Measurement of open heavy-flavour production with ALICE at the LHC

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Introduction

Heavy quarks (charm and beauty) are effective probes to investigate the properties of the hot and dense strongly-interacting medium created in heavy-ion collisions as they are produced in high-energy hard partonic scattering processes occurring in the early stages of the collision. Due to their long life time, they probe all the stages of the medium evolution and they interact with its constituents, losing energy via gluon radiation and elastic collisions. In pp collisions, heavy quarks serve as a fundamental test of perturbative QCD calculations and also provide reference for measurements in p-Pb and Pb-Pb collisions. Pb-Pb collisions give the possibility of studying the properties of strongly-interacting matter at high temperature and density, while p-Pb collisions allow us to disentagle cold nuclear effects (such as k_T broadening, the nuclear modification of parton distribution functions, parton saturation at low x and energy loss) from the hot nuclear effects arising during the evolution of the medium.

ALICE detector and heavy-flavour reconstruction strategy

The ALICE apparatus has excellent capabilities for heavy-flavour measurements. It is composed of a central barrel and a forward muon arm. A detailed description of the experimental setup can be found in [1]. At mid rapidity ($|\eta|$ <0.9), open heavy-flavour production is measured in the central barrel via the hadronic decays of D mesons ($\mathrm{D}^0, \mathrm{D}^+, \mathrm{D}^{*+}$ and D_s^+) and Λ_c^+, the semileptonic decays to electrons of charm and beauty hadrons and also semileptonic decays to electrons from Λ_c^+ and Ξ_c^0. At forward rapidity (-4< η <-2.5), muons from heavy-flavour hadron decays are reconstructed in the muon spectrometer. ALICE collected pp collisions at centre of mass energies $\sqrt{s}$ = 7 TeV, 8 TeV and 2.76 TeV [Run-1] and 5.02 and 13 TeV [Run-2], Pb-Pb per nucleon-nucleon collisions $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV [Run-1] and $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV [Run-2] and p-Pb collisions $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV [Run-1 and Run-2] and 8.16 TeV [Run-2].

Results in pp collisions

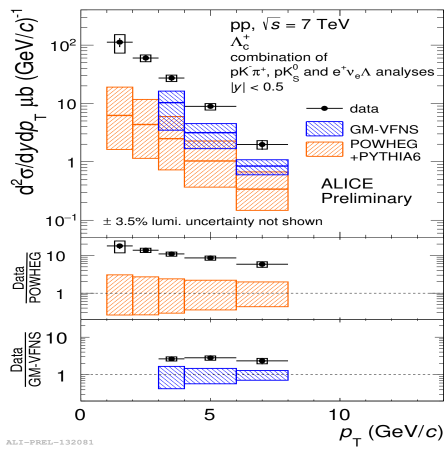

FIG. 1: p_T-differential cross section of Λ_c^+ compared with model predictions.

The differential cross sections of prompt D mesons ($\mathrm{D}^0, \mathrm{D}^+, \mathrm{D}^{*+}$ and D_s^+), heavy-flavour decay electrons, electrons from beauty-hadron decays and heavy-flavour decay muons were measured in pp collisions at $\sqrt{s}$=7 TeV [2, 3], 2.76 TeV [4], 8 TeV and 13 TeV. They are well described by pQCD calculations [5–7]. The first measurement of the production cross section of Λ_c^+ at mid-rapidity at LHC is shown in

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Fig. 1 which is also compared with the model predictions. The comparison with model predictions shows an underestimation of factor 2-10 of Λ_c^+ production in the whole $p_{\rm T}$ range considered.

Results in p-Pb collisions

The p-Pb spectra are quantitatively compared to the pp reference by computing the nuclear modification factor, R_{pPb} which is defined as:

$$R_{\rm pPb} = \frac{1}{\rm A}\frac{{\rm d}\sigma_{\rm pPb}/{\rm d}p_{\rm T}}{{\rm d}\sigma_{\rm pp}/{\rm d}p_{\rm T}}$$

where A is the number of nucleons in the p-Pb nucleus, $\sigma_{\rm pp}$ and $\sigma_{\rm pPb}$ are the production cross section in pp and p-Pb collisions, respectively. Fig. 2 shows the $R_{\rm pPb}$ of the averaged non-strange D mesons $({\rm D}^0, {\rm D}^+, {\rm D}^{*+})$ and strange D mesons $({\rm D_s^+})$ from Run-2. The $R_{\rm pPb}$ is consistent with unity for strange as well as non-strange D mesons. The results are compatible with those obtained in Run-1 results [8].

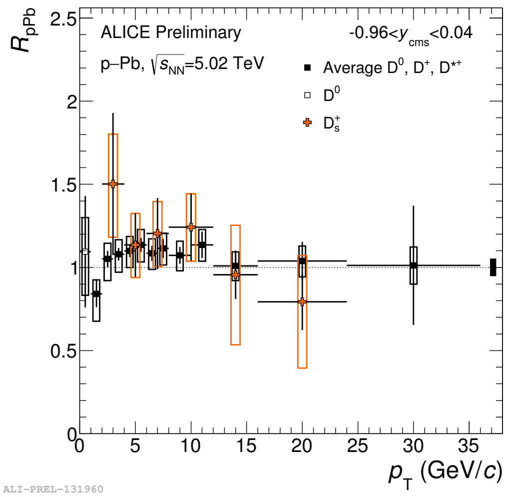

FIG. 2: Average of D-meson $({\rm D}^0, {\rm D}^+, {\rm D}^{*+})$ $R_{\rm pPb}$ and ${\rm D_s^+}$ $R_{\rm pPb}$ as a function of $p_{\rm T}$.

Results in Pb-Pb collisions

Fig. 3 shows the $R_{\rm AA}$ of the average of non-strange D-mesons $({\rm D}^0, {\rm D}^+, {\rm D}^{*+})$ and the $R_{\rm AA}$

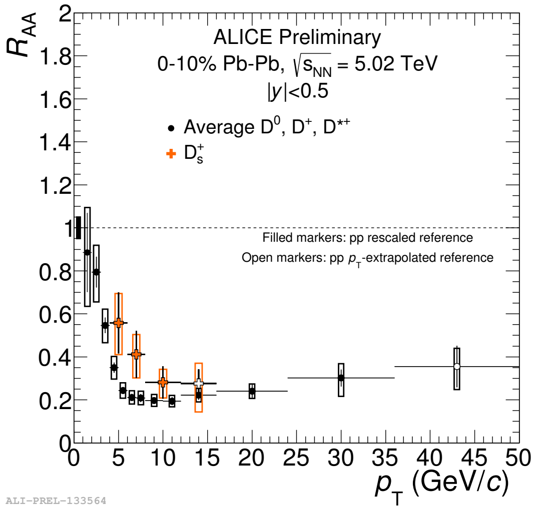

FIG. 3: Average of D-meson $({\rm D}^0, {\rm D}^+, {\rm D}^{*+})$ $R_{\rm AA}$ and ${\rm D_s^+}$ $R_{\rm AA}$ as a function of $p_{\rm T}$ compared to various models in the 10% most central collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV.

of ${\rm D_s^+}$ mesons. The ${\rm D_s^+}$ $R_{\rm AA}$ is larger than D-meson $R_{\rm AA}$ which hints to an enhancement of strange D mesons w.r.t non-strange D mesons due to the strangeness content.

References

[1] K. Aamodt et.al, ALICE Collaboration, JINST, 3 (2008) S08002.
[2] J. Adam et. al, ALICE Collaboration, PRC 94, (2016) 054908.
[3] B. Abelev et. al, ALICE Collaboration, JHEP 1201 (2012) 128, PLB 718 (2012) 279, PRD 86 (2012) 112007, PLB 708 (2012) 265, PLB 721 (2013) 13.
[4] B. Abelev et. al, ALICE Collaboration, JHEP 1207 (2012) 191, PRD 91 (2015) 012001, PRL 109 (2012) 112301, PLB 738 (2014) 97.
[5] M. Cacciari et. al, JHEP, 1210 (2012) 137.
[6] B. Kniehl et. al, EPJC 72 (2012) 2082.
[7] R. Maciula and A Szczurek, PRD87 (2013) 094022.
[8] B. Abelev et. al, ALICE Collaboration, PRL 113 (2014) 232301.