# Single electron yields of charm and bottom hadron decays in central Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV

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Heavy quarks (charm and bottom) are sensitive probes of the Quark-Gluon Plasma (QGP) created in high-energy nuclear collisions. The modification of their phase-space distributions in the QGP reflects strongly the dynamics because they are generated in the early stage of collisions, not destroyed by the strong interaction and subsequently propagate through the QGP. Therefore, the transport properties of the QGP, the diffusion coefficient $D$, can be studied from the measurements of heavy quarks.

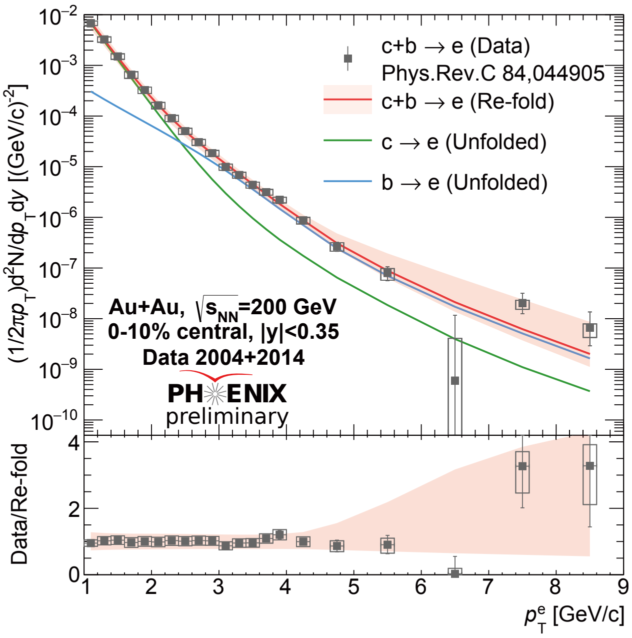


Fig. 1. The invariant yield of charm and bottom hadron decay electrons as a function of $p_{\mathrm{T}}$.

The PHENIX collaboration at the Relativistic Heavy Ion Collider has measured the large modification of the momentum and angular distributions of inclusive heavy flavor decay electrons in the QGP.[1)] Recently the silicon vertex detector was installed in PHENIX to measure precisely the displaced vertices, where the distribution of the distance of closest approach (DCA) of the track to the primary vertex allows the separation of electrons from charm and bottom hadron decays. PHENIX silicon vertex detector has achieved a sufficient DCA resolution, approximately 60 $\mu$m at $p_{\mathrm{T}} > 2.5$ GeV/$c$, for the separation because heavy flavor hadrons have the longer life time, $c\tau(D^0) = 123$ $\mu$m, $c\tau(B^0) = 456$ $\mu$m. PHENIX has established the unfolding method to a separation of charm and bottom hadron decay electrons using Bayesian inference techniques applied simultaneously to the yield and DCA distributions.[2)]

In 2014–2016, PHENIX collected 20 billion events in Au+Au at $\sqrt{s_{NN}} = 200$ GeV, which is 20 times larger than the 2011 dataset. This dataset allows to measure the charm and bottom yields as a function of a collision centrality and impose a strong constraint on theory. The invariant yield of charm and bottom hadron decay electrons in the most central Au+Au at $\sqrt{s_{NN}} = 200$ GeV is measured in the 2014 data set as shown in Fig. 1.

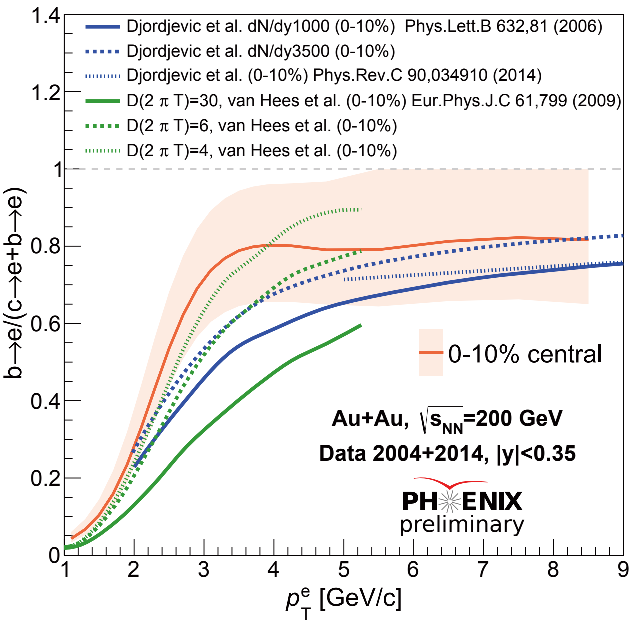


Fig. 2. The bottom electron fraction as a function of $p_{\mathrm{T}}$ compared to model predictions.

The bottom electron fraction (b→e/c + b→e) is compared to model predictions as shown in Fig. 2. Based on model predictions, we find that the diffusion coefficient of QGP is approximately 4 m$^2$/s which indicates the strong coupling of QGP, and the radiative energy loss model can reproduce well at high $p_{\mathrm{T}}$ ($> 5$ GeV/$c$).[3)]

References

1) A. Adare *et al.*, Phys. Rev. Lett. **98**, 172301 (2006).
2) A. Adare *et al.*, Phys. Rev. C **93**, 034904 (2016).
3) K. Nagashima *et al.*, Nucl. Phys. A **967**, 644 (2017).

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