v_2 Measurements of single electrons from heavy flavor meson decays in Au +Au collisions at $\sqrt{s_{NN}}$=62.4 GeV by PHENIX

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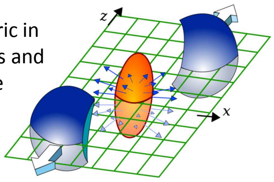
The measurement of azimuthal anisotropy (v_2) of single electrons from semi-leptonic decay of open heavy flavor mesons in PHENIX in Au+Au collision at $\sqrt{s_{NN}}$=200GeV shows that c and b quarks have unexpected large flow [1][2], which is not well understood. We extend the PHENIX systematic study of azimuthal anisotropy by reducing the beam energy to at $\sqrt{s_{NN}}$=62.4GeV, where the medium formed in Au+Au collisions is expected to have a lower energy-density. The heavy favor v_2 preliminary result using the 2010 Au+Au 62.4 GeV data will be presented.

Motivation



- The collision area of nuclei is not azimuthally symmetric in non-central collisions. This causes a pressure gradients and azimuthal anisotropy of the particle distribution in the thermodynamic limit
- v_2 is the second Fourier coefficient of the azimuthal distribution of particle yield w.r.t. the reaction plane.

$$\frac{dN}{d\Delta\phi} = N_0 \cos(1 + 2v_1\cos(\Delta\phi) + 2v_2\cos(2\Delta\phi) + 2v_3\cos(3\Delta\phi) + \cdots)$$

- Heavy quarks are hard probes of Quark Gluon Plasma (QGP). They are expected to suppress less and has small flow in QGP compare to light quarks because of the heavy mass. However the current PHENIX measurement shows that, similar to light quarks, heavy quarks also have large flow in Au+Au collisions at $\sqrt{s_{NN}}$=200GeV.
- Do heavy quarks flow at lower beam energy?

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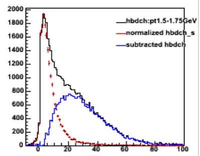
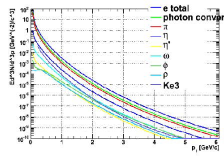
Background Subtraction

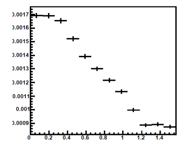
- Hadron background and randomly HBD matching background can be subtracted by HBD swapping method. Then a clean sample of inclusive electrons can be obtained.
- To measure the heavy flavor electrons, photonic component should be subtracted from the inclusive electron spectrum.
- Cocktail method is used to estimate the photonic electrons background



Hbd charge



Photonic electron invariant yield by cocktail method



Photonic electron flow by cocktail method

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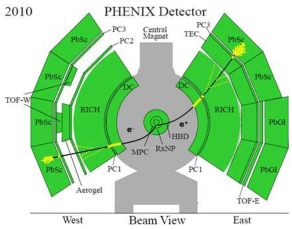
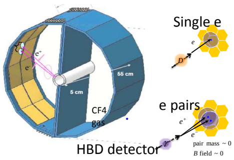
Detector and Heavy Flavor e measurement

Heavy quarks can measured indirectly by electrons from open heavy flavor meson semi-leptonic decay channel using PHENIX central arm at mid rapidity (|y|≤0.35). The detectors using the following subsystems for electron measurement:

- p_T reconstruction and tracking: Drift Chamber(DC)
- Electron identification (eID): The Ring Imaging Cherenkov detector(RICH) and E/p measurement
- Electron magnetic calorimetry: Emcal

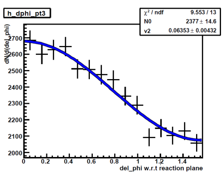


- Additional eID and background rejection: Hadron Blinder Detector (HBD)



HBD is designed to separate single electrons and electron pairs happened before the HBD backplane. It can also be used to reject the conversions happened in or after the HBD backplane.

In this analysis, a lower band HBD charge cut is used to remove conversion background from HBD backplane.



Inclusive e flow (MB) at p_T 1.5-2GeV/c

After applying all cuts, inclusive electron flow can be measured. Left figure show the inclusive e flow at centrality bin 20-40% at p_T 1.5-2GeV/c.

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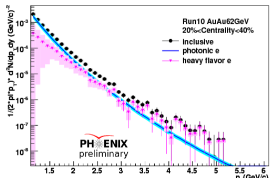
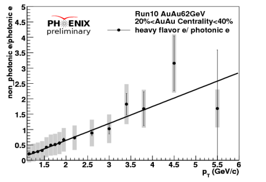
Results

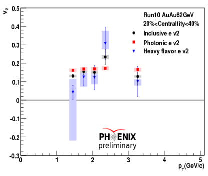
Heavy flavor e spectrum and v_2 are obtained by subtracting photonic e cocktail from the inclusive e spectrum and v_2



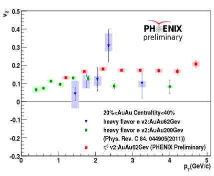
Inclusive, photonic and hf e spectra (centrality 20-40%)



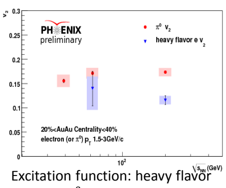
Heavy flavor to photonic ratio (centrality 20-40%)



Inclusive, photonic and HF electron v_2 at Au+Au 62.4GeV (20-40% centrality)



Heavy flavor e v2 at 62.4GeV compare to 200GeV and π^0 v_2 at Au+Au 62.4GeV



Excitation function: heavy flavor e v_2 and π^0 v_2 as a function of beam energy at pT 1.5-3GeV/c in Au+Au collision

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Conclusions

- Heavy flavor electron flow is measured in Au+Au collision at $\sqrt{s_{NN}}$=62.4GeV in PHENIX. The v_2 at this low beam energy is consistent with the 200GeV.
- Heavy quarks likely flow in Au+Au collision at 62.4GeV in PHENIX.
- Similar magnitude D meson v_2 are observed from Pb+Pb collision at 2.76TeV with ALICE at LHC[3]. This extends the picture of heavy flavor v_2 to higher energy scale.

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References

[1] Phys. Rev. C 84, 044905 (2011)

[2] Phys. Rev. Lett. 98, 172301 (2007)

[3] Nuclear Physics A 00 (2012) 1–4, arXiv:1111.6886v1