



ALICE

D* production vs multiplicity in pp collisions at $\sqrt{s} = 13$ TeV

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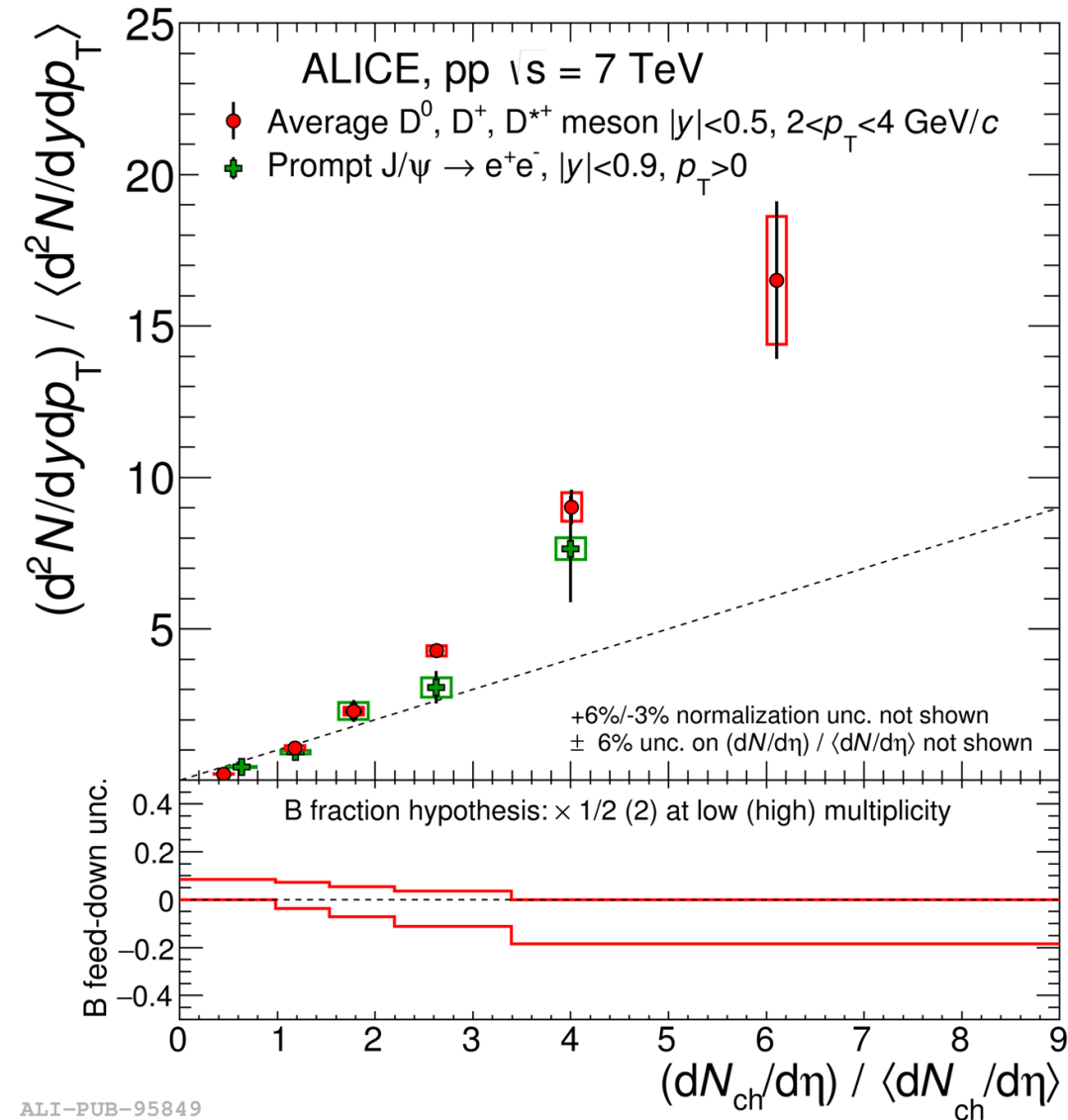
for the ALICE collaboration

106° Congresso Nazionale
SIF

Motivation

- Analysis of D^* -meson production as a function of multiplicity in pp collisions allows us investigate the role of multi-parton interactions \rightarrow expected to have a relevant role at high multiplicity at LHC energies
- Analysis already performed at $\sqrt{s} = 7$ TeV \rightarrow average D mesons and J/ψ show the production yields increase stronger than linear vs multiplicity
- New analysis at 13 TeV with a larger data sample will be performed \rightarrow considerable improvement of results precision

[JHEP 09 \(2015\) 148](#)

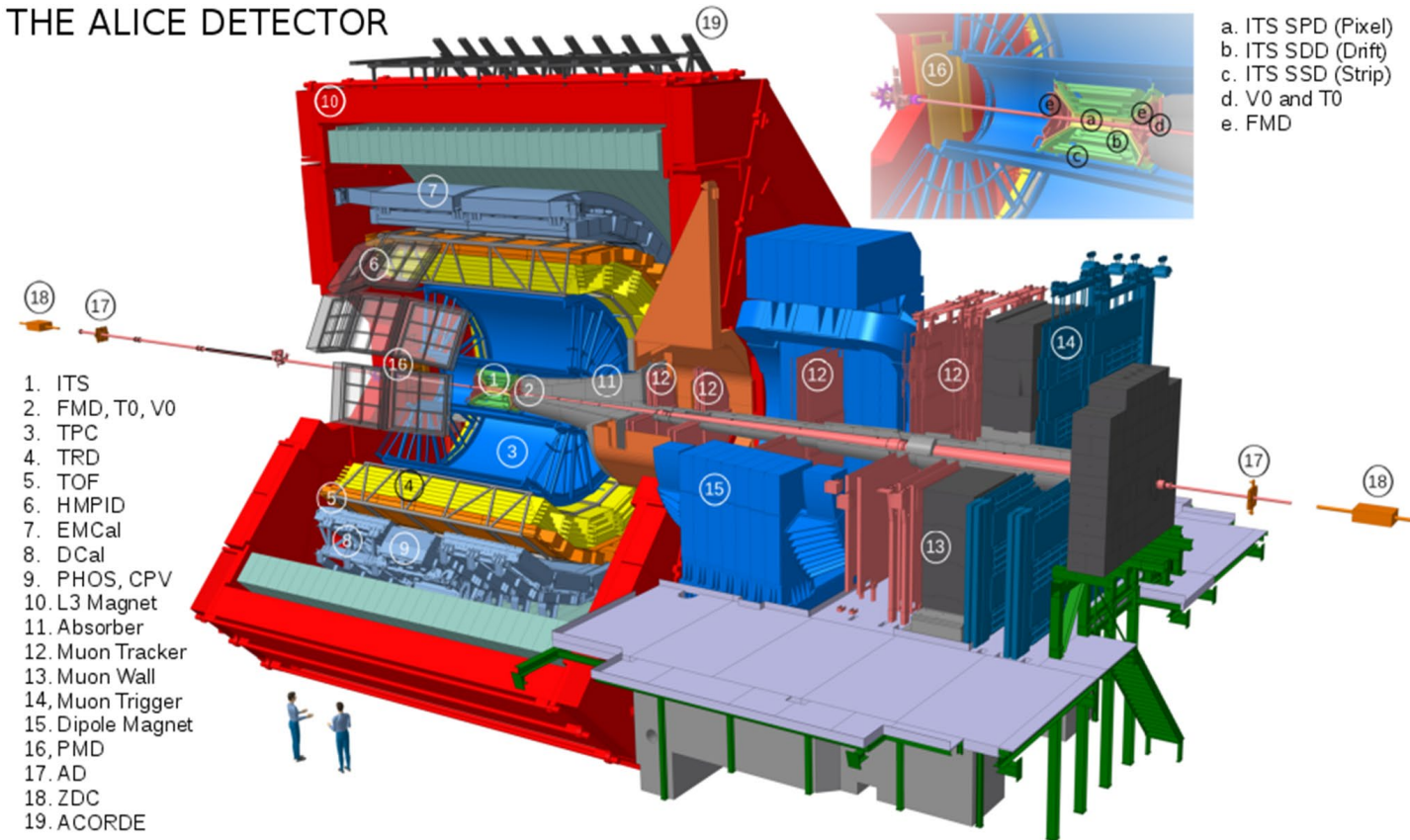


ALI-PUB-95849

The ALICE experiment

- ALICE excellent capabilities for tracking and particle identification were used for the D^* analysis
 - 2016, 2017 and 2018 Minimum Bias triggered data (MB) $\rightarrow \sim 1.7 \times 10^9$ events
 - 2018 High Multiplicity (HM) triggered data $\rightarrow \sim 115 \times 10^6$ in the multiplicity interval considered
- The following detectors were used in particular:
 - Inner Tracking System (ITS), $|\eta| < 1 \rightarrow$ vertexing, tracking and multiplicity estimator using its Silicon Pixel Detector (SPD)
 - Time Projection Chamber (TPC), $|\eta| < 0.9 \rightarrow$ PID and tracking
 - Time Of Flight (TOF), $|\eta| < 0.9 \rightarrow$ PID

THE ALICE DETECTOR



SPD tracklets corrections

- Multiplicity defined as number of tracklets (N_{trk}) reconstructed in the SPD of the ITS
- Product of acceptance and efficiency of the detector depends on Z_{vtx} → correction applied using the formula:

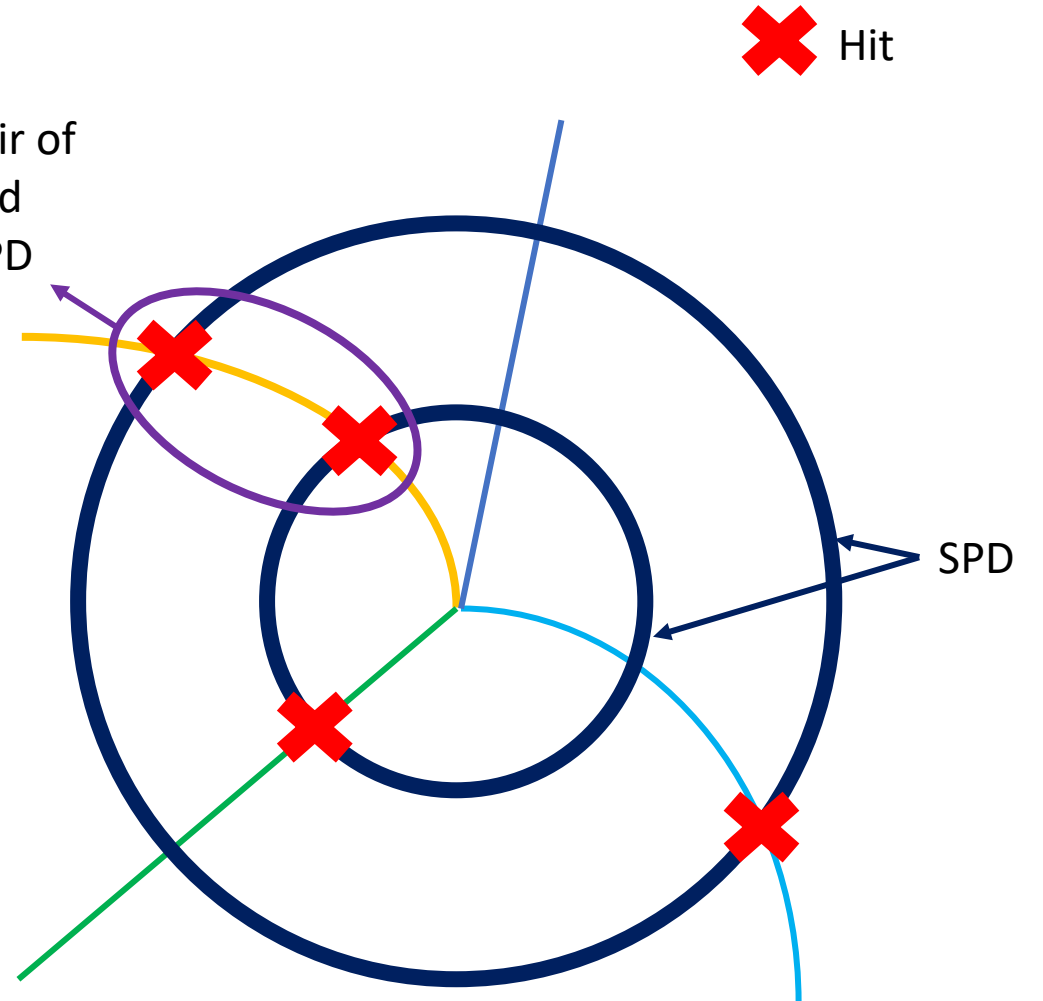
$$N_{\text{corr}}(Z) = \frac{N_{\text{raw}}(Z) \langle N_{\text{ref}} \rangle}{\langle N_{\text{period}}(Z) \rangle}$$

$N_{\text{raw}}(Z)$: measured uncorrected N_{trk}

$\langle N_{\text{ref}} \rangle$: reference value

$\langle N_{\text{period}}(Z) \rangle$: mean N_{trk} for event with vertex at a given Z

Tracklet = pair of reconstructed hits in the SPD



SPD tracklets corrections

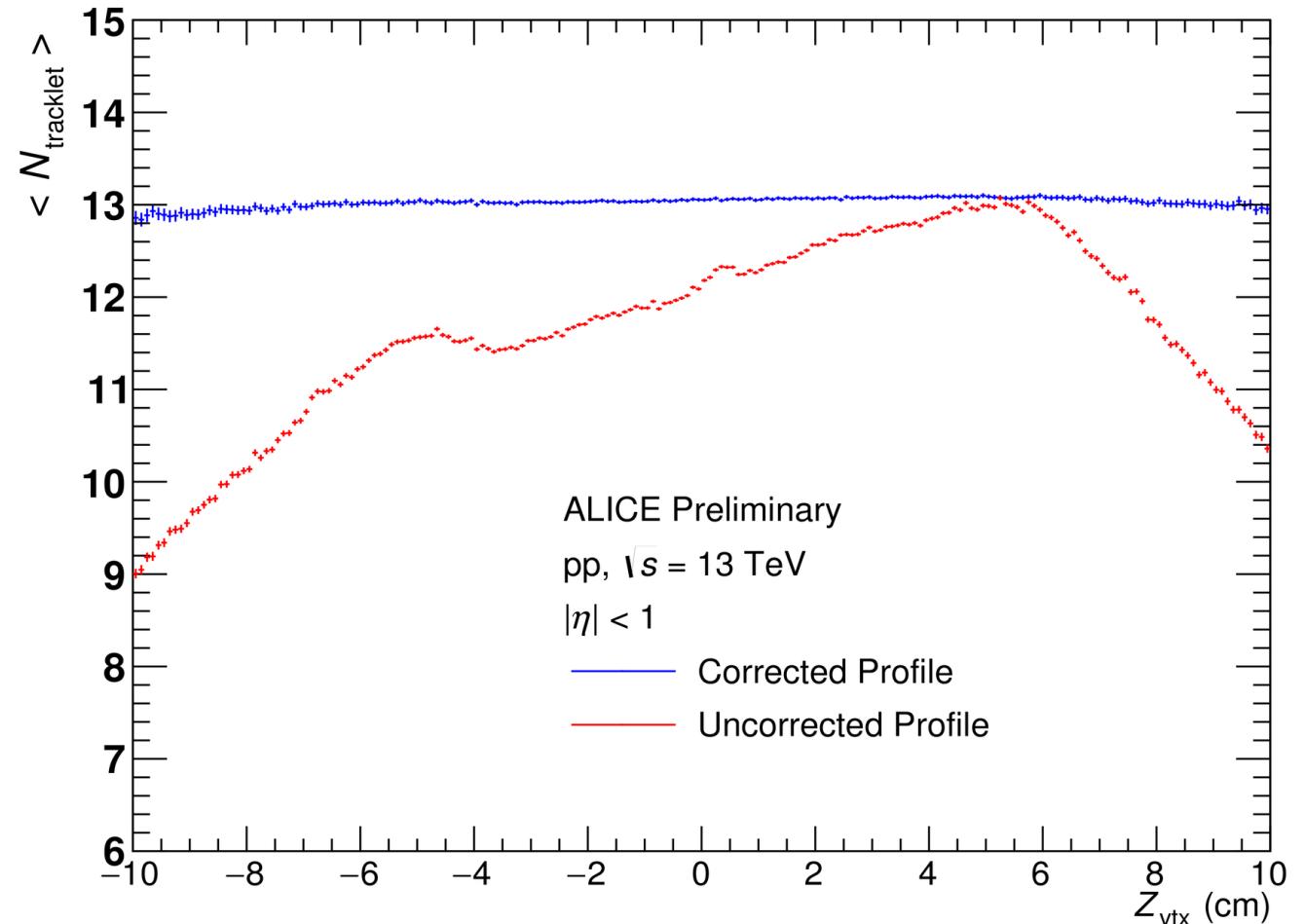
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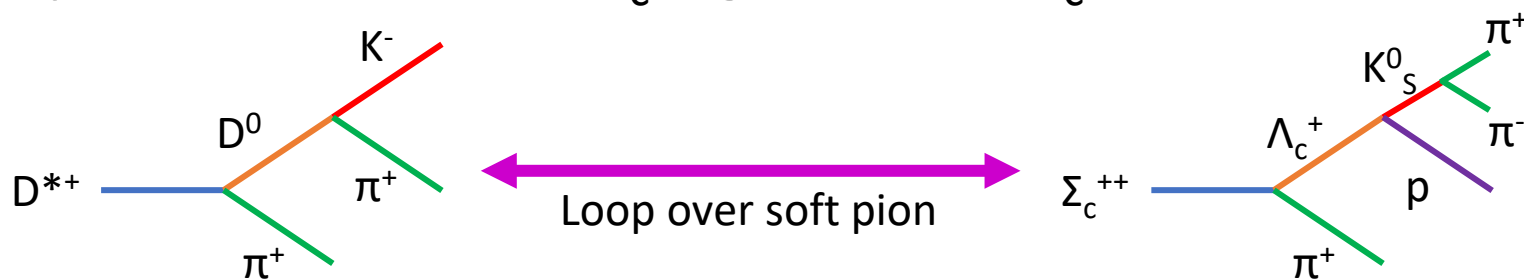


ALI-PREL-147538

- Flat profile obtained after correction is applied

Signal extraction

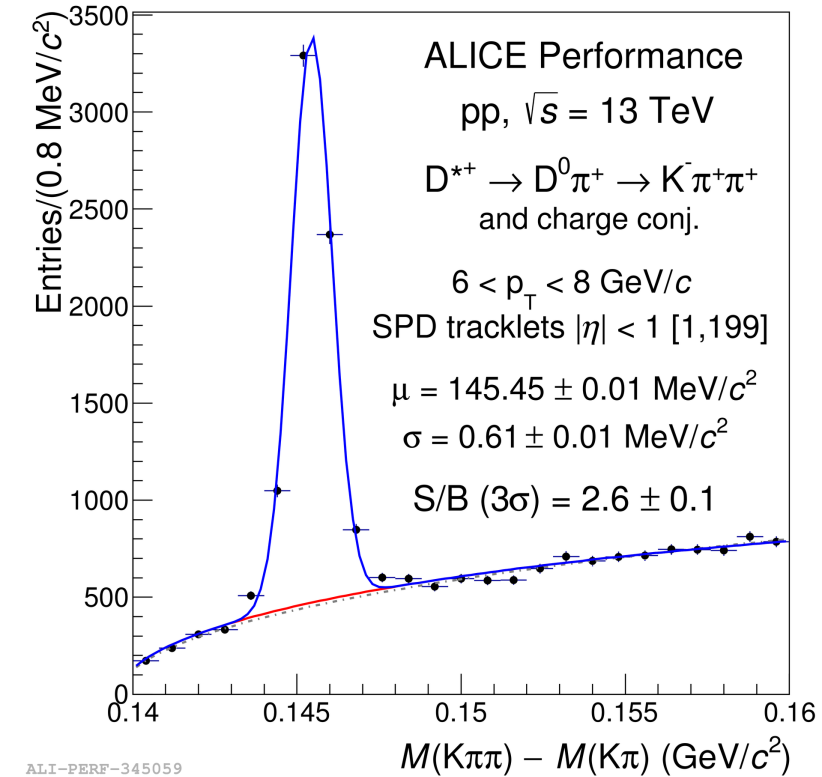
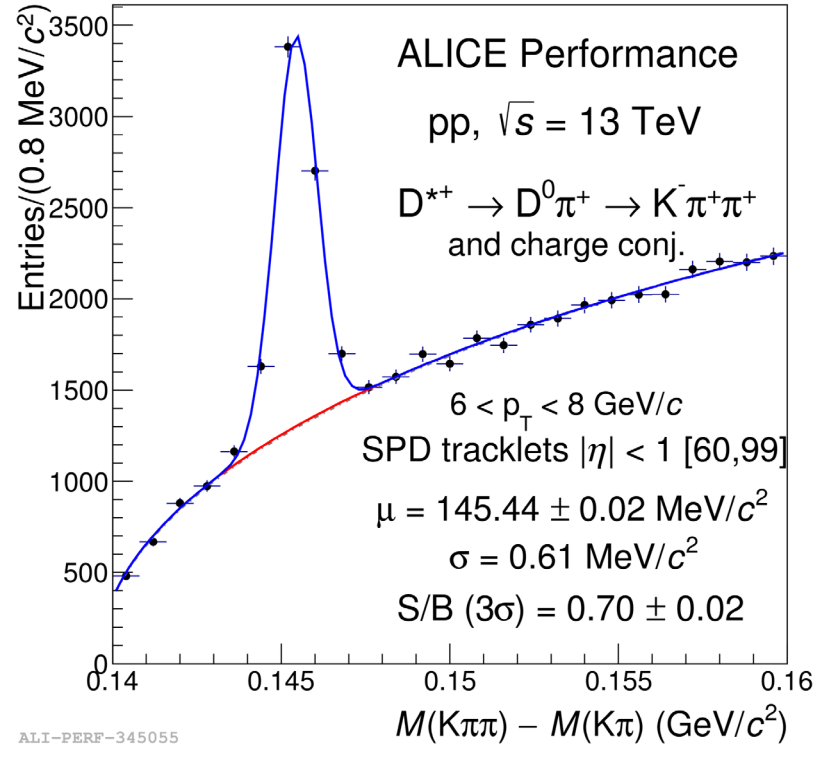
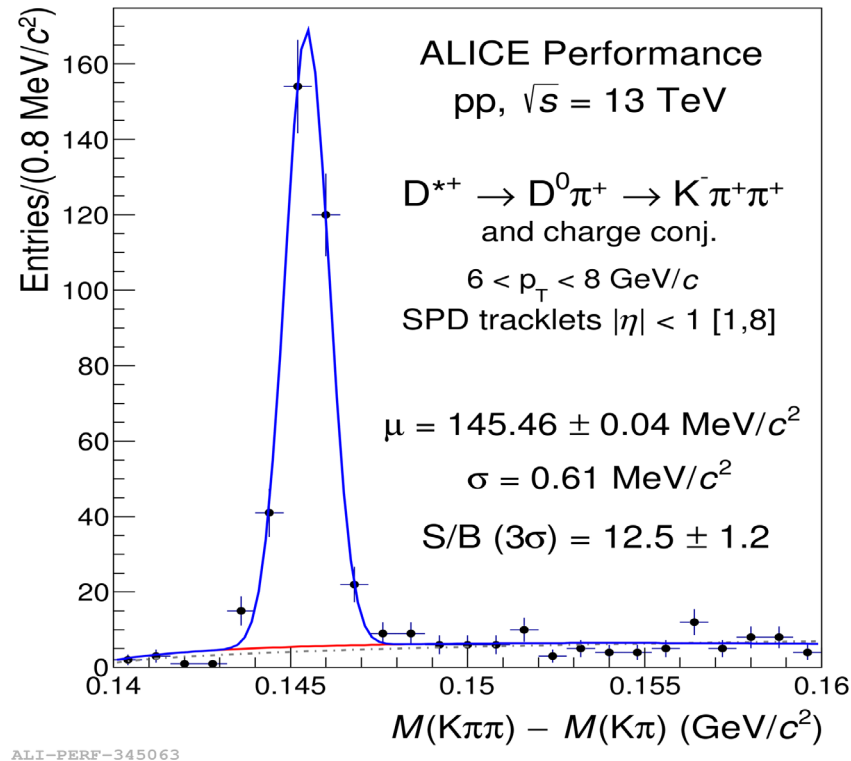
- Decay channel considered is $D^{*+} \rightarrow D^0 \pi^+$ (and charge conjugate)
- Topological and PID selections applied to pair a D^0 candidate ($D^0 \rightarrow K^- \pi^+$ and c. c.) with a soft pion at the primary vertex \rightarrow this procedure was later used in another analysis to extract the Σ_c signal from Λ_c candidates



- Fit on the invariant mass plots was performed using:
 - Signal: Gaussian function
 - Background: exponential with power function

$$y = \alpha e^{-\beta(x-\pi)} \sqrt{x - \pi}$$

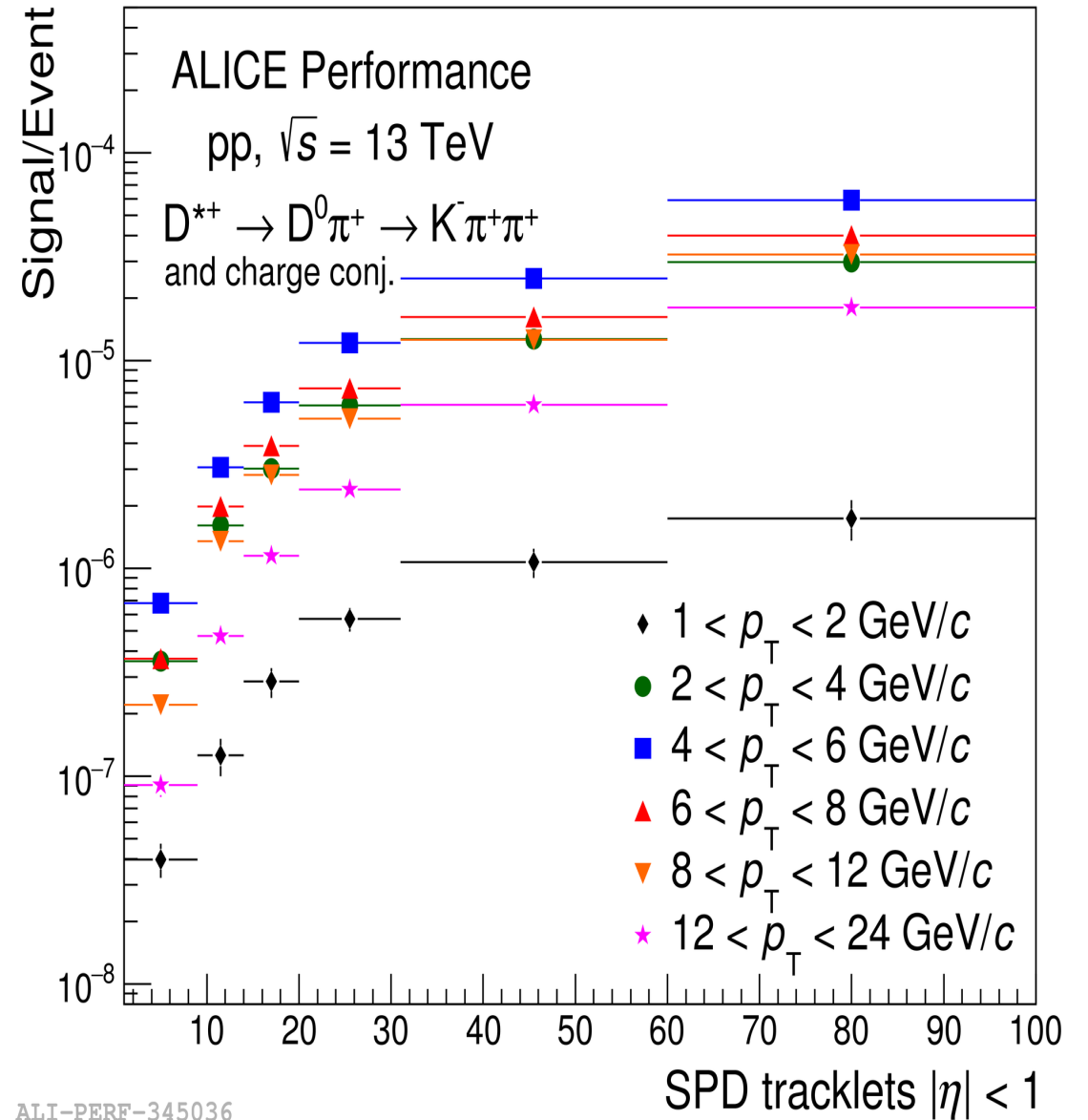
D* invariant mass plots vs multiplicity



- Obtained invariant masses \rightarrow three different multiplicity intervals in the same interval at intermediate p_T
- The $K^- \pi^+ \pi^+ - K^- \pi^+$ (and c. c.) mass difference is shown in the plots

Signal per event

- Raw yields per event as a function of the number of tracklets for various p_T intervals were obtained
- All curves share a similar shape
- Larger Signal/Event values obtained at intermediate p_T intervals $\rightarrow p_T$ -dependent topological selections were applied



Conclusions

- 1.7×10^9 MB events and 115×10^6 HM triggered events in pp collisions at $\sqrt{s} = 13$ TeV were analyzed
- The SPD tracklets used as multiplicity estimator were corrected accordingly in order to remove their dependence on time and on the Z-vertex
- A Gaussian function was used to fit the signal of the invariant mass spectra, while the background was fitted using a power function with exponential
- The analyzed statistics is sufficient to extend the self normalized analysis to higher p_T and higher event multiplicities with respect to those at 7 TeV

Outlook

- Work on D^* cross-section analysis is ongoing \rightarrow preliminary results will be presented in the next future
- The experience obtained with the D^* analysis, combining a particle candidate with a soft pion, was applied to the $\Sigma_c \rightarrow$ Invariant mass preliminary plots obtained and more results will be published soon

