Identical charged pion correlations measured by PHENIX at sqrt(s_{NN})=200GeV

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JPS 3/26/2002

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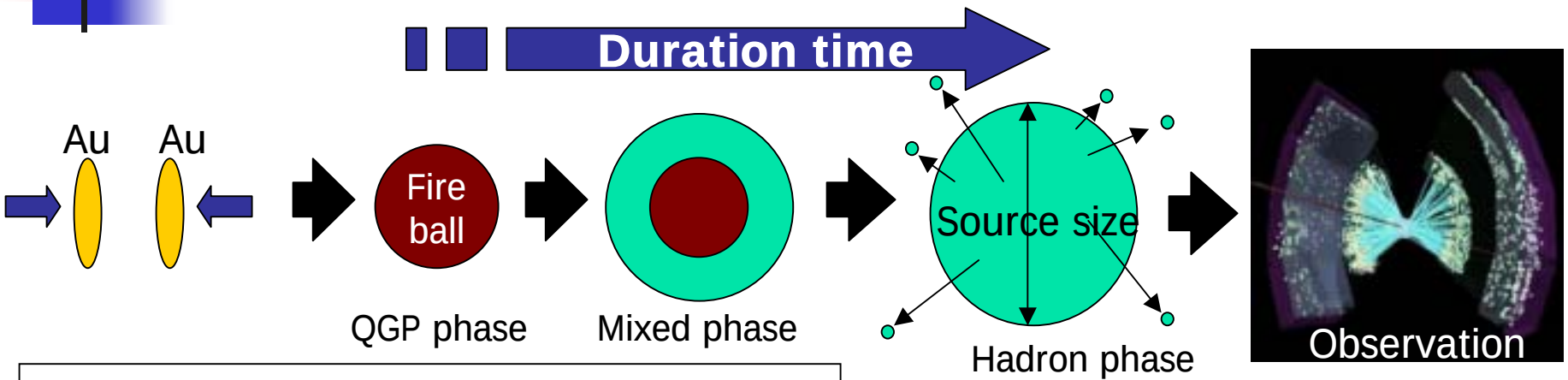
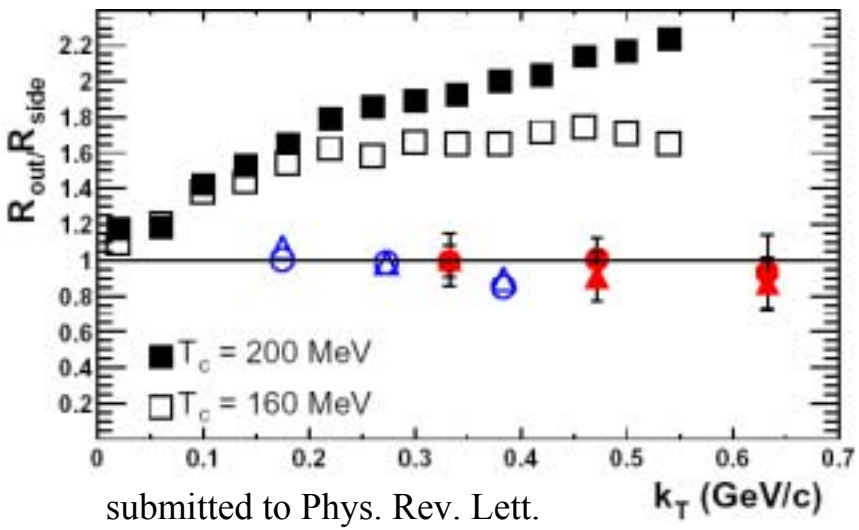
Physics Motivation of HBT analysis



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

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



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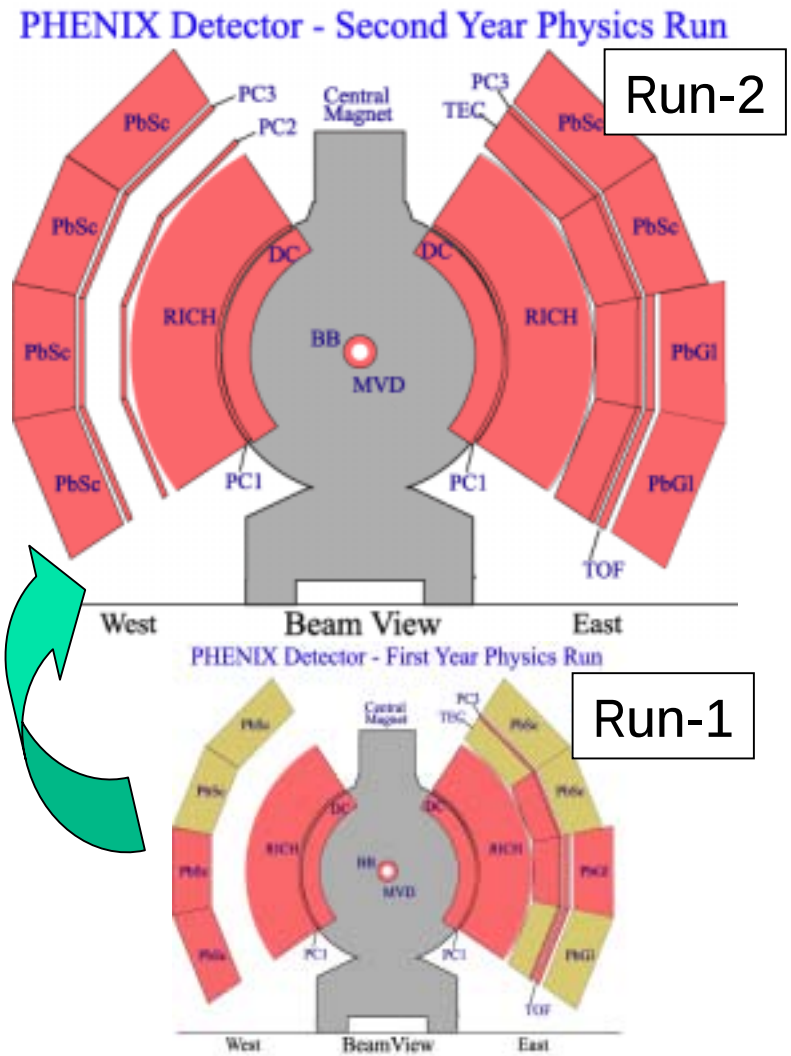
PHENIX Run-2 Experiment

Au-Au Run-2 (8/15/2001~11/25/2001)

- sqrt(s_{NN}) is increased to 200GeV from Run-1 (130GeV)
- About 92 million min. bias events.
  (this analysis is based on ~***10M*** events of first data set among it)

- EMC detector (west arm) acceptance
  sector0-1 (Run-1) → sector0-3 (Run-2)
  (this analysis is based on charged pions which are identified using EMC-timing module)



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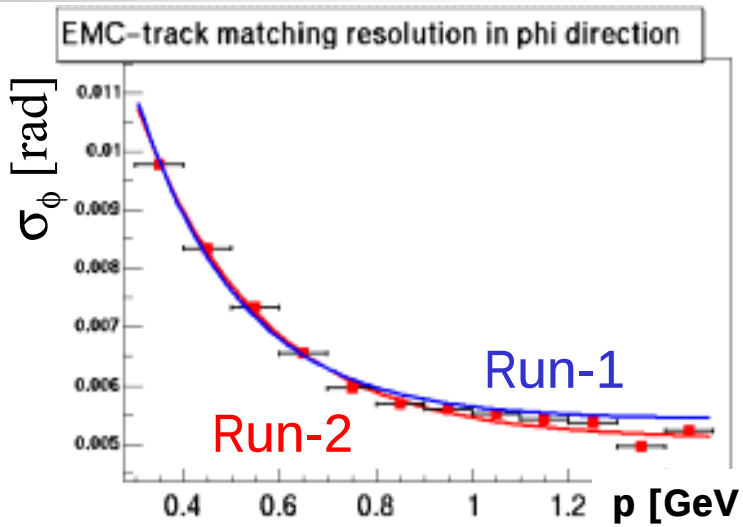
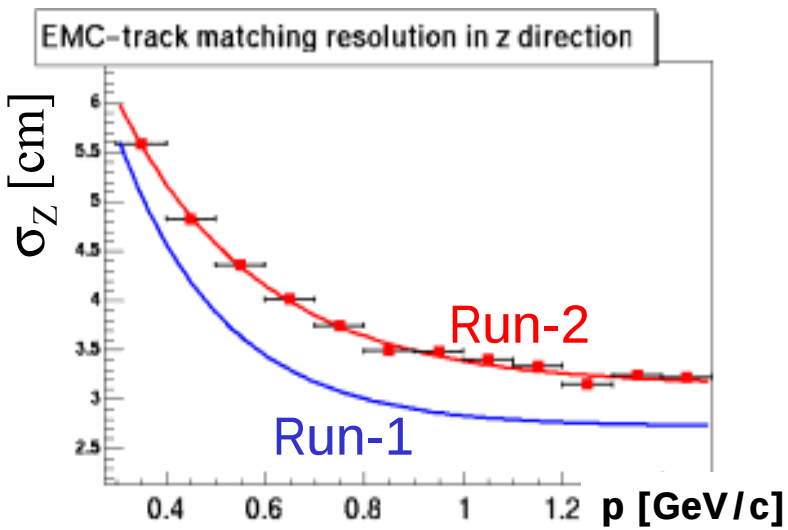
Data selection

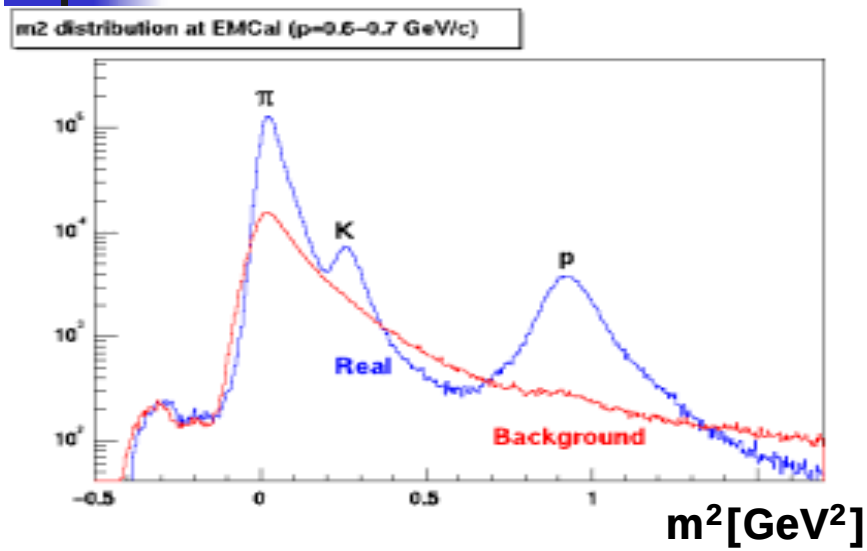
- Run & Event selection
  - Full field data
  - Bbc-zvertex < 30 cm
  - centrality in the top 30%
- Track selection
  - Dch good quality
  - p_T >0.2 GeV/c
  - EMC-Track matching cut < 2σ

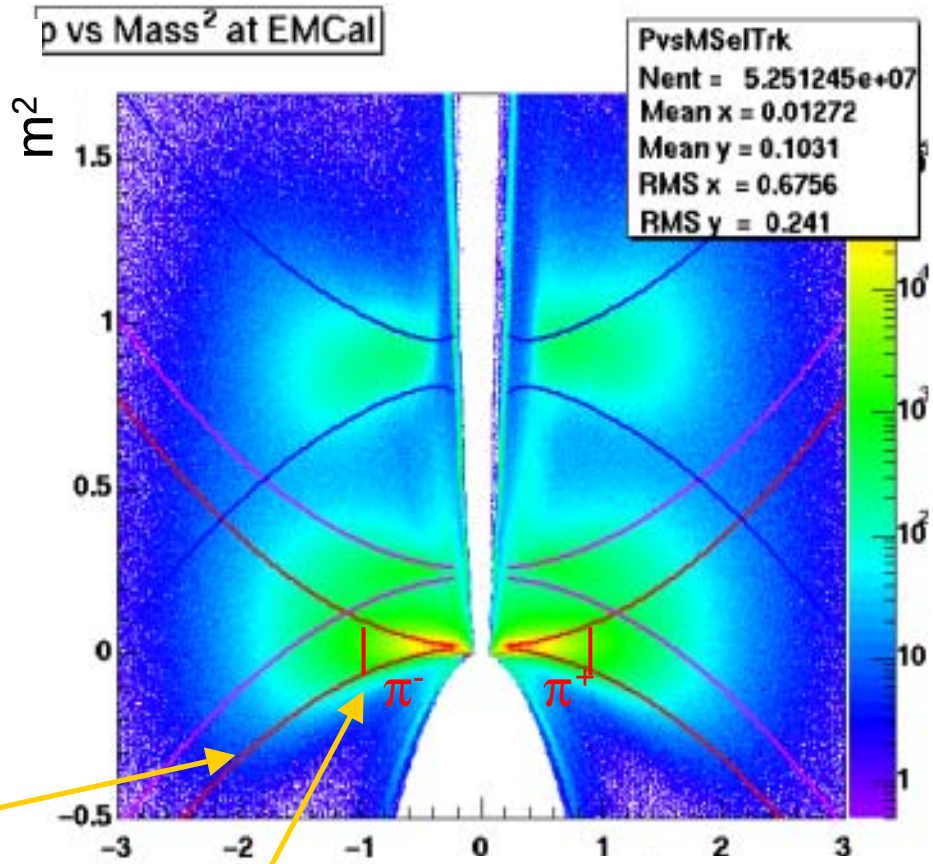




•After these selections
Total events = 428K (Run-1)
Total tracks = 9800K (Run-1)
Total events = 2097K (Run-2)
Total tracks = 53000K (Run-2)

Particle identification





σ_T(EMC) ~ 500psec

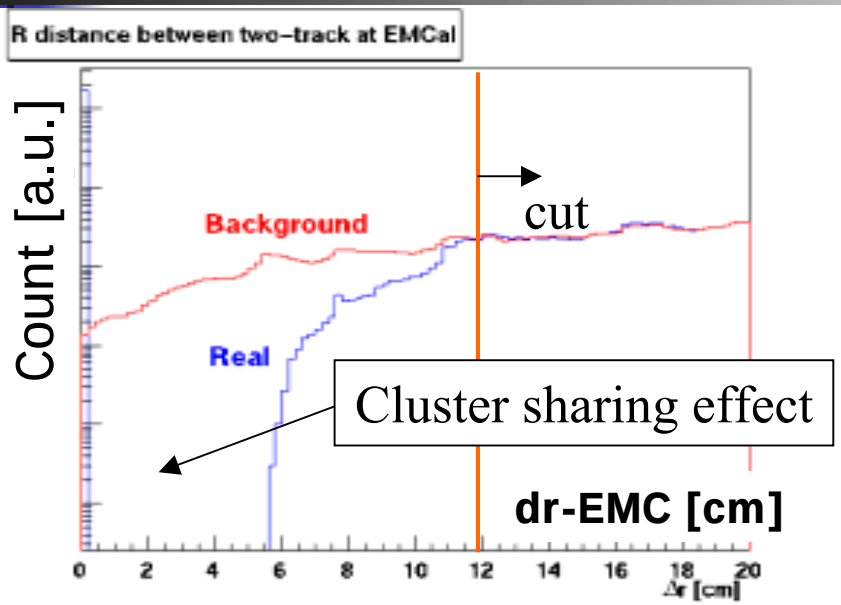
(better than Run-1 ~700psec)

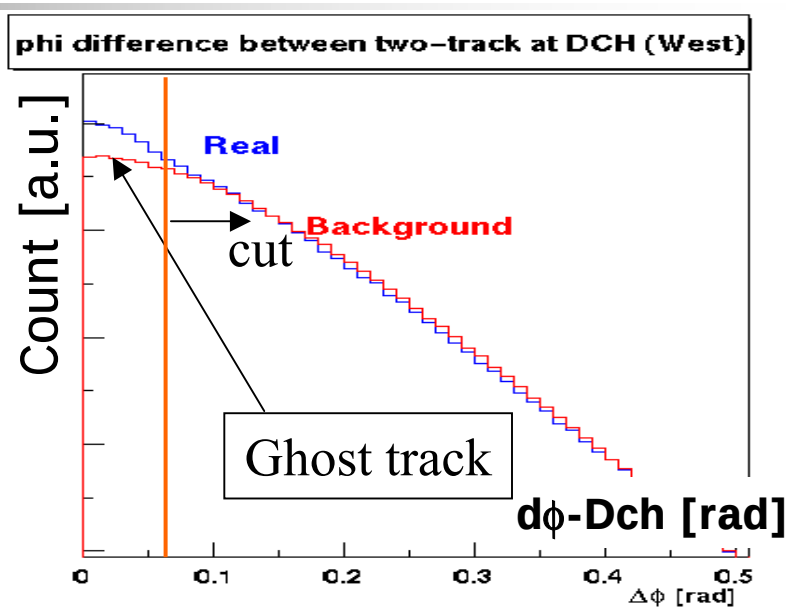
$1.5\sigma_m$ Cut

Momentum range 0.2<p<1.0 GeV/c

Two-track (pion) separation quality cut

*Normalized by integrated yield





|dz_Dch|>2cm “OR” |dϕ_Dch|>0.06rad
AND
|dr_EMCal|>12cm
AND
|dr_PC1|>5cm

This Cuts are same as Run-1 analysis

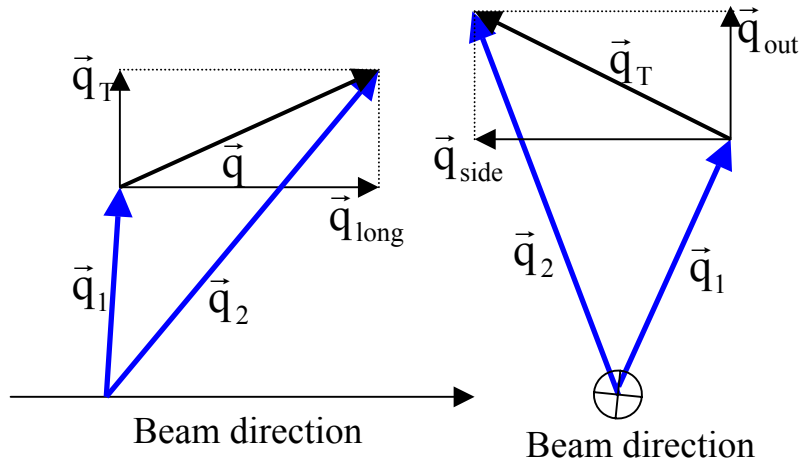
Two particle correlation

Bertsch-Pratt parameterization

$$C_2 = \frac{q_{inv}(\text{actual pair})}{q_{inv}(\text{mixed pair})}$$

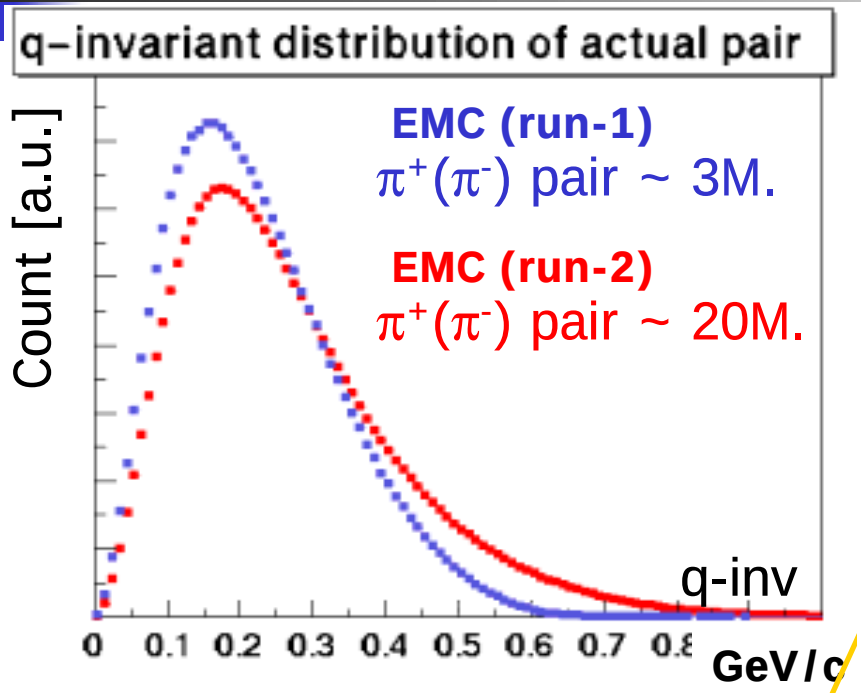
$$= 1 + \lambda \exp\left(-q_X^2 R_X^2 - q_Y^2 R_Y^2 - q_Z^2 R_Z^2 - q_t^2 \sigma_t\right)$$

$$= 1 + \lambda \exp\left(-q_{TS}^2 R_{TS}^2 - q_{TO}^2 R_{TO}^2 - q_L^2 R_L^2\right)$$

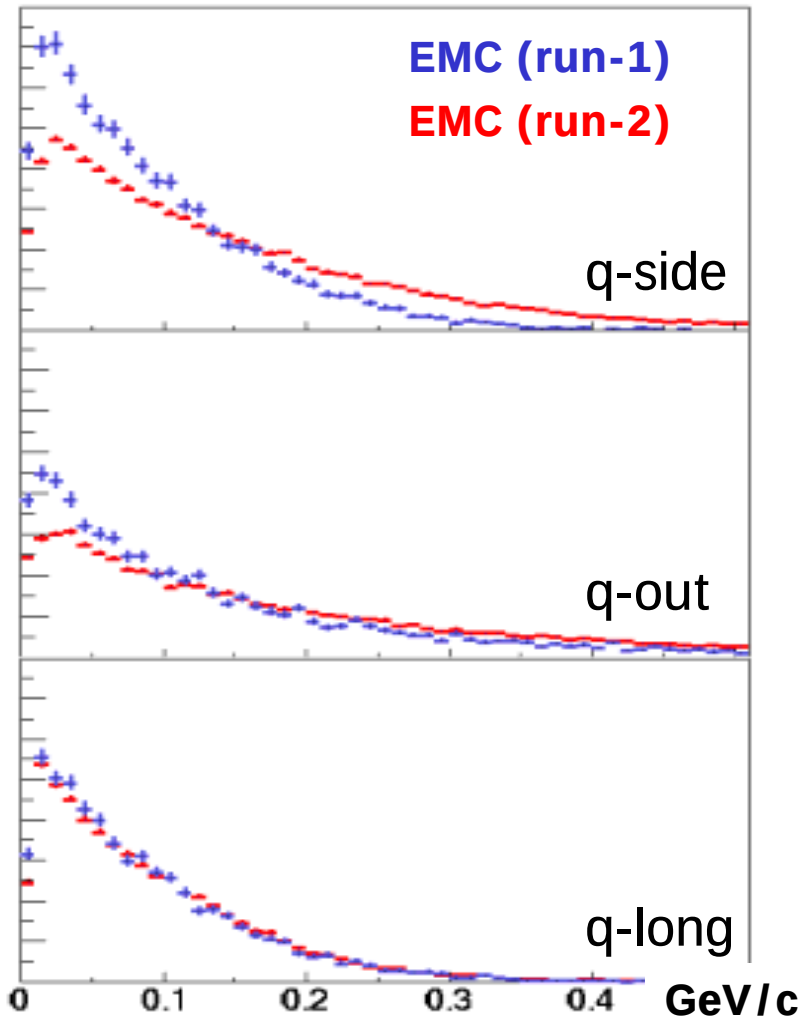


- q_{inv}(actual pair)
  - All possible pair combination of identical particle within same event
- q_{inv}(mixed pair)
  - Stored 200 events
  - All possible pair combination of identical particle between different event
    - $|\Delta$bbc-zvertex$| < 1$cm

q_{inv} (q_{side},q_{out},q_{long}) distributions



*Normalized by integrated yield



q-side distributions are different

The EMC acceptance of Run-2 is enlarged in azimuth direction compared to the Run-1 acceptance.

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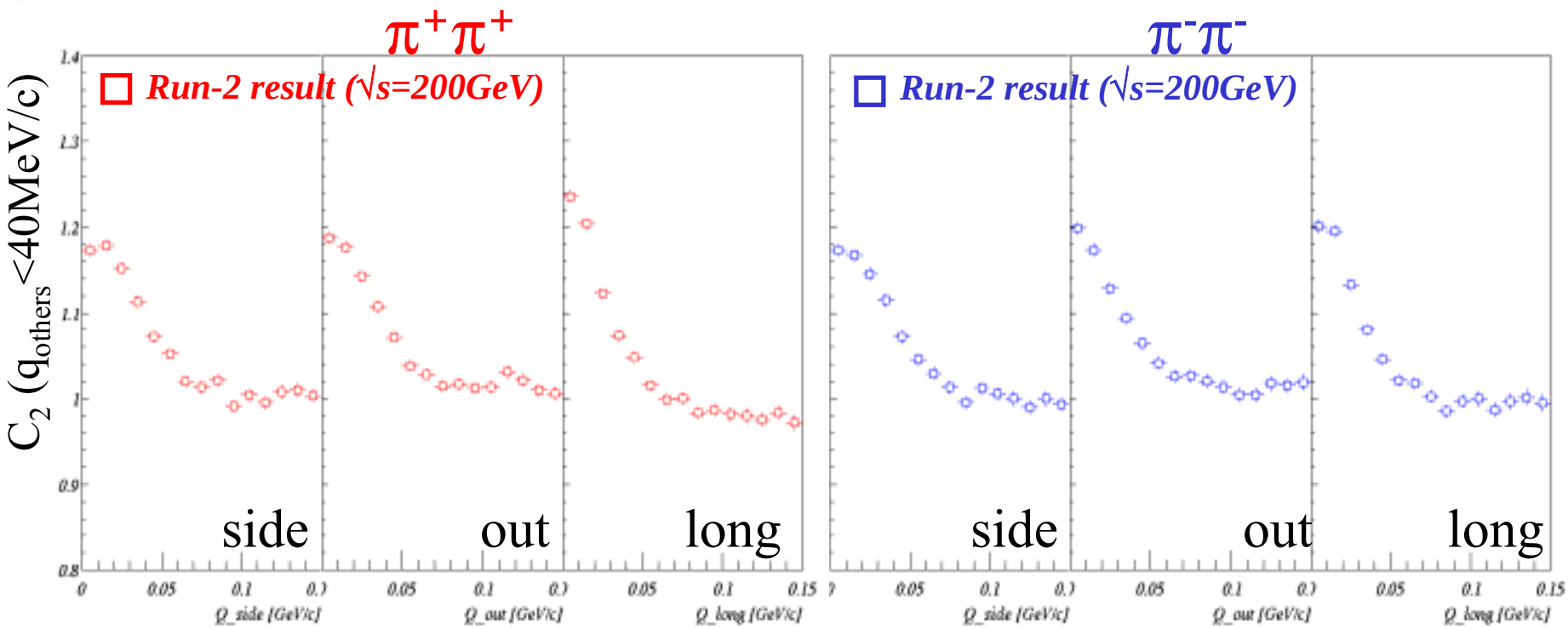
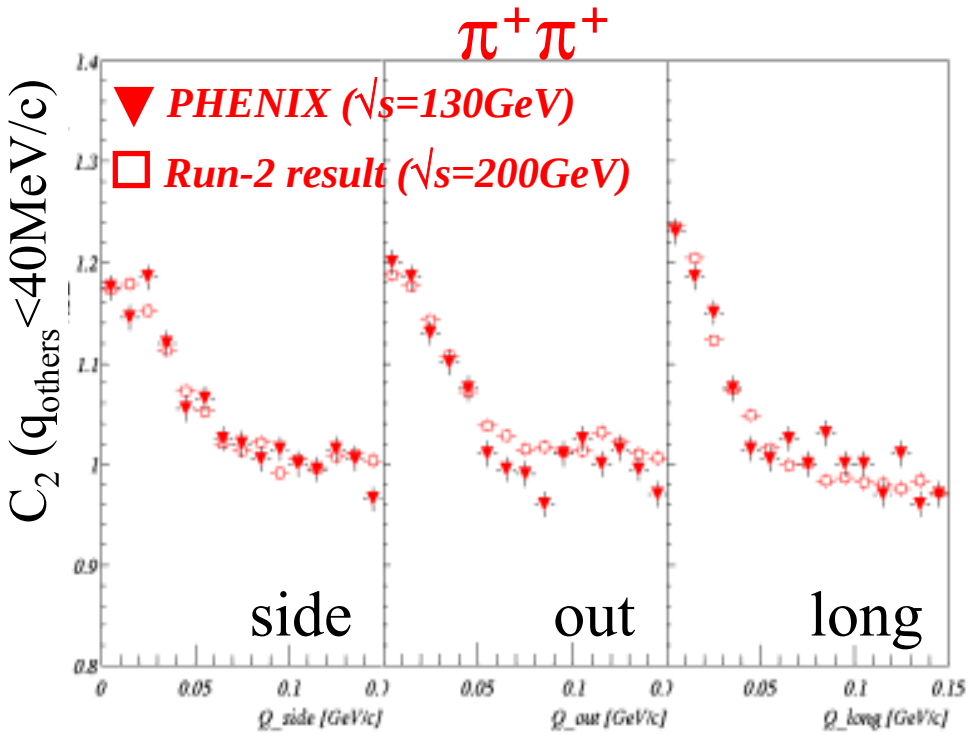
Correlation function at sqrt(s_{NN})=200GeV

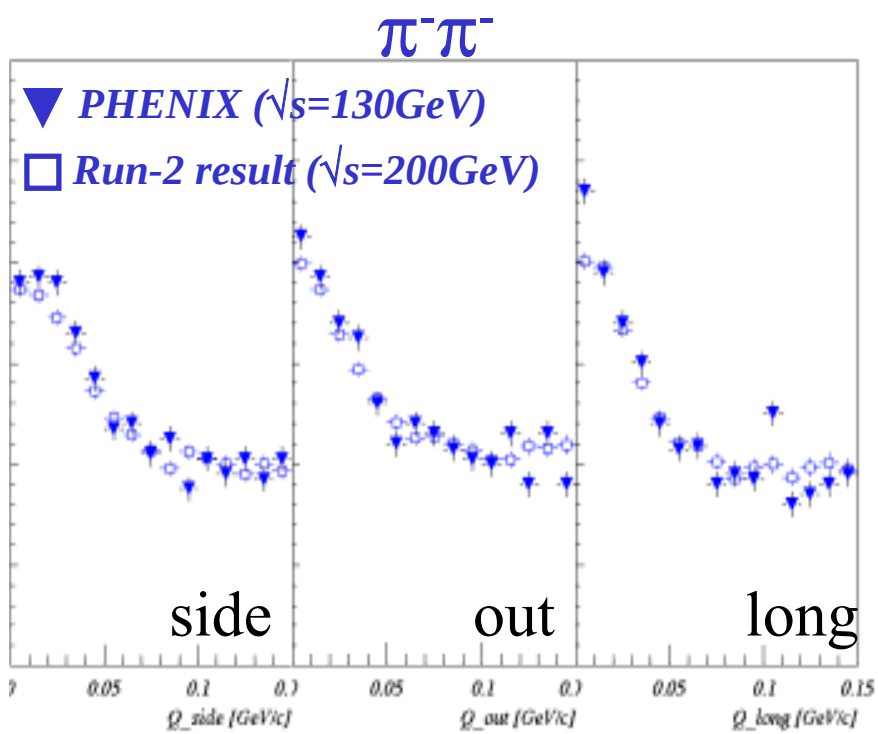


- Coulomb effect is corrected iteratively by the full Coulomb correction
- No acceptance correction.

Same analysis procedure as Run-1

Comparison between sqrt(s_{NN})=130 and 200GeV





PHENIX (sqrt(s_{NN})=130GeV)

$\lambda = 0.395 \pm 0.026$

$R_{side} = 4.42 \pm 0.22$

$R_{out} = 4.45 \pm 0.22$ [fm]

$R_{long} = 5.28 \pm 0.32$

PHENIX (sqrt(s_{NN})=130GeV)

$\lambda = 0.399 \pm 0.026$

$R_{side} = 4.41 \pm 0.22$

$R_{out} = 4.30 \pm 0.24$ [fm]

$R_{long} = 5.13 \pm 0.26$

Conclusion

- pi-plus (22M) and pi-minus (20M) pairs are analyzed at sqrt(s_{NN}) = 200GeV using first data set.

  (The statistics is about 7 times larger than the data of Run-1)

- Some quality (track, PID) cuts need to be improved.

- 3-D (Bertsch-Pratt parameterization) correlation function is got at momentum region 0.2<p<1.0 GeV/c same as year1.

  Bertsch-Pratt source radii don't change remarkably in this energy region, sqrt(s_{NN})=130~200GeV/c.

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Prospects

•We have about 70 times statistics for useful Run-2 data set than Run-1.

[Run-2 full] show the estimation of all full field data for Run-2

	EMC Run-1	EMC Run-2	[Run-2 full]	TOF Run-2	[Run-2 full]
Event	~ 1.2M	~10M	~70M		
pi+ pair :	3.0M	21.7M	~150M	8.0M	~56M
pi- pair :	3.3M	20.1M	~140M	6.5M	~46M
K+ pair :	12k	86k	~600k	24k	~170k
K- pair :	16k	100k	~700k	21k	~150k
p pair :	17k	103k	~720k	55k	~390k
pbar pair:	9k	68k	~470k	24k	~170k

• Kaons and (anti-)proton can be analyzed at EMC.

• More high kT region can be seen than Run-1.

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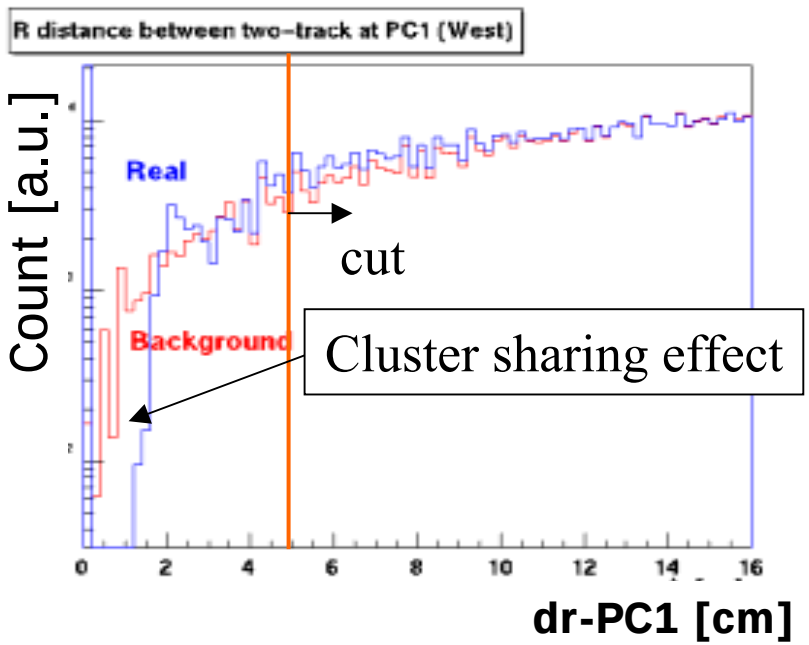
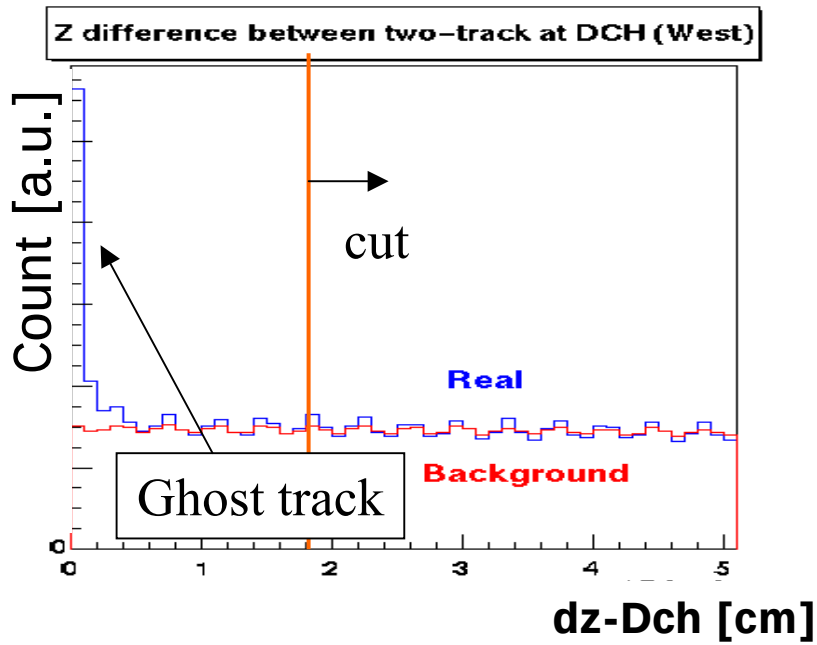
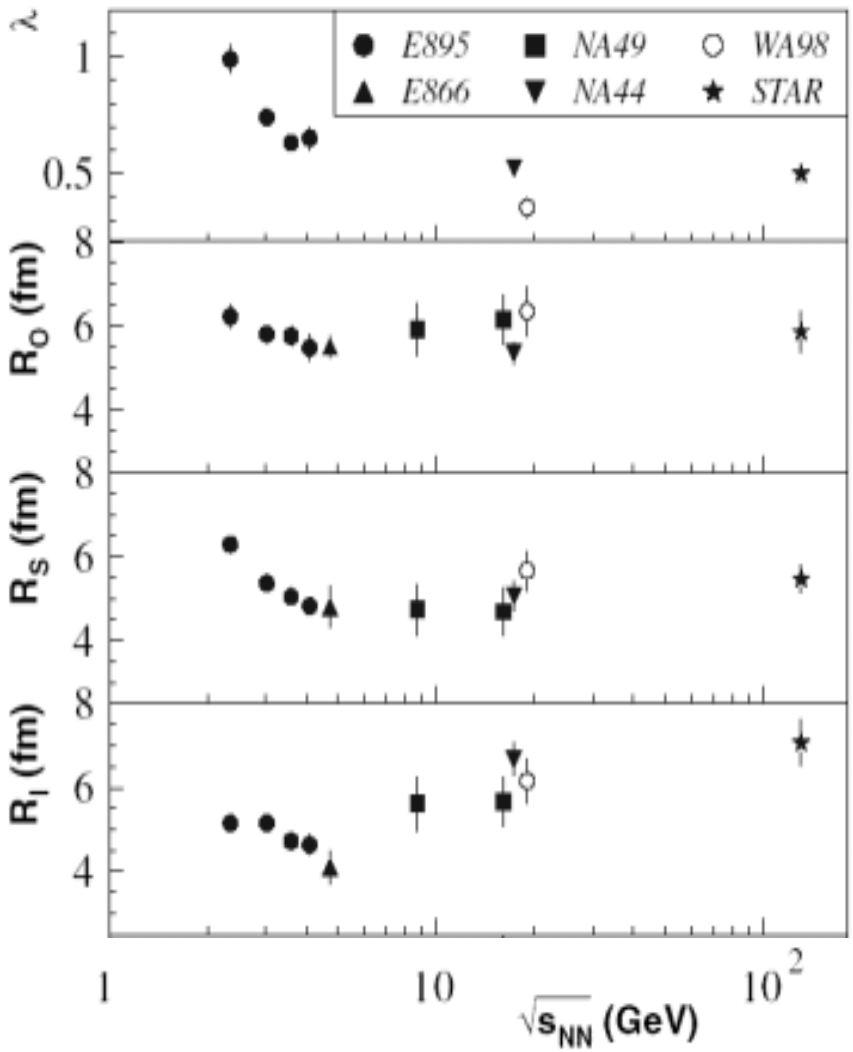
Two-track (pion) separation quality cut (2)

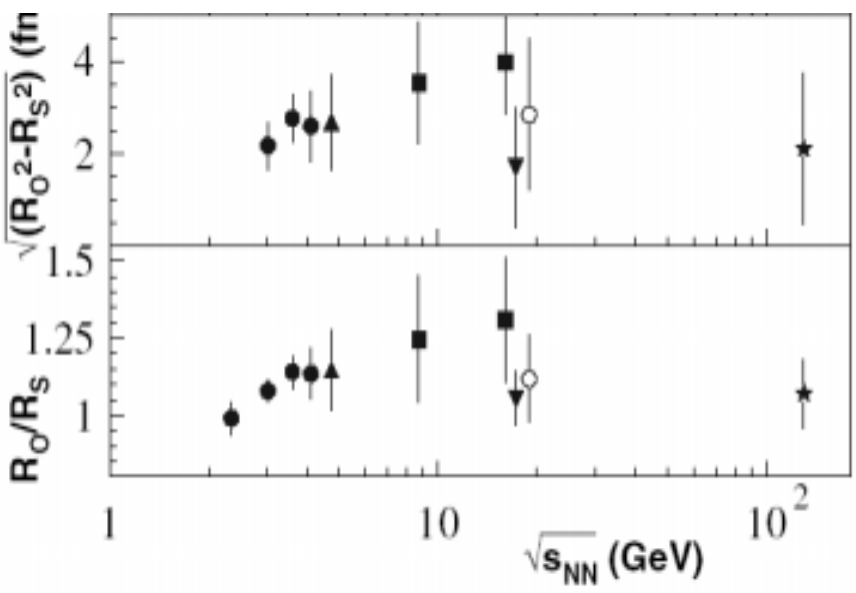
*Normalized by integrated yield





Energy dependence





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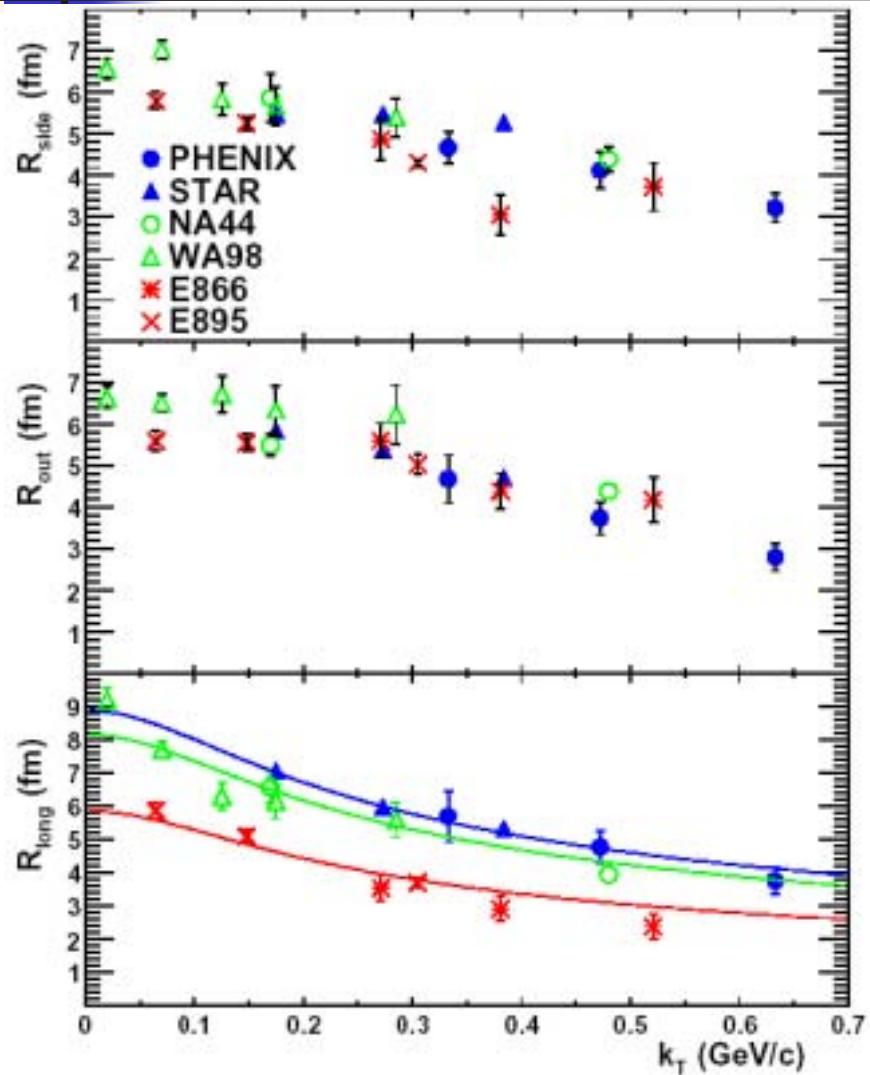
Kt dependence



	k_T (MeV)	200 – 400	400 – 550	550 – 1000
	$\langle k_T \rangle$	333	472	633
π^+	$R_{\rm inv}$	6.74 ± 0.31	6.42 ± 0.46	3.46 ± 0.46
	λ_{LCMS}	0.423 ± 0.037	0.389 ± 0.039	0.287 ± 0.048
	$R_{\rm long}$	6.01 ± 0.45	4.76 ± 0.35	2.97 ± 0.38
	$R_{\rm side}$	4.81 ± 0.30	3.74 ± 0.36	2.79 ± 0.37
	$R_{\rm out}$	4.78 ± 0.30	3.76 ± 0.26	2.59 ± 0.46
	$R_{\rm out}^{\rm PCMS}$	11.35 ± 0.69	12.20 ± 1.02	8.60 ± 1.13
π^-	$R_{\rm inv}$	6.00 ± 0.30	5.96 ± 0.41	4.58 ± 0.48
	λ_{LCMS}	0.431 ± 0.079	0.405 ± 0.067	0.353 ± 0.062
	$R_{\rm long}$	5.69 ± 0.76	4.77 ± 0.49	3.76 ± 0.41
	$R_{\rm side}$	4.67 ± 0.38	4.13 ± 0.45	3.22 ± 0.35
	$R_{\rm out}$	4.69 ± 0.58	3.75 ± 0.40	2.81 ± 0.34
	$R_{\rm out}^{\rm PCMS}$	11.27 ± 0.72	12.42 ± 1.18	11.89 ± 1.73

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