Ξ_c^0 production vs multiplicity via hadronic decay in pp at $\sqrt{s} = 13$ TeV

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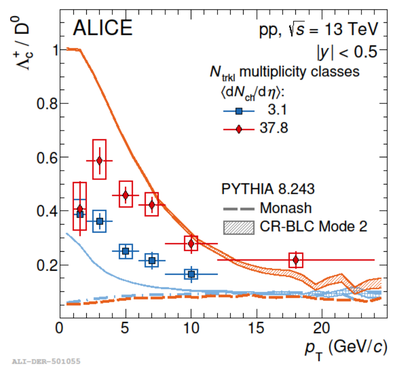
Motivation

The heavy-flavour production cross section can be calculated as a convolution of three terms

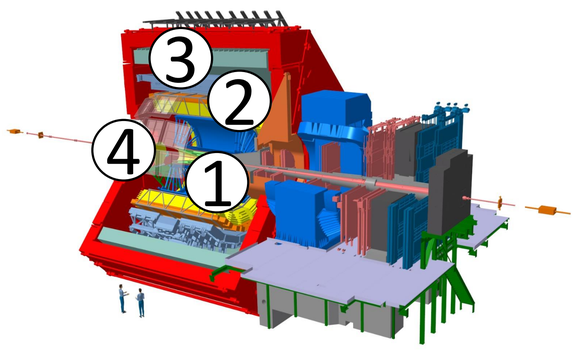
$$\frac{d\sigma^{\mathrm{D}}}{dp_{\mathrm{T}}}(p_{\mathrm{T}}; u_{\mathrm{F}}; u_{\mathrm{R}}) = \mathrm{PDF}(\mathrm{x}_1, \mathrm{u}_{\mathrm{F}})\mathrm{PDF}(x_2, u_{\mathrm{F}}) \otimes \frac{d\sigma^{\mathrm{c}}}{dp_{\mathrm{T}}^{c}}(x_1, x_2, u_{\mathrm{R}}, u_{\mathrm{F}}) \otimes D_{c\to \mathrm{D}}(z = p_{\mathrm{D}}/p_c, u_{\mathrm{F}})$$



- The measurements of the Λ_c^0/D^0 and $\Xi_c^{0,+}/\mathrm{D}^0$ cross section ratios in pp collisions are systematically larger with respect to measurements in e^+e^- and ep collision
- The p_{T}-differential yield ratio of Λ_c^+/D^0 shows a significant multiplicity dependence.

The measurement of the multiplicity dependence of Ξ_c^0/D^0 yield ratio can provide further constraints on the study of charm hadronization.

The ALICE detector and data set (Run 2)

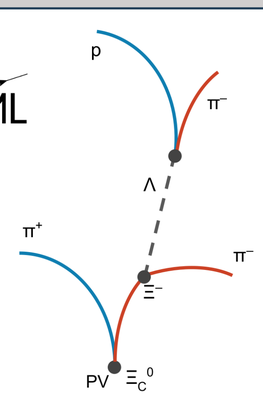


1. Inner Tracking System(ITS): trigger, tracking, vertexing
2. Time Projection Chamber(TPC): tracking, PID via dE/dx
3. Time Of Flight(TOF): PID via time-of-flight measurement
4. V0: trigger, multiplicity

Data set: pp collisions at $\sqrt{s} = 13$ TeV collected by ALICE in 2016, 2017, 2018. The measured charge-particle multiplicity classes are [0-100], [30-100], [0.1-30], [0-0.1]

Analysis strategy

hipe4ML

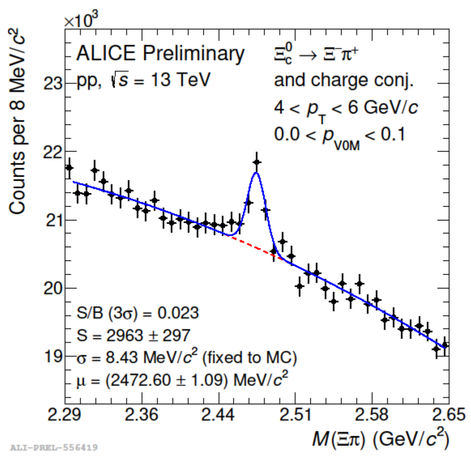


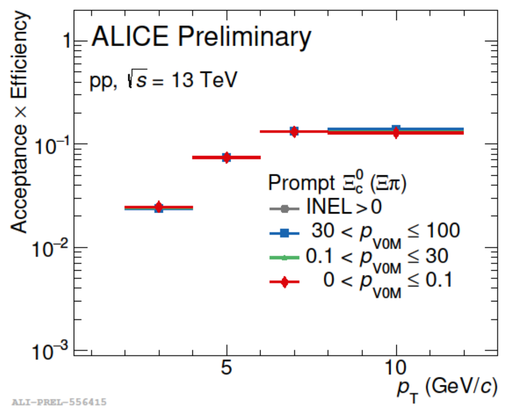
Reconstruction of Ξ_c^0 in the hadronic decay channel

$$\Xi_c^0 \to \pi^+\Xi^- \to \pi^+(\mathrm{K}^-\Lambda) \to \pi^+(\mathrm{K}^-(p\pi^-))$$

1. Machine learning to separate signal and background
2. Raw yield extraction via invariant-mass fit

   The Ξ_c^0 signal is extracted from the $\Xi^-\pi^+$ invariant mass

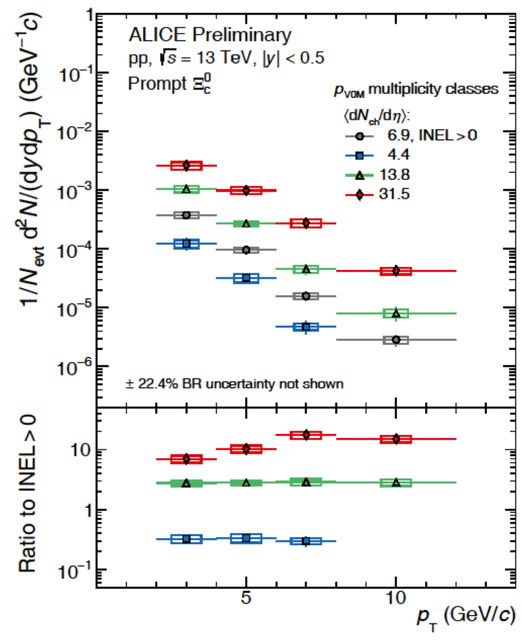




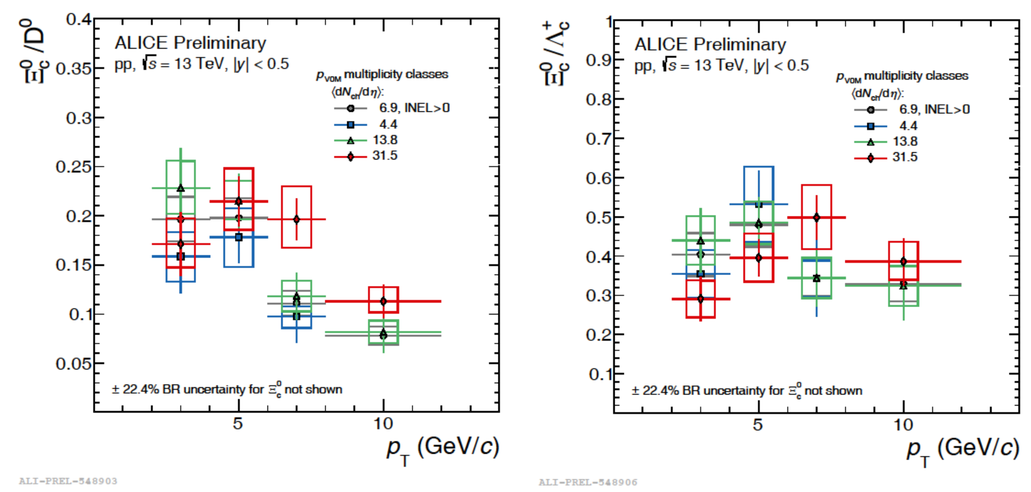
3. Acceptance × efficiency and non-prompt correction
4. Calculae the cross section of Ξ_c^0 as a function of p_{T}

$$\frac{1}{N_{mult}}\frac{dN_{mult}^{hadron}}{dp_{\mathrm{T}}}\Big|_{|y|<0.5} = \frac{1}{N_{mult}}\frac{1}{\Delta p_{\mathrm{T}}}\frac{1}{\mathrm{BR}_{\mathrm{channel}}}\frac{f_{prompt}\varepsilon_{triger}N_{mult}^{hadron,raw}|_{|y|<0.5}}{2y_{fid}(Acc\times\varepsilon)_{prompt}}$$

Result

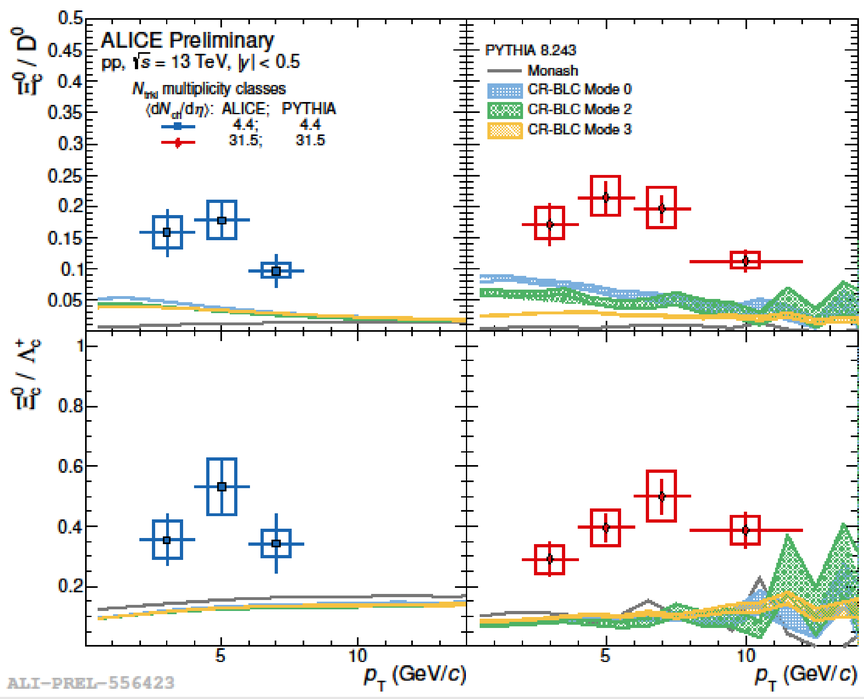


Transverse-momentum spectra of Ξ_c^0 measured in different multiplicity classes selected with V0M at forward rapidity. The corresponding ratios to inelastic collisions event with at least one charged particle in the pseudorapidity range $|\eta| < 1$(INEL > 0) are shown in the bottom panel



The Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ ratios measured in pp collisions at $\sqrt{s} = 13$ TeV for different multiplicity classes are shown

The multiplicity dependence of Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ is not observed with the current uncertainties, but the new Run 3 data will allow making a significant statement.



The Ξ_c^0/D^0(top) and Ξ_c^0/Λ_c^+(bottom) ratios measured in pp collisions at $\sqrt{s} = 13$ TeV for the lowest(left) and highest (right) multiplicity. The measurements are compared to PYTHIA 8 predictions with the Monash estimated in similar multiplicity classes.

The Monash and CR-BLC tune does not reproduce the Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ ratio, and does not show a multiplicity dependence.

Summary & Outlook

- The first measurement of Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ ratios as a function of charged-particle multiplicity in pp collisions at $\sqrt{s} = 13$ TeV are shown. The p_{T}-differential Ξ_c^0/D^0 and Ξ_c^0/Λ_c^+ yield ratio does not show a strong multiplicity dependence as function of p_{T} with the uncertainties.
- More precise measurements with the data sample collected during the Run 3 of the LHC will allow us to further investigate the shape of the p_{T}-integrated baryon-to-meson ratios versus multiplicity, extending the multiplicity reach to lower and higher multiplicity intervals.