Measurements of π^0 elliptic flow in Cu+Au collisions

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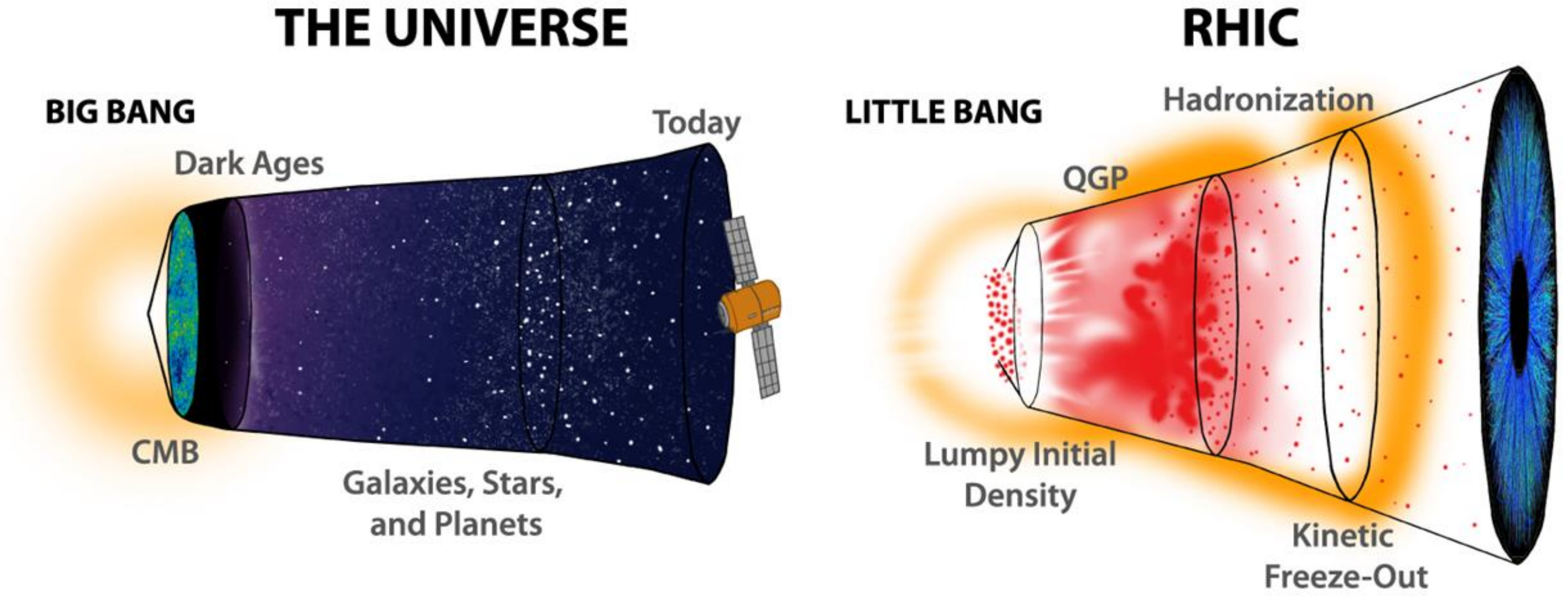
Quark-gluon plasma (QGP)



*Agnes Mocsy(Pratt Inst. and Frankfurt U., FIAS), Paul Sorensen(Brookhaven) (Aug, 2010)

The observables are used to investigate QGP's properties.

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Azimuthal anisotropy

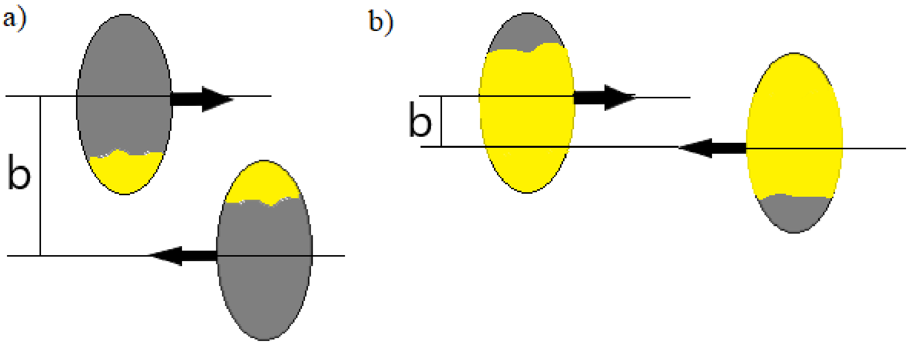
Collision geometry

Centrality:

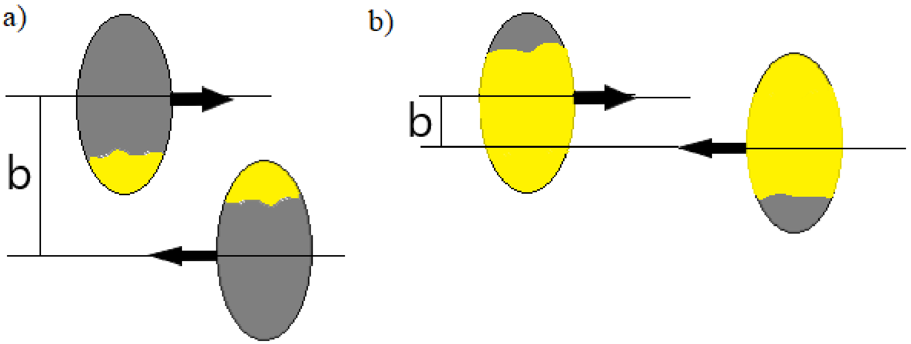
a) Central collisions;
b) Peripheral collisions.

b – impact parameter.

● Participant-nucleons
● Spectator-nucleons



Collision geometry



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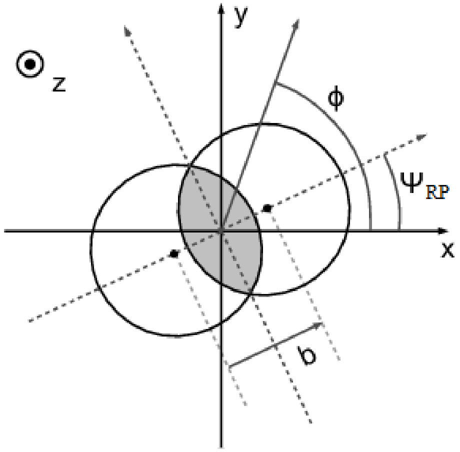
ϕ – azimuthal angle of particle,

z – beam direction,

Ψ_{RP} – azimuth of the reaction plane.



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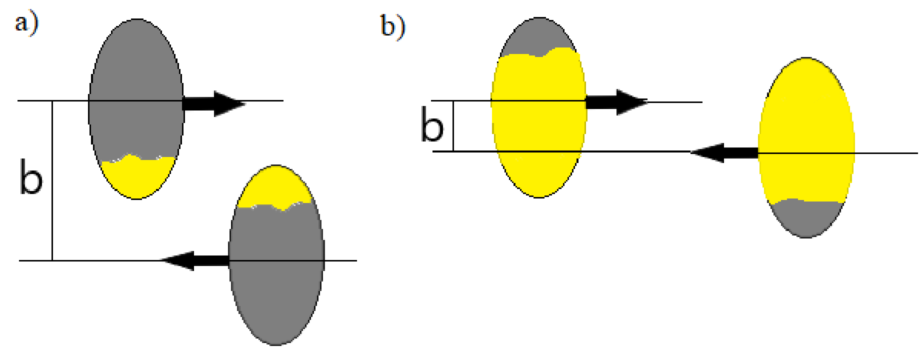

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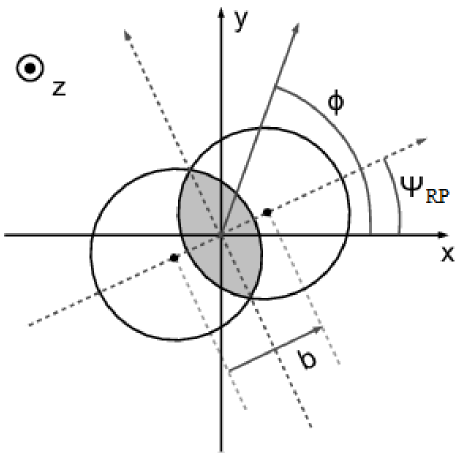

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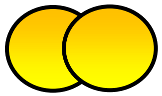
Collision system:

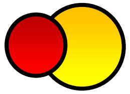
a) Symmetric collisions;

Au+Au

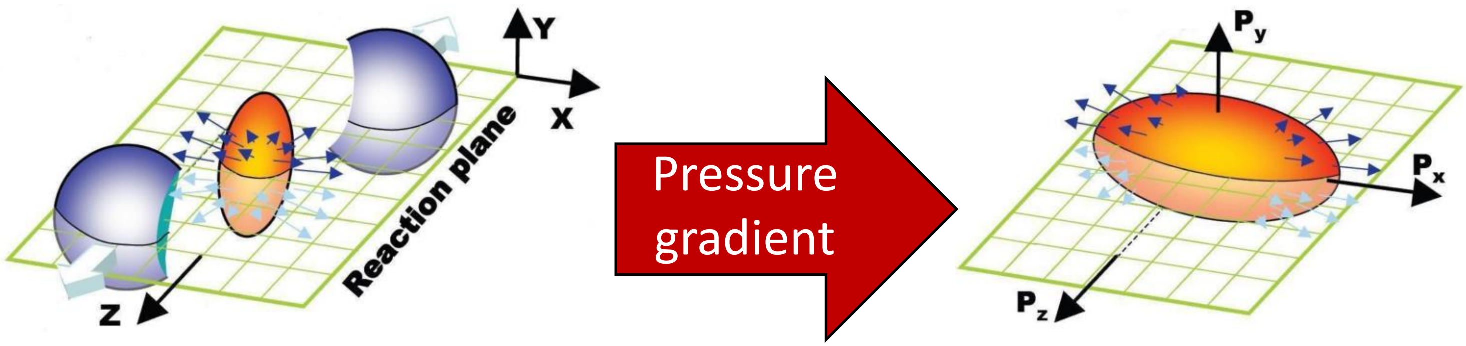


b) Asymmetric collisions.

Cu+Au



Azimuthal anisotropy



Spatial anisotropy

Momentum anisotropy

Elliptic flow (v_2)

$$v_2 = \left\langle \frac{p_x^2 - p_y^2}{p_x^2 + p_y^2} \right\rangle$$

$$f(\varphi, p_T) \propto 1 + 2\sum_{n=1}^{\infty} v_n(p_T)\cos(n(\varphi - \Psi_{RP}))$$

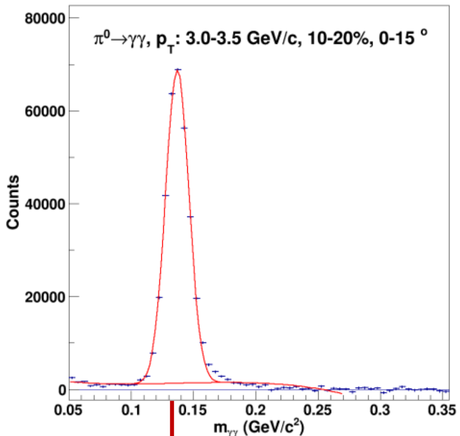
$n = 2$

$$v_2 = \langle cos(2(\varphi - \Psi_{RP}))\rangle$$

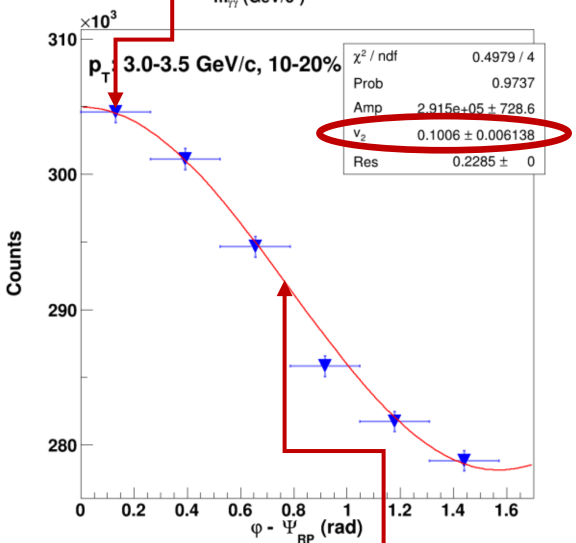
$v_2 > 0$ => the yields of emitted particles dominate along p_x (in the direction transverse to the reaction plane)

Measurement methods of v_2

«Subtraction method»:

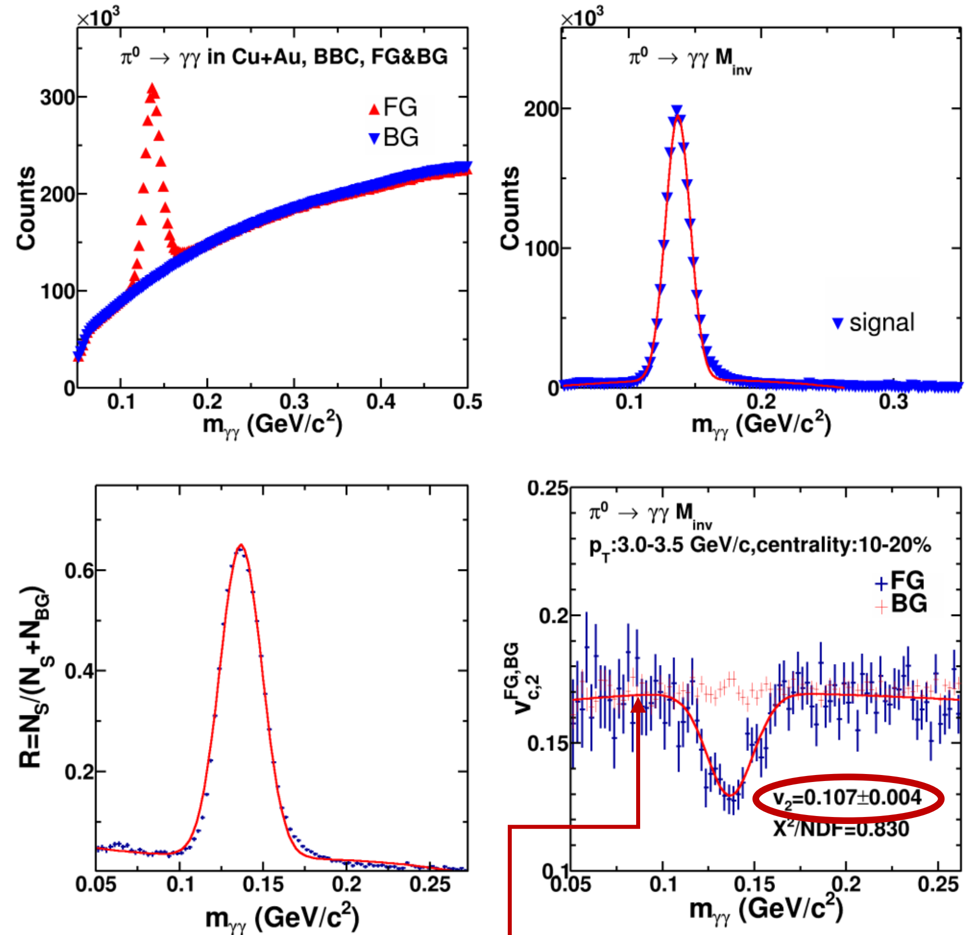


The yields of $\gamma\gamma$ $(dN/(\varphi - \Psi))$ in 6 ranges:
$0 < \varphi - \Psi_{RP} < \pi/2$



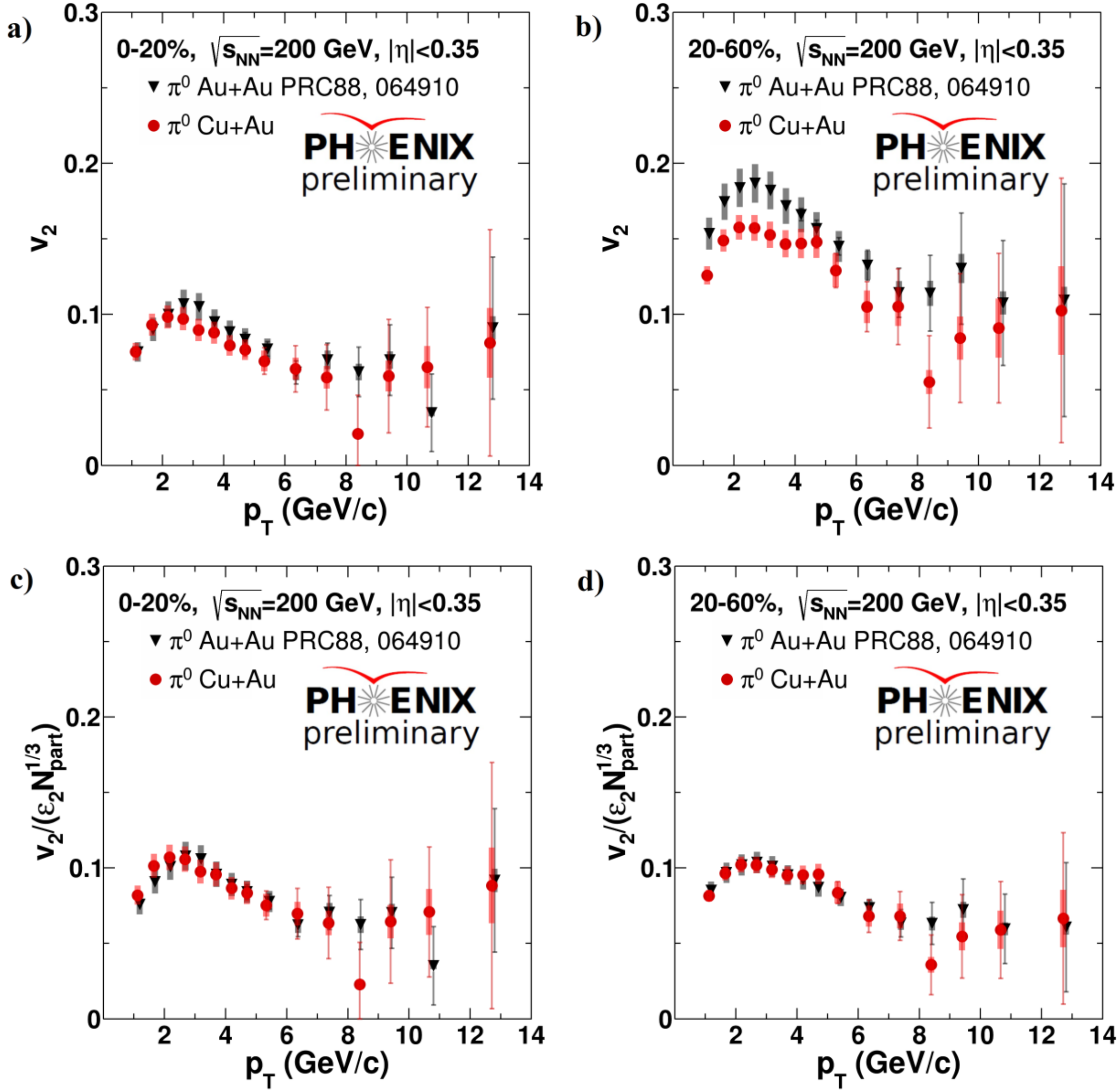
$$dN/(\varphi - \Psi) = N(1 + 2v_2 \cos[2(\varphi - \Psi)])$$

«Invariant mass fit method»:



$$v_2^{\text{pair}}(\mathrm{M_{inv}}) = v_2^{\text{signal}} N_{\text{signal}}/N_{\text{pair}}(\mathrm{M_{inv}}) + v_2^{\text{BG}}(1 - R(\mathrm{M_{inv}}))$$

Results


a)
0-20%, $\sqrt{s_{NN}}$=200 GeV, |η|<0.35
π^0 Au+Au PRC88, 064910
π^0 Cu+Au
PHENIX preliminary
v_2
p_T (GeV/c)
b)
20-60%, $\sqrt{s_{NN}}$=200 GeV, |η|<0.35
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$v_2/(\varepsilon_2 N_{part}^{1/3})$
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d)
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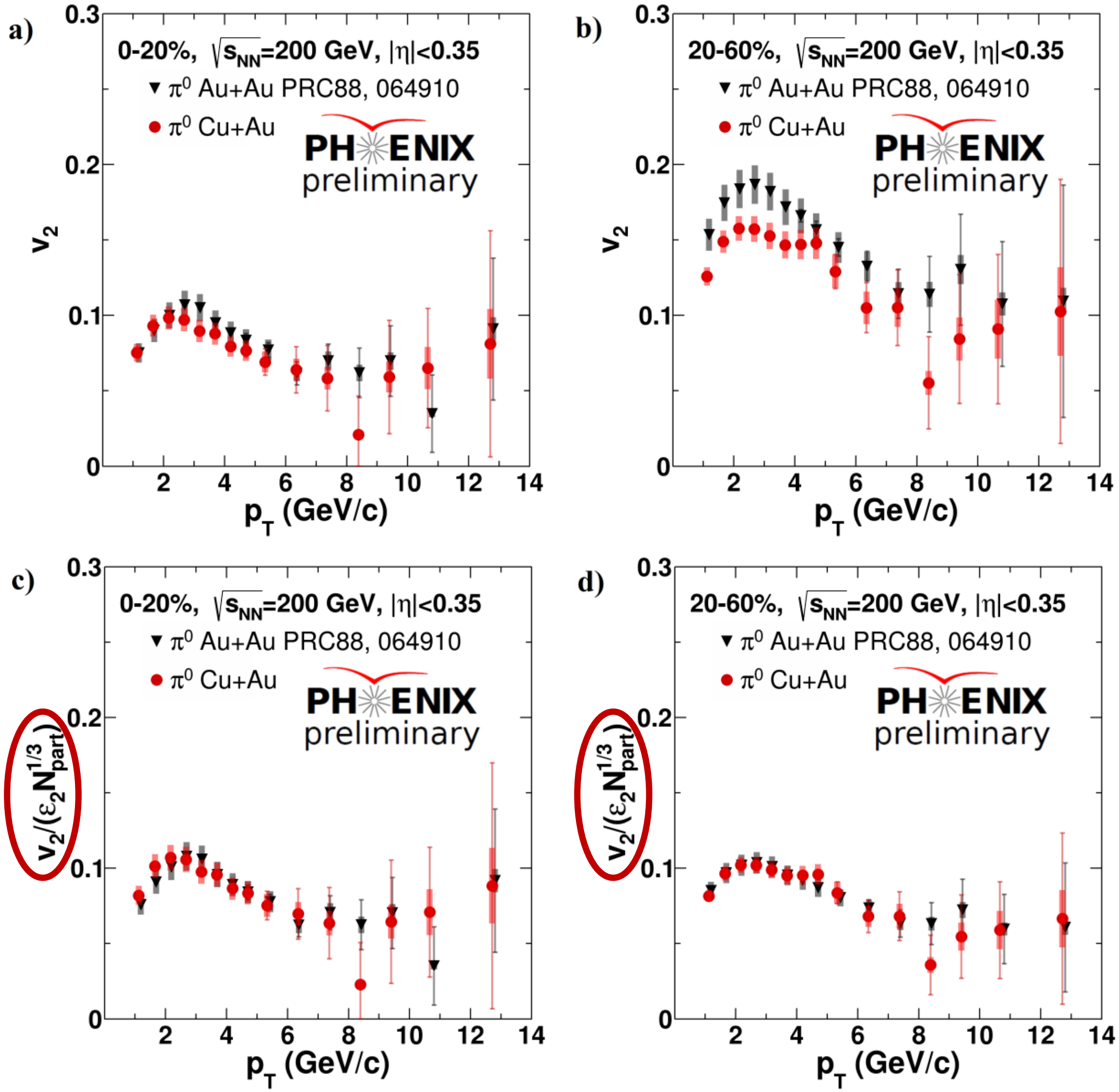
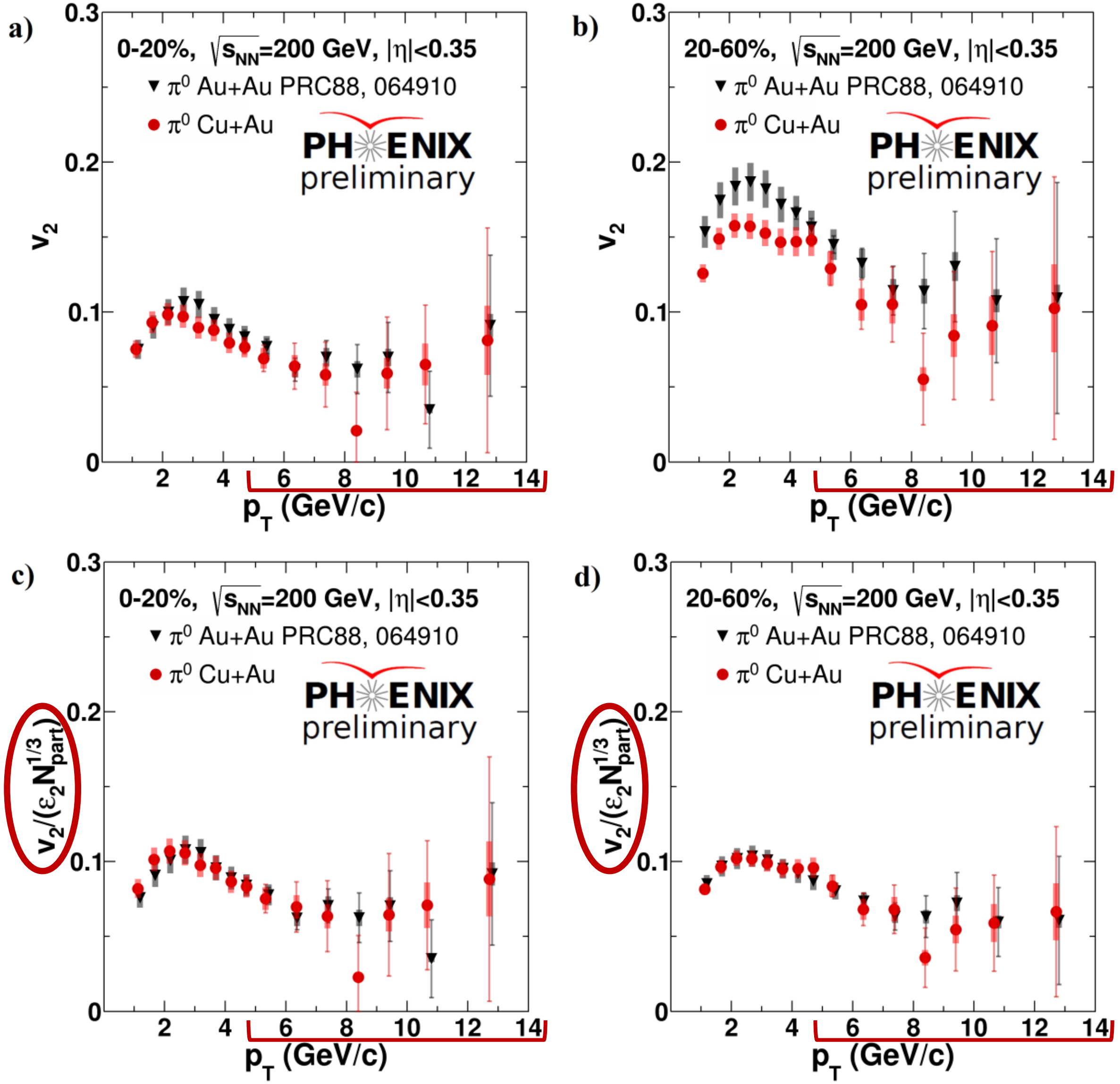


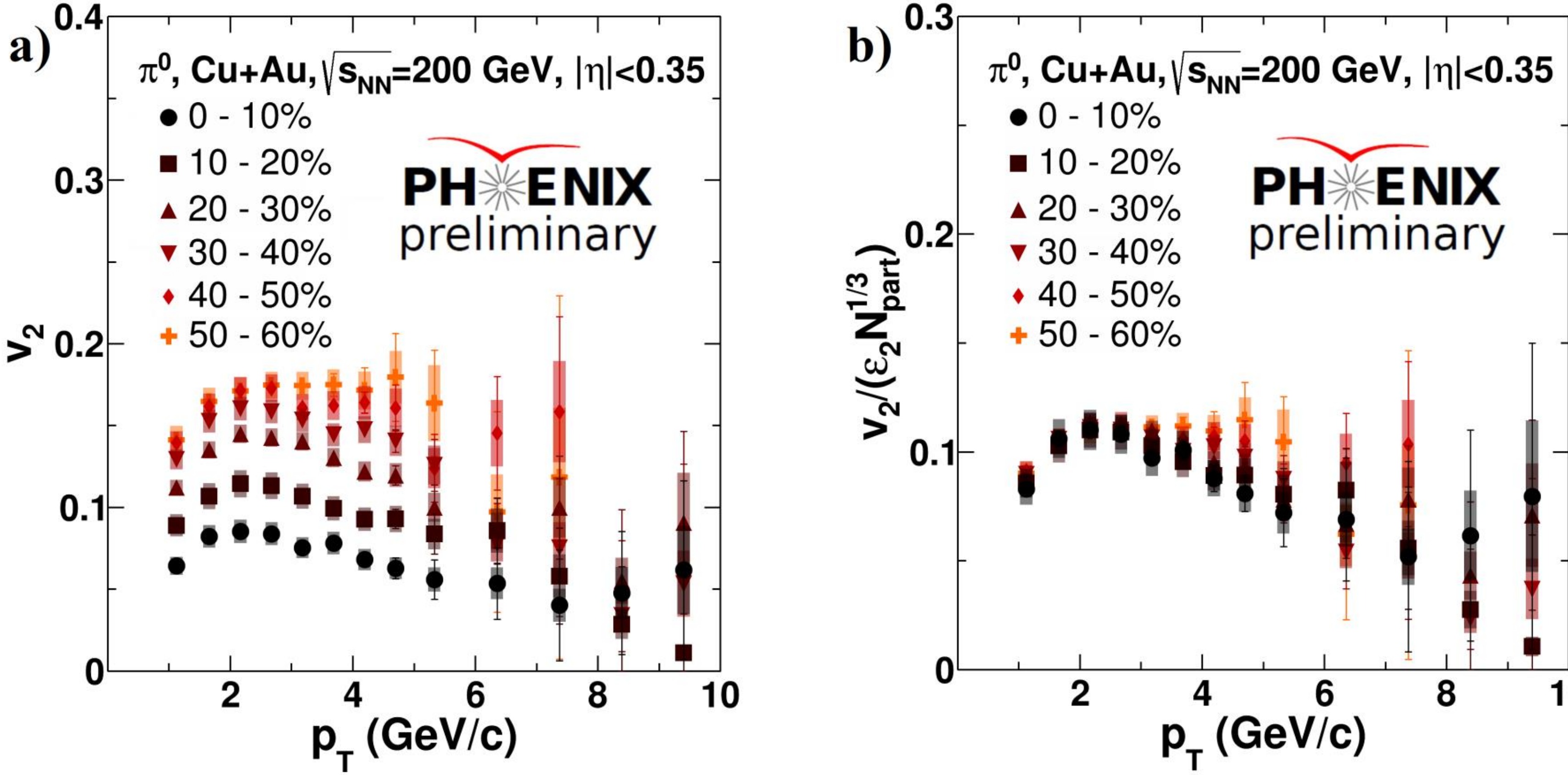
The $v_2/\varepsilon_2 N_{part}^{1/3}$ values are consistent within the uncertainties in Cu+Au and Au+Au collisions

Results



- The $v_2/\varepsilon_2 N_{part}^{1/3}$ values are consistent within the uncertainties in Cu+Au and Au+Au collisions
- The elliptic flow values are nonzero at $p_T > 5\ GeV/c$

Results



a)
b)
π^0, Cu+Au, $\sqrt{s_{NN}}$=200 GeV, |η|<0.35
0 - 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50%
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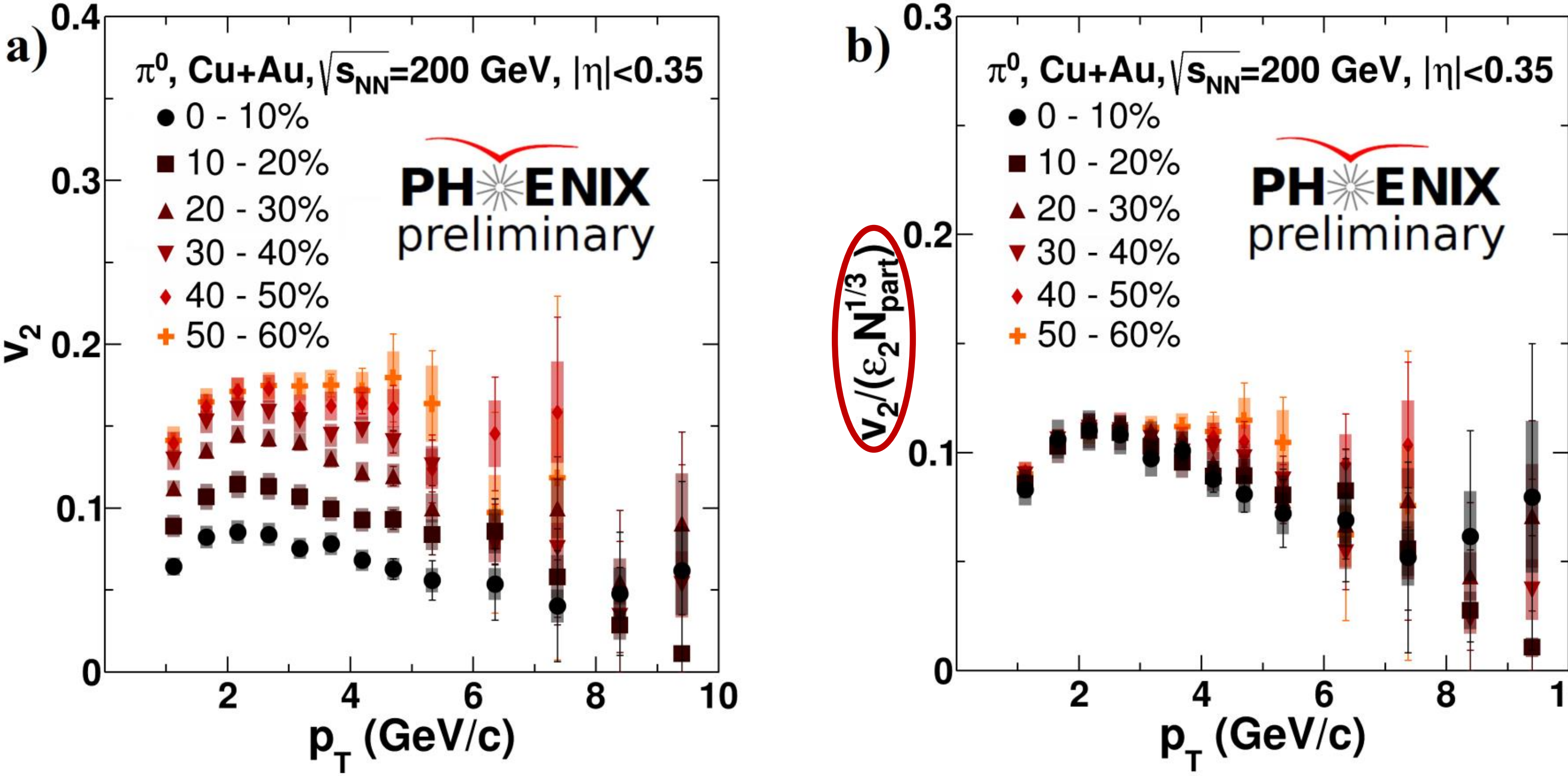
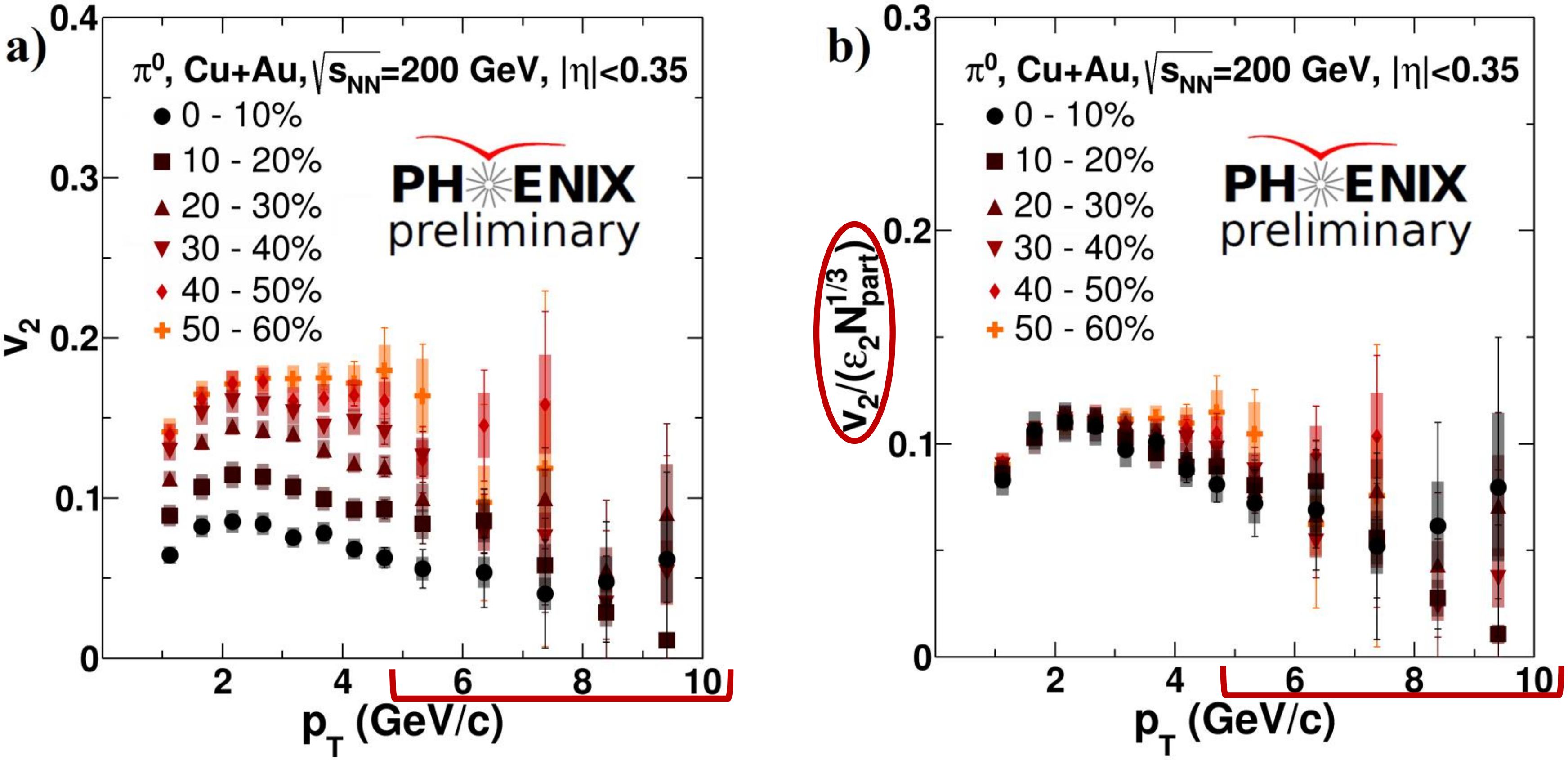
Results



The $v_2/\varepsilon_2 N_{part}^{1/3}$ values are consistent within the uncertainties for all centrality classes in Cu+Au collisions

Results



- The $v_2/\varepsilon_2 N_{part}^{1/3}$ values are consistent within the uncertainties for all centrality classes in Cu+Au collisions
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Conclusions

- The π^0 elliptic flow values in Cu+Au collision system at 200 GeV were obtained;
- It was found that the $v_2/\varepsilon_2 N_{part}^{1/3}$ values for π^0 are consistent within the uncertainties in Cu+Au and Au+Au collisions and in all centrality classes => **the size and geometry of the collision system does not seem to affect the $v_2/\varepsilon_2 N_{part}^{1/3}$ values for π^0**;
- Obtained v_2 values for π^0 are nonzero at high transverse momentum ($p_T > 5\ GeV/c$). It could be explained in terms of **parton energy loss models**.

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- ✓ Obtained v_2 values for π^0 are nonzero at high transverse momentum ($p_T > 5\ GeV/c$). It could be explained in terms of **parton energy loss models**.

Thank you for your attention!