D meson reference spectra in pp collisions at √s = 2.76 TeV with ALICE

Zaida Conesa del Valle for the ALICE Collaboration
European Organization for Nuclear Research (CERN), Geneva, Switzerland

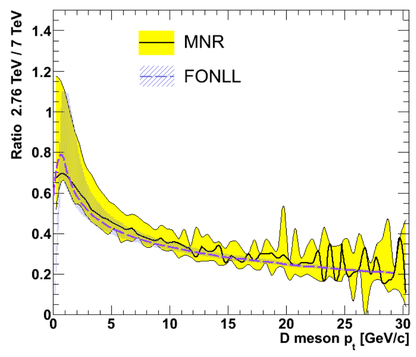
Abstract: Charm production in proton proton collisions is an important tool to test pQCD calculations. Its spectrum in heavy ion interactions is influenced by the formation of hot and dense QCD matter. A common procedure to study the characteristics and effects of this matter is to compare particle production in heavy ion and proton proton reactions. Here we present a pQCD-based energy extrapolation of ALICE D meson pp measurements at √s = 7 TeV to √s = 2.76 TeV, as a reference for the PbPb studies at this energy. The results are confronted to the measured cross-section at √s = 2.76TeV in the $D^0 \rightarrow K^- \pi^+$ decay channel.

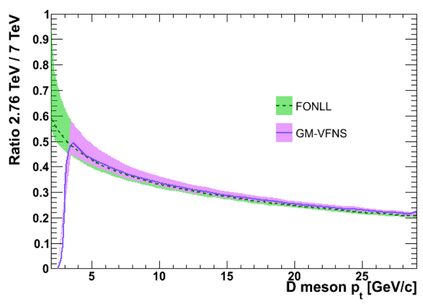
Energy extrapolation of the D meson √s = 7 TeV measurements

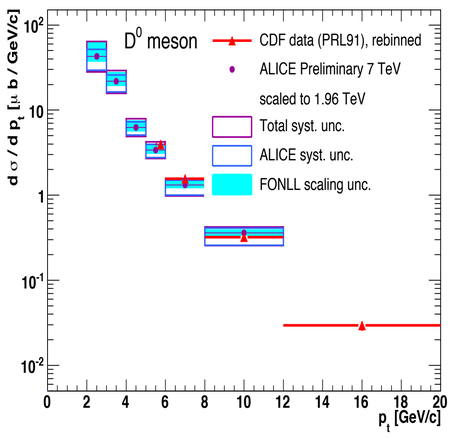
The recipe

We consider the pQCD calculations scaling factors for different sets of scales $0.5<\mu_F/\mu_0<2$, $0.5<\mu_R/\mu_0<2$ (with the constraint $0.5<\mu_F/\mu_R<2$), and a charm quark mass $1.3<m_c<1.7$ GeV/c².
The calculation parameters at different energies are assumed to be correlated.

The procedure:
1. Rebin the pQCD predictions to the measurement pt binning.
2. Evaluate the scaling factor:
   a. Define the central value as the ratio of the central predictions,
   b. The uncertainty is given by the spread of the ratios for the different sets of scales.
3. Multiply the ALICE √s = 7 TeV cross sections by these scaling factors and propagate the uncertainties.

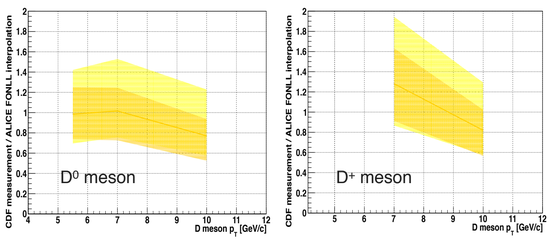


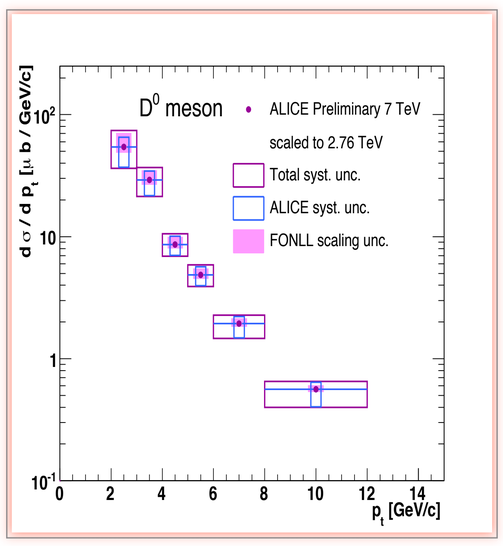


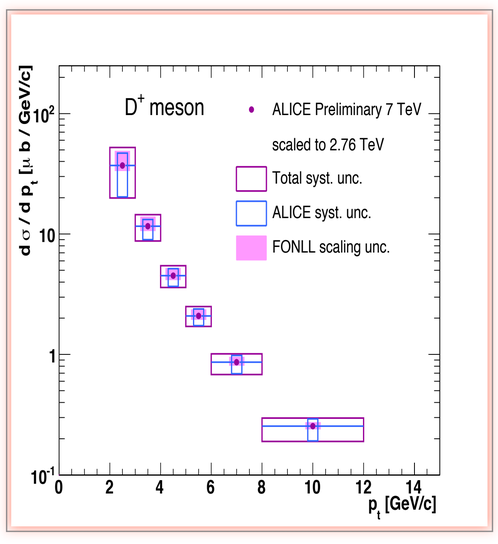


Scaling cross-checks

- Influence of the theoretical calculation
  - ☑ MNR vs FONLL : these scalings are consistent, FONLL involving smaller uncertainties.
  - ☑ GM-VFNS vs FONLL : the scaling is in good agreement, the uncertainties being similar.
- Confront ALICE and CDF measurements
  - ☑ ALICE √s = 7 TeV D meson cross sections were scaled to √s = 1.96 TeV. The comparison to the CDF cross sections and their relative ratios probe the goodness and performance of this FONLL-based scaling procedure.
  - ☑ The scaling of both ALICE and CDF D meson cross-sections to √s = 2.76 TeV is also consistent.



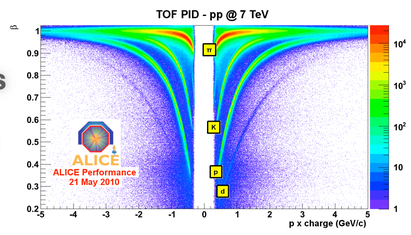




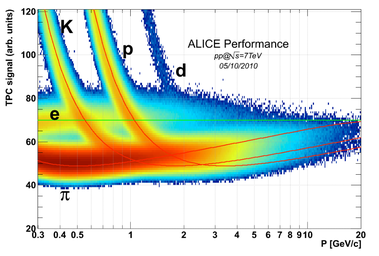
$D^0 \rightarrow K^- \pi^+$ measurement in pp collisions at √s = 2.76 TeV

The $D^0 \rightarrow K^- \pi^+$ analysis

Thanks to the precise measurement of the tracks impact parameter in the central barrel, the ALICE experiment has the ability to identify displaced vertexes, crucial characteristic of charmed hadron decays, with a primary vertex displacement of few hundreds of μm.

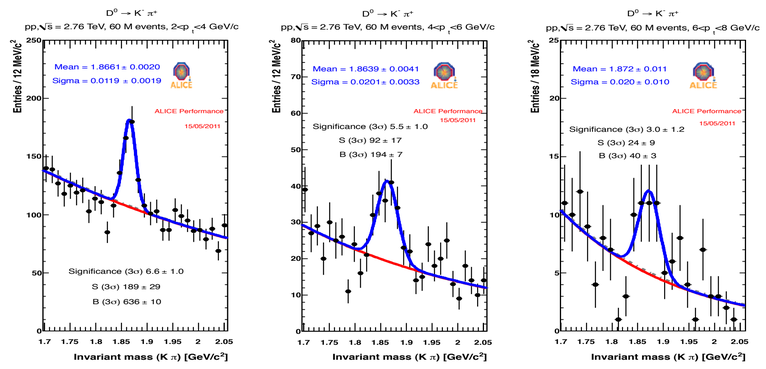


- Detectors involved in this analysis:
  - ☑ Inner Tracking System (ITS),
  - ☑ Time Projection Chamber (TPC) ,
  - ☑ Time Of Flight (TOF).

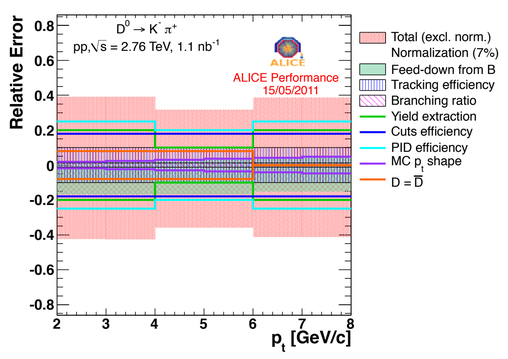


- Main topological cuts:
  - ☑ Impact parameter of the tracks,
  - ☑ Angle between the meson flight line and the particle momentum.

- Particle identification:
  - ☑ TPC allows K/π separation up to ~0.6 GeV/c,
  - ☑ TOF allows K/π separation up to ~2 GeV/c.



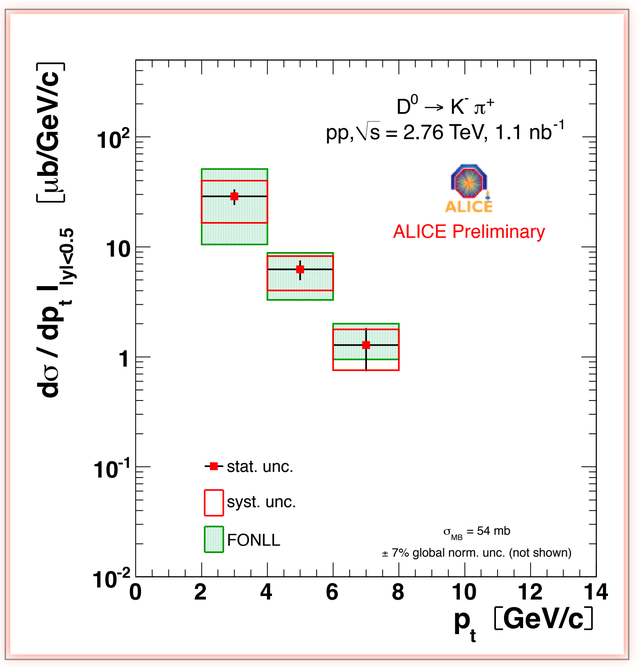
- pQCD (FONLL) driven feed-down subtraction.



- Measurement systematics
  - ☑ Signal extraction,
  - ☑ MC corrections,
  - ☑ D pt shape used for the MC corrections,
  - ☑ Tracking efficiency,
  - ☑ PID efficiency,
  - ☑ Particle/anti-particle inefficiencies,
  - ☑ Feed-down subtraction,
  - ☑ Normalization.

Results

The measured D^0 cross section in pp collisions at √s = 2.76 TeV is in very good agreement with FONLL calculations for D^0 mesons at the same energy.



References

- FONLL: M. Cacciari, M. Greco, P. Nason, JHEP 9805 (1998) 007; M. Cacciari, S. Frixione, P. Nason, JHEP 0103 (2001) 006; M. Cacciari et al, private communication.
- GM-VFNS: B.A.Kniehl, G.Kramer, I.Schienbein, H.Spiesberger, in preparation.
- MNR: M. Mangano, P. Nason, and G. Ridolfi, Nucl. Phys. B373 (1992) 295.
- D. Acosta et al. (CDF Collaboration), Phys. Rev. Lett. 91 (2003) 241804.

D meson reference for the PbPb analysis at √s = 2.76 TeV

- The D^0 and D^+ meson measurements at √s = 2.76 TeV have been performed in lager pt bins than the √s = 7 TeV analysis due to the lower statistics.

- The D^0 and D^+ meson √s = 7 TeV scaled cross sections to √s = 2.76 TeV are in good agreement with the cross sections measured at √s = 2.76 TeV.
  - ☑ Only the first pt bin for D^0 show a tiny statistical deviation to the trend. A systematic uncertainty was associated to the reference spectrum to compute the D^0 nuclear modification factor.

- The D meson reference spectrum for the nuclear modification factor calculations at √s = 2.76 TeV has been presented and successfully confronted to the measurements at √s = 2.76 TeV.