# K*(892)± production in pp collisions at √s = 5.02 and 8 TeV with ALICE at the LHC


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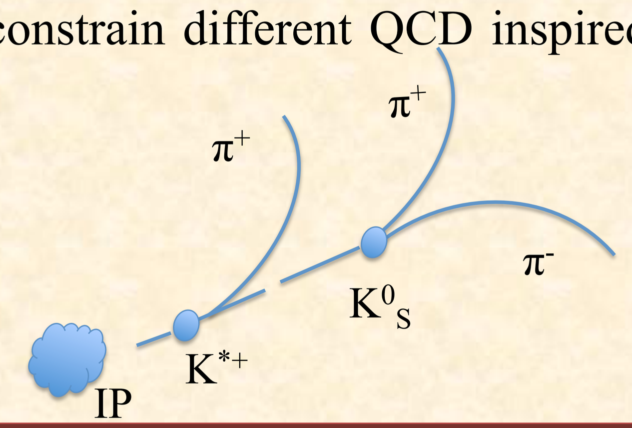
## Introduction

- ✧ The study of short-lived hadronic resonances in heavy-ion collisions provides information about the hadronic phase of the system. They are good candidates to probe the interplay of particle re-scattering and regeneration in the hadronic phase.
- ✧ $K^{*\pm}$ is a strange resonance with a short lifetime (~ 4 fm/c) and so its study is very suitable to characterize the hadronic phase in Pb-Pb collisions and supports the measurement from $K^{*0}$ analysis.
- ✧ Resonance measurements in pp collisions set the baseline for heavy-ion collisions.
- ✧ These studies contribute to the understanding of particle production mechanisms through comparison with different model predictions and constrain different QCD inspired models (like PYTHIA, PHOJET etc.)

$K^{*\pm}$ are reconstructed via two step decay processes:

$K^{*\pm} \rightarrow \pi^{\pm} + K^0_S$ , $K^0_S \rightarrow \pi^+ + \pi^-$




| Particle | Quark content | Mass (MeV/c²) | Width (MeV/c²) | Decay Channels (B.R.) |
|---|---|---|---|---|
| $K^{*\pm}$ | $u\bar{s}, \bar{u}s$ | 891.66 ± 0.26 | 50.8 ± 0.9 | $\pi^{\pm} + K^0 (K^0 \rightarrow \pi^+\pi^-)(0.66)$<br>$\pi^0 + K^{\pm} (\pi^0 \rightarrow \gamma\gamma)(0.33)$ |
| $K^{*0}$ | $d\bar{s}, \bar{d}s$ | 895.81 ± 0.19 | 47.4 ± 1.3 | $\pi^{\pm} + K^{\mp}$ (0.66) |

## ALICE at The LHC

- ✧ Global tracking in ALICE is performed using the ITS and TPC detectors.
- ✧ Minimum bias trigger accepted, when hits in both the V0A and V0C detectors.
- ✧ The tracks were accepted only in the range $|\eta| < 0.8$, $p_T > 0.15$ GeV/c with the PID selection: $|n\sigma_{\pi,TPC}| < 3\sigma$

**Detectors used for this Analysis:**

✧ Inner Tracking system (ITS)
- Tracking
- Vertexing

✧ Time Projection Chamber (TPC)
- Main tracking detector
- Particle identification (PID)
- Momentum measurement

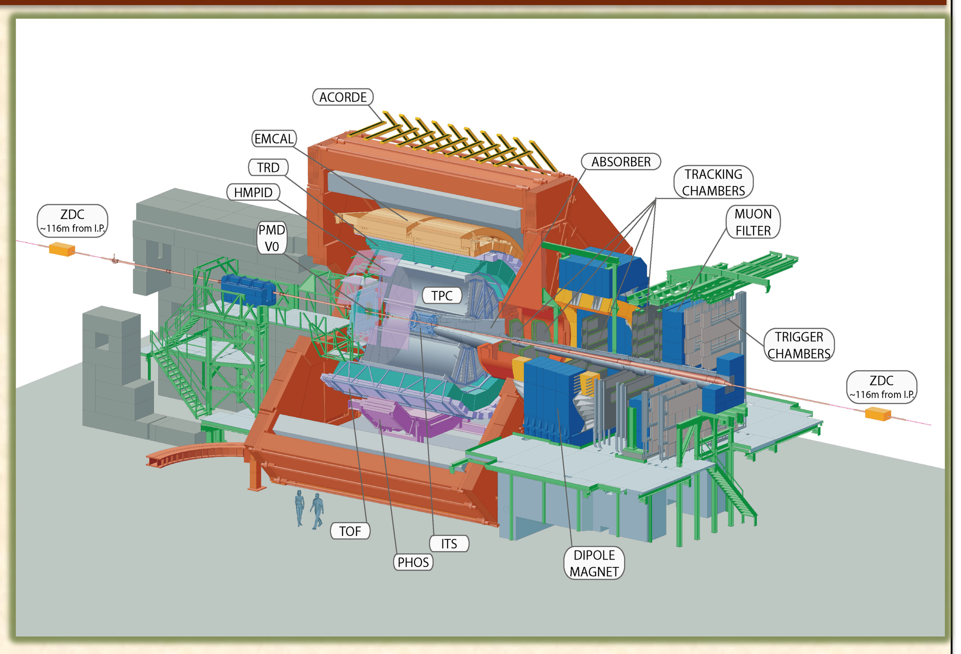
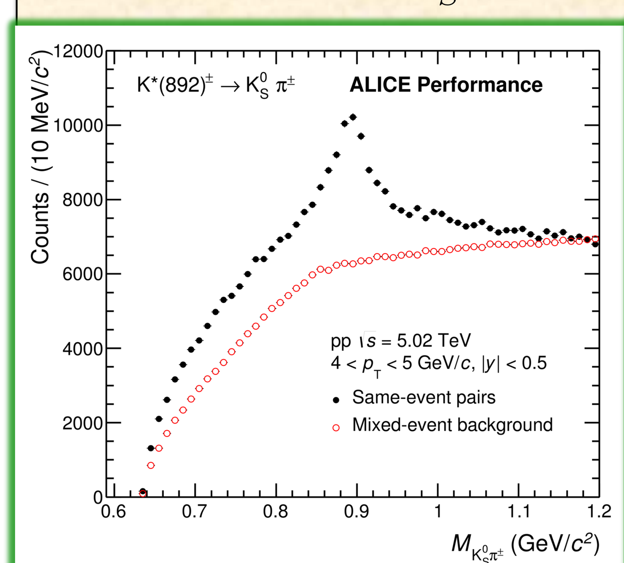


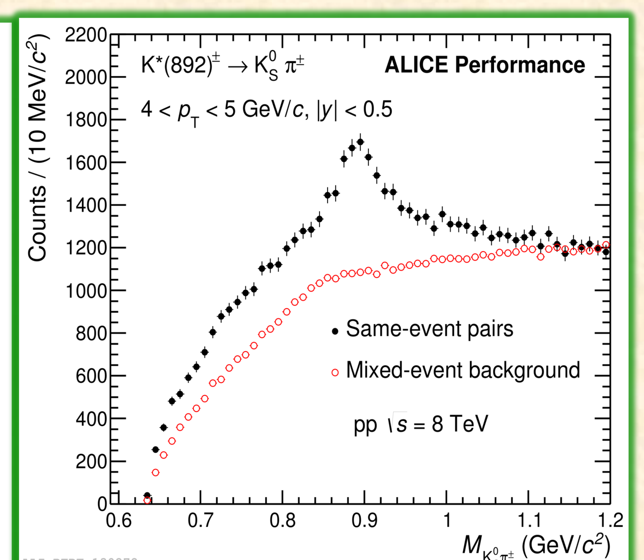

Fig.1. Schematic drawing of the ALICE detector at the LHC.

## Signal Extraction

- ✧ The uncorrelated combinatorial background is estimated with the event mixing technique.
- ✧ The events for mixing are grouped based on some similar criteria: $||v_z|_{ev1} - |v_z|_{ev2}| < 2$cm, difference in multiplicity < 5, etc.
- ✧ The invariant mass distribution is fitted with a non-relativistic Breit –Wigner function and an exponential of 2nd order polynomial in the invariant mass for the residual background:

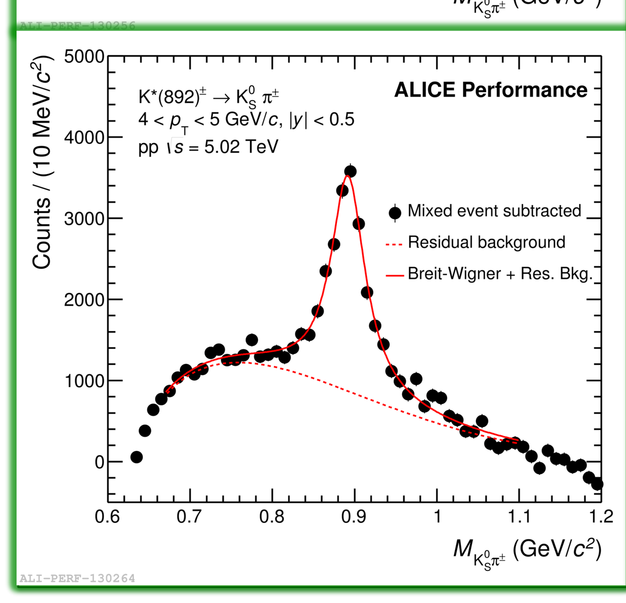
$$\frac{Y}{2\pi}\frac{\Gamma}{(M^2_{\pi K^0_S} - M^2_{K^{*\pm}}) + \Gamma^2/4} + exp(pol2) * (M^2_{K^{*\pm}} - M^2_{\pi K^0_S})^n$$

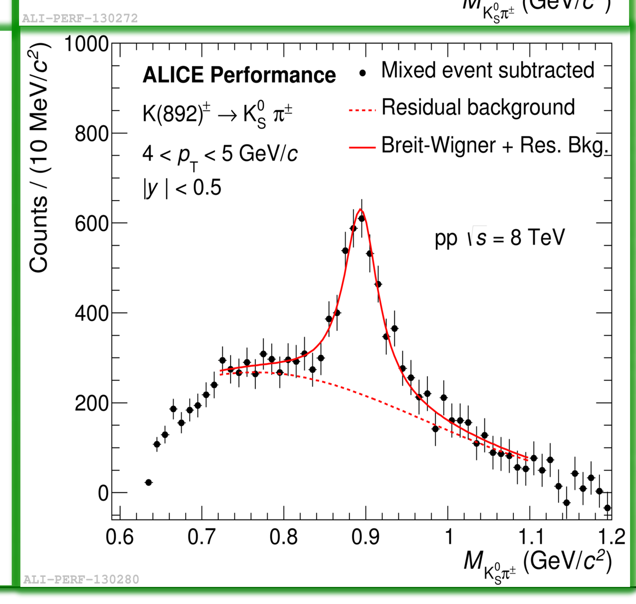



The mixed event is normalized with the same event distribution outside the signal region: 1.1 – 1.2 GeV/c² ($N_{factor}$).

Fig.2. The invariant mass distribution from the same event and from mixed events for √s = 5.02 and 8 TeV.



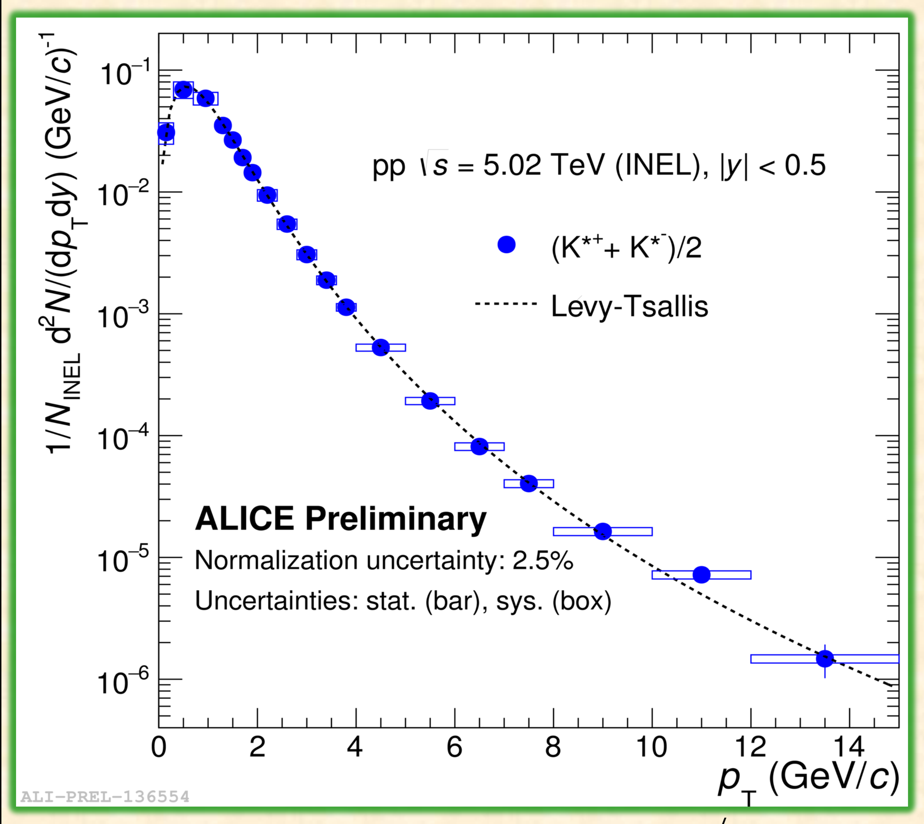




Signal: Same – ($N_{factor}$)×Mixed

Fig.3. The invariant mass distribution after background subtraction.

## $p_T$ spectrum and $K^{*\pm}/K^{*0}$ ratio

Fig.4. (Left) $K^{*\pm}$ $p_T$ spectrum for √s = 5.02 TeV with Lévy-Tsallis fit[1]. (Right) $K^{*\pm}$ and $K^{*0}$ $p_T$ spectrum with the ratio ($K^{*\pm}/K^{*0}$) in the bottom panel.



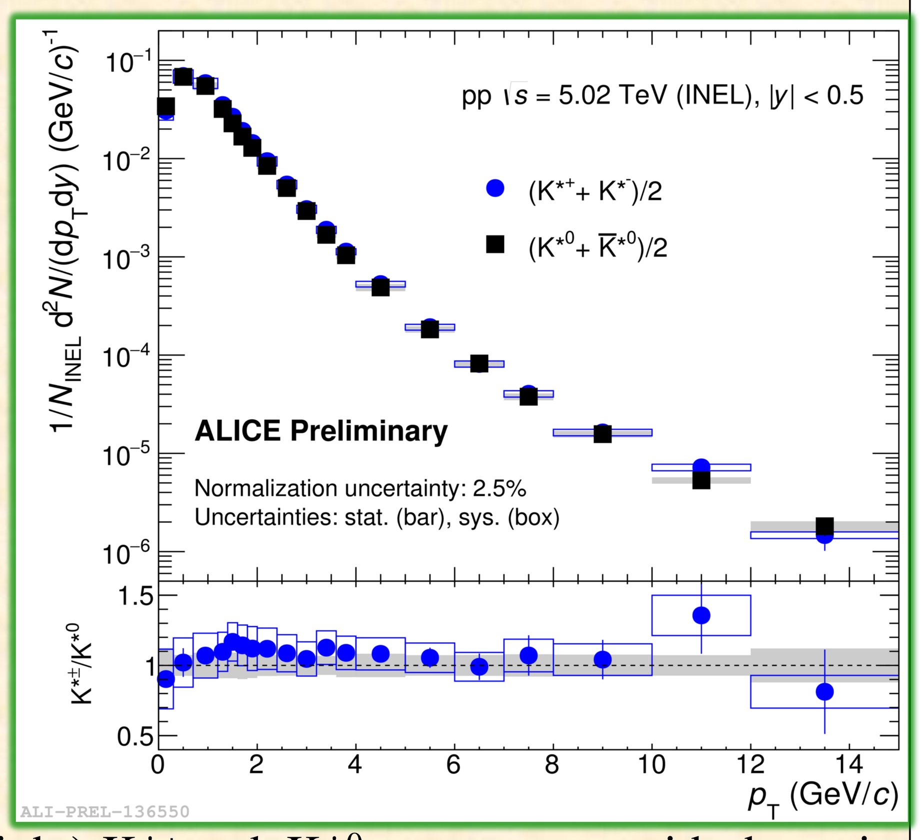
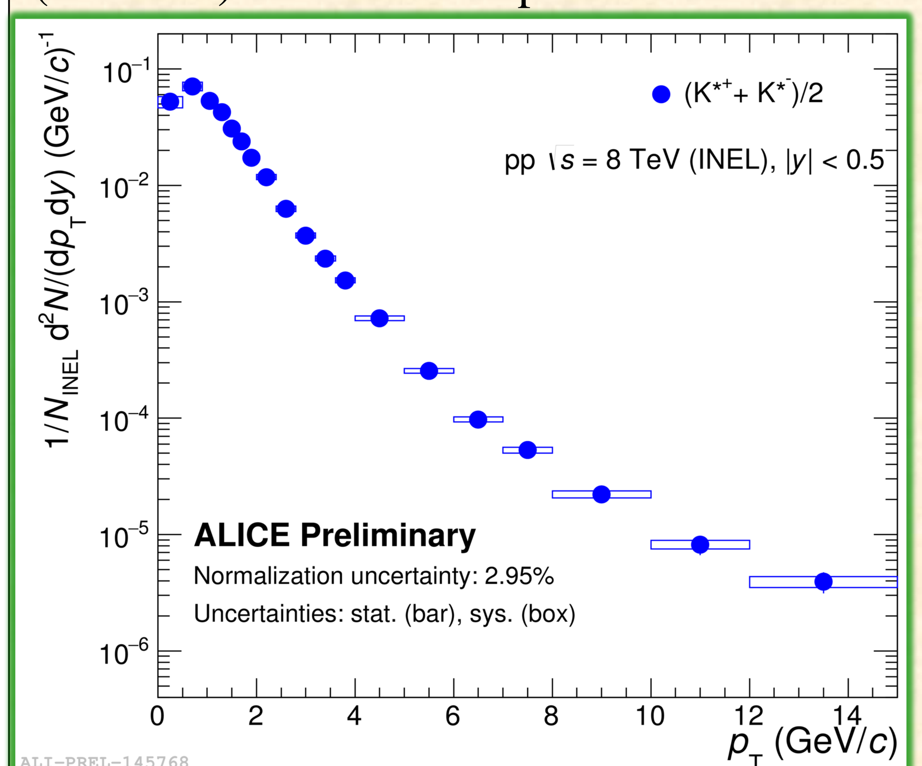
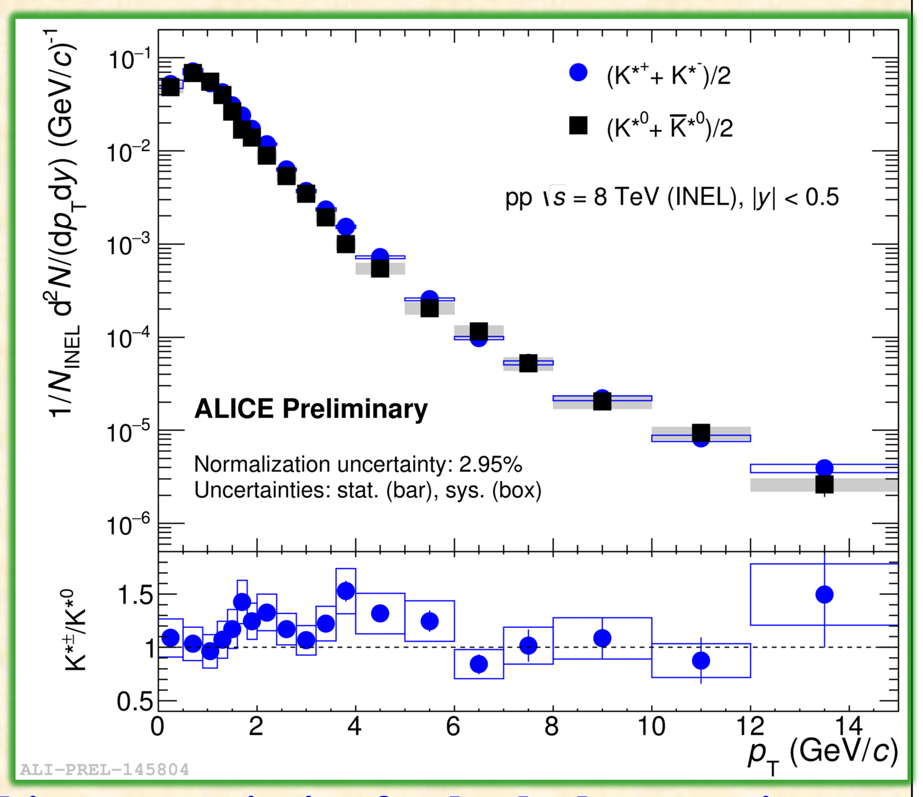




Fig.5. (Left) $K^{*\pm}$ $p_T$ spectrum for √s = 8 TeV. (Right) $K^{*\pm}$ and $K^{*0}$ $p_T$ spectrum with the ratio ($K^{*\pm}/K^{*0}$) in the bottom panel.




❑ $K^{*\pm}$ and $K^{*0}$ $p_T$ spectra are consistent within uncertainties for both the energies as it has been observed for the measurement at 13 TeV.

## Model Comparison & Energy Dependence

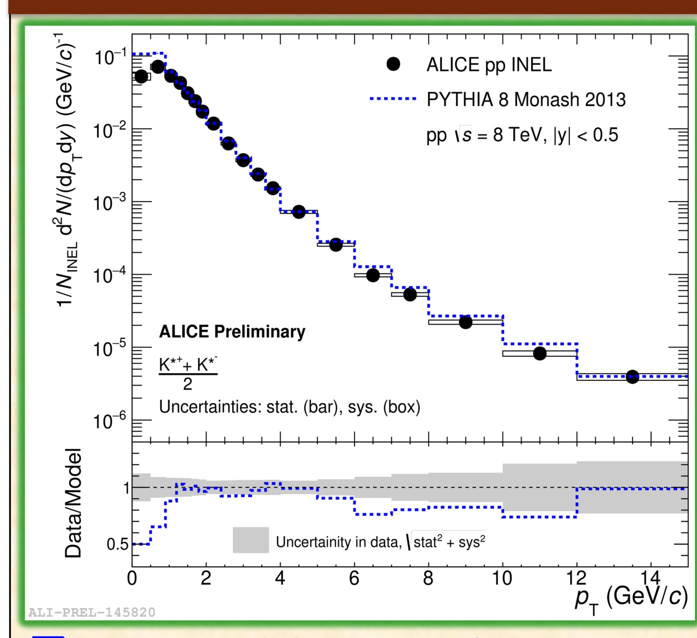
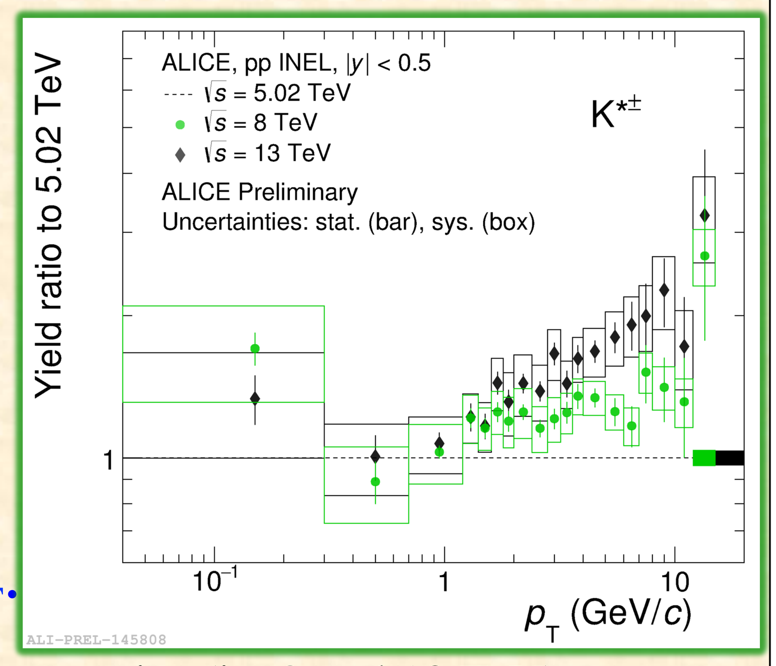



Fig.6. Comparison of inelastic $K^{*\pm}$ $p_T$ spectrum in pp collisions at √s = 8 TeV to PYTHIA8-Monash 2013 prediction[2].




❑ PYTHIA8 overestimates the production at $p_T$ < 1 GeV/c but agrees with the results for higher $p_T$.

Fig.7. Ratios of $K^{*\pm}$ $p_T$ spectra at various center-of-mass energies (i.e 8 and 13 TeV) to 5.02 TeV.

❑ Spectra become harder with increasing energy :: particle production from hard scattering dominates for higher energies at higher $p_T$.

## Summary

- ✧ $p_T$ spectra, dN/dy and $\langle p_T \rangle$ for $K^{*\pm}$ at √s = 5.02 and 8 TeV have been measured.
- ✧ $K^{*\pm}$ measurement is in agreement with $K^{*0}$ measurement at the same collision energy within uncertainties.
- ✧ $K^{*\pm}$ $p_T$ spectrum has been compared to PYTHIA8 predictions at √s = 8 TeV and a good agreement is observed for $p_T > 1$ GeV/c within uncertainties.
- ✧ Ratios of $K^{*\pm}$ $p_T$ spectra at various energies to 5.02 TeV show that spectra become harder with increasing energy.

## References


[1] Tsallis C 1988 J. Stat. Phys. 52 479
[2] T. Sjostrand et al. comp. Phys. Comm. 178(2008) 852