Non-Photonic Electron and Charged Hadron Azimuthal Correlation in 500 GeV p+p Collisions at STAR

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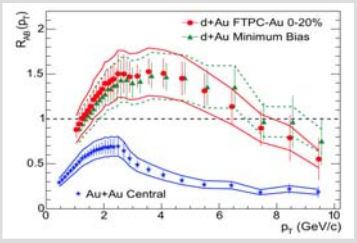
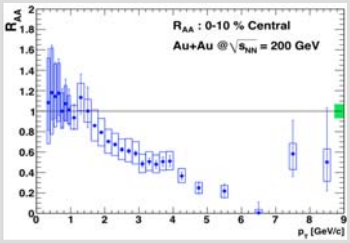
Abstract

The preliminary results of non-photonic electron and charged hadron azimuthal correlation at $6.5<p_T<12.5$ GeV/c in run 2009 p+p collisions at $\sqrt{s}$=500 GeV at RHIC have been constructed. The correlation distributions are compared with PYTHIA simulations to extract the bottom relative contribution to non-photonic electrons. The comparison between 200 GeV and 500 GeV results will deepen our understanding on the heavy flavor production at RHIC.



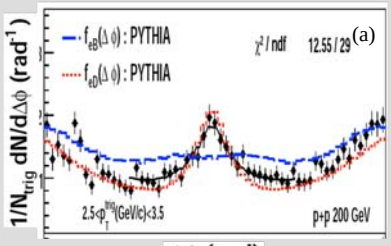


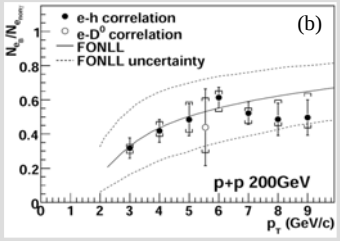
STAR Collaboration, Phys. Rev. Lett. ***91 072304 (2003)*** *PHENIX collaboration, arXiv:1005.1627*

- Charged hadron R_{AA} in entral Au+Au collision suppressed means energy loss though interaction with QGP
- Non-photonic electron R_{AA} suppressed at high p_T region, which implies that heavy quarks may lose a substantial amount of energy in central Au+Au collisions
- In contradiction with gluon radiative energy loss mechanism which predicted that heavy quark will lose less energy than light quarks due to dead cone effect

Motivation

RHIC measurement on non-photonic electrons from heavy quark decays shows similar suppression as light hadrons at high p_T in central Au+Au collisions. However, the interpretation is complicated by the combined contributions from charm and bottom decays. Non-photonic electron and charged hadron azimuthal correlation has been used as a powerful tool to disentangle charm and bottom contributions at $\sqrt{s}$ = 200 GeV up to pT ~ 9 GeV/c. Combining the non-photonic electron R_{AA} and the relative bottom decay contribution in p+p collisions suggests the bottom decay electrons are also suppressed in central Au+Au collisions.





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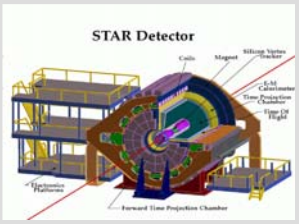
a) Non-photonic electron and charged hadron azimuthal correlation at $\sqrt{s}$ = 200 GeV from STAR

b) The extracted B decay contribution is approximately 50% at a transverse momentum of p_T >5 GeV/c in 200 GeV p+p collisions

Non-photonic electron identification



Signal:
non-photonic electron
- Charm decay
- Bottom decay
- Weak kaon decay
- Vector meson decays

Background:
Photonic electron
- Photon conversion
- π^0 Dalitz decay
- η Dalitz decay

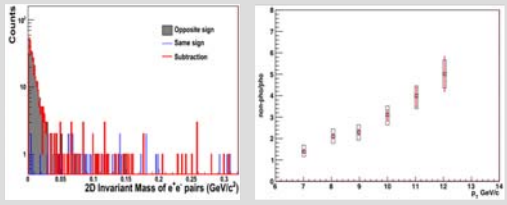
Detector used:
- **Time Projection Chamber (TPC)**
- **Barrel Electro-Magnetic Calorimeter (BEMC)**
- **Barrel Shower Maximum Detector (BSMD)**

Data Sample:

p+p collisions at $\sqrt{s_{NN}}$ = 500 GeV in run9 (2009)

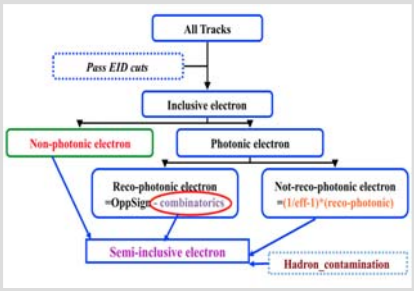
5.4 million BEMC HT3 triggered events with threshold 7.4 GeV

Photonic Backfround



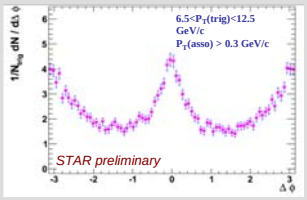
- The invariant mass for a pair of photonic electrons is small. Choose 2D Invariant mass < 0.1 GeV/c^2 to remove photonic background
- Reconstructed photonic = Opposite sign – Same sign.
- Photonic electron = reconstructed-photonic/ ε . ε is the background reconstruction efficiency calculated from simulations
- We assume efficiency ε to be 65% here to get the preliminary results and vary it by 5% to estimate systematic errors

Method to Extract the Signal of e-h Correlations



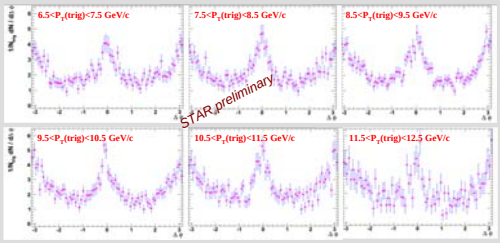
- **Signal:**
  non-photonic = semi-inclusive+combinatorics-(1/eff-1)*reco-photonic-hadron_contamination
- **Each item has its own corresponding Δ ϕ histogram.**

Preliminary electron-hadron correlation results



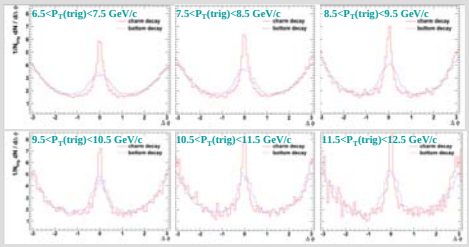
- Raw correlation with assumed efficiency and with pileup correction
- Clear azimuthal correlation can be seen on near side and away side

e-h correlation at different trigger pt region



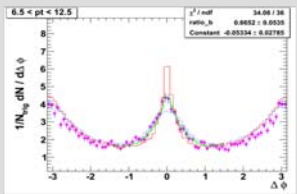
PYTHIA simulation

We use PYTHIA 8 to generate e(D)-h and e(B)-h correlation in 500 GeV p+p collision



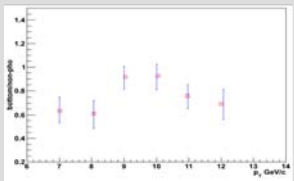
STAR Heavy Flavor Tune v1.1 Mini Bias Mode

Use PYTHIA Curves to Fit Data Points



- **Fit function:**
  R*PYTHIA_B+(1-R)*PYTHIA_D+fitting_constant
- **R is B contribution, i.e. B/(B+D), as a parameter in fit function.**

Fit Results



- **The extracted B/(B+D) ratio is above 60% within the current statistics and assumed efficiency**
- **Error bars are statistical only!**

Summary

- Non-photonic electron and charged hadron azimuthal correlations have been measured in 500 GeV p+p collisions
- PYTHIA simulation on e(D)-h and e(B)-h correlation have been constructed from PYTHIA 8.1 combined with STAR Heavy Flavor Tune v1.1
- Compare PYTHIA results to experimental data to extract bottom quark contribution to non-photonic electrons
- From the preliminary results, the bottom contribution is well above 60% at p_T ~ 6.5-12.5 GeV/c in 500 GeV p+p collisions