Rapidity Dependence of Elliptic Flow at RHIC

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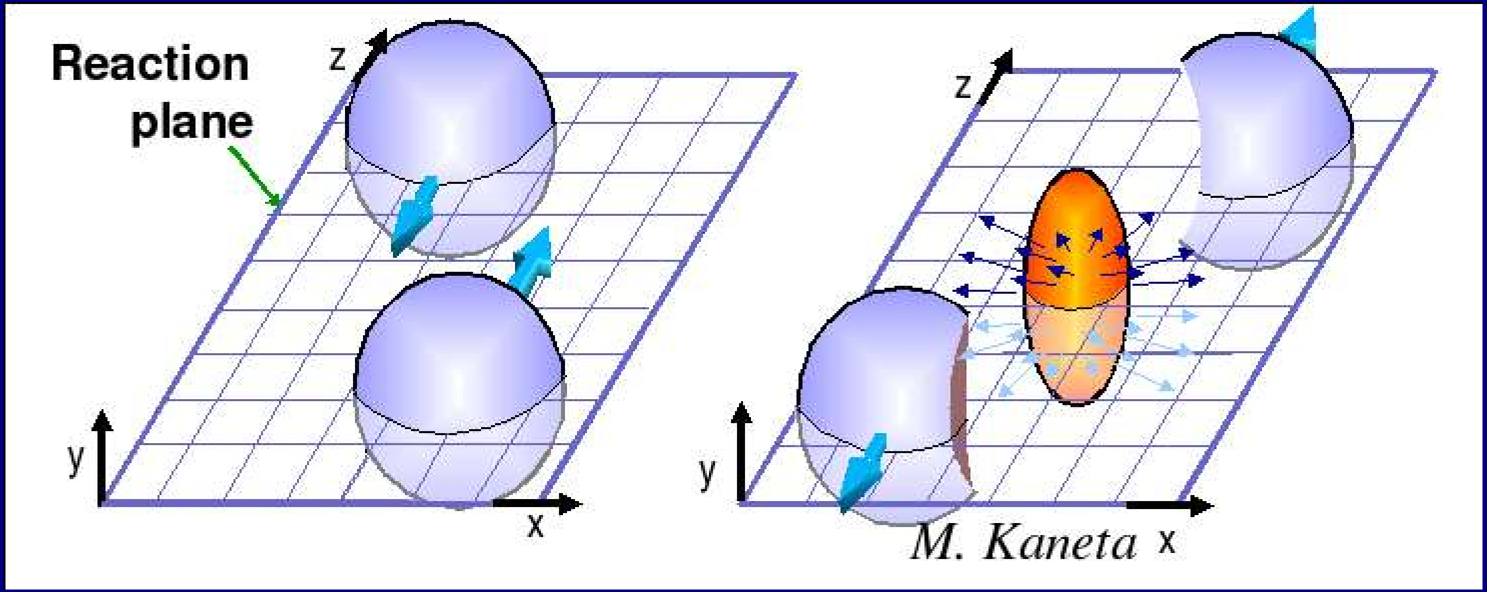
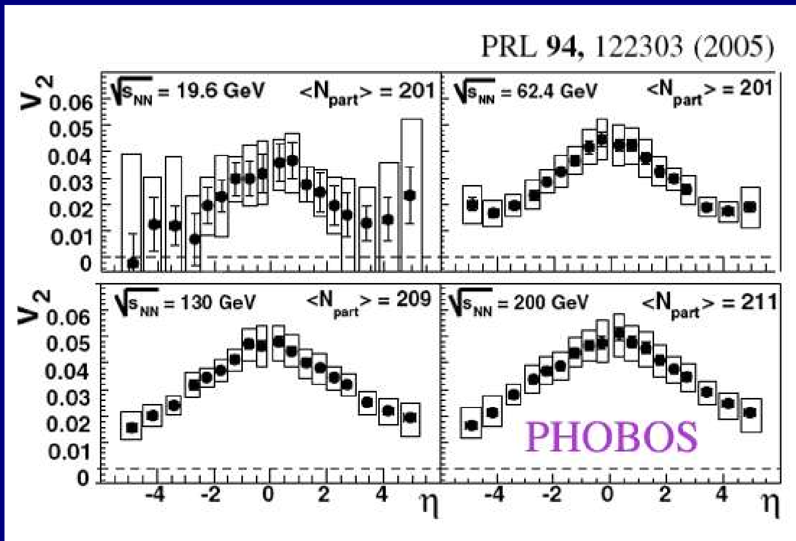
Overview of Flow

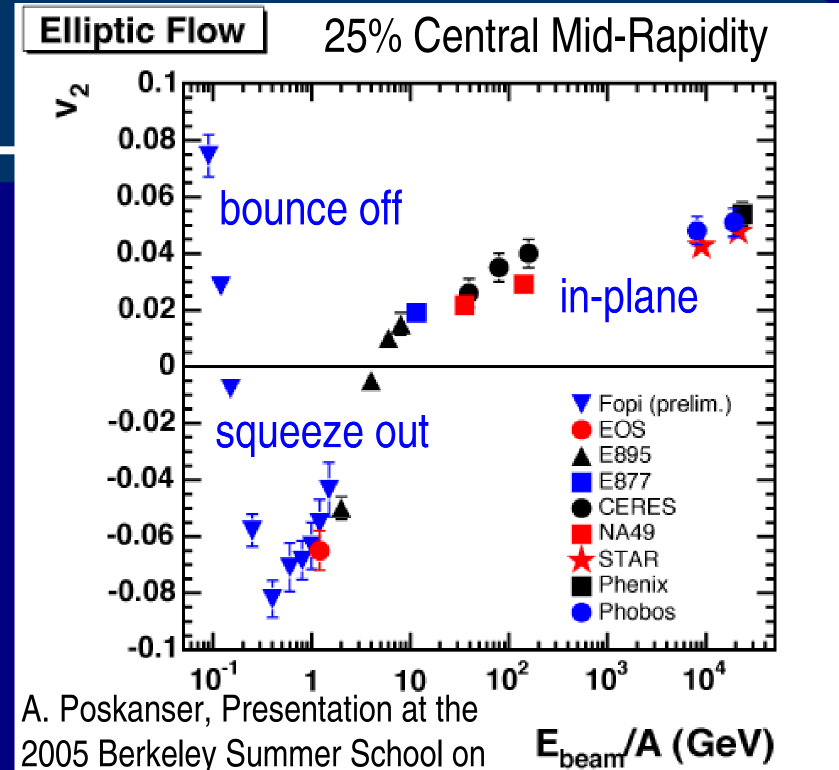


$$\frac{d^3N}{2\pi p_T dp_T dy d(\phi-\Psi_R)} = \frac{d^2N}{2\pi p_T dp_T dy}\left(1+\sum_n 2v_n\cos[n(\phi-\Psi_R)]\right)$$

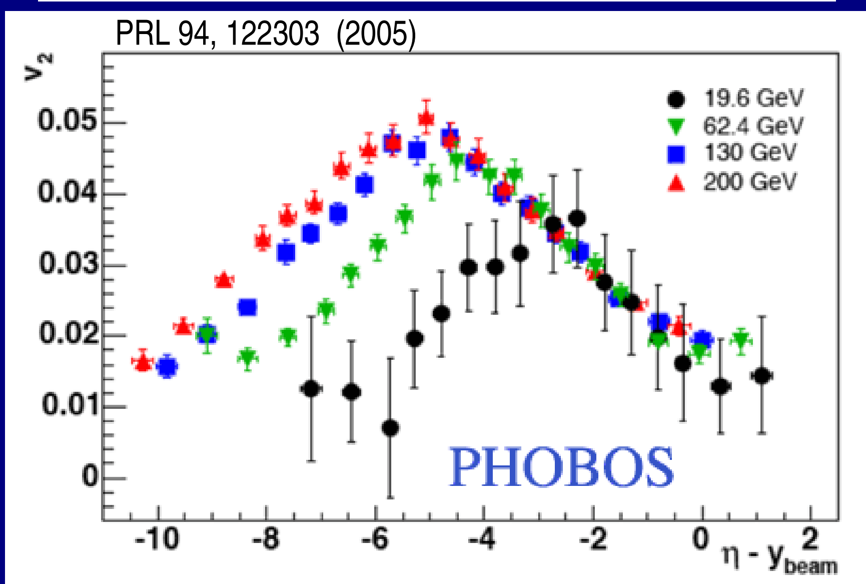
- Initial collision geometry leads to pressure gradients in the produced medium.
- The density of particles produced is correlated to these gradients.

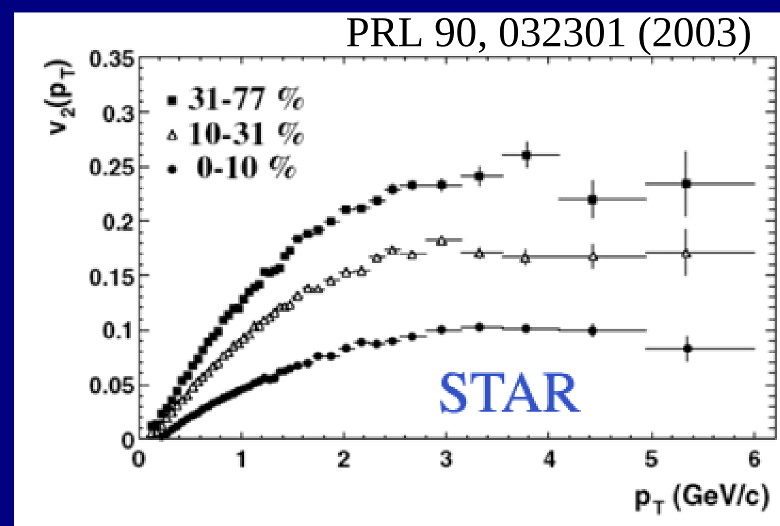
Flow History



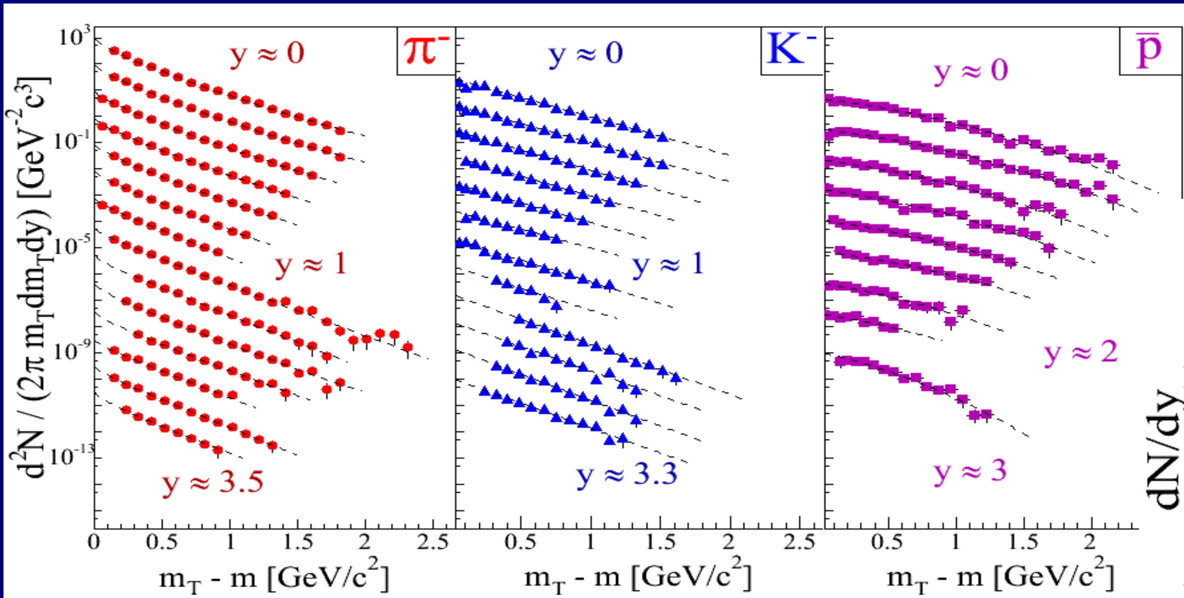


A. Poskanser, Presentation at the 2005 Berkeley Summer School on Collision Dynamics

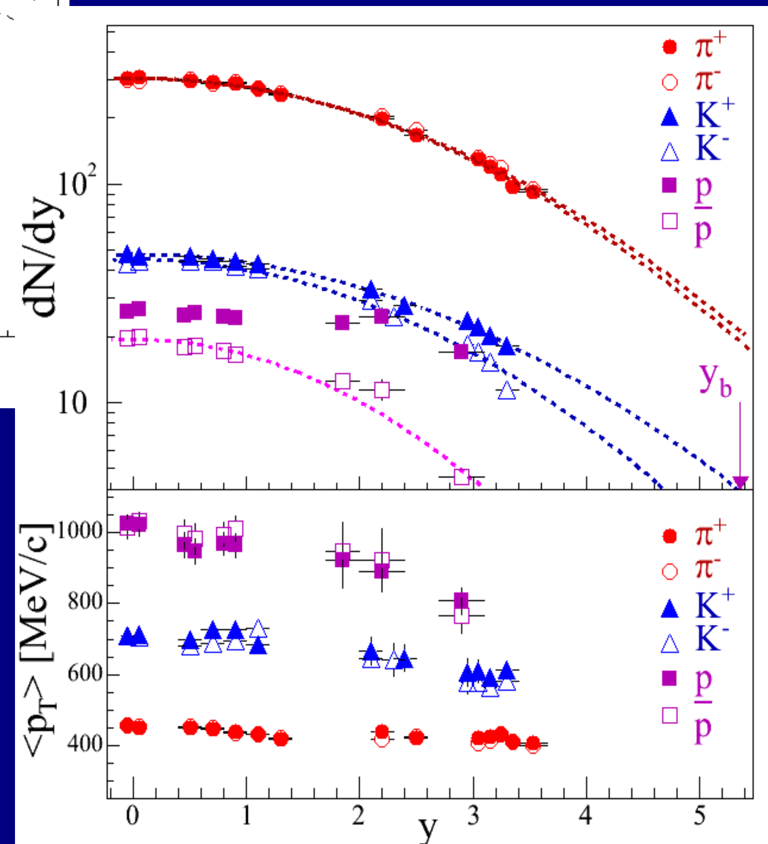




Flow at Forward Rapidities

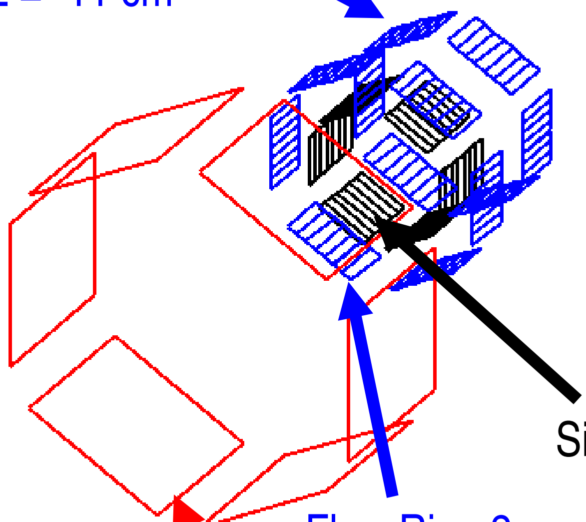


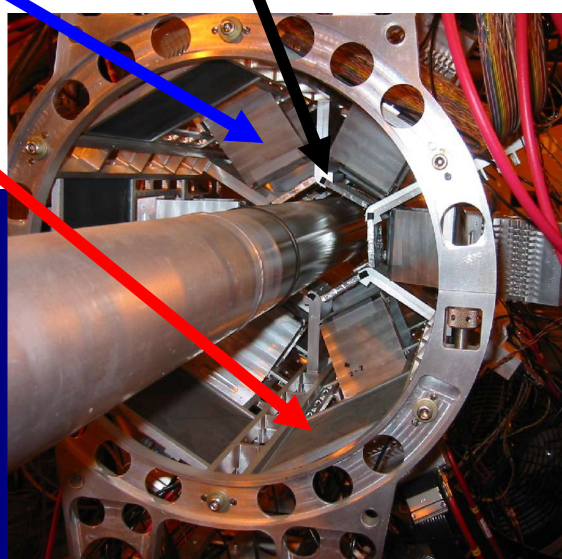
$AuAu \sqrt{s_{NN}} = 200\, GeV$

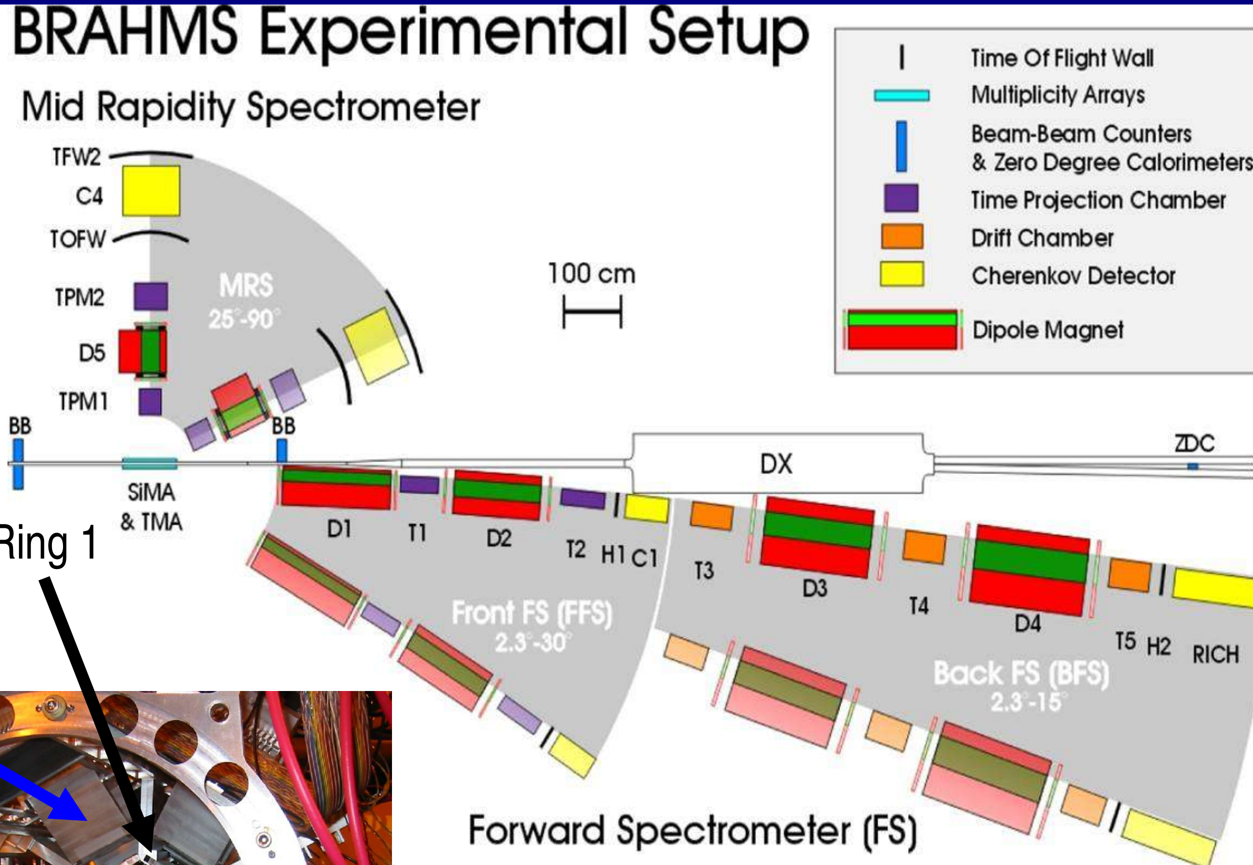


- BRAHMS is unique at RHIC in that it can measure spectra at forward rapidities.
- Interesting to understand how flow affects the dynamics at forward rapidities.
- p: Phys. Rev. Lett. 93, 102301 (2004)
- π, K: Phys. Rev. Lett. 94, 162301 (2005)

BRAHMS Experiment



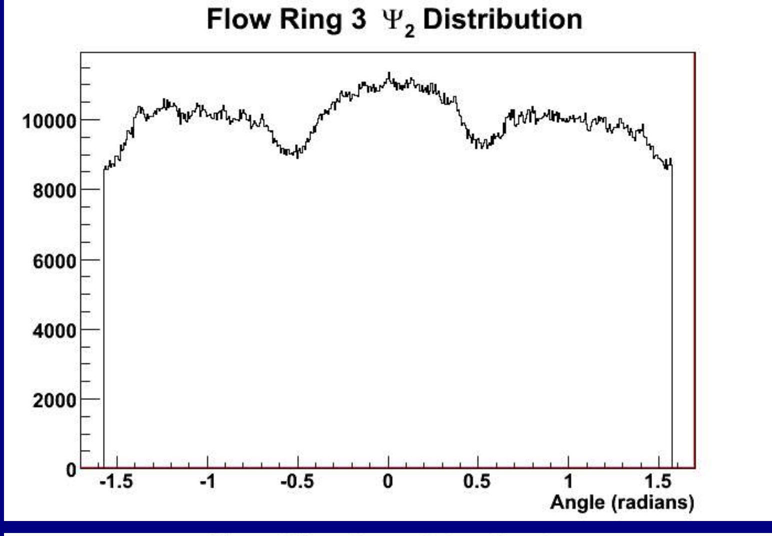


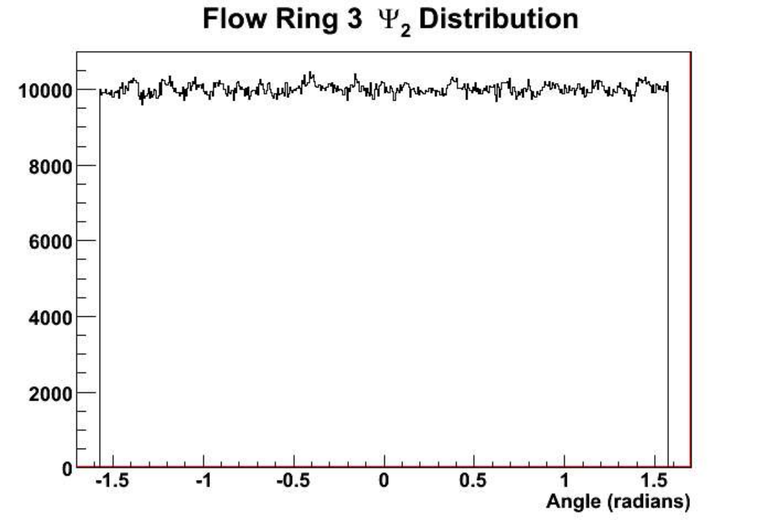


Measuring the Reaction Plane

- A.M. Poskanzer and S.A. Voloshin PRC 58, 1671(1998)
- Reaction Plane Determined For
  - Multiplicity Array Rings
  - 1 Ring in the Left BB Counters
- Corrections
  - Normalized the weights based on the average signal in the ring's elements.
  - Centered the <Σsin> and <Σcos> values.
  - Flattened the distribution using a Fourier decomposition: Barrette et al (E877 Collaboration) PRC 56, 3254 (1997)

$$\Psi_n = \frac{1}{n} atan \frac{\sum_i w_i \sin(n\phi_i)}{\sum_i w_i \cos(n\phi_i)}$$



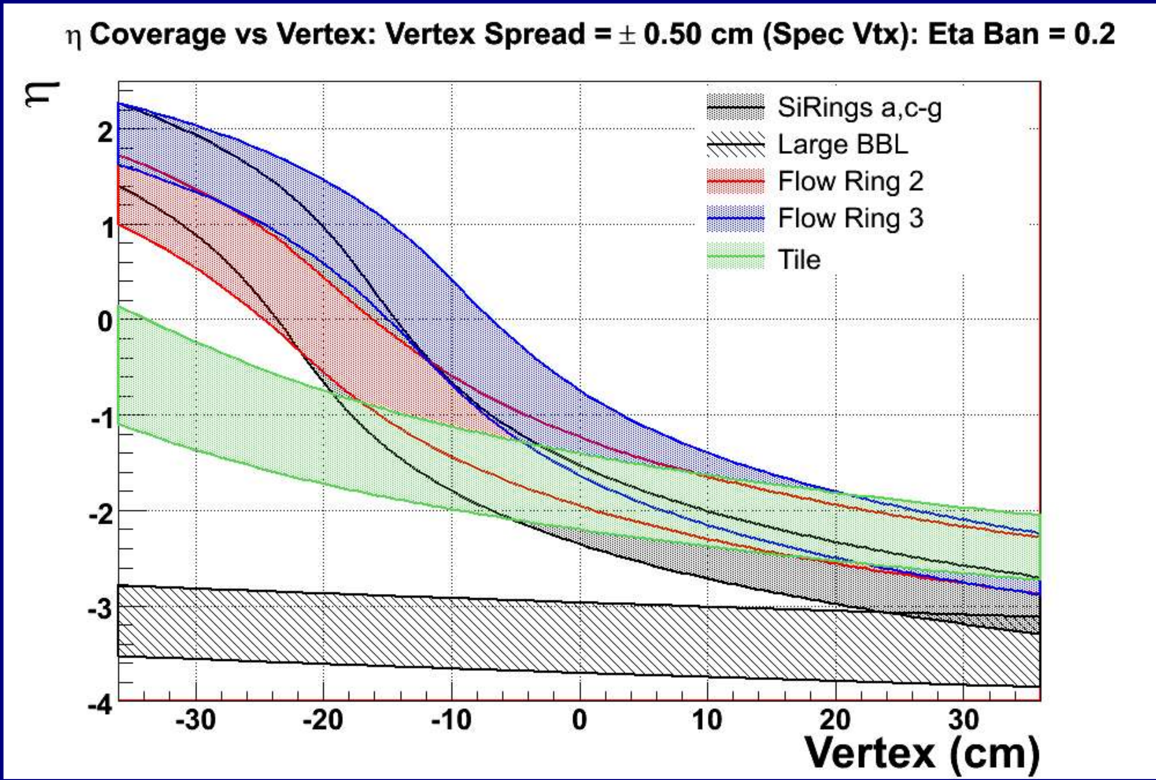


BRAHMS

Measuring the Resolution Correction

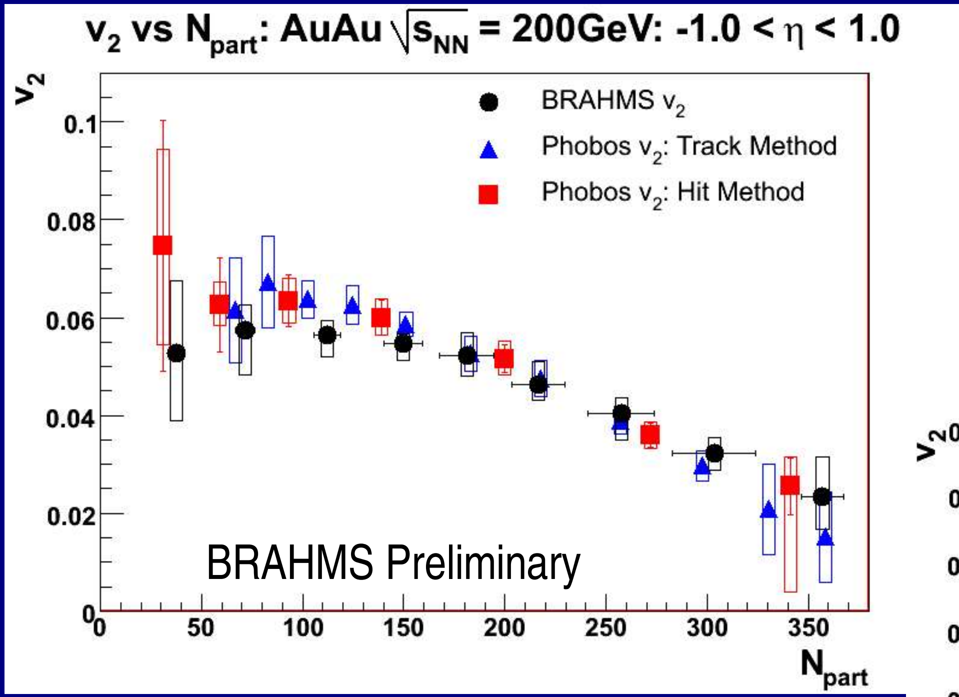
- The measured flow signal is corrected for the reaction plane resolution.
- Non-flow correlations are limited by choosing detectors whose effective η coverage is not overlapping.
- The resolution correction is determined using the correlation between three reaction plane measurements.

$$v_2 = \frac{BGCor}{ResCor} \frac{\sum_i w_i \cos 2(\phi_i - \Psi_2)}{\sum_i w_i}$$

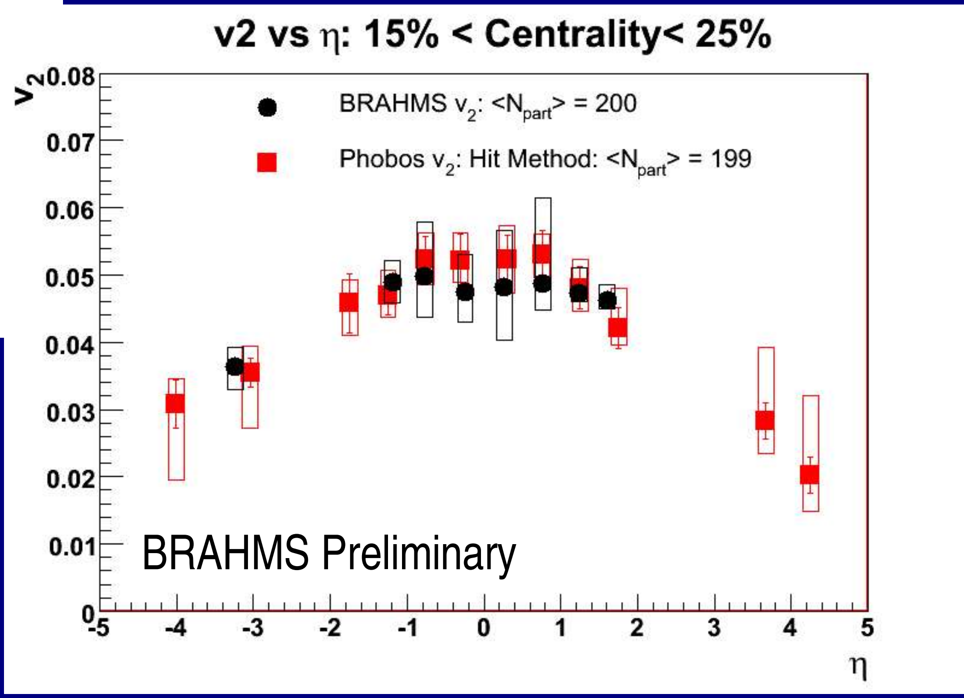


$$ResCor = \sqrt{\frac{\langle \cos[2(\Psi_a - \Psi_b)]\rangle \langle \cos[2(\Psi_a - \Psi_c)]\rangle}{\langle \cos[2(\Psi_b - \Psi_c)]\rangle}}$$

Integrated v_2



- Background and other non-flow effects are corrected using GEANT simulations.



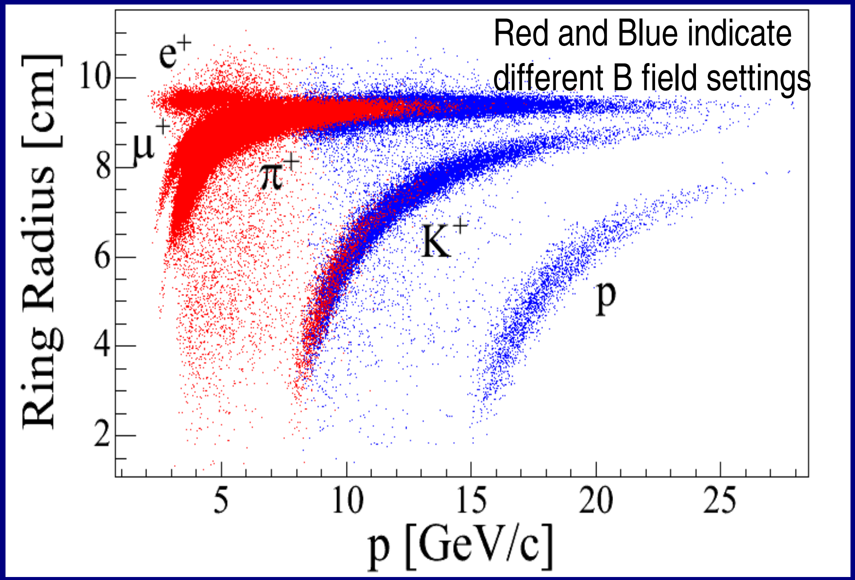
- Phobos Results: Submitted to Phys. Rev. C (Rapid Comm.) : (nucl-ex/0407012)

$$AuAu\sqrt{s_{NN}} = 200\,GeV$$

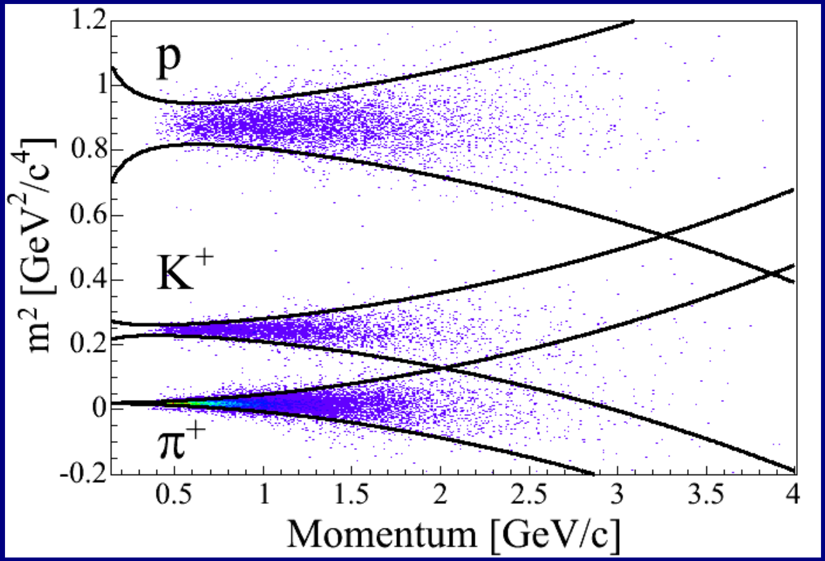
BRAHMS

Particle Identification

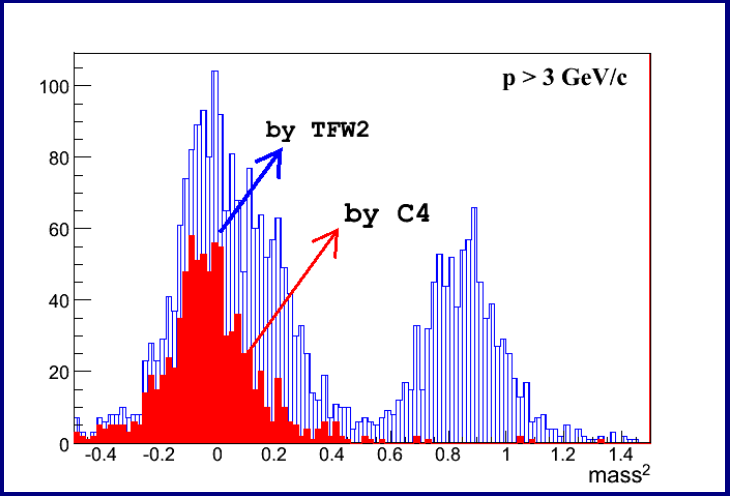
BRAHMS RICH



BRAHMS TOF

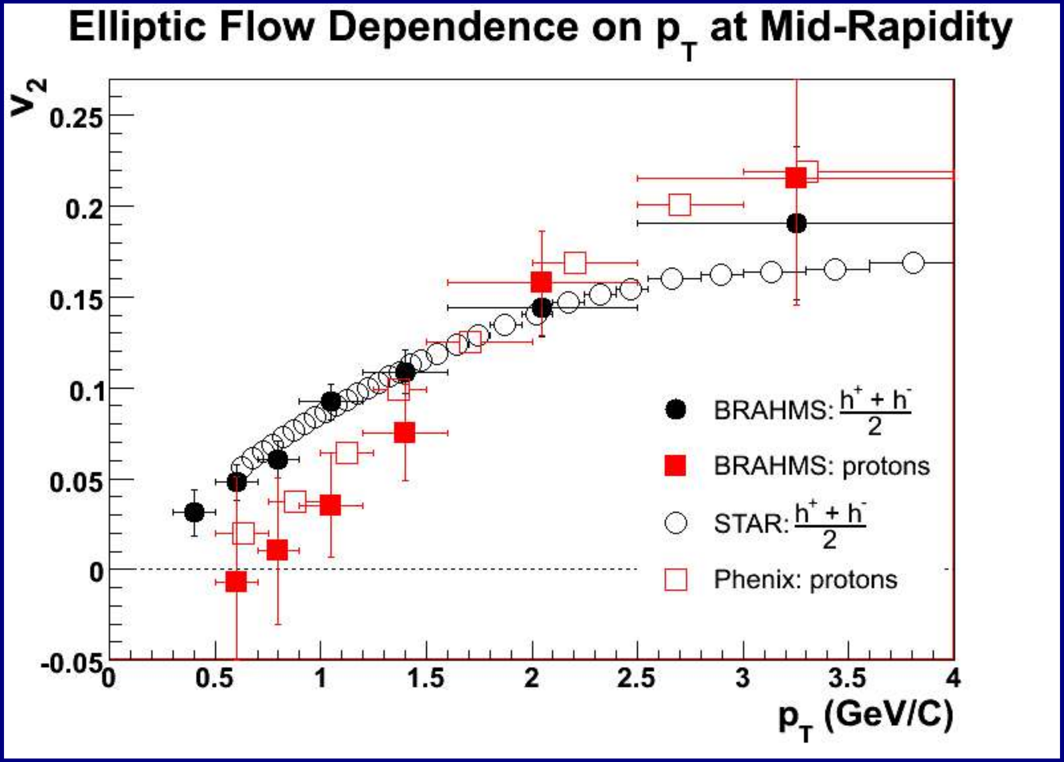


BRAHMS Cherenkov

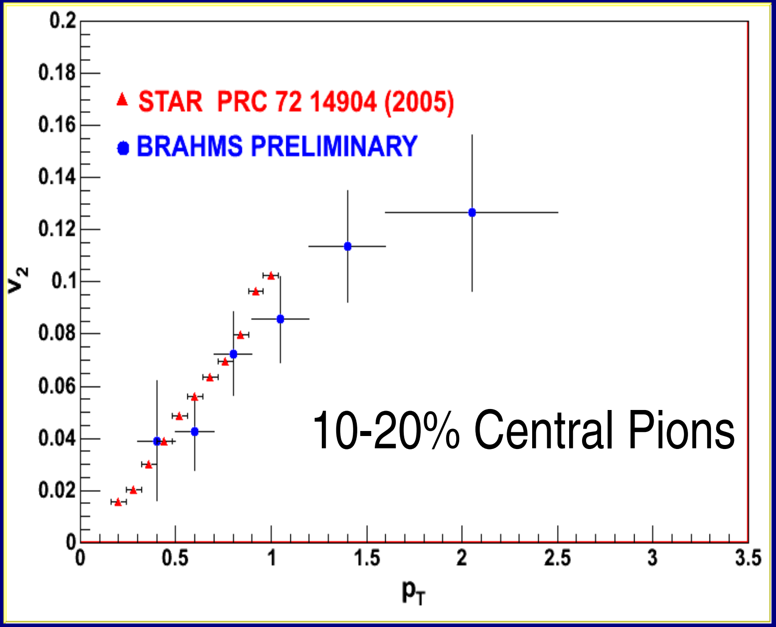


- BRAHMS has very healthy and high quality spectrometers.

Flow at Mid-Rapidity

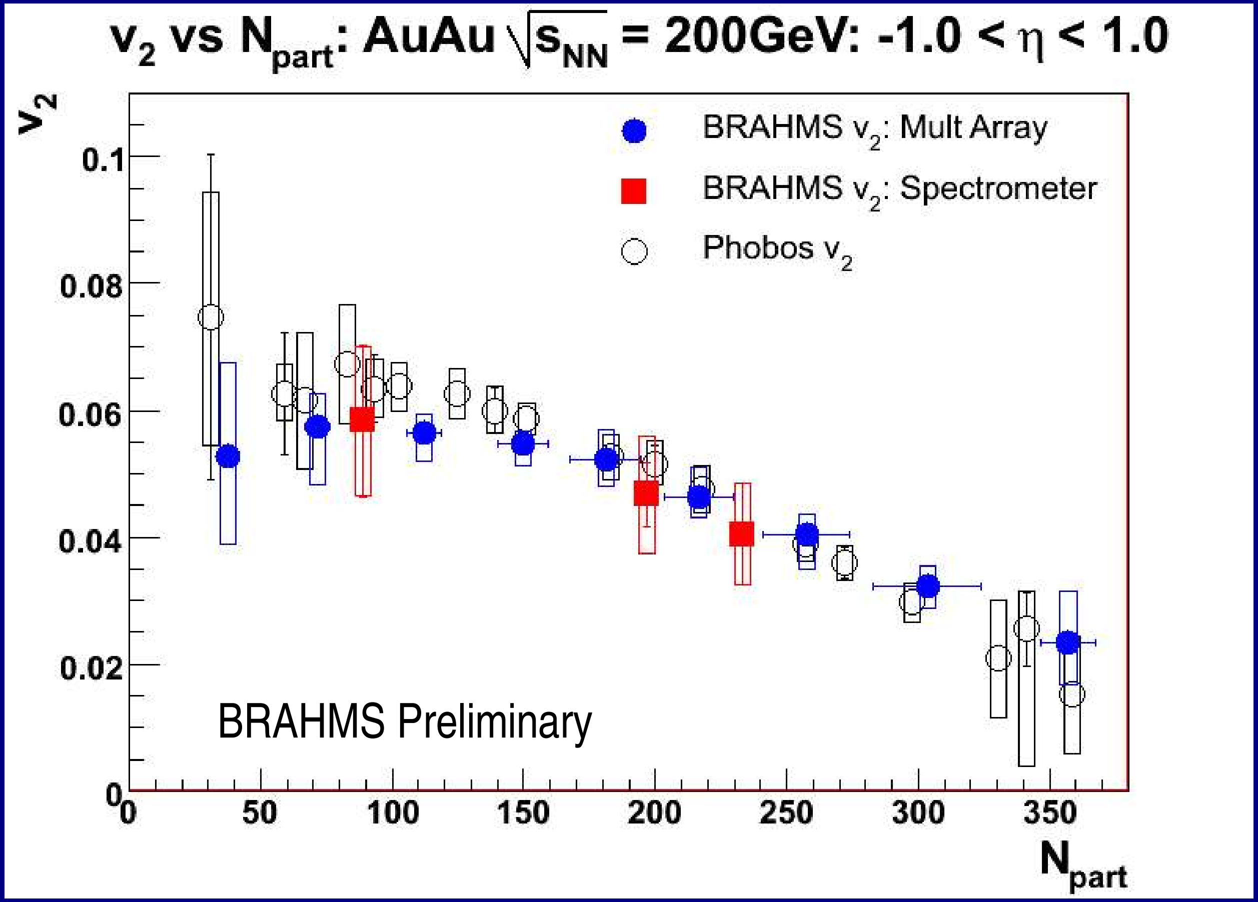


$$AuAu \sqrt{s_{NN}} = 200\, GeV$$



- BRAHMS: 10-30% Central
- STAR: PRL 92, 052302 (2004)
- Phenix: PRL 91, 182301 (2003)

Reproducing the Centrality Dependence



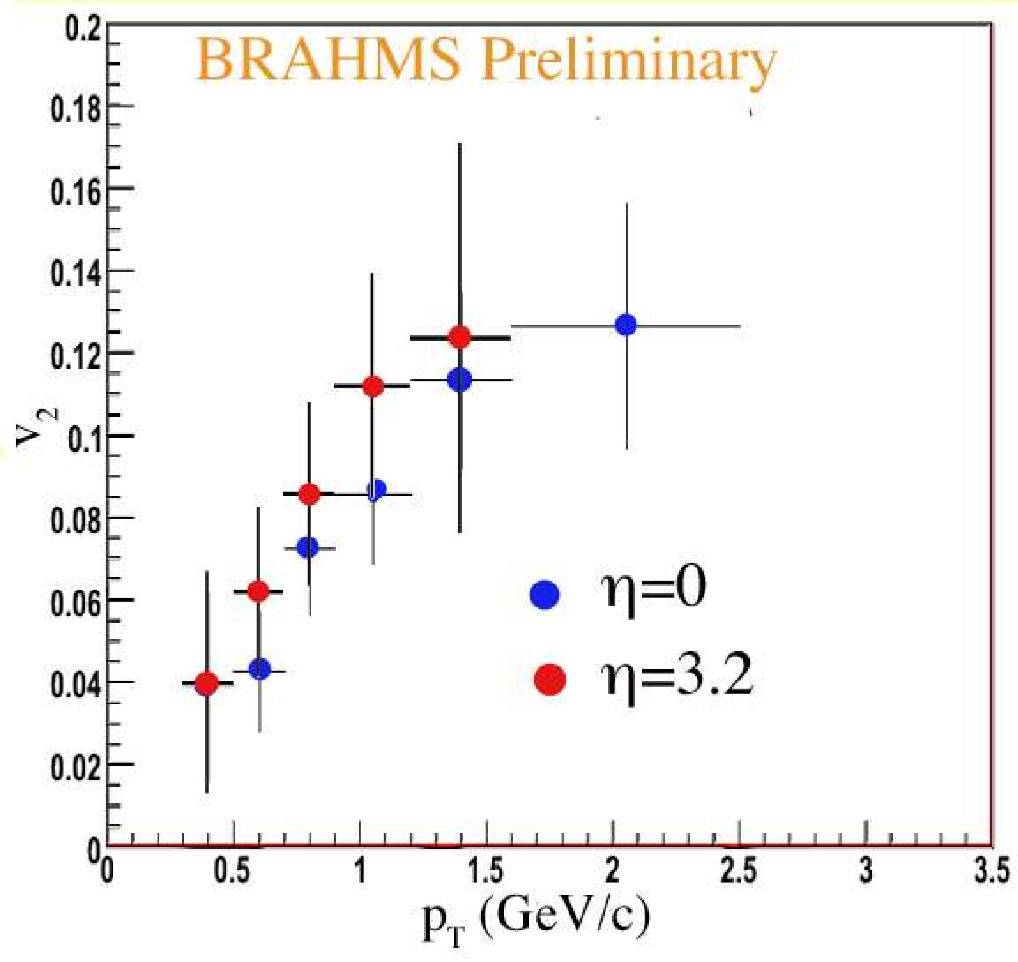
- Phobos Results (nucl-ex/0407012)

$$AuAu \sqrt{s_{NN}} = 200\,GeV$$

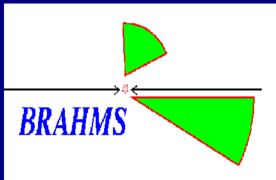
Pions at Forward Rapidities

Pions

$AuAu \sqrt{s_{NN}} = 200\, GeV$



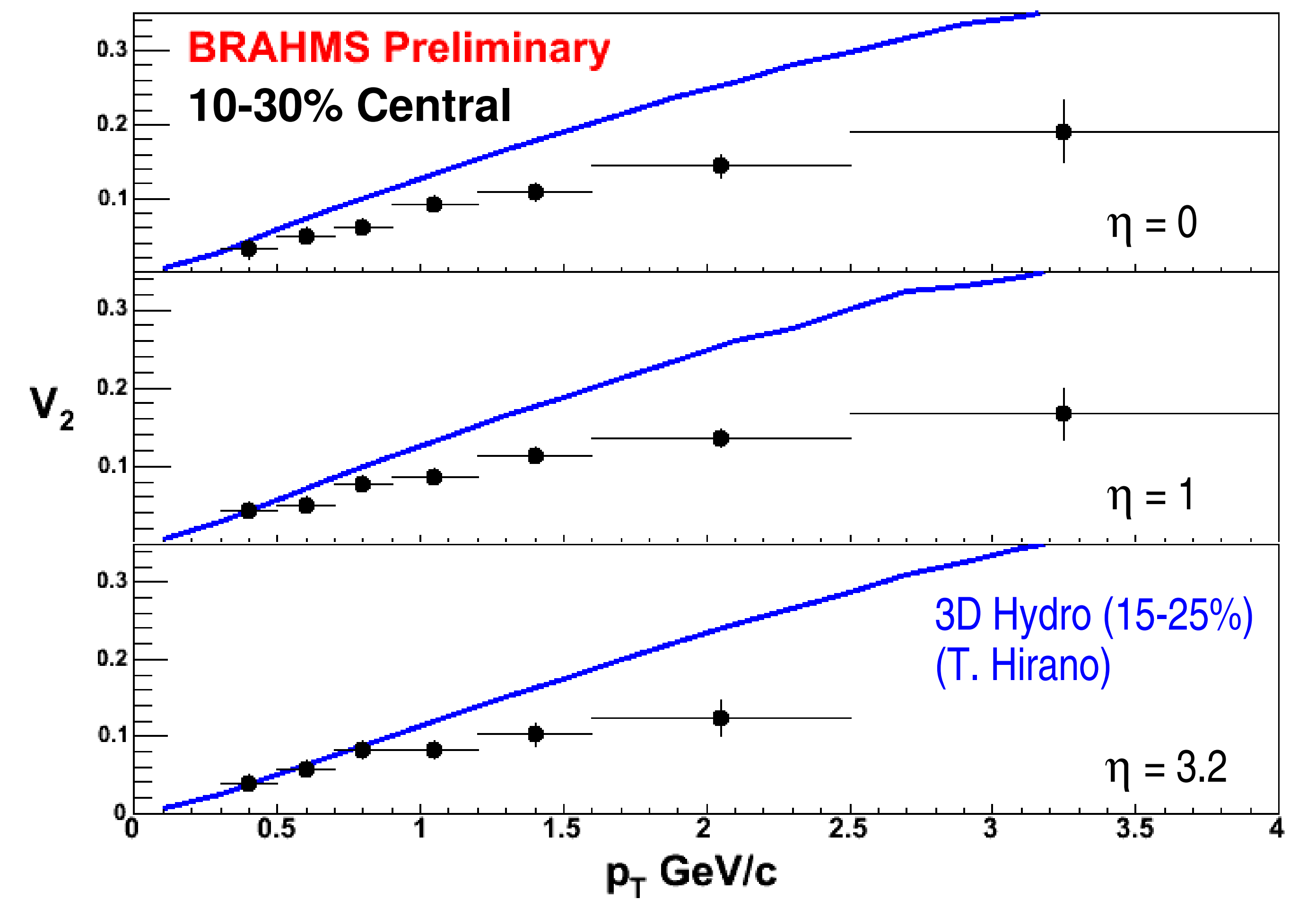
- Possible systematic effects due to event triggering.

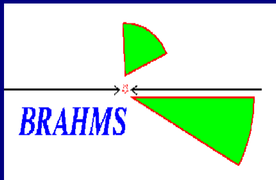


Rapidity Dependence of Charged Hadrons

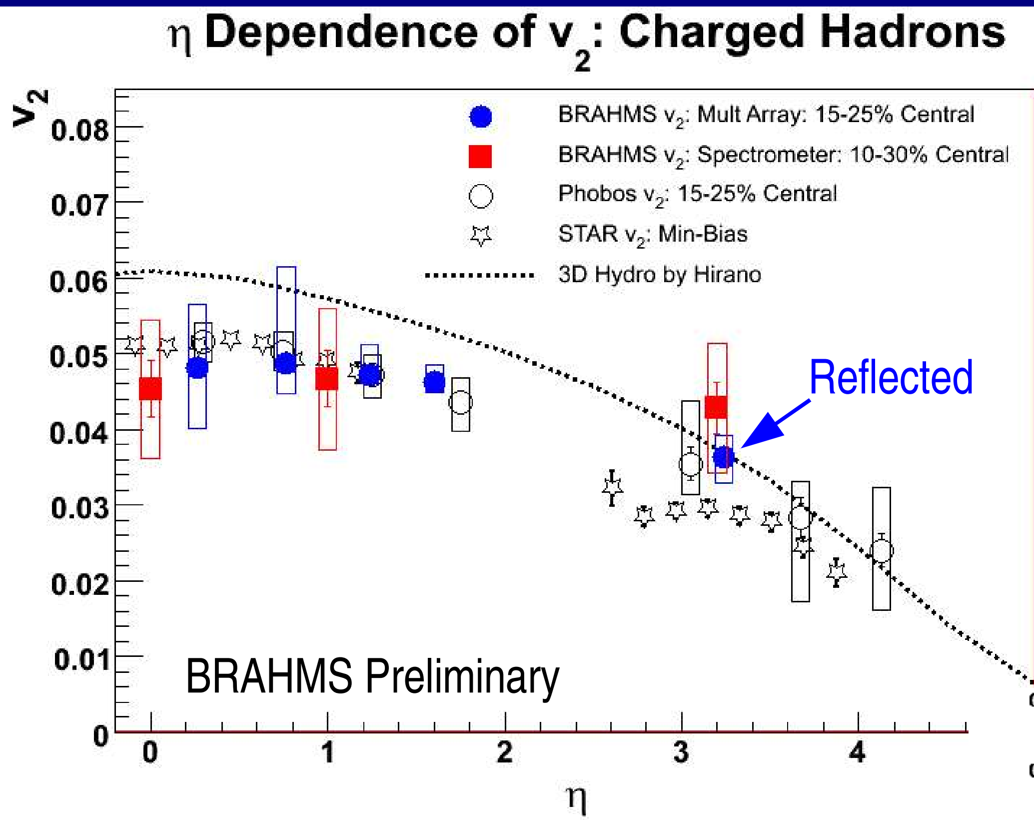
Charged Hadrons

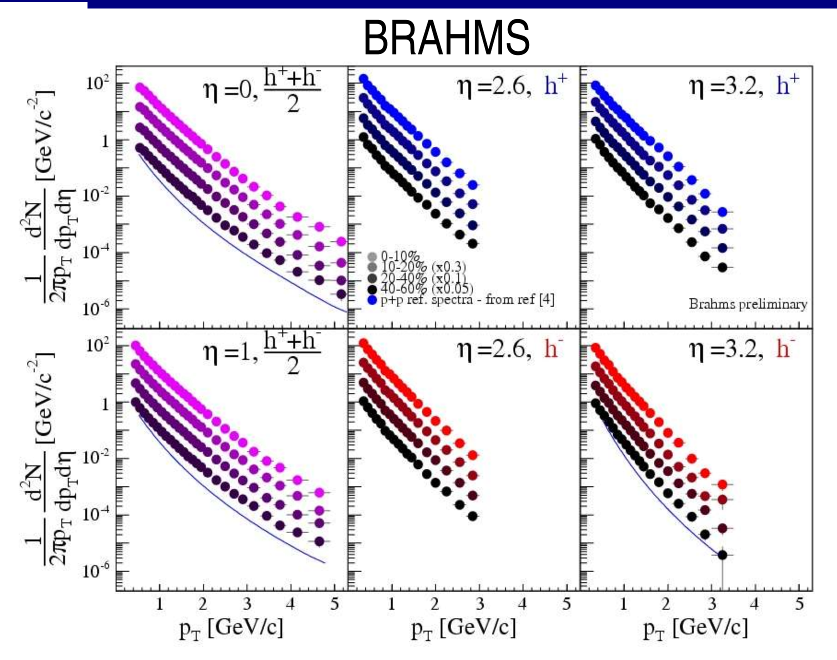
$AuAu\sqrt{s_{NN}}=200\,GeV$

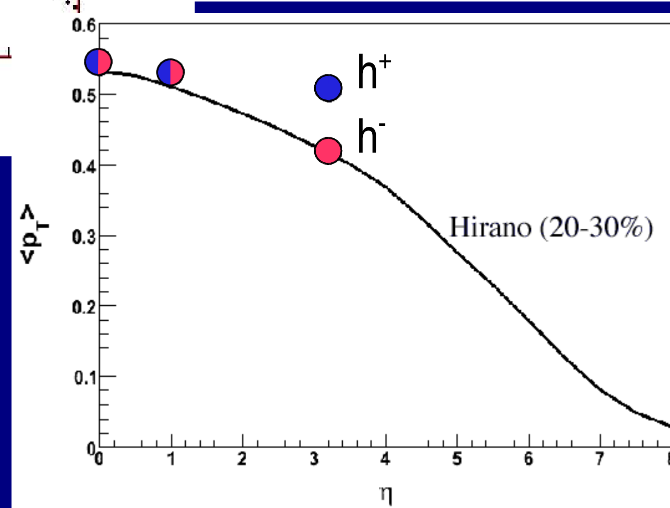




Understanding Forward Rapidities







- The errors on the integrated v_2 should decrease as the final spectra are determined.
- The 3D hyrdo calculations suggest that the underlying spectra is affecting the η dependence on v_2.

Summary

- The systematics of multiplicity array analysis are well understood.
- The mid-rapidity results from BRAHMS are consistant with the other RHIC results.
- Preliminary results of the forward rapidities show that there is little change from mid to forward rapidities for charged hadrons.
- The goal is to measure the elliptic flow signal for protons and kaons from y = 0 to y ~ 3.

BRAHMS

The BRAHMS Collaboration

I. Arsene[10], I.G. Bearden[7], D. Beavis[1], S.Bekele[11], C. Besliu[10], B. Budick[6], H. Bøggild[7], C. Chasman[1], C. H. Christensen[7], P. Christiansen[7], R.Clarke[10], R. Debbe[1],J. J. Gaardhøje[7], K. Hagel[8], H. Ito[1], A. Jipa[10], J. I. Jordre[10], F. Jundt[2], E.B.Johnson[11], J.I.Jordre[9], C.Jørgensen[7], R. Karabowicz[3], E. J. Kim[11], T.M. Larsen[7], J. H. Lee[1], Y. K.Lee[5], S.Lindal[12], G. Løvhøjden[2], Z. Majka[3], M. Murray[11], J. Natowitz[8], B.S.Nielsen[7], D.Ouerdane[7], R.Planeta[4], F. Rami[2], C.Ristea[7], O.Ristea[10], D. Röhrich[9], B. H. Samset[12], S. J. Sanders[11], R.A.Sheetz[1], P. Staszel[3], T.S. Tveter[12], F.Videbæk[1], R. Wada[8], H.Yang[9], Z. Yin[9], and I. S. Zgura[10]

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