Measurements of open bottom hadron production via displaced D⁰ in Au+Au collisions at \( \sqrt{s_{NN}} = 200 \) GeV in STAR

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Abstract: Recent RHIC and LHC results show that the nuclear modification factors of open charm hadrons at high transverse momenta as well as their elliptic flow are similar to those of light flavor hadrons, indicating that charm quarks also interact very strongly with the Quark Gluon Plasma (QGP). During interactions, charm quarks suffer from substantial energy loss and gain significant elliptic flow. It is then imperative to measure bottom production in heavy-ion collisions to study the mass dependence of parton-medium interactions in the QGP.

In this poster, we present open bottom hadron production through their displaced decay daughters (D⁰) in Au+Au collisions at \( \sqrt{s_{NN}} = 200 \) GeV, using STAR Heavy Flavor Tracker (HFT). With more data recorded in 2016 and the successful implementation of a supervised machine learning method in offline reconstruction, signal significance of non-prompt D⁰ gets improved.

**Introduction**

- Results from Quark Matter 2017 show
  - Strong suppression for B-→J/ψ and B-→D⁰ at high \( p_T \)
  - Indication of less suppression for B-→D- (→2γ) consistent with \( \Delta E_L > \Delta E_S \)
- More precise measurements are needed to study the mass dependence of parton-medium interactions in the QGP

**STAR detector**

- Time Projection Chamber
  - Inr1, full azimuth
  - Tracking, momentum
  - PID through dE/dx
- Time of Flight
  - PID through velocity (1/β)
  - Timing resolution: ~65 ps
- Heavy Flavor Tracker
  - Inr1, full azimuth
  - Precise reconstruction of displaced vertices

**Boosted Decision Trees method**

- Root TMWA package, BDT method
- Good performance for classification problems, better than Rectangular Cuts method when classified variables are correlated
- Inputs for training:
  - Background from real data
  - Signal (D⁰ from B decay) from data-driven fast simulation

**Inclusive D⁰ raw yield extraction**

- 2014 data ~ 900 Au+Au million minimum bias events
- Three methods used to extract D⁰ raw yields
  - Fit method: Gaussian + first-order polynomial
  - Counting method: total background is estimated with like-sign background plus arithmetic mean of two side bands from unlike-sign minus like-sign background
  - Sideband method: total background is estimated with geometry mean of two side bands from unlike-sign background
- New tuned cuts (BDT) perform better in \( p_T \) range of 2-3 GeV/c and D⁰ DCA range of 40-70 \( \mu \)m (\( D^0 \)-significance is from 20 to 27)

**Summary and outlook**

- Measurement of non-prompt D⁰ was extended down to 2 GeV/c in \( p_T \) using supervised machine-learning algorithm in TMVA
- Efficiency correction will be extracted and applied to both 2014 and 2016 data

**Reference**