$\pi^0 v_2$ analysis in $\sqrt{s_{NN}}$ = 200GeV Au+Au collisions

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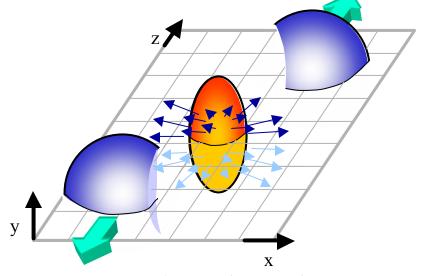
for the PHENIX Collaboration

RIKEN-BNI Research Center

Why Event Anisotropy?

- Because of sensitive to collision geometry
 - At low p_T (<2 GeV/c)
 - Pressure gradient of early stage
 - Hydrodynamical picture is established
 - At high p_T (>2 GeV/c)
 - Energy loss in dense medium (Jet Quenching)
 - Partonic flow(?)

Here we focus on ellipticity of azimuthal momentum distribution, v₂ (second Fourier coefficient) as physics message

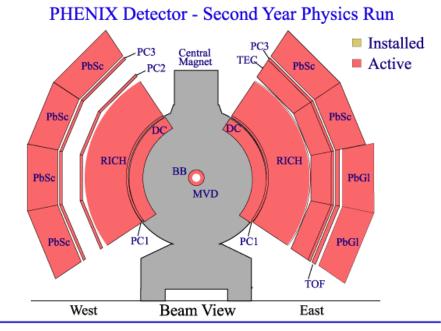


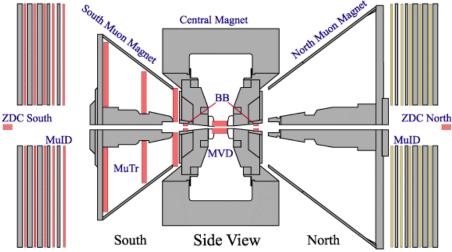
PHENIX experiment

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- Lead Scintillator and Lead Glass EMCs
 - Gamma measurement $(\pi^0 \rightarrow \gamma \gamma)$
- BBCs and ZDCs
 - Collision centrality determination
- BBCs
 - Reaction plane determination and
 - Its resolution correction







Method of $\pi^0 v_2$ Measurement

- Define reaction plane by charged multiplicity on Beam-Beam Counters
- π^0 reconstruction from Electro-Magnetic Calorimeter (EMC)
 - For each p_T , azimuthal angle, centrality
- Combine both information
 - Counting number of π^0 as a function of

$$E\frac{dN^{3}}{d^{3}p} = \frac{1}{2\mathbf{p}} \frac{d^{2}N}{p_{T} dp_{T} dy} \left(1 + \sum_{n=1}^{\infty} 2 \frac{v_{n}^{measured}}{\sqrt{1 + \sum_{n=1}^{\infty} 2 \frac{v_$$

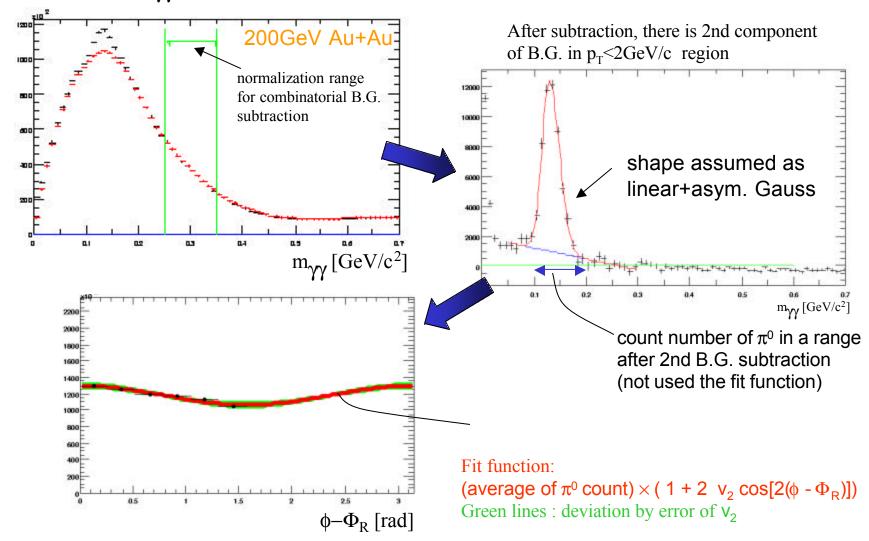
$$v_n^{\text{ real}} = v_n^{\text{ measured}/\text{ (reaction plane resolution)}_n$$

Note: the detail of reaction plane definition will be found in nuclex/0305013

Some example plots from an analysis procedure

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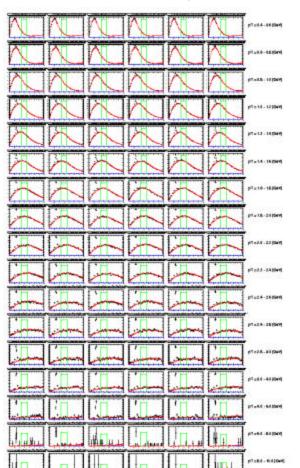
Invariant mass of γγ from same event and mixed event



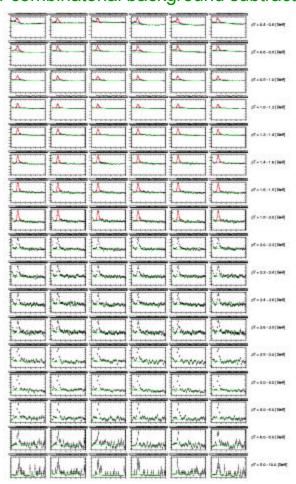
Tooooo many histograms checked

Example of invariant mass distributions for each p_T , ϕ - Φ_R in a centrality bin

Before combinatorial background subtraction

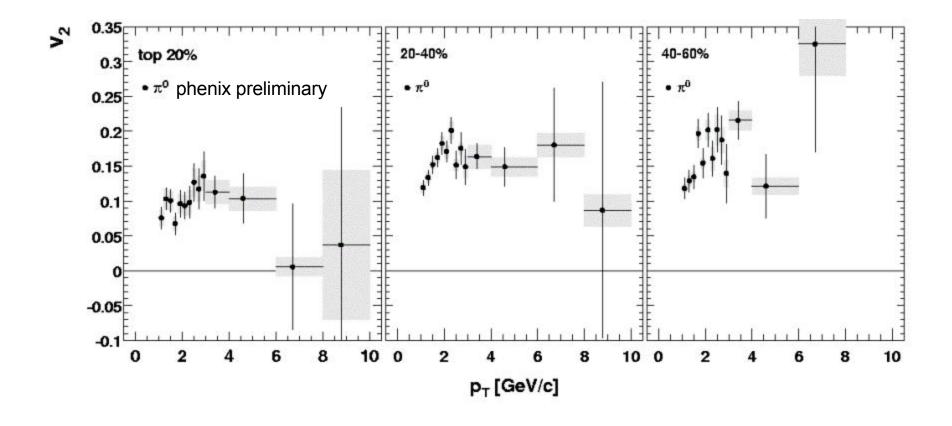


After combinatorial background subtraction



v₂ vs. p_T vs. Centrality from 200GeV Au+Au

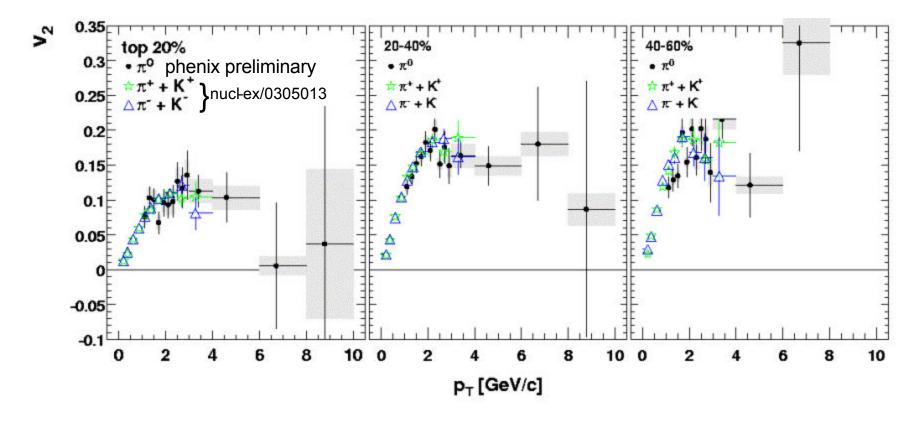
Statistical error is shown by error bar Systematic error from π^0 count method and reaction plane determination is shown by gray box



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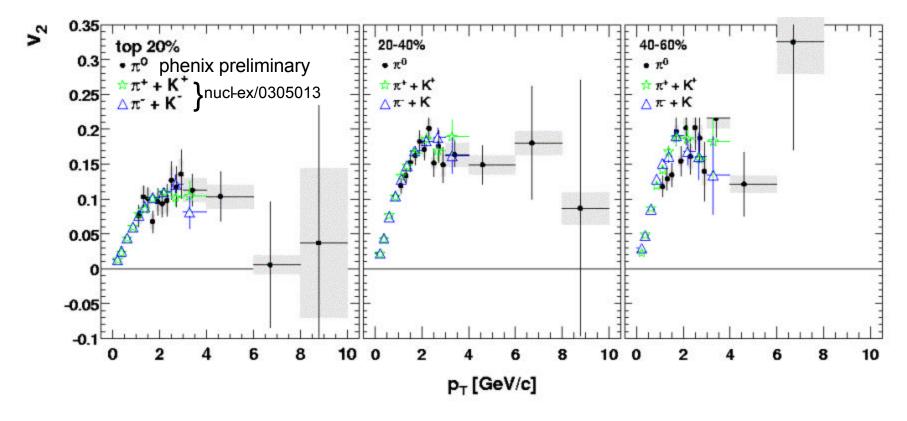
The charged π and K v_2 are shown only with statistical errors



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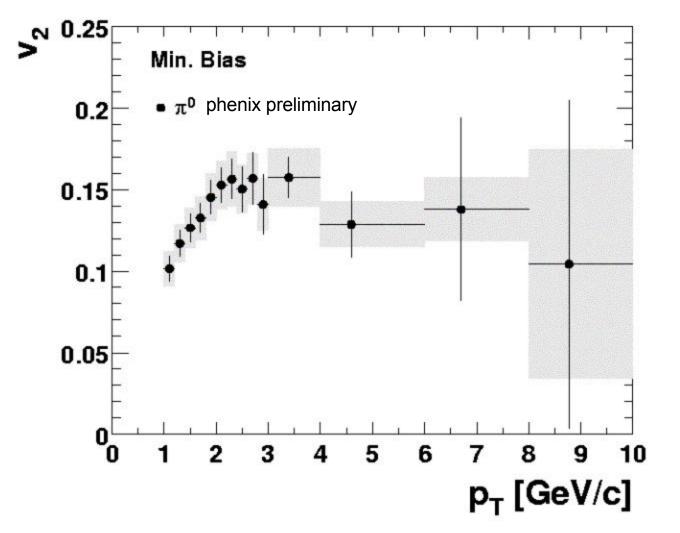
The charged π and K v_2 are shown only with statistical errors



• Charged $\pi + K v_2$ consistent with $\pi^0 v_2$ in $p_T < 4 GeV/c$

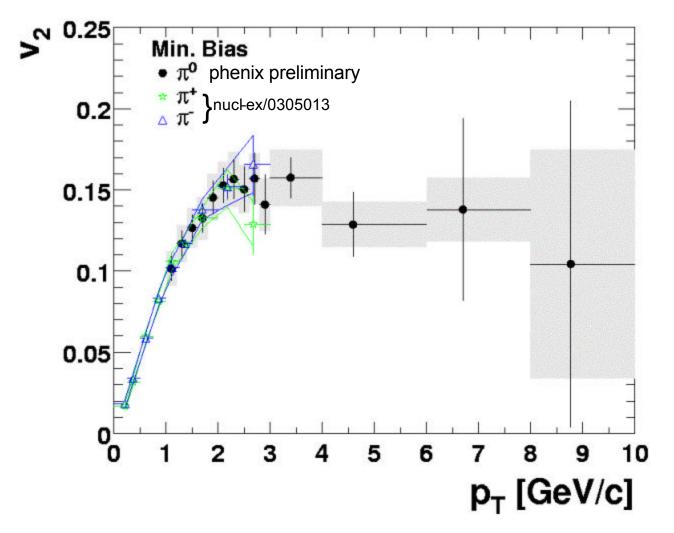
v₂ vs. p_T (Minimum Bias) from 200GeV Au+Au

• Identified particle v_2 up to $p_T=10$ GeV/c



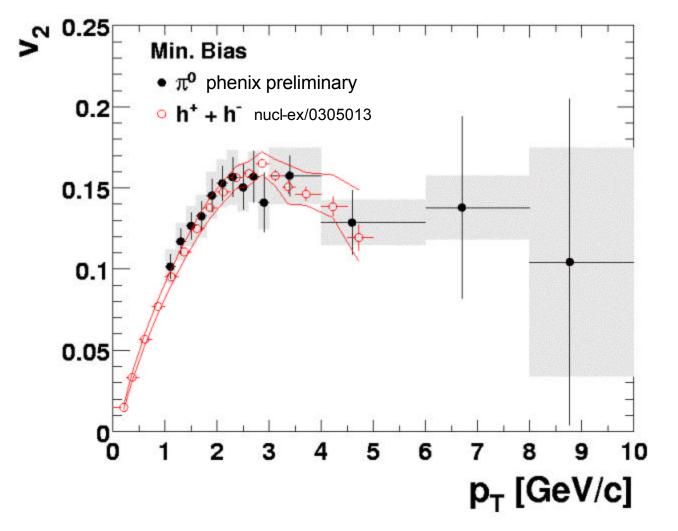
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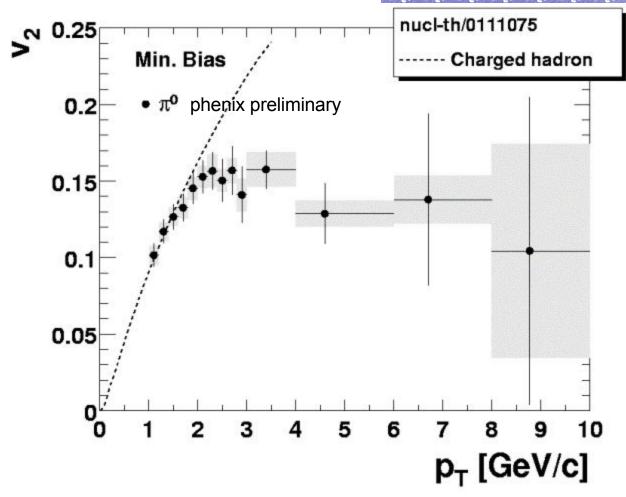


v₂ vs. p_⊤ (Minimum Bias) from 200GeV Au+Au

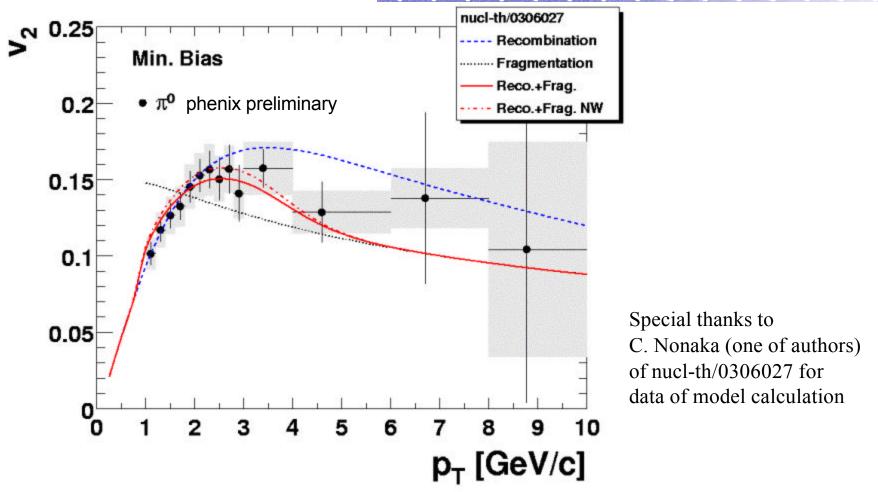
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Comparison with a model



Comparison with a model



Comparison with a model which is described in nucl-th/0306027. Here we don't want to discuss which model can describe the data. To conclude which model can describe the data, we need much more statistics in high p_T region.

Summary

- First measurement of π^0 v_2 at RHIC
 - In p_T =1-10 GeV/c
- Charged $\pi + K v_2$ consistent with $\pi^0 v_2$
 - In p_T =1-4GeV/c
- Minimum bias data shows finite π^0 v_2
 - Up to $p_T \sim 8 \text{ GeV/c}$
- RHIC run4 Au+Au, it will be
 - Much more statistics
 - Detail study of v_2 shape around p_T =2-4GeV/c
 - Much higher p_T
 - We want to know where is end of finite v_2 in very high p_T