Non-photonic electron production in p+p collisions at √s=200 GeV

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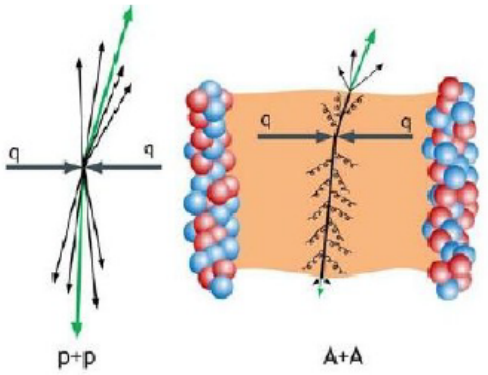
Outline

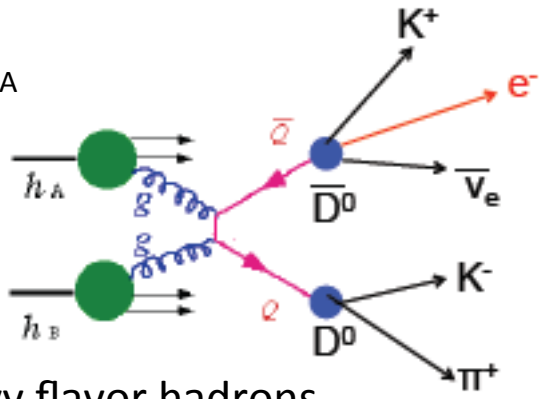
- Motivation
- Data Analysis for Non-photonic electron (NPE)
- NPE spectrum
- Summary and outlook

Motivation

- Heavy flavor particles:
  - Large mass, produced dominantly by hard scatterings in the early stage
  - Excellent probe for the Quark-Gluon Plasma (QGP)

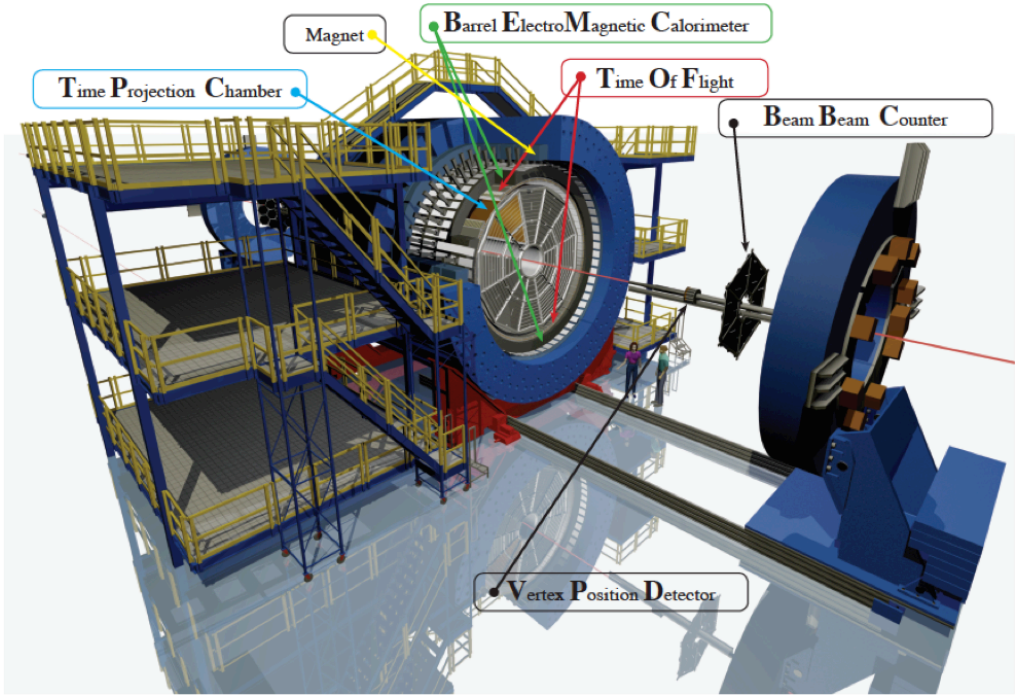


- Heavy flavor production in p+p collisions
  - Baseline for studies in heavy ion collisions, e.g. R_{AA}
  - Test the validity and constrain the parameters of pQCD calculations of heavy quark production



- Non-photonic electrons
  - Produced from semi-leptonic decays of open heavy flavor hadrons
  - A good proxy to study open heavy flavor production

STAR Detector



Time Projection Chamber (TPC)
large acceptance: $|\eta|<\sim1.3$, $0<\Phi<2\pi$
tracking, momentum
electron ID through energy loss dE/dx

Barrel Electromagnetic Calorimeter (BEMC)
large acceptance: $|\eta|<1$, $0<\Phi<2\pi$
electron ID through E/p and shower shape
triggering on high p_T ($2.5\ GeV/c<p_T$) electron

Time Of Flight (TOF)
large acceptance: $|\eta|<0.9$, $0<\Phi<2\pi$
electron ID through flight time
at low p_T ($p_T<2.5\ GeV/c$)

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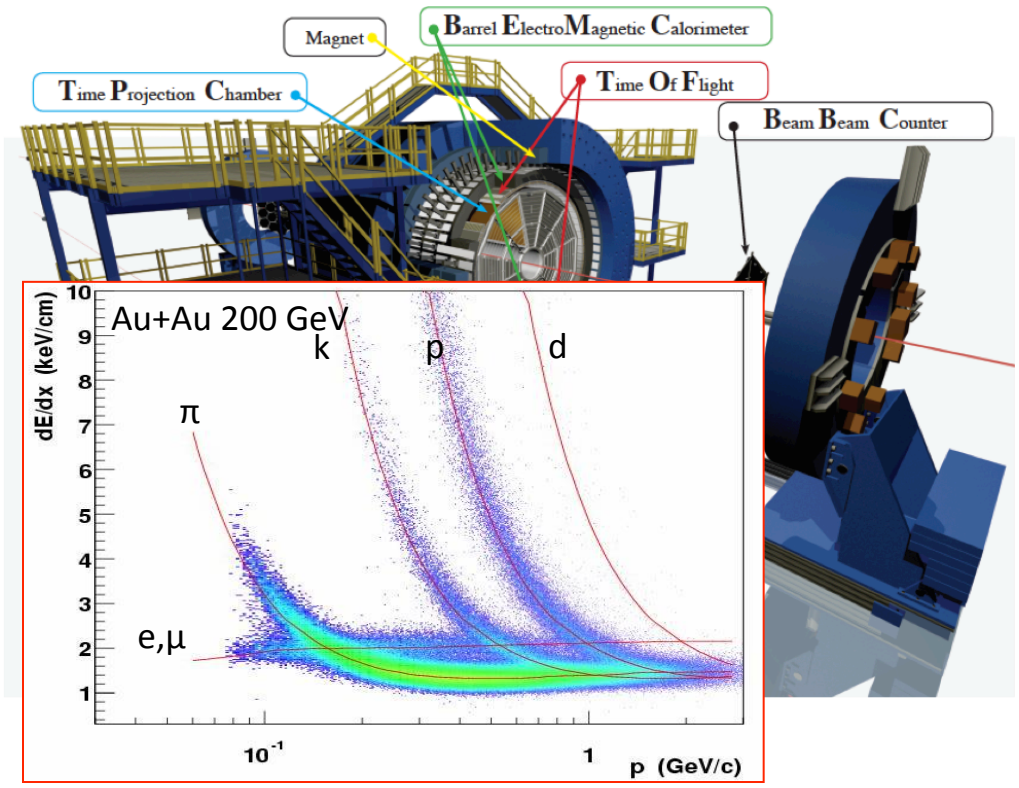

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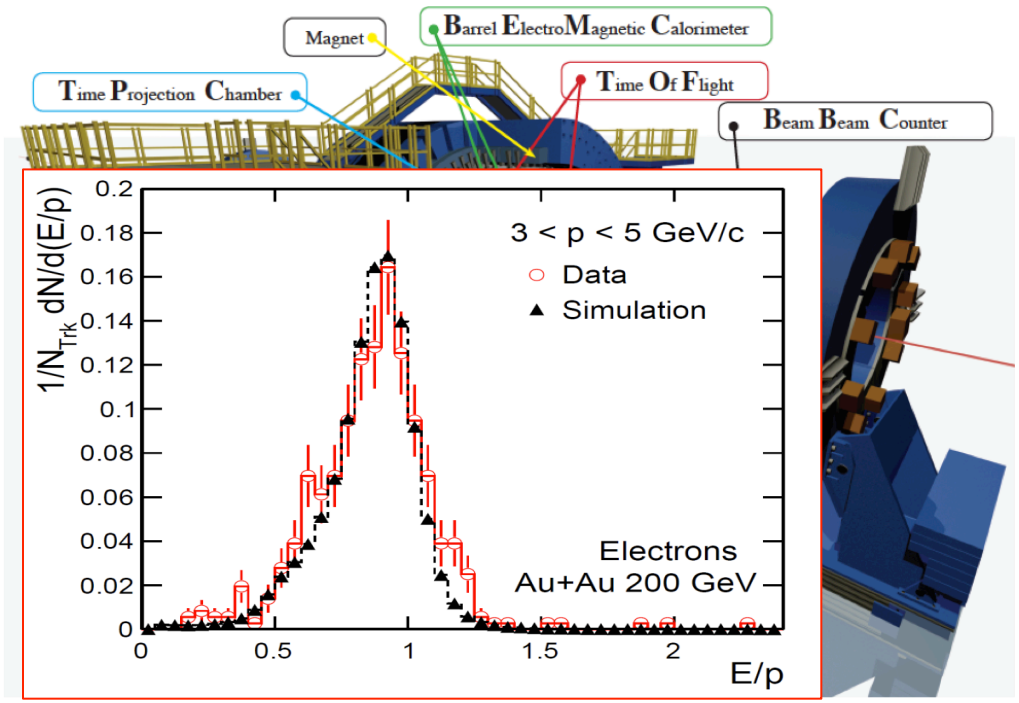

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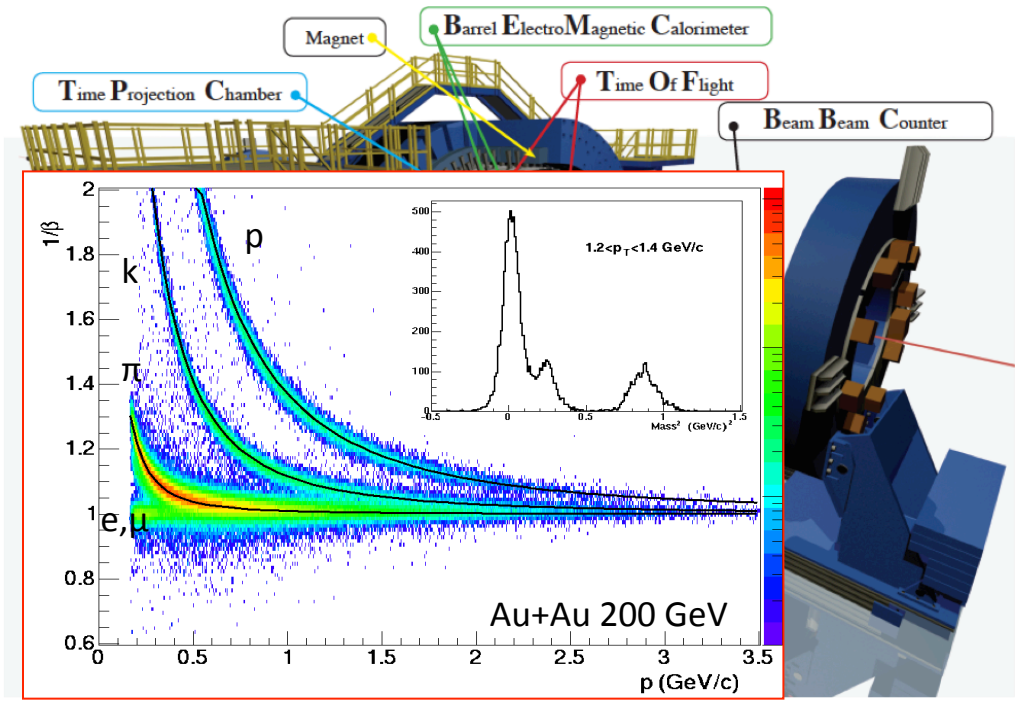

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Dataset and electron selection

- Fast detector BEMC select (or trigger on) interesting events
- High tower trigger event: an event with an energy deposition in a single tower of the BEMC above a certain threshold

Data samples in p+p collisions at $\sqrt{s}$ = 200 GeV from Run 2012

Trigger threshold	Number of Events	Sampled Luminosity
11<ADC (2.6 GeV<E_T)	38 M	1.4 pb^{-1}
18<ADC (4.2 GeV<E_T)	40 M	24 pb^{-1}

Analysis procedure

Inclusive electron

After all the ePID cuts:
Hadron contamination

- Non-photonic electron(from open heavy flavor decay)
  bottom and charm hadrons via semi-leptonic decay.
- PHE
  All ePID cuts and
  Invariant mass cuts
  Not 100% reconstructed
  - Gamma conversion $\gamma \rightarrow e^+e^-$ (~54%)
  - π^0 Dalitz Decay $\pi^0 \rightarrow \gamma e^+e^-$ (~36%)
  - η Dalitz Decay $\eta \rightarrow \gamma e^+e^-$ (~10%)

$$N_{npe} = N_{inclusive} * purity - N_{photonic} / \varepsilon_{photonic}$$

The NPE invariant cross section:

$$E\frac{d^3\sigma}{dp^3} = \frac{1}{L}\frac{1}{2\pi p_T dp_T dy}\frac{N_{npe}}{\varepsilon_{Total}}$$

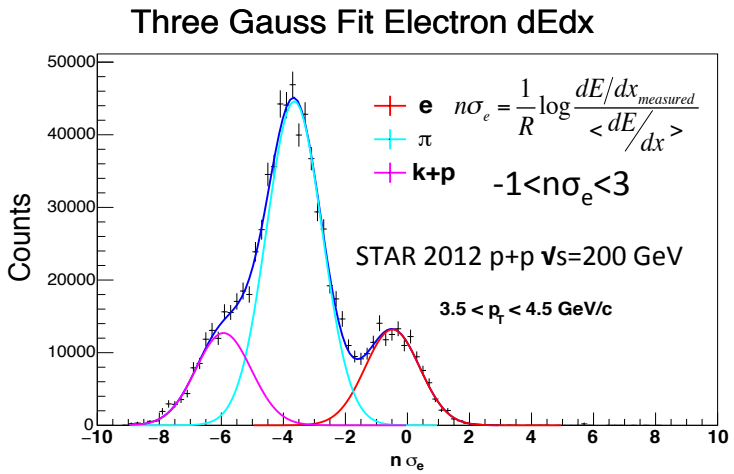
N_{npe}: electrons from open heavy flavor decay

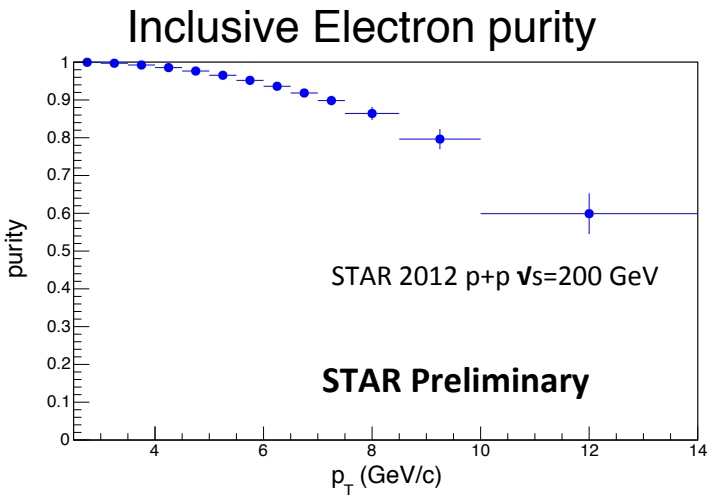
purity: purity of inclusive electron

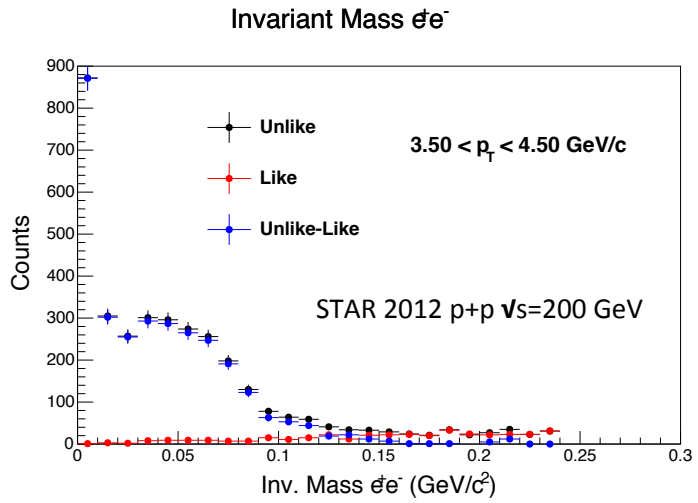
$\varepsilon_{photonic}$:photonic electron reconstruction efficiency

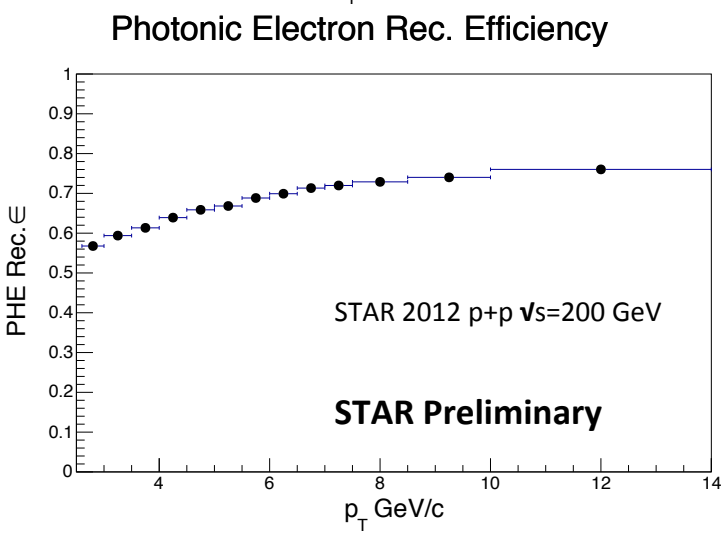
$$\varepsilon_{Total} = \varepsilon_{dEdx}\varepsilon_{EMC}\varepsilon_{Trg}\varepsilon_{Trk}$$

Inclusive electron and photonic electron

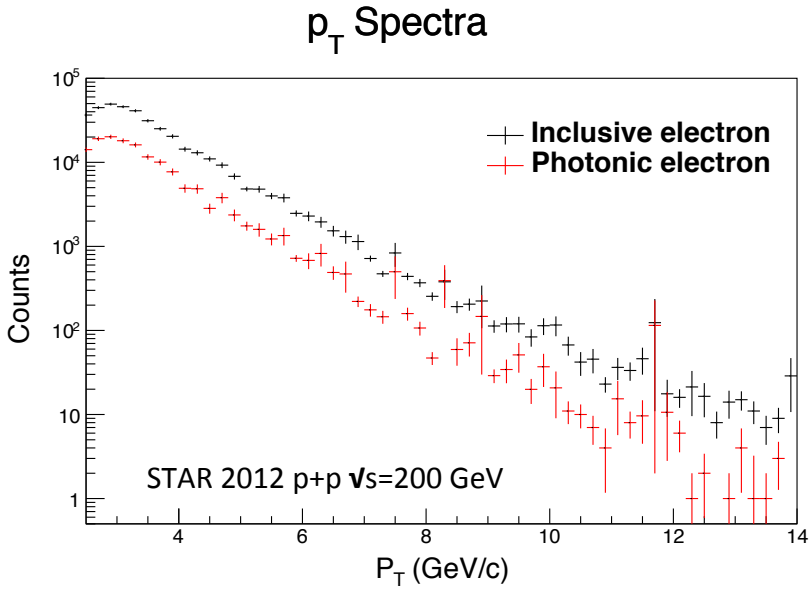


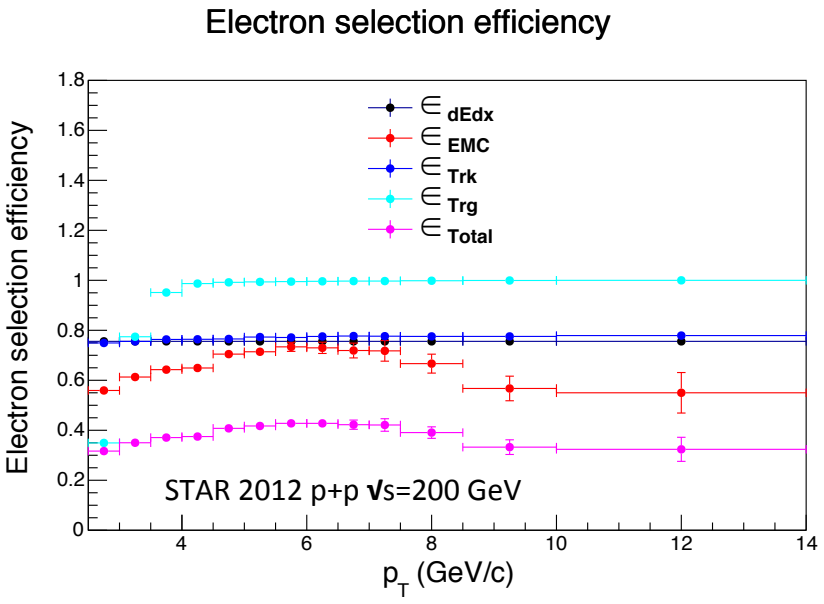






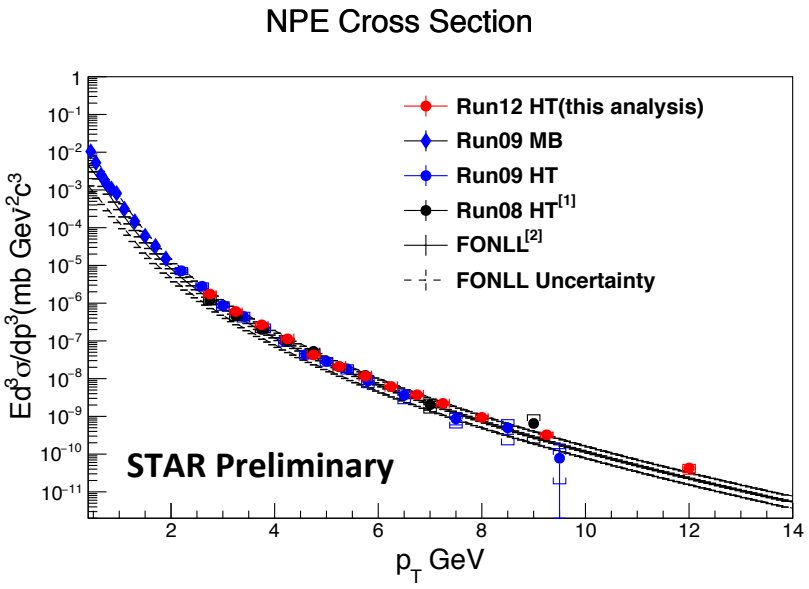
Raw spectra and detector efficiency

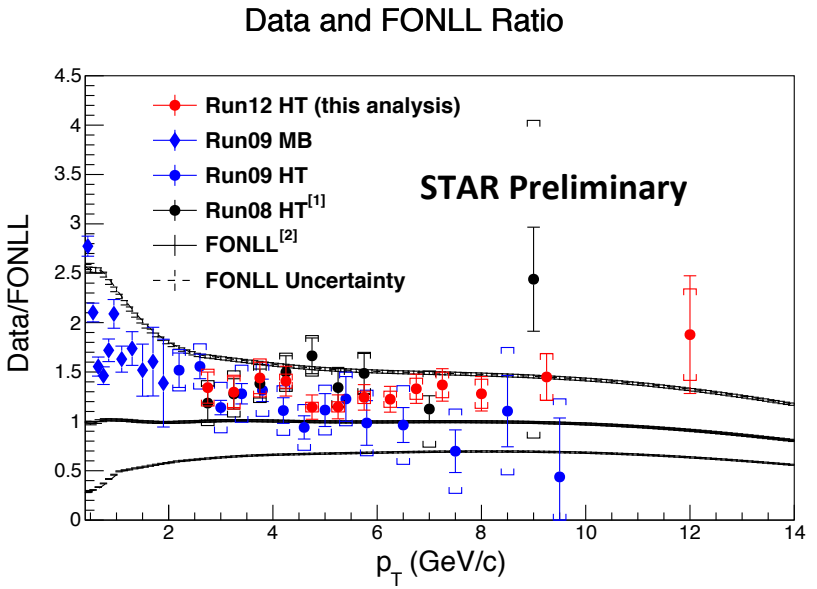




- ε_{dEdx} TPC ePID cut efficiency from data
- ε_{EMC} EMC ePID cut efficiency from data
- ε_{Trg} High tower trigger efficiency from MC simulation
- ε_{Trk} TPC tracking efficiency from MC simulation

NPE cross section





Consistent with pQCD FONLL calculation and previous STAR results.

This analysis has better precision and extended to a higher p_T range

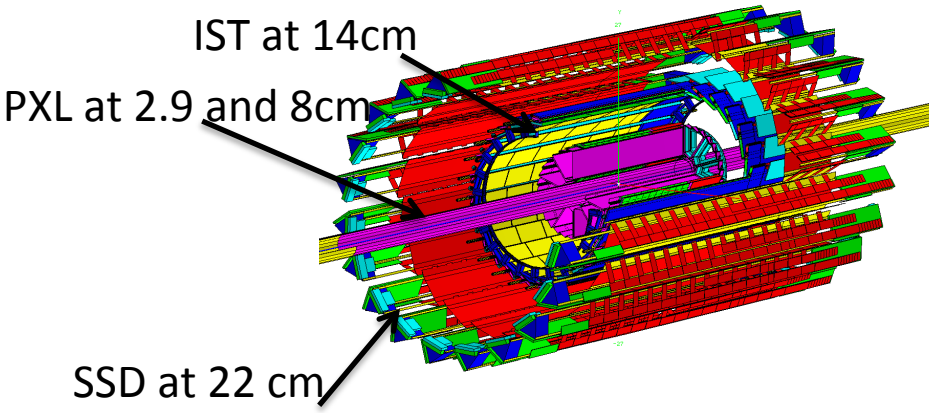
[1] STAR collaboration, Phys. Rev. D **83** (2011) 52006

[2] R.E.Nelson, R.Vogt, and A.D.Frawley, Phys.Rev.C 87 (2013) 014908

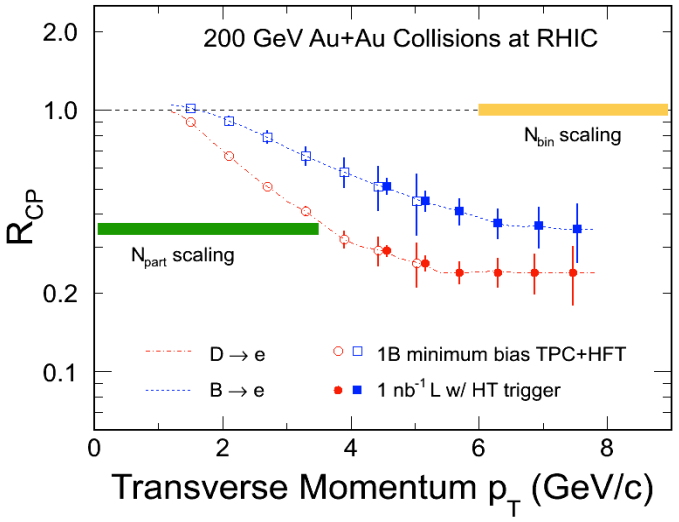
Summary and outlook

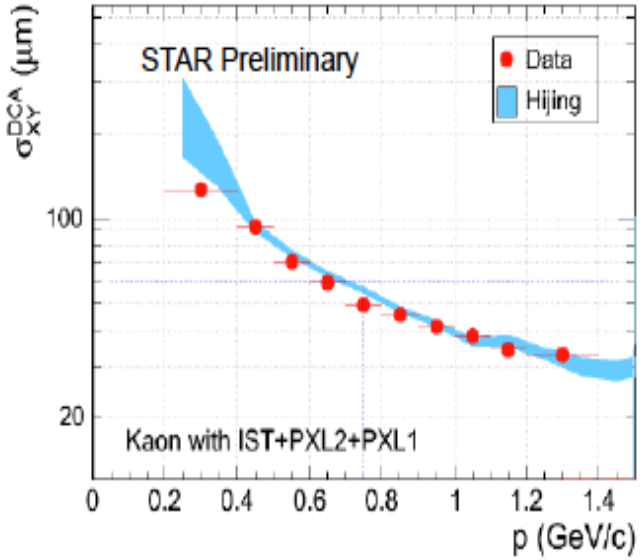
- A new and improved NPE cross section measurement in p+p collisions at √s=200 GeV at STAR.
- Results consistent with pQCD FONLL calculation and previous STAR results.
- The data analysis is ongoing to measure the NPE cross section for p_T<2.5 GeV/c, using 700M MinBias events collected during year 2012 run.
- NPE invariant yield will be used as the baseline reference for the Nuclear modification factor R_{AA} in Au+Au collisions.

Detector upgrade: Heavy Flavor Tracker



Simulation with HFT





High precision R_{AA} and v_2 of Non-photonic electron from charm and bottom hadrons decay separately