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

Victoria Zhukova
University of Kansas

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:**
  \[ \Psi_2 = \frac{1}{2} \sum_i w_i \sin(2\phi_i) \]

- **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:**
  \[ v_2 = \frac{v_2^{obs}}{R} \]

- **Flattening (average over min. bias events for a given centrality bin):**
  \[ \Psi_{flat} = \Psi + \sum_n \frac{2}{n+1} \left\{ \langle \cos((n+1)|\Psi|) \rangle \sin[(n+1)\Psi] - \langle \sin((n+1)|\Psi|) \rangle \cos[(n+1)\Psi] \right\} \]
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
($\eta = 1$)

\[ \eta = 1 \]

0 - 25 %

Preliminary

\[ p_t \]
Results(2):
Charged hadrons 200 GeV AuAu

$\eta \approx 3$

$\eta \approx 0$

$\eta \approx 1$
Identified particles AuAu 200GeV
(pions, kaons, protons):

Preliminary
**Integral $v_2$:**

Blast Wave Analysis

hadrons  
$Au+Au \ \sqrt{s_{NN}}=200 \ \text{GeV}$

$\chi^2$/ndf  0.7452/2
Prob  0.6884
p0  -0.023 $\pm$ 0.01898
p1  0.1215 $\pm$ 0.03349
p2  -0.02573 $\pm$ 0.01322

$\langle v_2 \rangle = 0.035 \ (78\% \text{ in range})$
Charged Hadrons CuCu 200GeV $\eta=0$:

$\nu^2$ vs. $p_t$ (GeV/c) for $0 - 30\%$.
Charged Hadrons CuCu 200GeV $\eta=1$: Preliminary

![Graph showing v2 vs. pT (GeV/c)](chart)

- $v_2$ vs. $p_T$ (GeV/c) for different $p_T$ bins.
- Preliminary analysis.

$P_T$
Systematics:

**PHENIX** (Phys. Rev. Lett. 93, Preliminary: QM05, GRC 06)
- $\pi^+ + \pi^-$: min.bias, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%
- $\pi^0$: min.bias
- $K^+ + K^-$: min.bias, 0-10%, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%
- p+p: min.bias, 0-10%, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%
- $\Omega^-$: min.bias, 20-60%

**STAR** (Phys. Rev. Lett. 93, Phys. Rev. C70, Preliminary QM05, QM06)
- $\pi^+ + \pi^-$: min.bias
- $K^+ + K^-$: min.bias, 5-30%, 20-70%
- p+p: min.bias
- $\Lambda + \Sigma$: min.bias, 5-30%, 20-70%
- $\Xi + \Omega$: min.bias
- $\Omega + \Omega$: min.bias

R.A. Lacey and A. Taranenko, nucl-ex/0610029
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.