Measurement of angular correlations between D^0 mesons and charged particles in p–Pb collisions with ALICE at the LHC

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1. Introduction

ALICE (A Large Ion Collider Experiment) at the LHC is dedicated to the study of the properties of the Quark-Gluon Plasma (QGP).

The study of two-particle azimuthal correlations not only provides insights to the particle production mechanism in the high-energy hadronic collisions, but also is a powerful tool to explore various properties of the QGP medium produced in heavy-ion collisions [2].

The correlations between heavy-flavour particles and other charged particles reveal extra information on the medium that is formed in relativistic heavy-ion collisions. The heavy-flavor particles (quarks) which are produced at an early stage of the collisions, witness the entire evolution of the medium formed in the collisions and so are considered as very useful tool for characterising the medium.

The correlation study in proton-lead (p–Pb) collisions is also important to disentangle the "hot" medium (QGP) effects in heavy-ion collisions from the so called "cold nuclear matter effects" such as the modification of parton densities in nuclei via shadowing or saturation, and k_T-broadening from multiple soft scatterings of partons, or parton energy loss in the initial and final state of the collisions.

The ridge-like long-range structure, a striking feature of angular correlations between light flavour particles, has been reported by both ALICE [3] and CMS [4] in p-Pb collisions. This can be investigated for heavy quarks as well through heavy-flavour correlation studies.

This contribution presents the measurement of azimuthal correlations between D^0 mesons and charged particles in p–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV with the ALICE detector at the LHC.

2. D^0 mesons and charged particles azimuthal correlation analysis

For the correlation study, we have analysed $\approx 100\times10^6$ minimum-bias p–Pb events. The D^0 meson (and its charge conjugate) is reconstructed via its hadronic decay channel $D^0 \rightarrow K^-\pi^+$ [5], based on the reconstruction of a secondary vertex, separated by ∼100 micrometers from the primary vertex. With excellent spatial resolution, the ALICE Inner Tracking System (ITS) provides the necessary precision to identify the displaced secondary decay vertices. Charged tracks are reconstructed with the ITS and the Time Projection Chamber (TPC) in full azimuth and in the pseudorapidity interval $|\eta| < 0.9$. The TPC and Time Of Flight (TOF) detectors provide identification of charged pions and kaons in order to reduce background contribution to the D^0 candidates. The invariant mass spectrum of reconstructed D^0 candidates is fitted with a Gaussian function to describe the signal component and exponential function for the background. All the D^0 candidates (both signal and background) are then correlated with all primary charged particles of the same event with $p_{\rm T} > 0.3$ GeV/c and pseudo-rapidity $|\eta| < 0.8$. For the background subtraction, the azimuthal correlation of background candidates in the sidebands of the D^0 mass peak, is used. Before using sideband subtraction, both signal and background correlations are corrected for limited detector

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acceptance and spatial inhomogeneities using mixed event techniques. The correlation is further corrected by the trigger and associated track efficiencies. The corrected correlation $(\Delta\varphi, \Delta\eta)$ is normalized by the number of trigger particles and multiplied by the purity of the primary particle sample. The contributions of D^0 mesons originated from B-hadron decays were removed via feed-down correction as described in reference [6].

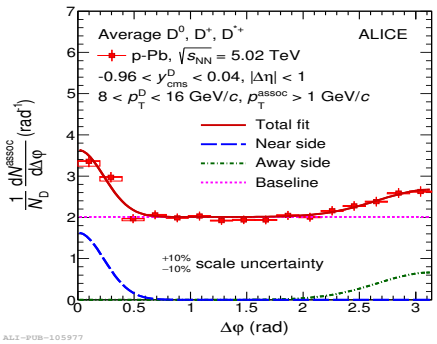

FIG. 1: Average D meson and charged particle correlations in p–Pb at $\sqrt{s_{\rm NN}} = 5.02$ TeV [7].

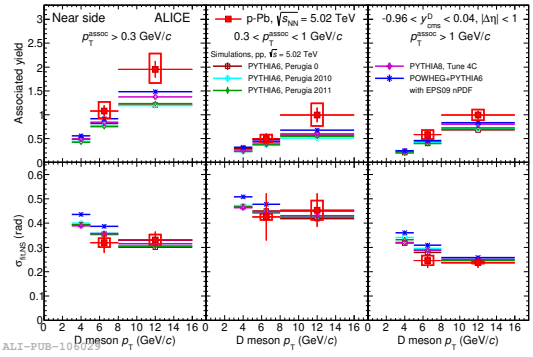

FIG. 2: Near-side associated yield and width as function of the D-meson $p_{\rm T}$ in p–Pb at $\sqrt{s_{\rm NN}} = 5.02$ TeV [7].

3. Results

Figure 1 presents angular correlations between average D mesons and charged particles in p–Pb collisions, fitted with two Gaussian functions and a pedestal. Figure 2 shows the near-side peak associated yields and widths as a function of the D-meson $p_{\rm T}$, compared with different model calculations. The near-side peak associated yield exhibits an increasing trend with D-meson $p_{\rm T}$ whereas near-side peak widths does not strongly depend on D-meson $p_{\rm T}$. The results are shown for the average of three D mesons as they are found to be compatible within the the statistical and systematic uncertainties.

4. Summary

The results from the measurement of azimuthal correlations between D^0 mesons and charged particles in p–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV, performed with the ALICE experiment is presented. The study has been performed in three different $p_{\rm T}$ intervals of D^0 mesons and with three different $p_{\rm T}$ thresholds for the associated primary charged particles. With current statistical and systematic uncertainties it is not possible to observe possible modifications due to cold nuclear matter effects in p–Pb collisions. The upcoming p–Pb runs scheduled end of 2016 will allow us to perform this study with a better statistical precision and in different event multiplicity classes.

Acknowledgments

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