Measurements of electrons from semileptonic decays of open heavy flavor hadrons in p+p and Au+Au collisions at $\sqrt{s_{NN}}$=200 GeV

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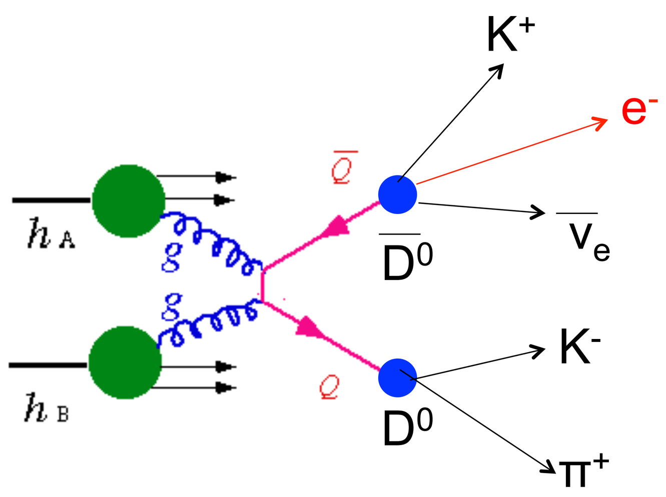
Abstract

Heavy flavor quarks have been suggested as excellent probes to study the properties of the hot and dense nuclear matter created in high-energy heavy- ion collisions. In this regard, high precision measurements of heavy flavor production in p+p collisions are also important as they provide a reference to study the medium effects in heavy-ion collisions. In this poster, we will present the latest results on electrons produced from semileptonic decays of open heavy flavor hadrons in p+p and Au+Au collisions at $\sqrt{s_{NN}}$=200 GeV. The p+p results are extracted from data taken by the STAR experiment at the Relativistic Heavy Ion Collider in the year 2012, which have a highly improved precision than previous results over a wider range of transverse momentum, 0.3<p_T<12 GeV/c. With this new p+p baseline, improved nuclear modification factors R_{AA} in Au+Au collisions are also obtained and compared with theoretical model calculations.

Motivation

Heavy-flavor production in p+p collisions is calculable by perturbative QCD with inputs from universal parton distribution functions and fragmentation functions, albeit with large uncertainties from the choice of quark mass, factorization and renormalization scale parameters. Precise measurements of heavy-flavor production cross section in p+p collisions are essential to validate such a framework and to constrain the available parameter space [1]. These measurements also provide a baseline to interpret heavy-flavor measurements in heavy-ion collisions for the study of quark-gluon plasma and its interaction with heavy-flavor quarks. Heavy flavor quarks produced from semi-leptonic decay of open heavy flavor hadrons, so it is a good proxy to measure heavy flavor quark production.



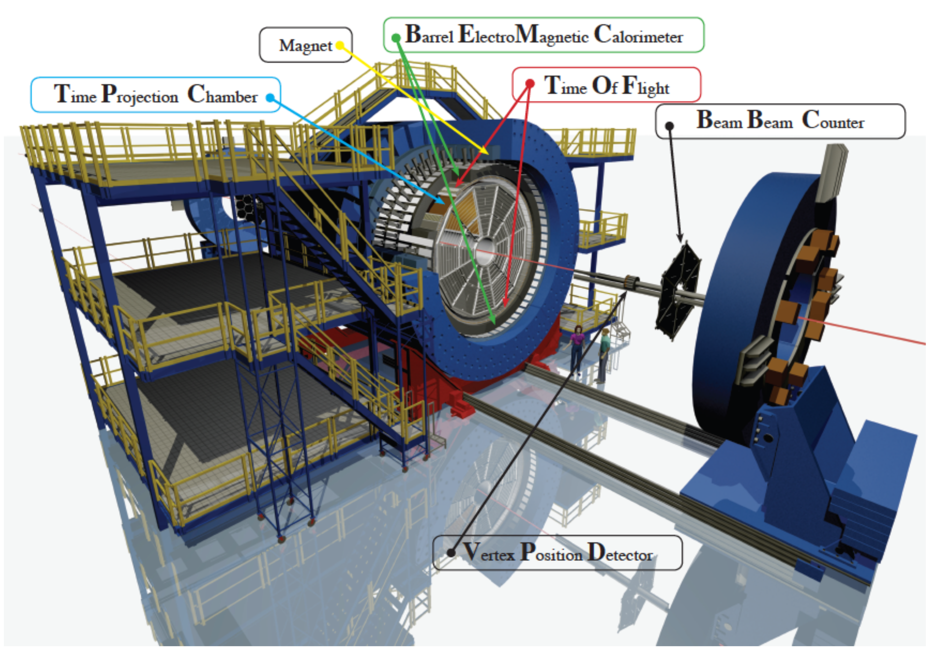
The invariant cross section for nonphotonic electron is calculated according to:

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

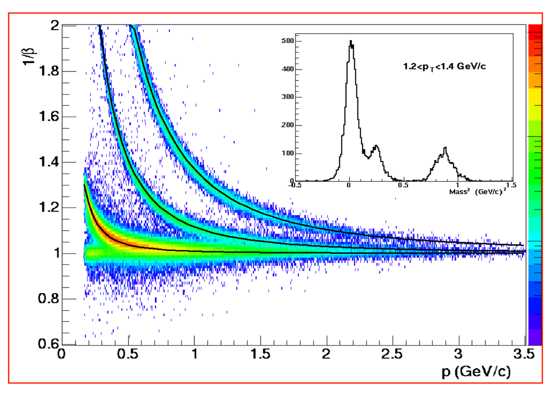
$$E\frac{d^3\sigma}{dp^3} = \frac{1}{L}\frac{1}{2\pi p_T dp_T dy}\frac{N_{npe}}{\varepsilon_{trk}\varepsilon_{trg}\varepsilon_{dEdx}\varepsilon_{EMC}}$$

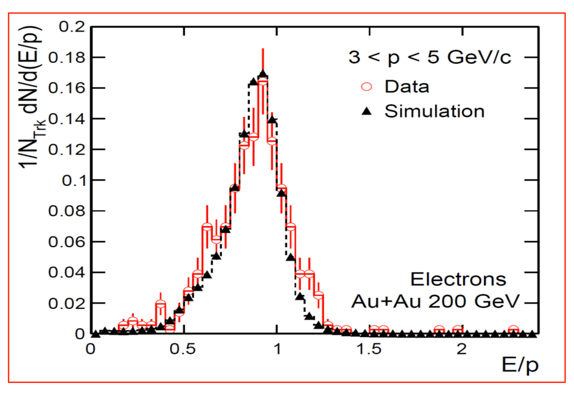
N_{npe}: electrons from open heavy flavor decay
$N_{photonic}$: electrons from photon conversion, π^0/η Dalitz decay
$N_{inclusive}$: all the electron pass the electron ID cut.
purity: purity of inclusive electron
$E_{photonic}$:photonic electron reconstruction efficiency
$\varepsilon_{trk/trg}$: tracking or trigger effiiciency
$\varepsilon_{dEdx/EMC}$: electron ID (dE/dx or EMC) efficiency

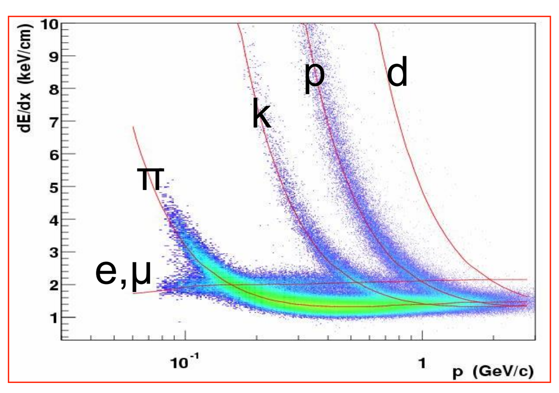
STAR Detector(in 2012)



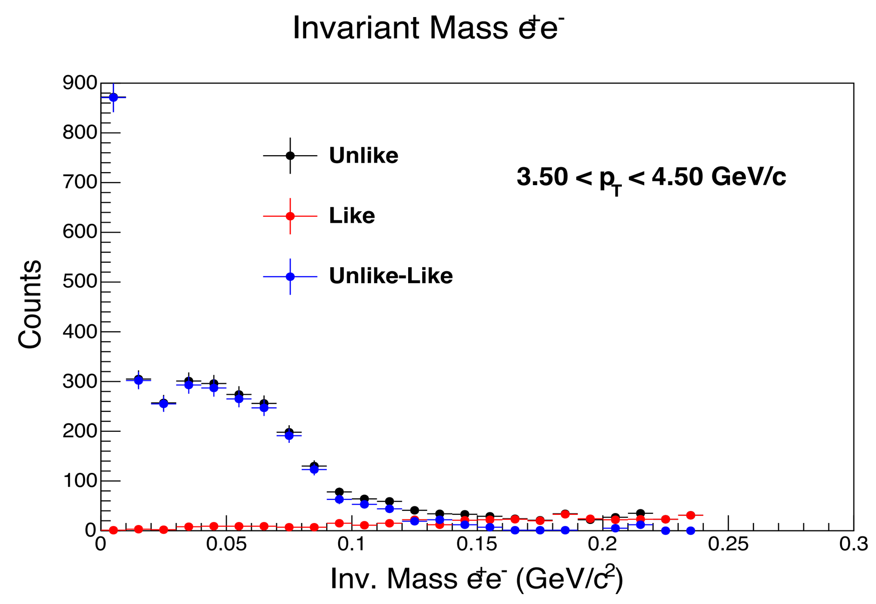
- **Time Projection Chamber**
  |η|<1, 0<Φ<2π
  tracking, momentum measurement.
  electron ID
- **Barrel Electromagnetic Calorimeter**
  |η|<1, 0<Φ<2π
  electron ID through E/p and triggering on high p_T electron (1.5 GeV/c < p_T)
- **Time Of Flight**
  |η|<0.9, 0<Φ<2π
  electron ID through flight time.
  at low p_T (p_T < 1.5 GeV/c)
- **Vertex Position Dectector**
  Minbias trigger

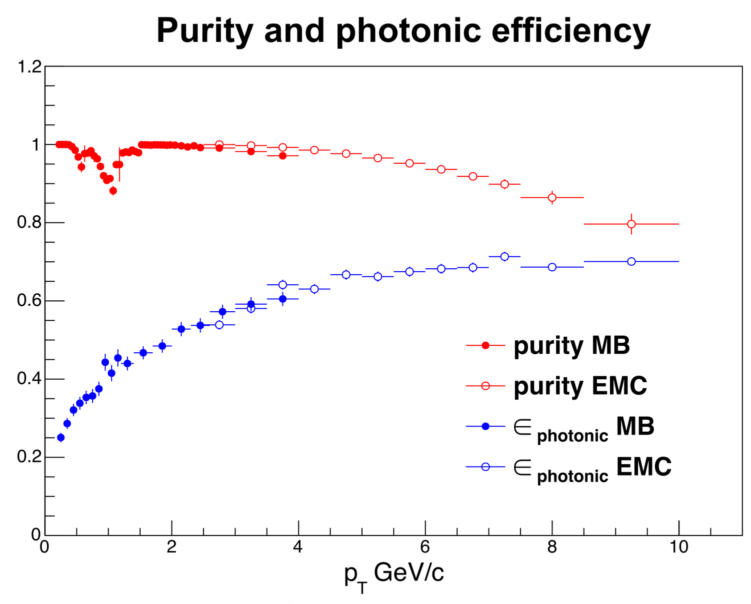


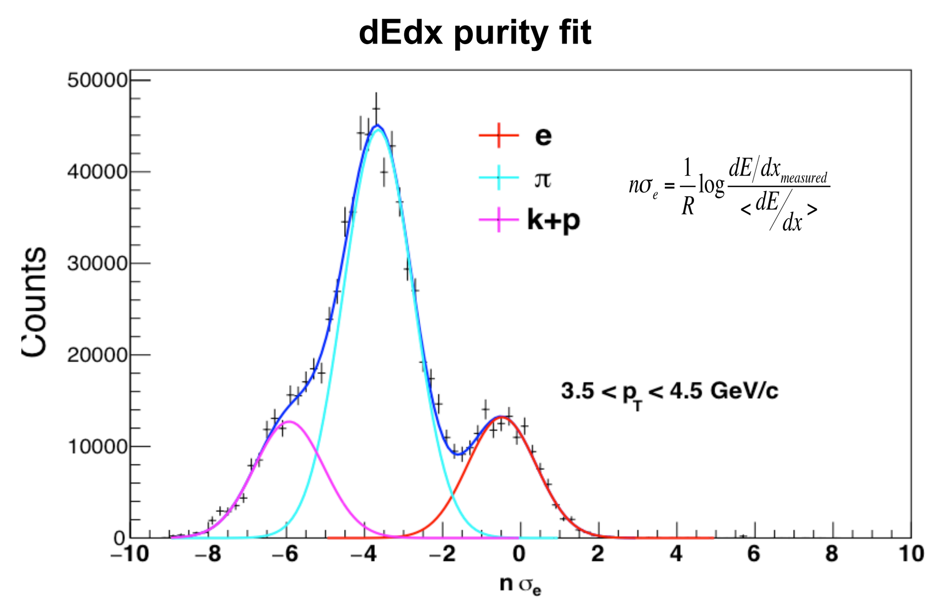


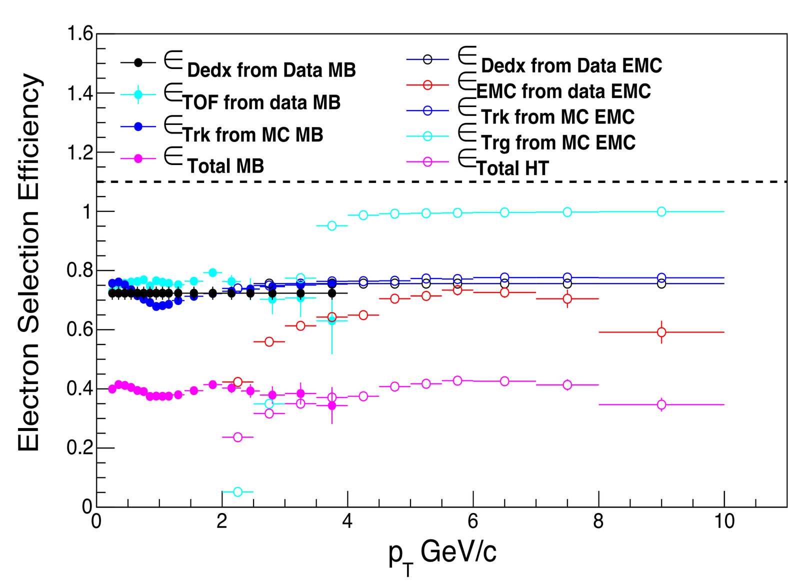


Data Analysis

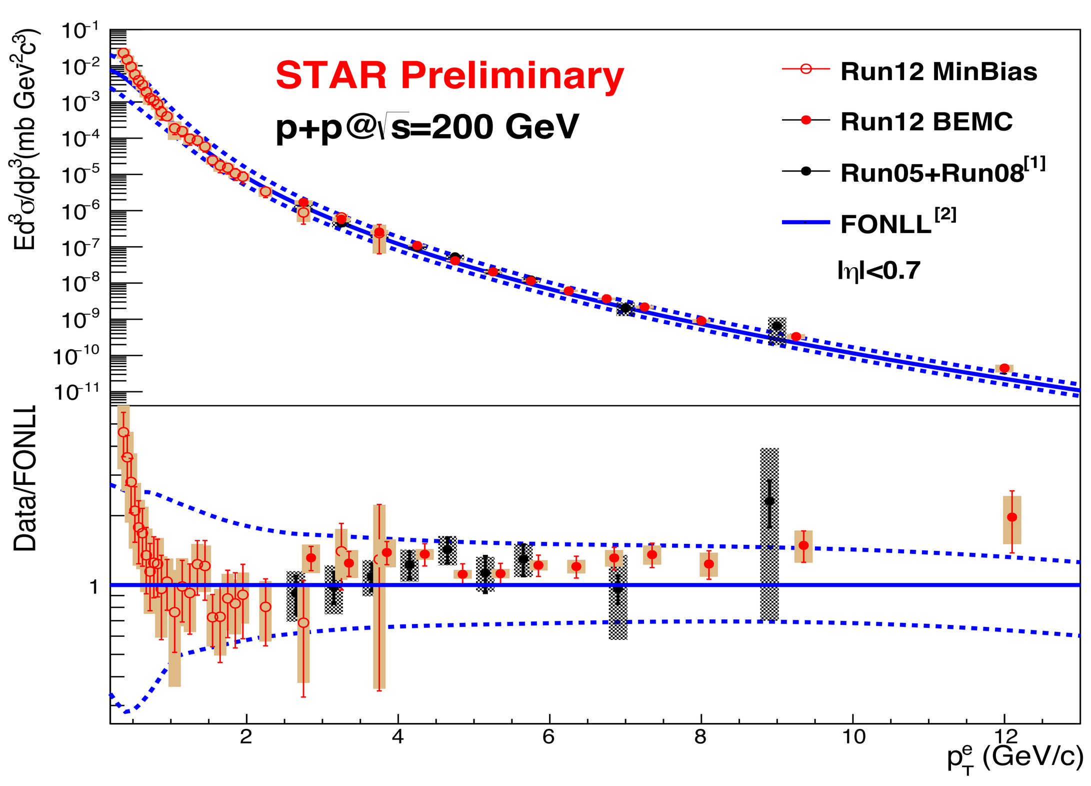


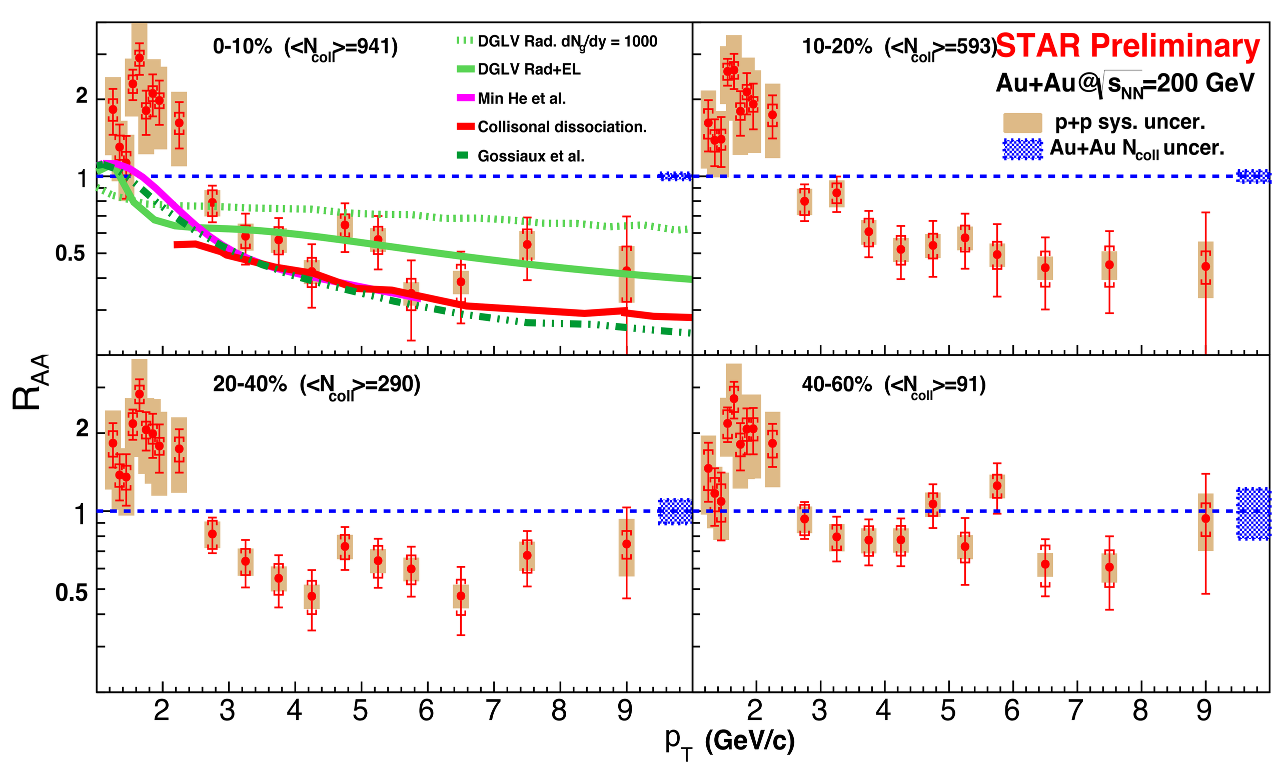






Result and Conclusion





- **Production cross section in 200 GeV p+p collisions**
  - measured as a function of p_T over a broad p_T range 0.3-12 GeV/c with significantly improved precision than previous measurements.
  - confirm and constrain pQCD FONLL calculations.
- **R_{AA} in 200 GeV Au+Au collisions**
  - strong suppression for p_T>4 GeV/c in central collisions, less towards more peripheral collisions.
  - Likely enhancement at low p_T in both central andperipheral collisions.

References: [1] STAR collaboration, Phys. Rev. D 83 (2011) 52006 [2] R.E. Nelson et al. PRC 87 (2013) 01498

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