PROCEEDINGS OF SCIENCE

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

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Production measurements of heavy-flavour hadrons in pp collisions provide a stringent test to pQCD calculations. Analysing their production as a function of charged-particle multiplicity allows us to study multi-parton interactions, which are expected to have a relevant role in charged particle production at high energy at the LHC. Moreover, the comparison with theoretical models allows investigating the contribution of colour reconnection in hadronization mechanisms of heavy quarks into hadrons. In this report, the production measurements in pp collisions at $\sqrt{s}$ = 13 TeV of D mesons (D^0, D^+, D^{*+}) as well as their dependence on multiplicity are presented. The results are compared with similar studies for other particle species, with D-meson measurements performed at $\sqrt{s}$ = 7 TeV, and with predictions from Monte Carlo event generators.

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1. Introduction

Measurements of charm hadron production in pp as a function of the multiplicity of charged particles in the event allow the investigation of effects related to multiple parton interactions and colour reconnection, which are expected to play a relevant role in the production of charged particles at high energy at the LHC.

The excellent particle identification and tracking capabilities of the ALICE detectors [1] are exploited to study D-mesons production, reported in this contribution.

The particle identification in the central barrel ($|\eta| < 0.9$) is provided by the Time Projection Chamber (TPC) and the Time Of Flight (TOF) detectors, as well as by the Electromagnetic Calorimeter (EMCal) for high-p_{T} electron identification. The position of the track is determined with high resolution using the Inner Tracking System (ITS) and TPC. The silicon pixel detector (SPD) is used to estimate the multiplicity, which is defined as the number of track segments reconstructed from two hits in the detector layers.

The multiplicity intervals estimated with this method are converted to mean charged-particle multiplicity density ($\langle \mathrm{dN_{ch}}/\mathrm{d}\eta \rangle$) of charged primary particles $\mathrm{N_{ch}}$.

Selection criteria for tracks and more detailed information on the analysis procedure can be found in the published previous analysis ($\sqrt{s}$ = 7 TeV) [2].

2. Analysis strategy and results

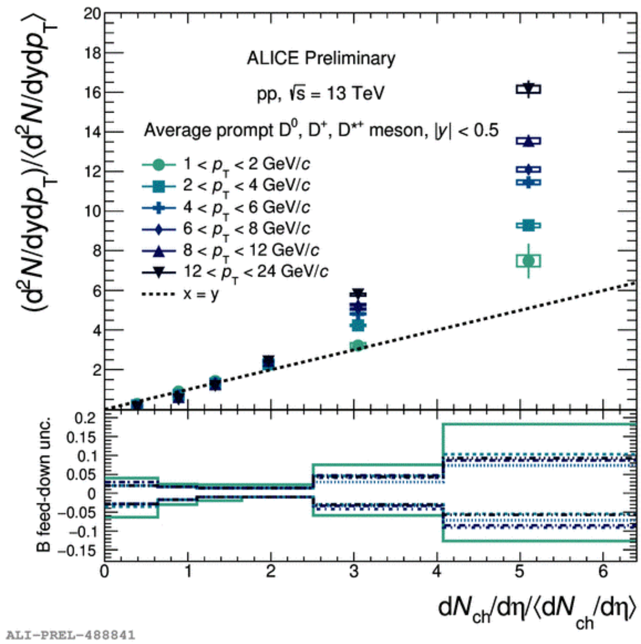

Figure 1: Average of $\mathrm{D^0, D^+, D^{*+}}$ meson self-normalised yields vs. charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 13 TeV at midrapidity in different p_{T} intervals. The b-hadron feed-down systematic uncertainties are shown in the bottom panel.

The production of each D meson is measured using the so-called self-normalised yield, defined as

$$\frac{\mathrm{d}^2 N_{\mathrm{mult}}/(\mathrm{d}y\mathrm{d}p_{\mathrm{T}})}{\langle \mathrm{d}^2 N_{\mathrm{int}}/(\mathrm{d}y\mathrm{d}p_{\mathrm{T}})\rangle} = \frac{Y_{\mathrm{mult}}}{Y_{\mathrm{int}}} \tag{1}$$

where $Y_{\mathrm{mult/int}}$ are the corrected yields in multiplicity intervals and in the multiplicity-integrated case, respectively. This quantity was found to be compatible for all the species analysed, therefore the results are presented as their average.

Measurements of D-meson and non-prompt J/ψ production as a function of multiplicity in pp collisions at $\sqrt{s}$ = 7 TeV were reported in [2]: the self-normalised yields of both particle species show a faster than linear increase as a function of multiplicity. Within uncertainties, the evolution of the self-normalised yield with multiplicity does not depend significantly on p_{T}.

The results for D mesons at $\sqrt{s}$ = 13 TeV are shown in Fig. 1 in six p_{T} intervals from $1 < p_{\mathrm{T}} < 24$ GeV/c. The larger statistics collected by ALICE in pp collisions at $\sqrt{s}$ = 13 TeV with respect to that collected at $\sqrt{s}$ = 7 TeV allowed us to appreciate a dependence on p_{T}, and high-p_{T} intervals show a stronger increase of self-normalised yields with multiplicity. The measured average D^0, D^+, D^{*+} meson self-normalised yields is compared to different Monte Carlo models in Fig. 2. The EPOS3 generator [3] with initial flux-tube conditions, generated in the Gribov-Regge multiple scattering framework, and including a hydrodynamical evolution describe the data reasonably well, while the generators EPOS3 without hydrodynamical modelling of collision and 3-pomeron colour glass condensate (CGC) [4] underestimate and overestimate them, respectively.

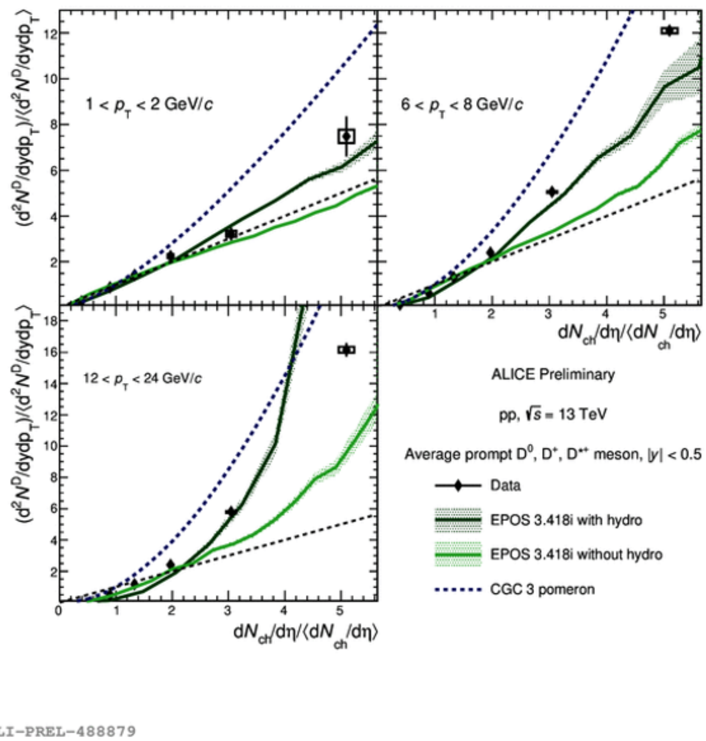

Figure 2: Comparison of D-meson self-normalised yields as a function of charged-particle multiplicity to models data in three p_{T} intervals in pp collisions at $\sqrt{s}$ = 13 TeV.

Furthermore, the self-normalised yields of J/ψ, D-meson average, and heavy-flavour decay electrons compared in similar p_{T} intervals in Fig. 3 express similar trends as a function of multiplicity.

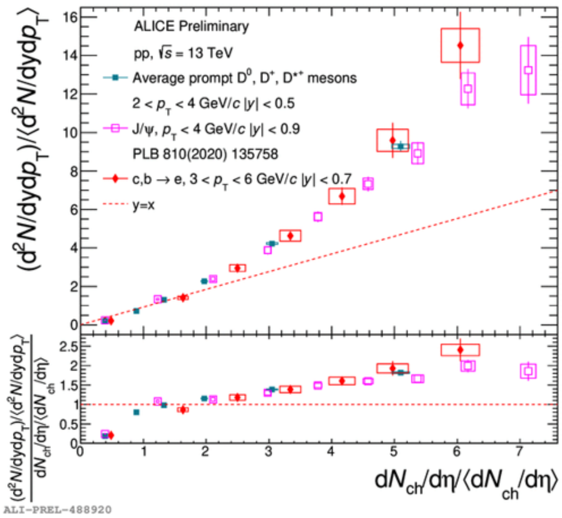

Figure 3: Comparison of self-normalised yields of D-meson average, J/ψ and heavy-flavour electrons at low p_{T} in pp collisions at $\sqrt{s}$ = 13 TeV.

3. Summary

Self-normalised yield measurements in pp collisions at $\sqrt{s}$ = 13 TeV of D mesons, J/ψ and heavy-flavour decay electrons are compatible in similar p_{T} intervals: they all increase faster than linear as a function of charged-particle multiplicity, and a significant p_{T} dependence was found. The dependence of the normalised yields as a function of multiplicity is reproduced well by EPOS3 generator with hydrodinamical evolution of the collision.

References

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