Study of open heavy-flavour hadron decay muons in pp collisions with ALICE at the LHC

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Introduction

Heavy-quark production is one of the probes for the investigation of the properties of the high-density medium formed in heavy-ion collisions. This investigation requires also the study of proton-proton collisions. In addition to provide the necessary baseline for nucleus-nucleus and proton-nucleus collisions, proton-proton collisions are of great interest, also in their own right, since they allow to test perturbative QCD.

A significantly large data sample is being collected as part of Run 2 of the LHC, much higher statistic is expected with high luminosity and it will allow to extend measurements into both lower and higher p_T regions. In Run 2, an unprecedentedly large yield is expected for heavy flavour production. The extraction of the heavy-flavour signal from the inclusive muon spectra requires the subtraction of the background contribution which comes from light hadron decay and from particles produced in the absorbing elements.

In this contribution, we present the measurement of heavy-flavour production by detecting single muons from semi-leptonic decay of heavy mesons measured in A Large Ion Collider Experiment (ALICE) at the Large Hadron Collider (LHC).

Experimental Set Up

The experimental measurement of heavy-flavour decay muons (HFM) has been performed using the Muon Spectrometer (MS) of the ALICE detector at forward rapidity ($-4.0 < \eta < -2.5$). The design of the MS is shown in Fig.1. It consists of a front absorber, a dipole magnet, a muon filter, a tracking and a trigger system. The tracking system has five tracking stations and the trigger system has two trigger stations. The HFM are investigated from the decay of heavy mesons (D and B) via their muonic channels.

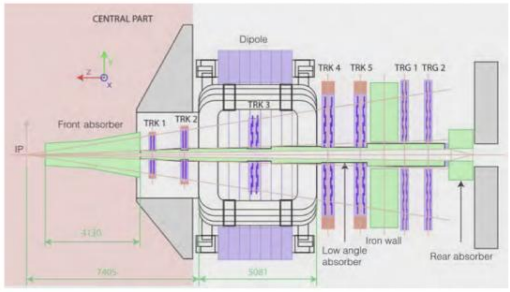

Fig. 1 The Layout of the Muon Spectrometer of ALICE Detector.

Heavy-flavour hadron decay muons in proton-proton collisions

The HFM production cross section as a function of transverse momentum (p_T) and rapidity (y) have been measured in proton-proton (pp) collision energies √s = 5.02 and 8 TeV in the LHC Run 2 [1, 2]. The p_T-differential cross sections of HFM in the whole acceptance of the MS ($-4.0 < \eta < -2.5$) at √s = 5.02 TeV and √s = 8 TeV are shown in Fig.2 and Fig.3, respectively. Finally, the results for HFM production cross-section are compared to the Fixed-Order Next-to-Leading Logarithm (FONLL) calculations. The bottom panel of each figure shows the ratio of the measured HFM cross sections from data to that from FONLL calculations. The results are well reproduced by FONLL calculations within uncertainties.

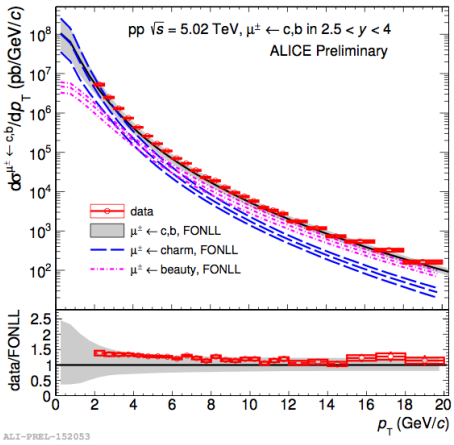

Fig. 2 The p_T-differential HFM cross section in pp collisions at √s = 5.02 TeV.

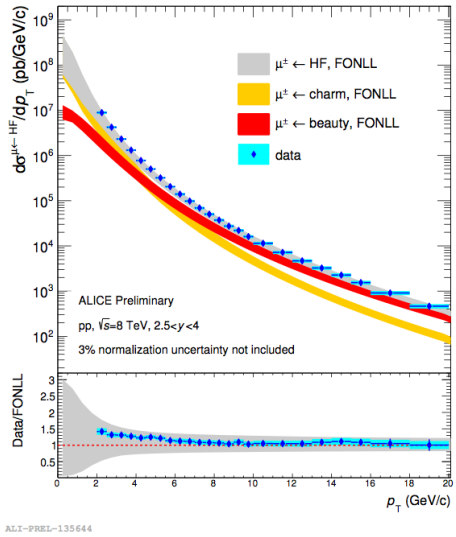

Fig. 3 The p_T-differential HFM cross section in pp collisions at √s = 8 TeV.

The yield of muons from the heavy-flavour hadron decay as a function of multiplicity normalised to that of inelastic events is shown in Fig.4 at √s = 8 TeV. The points are slightly horizontally displaced to increase visibility. The dashed line is the bisector of the figure.

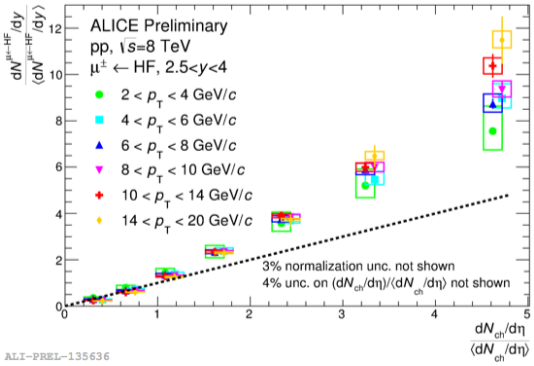

Fig. 4 Relative muon yield in bins of p_T as a function of the relative charged-particle multiplicity at √s = 8 TeV.

Analysis for the HFM production in pp collisions at $\sqrt{s}$ =13 TeV

The ALICE collaboration has extended the work for HFM production to a higher energy at $\sqrt{s}$ = 13 TeV. The background subtraction is the crucial task to extract the single muons from heavy- flavour decay. The various sources of muons are identified by means of Monte-Carlo (MC) simulation. For $p_T \geq 2$ GeV/c, the contribution of secondary muons is very small. Hence the prominent source of background consists of decay muons coming basically from primary charged pion and kaon decay.

The measurement of HFM production at $\sqrt{s}$ =13 TeV will also allow to investigate the pQCD calculations at this LHC energy. Furthermore, the nuclear modification factor (R_{AA}) for heavy flavour hadrons decaying in semileptonic channels will provide an understanding of the transport properties of the medium produced in heavy-ion collisions at this LHC energy. Finally, the inclusive differential production cross section of the muons from heavy-flavour decay in pp collisions at √s = 13 TeV measured in ALICE will be compared with FONLL predictions.

References

[1] ALICE-ANA-2015-V3.0, April 20, 2018.

[2] ALICE-ANA-2017-3988, June 9, 2017.