DCA and secondary vertex measurement of electron pairs using PHENIX-VTX

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Introduction

Heavy quark (charm and bottom) production is a powerful tool to study the property of QGP.

- Calibrated probe:
  - Heavy quark is mainly produced in the initial hard scattering.
  - Heavy quark production is calculable by perturbative QCD
    • their large mass (M_c ~1.3GeV/c^2, M_b ~4.2GeV/c^2).
- Carrying QGP information:
  - Heavy quarks propagate through the QGP after the production
  - Modification of the yield and angler distribution is directly reflected by the property of QGP.

- Bottom and charm separation is important to study QGP in detail.
  - Observed strong suppression of heavy quarks is not well understood.

Secondary Vertex Reconstruction

1. e+e- pairs are measured by the central arm + VTX
- VTX improves momentum resolution
2. Secondary vertex position is reconstructed
- The position of closest approach for e+e- pairs

Structure:

- 4 layers of silicon detectors
  - 2 inner pixel and 2 outer stripixel layers
- Wide acceptance: |φ|<2π, |y|<1.2
- Capabilities:
  - A precise tracking around the collision vertex
  - Collision vertex determination

VTX archives 74μm DCA resolution for single electron measurement
- Distance of Closest Approach (DCA) from collision vertex

Data analysis

- e+e- invariant mass in p+p 200GeV

Summary & Outlook

- Secondary J/ψ as a probe
  - B → J/ψ +X → e+ + e-
  - This is a direct measurement of B meson production.
  - Bottom and charm contributions needs to be separated in single electrons from heavy quark decays.
  - It is challenging to extract the signal
  - Branching ratio (B → J/ψ) is small (~1%)
  - Main background is prompt J/ψ that comes from the collision vertex

- Secondary J/ψ measurement via e+e- pairs is feasible
- Data analysis for p+p and Au+Au 200 GeV is in progress.
- VTX reduces combinatorial background and improves the J/ψ yield measurement
- High statistics Au+Au data is coming in run2014
  - Run2014 is going smoothly and the integrated luminosity will be twice than the plan

- Expected yield of secondary J/ψ
  - Number of J/ψ is 10000 @ 10 billion minimum bias data in Au+Au 200GeV
  - J/ψ yield in p+p 200GeV
    - Secondary J/ψ: σ_d/J/ψ→e+e→e+e~ = 1.2nb (PRL.103.082002 PHENIX)
    - Prompt J/ψ: σ_d/J/ψ→e+e→e+e~ = 45 nb (PRL.98, 232002 PHENIX)
    - Production ratio : 2.6% in p+p, 5.2% in Au+Au
  - The expected secondary J/ψ is 100~200 in Au+Au 200GeV (including VTX efficiency)