Elliptic flow of electrons/positrons in 200 GeV Au+Au collisions at RHIC-PHENIX

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Introduction

The azimuthal anisotropy of particle emission reflects

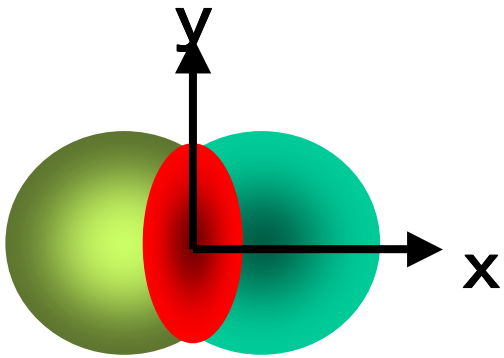
-> Low p_t

- **pressure gradient of early stage of collision**
- **hydrodynamical behavior**

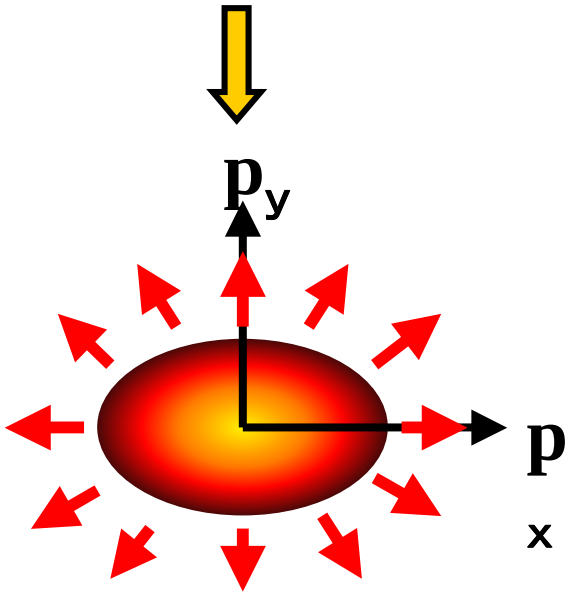
-> High p_t

- **parton energy loss in hot & dense medium**

$$\frac{dN}{d\varphi} = N_0(1 + 2v_1\cos(\varphi) + 2v_2\cos(2\varphi) + \ldots)$$



Initial spatial anisotropy



Momentum space anisotropy of particle emission

Motivation

From Run1 result

(PHENIX: PRL 88(2002)192303)

Electron sources

- **Dalitz decays**
- **Di-electron decays**
- **Photon conversions**
- **Kaon decays**
- **Thermal dileptons**
- **charm decay**
- **beauty decay**

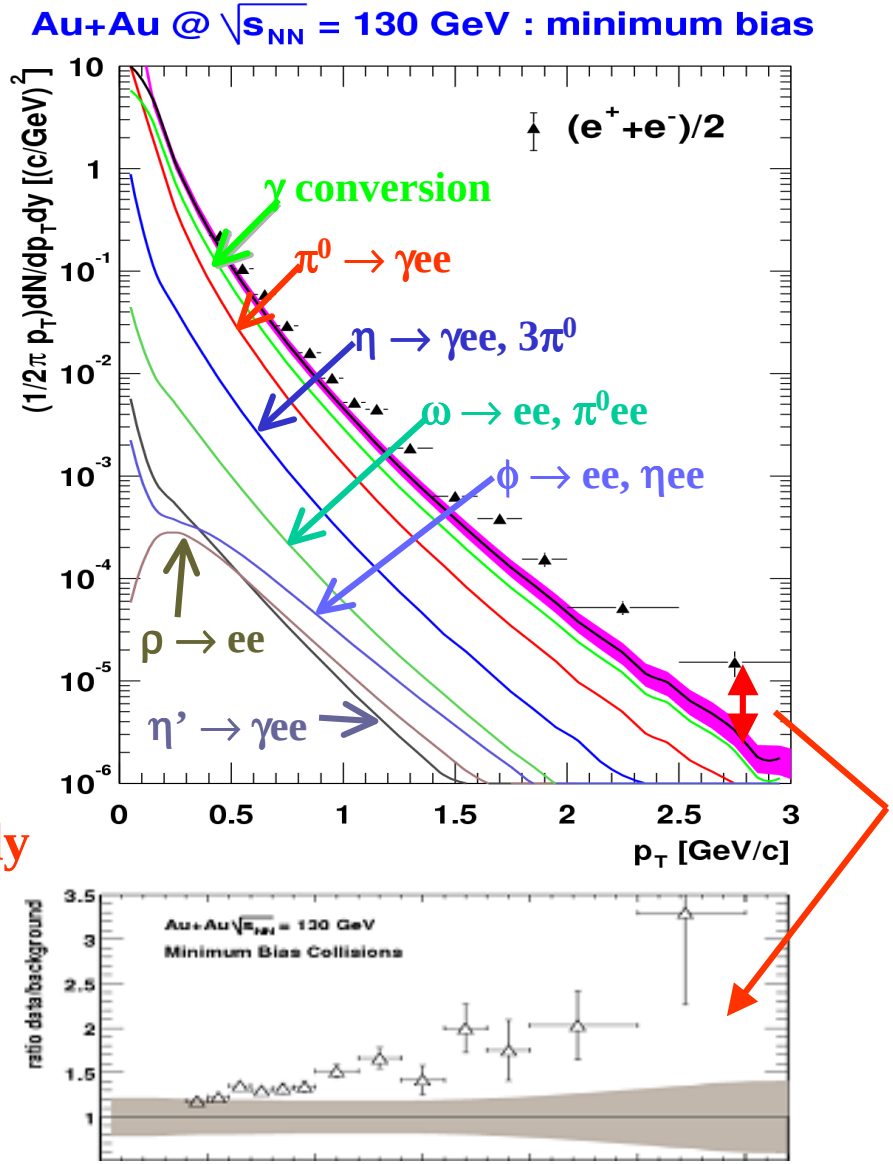
increase relative charm yield

at p_t>0.7GeV/c

measurement of v_2^e is useful way to study

→ **heavy-quark's elliptic flow**

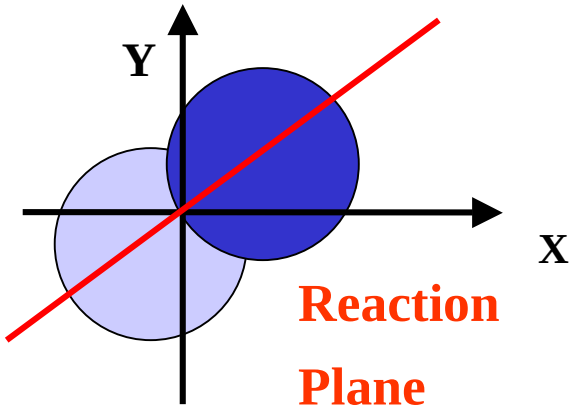
→ **energy loss of charm in the hot & dense medium**



Measurement of v_2^e

<<Reaction Plane Method>>

Measure azimuthal angle of each particle respect to the reaction plane

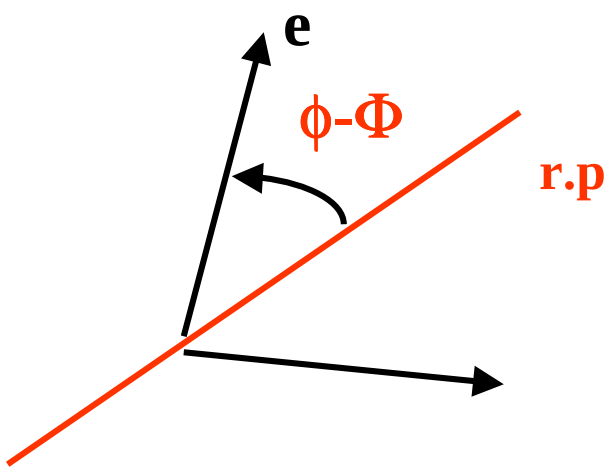


$$dN/d(\phi-\Phi) = N\,(1 + 2v_2^{obs}\cos(2(\phi-\Phi)))$$

Φ : azimuthal angle of reaction plane
ϕ : azimuthal angle of electrons
v_2^{obs}: strength of azimuthal anisotropy
(fitting of $dn/d(\phi-\Phi)$ or $v_2=\langle\cos2(\phi-\Phi)\rangle$)
$v_2 = v_2^{obs}/\ \sigma$

$$\tan2\,\Phi_{rp} = \frac{\Sigma\, w_i*\sin(2\phi_i)}{\Sigma\, w_i*\cos(2\phi_i)}$$

$$\sigma = \langle\cos(2(\Psi_m-\Psi_{real}))\rangle$$
$$= \{\langle\cos(2(\Psi_A-\Psi_B))\rangle\}^{1/2}$$



PHENIX detector

***Electron ID (RICH)**

- **CO_2**
- **eID p_t range : ~ 4.9 GeV/*c***

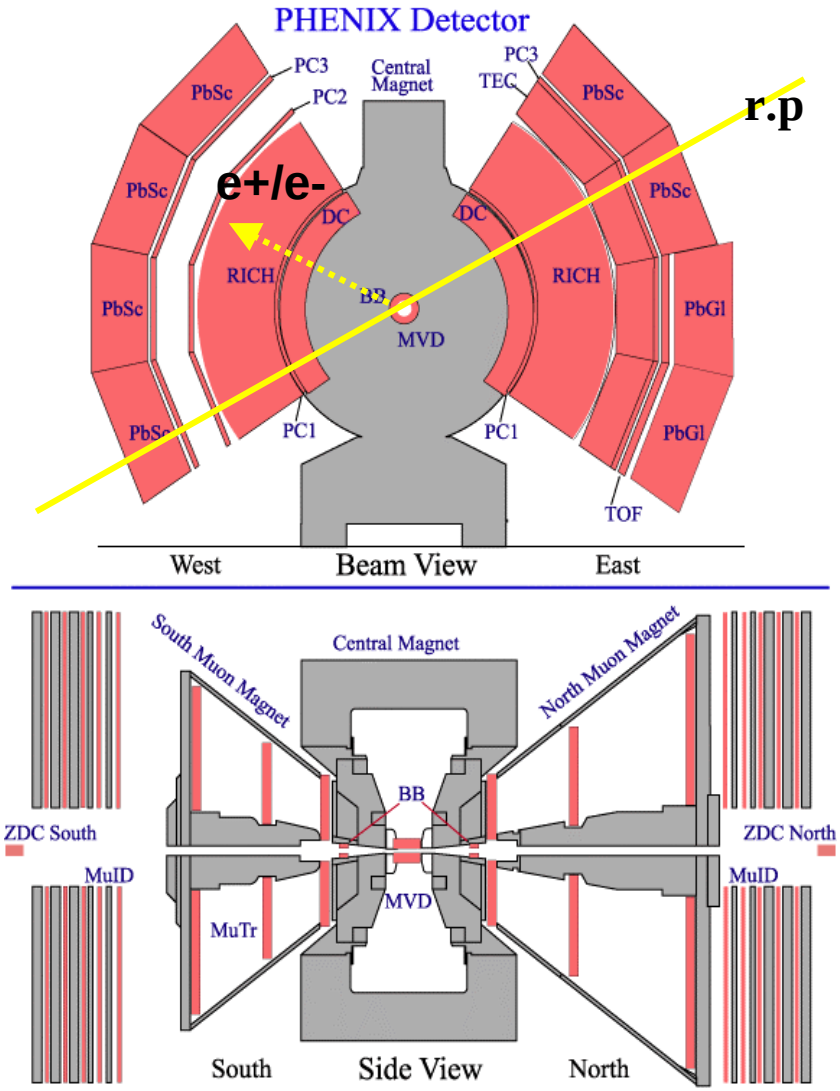
***Reaction Plane (BBC)**

- **64 PMTs in each BBC (installed North & South side)**

$$\tan 2\Phi_{rp} = \frac{\Sigma\, w_i * \sin(2\phi_i)}{\Sigma\, w_i * \cos(2\phi_i)}$$

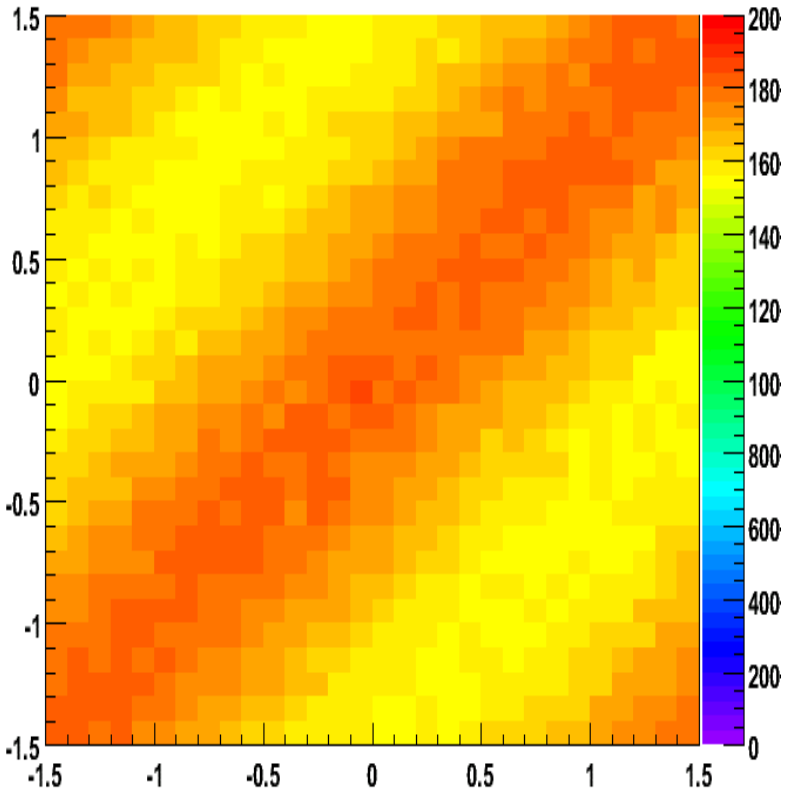
azimuthal angle of PMT

- **less non-flow contribution**

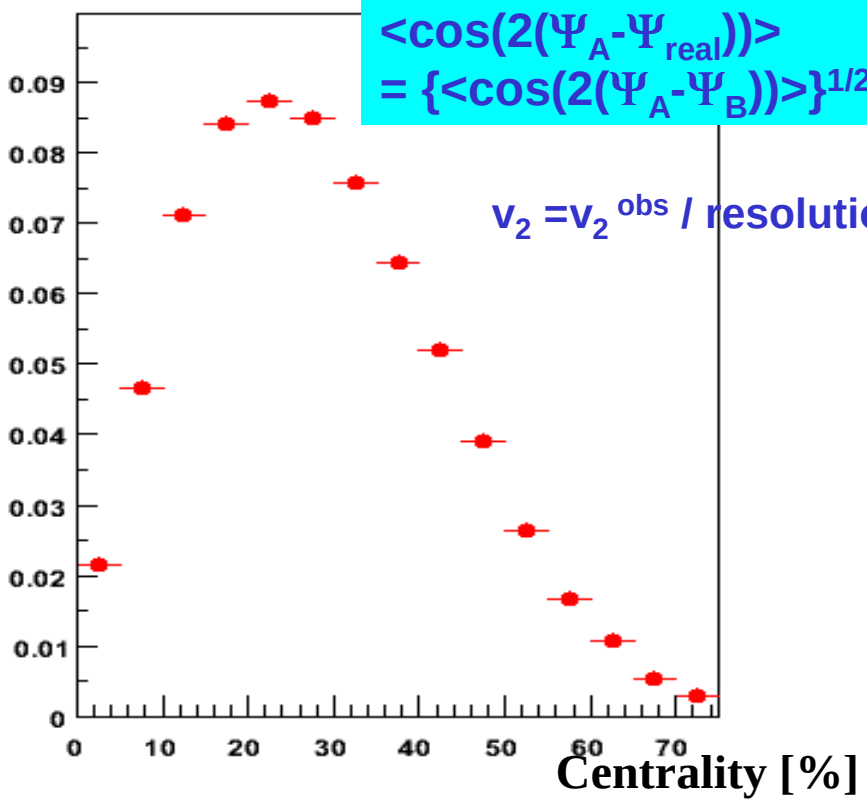


Reaction plane

Correlation r.p $_{BBC_north}$ & r.p $_{BBC_south}$



r.p resolution
$<\cos(2(\Psi_A-\Psi_{real}))>$
$= \{<\cos(2(\Psi_A-\Psi_B))>\}^{1/2}$



$v_2 = v_2^{obs}$ / resolution

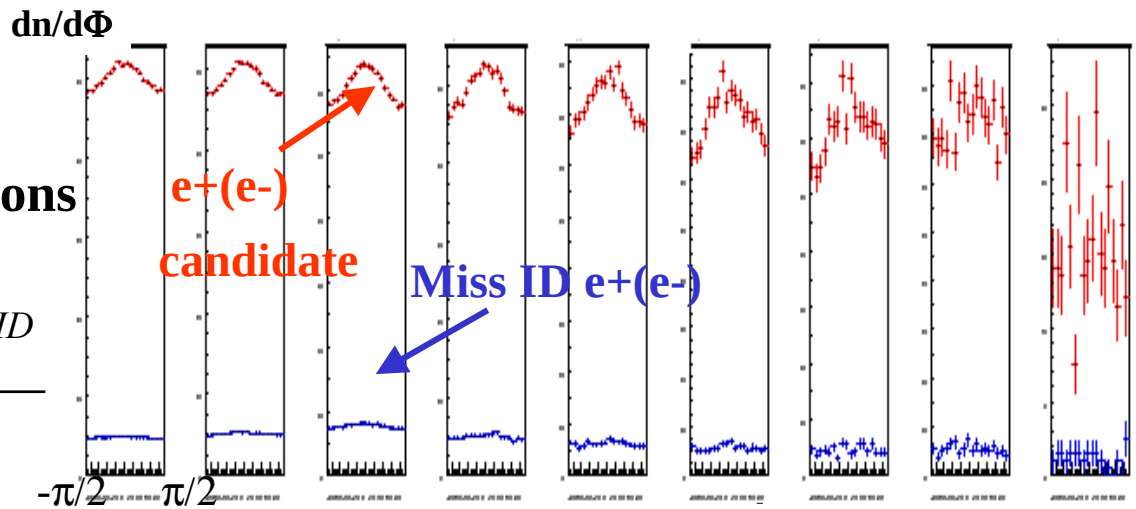
central ⟷ **peripheral**

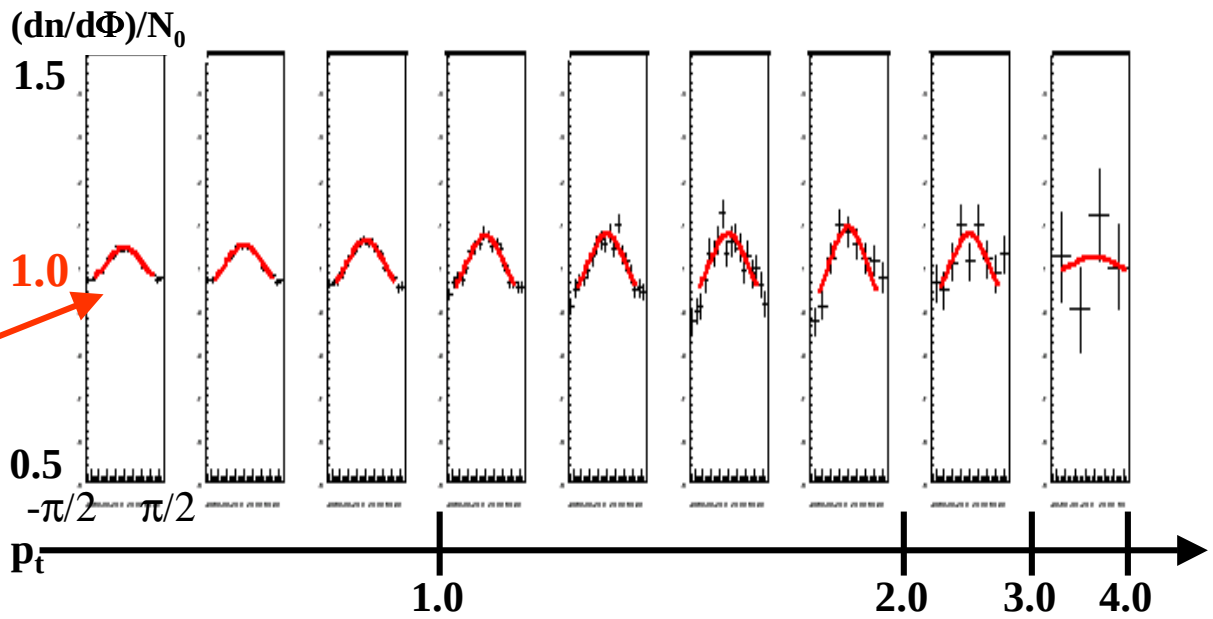
Correction of $v_2{}^e$

$v_2{}^e$ is corrected by subtracting miss ID of electrons

$$\frac{dN^{corr}}{d\phi} = \frac{dN^{cand}}{d\phi} - \frac{dN^{missID}}{d\phi}$$

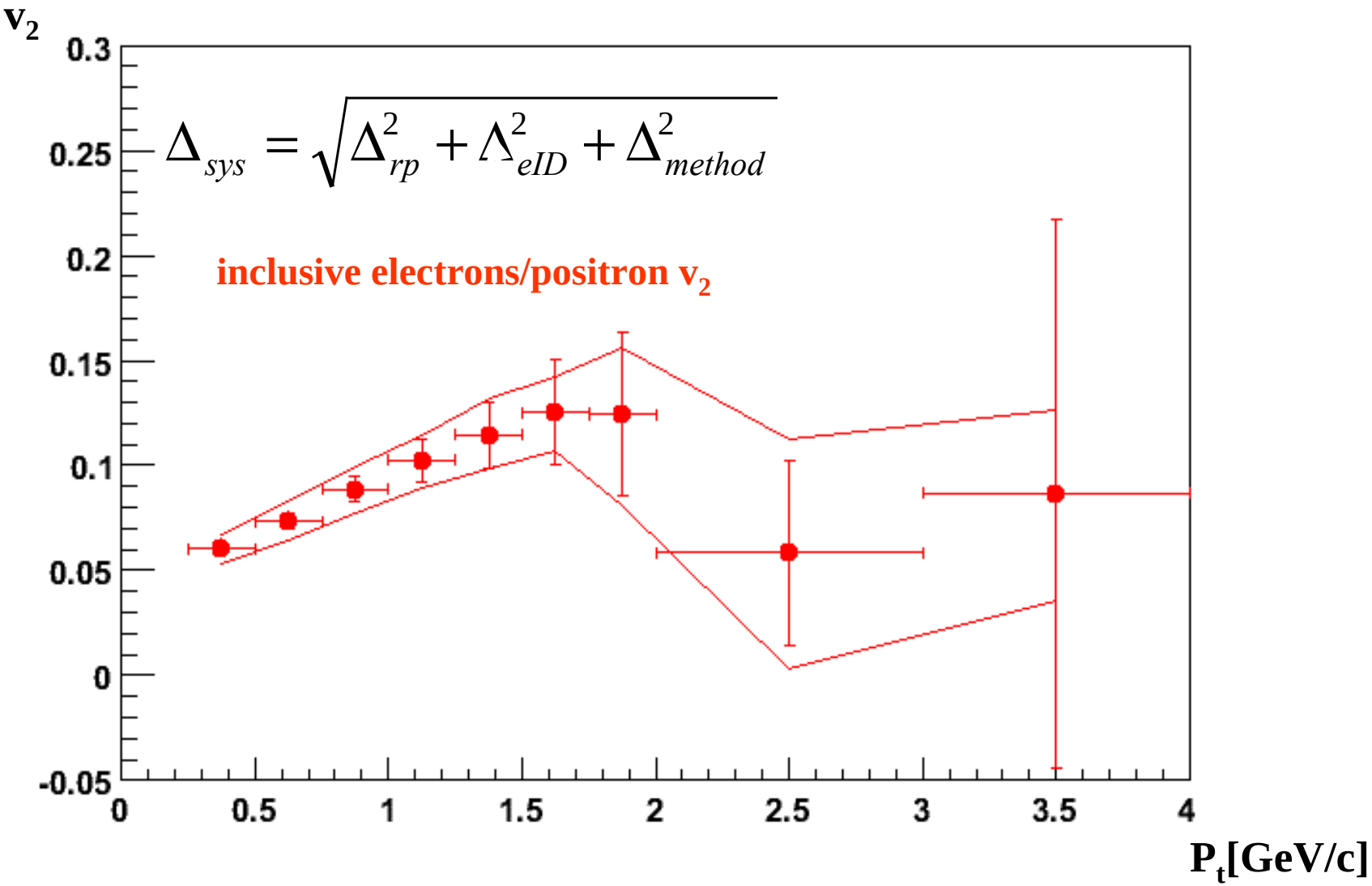
cand --- dn/dphi of candidate (detected RICH) e+(e-)
miss ID --- dn/dphi of miss ID e+(e-)



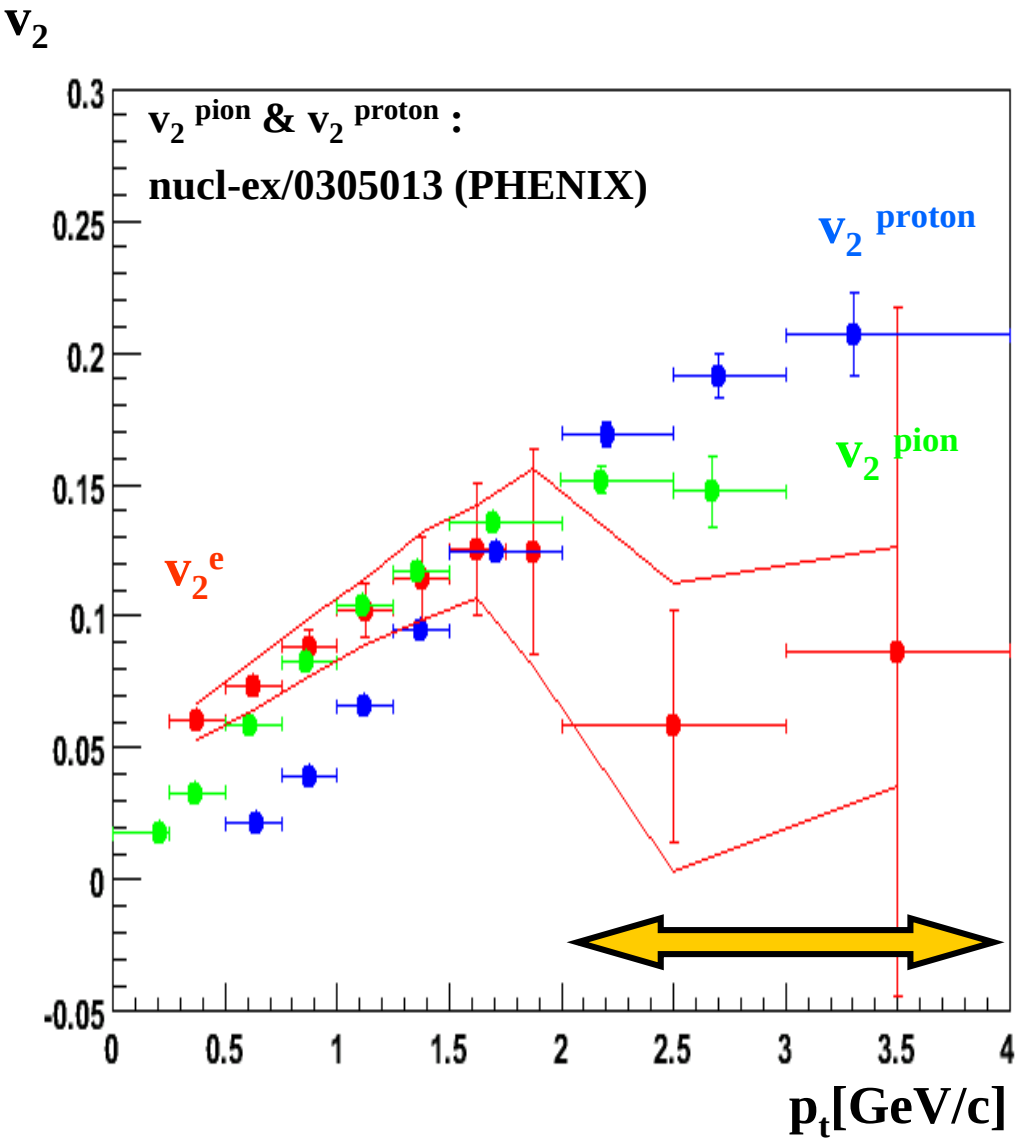


dn/dΦ of after subtract Miss ID e+(e-)

p_t dependence of v_2^e



Comparison with v_2 of hadrons



<<Low p_t (p_t<1.0GeV/c)>>

v_2^e is larger than v_2 pion & v_2 proton

-> dominant pi0 decay

- small decay angle

- decay from higher p_t

<<High p_t (p_t>2.0GeV/c)>>

v_2^e is smaller than v_2 pion

particular interest because of the contributions from heavy-quark (c/b) decays !(but the data include another sources now)

What needs to estimate charmed electron v_2 ?

- Relative charm/beauty yield to the inclusive electron yield at Run2.
- Study $v_2^{D\text{->}eX}$ (due to large Q value)
- Estimate electrons v_2 which come from non-charm source
  - photon conversions
  - Dalitz decay
    - $\pi^0 \rightarrow e^+e^-\gamma$, $\eta \rightarrow e^+e^-\gamma$

Summary&next step

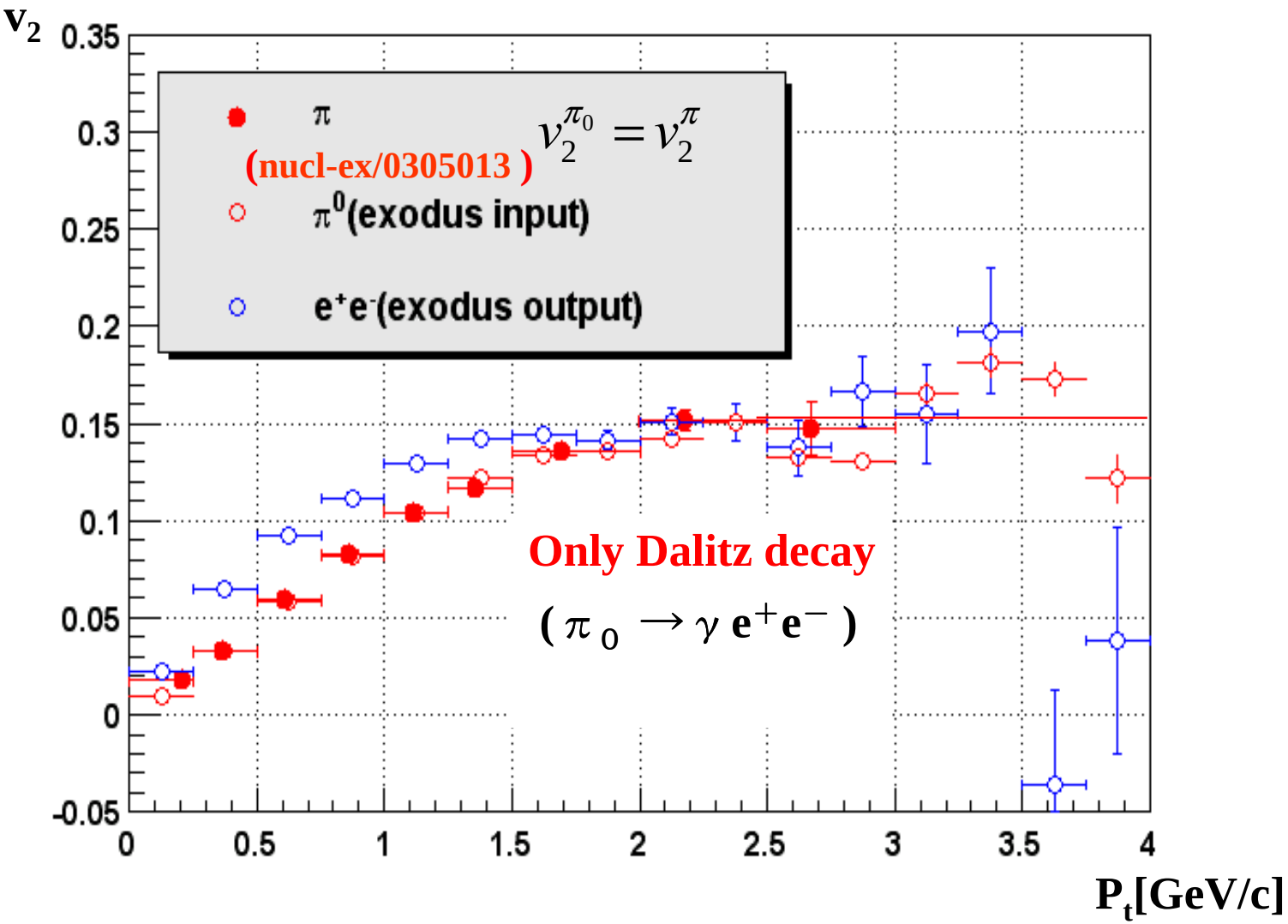
Summary

- Azumithal anisotropy of inclusive electrons/positrons are measured with respect to the reaction plane in 200 GeV Au+Au collision at RHIC-PHENIX.
- v_2^e is larger than v_2^{pion} & v_2^{proton} at low p_t (p_t<1.0GeV/c).
- v_2^e is smaller than v_2^{pion} at high p_t

Next step

- Estimate charmed electron v_2

Appendix 1


v_2
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
0.5
1
1.5
2
2.5
3
3.5
4
P_t[GeV/c]
π
(nucl-ex/0305013)
$v_2^{\pi_0} = v_2^{\pi}$
π^0(exodus input)
e^+e^-(exodus output)
Only Dalitz decay
$(\pi_0 \rightarrow \gamma\, e^+e^-)$