Measurements of heavy flavor decay electron production in p+p collisions at $\sqrt{s}$=200 GeV at STAR

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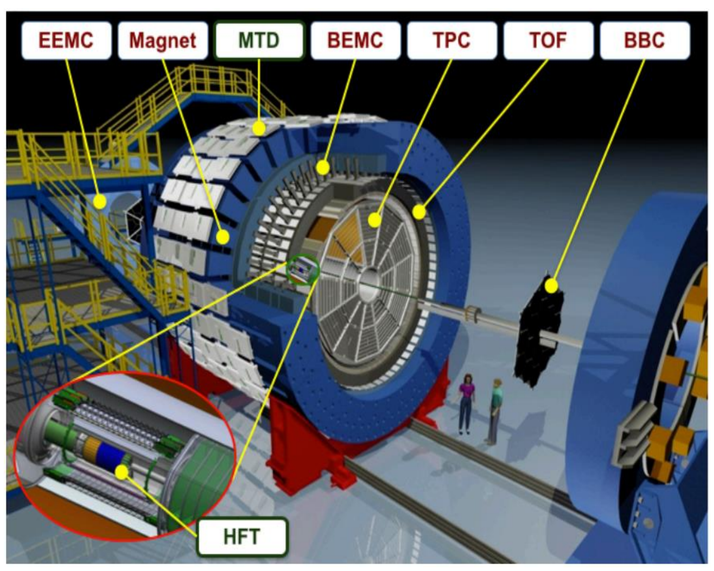
Abstract

Heavy quarks are believed to be produced at early stages of high-energy heavy-ion collisions. Measurements of heavy quarks can improve our understanding of parton interactions with the Quark-Gluon Plasma (QGP) and its properties. Heavy quark production in p+p collisions is a baseline to investigation of the QGP in heavy-ion collisions and is expected to be well described by perturbative Quantum Chromodynamics (pQCD). However, the pQCD calculations have large uncertainties at low transverse momentum (p_T). Thus measurements of heavy quark production at low p_T in p+p collisions, which can be studied by measuring electrons from semi-leptonic decays of heavy flavor hadrons, are crucial for constraining the pQCD models.

In this poster, we will present the STAR measurements of low p_T heavy flavor decay electron (HFE) production in p+p collisions at $\sqrt{s}$=200 GeV in RHIC run 2012.

STAR Detector



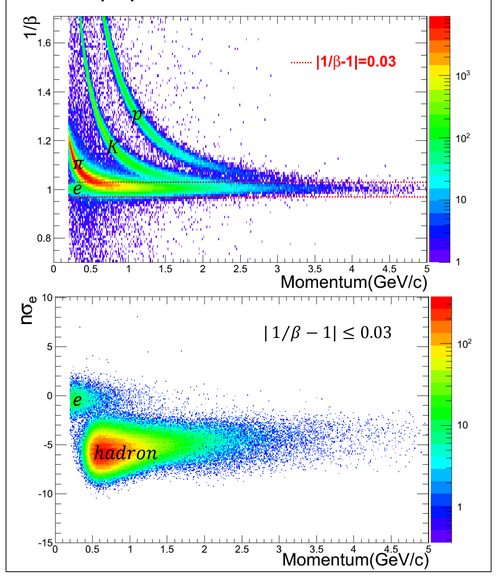
Time Projection Chamber
- *$|\eta|$<1,full azimuth*
- *Tracking, momentum.*
- *PID through dE/dx*

Time of Flight
- *$|\eta|$<0.9,full azimuth*
- *PID through TOF*
- *Timing resolution:~85 ps.*

Barrel Electromagnetic Calorimeter
- *$|\eta|$<1,full azimuth*
- *p/E for PID*
- *Fast online trigger*

Electron Identification

Dataset: 299M min-bias events from p+p 200 GeV from Run 12



Analysis

✓ *Inclusive electron*

1) $Part\ of\ hadrons\ rejected\ by\ dE/dx\ and\ velocity\ cuts$

2) $Fit\ n\sigma_e\ distribution\ (n\sigma_e = \ln\left(\left(\frac{dE}{dx}\right)^{Mea}/\left(\frac{dE}{dx}\right)_e^{Bichsel}\right)\Big/R_{\frac{dE}{dx}})$

$-hadron\ fit\ function$:

$C * \exp\left\{-0.5 * \left(\frac{x-\mu}{\sigma}\right)^2 - \exp\left(-\frac{x-\mu}{\sigma} * \eta\right)\right\}$

$-electron\ fit\ function: Gaussian$

3) $Get\ purity\ according\ to\ n\sigma_e\ distibution\ and\ cut$

✓ *Photonic electron*

1) $Tagged\ electron + partner\ electron, get\ M_{ee}\ distribution$
$(M_{ee} < 0.15\ GeV/c^2,\ pairDca < 3.0cm\ )$

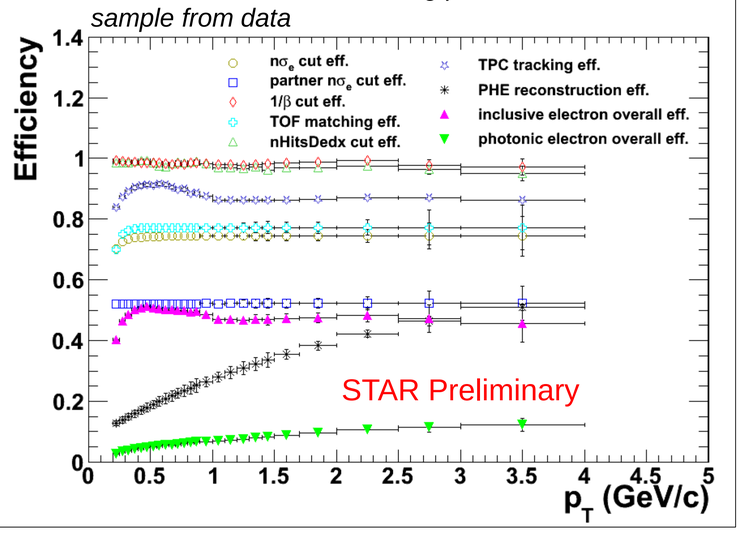
2) $Background\ reconstruction$:
$UnlikeSign - LikeSign(same\ event)$

✓ *Non-Photonic electron(NPE)*

$$N(inclusive\_e) * purity - \frac{N(photonic\_e)}{Photonic\ e\ reconstruction\ eff.}$$

Efficiency

- *TPC tracking eff. and PHE reconstruction eff. are from MC simulations (embedding)*
- *Other effs. are extracted using photonic electron sample from data*



Background from hadron decays

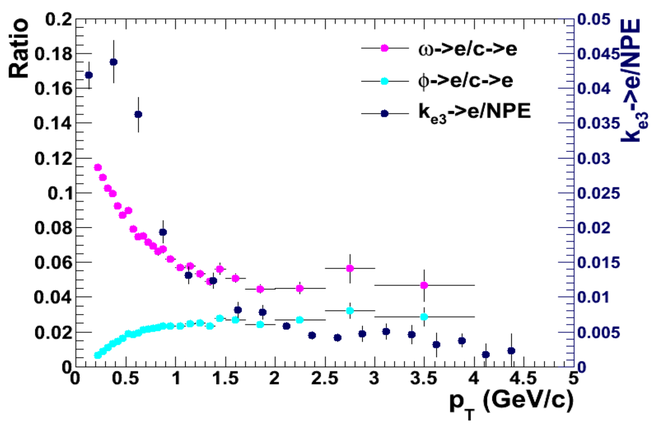
Study background by simulations

1) $K \to e\pi\nu(K_{e3})$:

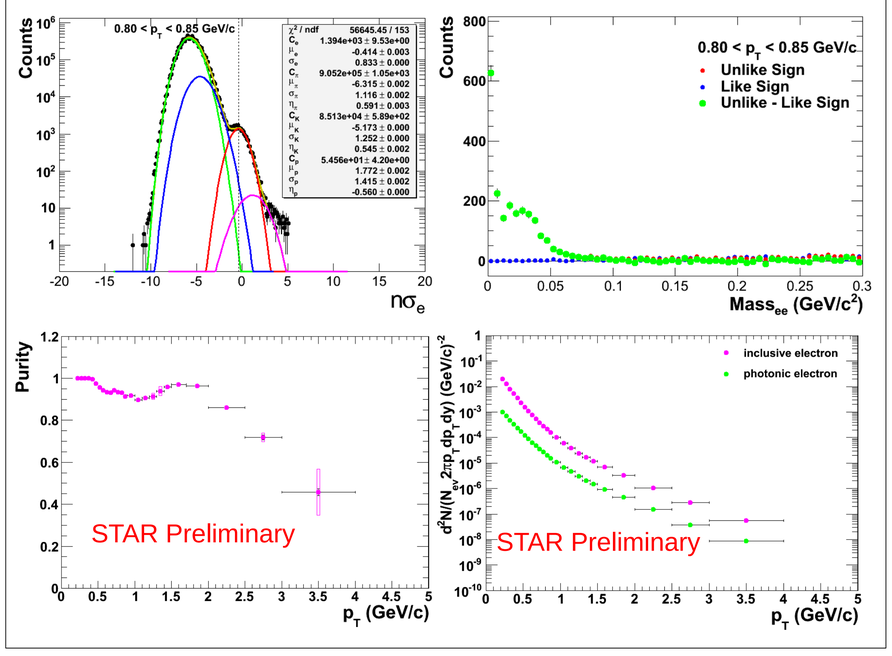
$K^+ \to e^+\pi^0\nu$ $\qquad$ $K_L^0 \to e^\pm\pi^\mp\nu$

2) *dielectron decays of vector mesons :*

$\omega \to e^+e^-/\omega \to \pi^0e^+e^-$ $\quad$ $\phi \to e^+e^-/\phi \to \eta e^+e^-$

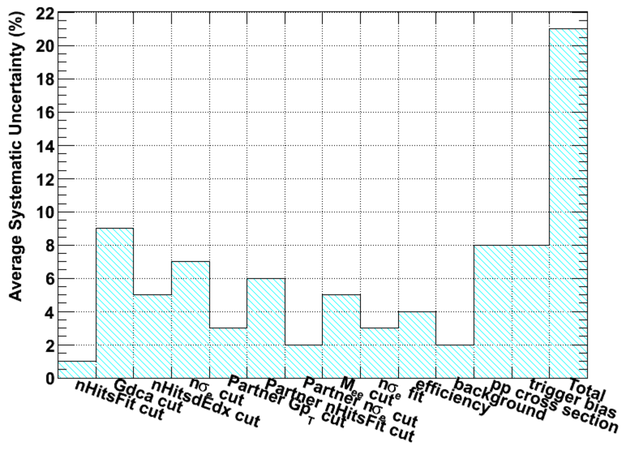


Inclusive electron $\qquad$ *Photonic electron identification*



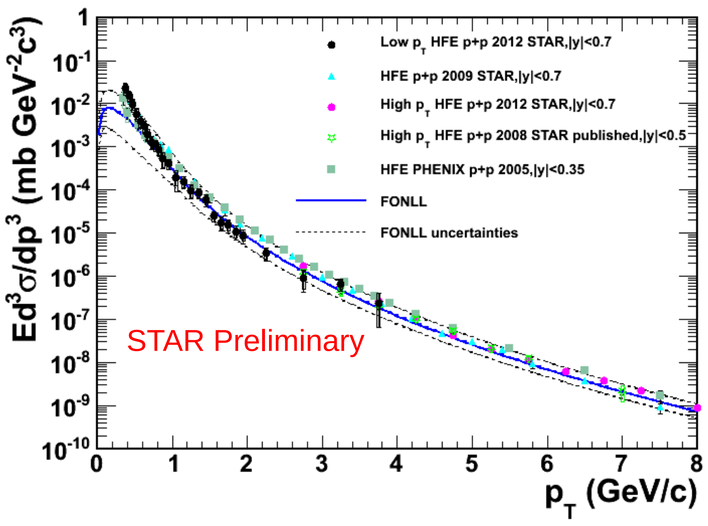
Systematic Uncertainty

- *Cuts*
- *Electron raw yield extraction*
- *Efficiency*
- *Background from vector mesons decay*

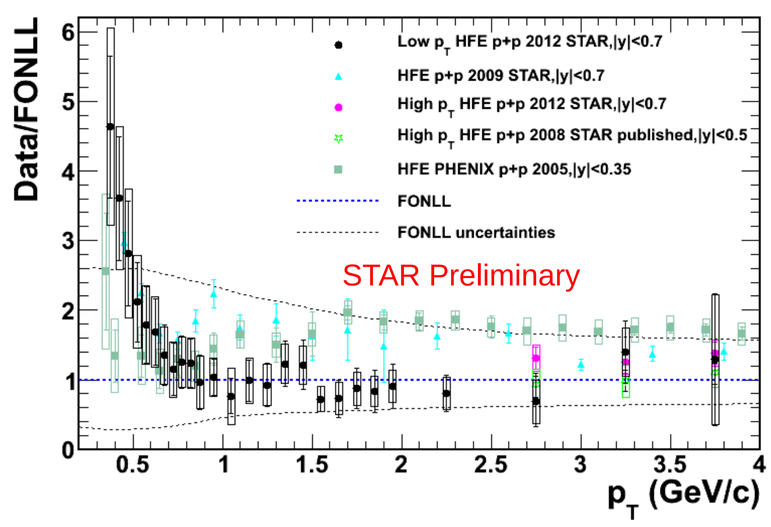


HFE production in p+p 200GeV

HFE invariant cross section



HFE Data/FONLL



✓ Spectrum is extended to low p_T and has a better coverage compare to STAR previous published result.
✓ Consistent with FONLL calculation.

Summary

1) $HFE\ production\ in\ the\ p_T\ range\ of\ 0.35 - 2.5 GeV/c\ in\ p+p\ collisions\ at\ \sqrt{s} = 200\ GeV\ is\ measured.$

2) $This\ measurement\ provides\ a\ reference\ for\ Nuclear\ Modification\ Factor\ R_{AA}\ \ measurement\ in\ heavy-ion\ collisions.$

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