Identified particle v_3 measurements in 200GeV Au+Au collisions at RHIC-PHENIX experiment

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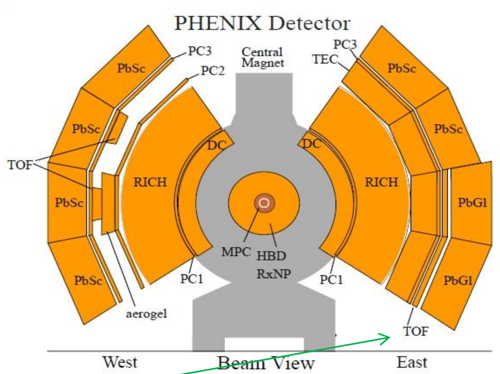
Introduction

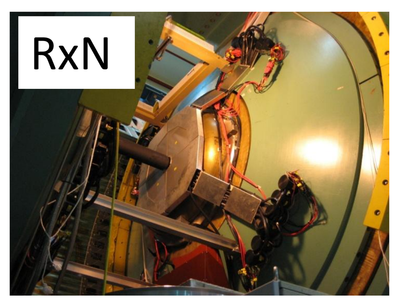
The particle species dependence of transverse momentum distributions as well as elliptic event anisotropy (v_2) have been beautifully described by hydrodynamic model calculation in terms of radial and elliptic collective expansion in high energy heavy ion collisions. The initial participant position fluctuations has been suggested as a source of a triangular initial geometry, which could then expand collectively to form a final triangular event anisotropy v_3 in momentum space. We present the first measurements of v_3 for identified particles at 200GeV Au+Au collisions from RHIC- PHENIX experiment will be presented. The collective triangular expansion behavior seen in v_3 is compared with hydro-dynamic model expectations in order to gain an understanding of possible differences, or similarities , from the radial and elliptic expansion.

Data set

PHENIX Run7 Au+Au 200GeV
Centrality 20-50%



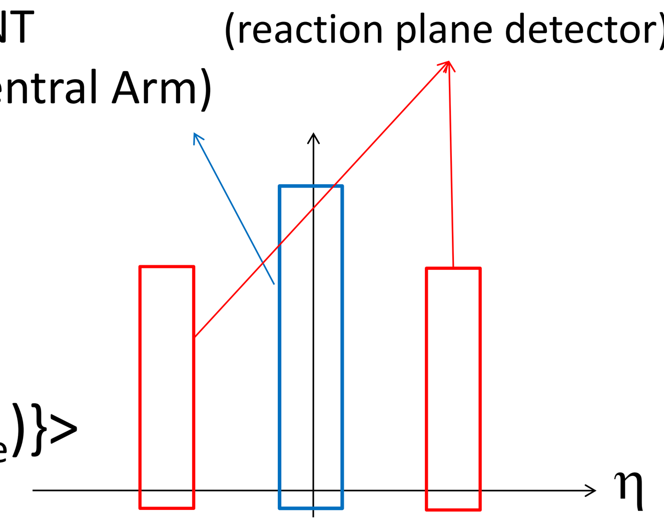
CNT
(PHENIX Central Arm)



(reaction plane detector)

TOF.E

Method



v_2 and v_3 are measured using function.

$v_{n,observed} = \langle\cos\{n(\Phi_{n,particle}-\Phi_{n,Reaction\ Plane})\}\rangle$

$v_{n,real} = v_{n,observed} / Res(\Phi_{n,Reaction\ Plane})$

$v_{n,observed}$: observed v_n , $\Phi_{n,particle}$: azimuthal angle of particle

$\Phi_{n,Reaction\ Plane}$: azimuthal angle of Reaction Plane

$v_{n,real}$: real v_n

Calculating Reaction Plane and Resolution is needed for measuring v_2 and v_3.

Reaction Plane and Resolution

Reaction Plane Calibration has 3 steps.

1. Gain correction
   $Q_{\{n\}x}=\Sigma_i w_i\{\cos(n\phi_i)\}$, $Q_{\{n\}y}=\Sigma_i w_i\{\sin(n\phi_i)\}$, $\Phi_{\{n\}}=\mathrm{atan2}(Q_{\{n\}x},Q_{\{n\}y})$
2. Re-Centering
   $Q'_{\{n\}x}=Q_{\{n\}x}-\langle Q_{\{n\}x}\rangle/\sigma_{Qnx}$, $Q'_{\{n\}x}=Q_{\{n\}x}-\langle Q_{\{n\}x}\rangle/\sigma_{Qnx}$, $\Phi'_{\{n\}}=\mathrm{atan2}(Q'_{\{n\}x},Q'_{\{n\}y})$
3. Flattening
   $n\Phi''_{\{n\}}=n\Phi'_{\{n\}}+\Sigma_i 2/i(-\langle\sin(in\Phi'_{\{n\}})\rangle\cos(in\Phi'_{\{n\}})+\langle\cos(in\Phi'_{\{n\}})\rangle\sin(in\Phi'_{\{n\}}))$

Measuring Resolution is needed Reaction Plane correlation.

$\langle\cos\{3(\Phi_A-\Phi_B)\}\rangle$

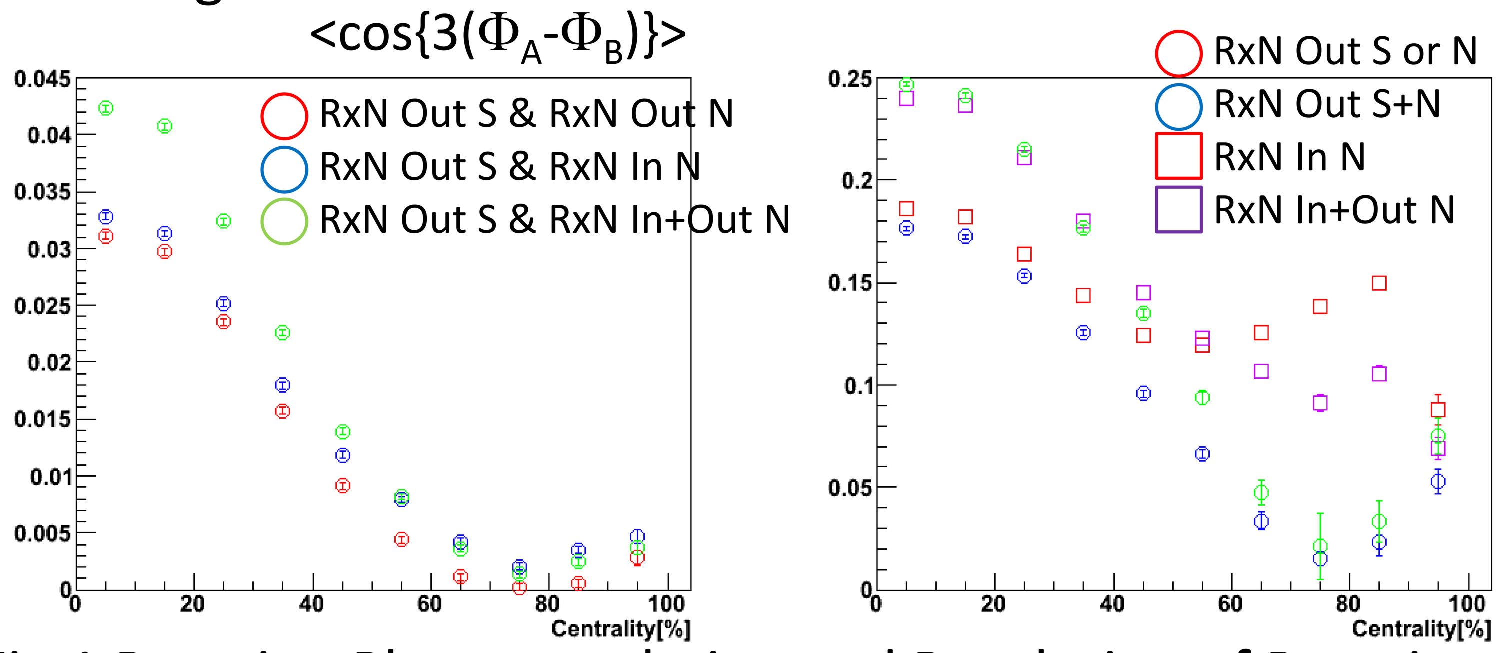


Fig.1 Reaction Plane correlation and Resolution of Reaction Plane

Particle identification

When selecting particle species (π, K, p) particle identification is used via time of flight measurements.

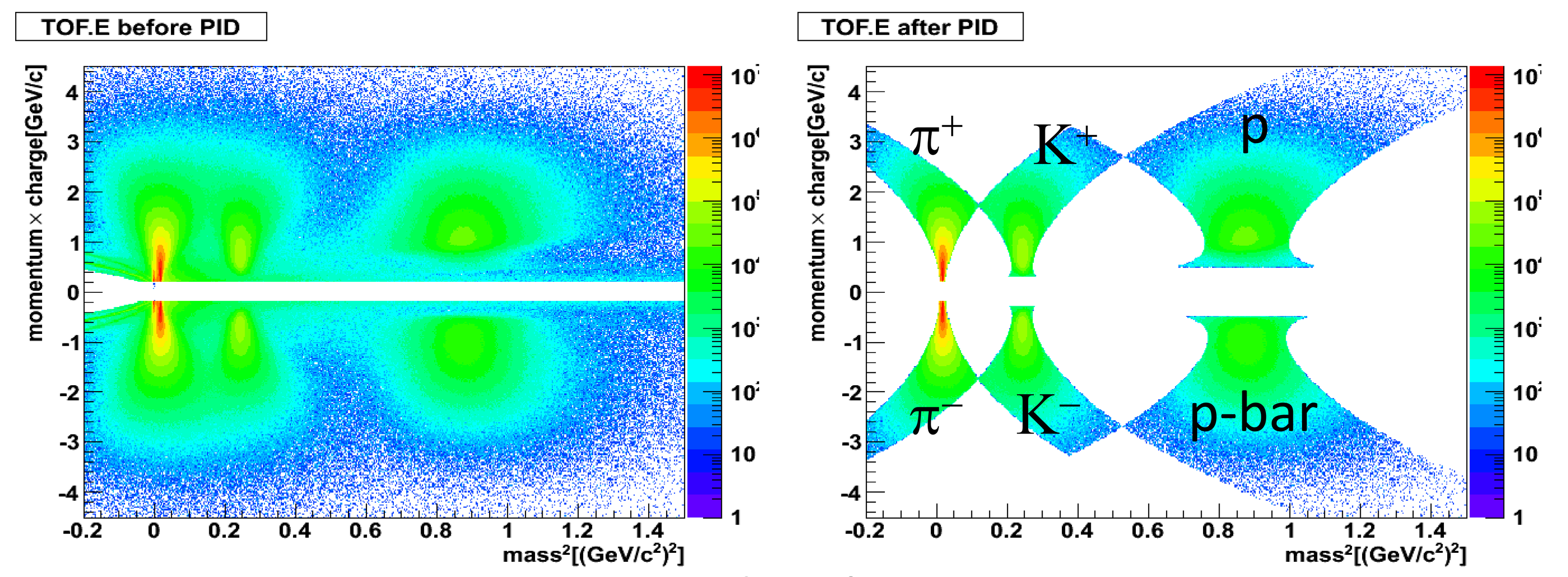


Fig.2 Mass distribution on TOF.E

Results

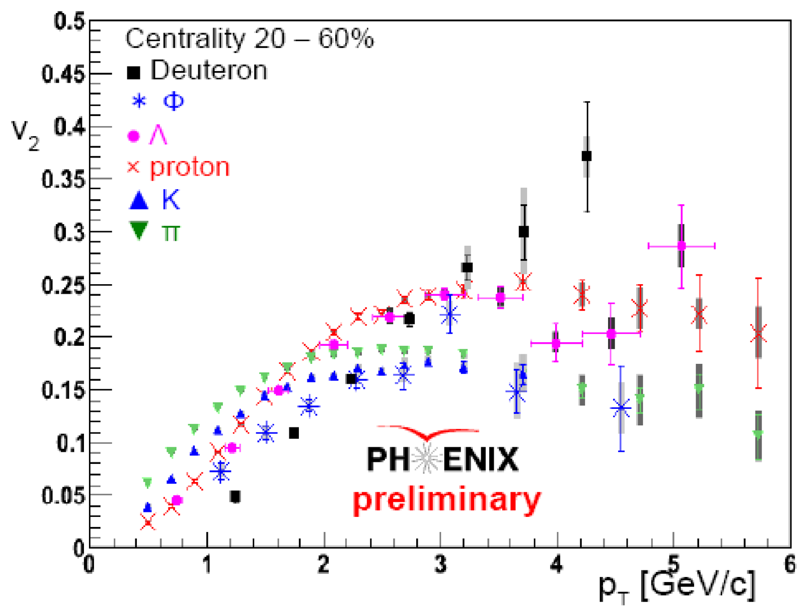


Fig.3 p_T dependence of Identified particle v_2

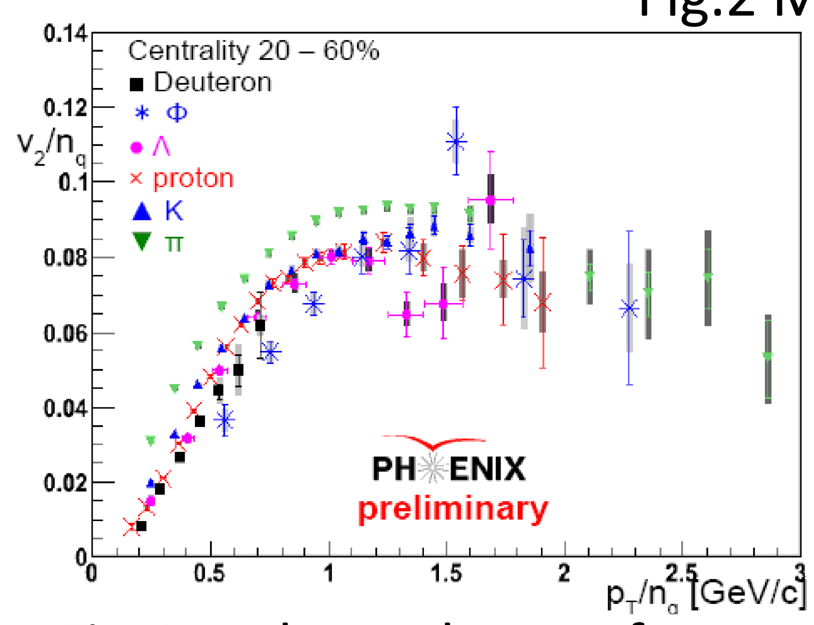


Fig.4 p_T dependence of n_{quark} scaling Identified particle v_2

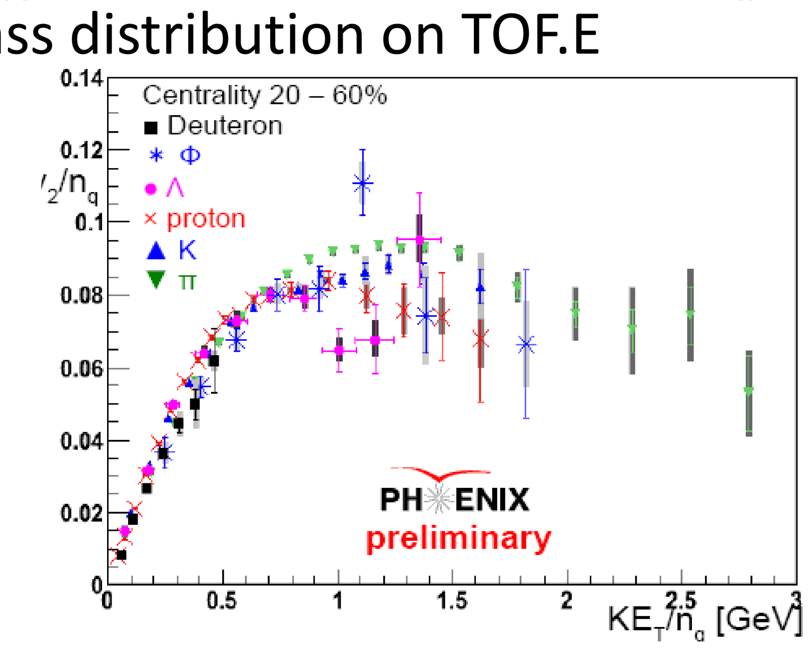


Fig.5 KE_T dependence of n_{quark} scaling Identified particle v_2

$$KE_T = \sqrt{{m_0}^2 + {p_T}^2} - m_0$$

Dependence is similar to meson(π and K) and baryon(p)

Triangular flow in hydrodynamics and transport theory[5]

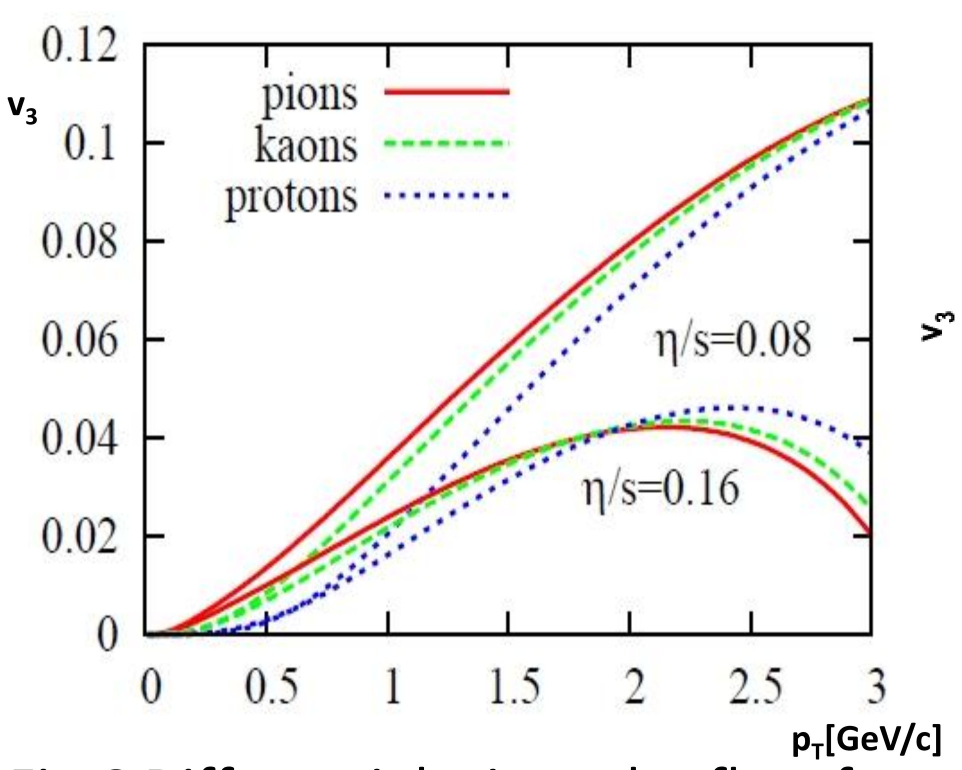


Fig.6 Differential triangular flow for identified particles in central (0-5%) Au-Au collisions at RHIC

[5]Burak Han Alver, arXiv:1007.5469[nucl-th]

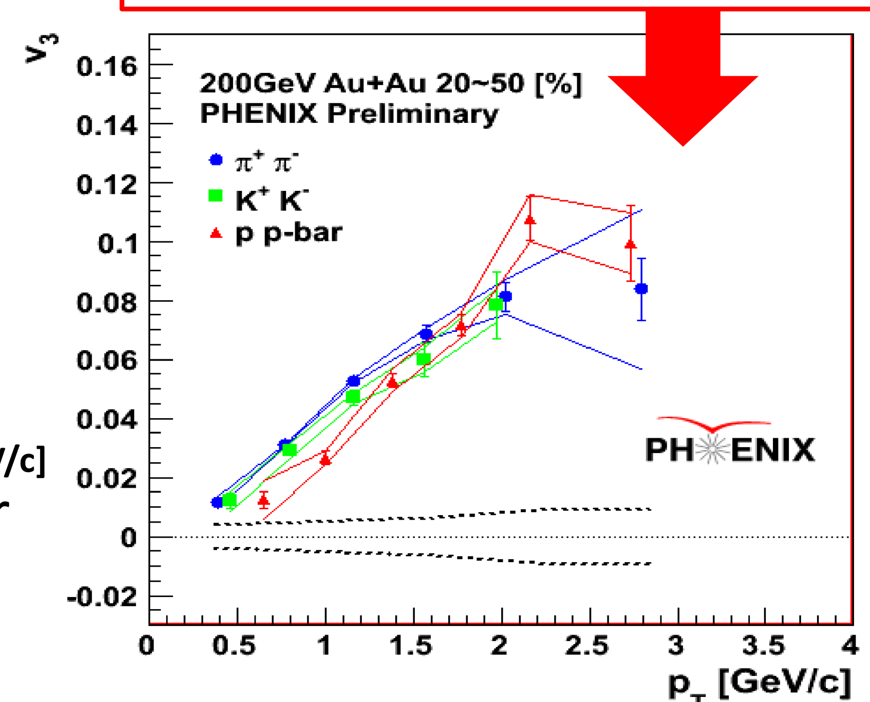


Fig.7 p_T dependence of Identified particle v_3

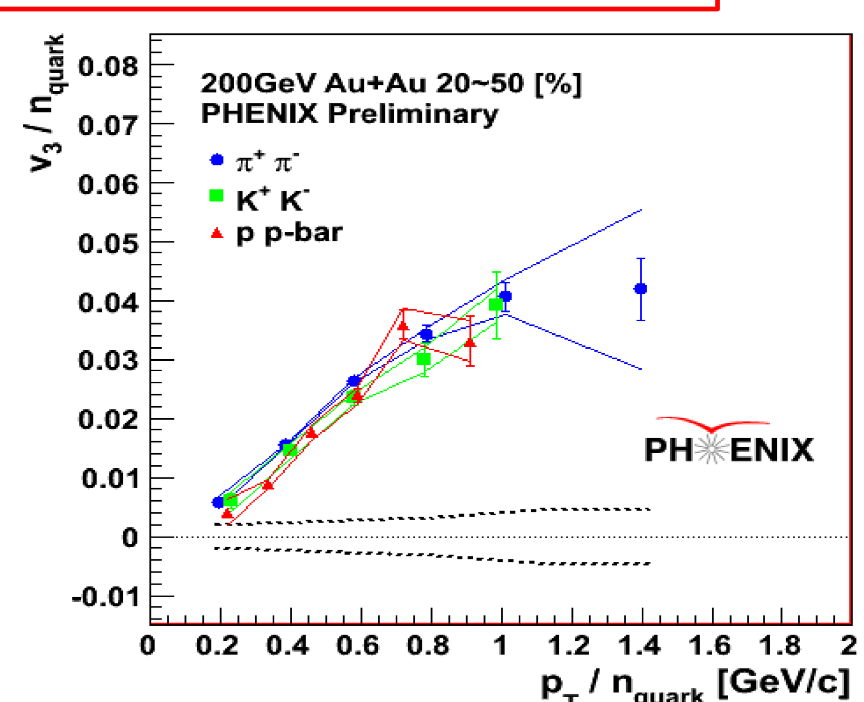


Fig.8 p_T dependence of n_{quark} scaling Identified particle v_3

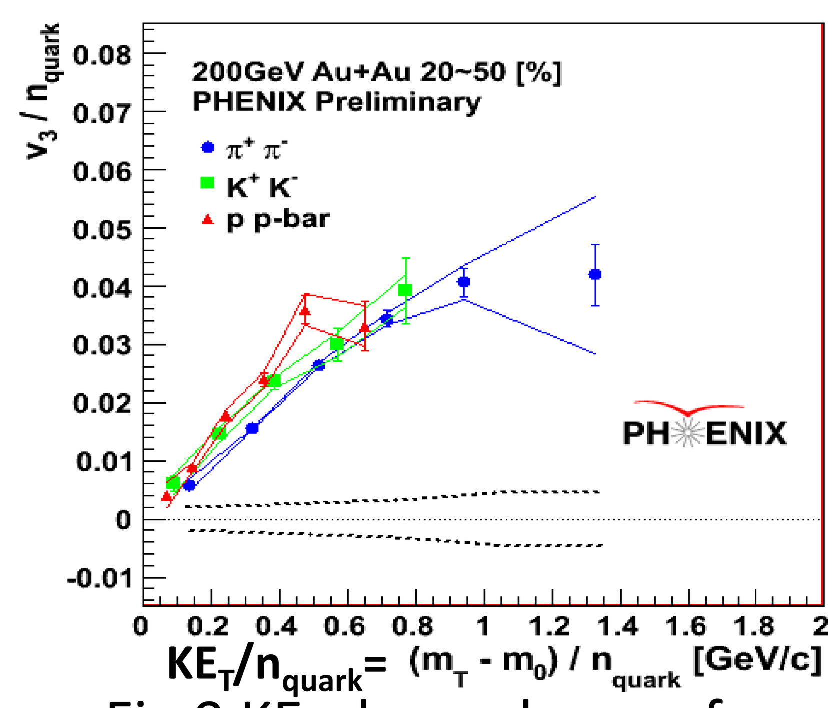


Fig.9 KE_T dependence of n_{quark} scaling Identified particle v_3

Conclusion and Outlook

- ● Identified particle v_3 as function of p_T was measured.
  → Triangular anisotropy has a particle species dependence.
- ● v_2 and v_3 of n_{quark} scaling was measured.
  → It seems that KE_T of n_{quark} scaling v_2 is more overlap, and p_T of n_{quark} scaling v_3 is more overlap.
- ☐ Using Run7 full statistics (to come) will enable, our analysis uses 1% of it.
  → Study finer centrality dependence.
  → Measure deuteron and other particle dependence.