Azimuthal correlations of D mesons and charged particles with ALICE at the LHC

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Introduction

A Large Ion Collider Experiment (ALICE) is a general-purpose heavy-ion experiment whose main goal is to study the properties of hadronic matter at extreme conditions of temperature and density. In such conditions quarks are no more confined into nucleons, giving rise to a new state of matter known as the Quark-Gluon Plasma (QGP) [1]. Heavy quarks (charm and beauty) have the potential to inspect the dynamics of the QGP. Since their production is restricted to the primordial stages of the collision, they undergo all the phases of the system evolution, interacting with the medium produced in the collisions. The study of angular correlations between D mesons and charged particles serves as a tool to address the medium-induced modifications of charm fragmentation and hadronization processes. Besides furnishing the necessary baseline for the heavy-ion collisions, the correlation measurements in pp collisions also provide useful insight about heavy-quark production mechanisms and their fragmentation. Data from p-Pb collisions are important to constrain possible modifications of the angular correlation pattern that could be induced by the cold nuclear matter effects in the initial and final states of the nuclear collision.

In this contribution, we present the ALICE results on azimuthal correlations between D mesons and charged particles in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV (LHC Run II data sample). These results are compared with the results obtained in pp collisions at $\sqrt{s} = 7$ TeV.

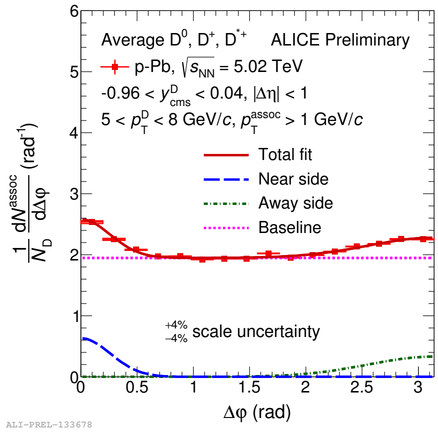

FIG. 1: Azimuthal-correlation distributions of D mesons with charged particles obtained for $5 < p_{\rm T}(D) < 8$ GeV/c, $p_{\rm T}(assoc) > 1$ GeV/c in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV.

D-meson reconstruction

ALICE [2] has excellent capabilities for heavy-flavour measurements. D mesons and their charge conjugates are reconstructed via hadronic decay channels and selected by exploiting the typical displaced-like topology of the decay vertices. In order to further suppress the background, particle identification (PID) [3] on the D-meson daughter tracks is used.

The ALICE central barrel detectors that are mainly involved in the D-meson analyses are: the Inner Tracking System (ITS), the Time Projection Chamber (TPC) and the Time Of Flight (TOF). In D-meson analyses, track reconstruction is performed using ITS and TPC in $|\eta| < 0.9$, while particle identification is assured by TPC and TOF detectors via the measurement of specific energy loss ($\frac{dE}{dx}$) and time of flight of the charged particles, respectively.

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In order to extract the D-meson raw yields the invariant mass method is used.

D meson-charged particle angular correlations

The two-dimensional ($\Delta\varphi$,$\Delta\eta$) angular correlations of D mesons (D^0, D^+, D^{*+}) with charged particles are evaluated for different ranges of D-meson and associated charged-particle p_T. The contribution of background candidates is removed by subtracting the correlations of background candidates taken from the sidebands of the D-meson invariant mass distribution. In order to account for the detector effects (limited detector acceptance and detector spatial inhomogenities), the Event Mixing technique is exploited. Corrections for reconstruction and selection efficiency of D mesons and charged particles are also applied.

Since a relevant fraction of D mesons comes from B-hadron decays, this contribution must be subtracted. This was done by using the template distributions of angular correlations between D mesons from B-hadron decays and charged particles from PYTHIA [4] simulations, normalized to the expected amount of feed-down contribution. This quantity was evaluated from FONLL [5] calculations together with the reconstruction efficiency of secondary D mesons obtained by using the detector simulation. Then a purity correction is also applied for the removal of secondary track contamination which comes from the long-lived hadrons from strange particle decay and particles which are produced by interaction with the detector material. The fully corrected 2D correlations were projected in the region $|\Delta\eta| < 1$ producing correlation distributions, which were normalized to the number of trigger D mesons. Then a weighted average of the results for the three D-meson species was performed to reduce the statistical uncertainty. A fit function composed of a constant term and two Gaussian functions modelling the near-side ($\Delta\varphi \sim 0$) and away-side ($\Delta\varphi \sim \pi$) correlation peaks was used to estimate the near-side peak associated yield and width, and the height of the baseline.

The azimuthal correlation distributions in

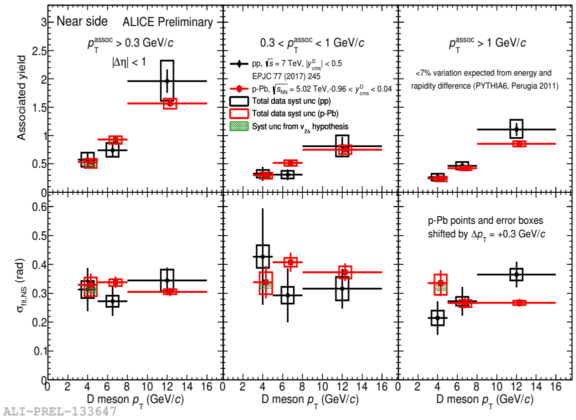

FIG. 2: Comparison of Near-side associated yields (top) and near-side widths (bottom) extracted in pp and p-Pb collisions as a function of D-meson p_T. The near-side yields are extracted by integrating the near-side Gaussian component of the fit function.

p-Pb collisions obtained for $5 < p_T(D) < 8$ GeV/c, $p_T(assoc) > 1$ GeV/c are shown in Fig. 1. Fig. 2 shows the comparison of the near-side yields measured in pp collisions at $\sqrt{s} = 7$ TeV and p-Pb collisions at $\sqrt{s_{NN}} =$ 5.02 TeV. These were found to be compatible, implying that no significant cold nuclear matter effects in p-Pb collisions are observed from the data within the current uncertainties.

References

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