


# *Pseudorapidity and $p_t$ dependence of identified-particle azimuthal flow for $\sqrt{s_{NN}}$ = 200 GeV Au+Au and Cu+Cu collisions*

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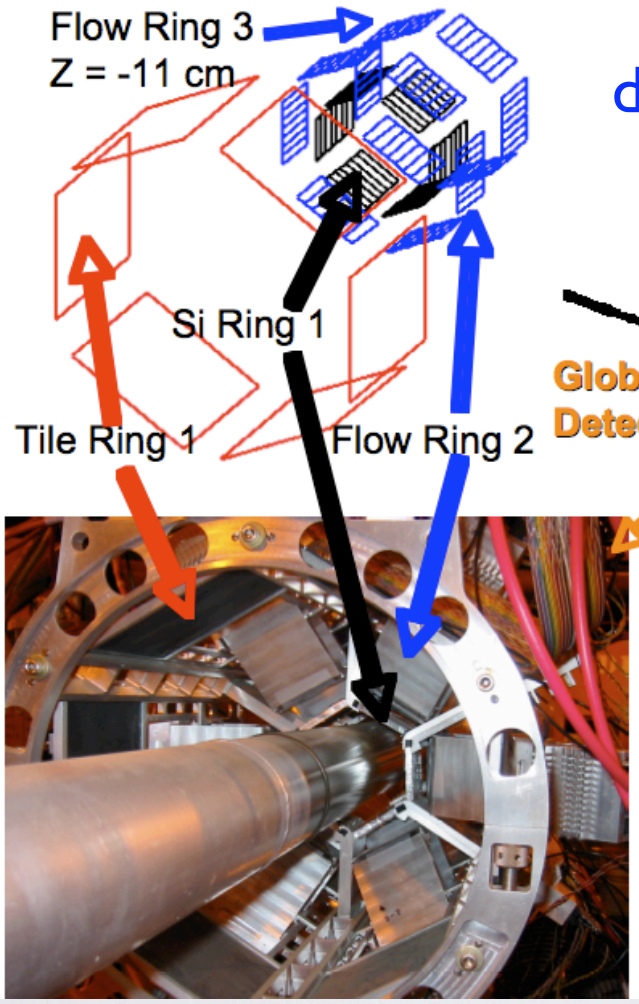
For the BRAHMS Collaboration

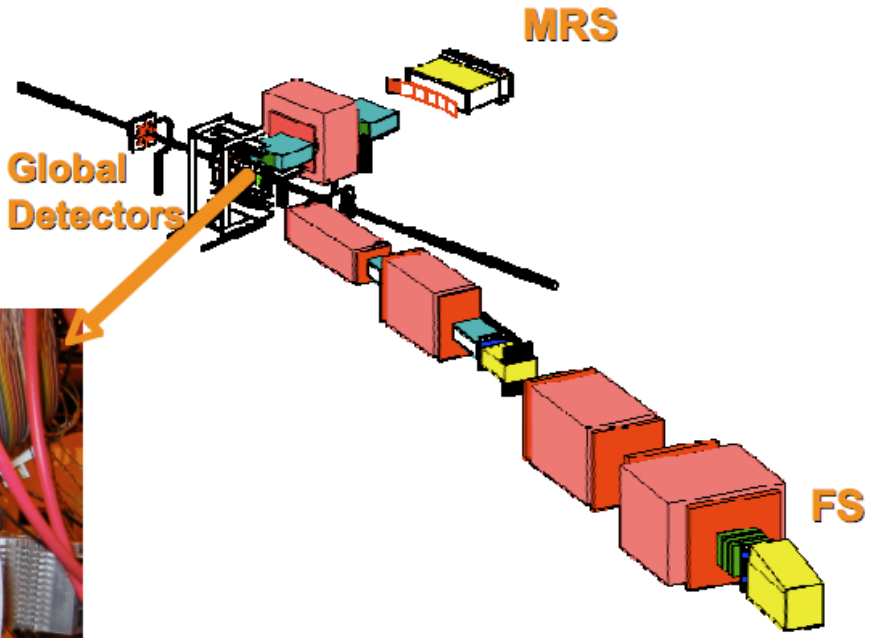
# ***Outline:***

- Motivation: What can BRAHMS data teach us about azimuthal flow in AuAu and CuCu collisions?
- Technique: Use of small acceptance spectrometers to establish particle-identified $v_2$ ($p_t$)
- Results

# Measuring Flow in BRAHMS




Reaction plane calculated for different global detector combinations




Identified particle $v_2$ deduced using spectrometer data, with global detectors

# $v_2$ Formalism:

- **The reaction plane:**

$$\Psi_2 = \frac{1}{2}\frac{\sum_i w_i sin(2\phi_i)}{\sum_i w_i cos(2\phi_i)}$$

- **Observed $v_2$ values (average over all events within a given range of transverse momenta):**

$$v_2^{obs} = \langle cos(2[\phi - \Psi_2]) \rangle$$

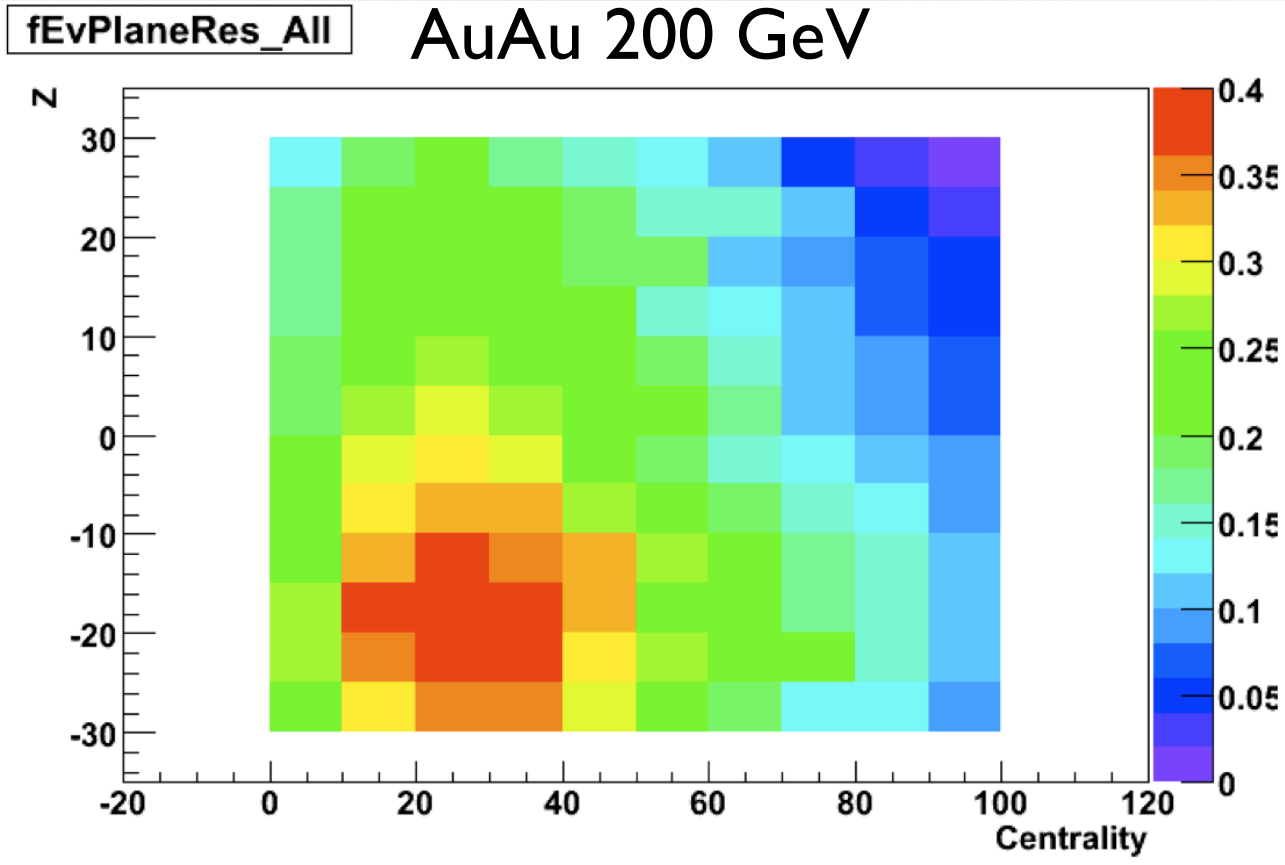
- **True $v_2$ value:**

$$v_2 = v_2^{obs}/R$$

- **Flattening(average over min. bias events for a given centrality bin):**

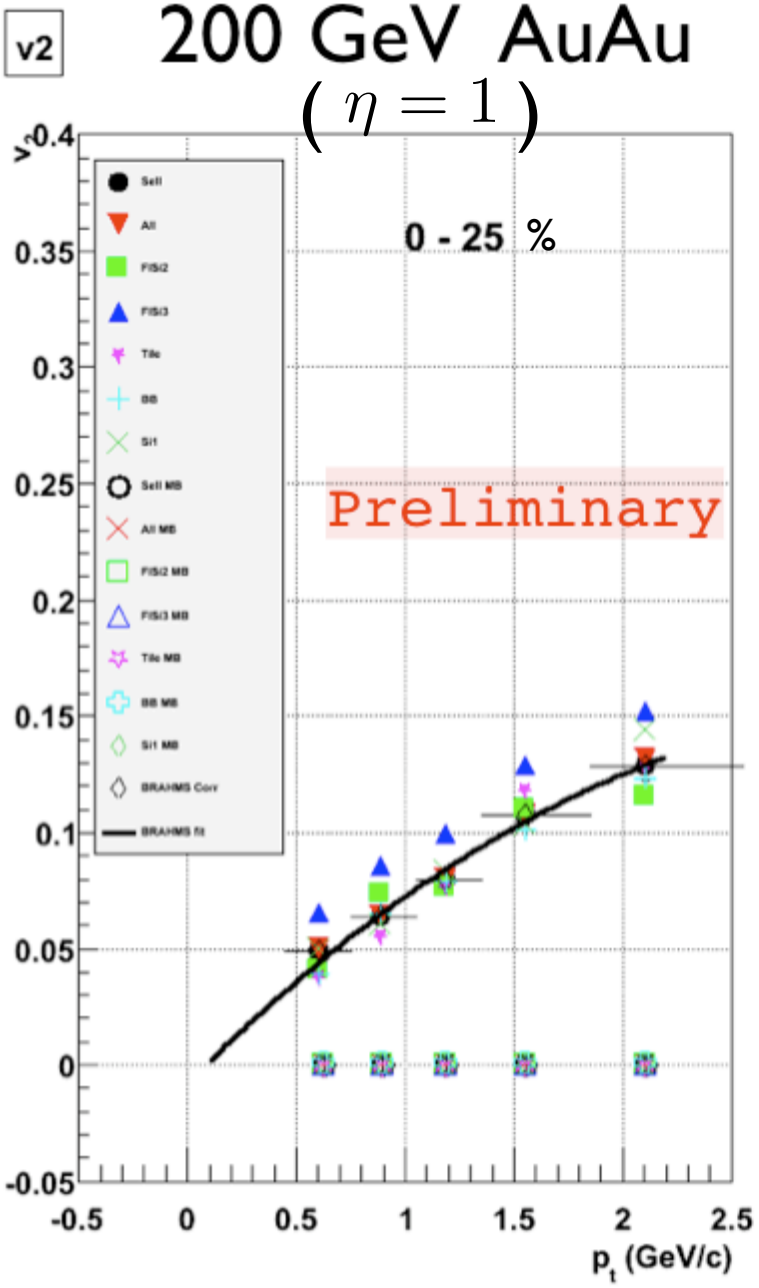
$$\Psi^{flat} = \Psi + \sum_n \frac{2}{n+1}\{\langle cos(|(n+1)\Psi|)\rangle sin[(n+1)\Psi] - \langle sin(|(n+1)\Psi|)\rangle cos[(n+1)\Psi]\}$$

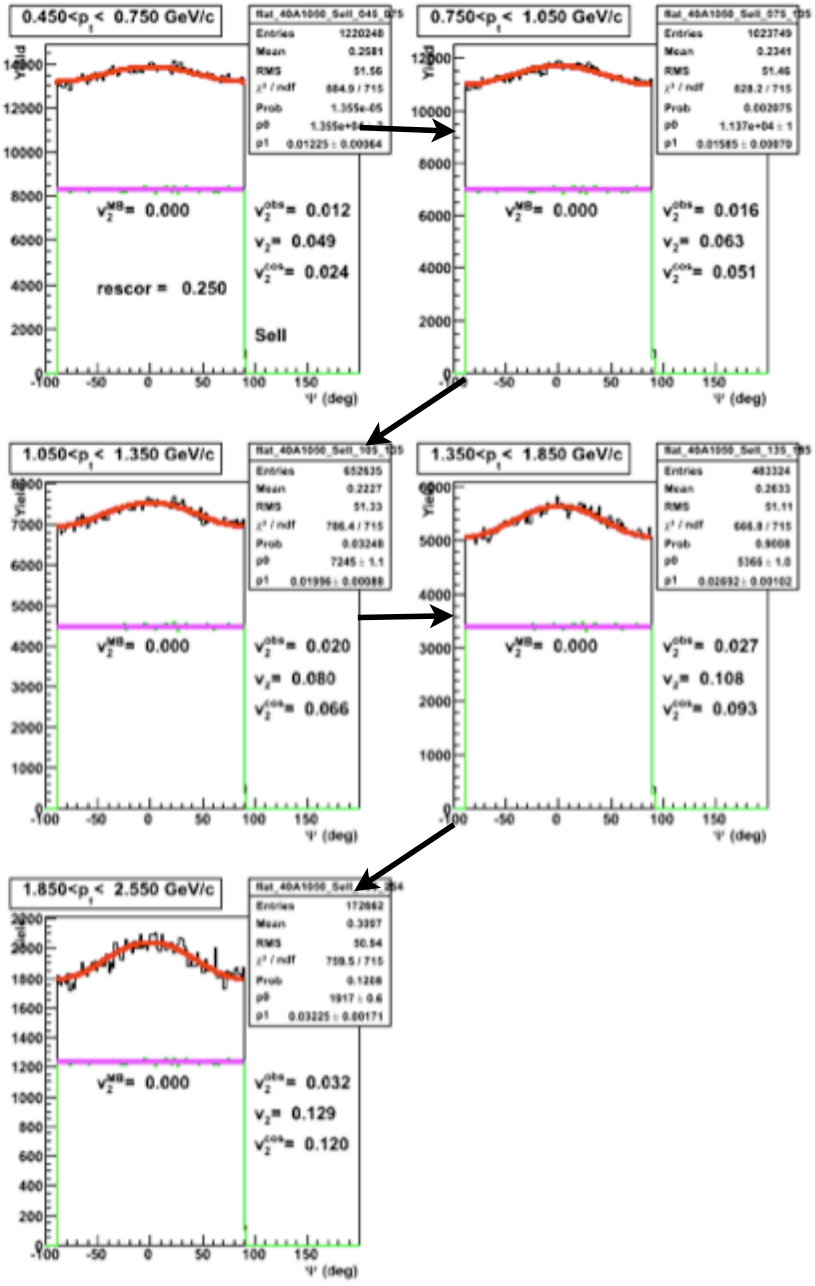
# *Event Plane Resolution:*



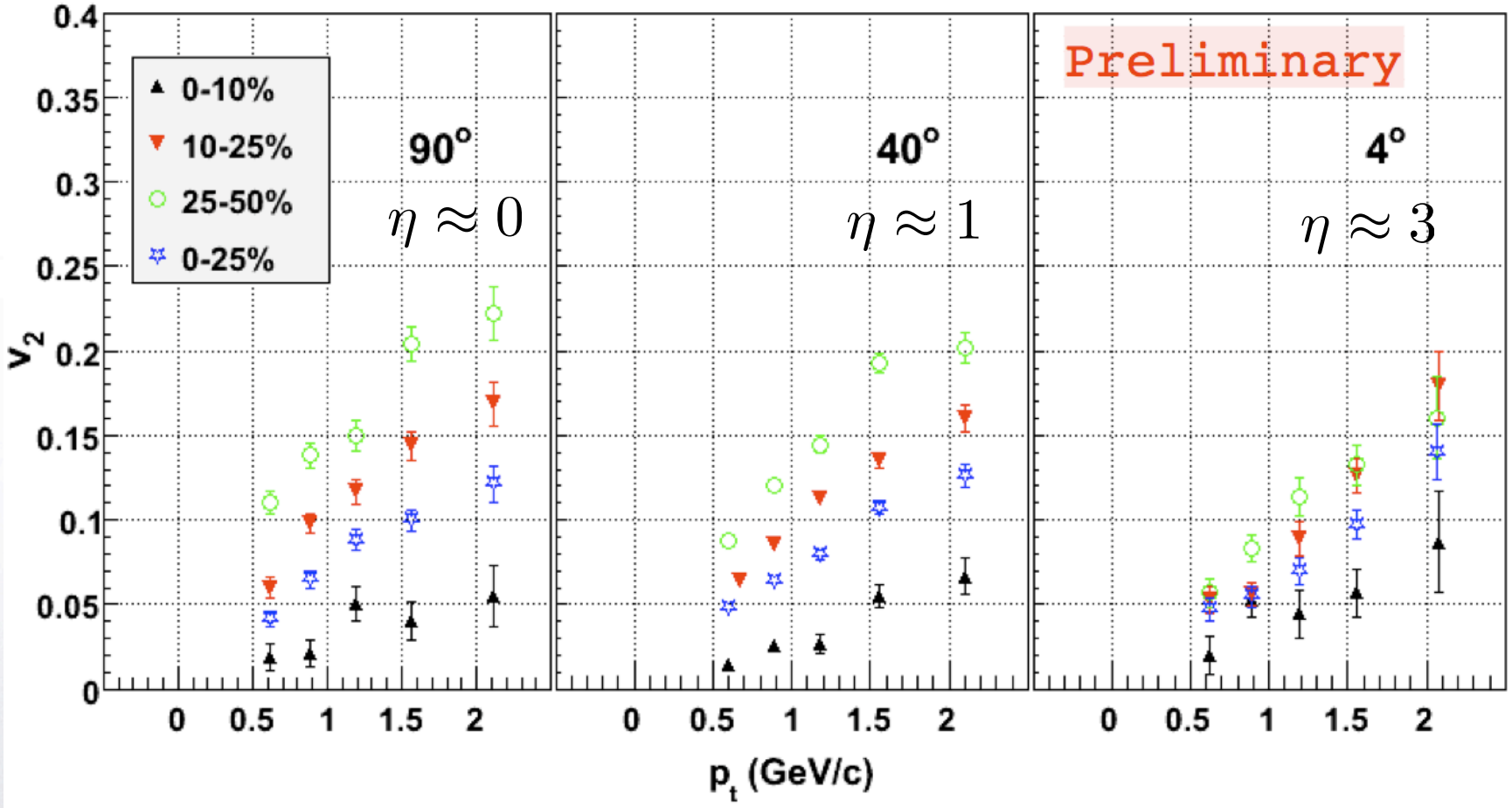

Resolution corrections are based on a Monte Carlo simulation where the particle spectra are set by BRAHMS data and where the $v_2$ values are based on published PHOBOS results. The thrown events are passed through a GEANT simulation of the BRAHMS detector system.

# Charged Hadrons
# 200 GeV AuAu
## ( $\eta = 1$ )

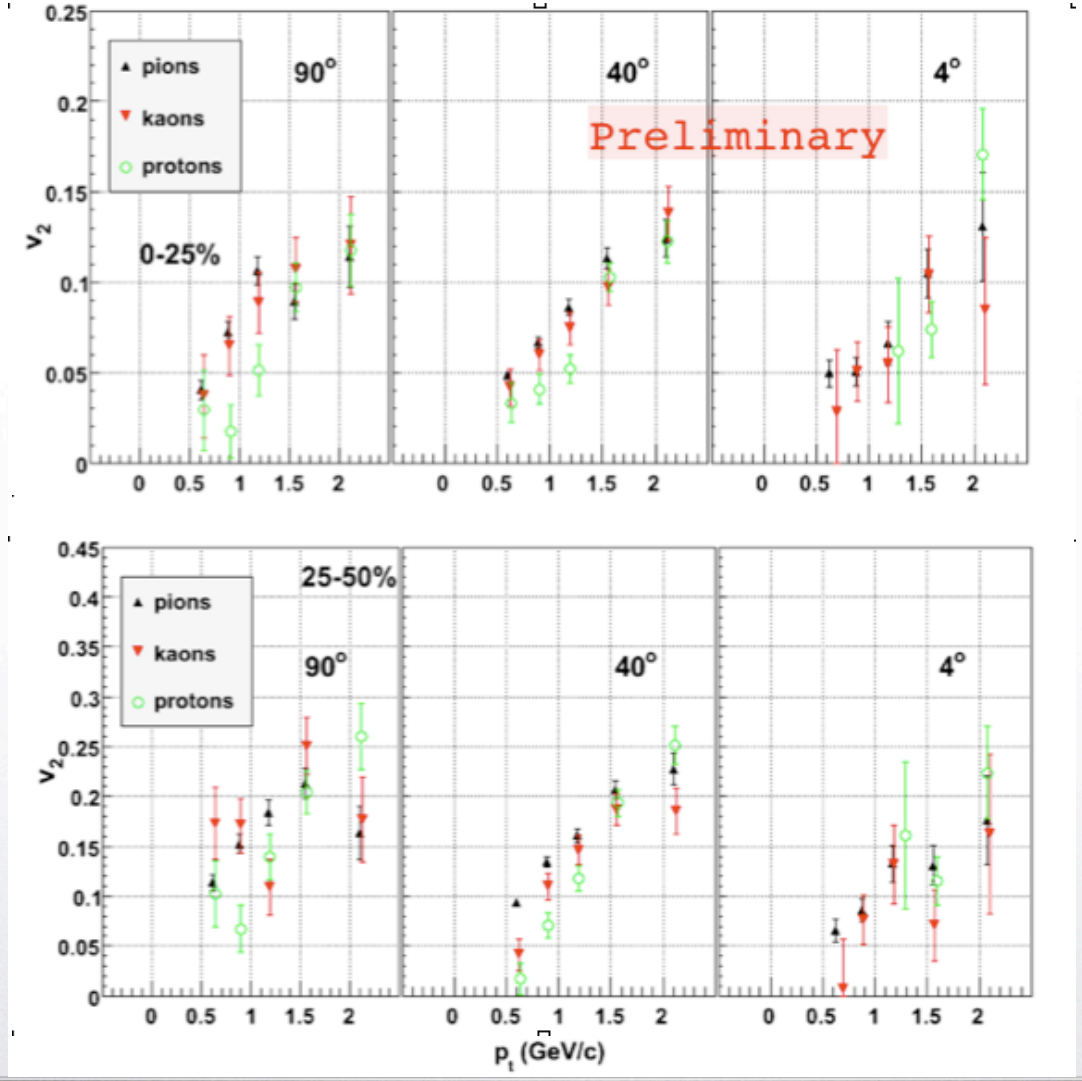


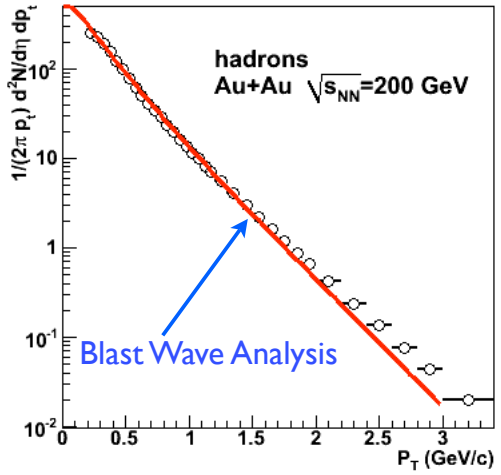
# Results(2):
# Charged hadrons 200 GeV AuAu

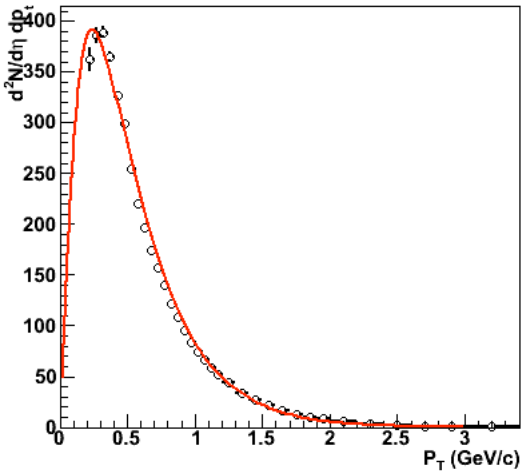


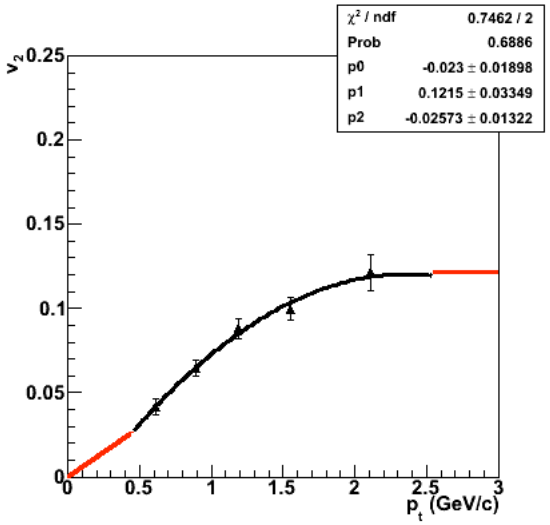
# Identified particles AuAu 200GeV (pions, kaons, protons):

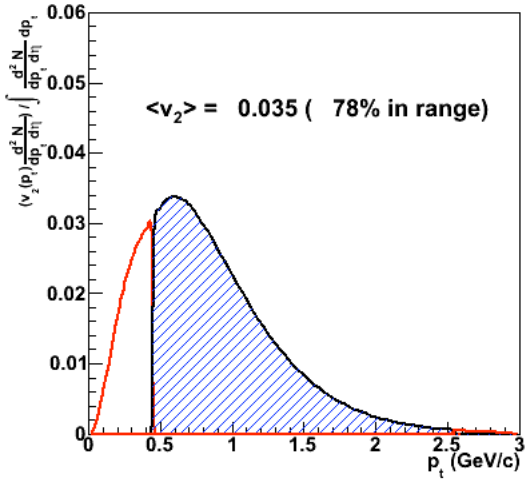


# Integral $v_2$:

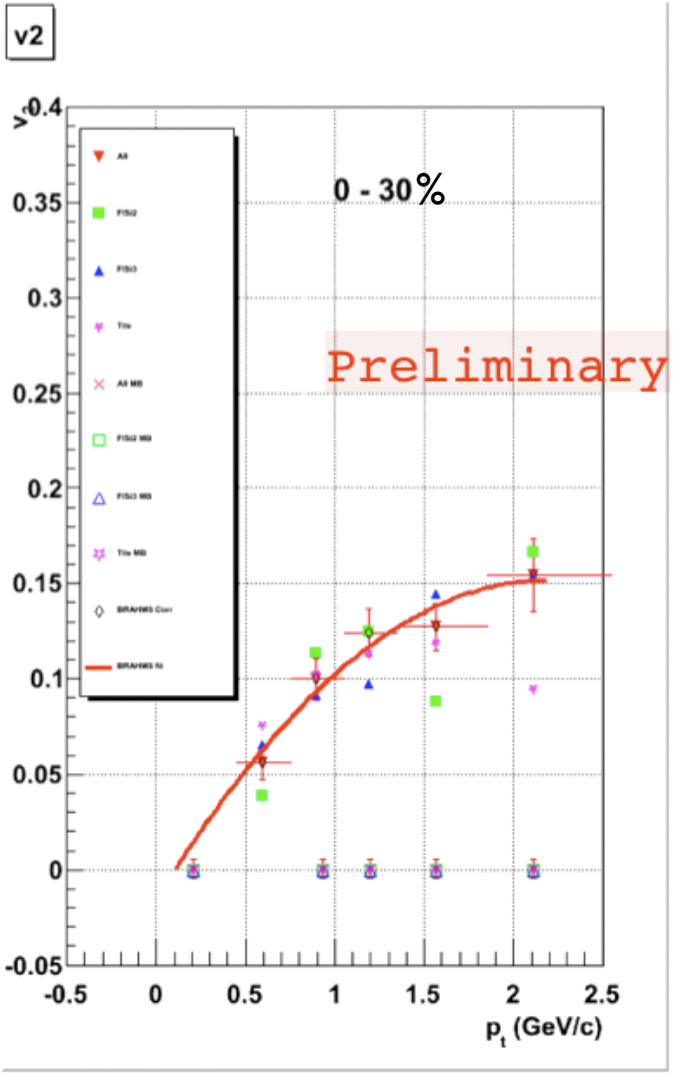

hadrons
Au+Au $\sqrt{s_{NN}}$=200 GeV
Blast Wave Analysis
$1/(2\pi p_t)\, d^2N/d\eta\, dp_t$
$P_T$ (GeV/c)

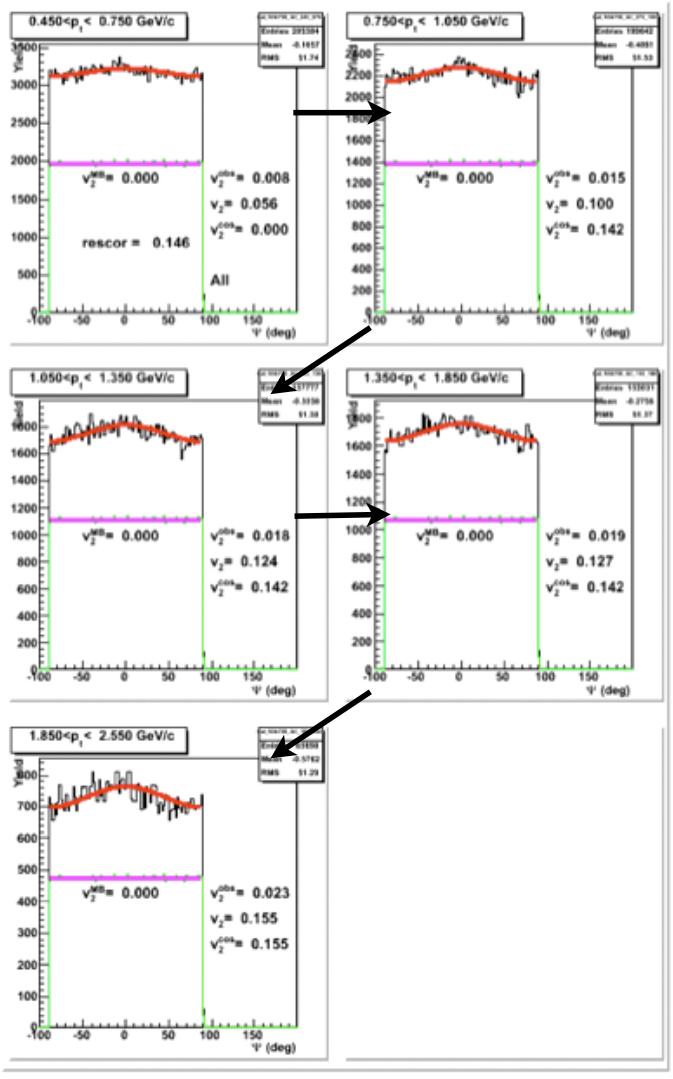

$d^2N/d\eta\, dp_t$
$P_T$ (GeV/c)


$\chi^2$ / ndf 0.7462 / 2
Prob 0.6886
p0 -0.023 ± 0.01898
p1 0.1215 ± 0.03349
p2 -0.02573 ± 0.01322
$v_2$
$p_t$ (GeV/c)


<$v_2$> = 0.035 ( 78% in range)
$p_t$ (GeV/c)

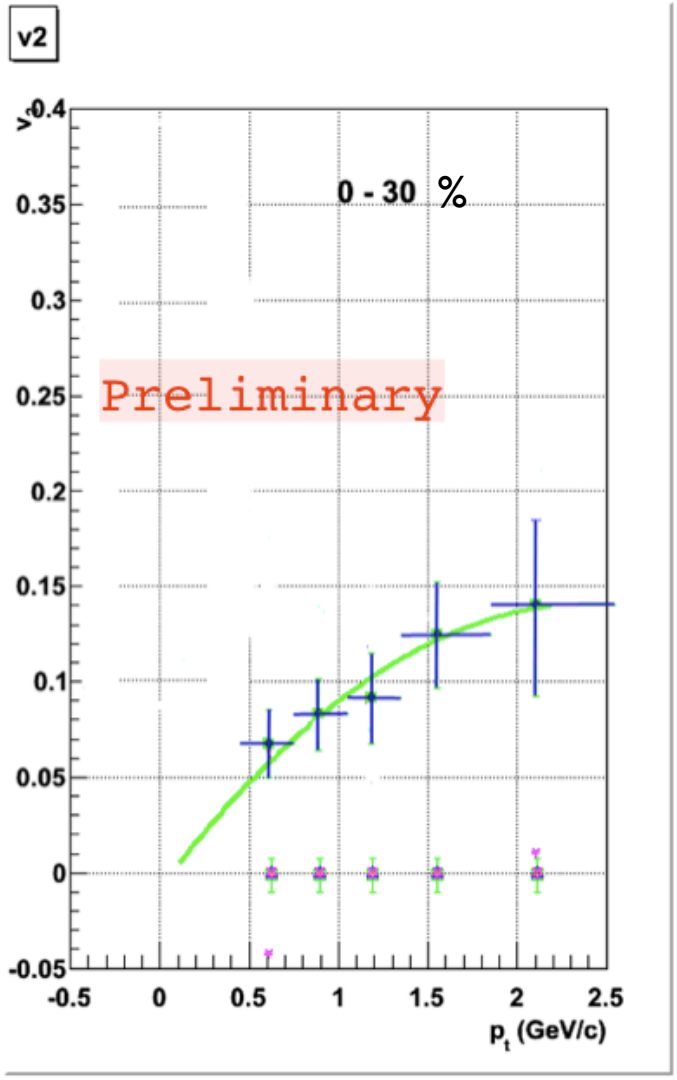
# Charged Hadrons CuCu 200GeV η=0:

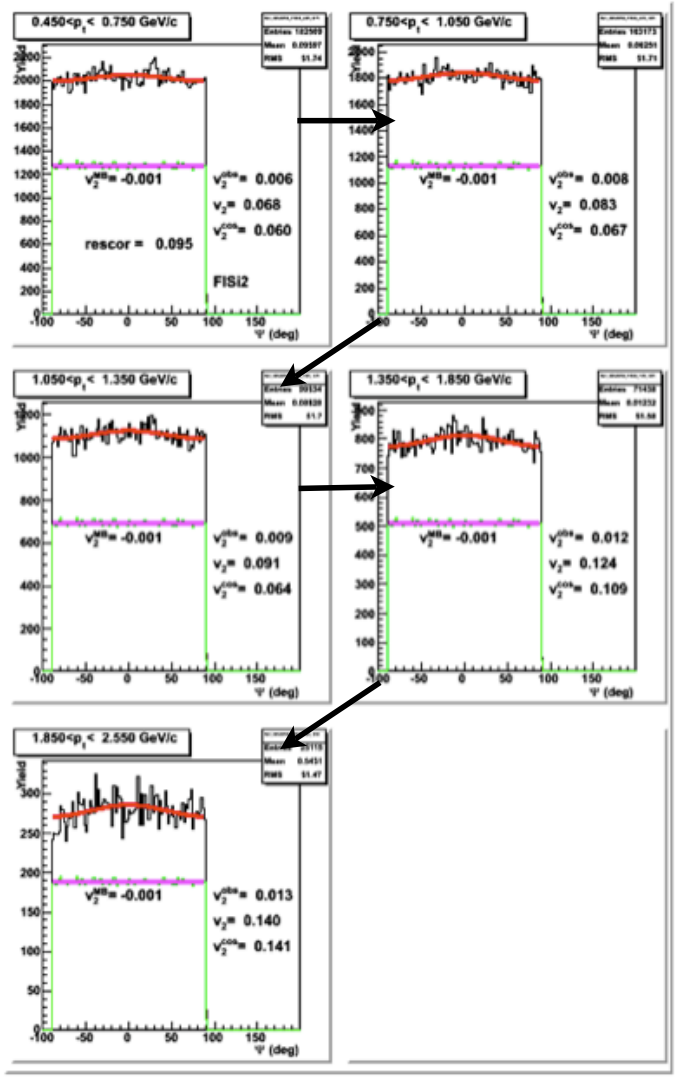



$p_t$

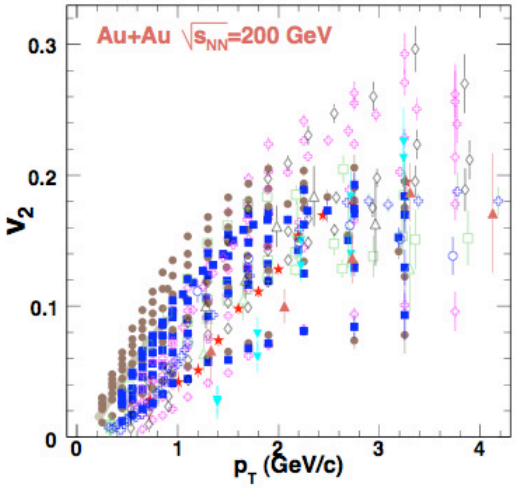
# Charged Hadrons CuCu 200GeV η=1:




$p_t$

# Systematics:




**PHENIX** ( Phys.Rev.Lett.91, Preliminary: QM05, GRC 06 )
- $\pi^+ + \pi^-$: min.bias,0-10%,10-20%,20-30%,30-40%,40-50%,20-60%
- $\pi^0$ : min.bias
- $K^+ + K^-$: min.bias, 0-10%,10-20%,20-30%,30-40%,40-50%,20-60%
- $p + \bar{p}$ : min.bias, 0-10%,10-20%,20-30%,30-40%,40-50%,20-60%
- d : min.bias, 10-50%
- $\phi$ : 20-60%

**STAR** (Phys.Rev.Lett. 92, Phys.Rev.C72(2005), Preliminary QM05,SQM06)
- $\pi^+ + \pi^-$: min.bias
- $K^0_S$ : min.bias, 5-30%,30-70%
- $p + \bar{p}$ : min.bias
- $\Lambda + \bar{\Lambda}$ : min.bias, 5-30%,30-70%
- $\Xi + \bar{\Xi}$ : min.bias
- $\Omega + \bar{\Omega}$ : min.bias

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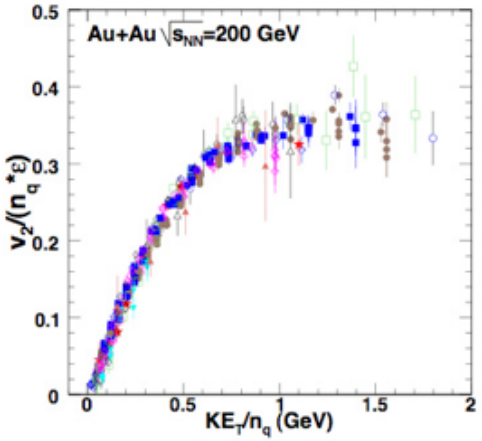

# Conclusions:

- **What have we learned:**

✓ For central events, $v_2$ ($p_t$) shows very little change with pseudorapidity for three different particle species in AuAu collisions.

✓ For mid-central events, $v_2(p_t)$ appears to decrease with increasing pseudorapidity.

✓ Charged hadrons show similar $p_t$ dependence for AuAu and CuCu systems.

- **Future work:**

✓ Complete analysis of the CuCu forward spectrometer data for charged hadrons.

✓ Explore the $v_2(p_t)$ dependence for different particle species.