Identified and charged particle azimuthal anisotropy in PHENIX at RHIC

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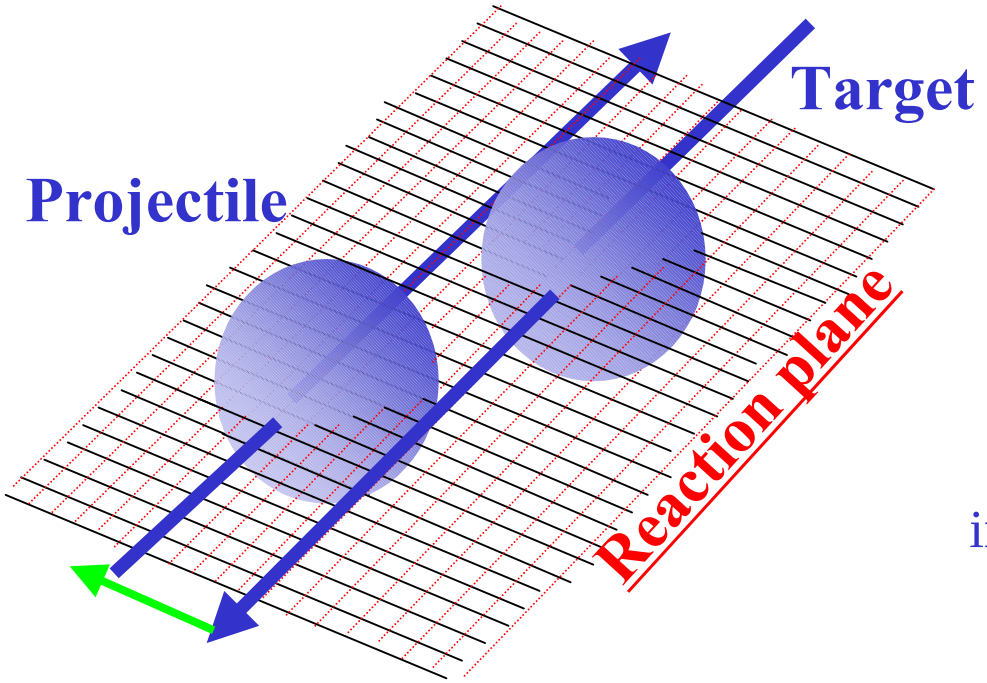
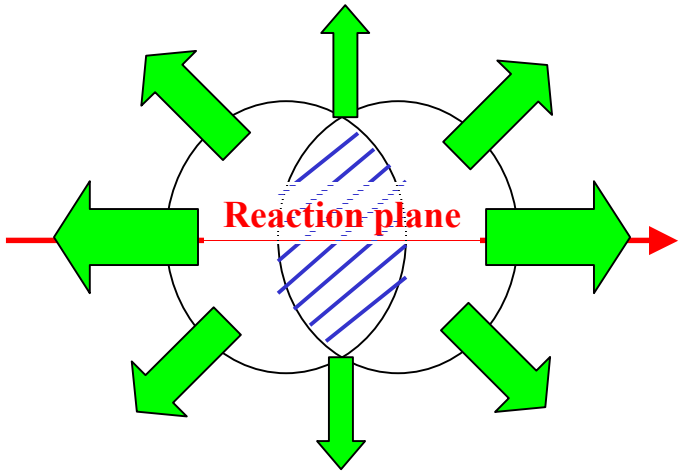
Introduction



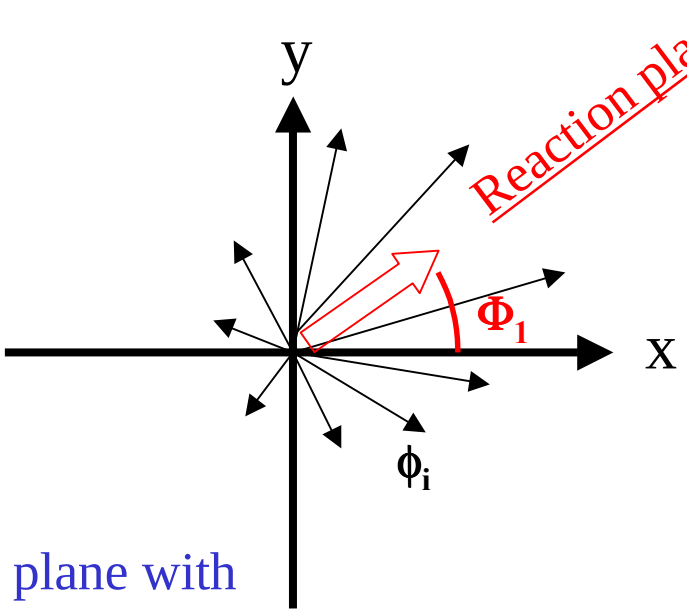


initial geometry → final momentum anisotropy

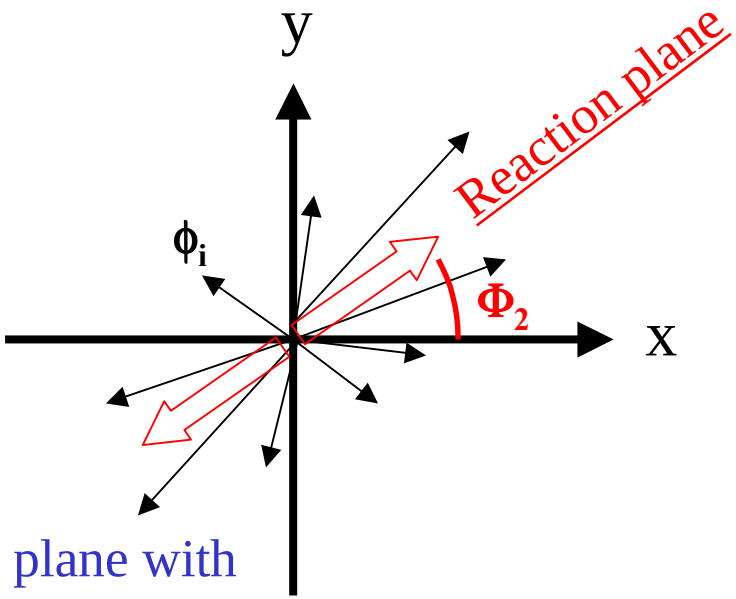
b:impact parameter

Relation to QGP, hard processes,
Jet-quenching and HBT radii,
v1,v2 for different particle species
and their p_T, rapidity, centrality
dependences

Reaction plane definition



plane with
the directed moment



plane with
the elliptic moment

$$\tan(\Phi_1) = \frac{\Sigma\, w_i * \sin(\phi_i)}{\Sigma\, w_i * \cos(\phi_i)}$$

$$\tan(2\Phi_2) = \frac{\Sigma\, w_i * \sin(2\phi_i)}{\Sigma\, w_i * \cos(2\phi_i)}$$

(w_i: 1 or p_T)

reaction plane based analysis

$$dN/d(\phi-\Phi) = N\,(1 + \Sigma\, 2v_n{}'\cos(n(\phi-\Phi)))$$

ϕ : azimuthal angle for measured particles

Φ : reaction plane angle

$v_n{}'$: raw anisotropy parameter

$v_n = v_n{}'/F$: corrected anisotropy parameter

F : reaction plane resolution

pair wise correlation analysis

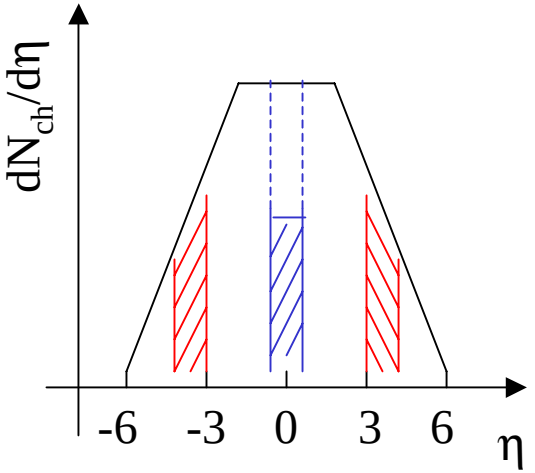
$$N^{real}(\Delta\phi)/N^{mixed}(\Delta\phi) = N\,(1 + \Sigma\, 2v_n{}^2\cos(n(\Delta\phi)))$$

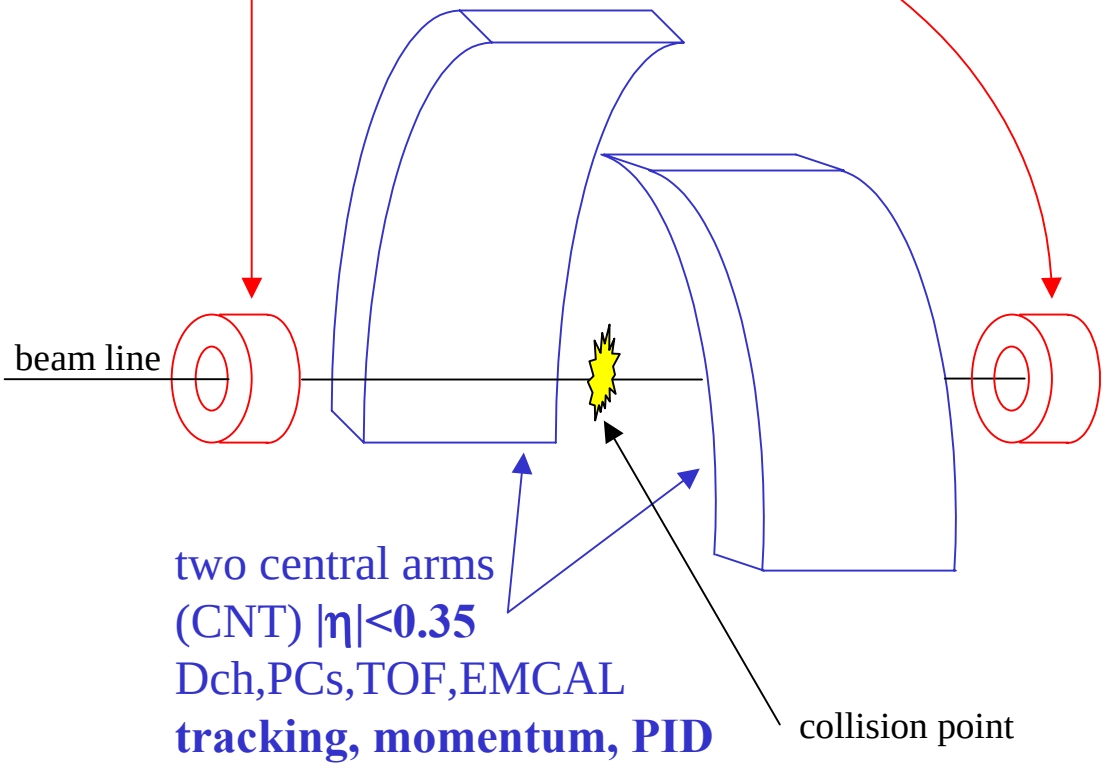
$\Delta\phi : \phi_i - \phi_j$

$$F(x) = A\,\exp(-0.5(x/\sigma)^2) + B\,(1+2v_2{}^2\cos(2x))$$

Gauss term is to account for some of the non-flow contribution.

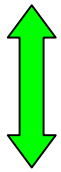
Beam-beam counter
(BBC) **|η|=3~4**
64pmts in each BBC
charged particles





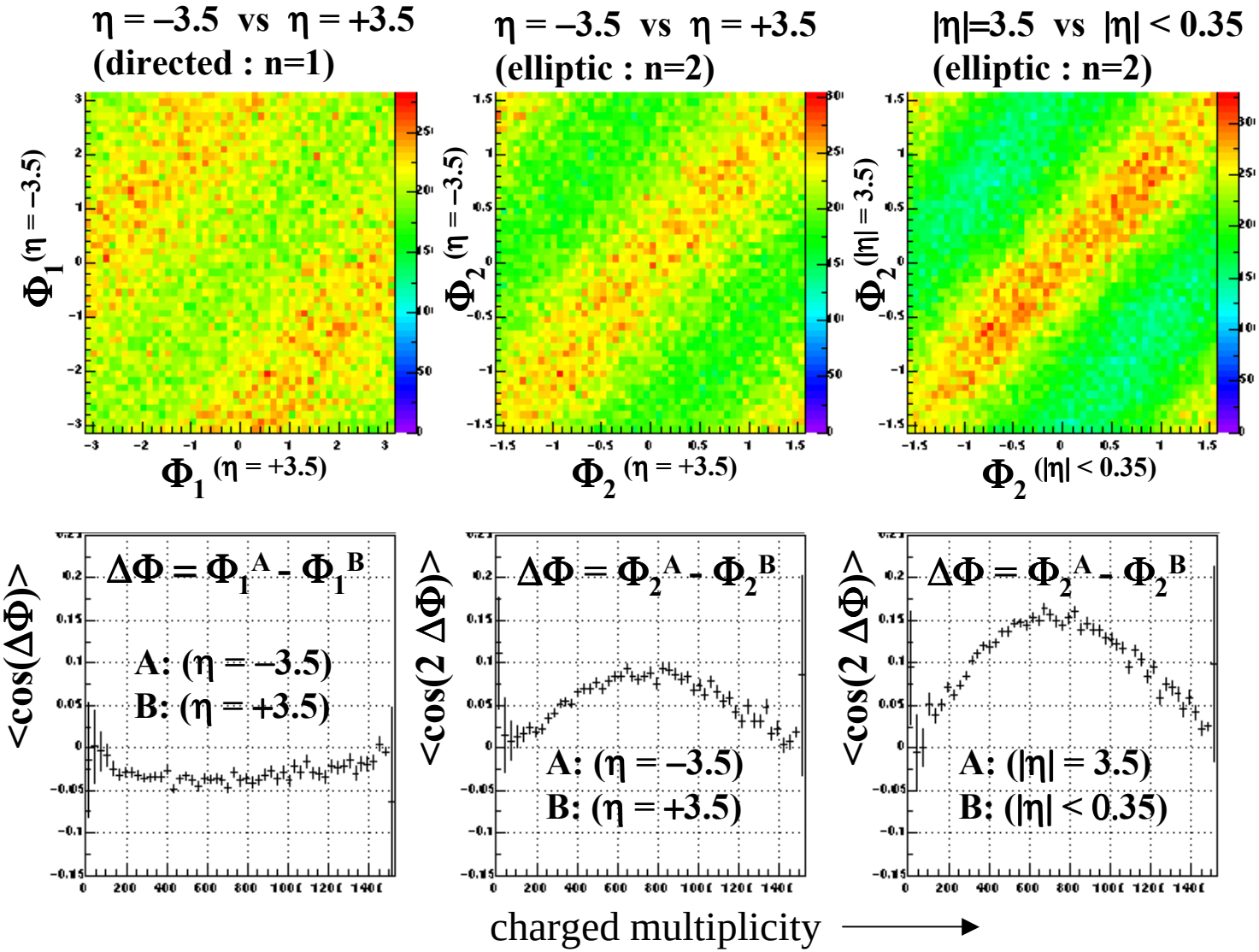
two central arms
(CNT) **|η|<0.35**
Dch,PCs,TOF,EMCAL
tracking, momentum, PID

Reaction plane determination is at 3 units of rapidity away from the mid-rapidity, therefore less non-flow contributions.

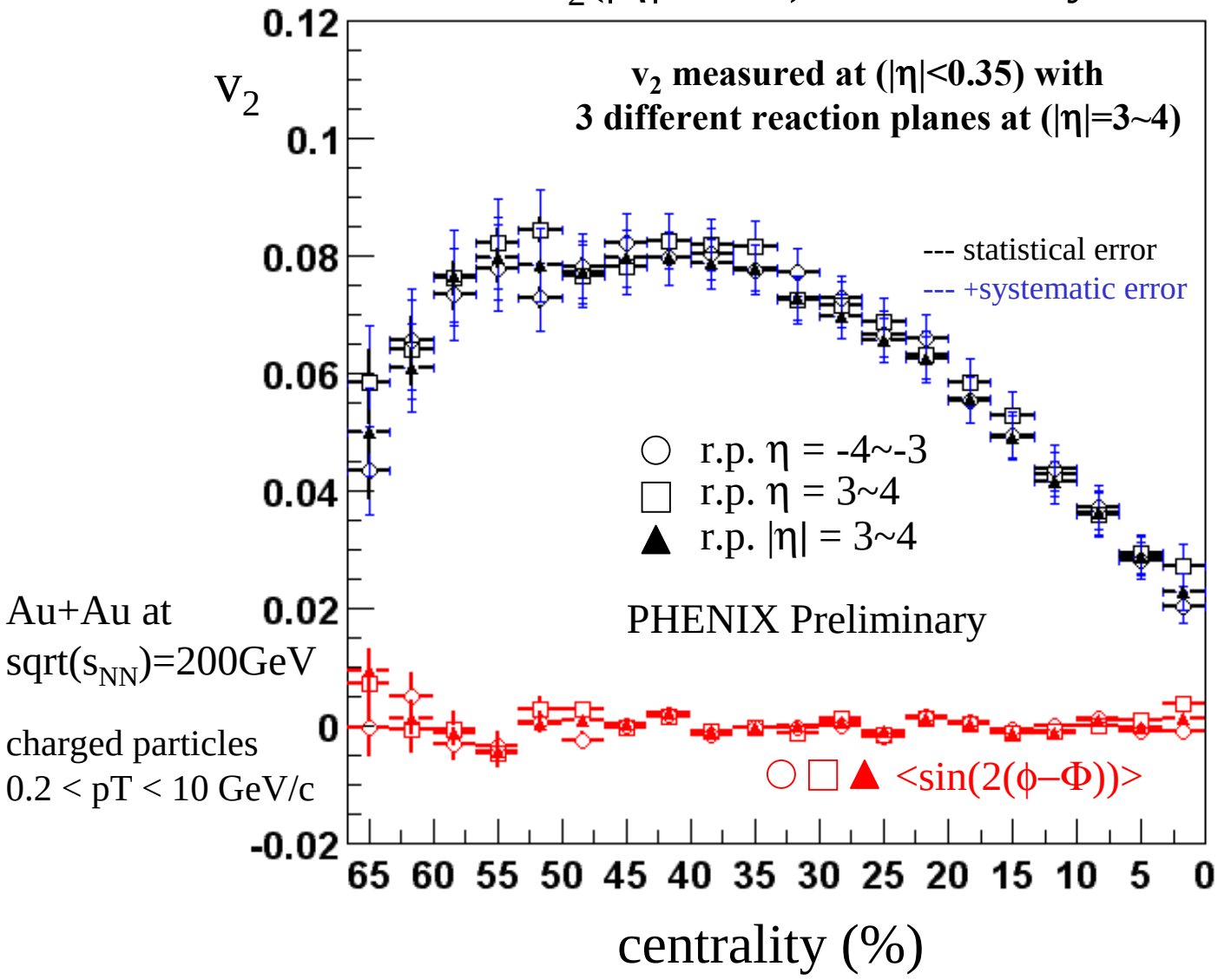


Pair correlation analysis uses charged tracks at mid-rapidity.

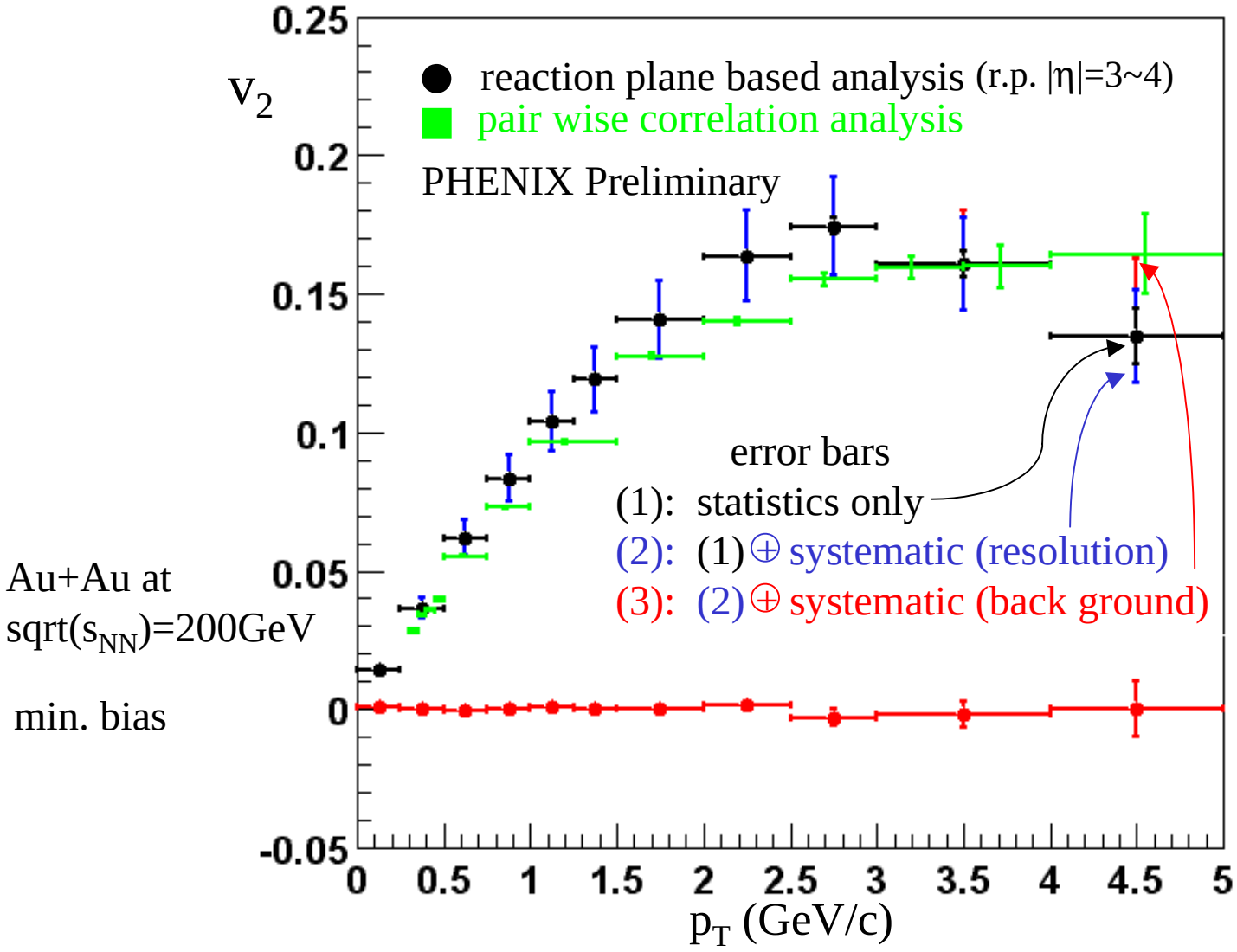
reaction plane correlation and resolution



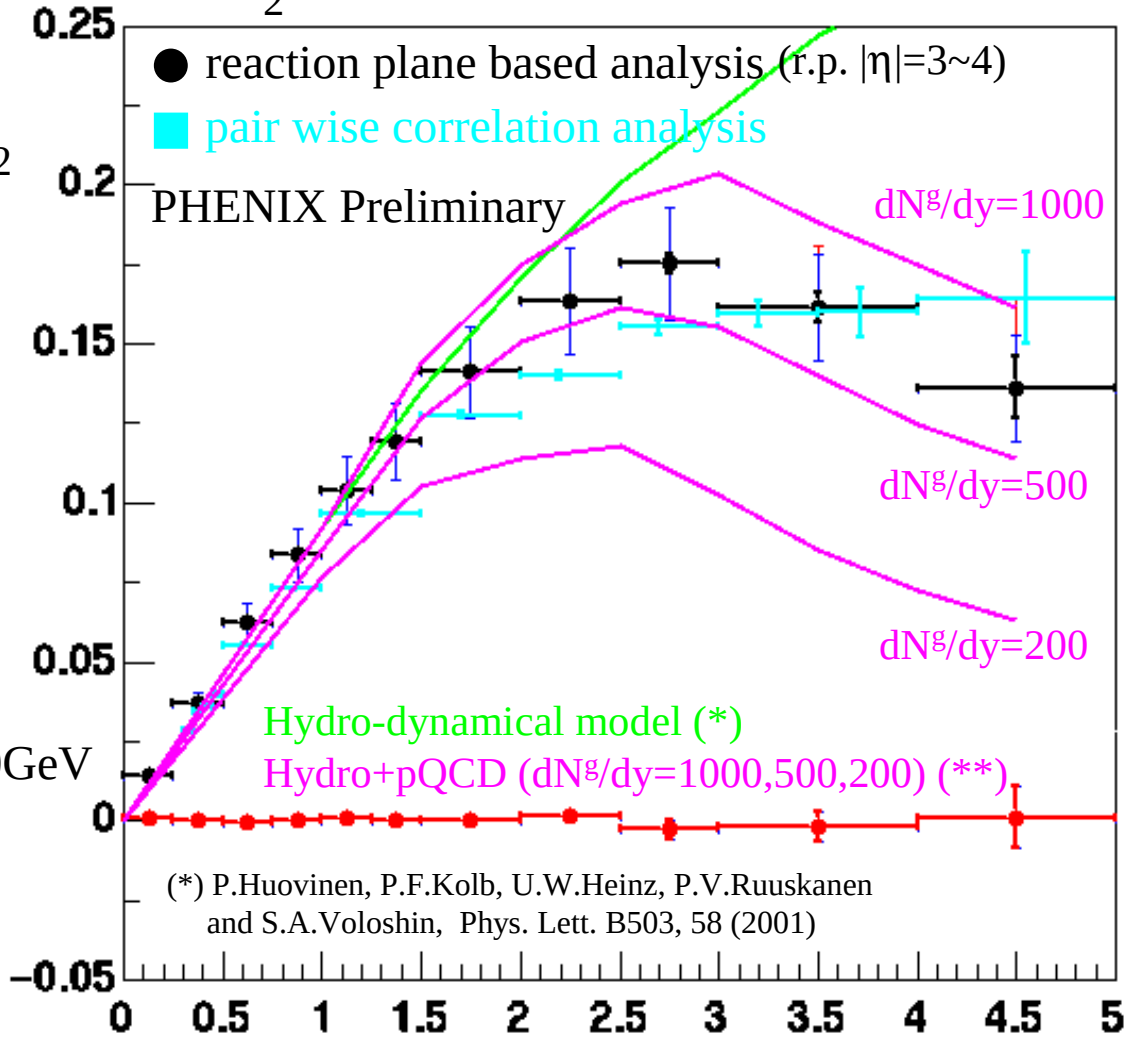
$v_2(|\eta|<0.35)$ vs centrality



v_2 vs transverse momentum



v_2 vs transverse momentum



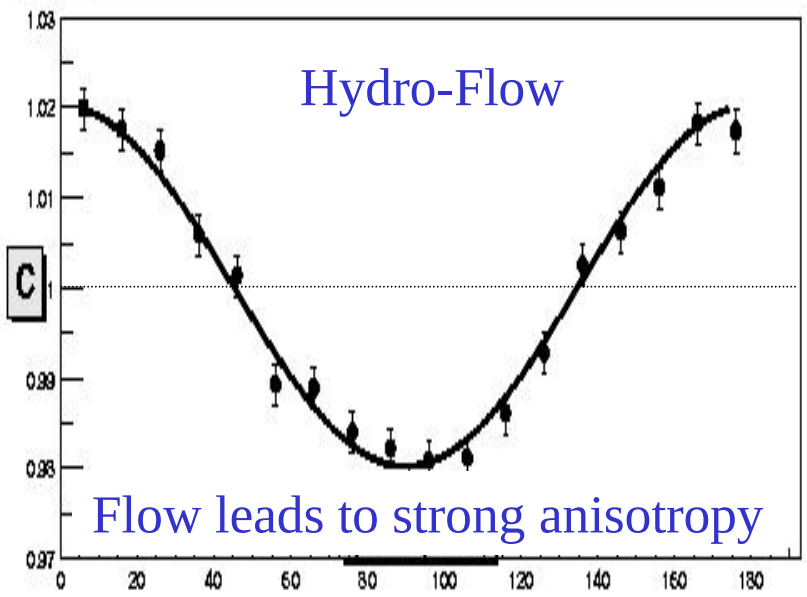
Au+Au at sqrt(s_{NN})=200GeV

min. bias

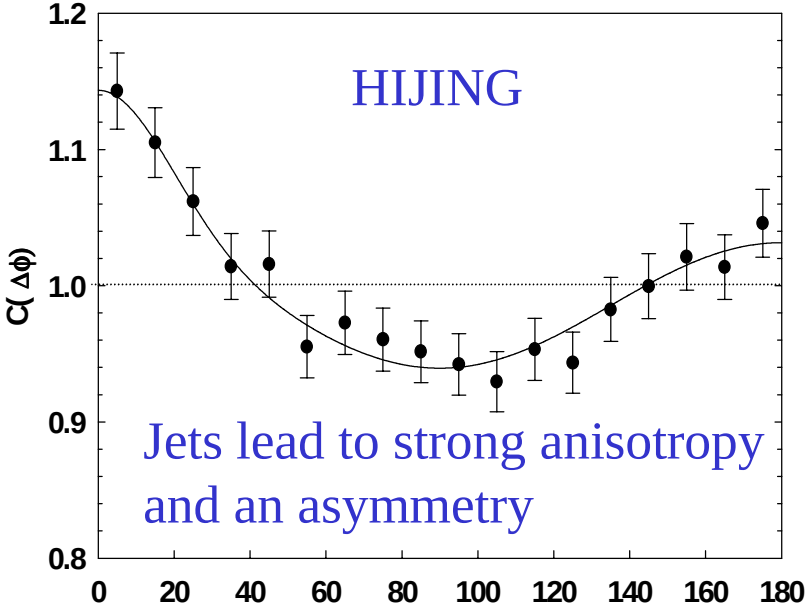
(*) P.Huovinen, P.F.Kolb, U.W.Heinz, P.V.Ruuskanen and S.A.Voloshin, Phys. Lett. B503, 58 (2001)

(**) M.Gyulassy, I.Vitev and X.N.Wang, Phys. Rev. Lett. 86, 2537, (2001)

effect of jets on pair wise correlation (MC)



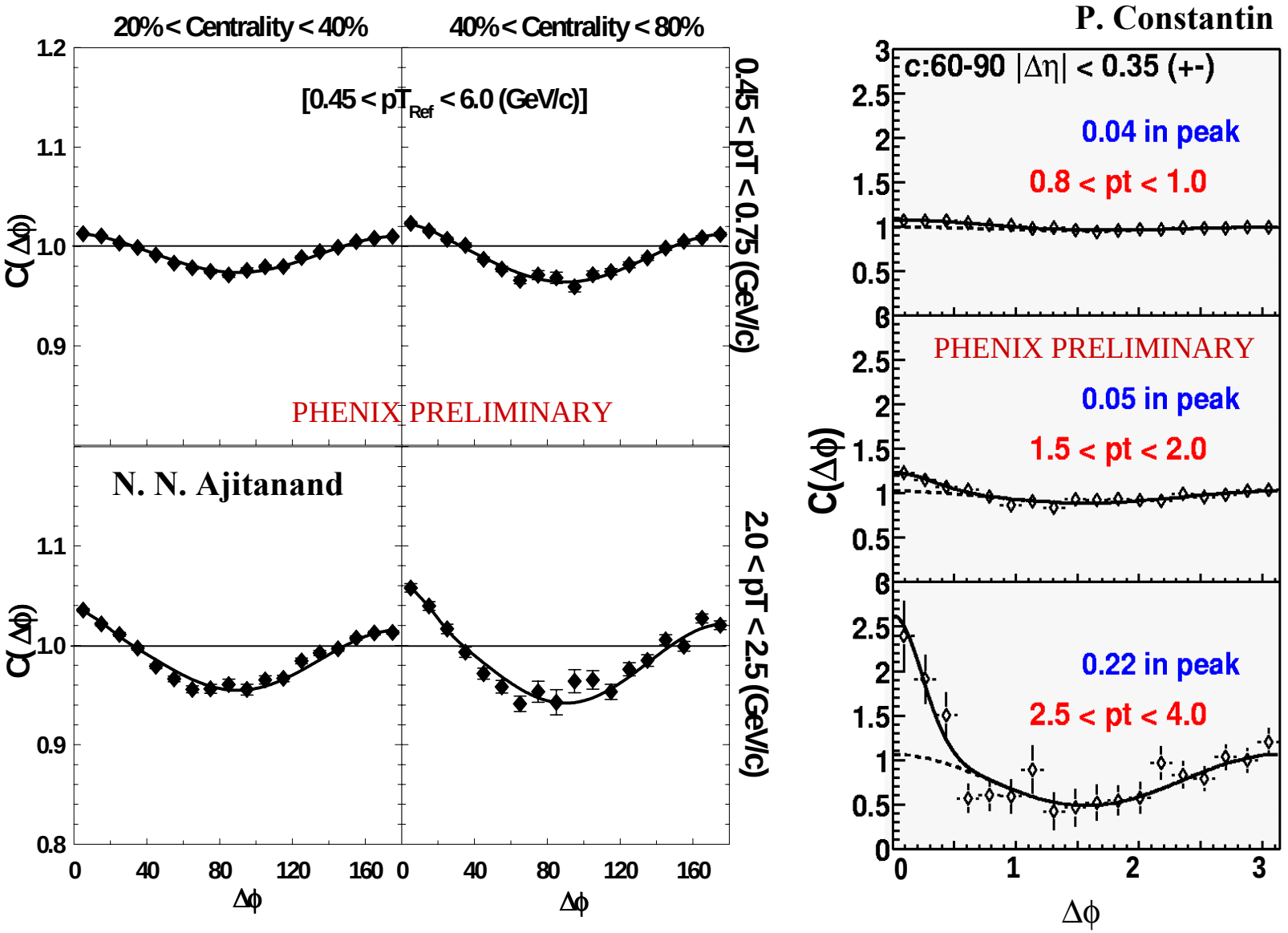
$\Delta\phi$ (deg)



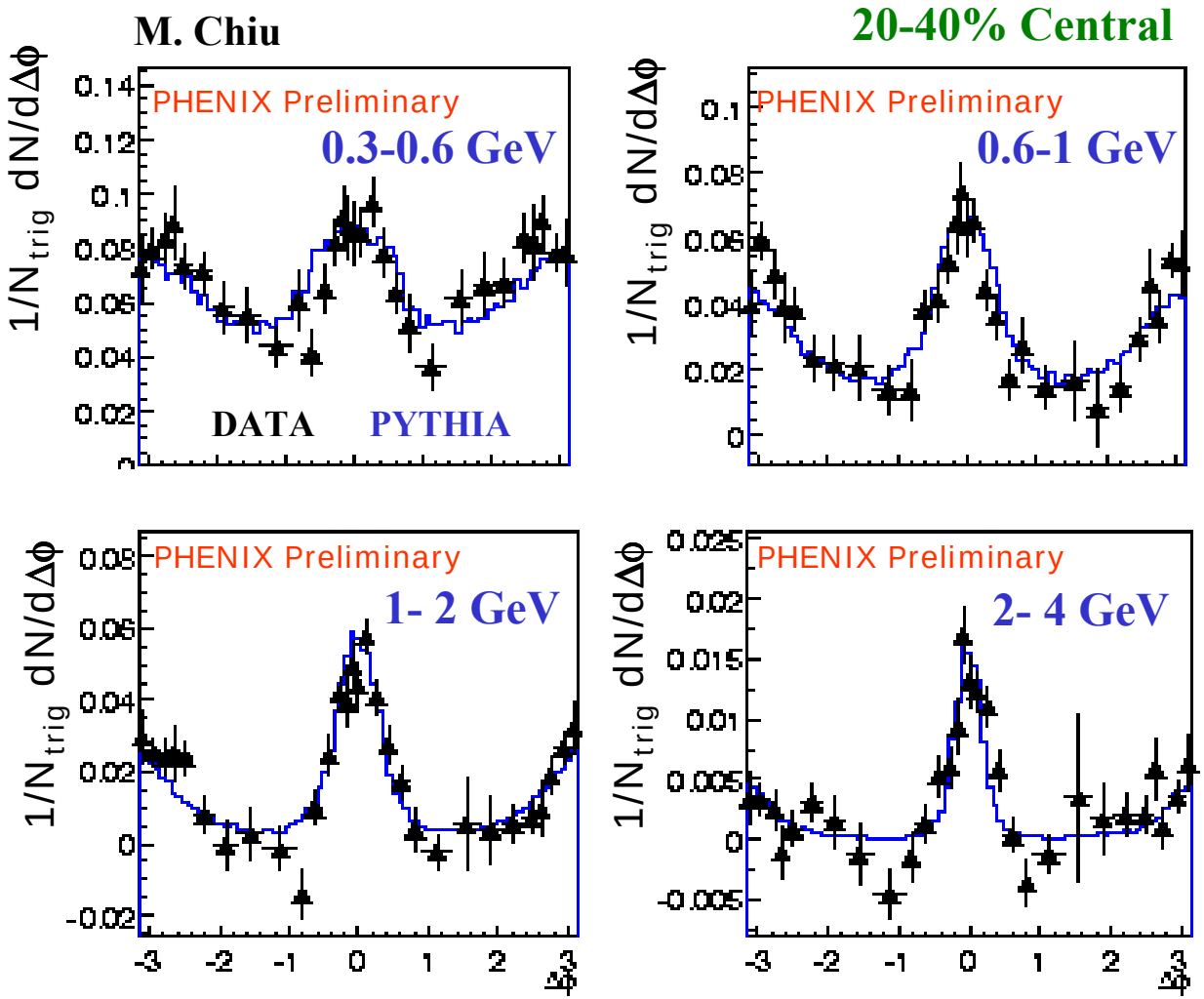
$\Delta\phi$ (deg)

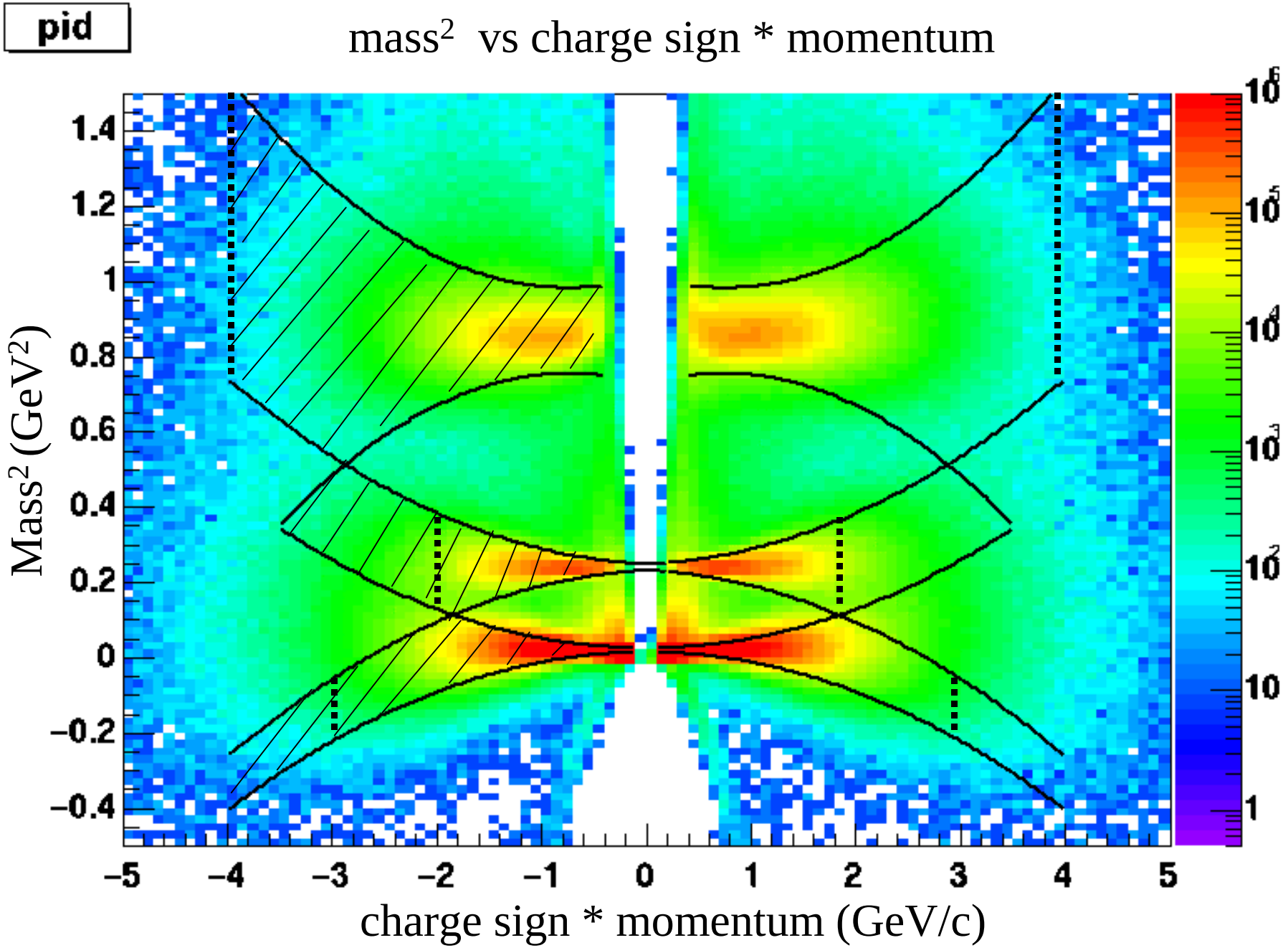
The anisotropy of the correlation function reflects
both flow and Jet contribution

jets like more in peripheral events and at higher p_T



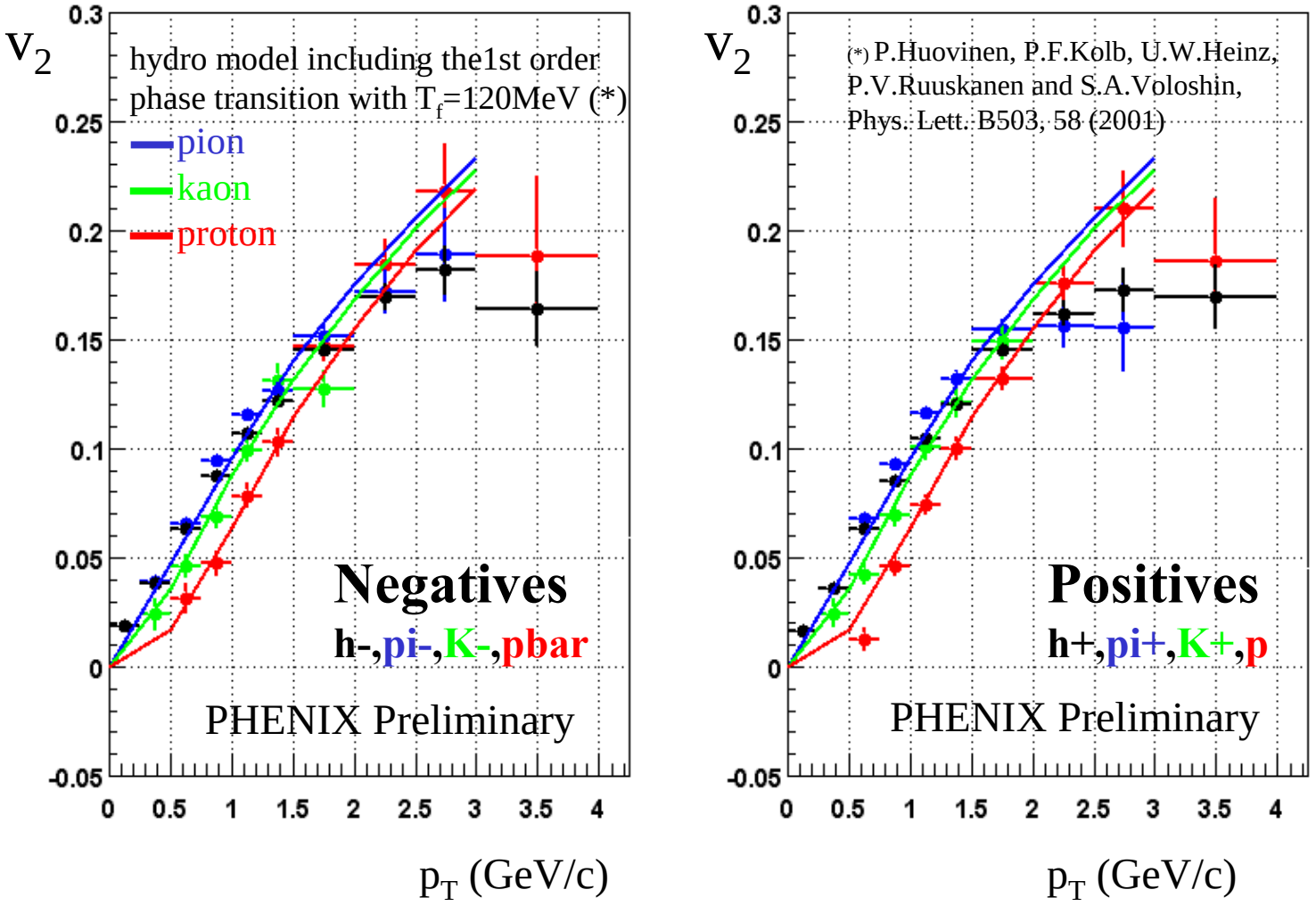
direct measurement of jets (charged particles) with respect to triggered (survived) photon (p_T > 2.5GeV/c)




pid
mass^2 vs charge sign * momentum
Mass^2 (GeV^2)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−5
−4
−3
−2
−1
0
1
2
3
4
5
charge sign * momentum (GeV/c)
10^6
10^5
10^4
10^3
10^2
10
1

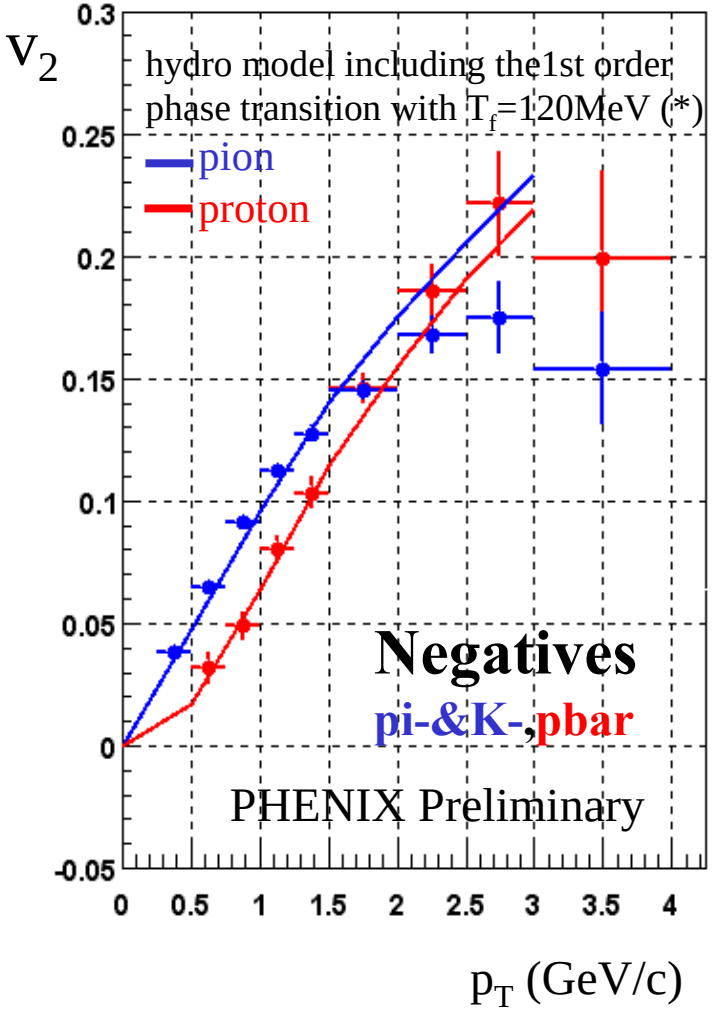
v_2 of identified hadrons

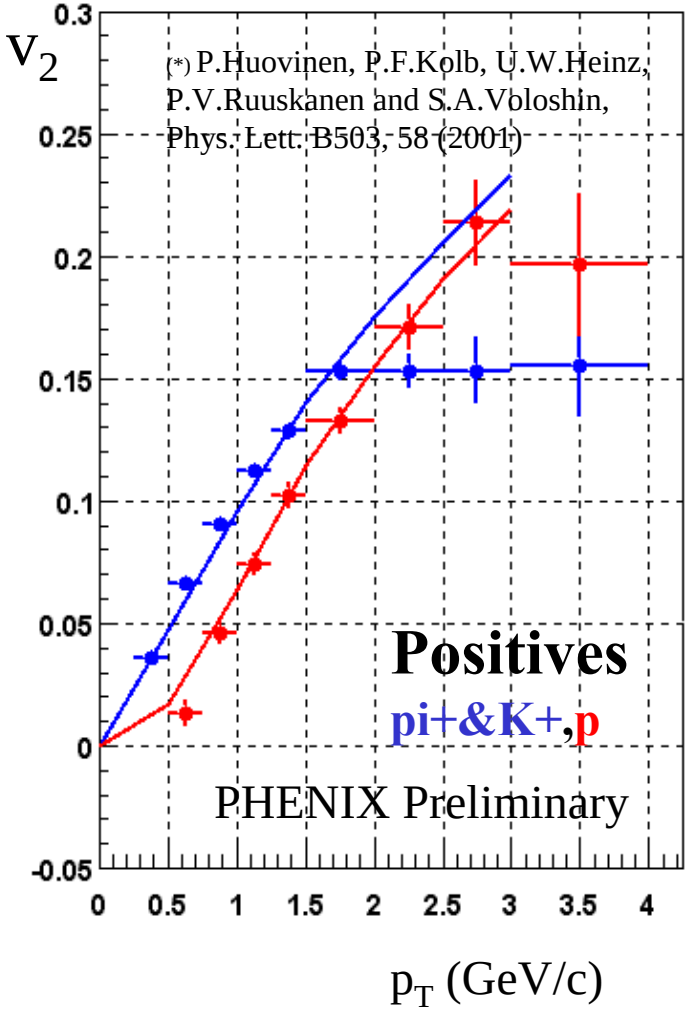
Au+Au at sqrt(s_{NN})=200GeV
min. bias r.p. |η|=3~4



v_2 of identified hadrons

Au+Au at sqrt(s_{NN})=200GeV
min. bias r.p. $|\eta|$=3~4





summary

(1) The reaction plane based event anisotropy analysis is done at PHENIX.
(2) Different techniques to extract anisotropy are compared and the results are consistent.
(3) Jet signal is seen more in peripheral events and at higher p_T.
(4) Identified particles (π+/−,K+/−,p,pbar) v2 parameters are measured and there is clear mass dependence on v2 which is expected by a hydro-dynamical expansion.
(5) There is some indication of v2(p,pbar) > v2(π+/−) for p_T>2.0GeV/c, where the hydro-type model always predicts v2(p,pbar) < v2 (π+/−)