Measurement of nonprompt $J/\psi$ at midrapidity in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE detector at the LHC.

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- $J/\psi$ suppression is one of the important signatures of hot and dense deconfined medium created in nuclear collisions [Phys.Lett.B 178, 416 (1986)]

- Prompt $J/\psi$: produced by hard scattering between the partons in the initial stages of nuclear collisions or from the decay of heavier charmonium states e.g. $\psi(2S)$

- Nonprompt $J/\psi$: produced via B-hadrons decay through weak interactions

- Separation of nonprompt $J/\psi$ provides a measurement of inclusive b-quark production in nuclear collisions

- Comparison of these two classes (prompt and nonprompt $J/\psi$) allows to probe beauty as well as charm interaction with the medium
J/ψ → e⁺e⁻ analysis with ALICE

- Analysis is performed in the J/ψ → e⁺e⁻ (branching ratio ~ 5.9 %)
- Central barrel detectors (|y| < 0.9):
  - TPC (Time Projection Chamber): Excellent particle identification capability in the broad momentum range (0.15 - 20 GeV/c)
  - ITS (Inner Tracking System): Capabilities of reconstructing secondary vertices for B → J/ψ + X decays
- Electron Identification is done via specific energy loss (dE/dx) in the TPC

**Track selection**
- At least one hit in the innermost layers (SPD) of ITS
- Rejection of electrons from γ-conversions
- Standard tracking selection for all the tracks $p_T > 1$ GeV/c and |η| < 0.9

**PID selection** (based on TPC-signal)
- 3σ electron band
- Pions > 3.2σ (< 3.2σ excluded)
- Proton > 3.5σ (< 3.5σ excluded)
Nonprompt $J/\psi$ fraction $f_B$ extraction

- Maximum likelihood fit performed on dielectron invariant mass $m$ and Pseudoproper decay length $x$
  
  $\text{Phys.Rev.D 71, 032001 (2005)}$

\[
x = L_{xy}(J/\psi) = \frac{M(J/\psi)}{[\vec{p}_T(J/\psi)]}
\]

\[
\ln L = \sum_{i=1}^{N} \ln F(m, x)
\]

- Ingredients to fit:
  - Parameterized decay length $x$-distribution
    - $F_{\text{prompt}}(x) \rightarrow$ prompt $J/\psi$ from MC simulations
    - $F_B(x) \rightarrow$ nonprompt $J/\psi$ from MC simulations convoluted with detector resolution
    - $F_{\text{bkg}}(x) \rightarrow$ background candidates from real data
  - Parameterized invariant mass $m$-distribution
    - $M_{\text{Sig}}(m) \rightarrow$ signal $J/\psi$ from MC simulations
    - $M_{\text{bkg}}(m) \rightarrow$ background $J/\psi$ candidates from real data

Analysis technique

Nonprompt $J/\psi$ production vertex is displaced from the primary vertex.

Projections of likelihood fits

- Signal: (Prompt + Nonprompt) $J/\psi$
Results & Current status

Recent updates from Pb-Pb 5.02 TeV

- $J/\psi$ reconstruction from Pb-Pb events using unlike sign candidate pairs after mixed event background subtraction
- Pseudo-proper decay length distribution for prompt and nonprompt $J/\psi$ obtained from MC simulations
- Work is ongoing for extracting nonprompt $J/\psi$ fraction

![Graph showing $J/\psi$ reconstruction](image1)

![Graph showing pseudo-proper decay length distribution](image2)
Opportunities with ALICE

- More precise measurements are possible with large data set of Pb–Pb collisions collected by the ALICE in LHC Run 2 with integrated luminosity $93 \, \mu b^{-1}$ (9 x 2015 data set) for central collisions.

- ALICE has unique capability to measure the nonprompt $J/\psi$ fraction at low $p_T \sim 1 \text{ GeV}/c$

- Thus, nuclear modification factors ($R_{AA}$) for prompt and nonprompt $J/\psi$ can be studied down to low $p_T \sim 1 \text{ GeV}/c$

Outlook

Stay tuned for the...

- Final results of
  - Nonprompt $J/\psi$ fractions ($f_B$)
  - Nuclear modification factors ($R_{AA}$)

Thank you very much for your kind attention