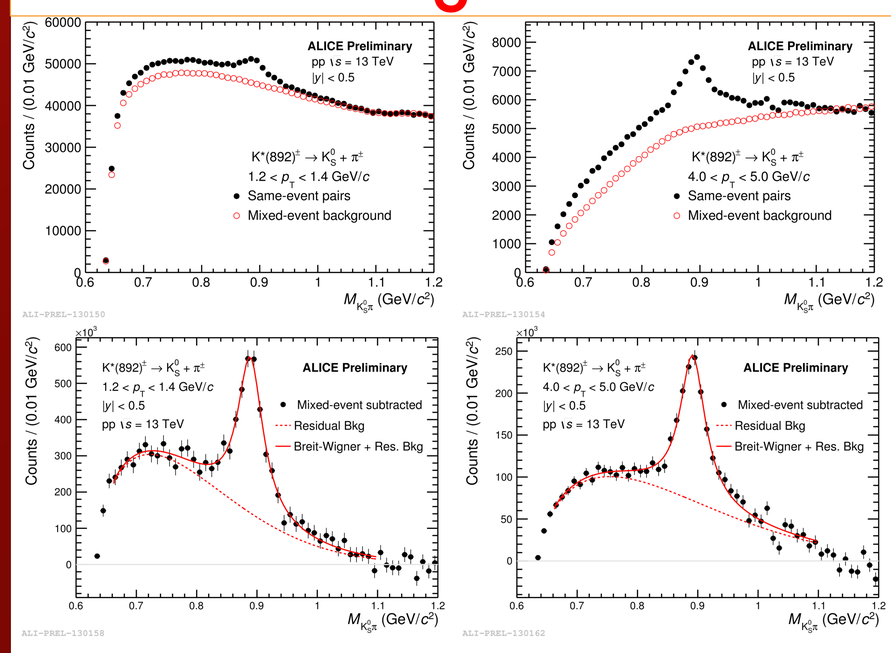
➢ **Inner Tracking System (ITS)**
- Tracking and Vertexing

➢ **Time Projection Chamber (TPC)**
- Main Tracking Device
- Momentum measurement
- Particle Identification: π± by dE/dx measurement, K^0_S through its weak decay topology

➢ **Trigger Detectors**
- V0A ∩ V0C



Signal extraction

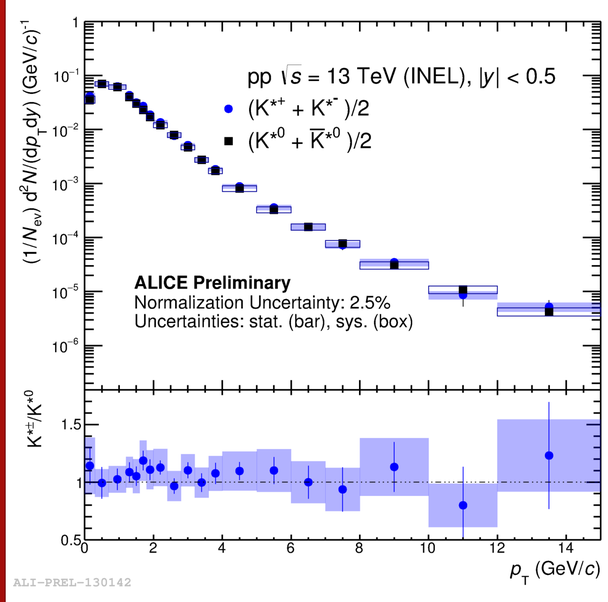


Top: Pair invariant mass distribution from the same event and from mixed events
Bottom: Background subtracted K^0_S π pair invariant mass distribution

- The uncorrelated background is estimated with the event mixing technique. The mixed event distribution is normalized to the same event distribution in the range 1.1 – 1.2 GeV/c
- 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

$$\frac{A}{2\pi}\frac{\Gamma_0}{(M_{K\pi}-M_0)^2+\frac{\Gamma_0^2}{4}} + [M_{K\pi} - (m\pi + mK)]^n \exp(A + BM_{K\pi} + CM^2_{K\pi}) \quad [4]$$

p_T spectrum and K*/K ratios

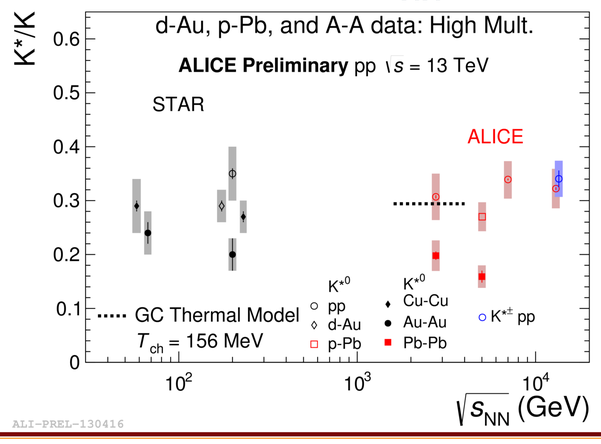


Top: K*0 p_T spectrum (black) and K*± p_T spectrum (blue) . Bottom: Ratio K*±/K*0

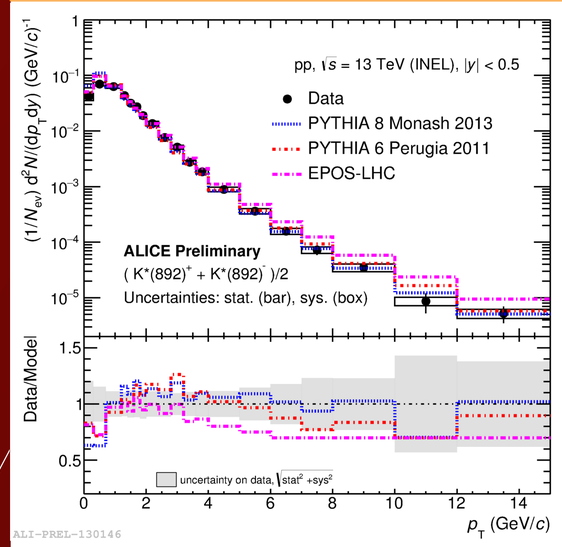
➢ **p_T spectra of K*± and K*0 in inelastic pp collisions at √s = 13 TeV** are consistent within uncertainties.

➢ 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]



Model comparison



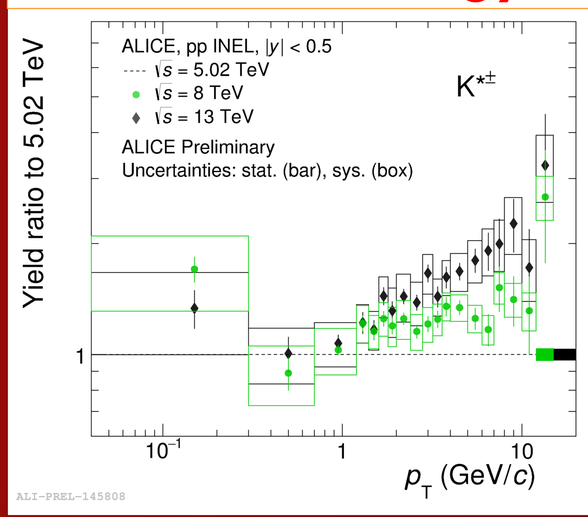
Top: K*± p_T INEL spectra at √s = 13 TeV compared with different models
Bottom: Measured spectrum/ Model predictions

➢ **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

Energy Dependence



➢ ***Ratio of K*± p_T spectra at pp collisions at different energies***
➢ Slope of p_T spectra increases with the energy collision.
➢ Similar hardening of the spectra has been observed by ALICE experiment also for other resonances (ϕ, K*0) and for stable hadrons

Ratio K*± p_T INEL spectra at √s = 13 TeV and 8 TeV respect to same spectrum at √s = 5 TeV

Summary

➢ Measured p_T spectrum, yield , $\langle p_T \rangle$ and K*±/K ratio for K*± at √s = 13 TeV.
➢ K*± in agreement with K*0 measurement at the same collision energy
➢ Hardening of the K*± p_T spectrum increasing the 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
3) T. Pierog et al., Phys. Rev. C92 (2015) 034906
4) P. Abreu et al, Z. Phys. C65 (1995) 587
5) ALICE coll., Phys. Rev. C91 (2015) 024609
6) ALICE coll. Eur. Phys. J C76 (2016)
7) ALICE coll. Phys. Rev. C95 (2017) 064606