Measurements of open bottom hadron production via displaced D^0 in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in STAR

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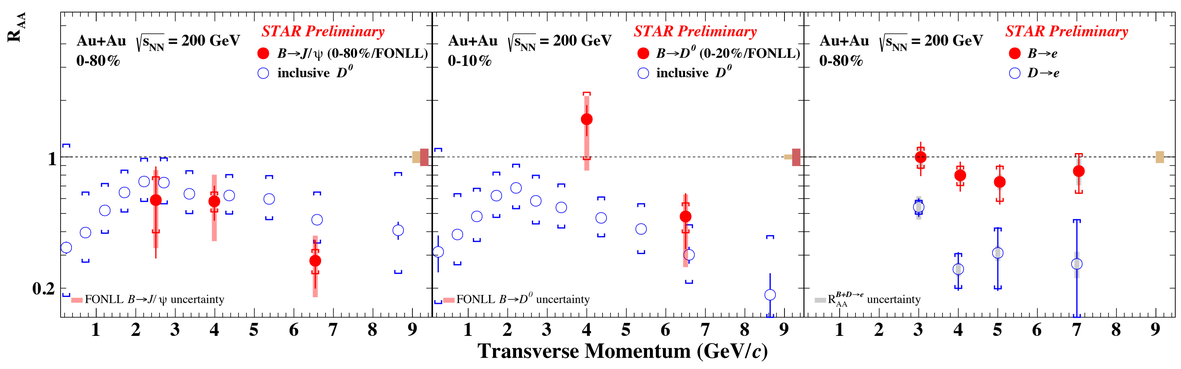
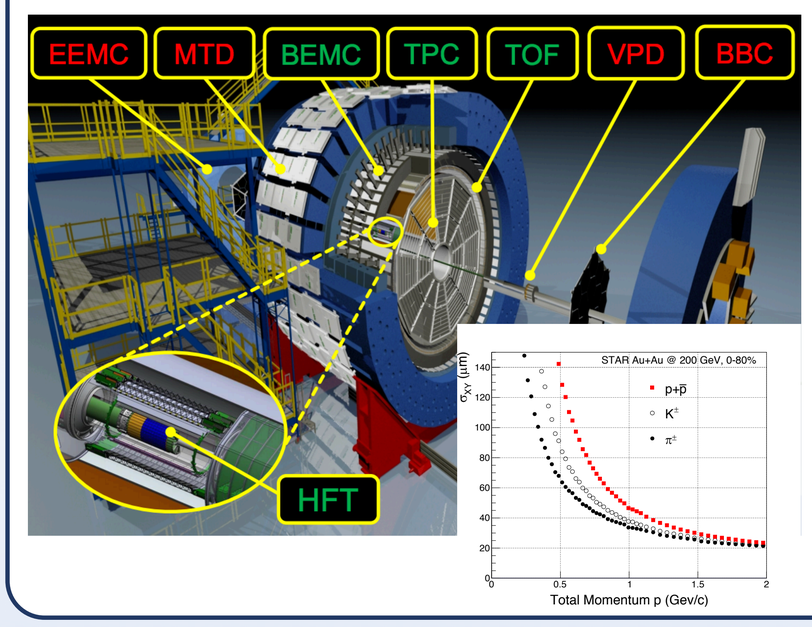
Abstract: Recent RHIC and LHC results show that the nuclear modification factors of open charm hadrons at high transverse momenta as well as their elliptic flow are similar to those of light flavor hadrons, indicating that charm quarks also interact very strongly with the Quark Gluon Plasma (QGP). During 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 suggested by QCD.
In this poster, we present open bottom hadron production through their displaced decay daughters (D^0) in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV, using STAR Heavy Flavor Tracker (HFT). With more data recorded in year 2016 and the successful implementation of a supervised machine learning method in offline reconstruction, signal significance of non-prompt D^0 gets improved.

Introduction



- Results from Quark Matter 2017 show
  - ✓ Strong suppression for B->J/ψ and B->D^0 at high p_T
  - ✓ Indication of less suppression for B->e than D->e (~2σ), consistent with $\Delta E_c > \Delta E_b$
- More precise measurements are needed to study the mass dependence of parton-medium interactions in the QGP

STAR detector

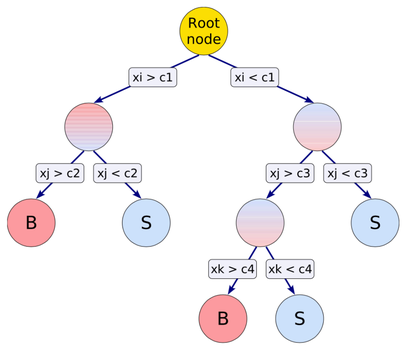


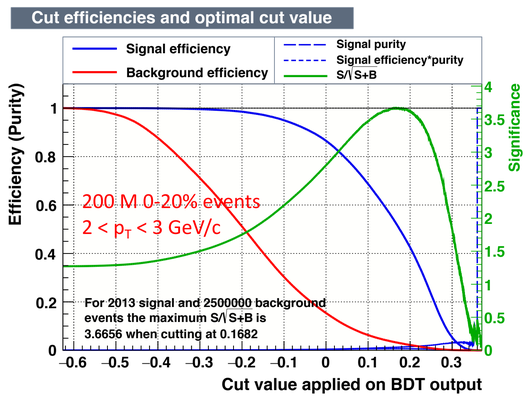
Time Projection Chamber
- |η|<1, full azimuth
- Tracking, momentum
- PID through dE/dx

Time of Flight
- PID through velocity (1/β)
- Timing resolution: ~85 ps

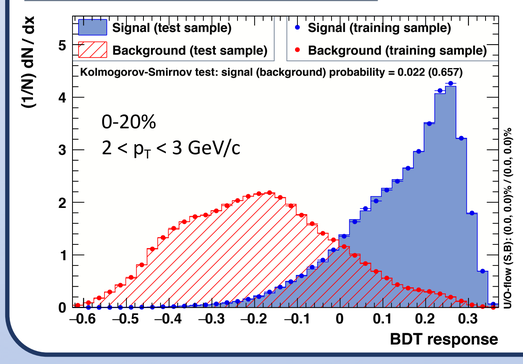
Heavy Flavor Tracker
- |η|<1, full azimuth
- Precise reconstruction of displaced vertex

Boosted Decision Trees method



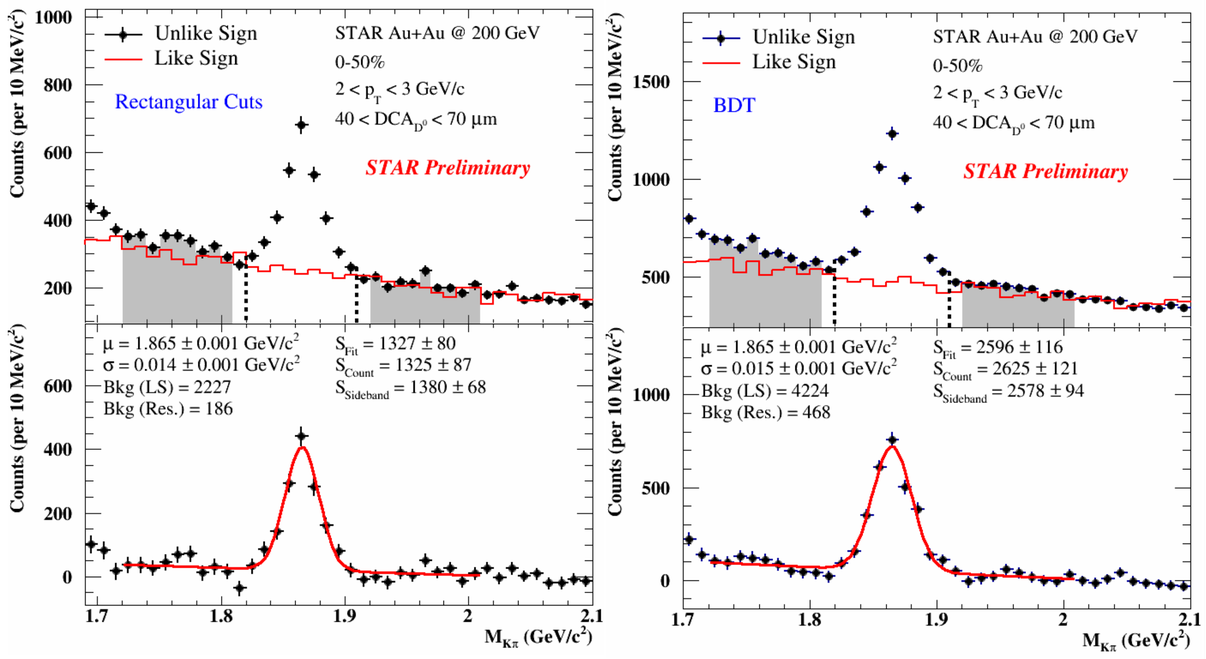


TMVA overtraining check for classifier: BDT



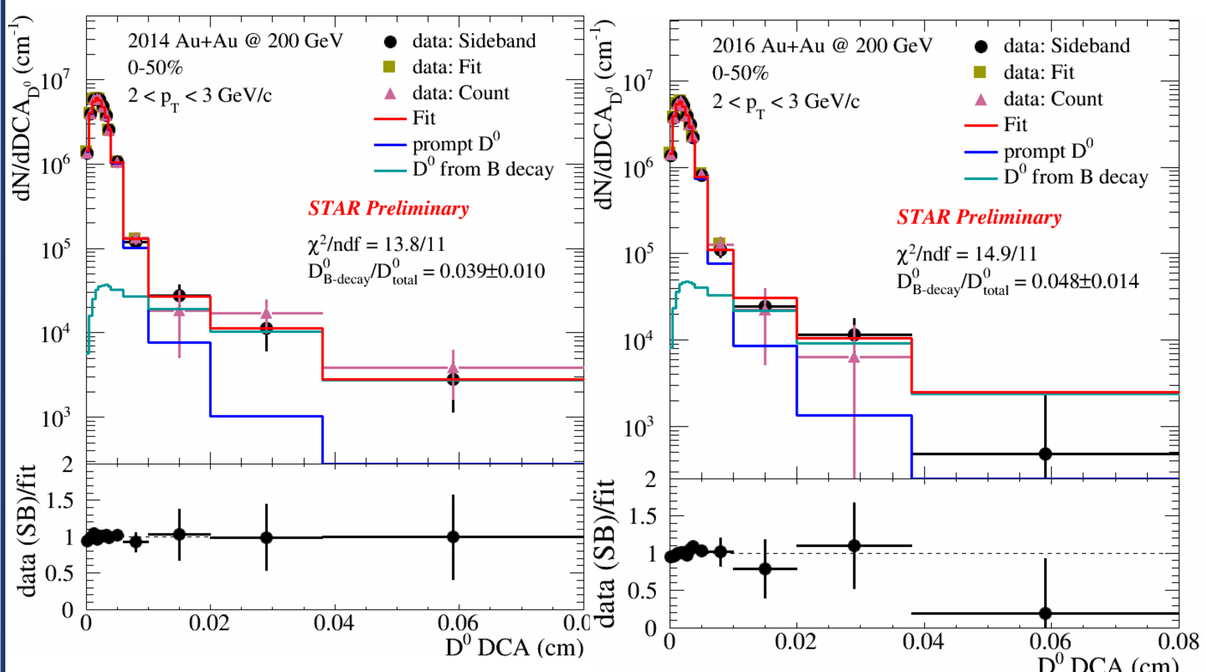
- Root TMVA package, BDT method
- Good performance for classification problems, better than Rectangular Cuts method when classified variables are correlated
- Inputs for training:
  - ✓ Background from real data
  - ✓ Signal (D^0 from B decay) from data-driven fast simulation

Inclusive D^0 raw yield extraction



- 2014 data ~ 900 Au+Au million minimum bias events
- Three methods used to extract D^0 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
- New tuned cuts (BDT) perform better in D^0 p_T range of 2-3 GeV/c and D^0 DCA range of 40-70 μm (D^0 significance is from 20 to 27).

Template fitting



- 2016 data ~ 1.1 billion Au+Au minimum bias events (70% of total statistics)
- D^0 DCA distributions from the three methods are consistent with each other
- Raw non-prompt D^0 fraction is extracted
- Significance of non-prompt D^0 fraction in p_T range of 2-3 GeV/c is about 4.0 and 3.5 in 2014 and 2016 data respectively

Summary and outlook

- Measurement of non-prompt D^0 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

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