Directed and elliptic flow in Au+Au collisions at RHIC-PHENIX

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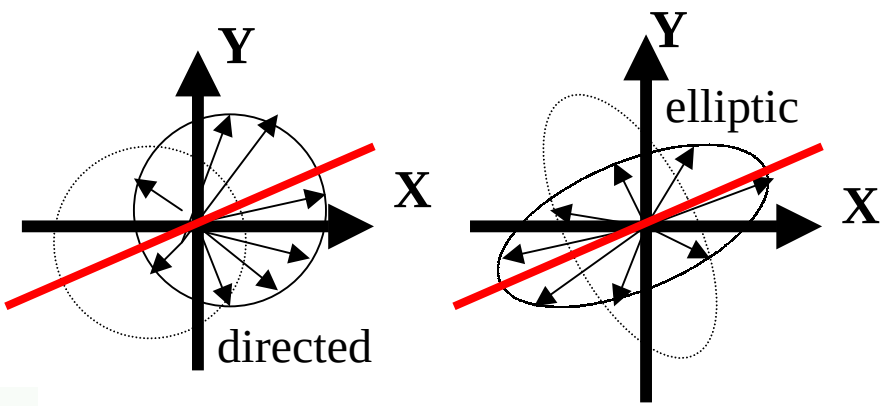
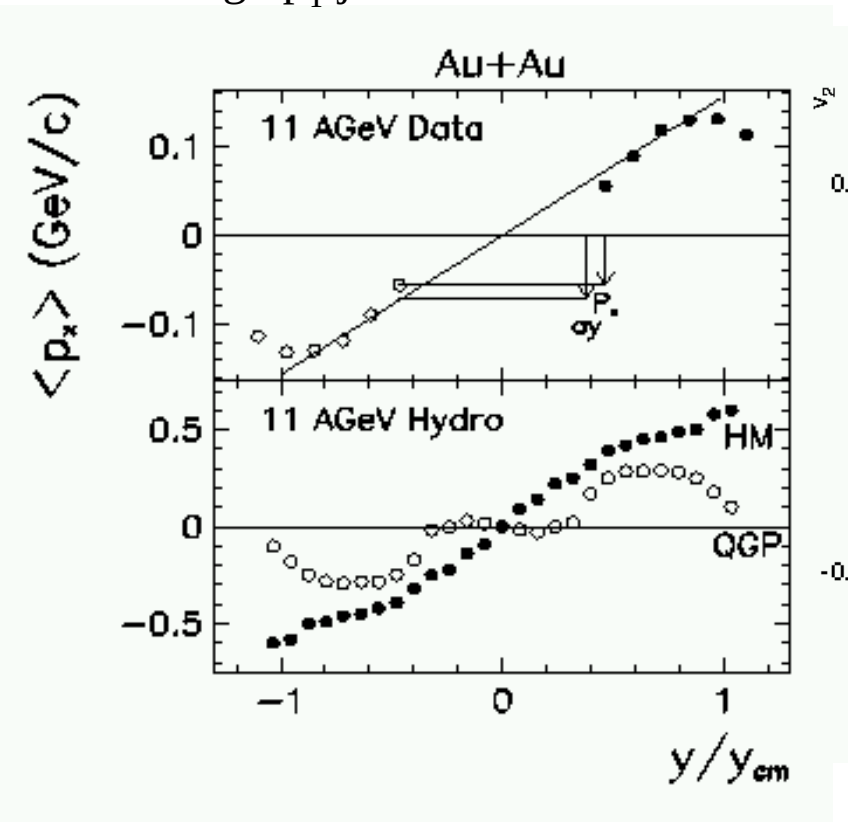
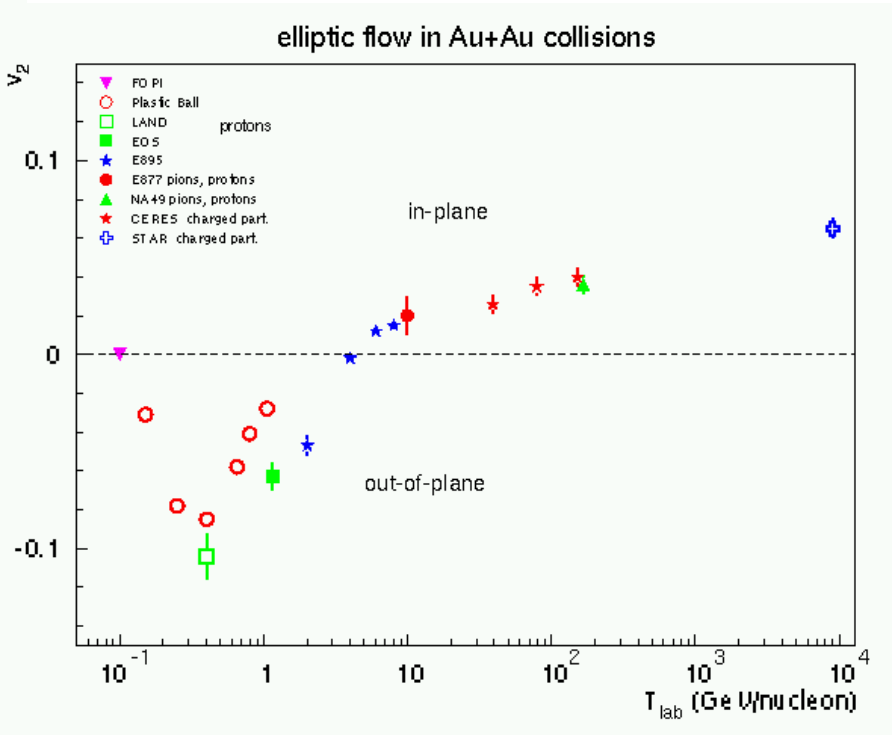
anisotropic flow
PHENIX experiment
reaction plane determination
results on v1 and v2

anisotropic flow
--- directed and elliptic ---

* memory of initial geometry
* hydro-dynamic picture
* relation between soft hadrons and high p_T jets



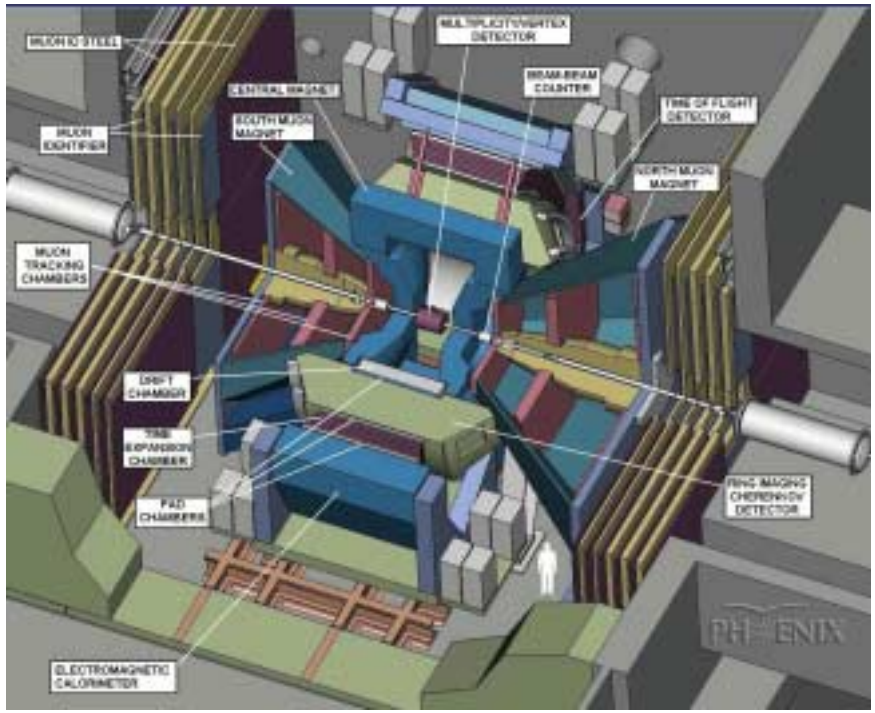


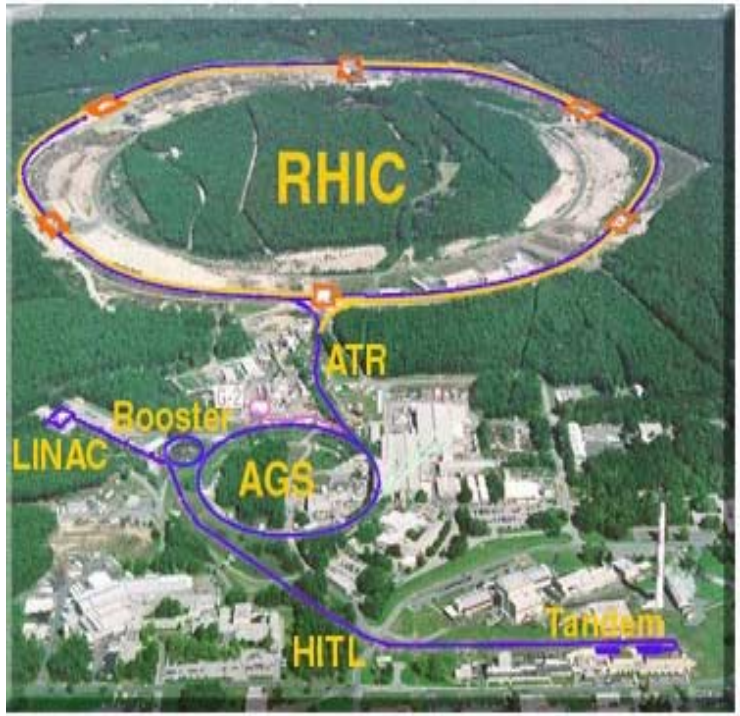


PHENIX detector at RHIC

Au+Au at $\sqrt{s_{NN}}$ = 130 GeV (year1: 2000) ~ 4M events

Au+Au at $\sqrt{s_{NN}}$ = 200 GeV (year2: 2001) ~ 170M events





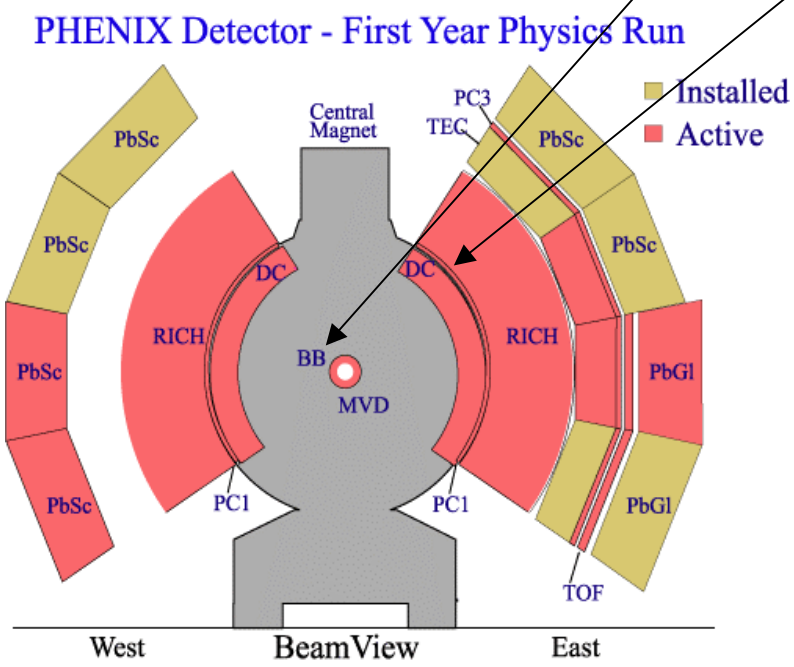
Reaction plane determination with Beam-Beam counters and with central arm detectors

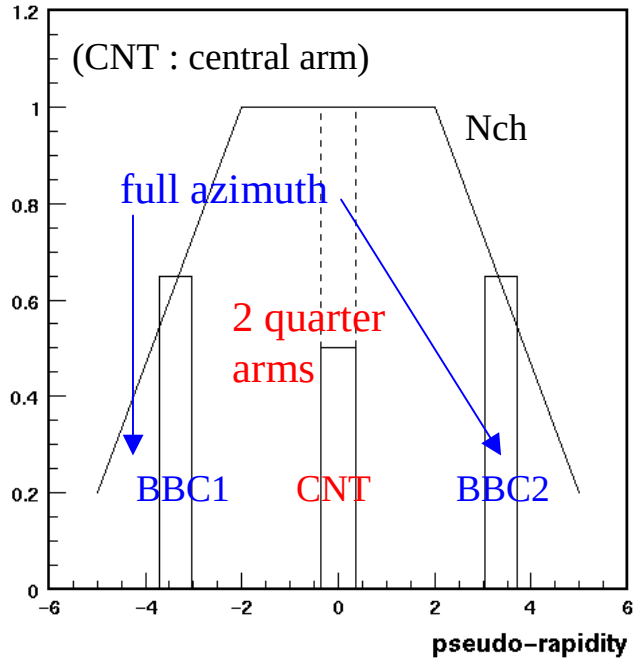
reaction plane : BBC

$$\tan n\Phi = \frac{\sum \mathrm{ADC_i} \sin n\phi_i}{\sum \mathrm{ADC_i} \cos n\phi_i}$$

reaction plane : CNT

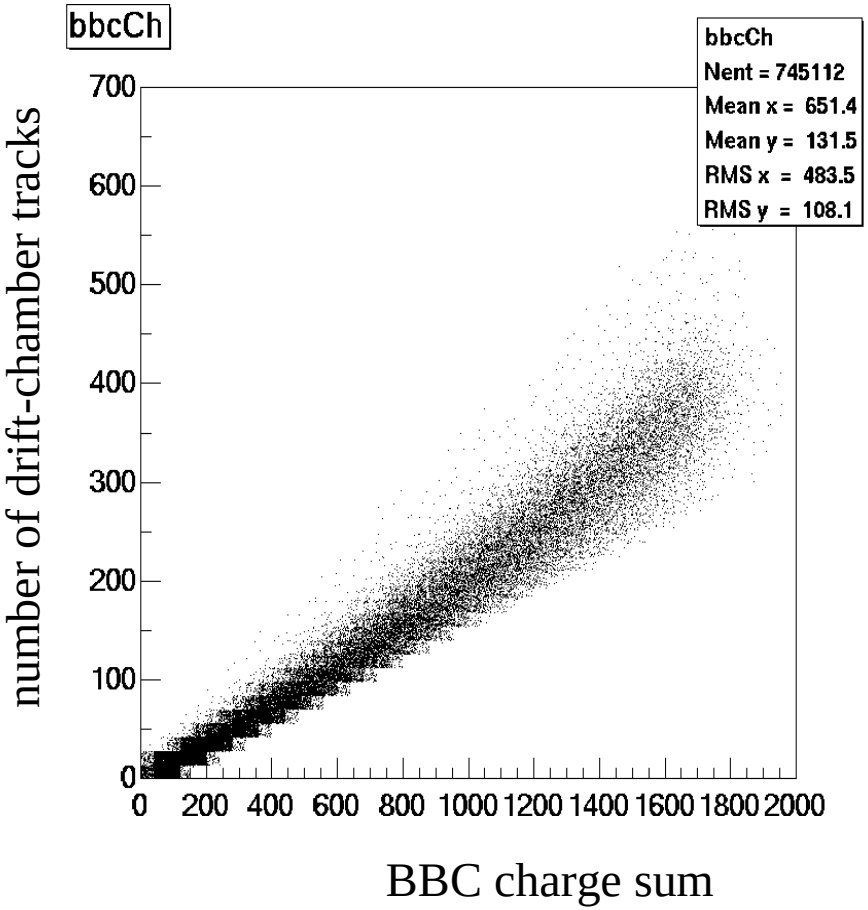
$$\tan n\Phi = \frac{\sum \mathrm{pt_i} \sin n\phi_i}{\sum \mathrm{pt_i} \cos n\phi_i}$$



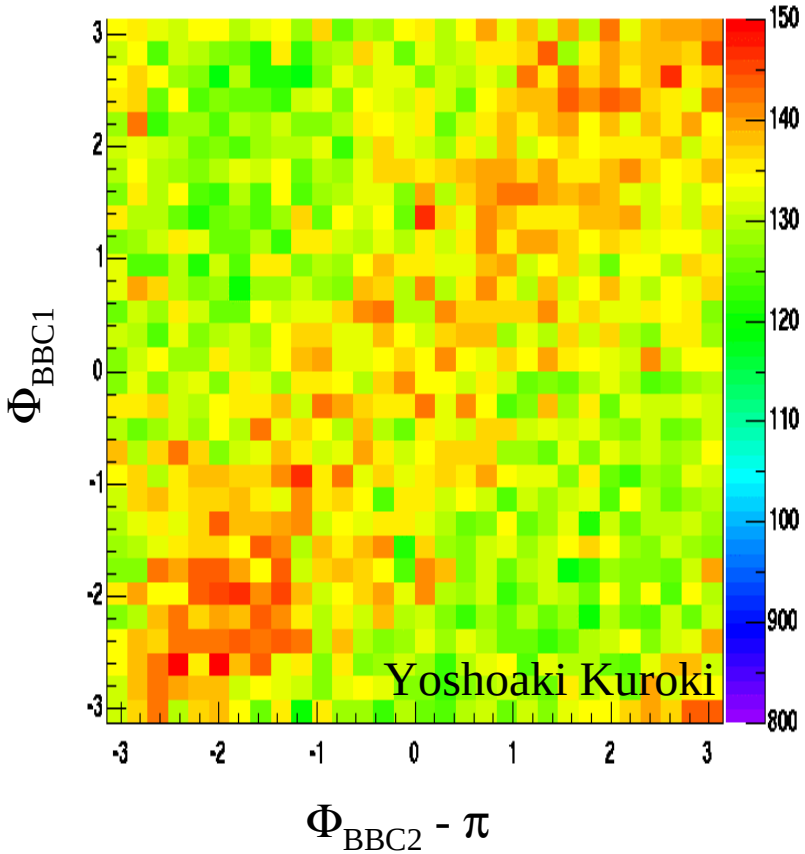


PHENIX Au+Au at 200GeV

centrality selection using charged multiplicity correlation between CNT and BBC



reaction plane correlation between BBC1 and BBC2



Reaction plane resolution (correlation between two reac. planes)

$\langle\cos(\Phi^{A1}-\Phi^{B1})\rangle$

$\langle\sin(\Phi^{A1}-\Phi^{B1})\rangle$

One BBC is forced to point opposite direction, That's why this is positive.

$\langle\cos(2(\Phi^{A2}-\Phi^{B2}))\rangle$

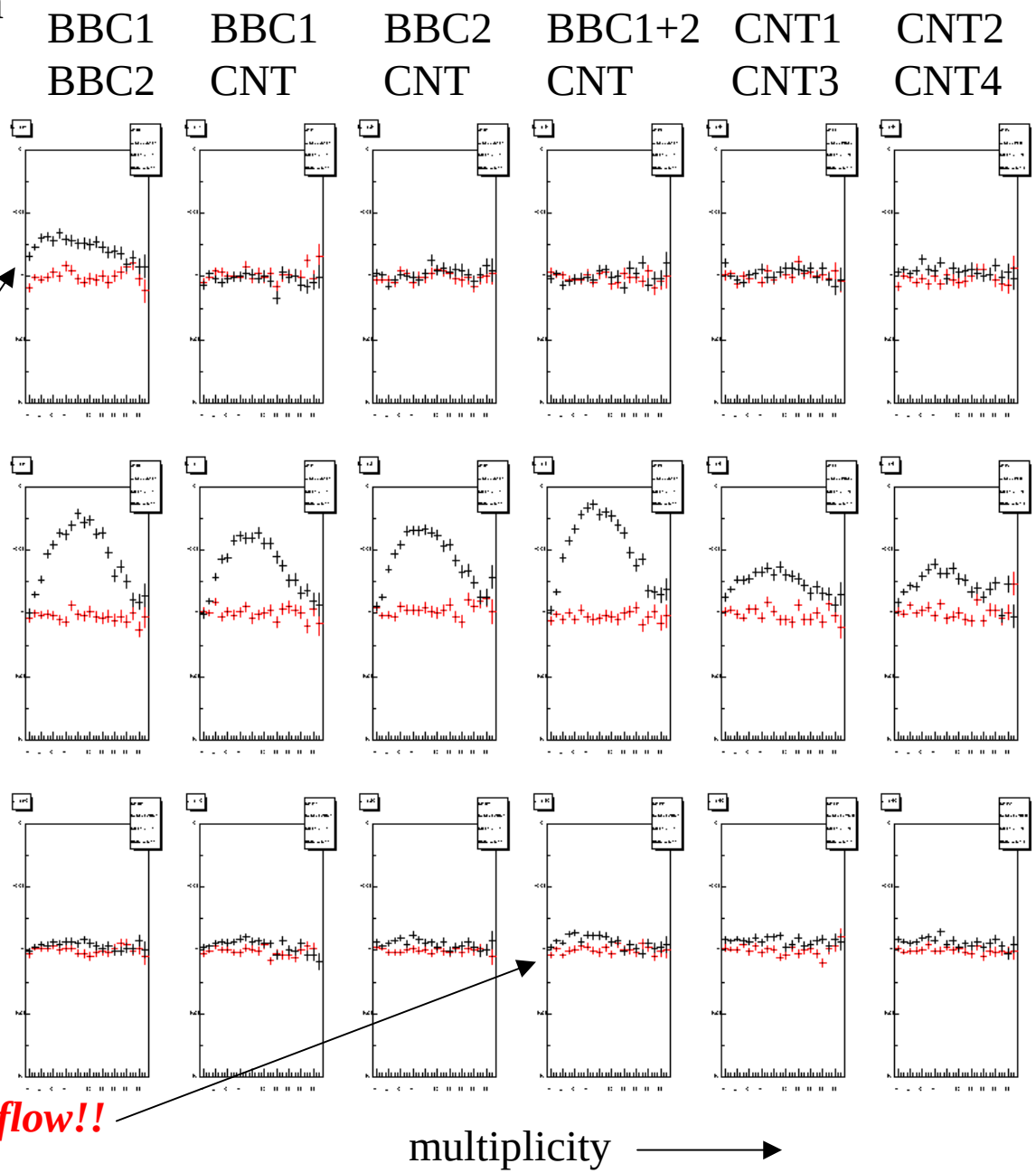
$\langle\sin(2(\Phi^{A2}-\Phi^{B2}))\rangle$

BBC has better resolution than CNT, BBC1+2 is the best.

$\langle\cos(2(\Phi^{A2}-\Phi^{B1}))\rangle$

$\langle\sin(2(\Phi^{A2}-\Phi^{B1}))\rangle$

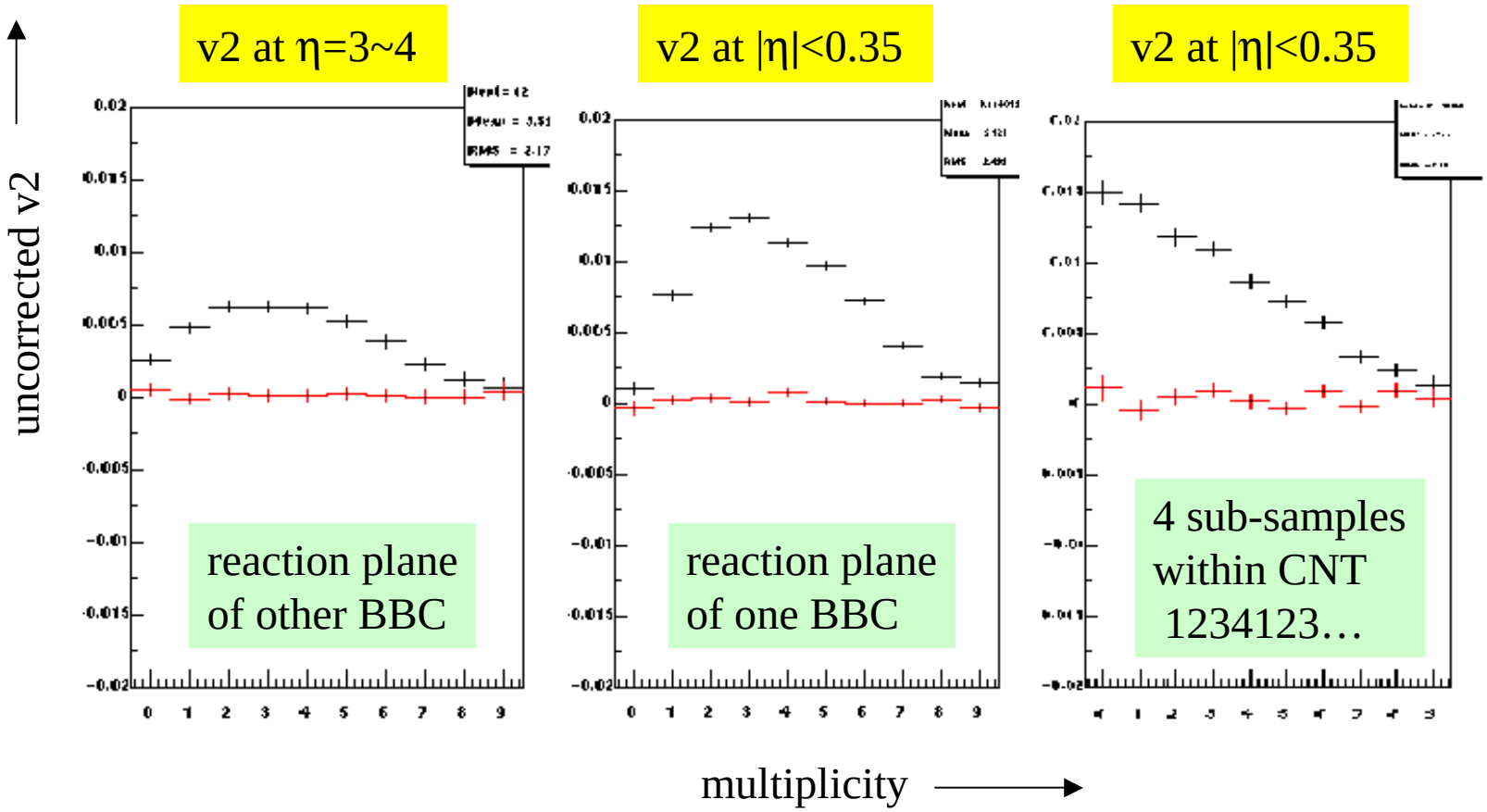
The 1st and the 2nd correlation is positive, ***in-plane elliptic flow!!***



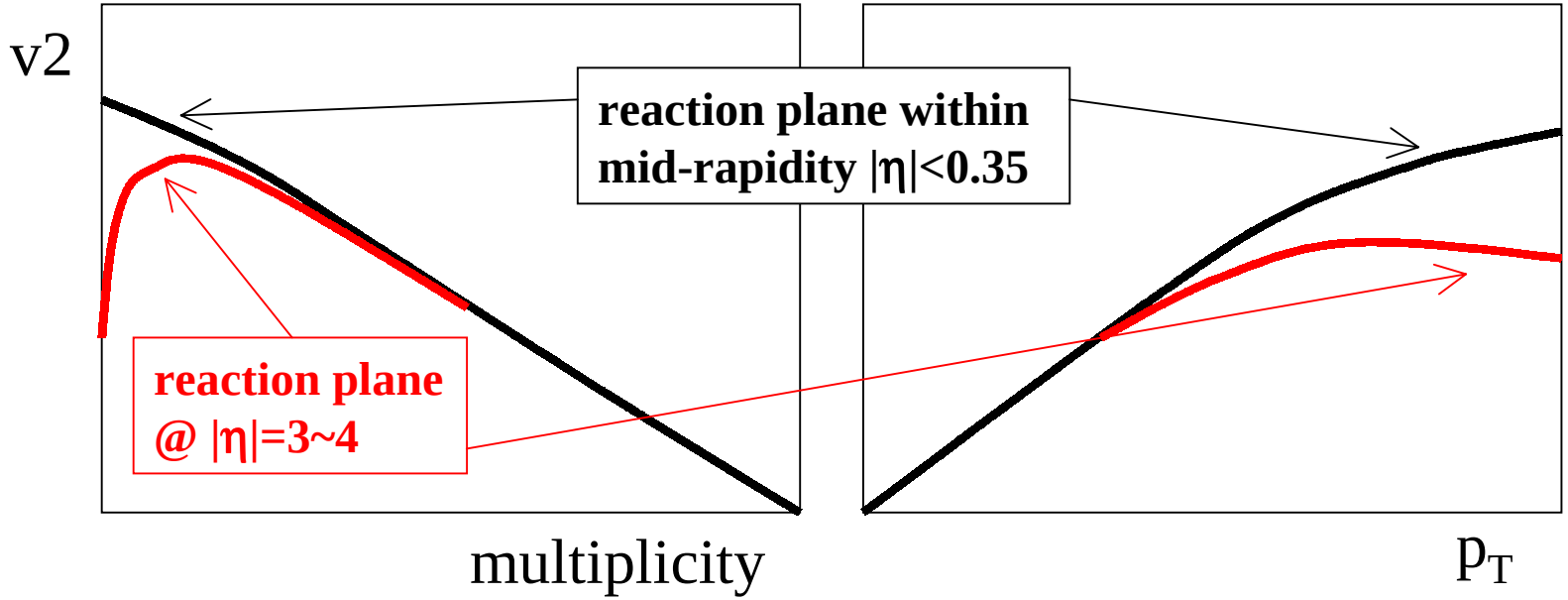
PHENIX Au+Au at 200GeV

v2 comparison at η=0, 3~4
and choice of reaction plane

PHENIX Au+Au at 200GeV

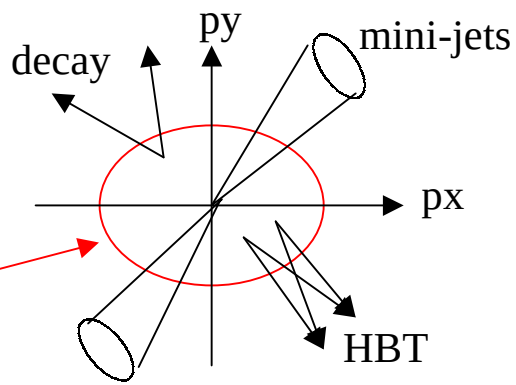


mid-rapidity v2



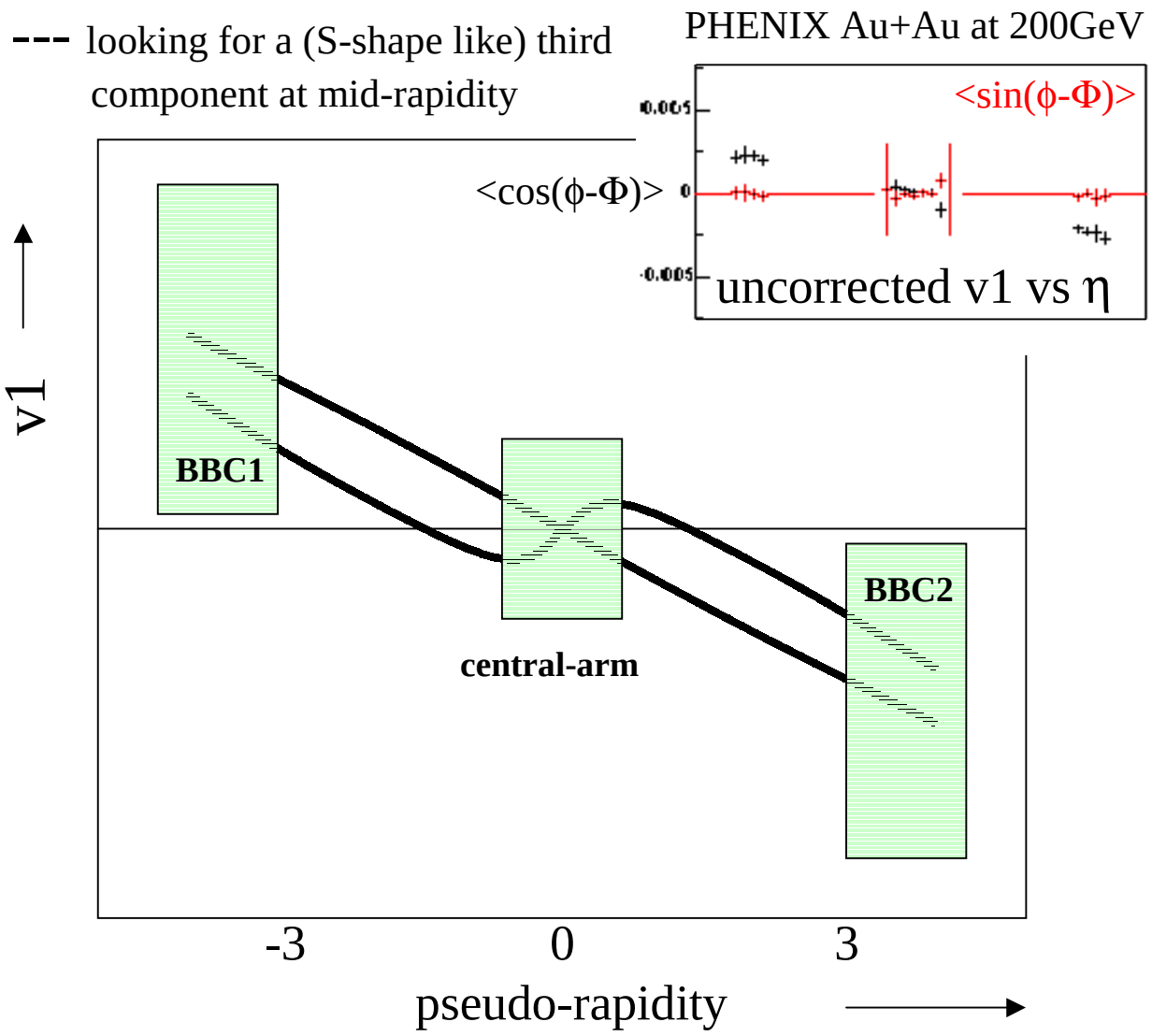
elliptic event anisotropy around the mid-rapidity → Jet?! (non-flow)

"normal" elliptic flow with respect to the true reaction plane

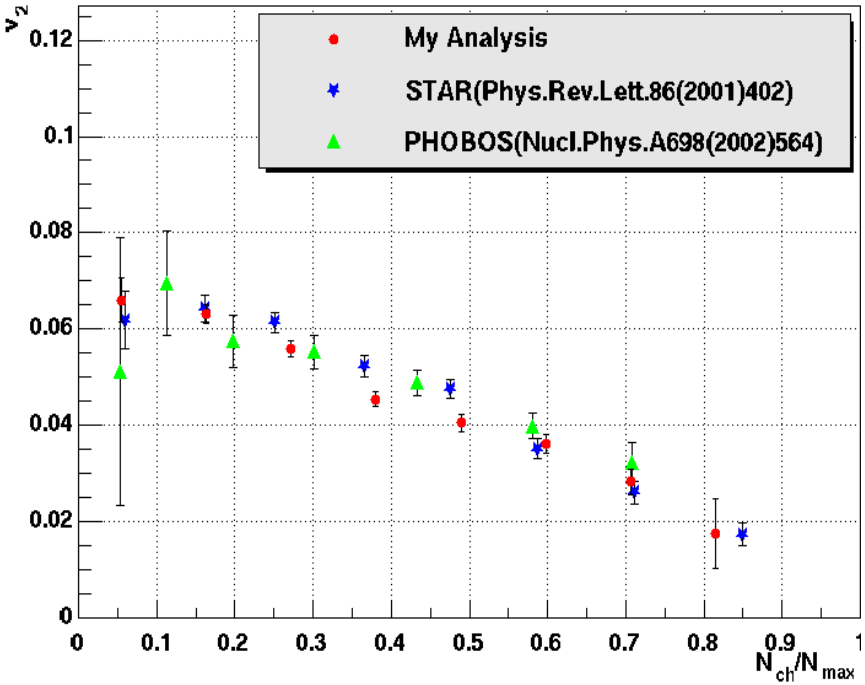


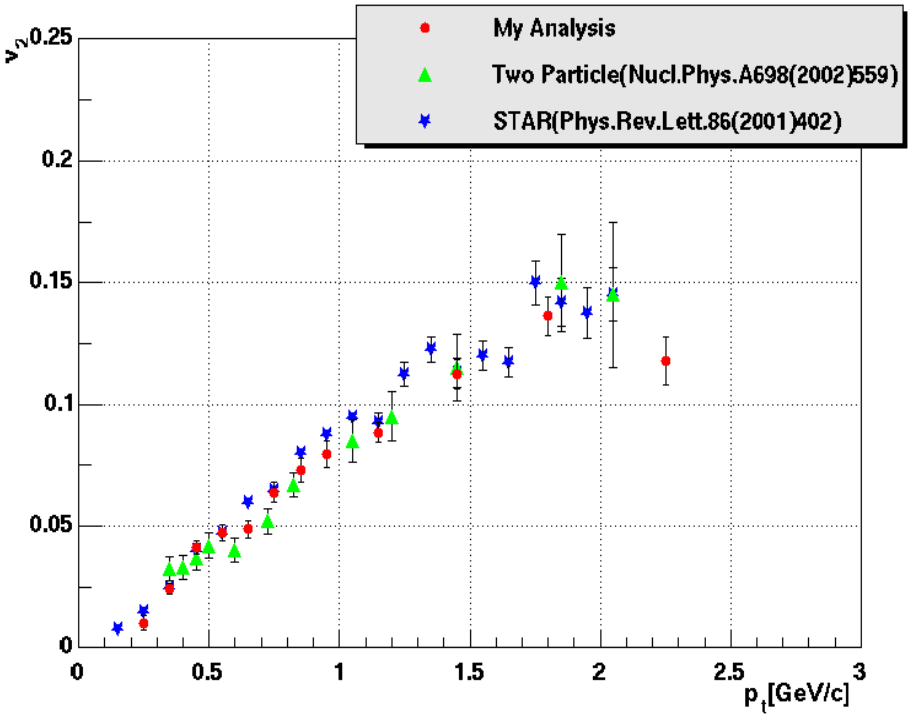
v1 vs η

--- looking for a (S-shape like) third component at mid-rapidity



Comparison of v2 at Au+Au 130GeV

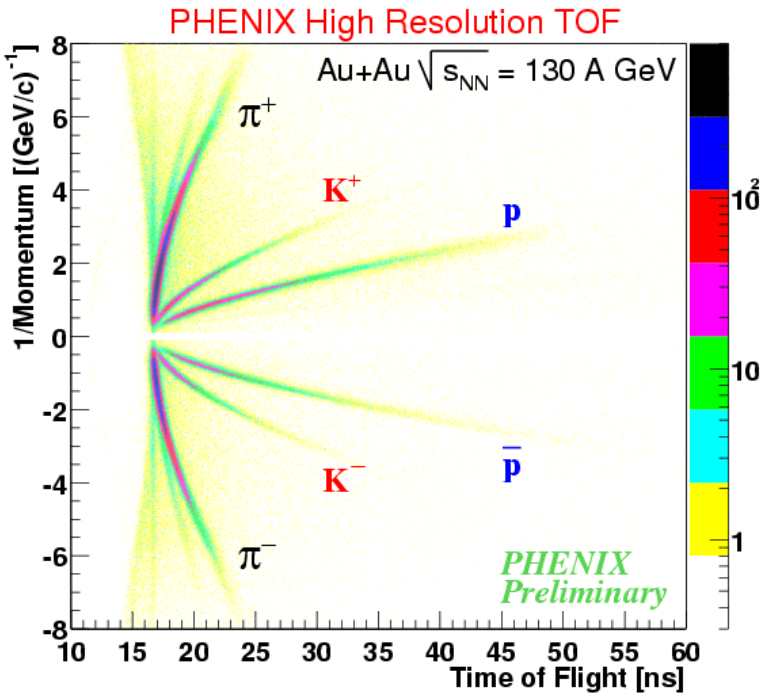




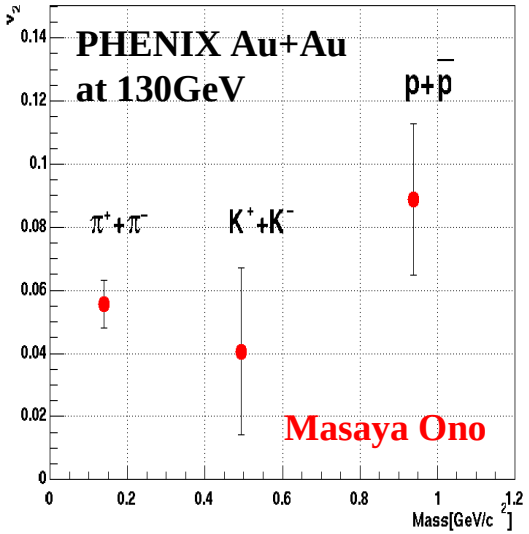
beautiful agreements with different methods
and different experiments at mid-rapidity

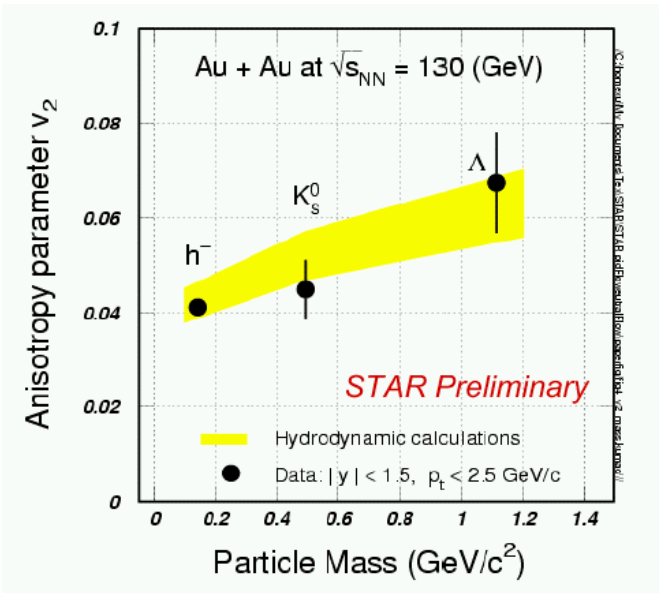
Masaya Ono

Flow of identified particles
in Au+Au 130GeV



Let's hope for year2!





Summary

Consistent results between different methods (reaction plane and pair wise) does not mean there is no other effects in v2.

Reaction plane with a large rapidity gap (defined in BBC) might tell us about the other sources in v2 especially at low-multiplicity and high pt.

High statistics in year2 data should allow us to study event anisotropy of identified particle and high pt particles in detail and possibly to find the 3rd flow component.