Measurements of electron production from open heavy flavor decays in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV by the STAR experiment

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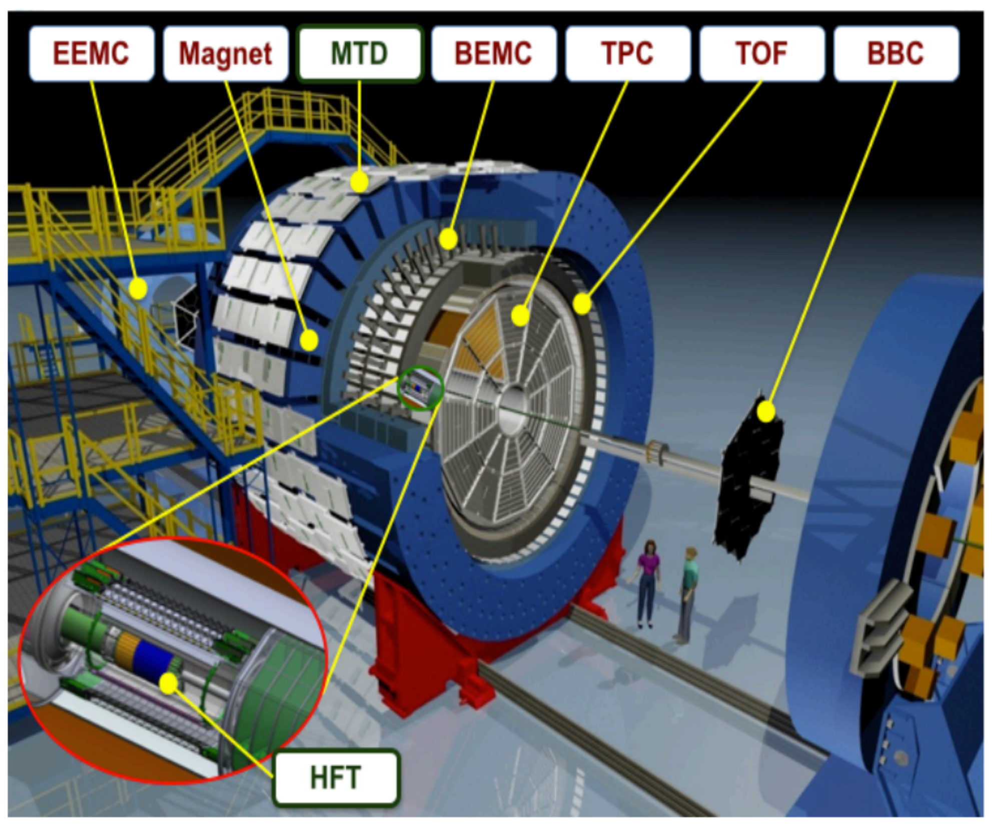
Abstract

Heavy quarks are predominantly produced at early stages of high-energy heavy-ion collisions due to their large masses. Studies of interactions between heavy quarks and the Quark- Gluon Plasma (QGP) in different collision systems can provide new insights to the properties of the QGP. Thus measurements of heavy quark production via measuring the electrons from semi-leptonic decays of heavy flavor hadrons, also known as Non-Photonic Electron (NPE), in Au+Au collisions are crucial.

In this poster, we present the latest measurements of the nuclear modification factor (R_{AA}) for NPE production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV from the STAR experiment using data recorded during RHIC 2014 run.

STAR Detector



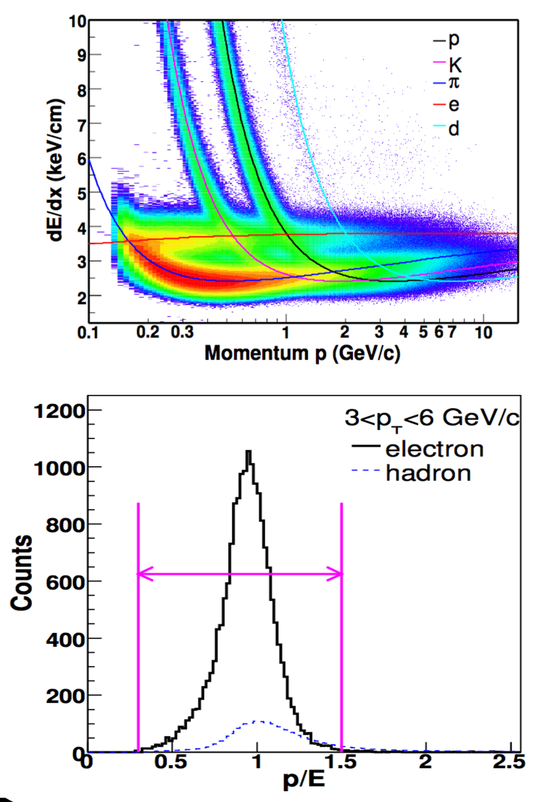
Time Projection Chamber (TPC)
- *$|\eta|$<1, full azimuth*
- *Tracking, momentum.*
- *PID through dE/dx*

Barrel Electromagnetic Calorimeter (BEMC)
- *$|\eta|$<1, full azimuth*
- *p/E and shower shape for eID*
- *Fast online trigger for high p_T electrons (HT1: E_T>~2.5 GeV, HT2: E_T>~4.3 GeV)*

Heavy Flavor Tracker (HFT)
- *Installed in 2014*
- *Not explicitly used in this analysis.*

Electron Identification

Dataset: BEMC triggered events in 200 GeV Au+Au collisions from 2014



Analysis

✓ *Inclusive electron*

1)Most of hadrons rejected by electron identification cuts
2)Fit multiple Gaussian function to the $n\sigma_e$ distribution to estimate the electron purity

$$n\sigma_e = \ln\left(\left(\frac{dE}{dx}\right)^{Measured} / \left(\frac{dE}{dx}\right)_e^{Bichsel}\right) / R_{\frac{dE}{dx}}$$

✓ *Photonic electron (PHE)*

1)Use electron paris with invariant mass $M_{ee} < 0.24\ GeV/c^2$
2)PHE background: difference of unlike–sign and like–sign electron pairs

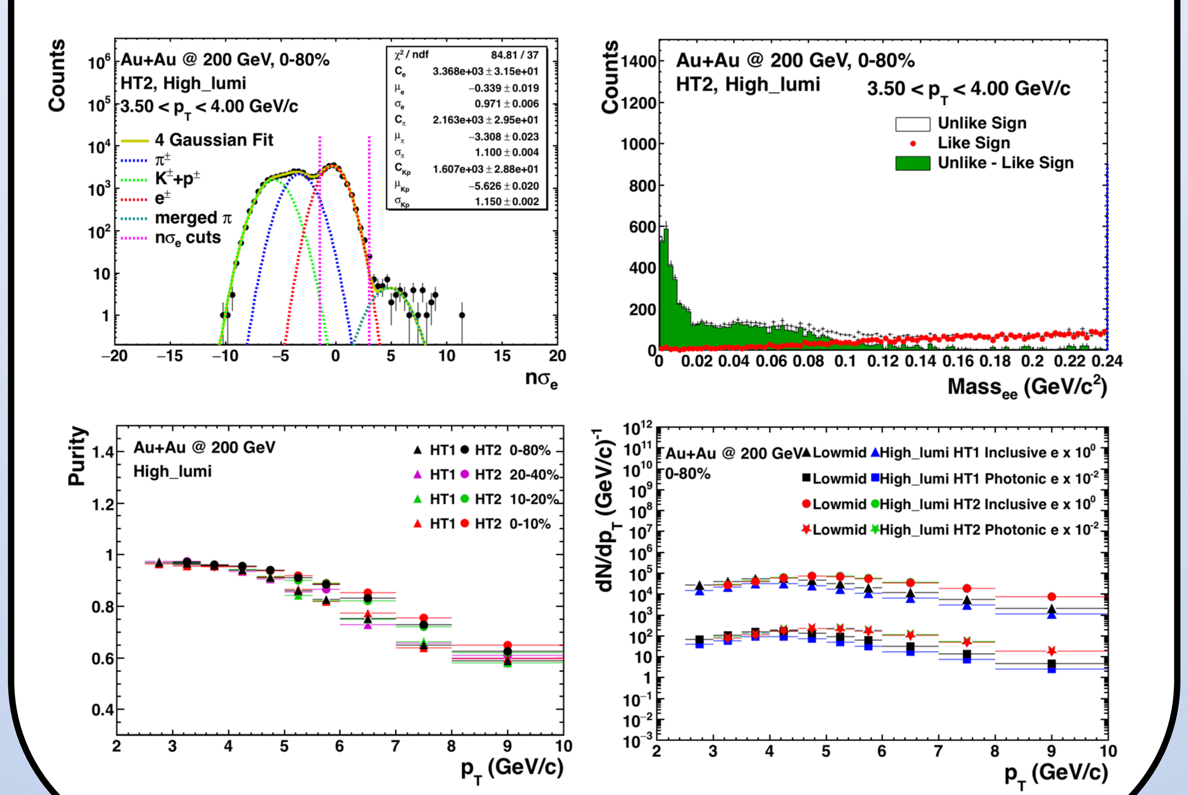
✓ *Non-photonic electron (NPE)*

$$N_{NPE} = N_{inclusive\_e} * purity - \frac{N_{PHE}}{PHE\ reconstruction\ eff.}$$

$$\frac{d^2N}{2\pi p_T dp_T dy} = \frac{1}{2\pi p_T dp_T dy} \frac{N_{NPE}}{\varepsilon_{ePID}\varepsilon_{Trk}\varepsilon_{Trg}}$$

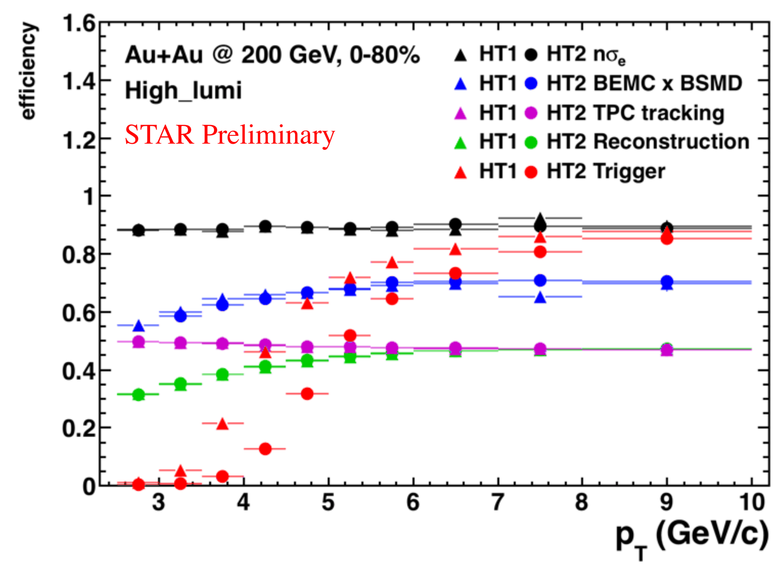
Extract Raw Yield

Inclusive electron — Photonic electron



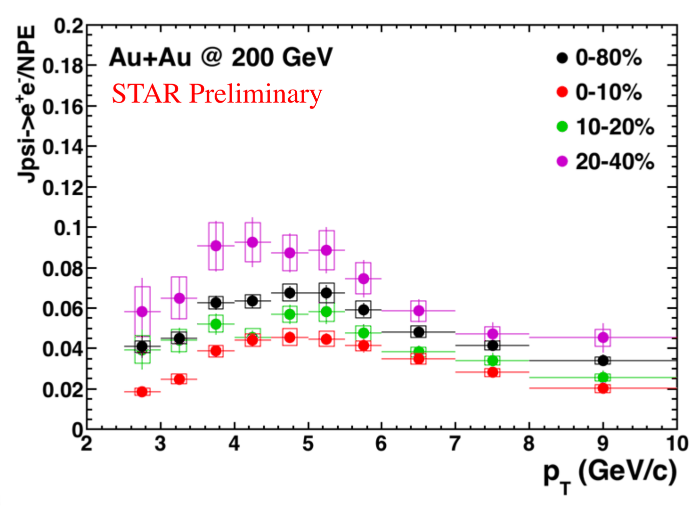
Efficiency

- *Tracking, trigger, and photonic electron reconstruction efficiencies estimated from the STAR detector simulation*
- *Electron identification efficiency estimated using the photonic electrons from data*



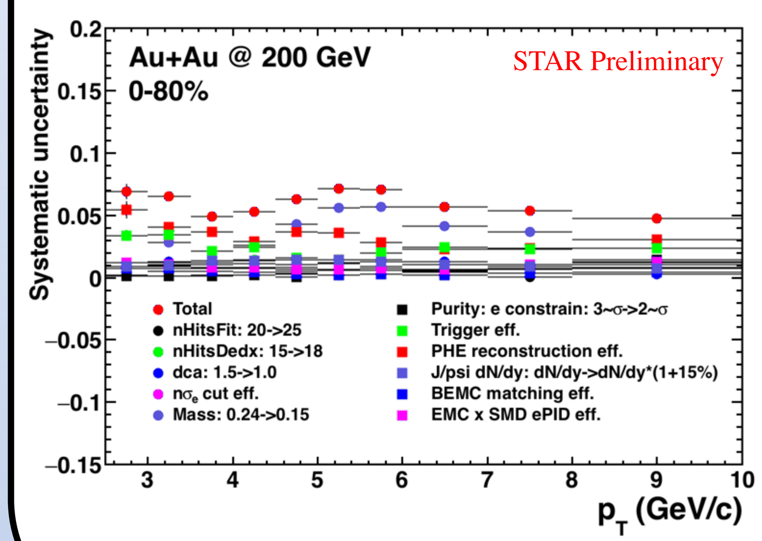
Background from J/ψ Decay

Contributions from $J/\psi \to e^+e^-$ are estimated and subtracted based on the measured J/ψ yields [4]



Systematic Uncertainty

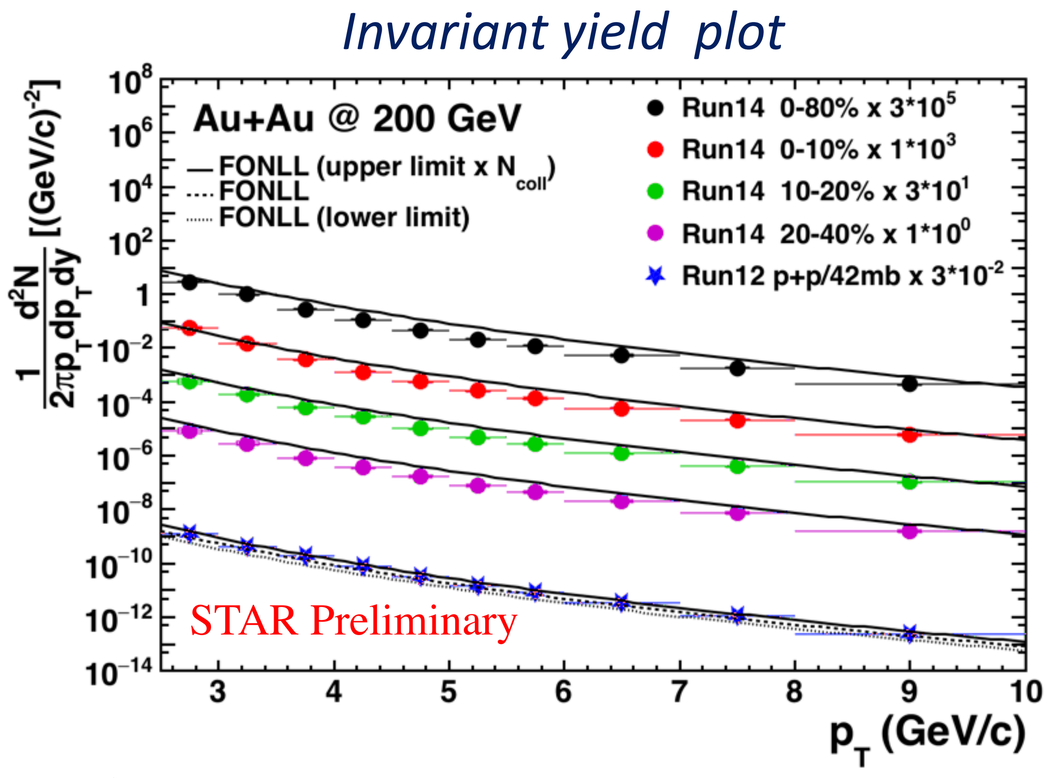
- *NPE yield extraction*
- *Efficiencies for tracking, trigger, PID, etc*
- *Background from J/ψ decay*



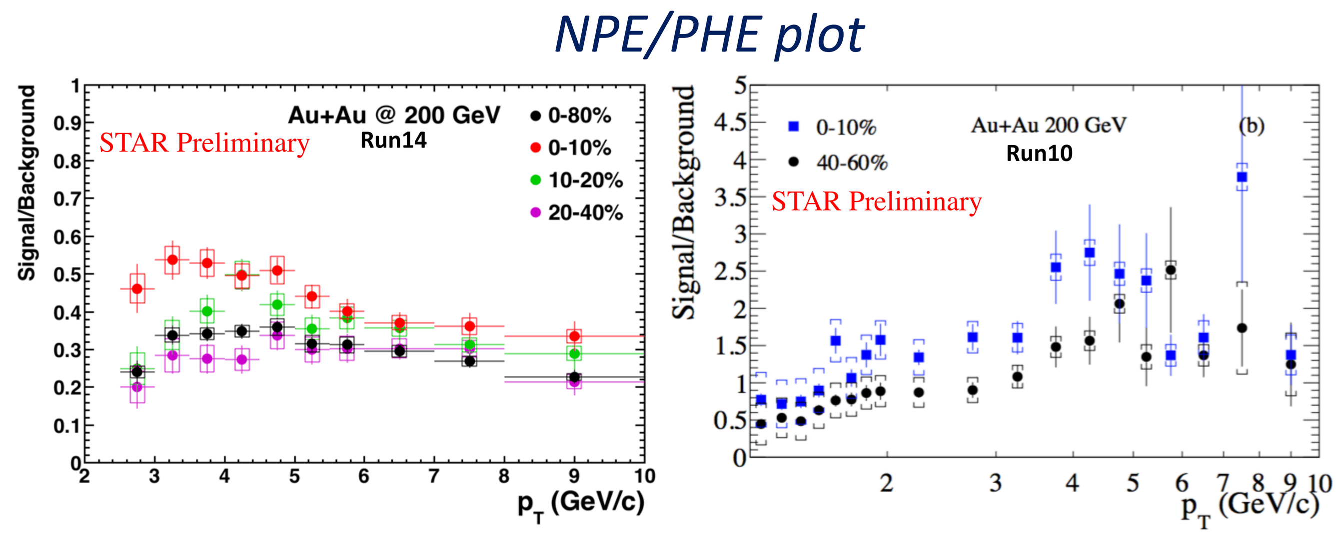
NPE production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV

❖ *This section will show NPE invariant yield, ratio of NPE and PHE and NPE R_{AA} plots in different centrality.*

Invariant yield plot

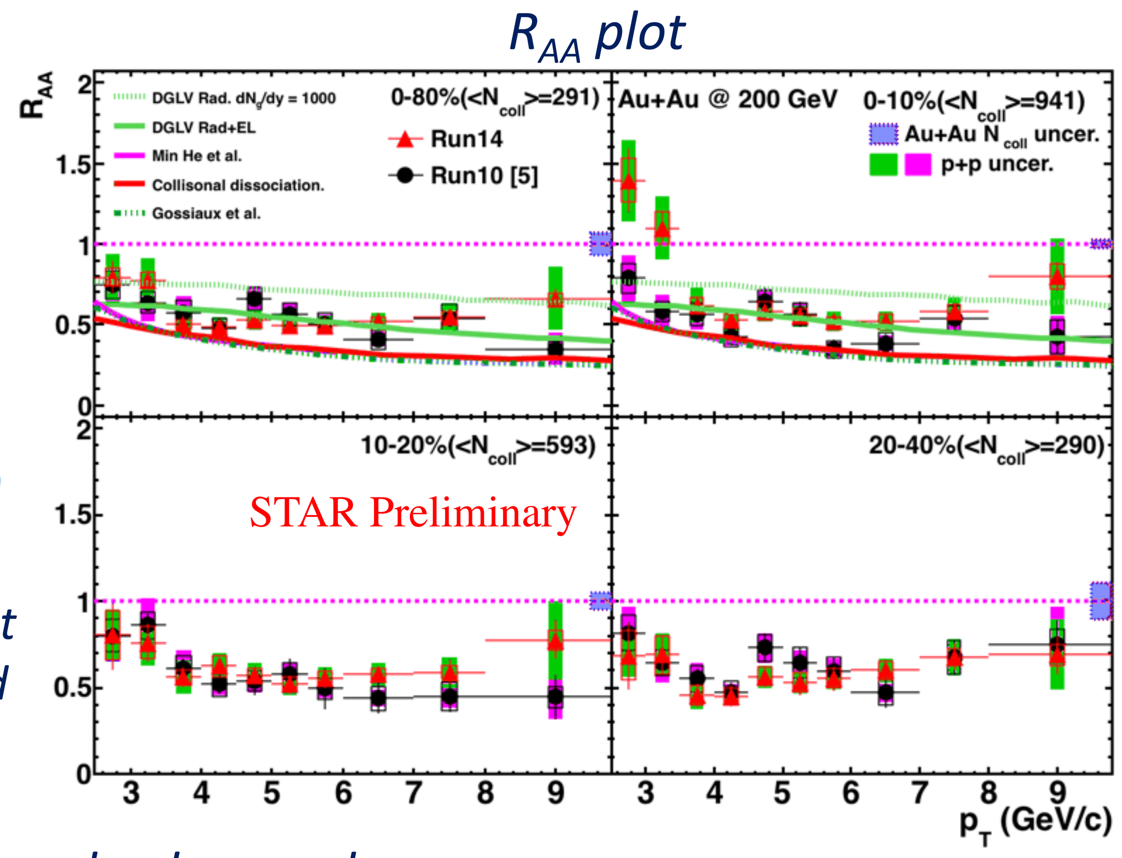


NPE/PHE plot



➢ *Due to the increased gamma conversions in the HFT and the supporting structure, the NPE to PHE ratio decreased by about a factor of 3-4 for central Au+Au collisions in Run14 compared to that in Run10.*

R_{AA} plot



✓ *Significant suppression at p_T > 4 GeV/c in the most central Au+Au collisions is observed.*

✓ *The new Run14 results are consistent with Run10 results despite large difference in photonic electron background.*

Summary

1)NPE production in the p_T range of 2.5 – 10 GeV/c in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV is measured.
2)This measurement is consistent with Run10 results within uncertainty and can be used to cross check NPE measurements with the HFT.
3)Significant suppression at p_T > 4 GeV/c in the most central Au+Au collisions is observed.

References

[1] S.S. Adler et al. (PHENIX) 2007 *Phys. Rev. Lett.* ,98 012002
[2] B. I. Abelev *et al.* (STAR) 2009 *Phys. Rev. C* , 79 034909
[3] A. Adare et al. (PHENIX) 2015 *Phys. Rev. C,* 91 064904
[4] T. Todoroki (for STAR) contribution to 2016 *sQM*
[5] X. Bai(for STAR) *Nuclear Physics A* 956 (2016) 513–516

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drupal.star.bnl.gov/STAR/presentations