Two-particle correlations measured by PHENIX at sqrt(s_NN)=200GeV in Au-Au collisions

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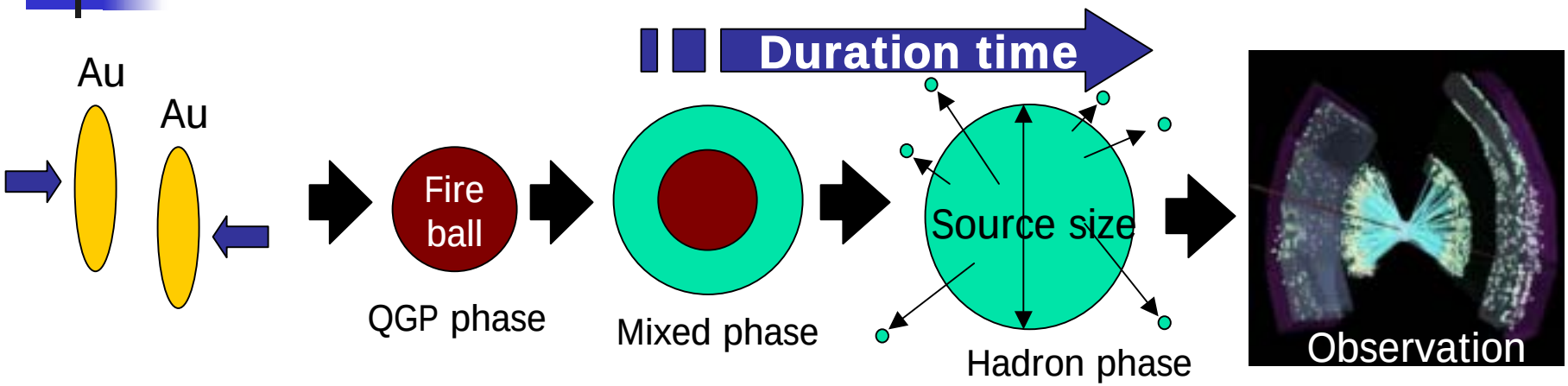
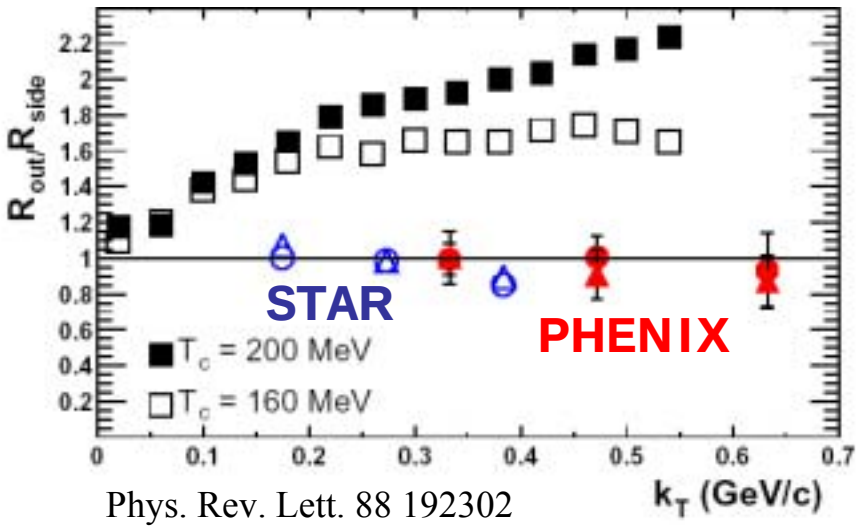
for the PHENIX collaboration

Physics motivation



Some models predict that the source size will become bigger and duration time become longer via QGP phase



Phys. Rev. Lett. 88 192302

PHENIX and STAR results show that source radii don't increase and no duration time at sqrt(s_{NN})=130GeV

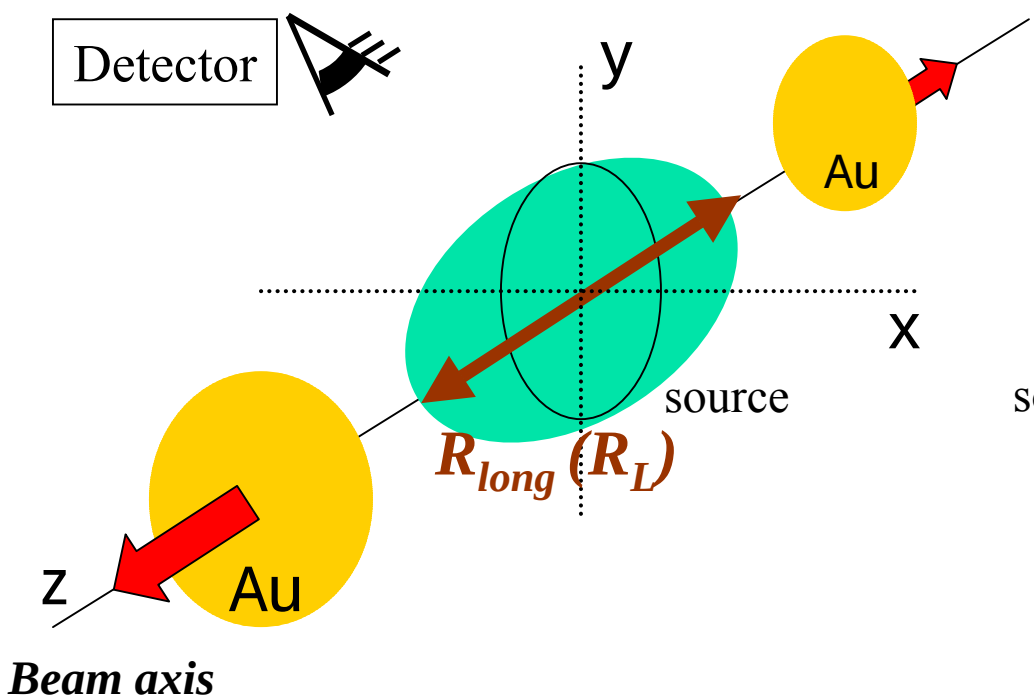
Bertsch-Pratt source radii

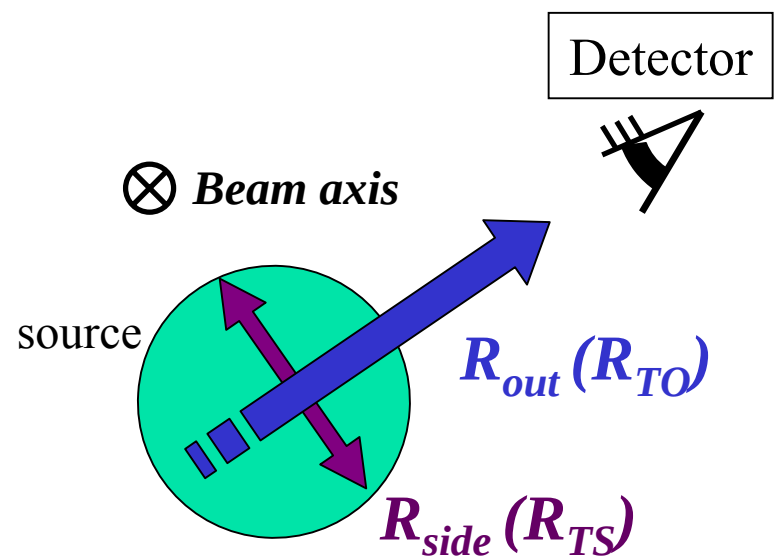
$$C_2 \equiv 1 + \lambda \exp\left(-R_{side}^2 q_{side}^2 - R_{out}^2 q_{out}^2 - R_{long}^2 q_{long}^2\right)$$

In LCMS frame

The duration time

$$\Delta\tau = \sqrt{R_{TO}^2 - R_{TS}^2} / \beta$$

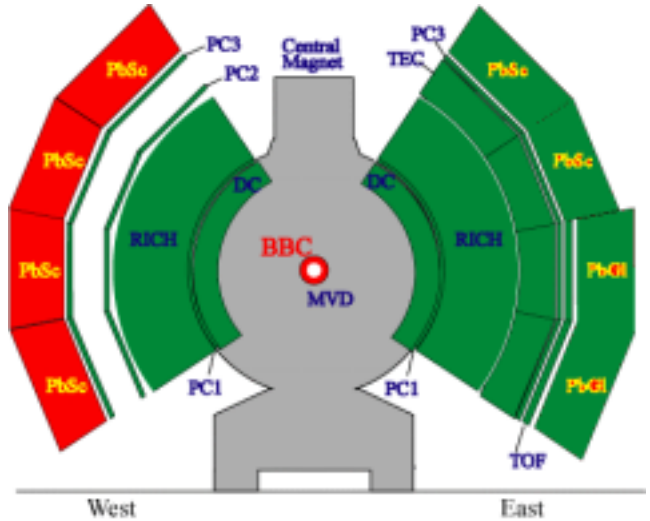


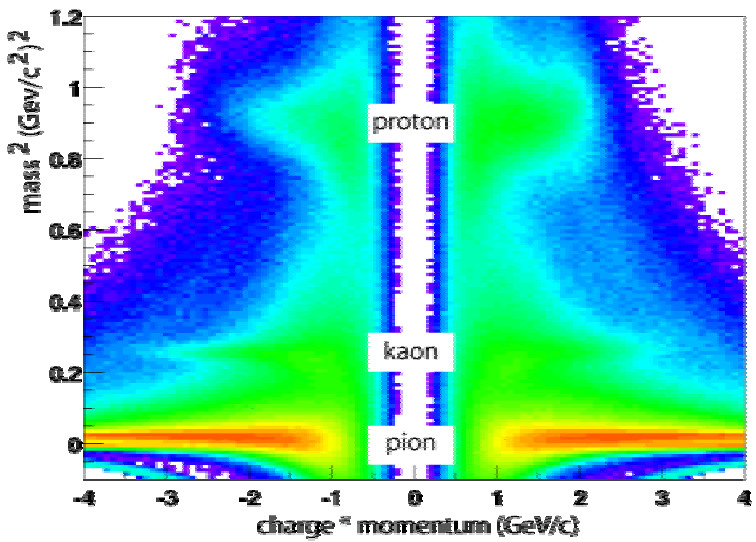


Data statistics from PHENIX Run2

- About 50M minimum bias event.
  - Z-vertex < 30 cm
  - p_T>0.2GeV/c
- Charged pi, K PID by EMCal
  - 1.5σ within pi mass,
    (and 2.0σ away from K mass)
  - 1.5σ within K mass,
    (and 2.5σ away from p, pi mass)

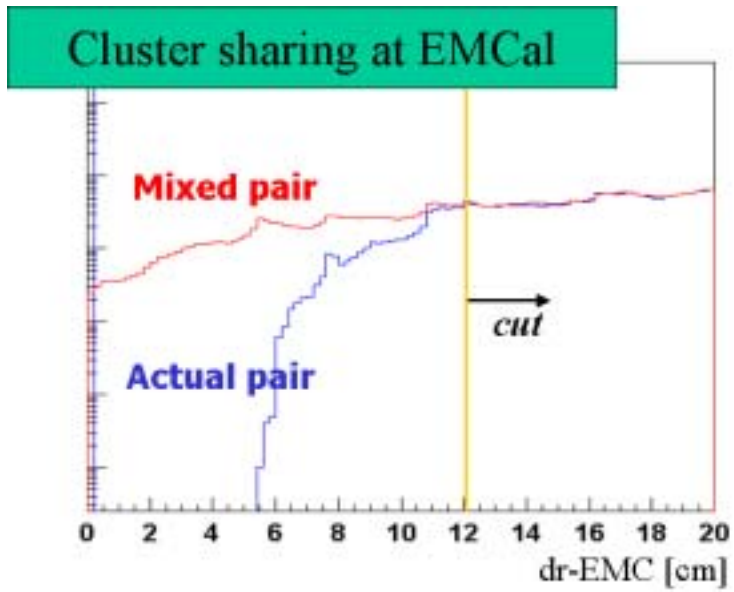
	Run2 data	Run1 data
pi+ pair	164M	4.2M
pi- pair	157M	4.6M
K+ pair	1.2M	0.023M
K- pair	1.1M	0.029M





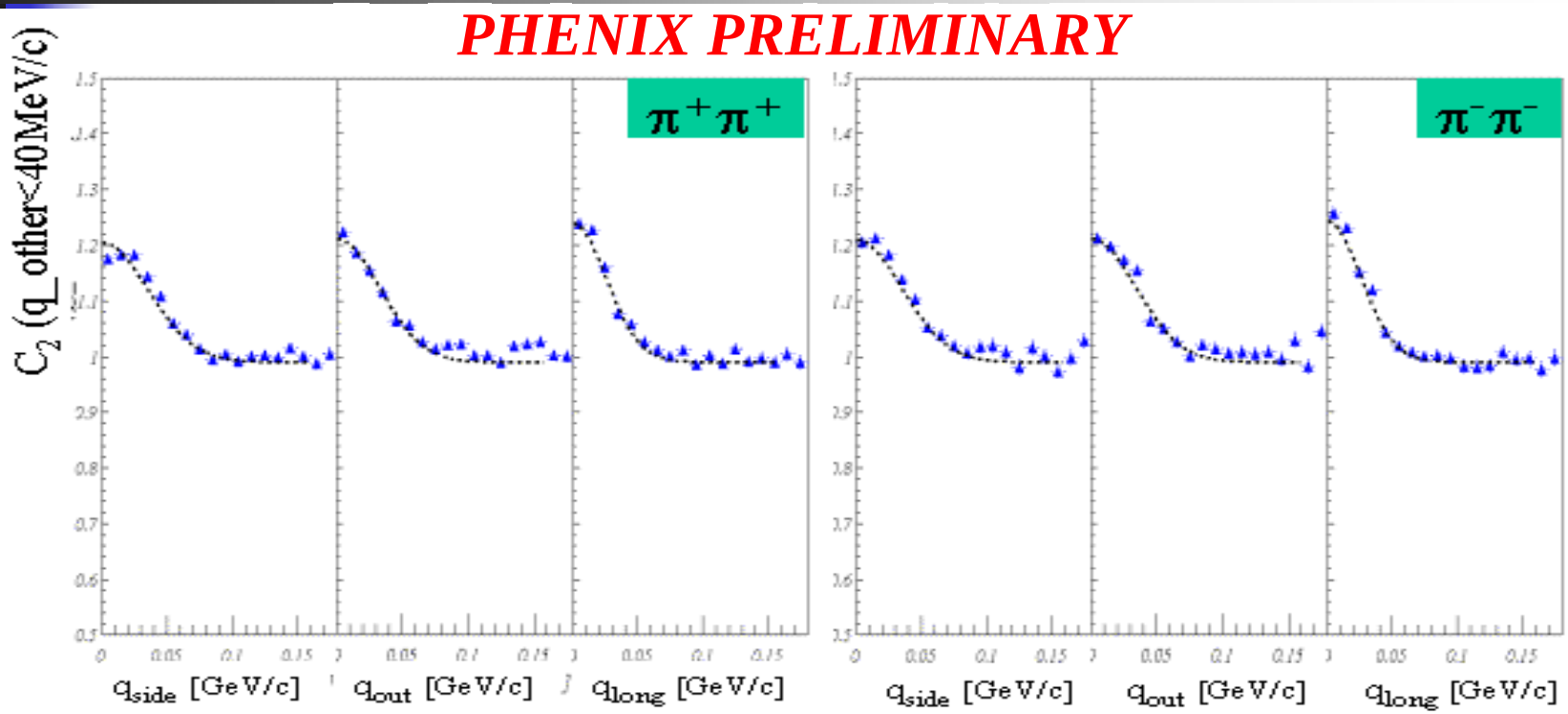
Corrections & systematic errors

- Pair cuts
  - Tracking inefficiency cut
  - Ghost track cut
  - Cluster sharing cut
- Coulomb correction
  - The Coulomb effect is corrected by full coulomb correction with momentum smearing.



Sytematic errors (%)	lambda	Rside	Rout	Rlong	Rout/Rside
Cluster share cut	11.7	4.9	5.7	4.4	1.1
Tracking inefficiency cut	5.9	2.6	6.4	2.5	2.4
Ghost track cut	2.8	0.8	3.4	1.3	4.2
Coulomb	3.1	2.4	3.7	2.2	2.9
Total (%)	13.9	6.4	10.1	6	5.7

3-D correlation result of charged pions



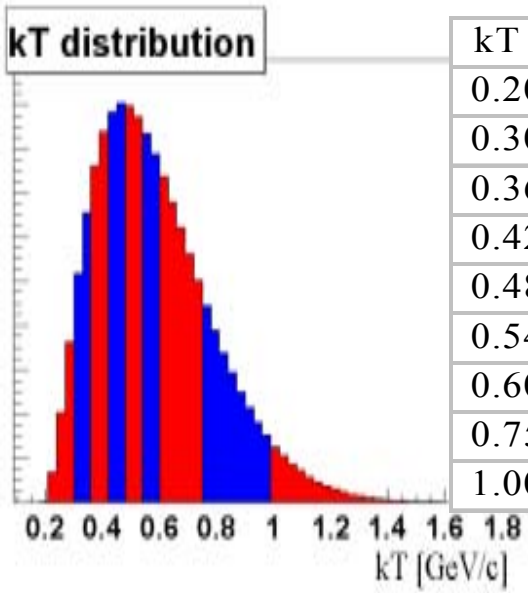
200 GeV Au+Au、Top 30% Centrality, 0.2<kT<2.0GeV/c, <kT>=0.46GeV/c

$\lambda = 0.397 \pm 0.015$
$R_{side} = 4.40 \pm 0.12$
$R_{out} = 3.73 \pm 0.12$ [fm]
$R_{long} = 4.82 \pm 0.15$

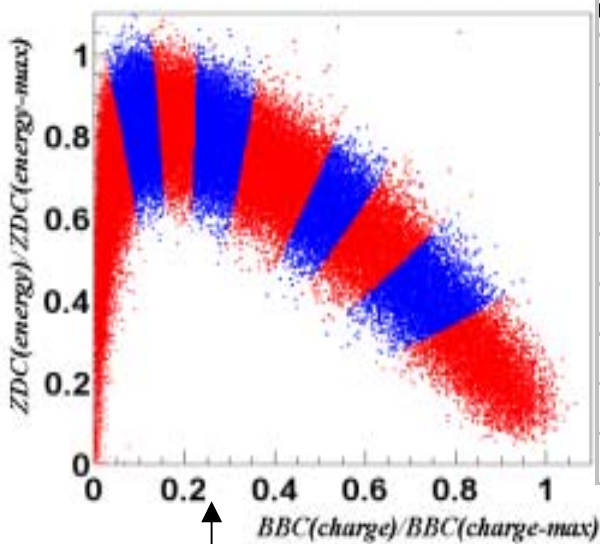
$\lambda = 0.434 \pm 0.018$
$R_{side} = 4.58 \pm 0.14$
$R_{out} = 3.88 \pm 0.14$ [fm]
$R_{long} = 5.24 \pm 0.18$

kT and centrality selections

Charged pion correlations are measured in 9 kT and centrality regions.

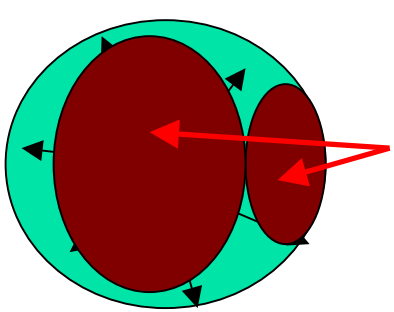


kT [GeV/c]	<kT> [GeV/c]
0.20-0.30	0.267
0.30-0.36	0.329
0.36-0.42	0.388
0.42-0.48	0.448
0.48-0.54	0.507
0.54-0.60	0.567
0.60-0.75	0.662
0.75-1.00	0.845
1.00-4.00	1.193



Centrality	Npart
0-5%	353.4
5-10%	300.2
10-15%	254.3
15-20%	215.2
20-30%	167.5
30-40%	115.2
40-50%	75.9
50-65%	43
65-93%	15.3

$$k_T = (p_{T1} + p_{T2})/2$$

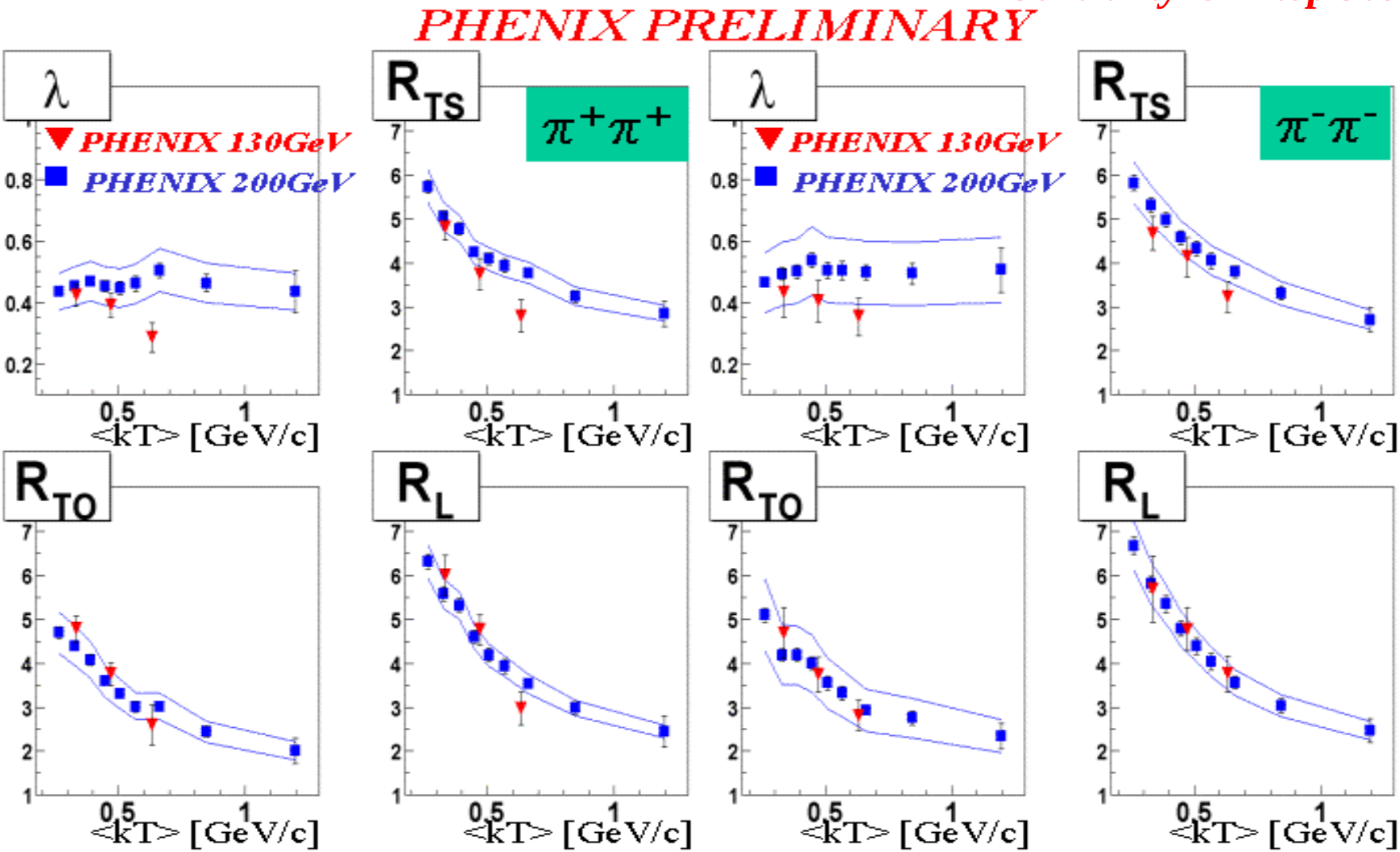


We can see "x-p correlation" if there is collective expansion of the source

- Centrality class is defined by BBC vs. ZDC.
- The number of participants is estimated with Glauber model.

kT dependence of source radii

Centrality is in top 30%



Comparison with hydrodynamic model

Recent hydrodynamic calculation by U.Heinz and P. F. Kolb (hep-ph/0204061)

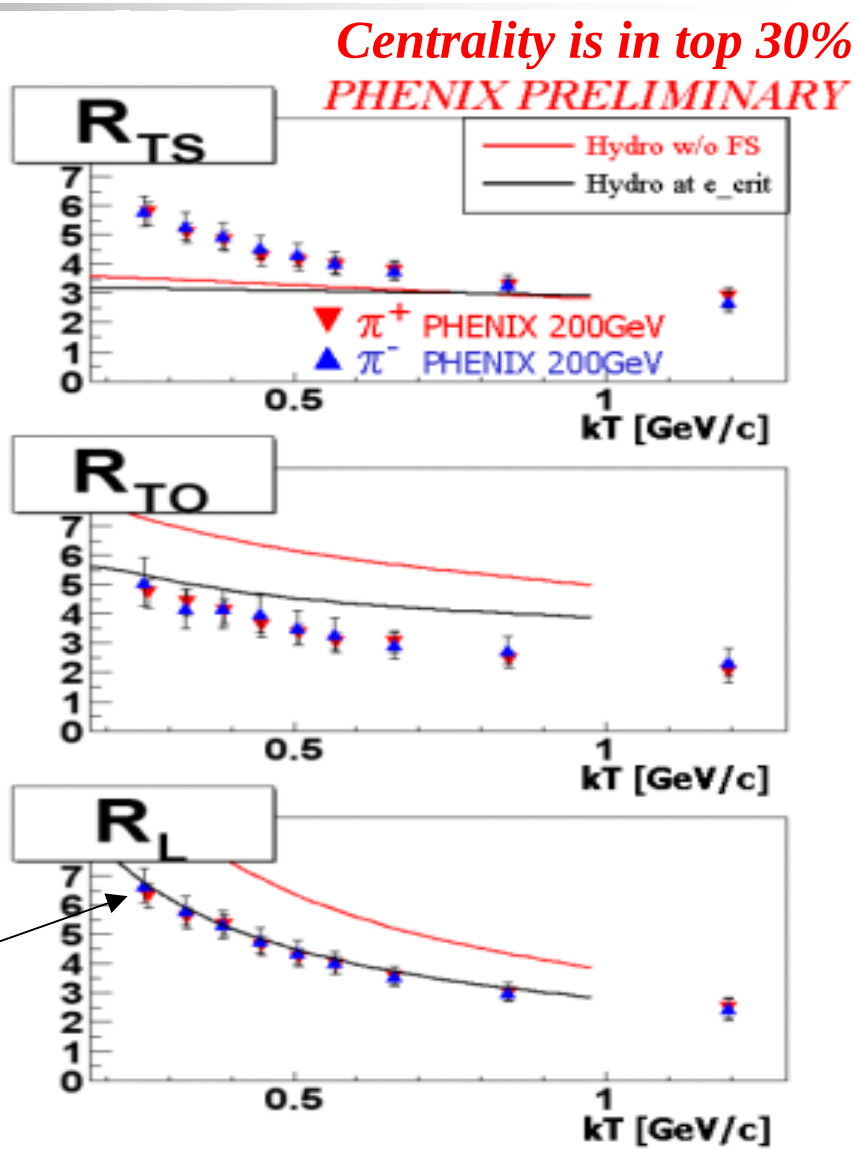
——— Hydro w/o FS

- Standard initialization and freeze out which reproduce single particle spectra.

——— Hydro at e_{crit}

- Assuming freeze out directly at the hadronization point. ($e_{dec} = e_{crit}$)

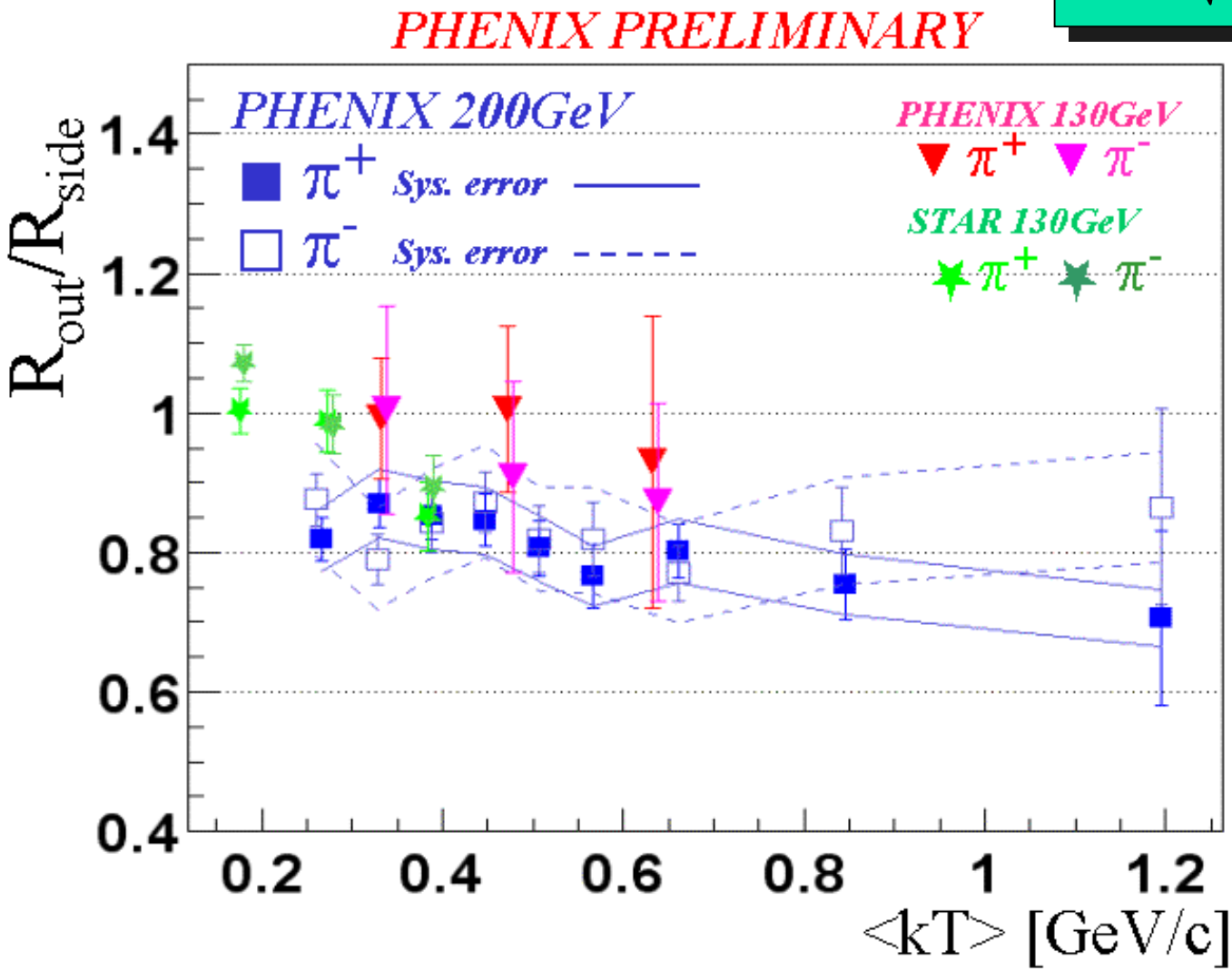
kT dependence of R_{long} indicates the early freeze-out?



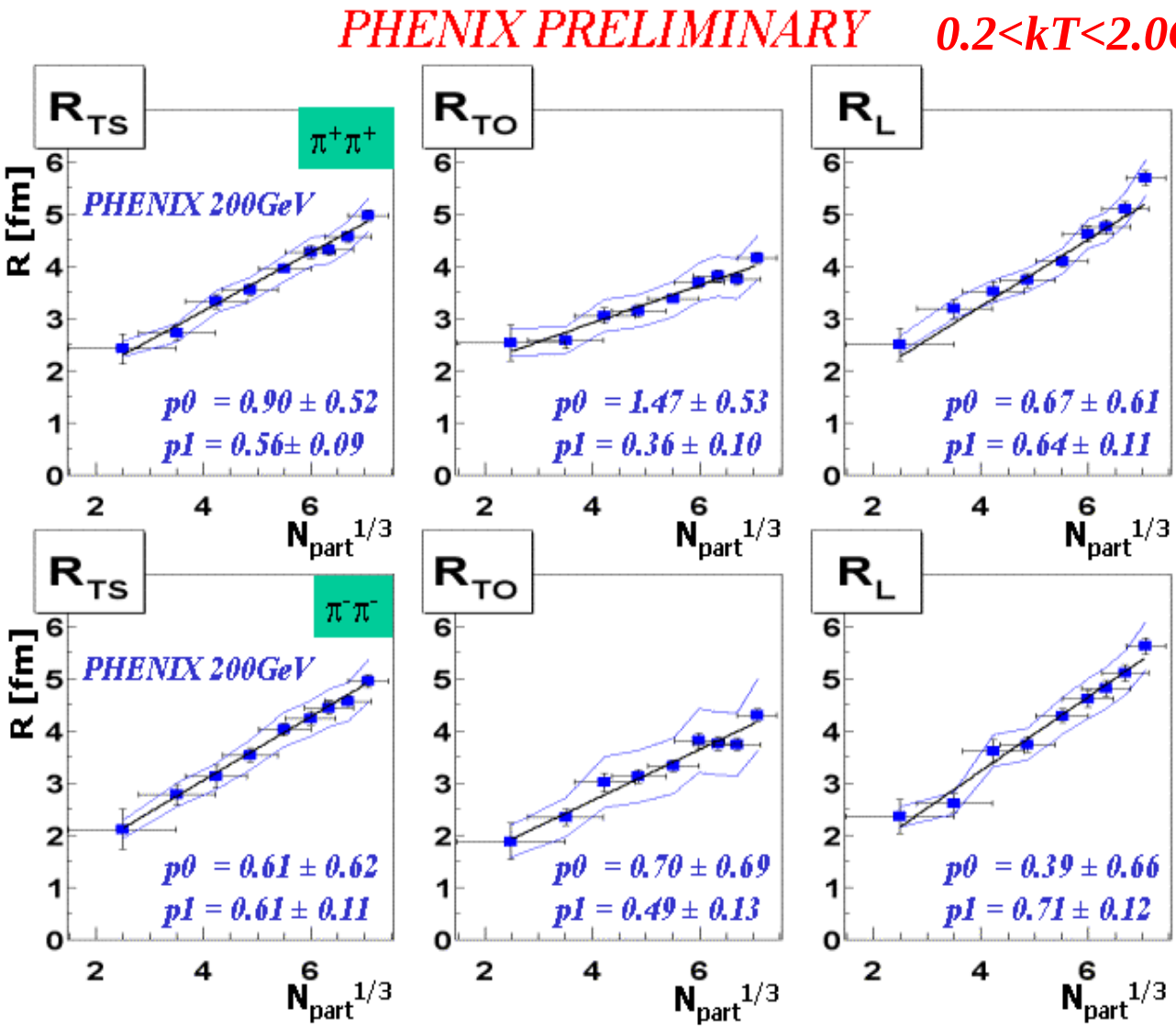
kT dependence of R_{out}/R_{side}

The duration time

$$\Delta\tau = \sqrt{R_{TO}^2 - R_{TS}^2} / \beta$$



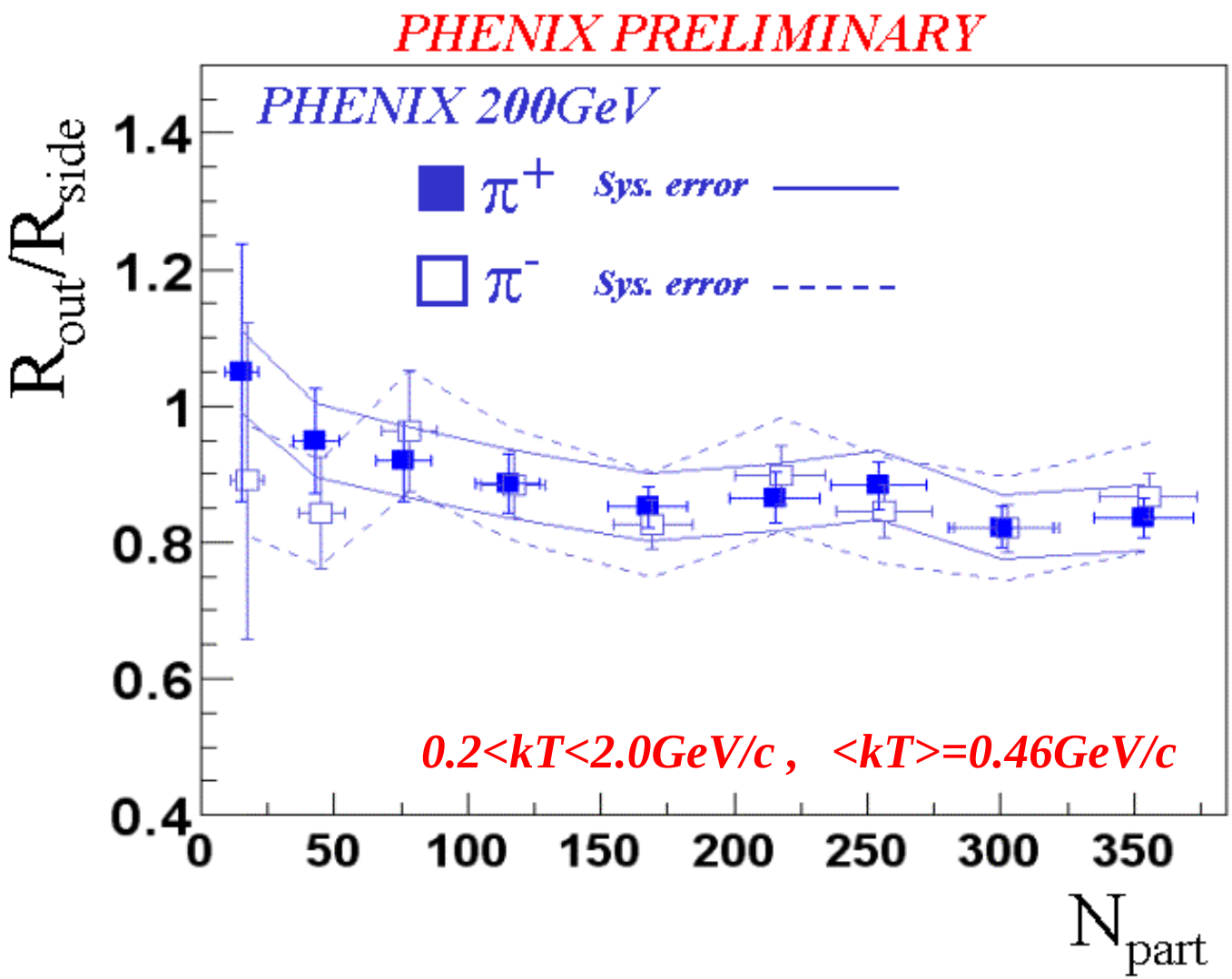
Centrality dependence of source radii



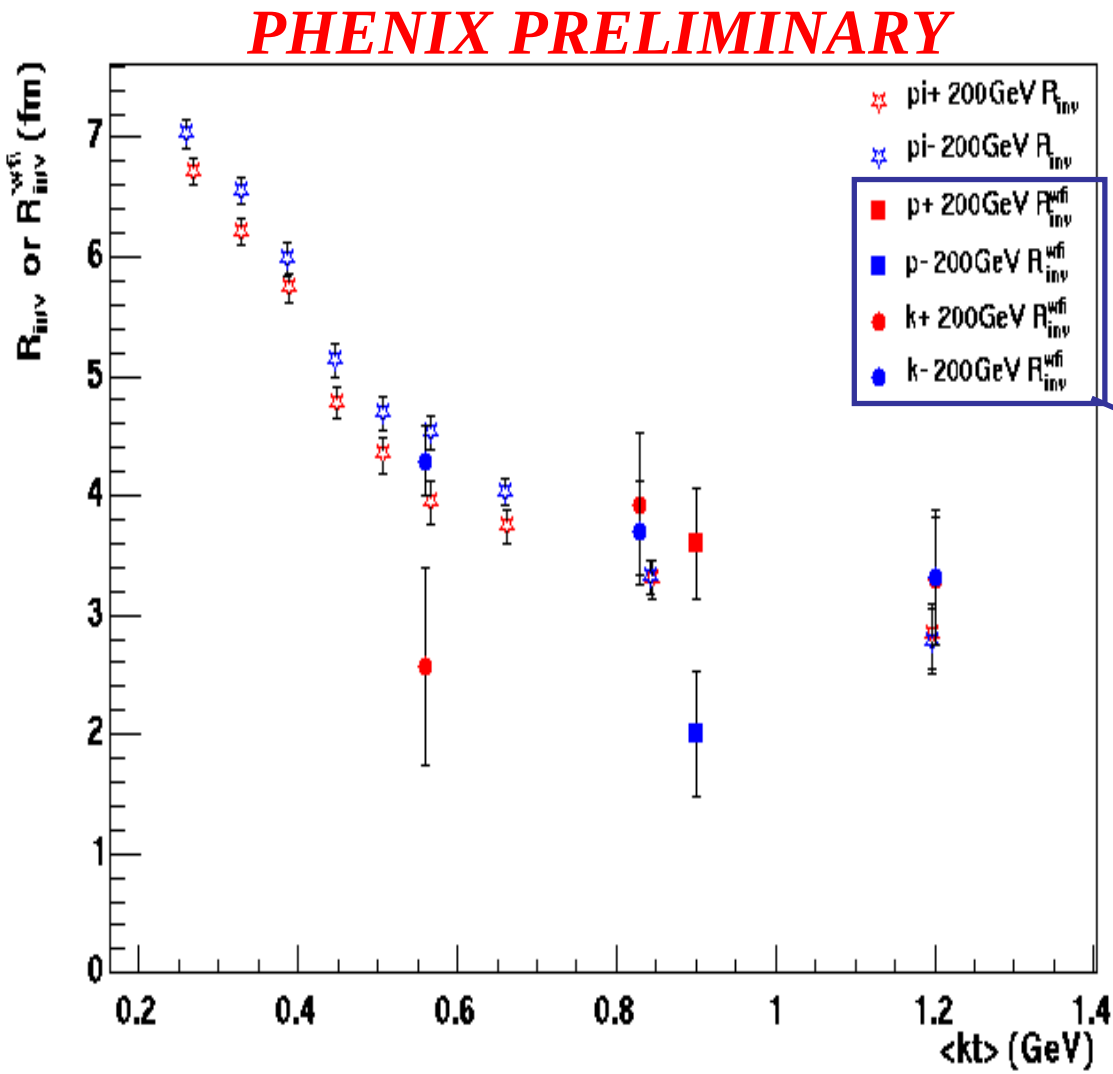
Fit with
p0+p1*N_{part}^1/3

R_{long} increases rapidly with the N_{part} than R_{out}.

Centrality dependence of R_{out}/R_{side}

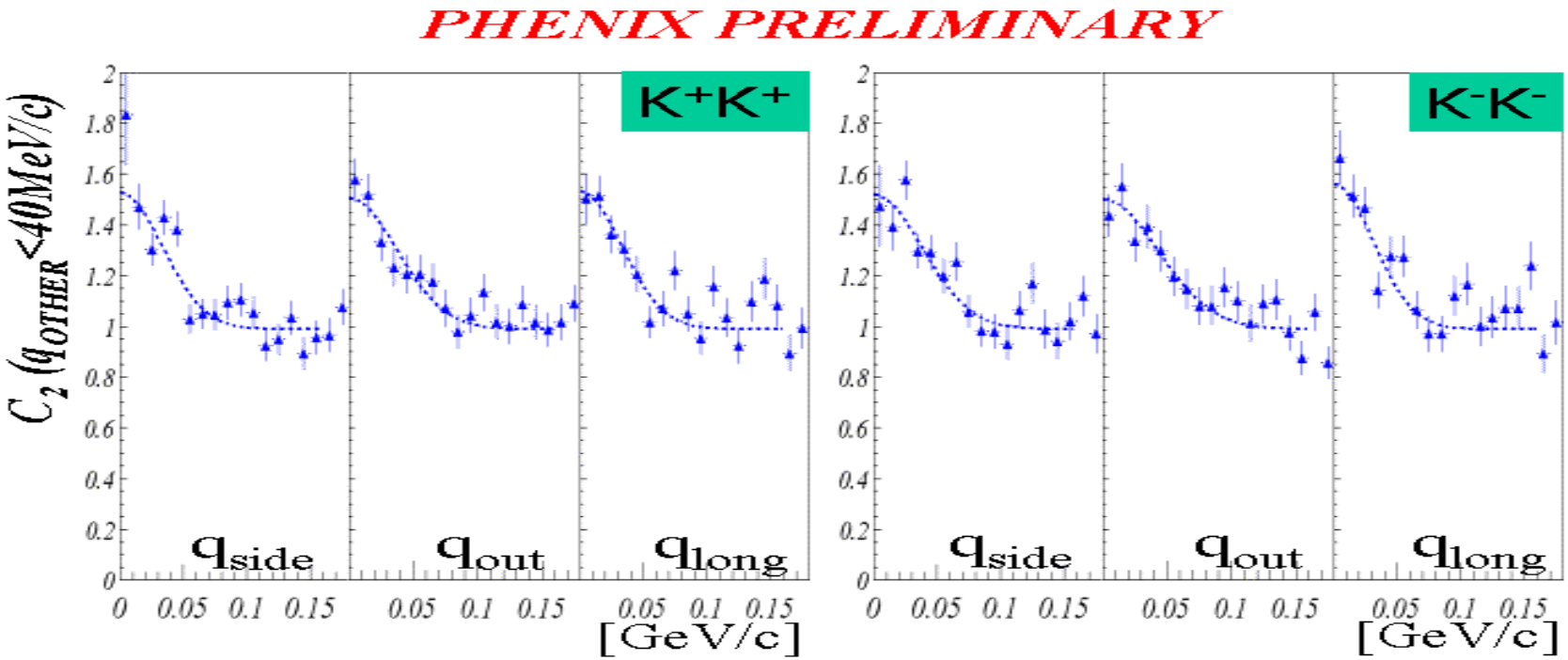


1-D results of new HBT analysis method



Calculated with a new HBT analysis method.
(based on imaging)
M. Heffner present at the poster session in detail.

3-D correlation results of charged kaons



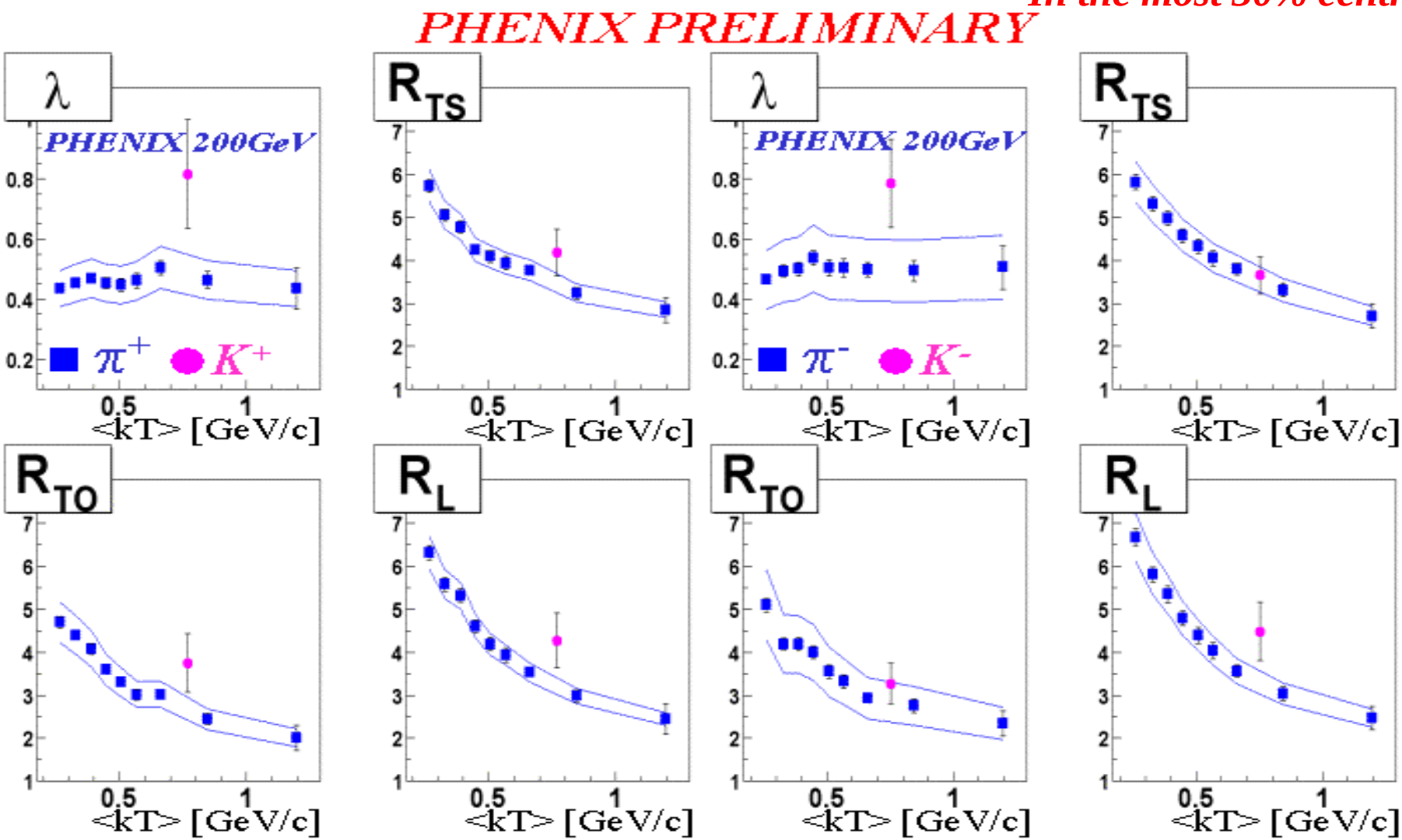
200 GeV Au+Au、Top 30% Centrality, 0.2<kT<2.0GeV/c, <kT>=0.76GeV/c

$\lambda = 0.815 \pm 0.181$
$R_{side} = 4.18 \pm 0.54$
$R_{out} = 3.72 \pm 0.69$ [fm]
$R_{long} = 4.27 \pm 0.65$

$\lambda = 0.785 \pm 0.181$
$R_{side} = 3.65 \pm 0.43$
$R_{out} = 3.23 \pm 0.47$ [fm]
$R_{long} = 4.48 \pm 0.68$

Comparison of kaon to pion

In the most 30% central



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Summary

- Using a first data sample from PHENIX Run2 (sqrt(s_NN)=200 GeV Au+Au), we have analyzed 164M pi+(157M pi-) pairs, and 1.2M K+ (1.1M K-) kaon pairs.
  - HBT source radii are consistent between 130 and 200 GeV.
  - All HBT source radii decrease with kT.
  - R_{out}/R_{side} is independent on the kT up to ~1GeV/c.
  - $R_{out}/R_{side} \leq 1$.
  - Kaon HBT is comparable or larger than pion HBT at same <kT>.

- HBT at larger range of kT will test transport models...

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