D-meson average production analysis as a function of multiplicity in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE at the LHC

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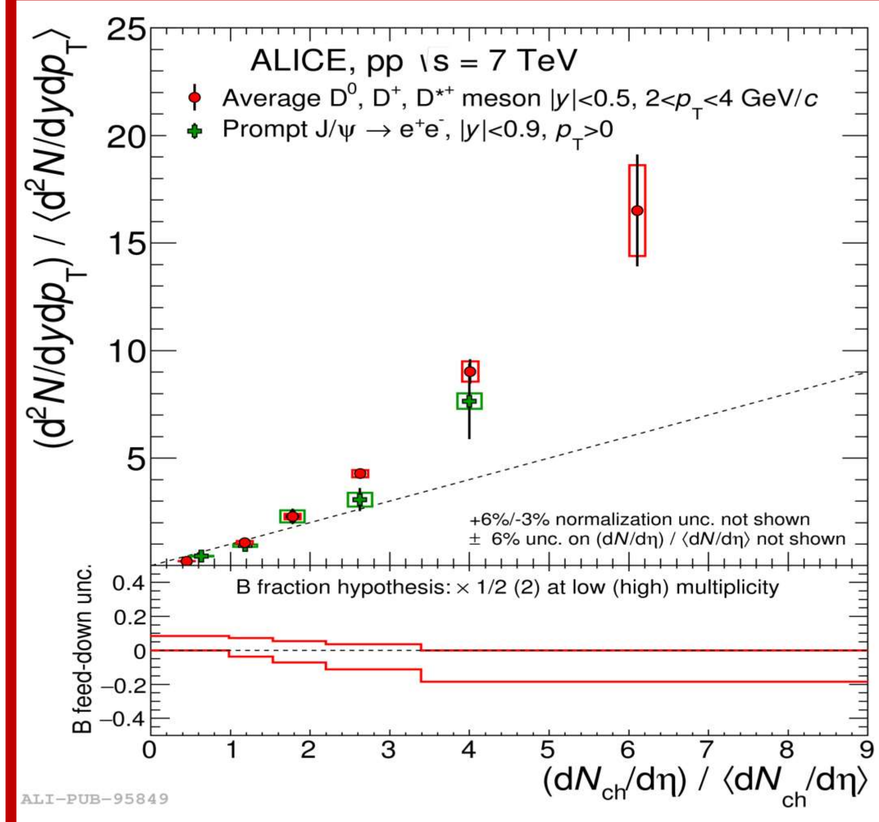

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Physics motivations

Measurements of heavy-flavour production as a function of charged-particle multiplicity N_{ch} in proton-proton collisions:

- Provide an important test for perturbative QCD calculations
- Allow us to assess the role of multiparton interactions (MPI)

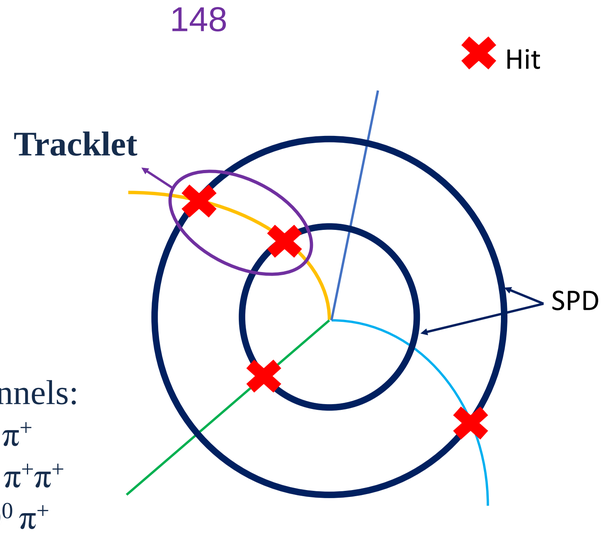
The effect of MPIs could be more relevant at high multiplicities than lower ones at LHC energies. Measurements of D mesons and J/ψ in pp collisions at $\sqrt{s}$ = 7 TeV and leptons from heavy quark hadron decays showed a faster than linear increase as a function of multiplicity in the transverse momentum intervals considered.

Detector setup

D-meson decays are reconstructed in the central barrel of the ALICE experiment at $|\eta| < 0.9$. The detectors used to perform the analysis are:

- Inner Tracking System (ITS)
- Time Projection Chamber (TPC)
- Time Of Flight (TOF)

where ITS and TPC are used to track charged particles, while TPC and TOF are employed for particle identification (PID). Minimum Bias data collected in 2016-17-18 and high multiplicity 2018 triggered data were considered for our analysis.



Decay channels:

- $D^0 \rightarrow K^-\pi^+$
- $D^+ \rightarrow K^-\pi^+\pi^+$
- $D^{*+} \rightarrow D^0\pi^+$

Analysis strategy

Multiplicity is determined via the measurement of the number of tracklets (N_{trk}) reconstructed in the two layers of the Silicon Pixel Detector (SPD) of the ITS detector. D mesons are first selected by applying particle-identification (PID) and topological selections. The D-meson yields are then extracted through the fit of the invariant mass of the daughter particles.

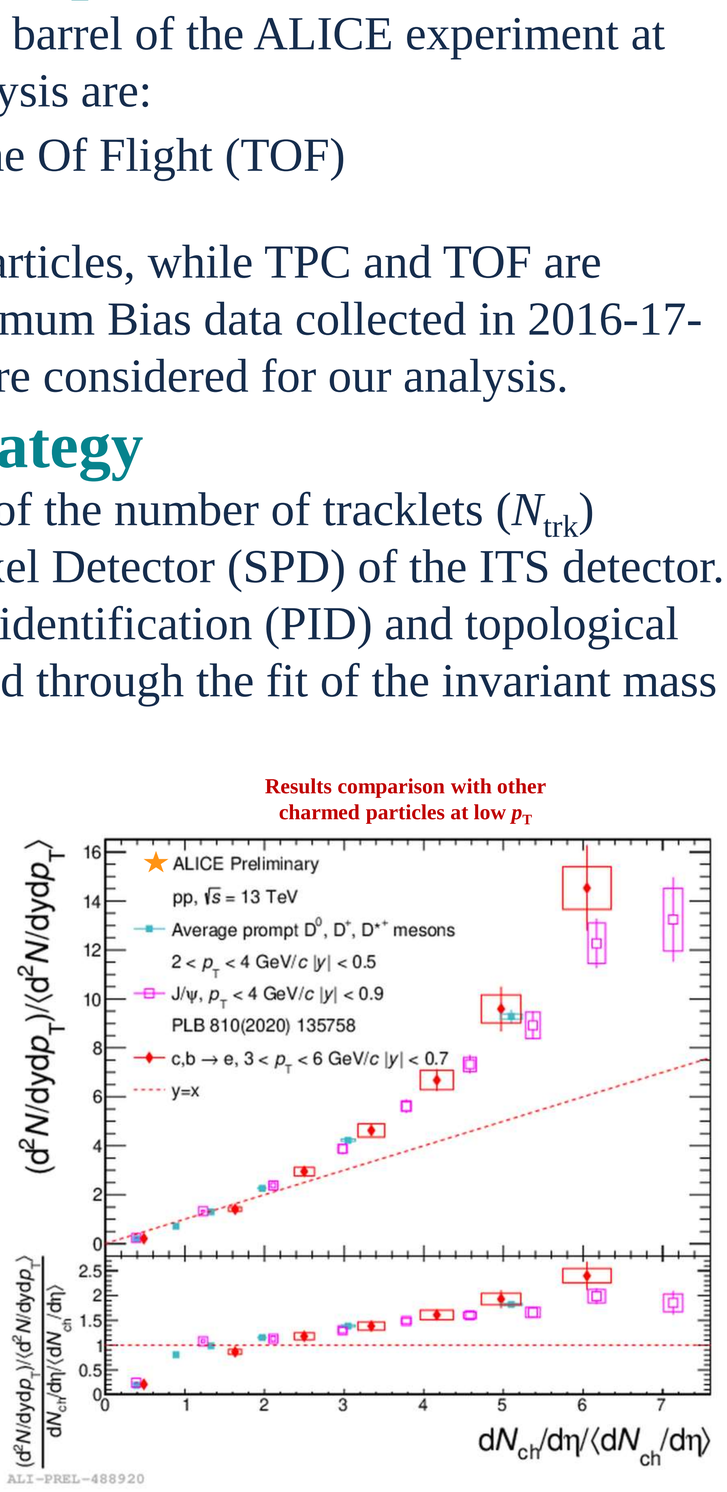
Results

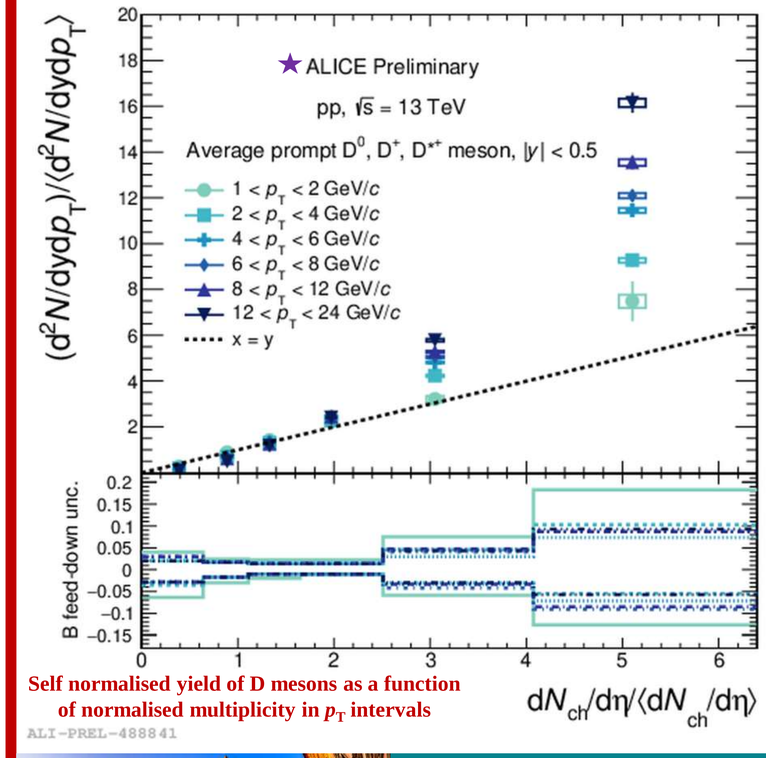
The D-meson results in pp collisions at $\sqrt{s}$ = 13 TeV are shown as the weighted average of D^0, D^+ and D* self-normalised yields (Y_{corr}^{mult}), defined as the production of charmed hadrons in a specified multiplicity interval. Y_{corr}^{mult} is normalized to the multiplicity integrated yield, where the yield is corrected by the trigger efficiency and the detector acceptance:

$$Y_{corr}^{mult} = \frac{Y^{mult}}{(\epsilon^{mult} \times N_{event}^{mult})/\epsilon_{mult}^{trg}} \Big/ \frac{Y^{mult\,int}}{(\epsilon^{mult\,int} \times N_{event}^{mult\,int})/\epsilon_{mult\,int}^{trg}}$$

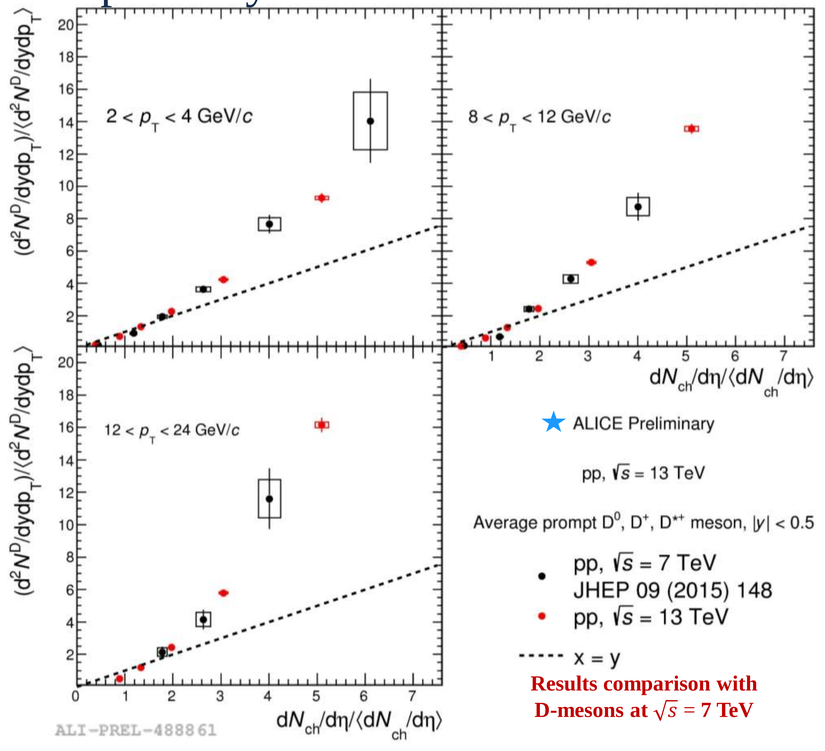
The results are expressed as a function of multiplicity normalised by the average integrated multiplicity and the trend of Y_{corr}^{mult} shows a more rapid increase at higher p_T intervals.★
The D-meson measurements in pp at $\sqrt{s}$ = 13 TeV agree with results obtained for other charmed particles at low p_T★ and with preliminary results at $\sqrt{s}$ = 7 TeV.★ Predictions based on EPOS3★ with and without hydrodynamic component provide a better description of the experimental data than the ones based on the Colour Glass Condensate (CGC) with the 3-Pomeron* mechanism at low multiplicity, but none of the considered models describes perfectly the data trend.

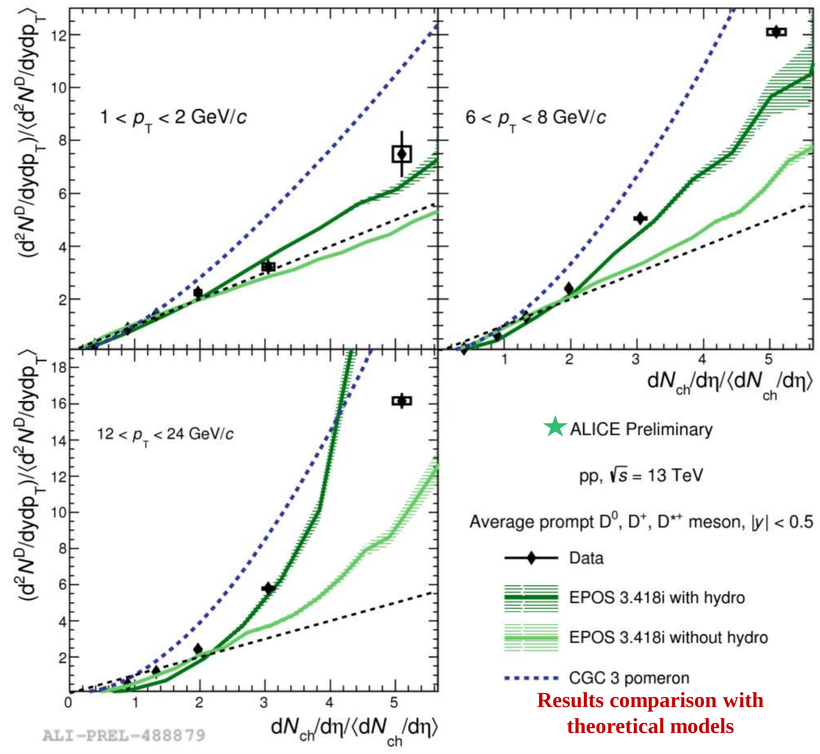
Results comparison with other charmed particles at low p_T





Self normalised yield of D mesons as a function of normalised multiplicity in p_T intervals





Results comparison with D-mesons at $\sqrt{s}$ = 7 TeV

Results comparison with theoretical models

*K. Werner et al., PRC 89, (2014) 064903
*I. Schmidt et al., PRD 101, (2020) 094020

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