Nuclear modification factors of semi-leptonic charm and bottom decay electrons in central Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV

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The PHENIX collaboration at the Relativistic Heavy Ion Collider has measured the strong suppression of electrons from heavy flavor hadron decays in quark-gluon plasma (QGP).[1)] The energy loss of heavy quark provides important information on the properties of QGP. Since the bottom and charm masses are greater than Λ_{QCD} and the QGP temperature, they are produced by hard scattering in the earliest stages of a heavy-ion collisions and they experience the time evolution of QGP. The quark mass dependence of the energy loss compared with perturbative NLO calculations provide information on the QGP properties: the gluon density and diffusion coefficient. Therefore the separated measurement of charm and bottom quark suppression in QGP is very important.

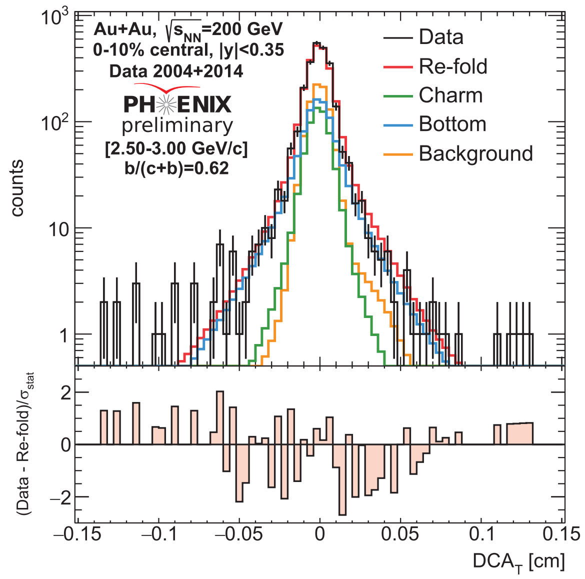

Fig. 1. DCA_T distribution for measured electrons compared with unfolded charm and bottom contributions.

The silicon vertex detector is installed at PHENIX to measure precisely displaced vertices, which allows the separation of the electron spectrum from charm and bottom semi-leptonic decays. The distribution of the distance of closest approach (DCA) of the track to the primary vertex for electrons from bottom hadron decays will be broader than that from charm hadron decays because the life time of bottom hadrons ($c\tau_{B^0}$ = 455 μm) is longer than that of charm hadrons ($c\tau_{D^0}$ = 123 μm) and they have different decay kinematics. PHENIX has published the first measurement of separated charm and bottom decay electron invariant yields and nuclear modification factor R_{AA} in 2011 for Au+Au at $\sqrt{s_{NN}}$ = 200 GeV by using Bayesian unfolding 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 are 20 times larger than the 2011 dataset. This dataset allows the measurement of centrality dependence of R_{AA} of electrons from charm and bottom hadron decays and impose a strong constraint on theory. In this analysis, we apply Bayesian unfolding techniques and obtain the electron yields from charm and bottom hadrons separately for each p_T bin as shown in Fig. 1 and measure the R_{AA} as shown in Fig. 2 for 0-10% Au+Au collisions. We find that electrons from bottom hadron decays are less suppressed than those from charm hadron decays in 3.0-5.0 GeV/c in 0-10% central Au+Au collisions.

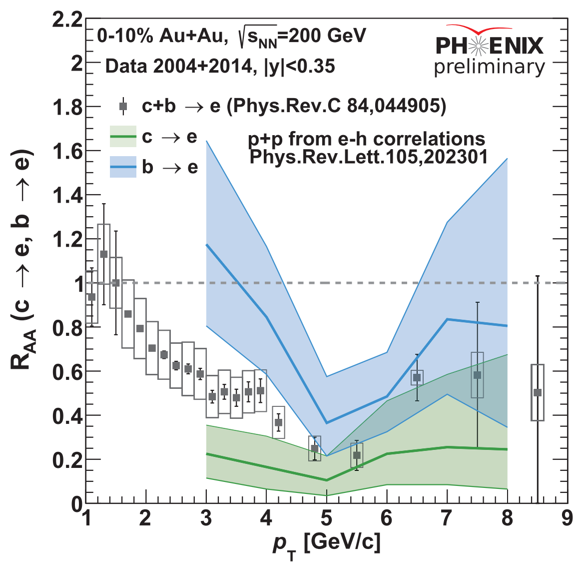

Fig. 2. Nuclear modification factor of electrons from charm and bottom in 0-10% central Au+Au collisions.

References
1) A. Adare et al., Phys. Rev. C **84**, 044905 (2011).
2) A. Adare et al., Phys. Rev. C **93**, 034904 (2016).

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