Central tendency study of nuclear modification factor of electrons from heavy-flavour hadron decays in p-Pb collisions with ALICE at the LHC
Sudipan De (for the ALICE Collaboration)
Indian Institute of Technology Indore, India

1. Physics Motivation

- The ALICE experiment is dedicated to study the properties of the strongly-interacting matter, usually referred to as the Quark-Gluon Plasma (QGP), created in high-energy heavy-ion collisions. Heavy quarks, i.e. charm and beauty are sensitive probes of the QGP as they are produced in the initial stages of the collision and witness the entire evolution of the system.

- Study of heavy-flavour production in p-Pb collisions is important to disentangle the cold nuclear matter effects (shadowing, gluon saturation, $k_t$ broadening, energy loss) from hot nuclear matter effects in Pb-Pb collisions.

- The nuclear modification factors in p-Pb collisions are defined as:

\[
\frac{dN_{pPb}}{d\eta} = \frac{1}{N_{\text{bin}}} \frac{dN_{\text{pp}}}{d\eta} \frac{d\eta}{d\eta}
\]

- Study of nuclear modification factor in p-Pb collisions in different multiplicity intervals can provide information on the dependence of cold nuclear matter effects on collision geometry and on the density of final-state particles.

2. A Large Ion Collider Experiment (ALICE)

- Detectors used for this analysis
  - Inner Tracking system (ITS)
  - Time Projection Chamber (TPC)
  - Main tracking device
  - Particle Identification (PID)
  - Momentum measurement
  - Electro-Magnetic Calorimeter (EMCal)
  - PID and trigger
  - Zero-Degree Neutral Calorimeter (ZNA)
  - Centrality estimation

- Event Selection
  - Minimum-bias (MB) data are used to select electrons up to $p_T = 8$ GeV/c
  - EMCal trigger data are used to extend the $p_T$ reach of electrons up to $16$ GeV/c
  - Two trigger thresholds on the energy deposited in the EMCal are used:
    - 7 GeV and 11 GeV
  - The Zero-Degree Calorimeters are used to estimate the centrality of the collisions based on the energy deposited by neutrons.

3. Analysis Strategy

- Electron identification: TPC ($2 < p_T < 8$ GeV/c) and TPC+EMCal ($8 < p_T < 16$ GeV/c)
- In TPC, electrons are identified by measuring $dE/dx (0 < |dE/dx - e|dE/dx_e| < 3)$
- In EMCal, electrons are identified by measuring $E/p$ distributions of electron candidates ($0.8 < E/p < 1.2$), where $E$ is the energy measured in EMCal and $p$ is the momentum measured in TPC.
- Hadron contamination in the electron sample identified with TPC is determined by fitting the $dE/dx - e$ distributions of protons, pions, and electrons.
- Hadron contamination in the electron sample with TPC+EMCal obtained using $E/p$ distribution of hadron candidates ($|dE/dx - e|dE/dx_e| < 4$).
- Background (mainly from photon conversions and Dalitz decay of neutral mesons) estimated with invariant mass of $e^+e^-$ pairs and selected for $M_{e^+e^-} < 0.15$ GeV/c$^2$
- Efficiency of background estimation is obtained using Monte-Carlo simulations
- Negligible background contribution from semileptonic kaon decays, dielectron decays of $J/\psi$ and $W$ mesons.
- Background subtracted electron spectra are corrected for track reconstruction and particle identification efficiency.

4. Results

- $p_T$-differential cross-section of heavy flavour decay electrons for different multiplicity intervals (0-20%, 20-40%, 40-60% 60-100%) at mid-rapidity ($-0.65 < y < 0.135$) in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV are presented.

- The $p_T$-differential cross-section of heavy flavour decay electrons in pp collisions at $\sqrt{s} = 5.02$ TeV is used as reference to calculate the nuclear modification factor in different multiplicity classes ($Q_{pp}$).

- The nuclear modification factor, $Q_{pPb}$, is consistent with unity within the uncertainties for all the multiplicity classes.

5. Summary

- Nuclear modification factors $Q_{pPb}$ and $Q_{pp}$ are measured for heavy-flavour hadrons decay electrons at mid-rapidity ($-0.65 < y < 0.135$) in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV for different multiplicity classes within $2 < p_T < 16$ GeV/c.

- $Q_{pPb}$ and $Q_{pp}$ are consistent with unity and multiplicity independent within the uncertainties in the measured $p_T$ region.

- This suggests that the suppression of the heavy-flavour particle yields in Pb-Pb collisions is not due to initial-state effects but rather to final-state effects induced by hot QCD medium.

Sudipan.De@cern.ch

The 27th International Conference on Ultra-Relativistic Nucleus-Nucleus Collisions (Quark Matter 2018)