Elliptic flow of di-electrons in $\sqrt{s_{NN}}$=200 GeV Au+Au collisions at STAR

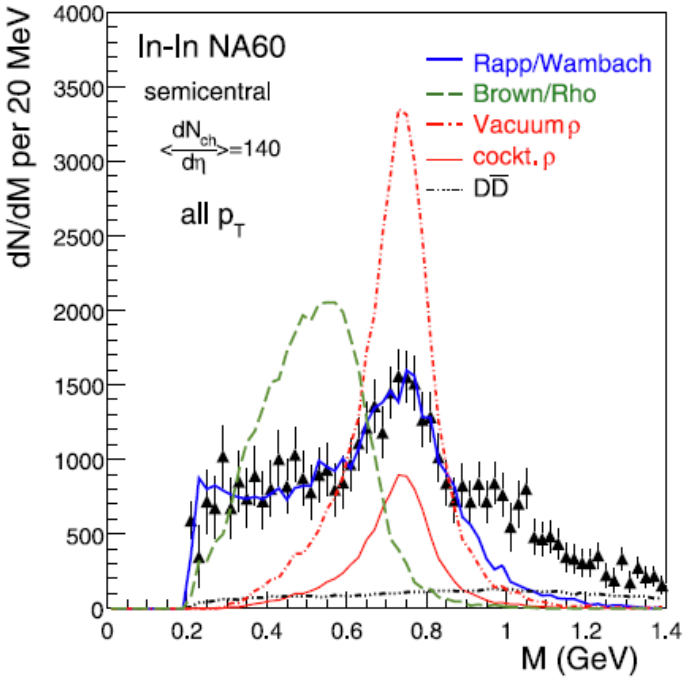
Xiangli Cui *(for the STAR Collaboration)*

University of Science and Technology of China (USTC)
Brookhaven National Laboratory (BNL)

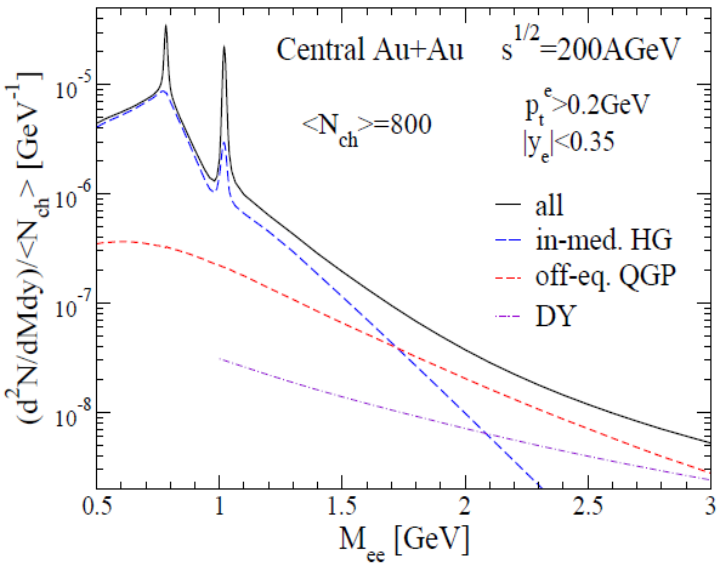
Outline

- Introduction & Motivation
- STAR detector
- Event plane method
- Preliminary results
  - M_{ee} dependence of di-electron v_2
  - p_T dependence of di-electron v_2 in different mass regions
- Summary & Outlook

Introduction



NA60: *Eur. Phys. J.C 61(2009) 711-720*

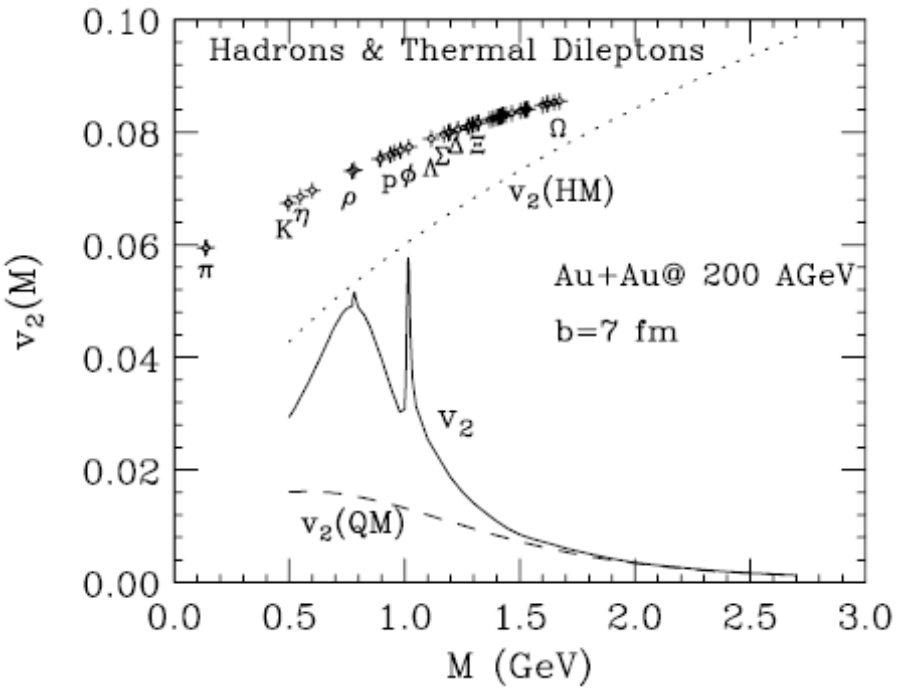


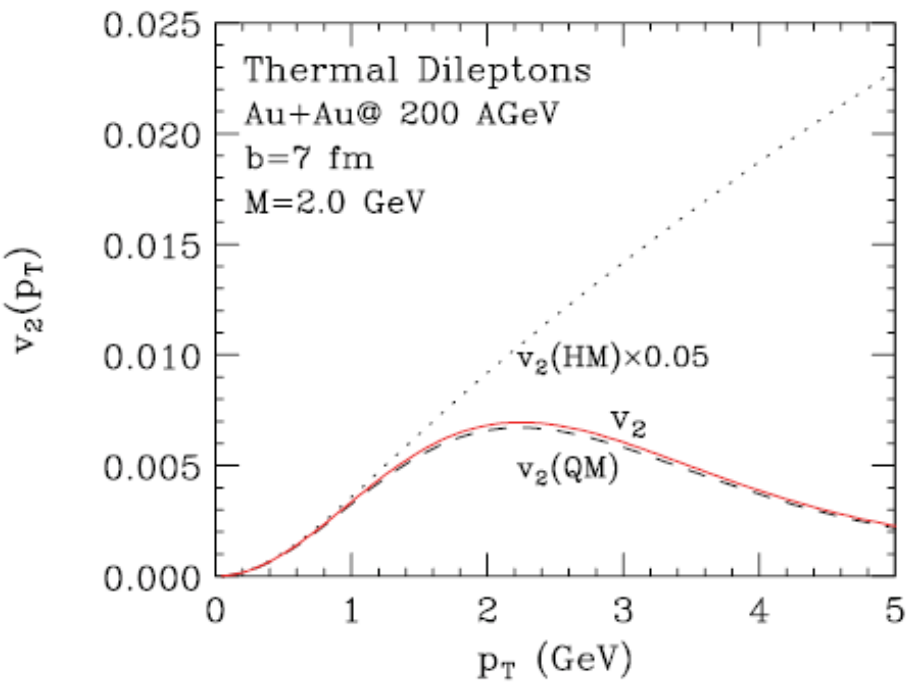
R. Rapp, et al .,*Phys.Rev. C63 (2001) 054907.*

Low mass region(M_{ll}<1.1GeV/c^2):
In-medium modifications of vector mesons.
Chiral symmetry restoration?

Intermediate mass region(1.1<M_{ll}<3.0GeV/c^2):
QGP thermal radiation.
Heavy flavor modifications.

Motivation



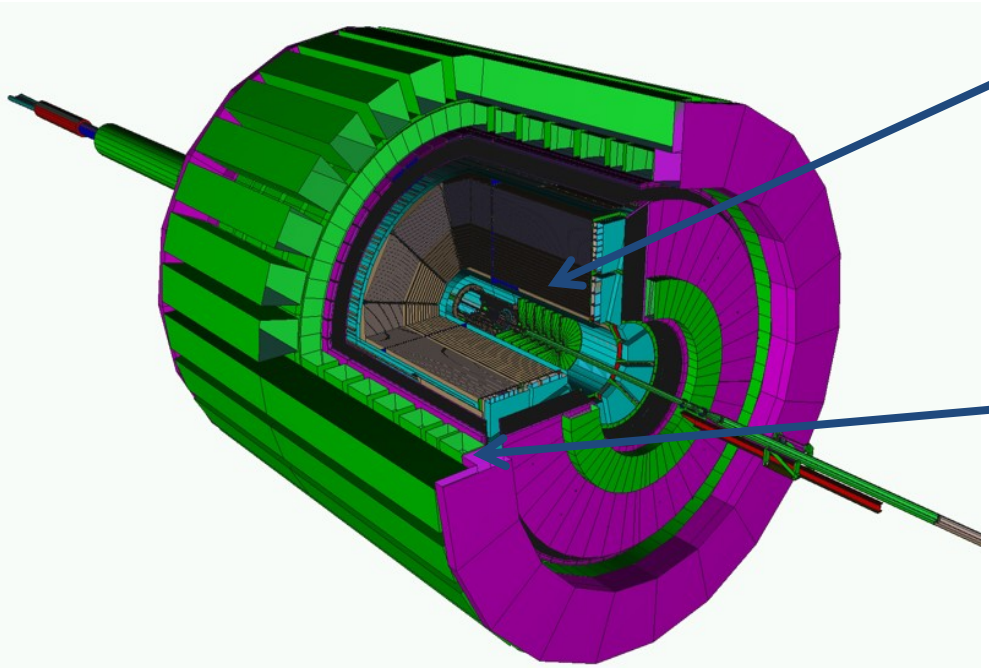


Rupa Chatterjee , et al., *Phys Rev C 75, 054909 (2007)*

The mass and p_T dependences of di-lepton v_2 could give a very rich information on specific stages of the fireball expansion

Measurements of v_2 of thermal di-lepton could distinguish partonic and hadronic radiation sources

STAR detector

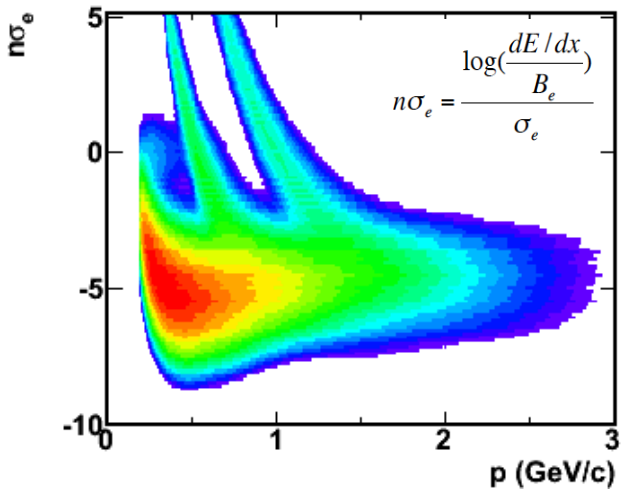


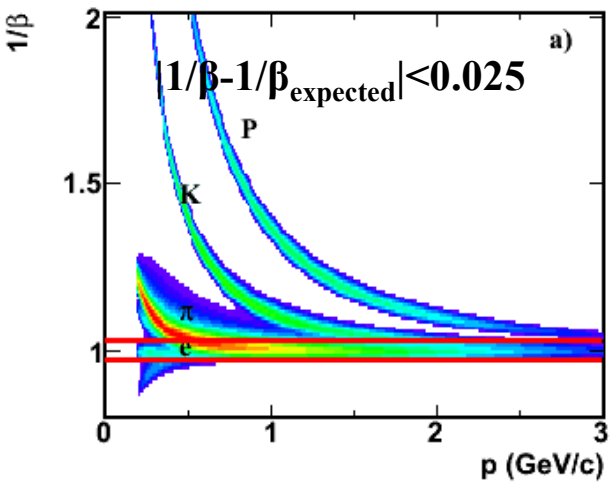
Tracking: TPC

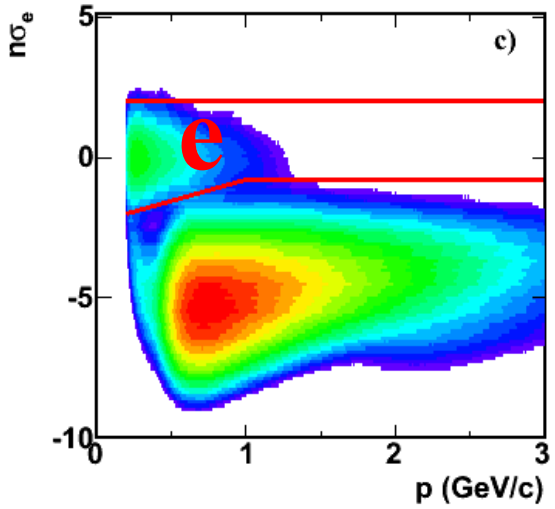
Time Projection Chamber
1. Tracking
2. Ionization energy loss (dE/dx PID):
3. Coverage $-1<\eta<1$, $0<\phi<2\pi$

Particle ID: TOF

Time Of Flight
1. Timing resolution (<100ps)
2. Coverage: $-0.9<\eta<0.9$, $0<\phi<2\pi$

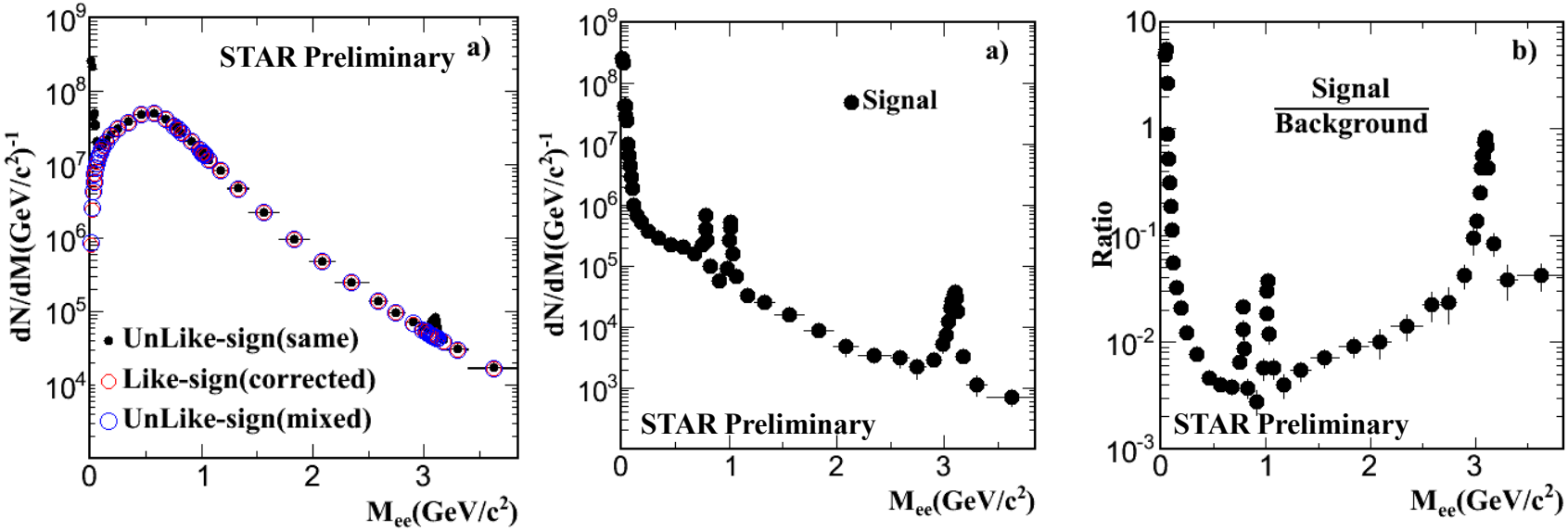






Invariant mass distribution

AuAu 0-80%@200GeV



M_{ee}<=0.7 GeV/c^2 :
Subtract the like-sign background
M_{ee}>0.7 GeV/c^2 :
Subtract the normalized mixed-event background (normalized to like-sign background at M_{ee}(0.7,3) GeV/c^2 and p_T(0,4)) GeV/c.

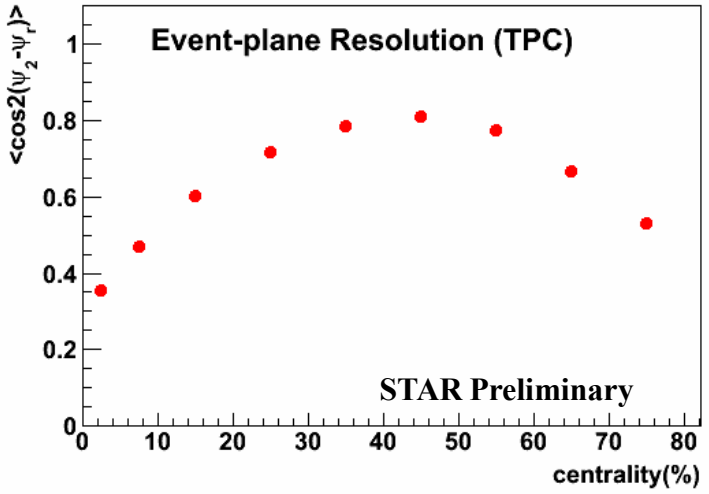
We mix events which are in the same centrality bin (9), vertex z bin (10) and event plane angle bin (100).

Event plane method

using TPC to reconstruct event plane:

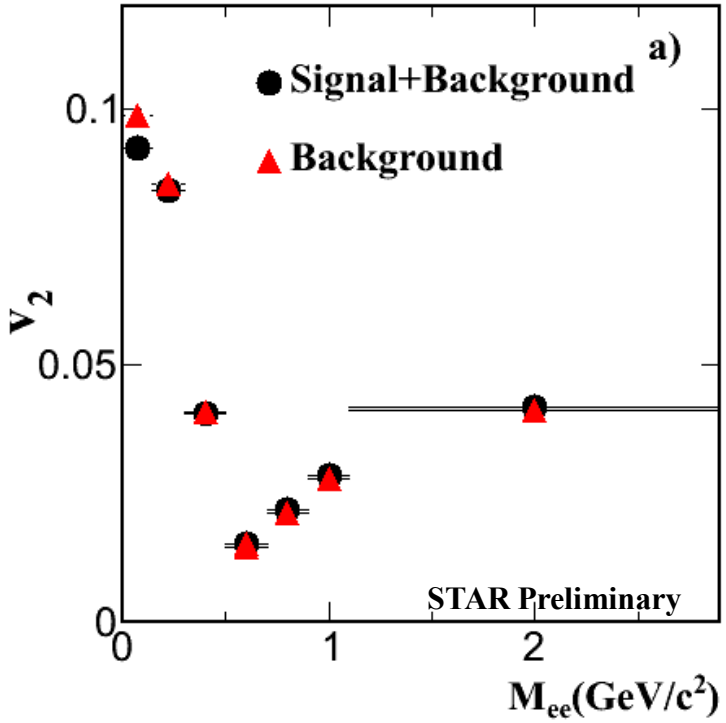
$$v_2^S \times \frac{N_S}{N_{(S+B)}} = v_2^T - v_2^B \times (1 - \frac{Ns}{N_{(S+B)}})$$

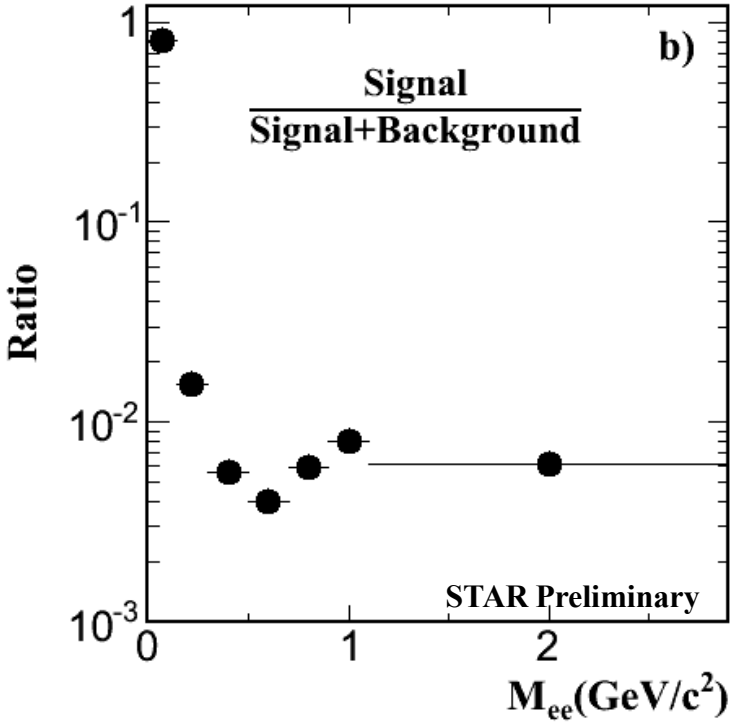
$$v_2 = < \cos(2(\phi_i - \psi_2)) / r_j >$$



v_2^T : *Signal + background* v_2,
v_2^B: *Background* v_2,
v_2^S: *Signal* v_2
$N_S/N_{(S+B)}$: *Signal/(Signal + background)*
r_j : *Resolution of event plane in centrality j*
<>: *average over all di-electron pairs in all events*

Unlike-sign and background v_2





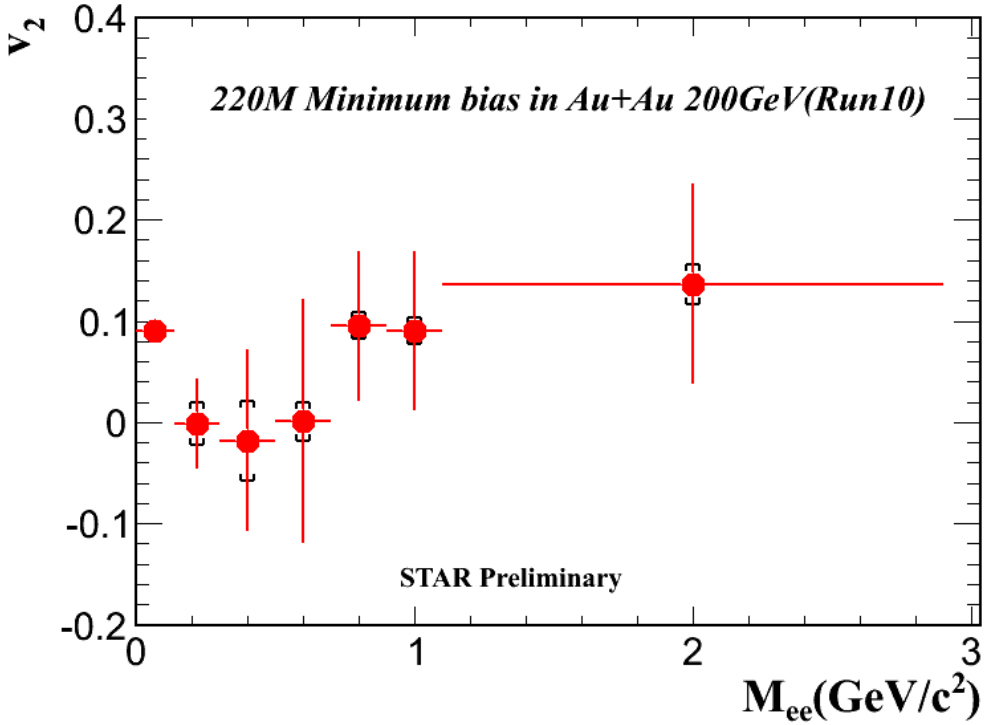
In each mass bin: $v_2^S \times \frac{N_S}{N_{(S+B)}} = v_2^T - v_2^B \times (1 - \frac{Ns}{N_{(S+B)}})$

Calculated the v_2^T, v_2^B *and* $N_S/N_{(S+B)}$ *, use above formula to get* v_2^S

Background: M_{ee}***<=0.7 GeV/c²: Like-sign same event,***

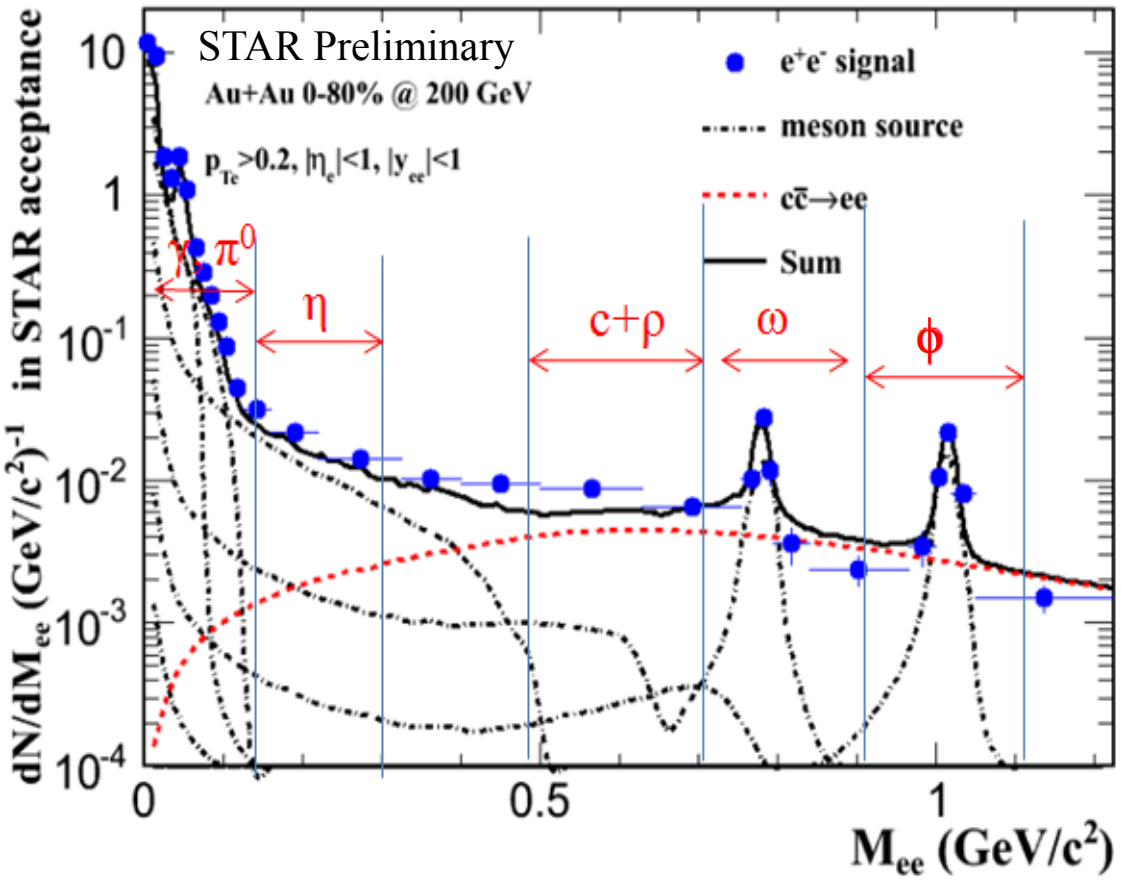
M_{ee}***>0.7 GeV/c² : Unlike-sign mixed-event***

M_{ee} dependence of v_2 at 200 GeV Au+Au



- ✓ ***The first measurement of di-electron elliptic flow at STAR***
- ✓ ***The systematic uncertainties include the track quality, PID selections***

Dominant particle contribution in different mass ranges



M_{ee}(0-0.14) : π^0+others

M_{ee}(0.14,0.3): η+others

M_{ee}(0.5,0.7) : charm+ρ+ others

M_{ee}(0.7,0.9): ω+others

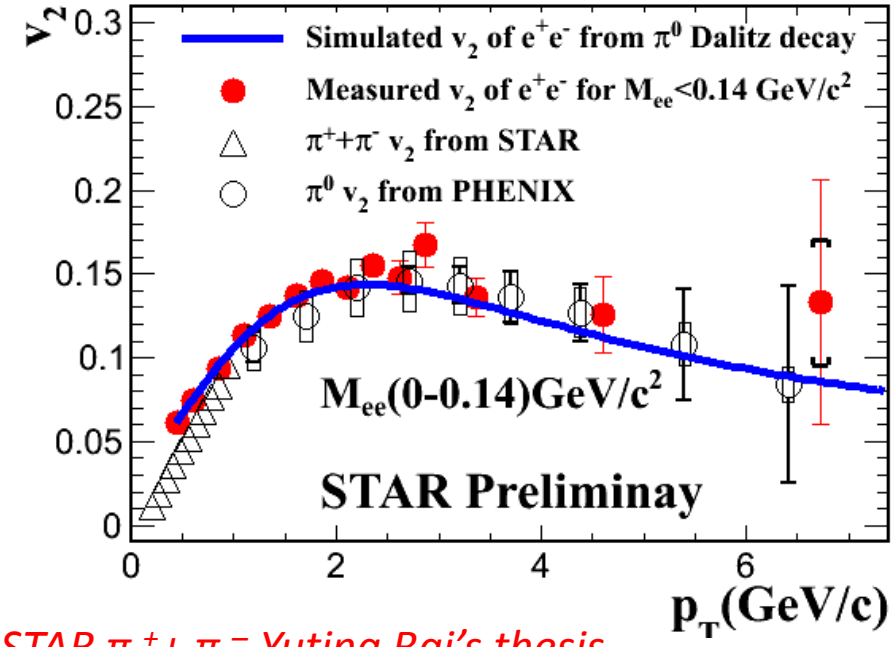
M_{ee}(0.9,1.1): ϕ+others

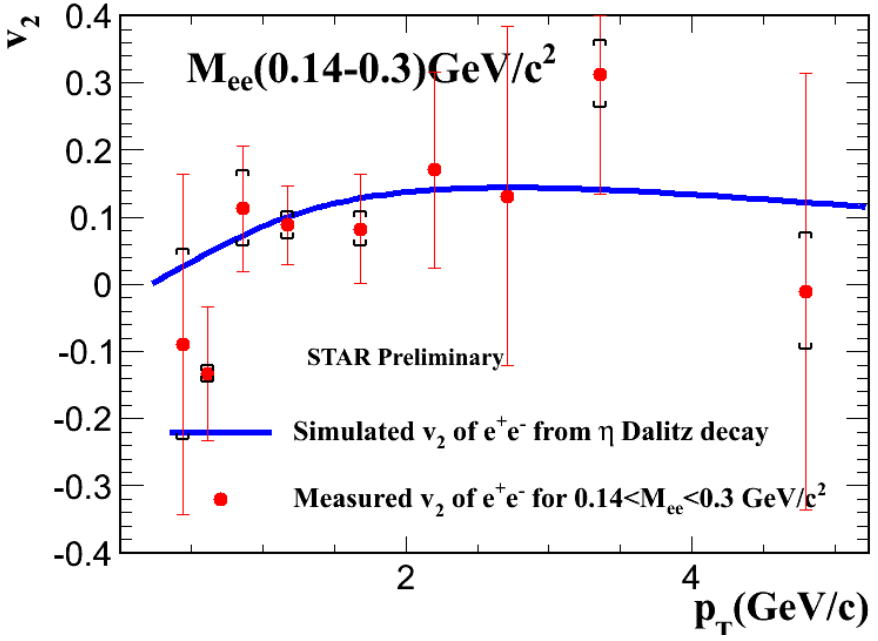
M_{ee}(1.1,2.9): charm+other

p_T dependence of di-electron v_2 in the π^0 and η Dalitz decay mass regions

PHENIX π^0 v_2 PHYSICAL REVIEW C 80, 054907 (2009)

AuAu 0-80%@200GeV





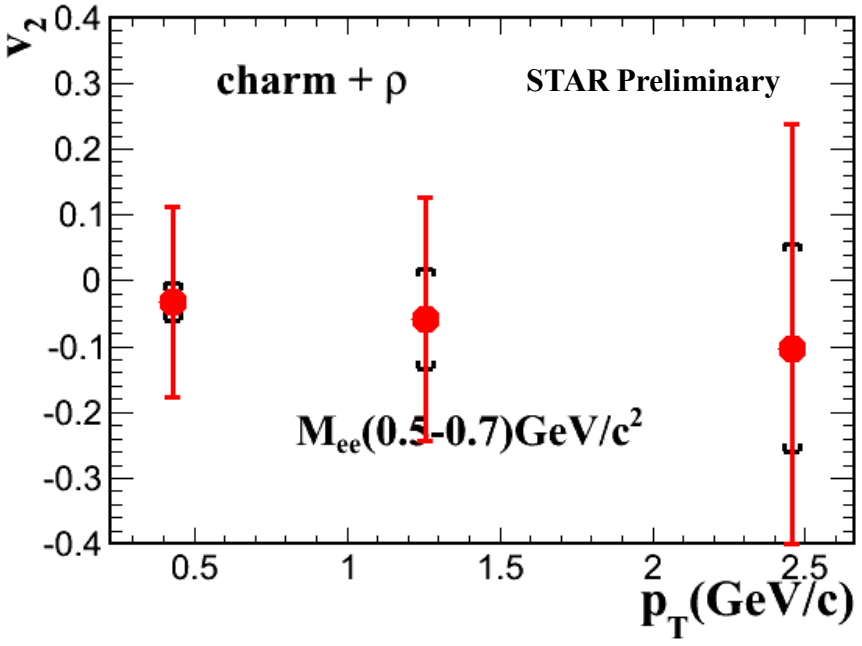
STAR $\pi^+ + \pi^-$ Yuting Bai's thesis

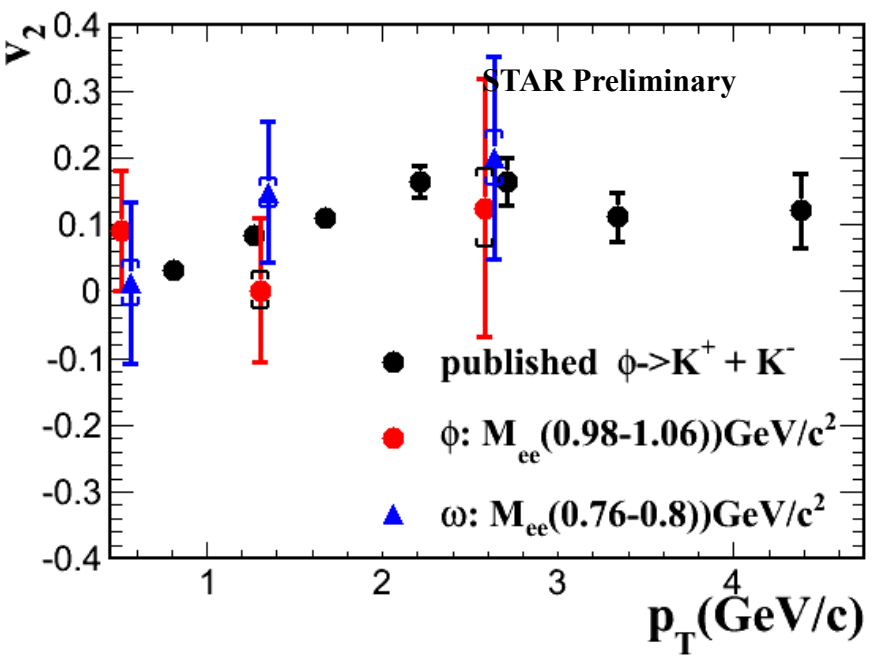
1. Parameterize π meson v_2 results
2. Do the Dalitz decay simulation and obtain expected v_2 of di-electrons from π^0 Dalitz decay.
3. The simulated di-electron v_2 results from π^0 Dalitz decay are consistent with the measured v_2 results

1.Assume η v_2 same as Ks v_2,
2.Do the Dalitz decay simulation and obtain expected v_2 of di-electrons from η Dalitz decay.
3. The simulated v_2 of e^+e^- are consistent with the measured v_2

p_T dependence of di-electron v_2 at $0.5<M_{ee}<1.1$ GeV/c^2

AuAu 0-80%@200GeV



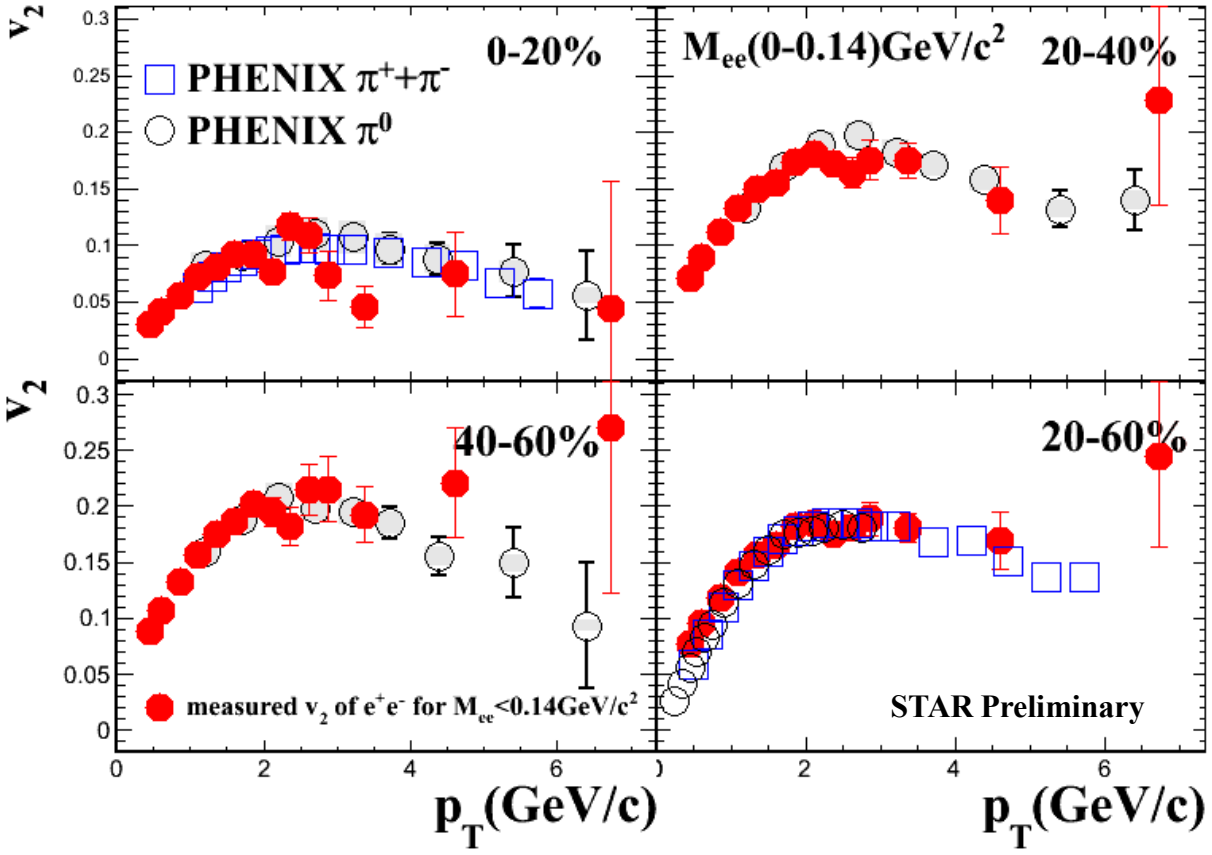


ϕ→KK, Phys. Rev. Lett. 99, 112301 (2007)

✓ ***The v_2 of di-electrons in the ϕ mass region is consistent with the results of ϕ→KK within large errors***

Centrality dependence of di-electron v_2 at M_{ee}<0.14 GeV/c^2

PHENIX $\pi^+ + \pi^-$ http://arxiv.org/abs/1203.2644v1



In future, we will parameterize π v_2, do Dalitz decay simulation and compare to our data

Summary:

- *Report preliminary results of mass and p_T dependence of di-electron v_2 in Au+Au 200GeV.*
- *The simulated v_2 results of e^+e^- from π^0, η Dalitz decays are consistent with the measured di-electron v_2 in the π^0 and η Dalitz decay mass regions.*
- *The di-electron v_2 in the ϕ mass range is consistent with results of $\phi \rightarrow KK$.*

Outlook:

- *A factor of two more minimum bias data from year 2011 200GeV Au+Au collisions*

backup

Comparison for simulated and measured results