Measurement of D*-meson production in pp and p-Pb collisions with ALICE at the LHC

Charm and beauty quarks are produced in hadron-hadron collisions. The production cross section of hadrons containing heavy quarks is measured in pp and p-Pb collisions. p-Pb collisions provide a sensitive test of pQCD calculations, set constraints on the production mechanisms and serve as a reference for studies in p-Pb and Pb-Pb collisions. p-Pb collisions allow the study of Cold Nuclear Matter (CNM) effects including: modifications of the parton-distribution functions in nuclei (nPDF) gluon saturation at low x test Colour-Glass Condensate predictions, kT-broadening energy loss in the initial and final state.

Analytical Strategy

D*- mesons (ct = 312 μm [1]) are measured exploiting their displaced vertex topology in the central rapidity region via hadronic decays D* → Kππ* (Branching Ratio, BR = 9.46 ± 0.24 %)

- Build triplets of tracks with proper combination of charges.
- Select criteria based on distance between primary and decay vertices and pointing of the reconstructed D*- meson momentum to the primary vertex.
- Particle identification of pions and kaons with TPC and TOF to reduce the background at low pT.
- D* yield is extracted by fitting the invariant mass distribution with a Gaussian function for the signal and an exponential function to model the background.

Experimental Setup

THE ALICE DETECTOR

Physics Motivation

- The main detectors of ALICE (A Large Ion Collider Experiment) used in this analysis are: Inner Tracking System (ITS) • Time Projection Chamber (TPC) • Time of Flight (TOF)
- Track reconstruction with ITS and TPC in |η| < 0.9
- Particle identification (PID) with TPC and TOF via the measurement of the specific energy loss dE/dx and of the time of flight from the interaction point to the TOF detector

Data sample:

- pp: √s = 5.02 TeV, L = 21.6 ab⁻¹ (2012)
- pp: √s = 8 TeV, L = 4.75 ab⁻¹ (2017)
- √s = 13 TeV, L = 110 fb⁻¹ (2016)

Collisions at √s = 13 TeV

Results

- For pp collisions at √s = 5.02 and 13 TeV:
  - Described by pQCD-based calculations within uncertainties
  - The data points lie on the upper edge of the theoretical uncertainty band as already observed in pp collisions at √s = 7 TeV [4] and 2.76 TeV [5]
  - The ratio of the cross sections at different energies can help to constrain gluon parton distribution functions at low x used in pQCD calculations
  - The ratio of the pT differential cross section at √s = 13 and 5.02 TeV is compatible with FONLL calculations within uncertainties

Corrections

- Raw yield corrected for the acceptance of the detector and for the reconstruction and selection efficiency which are obtained from Monte Carlo simulations:

  
  \[
  f_{\text{prompt}} = 1 - \frac{\text{acceptance}}{\text{prompt}} \cdot \frac{\text{prompt}}{\text{feed-down}}
  \]

where A=1 and Rsd=1 in pp collisions, c_{π0} is the rapidity acceptance correction factor

- Cross checked with a data-driven method that exploits the different shapes of the transverse-plane impact parameter distributions of prompt and feed-down D* mesons

References

[1] [Particle Data Group], Chin. Phys. C. 40 (2016) 00001
[2] [ALICE Collaboration], ALICE-PUBLIC-2014-006
[3] [ALICE Collaboration], ALICE-PUBLIC-2017-008
[4] [ALICE Collaboration], JHEP 1207 (2012) 191
[5] [ALICE Collaboration], JHEP 1201 (2012) 128
[6] [ALICE Collaboration], PRL 113 (2014) 252301