

Transverse momentum fluctuations –
system size dependence
(status of the draft)

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Plan of the draft

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2. Measures of fluctuations
3. Experimental Set-up
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 - 4.1 Data sets
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1. Introduction

- The main goals of event-by-event physics
- Dynamical fluctuations
- The subject of this paper – system size dependence of transverse momentum fluctuations

2. Measures of fluctuations

- Distribution of mean (per event) transverse momenta $M(p_T)$ for data and mixed events
- ϕ_{pT} correlation measure
- Two-particle correlation plots (x_1, x_2)

3. Experimental Set-up

- TPCs
- Different beam definitions (counters) and target arrangements (p+p, C+C, Si+Si and Pb+Pb)
- VCAL

Figure 1: The experimental set-up of the NA49 experiment [21] with different beam

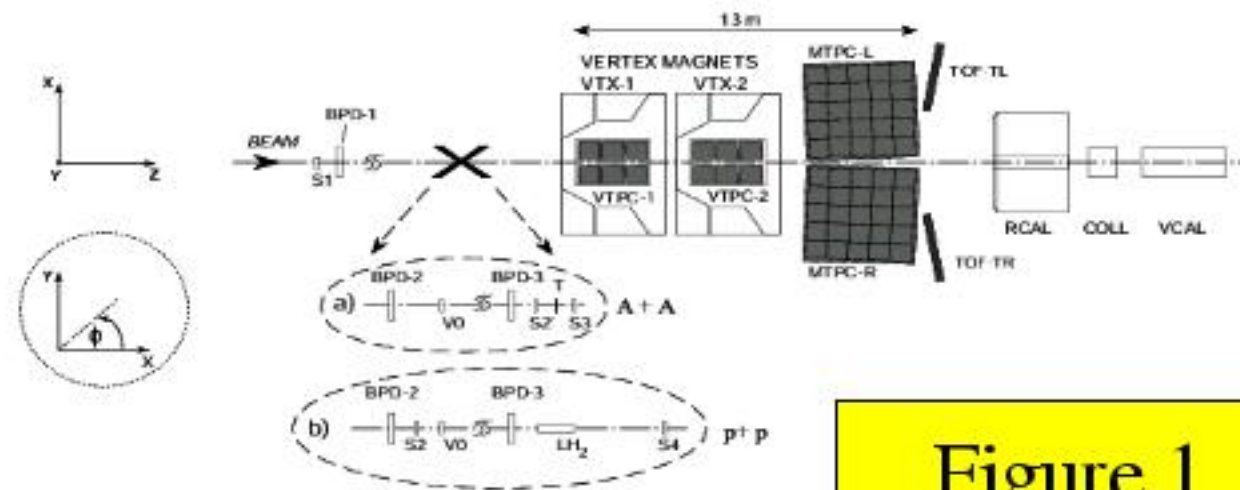


Figure 1

4. Data selection and analysis

- 4.1 Data sets

	No. of events	σ/σ_{tot}	$\langle N_W \rangle$	b range [fm]
p+p	570 000	0.9	2	
C+C	33 000	0.153	13.9	0 - 2.0
Si+Si	63 000	0.122	37	0 - 2.6
Pb+Pb(6)	117 000	0.57	42	10.2 -
Pb+Pb(5)	59 000	0.10	88	9.1 - 10.2
Pb+Pb(4)	68 000	0.10	134	7.4 - 9.1
Pb+Pb(3)	68 000	0.11	204	5.4 - 7.4
Pb+Pb(2)	45 000	0.075	281	3.4 - 5.4
Pb+Pb(1)	180 000	0.05	352	0 - 3.4

Table 1: Data sets used in analysis. Listed for p+p, C+C, Si+Si and six centralities of Pb+Pb collisions at 158 AGeV are: number of events, σ/σ_{tot} - the fraction of the total inelastic cross section, $\langle N_W \rangle$ - the mean number of wounded nucleons, b - impact parameter.

y_σ	$A[\frac{e}{GeV}]$	$B[\frac{GeV}{e}]$	$C[\frac{deg \cdot GeV}{e}]$
3.9 - 4.1	0	0.3	6500

Table 1

4.2 Event and particle selection

- * vertex cuts
- * track cuts (bx, by, nmp, np/nmp)
- * $4.0 < y_{\pi} < 5.5$
- * $0.005 < p_T < 1.5 \text{ GeV}/c$
- * geometrical acceptance (p_T versus azimuthal angle)

Table 2

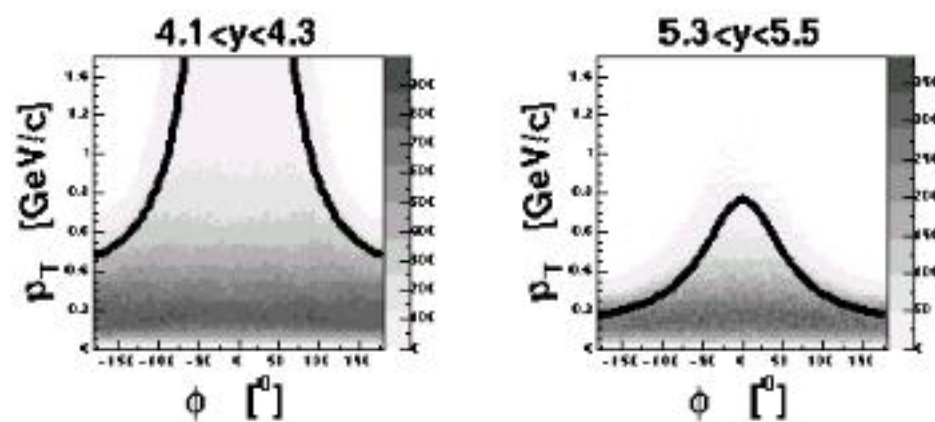


Figure 2

Table 1: Summary of the parameters used in the parametrization. The parameters are: p_T [GeV/c], y_{π} [pseudorapidity]. For Pb+Pb collisions at 158 AGeV are: number of events, σ/σ_{tot} - the fraction of total inelastic cross section, $\langle N_{w\pi} \rangle$ - the mean number of wounded nucleons, b - impact parameter.

y_{π}	$A[\frac{GeV}{c}]$	$B[\frac{GeV}{c}]$	$C[\frac{GeV^2}{c^2}]$
3.9 - 4.1	0	0.3	6500
4.1 - 4.3	0	0.3	5500
4.3 - 4.5	0	0.25	4500
4.5 - 4.7	0	0.25	3500
4.7 - 4.9	0	0.2	2500
4.9 - 5.1	0.5	0.2	2500
5.1 - 5.3	1.0	0.1	2500
5.3 - 5.5	1.5	0.1	2500

Table 2: The parametrization of NA49 $y - p_T$ acceptance at 158 AGeV for positively charged particles (STD+). For negatively charged particles one has to redefine azimuthal angle and use the same parametrization.

4.3 Corrections and systematic error estimates

- * influence of non-target interactions
- * influence of non-vertex tracks

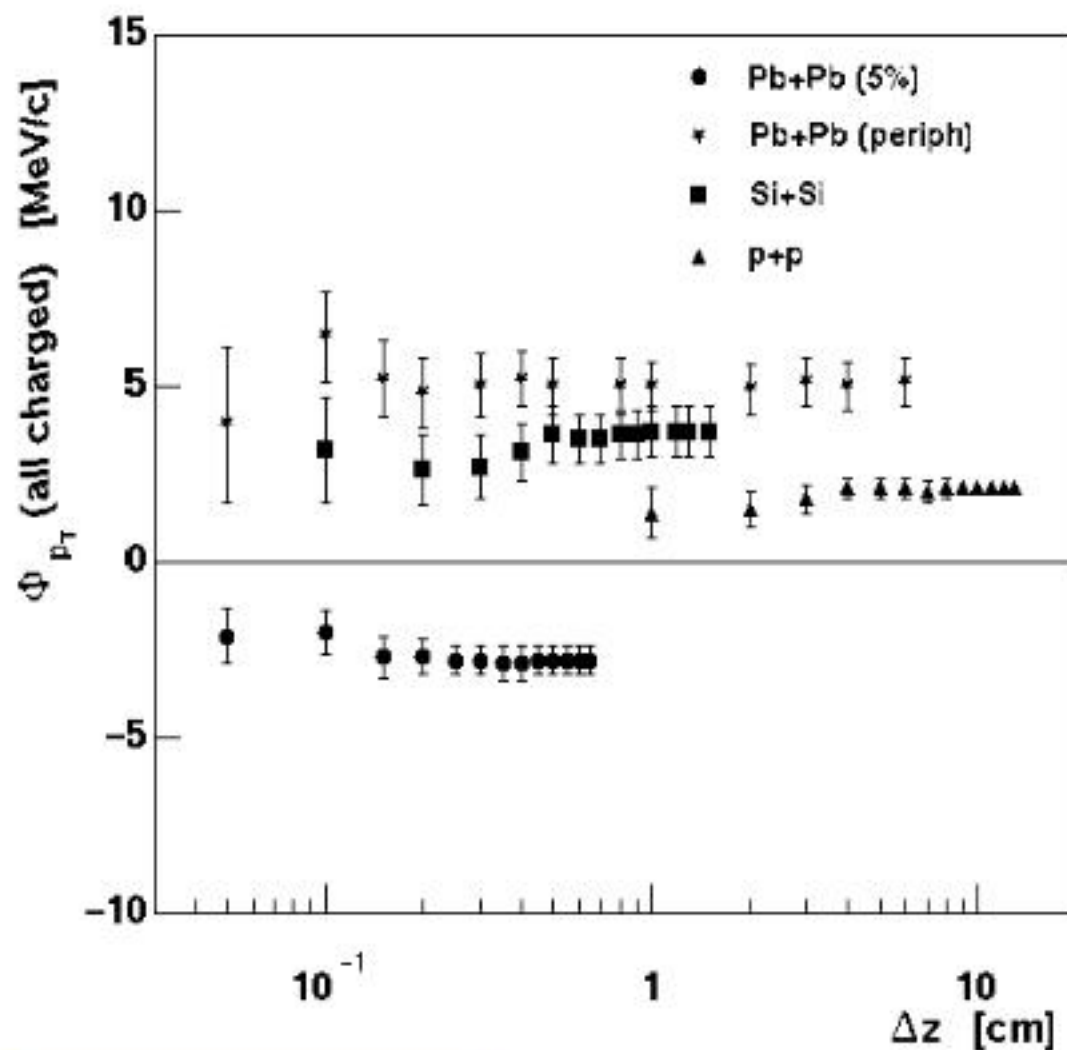


Figure 3

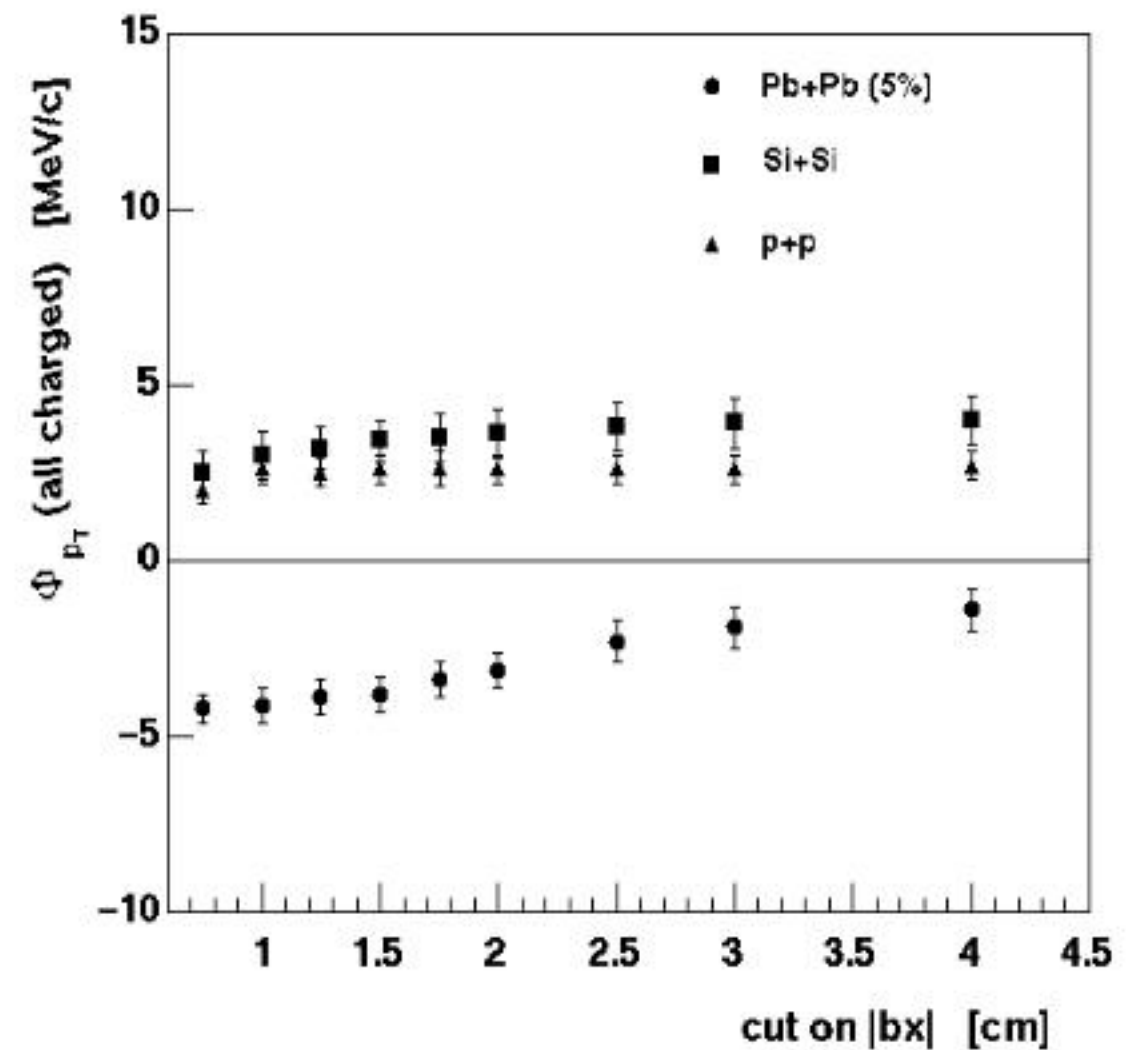


Figure 4

4.3 Corrections and systematic error estimates

- * losses of tracks due to reconstruction inefficiency and track selection cuts
- * limited two track resolution effect

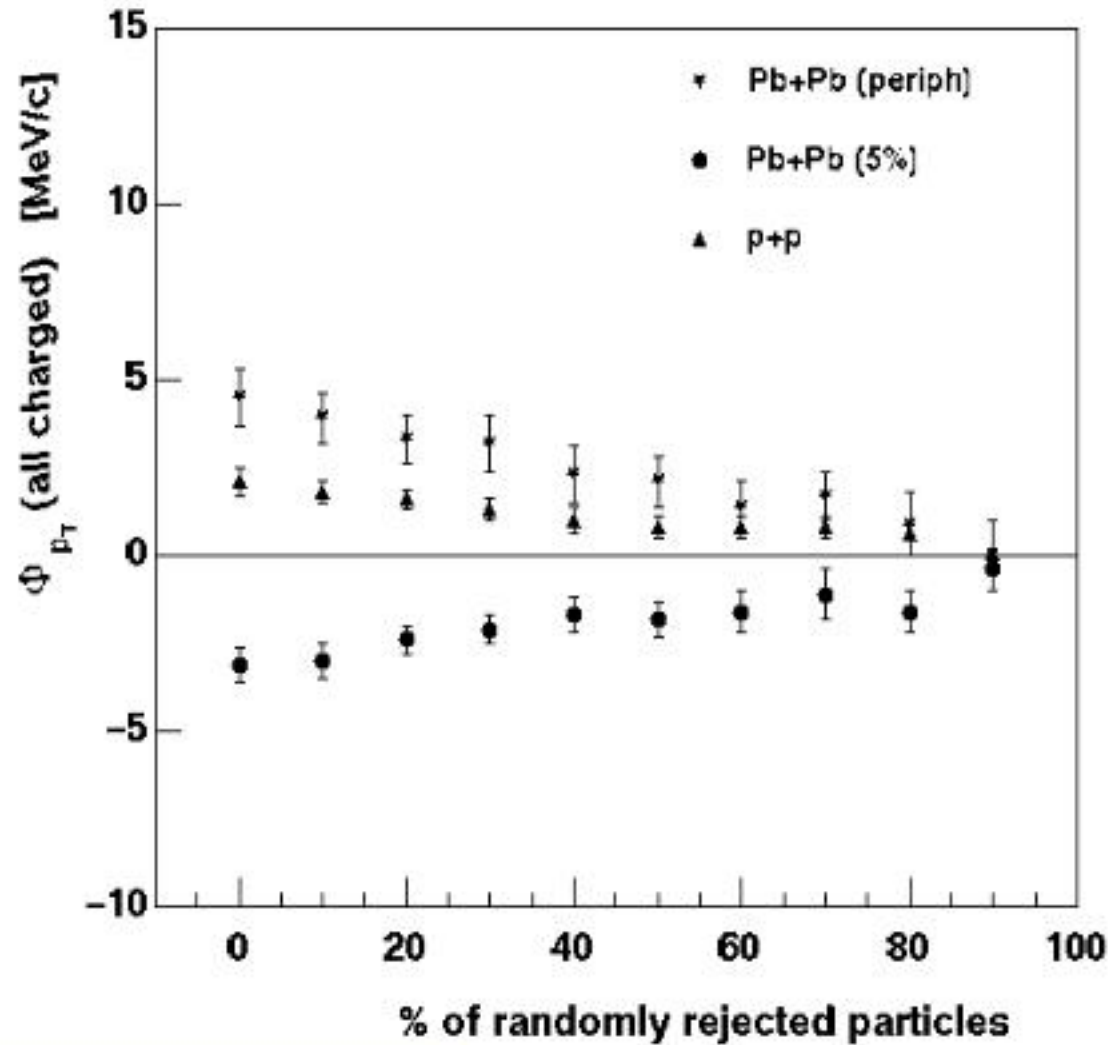


Figure 5

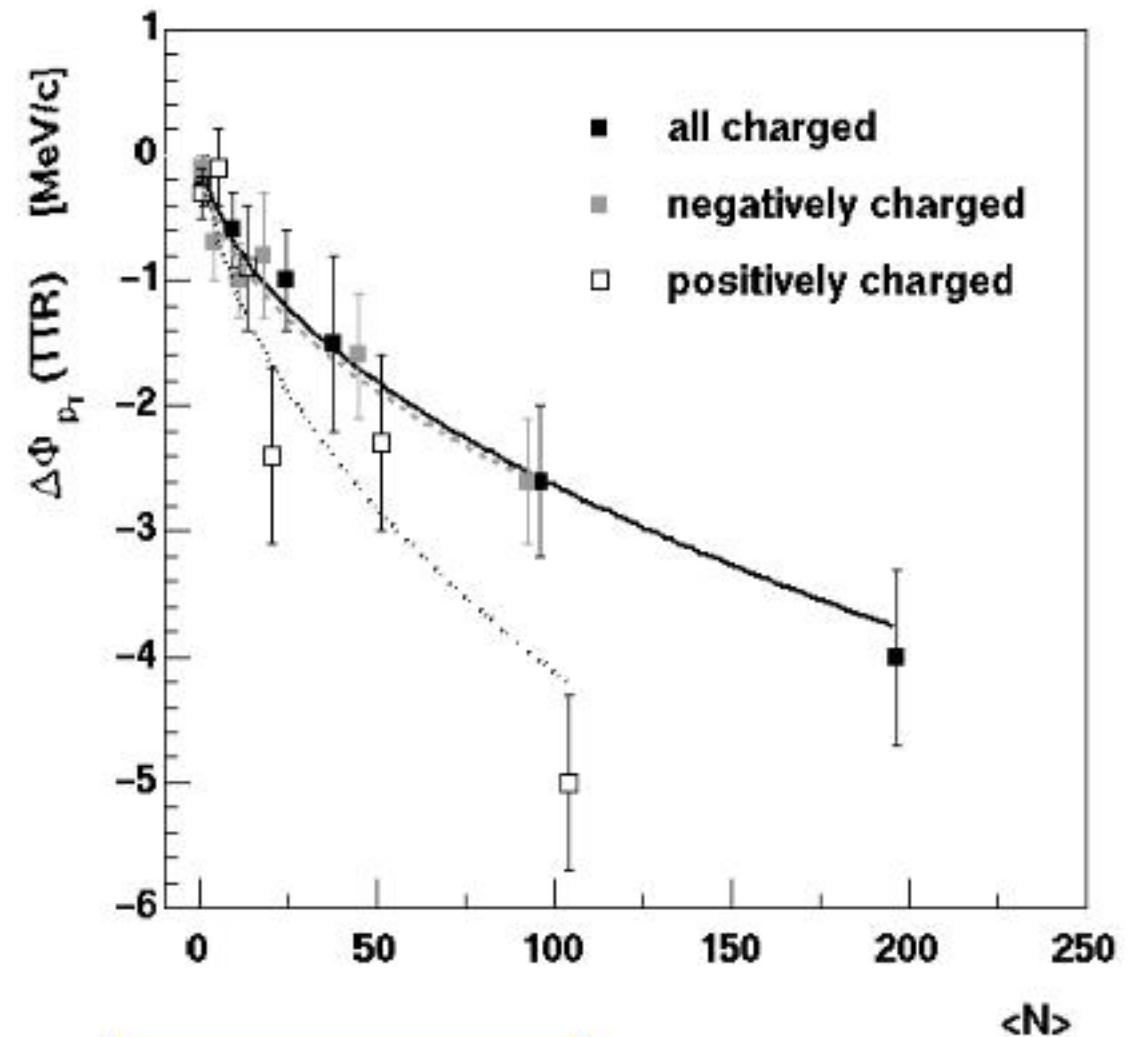
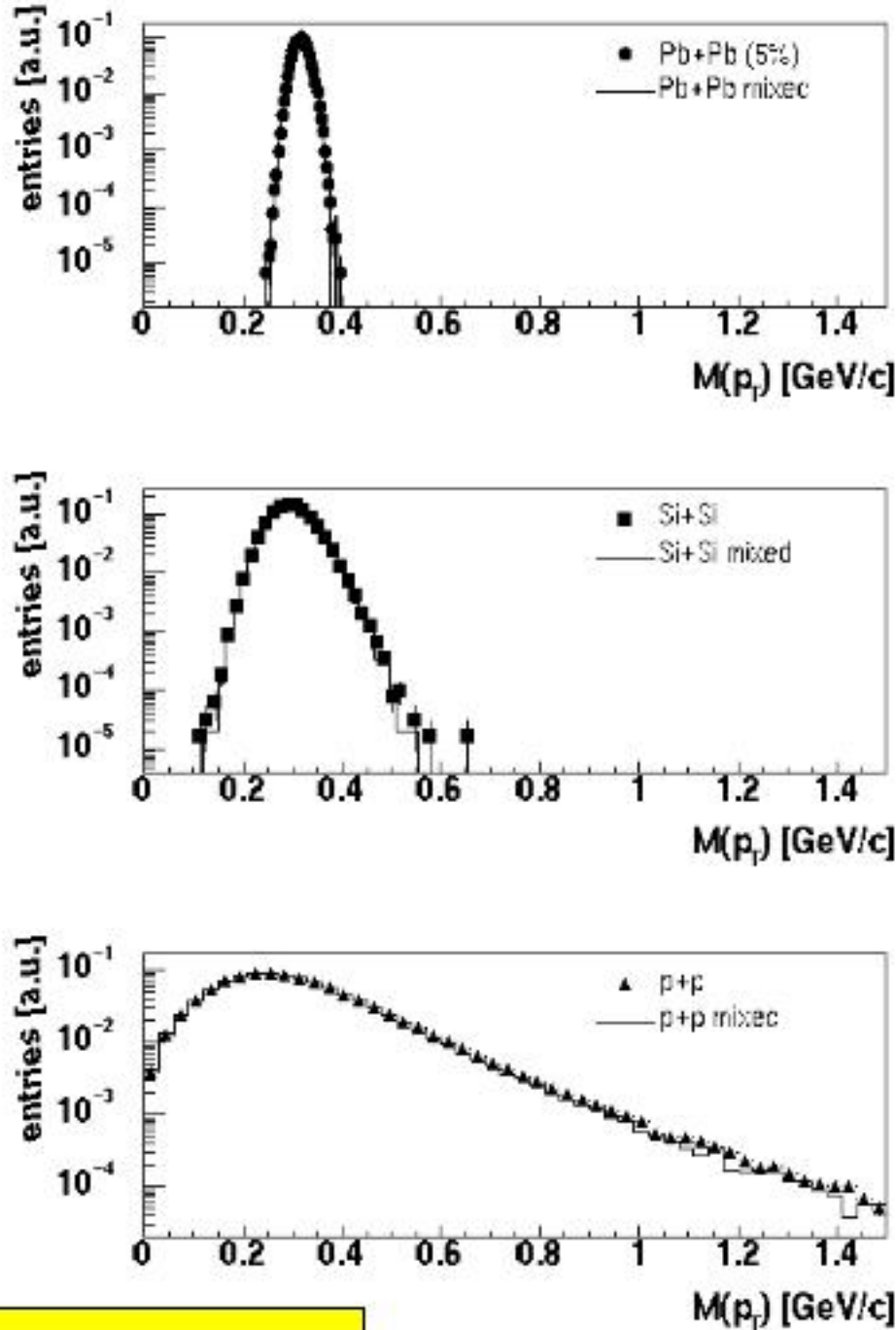


Figure 6

5. Results



	$\langle N \rangle$	$\sigma(N)$	$\overline{p_T}$ [MeV/c]	$\sigma(p_T)$ [MeV/c]	Φ_{p_T} [MeV/c]
p+p (all)	1.4	1.3	304	196	2.2 ± 0.3
p+p (-)	0.6	0.7	283	179	0.8 ± 0.1
p+p (+)	0.8	0.9	317	206	-1.4 ± 0.3
C+C (all)	10	4.3	300	210	5.4 ± 0.7
C+C (-)	4.5	2.4	279	190	1.8 ± 0.8
C+C (+)	5.5	2.7	317	224	0.7 ± 0.7
Si+Si (all)	27	7	301	217	4.9 ± 0.8
Si+Si (-)	12	4	277	195	2.6 ± 0.5
Si+Si (+)	15	4	320	231	-0.2 ± 0.7
Pb+Pb(6) (all)	39	18	299	220	7.2 ± 0.7
Pb+Pb(6) (-)	18	9	270	195	4.5 ± 0.5
Pb+Pb(6) (+)	21	10	325	237	1.9 ± 0.7
Pb+Pb(5) (all)	73	17	305	226	6.6 ± 0.7
Pb+Pb(5) (-)	34	9	273	199	4.5 ± 0.7
Pb+Pb(5) (+)	39	9	333	245	0.6 ± 0.8
Pb+Pb(4) (all)	104	19	309	230	5.6 ± 0.8
Pb+Pb(4) (-)	49	10	276	202	3.8 ± 0.5
Pb+Pb(4) (+)	55	11	337	249	-0.6 ± 0.9
Pb+Pb(3) (all)	148	21	312	233	4.6 ± 0.8
Pb+Pb(3) (-)	69	11	279	204	2.9 ± 0.8
Pb+Pb(3) (+)	79	12	342	252	-1.3 ± 0.8
Pb+Pb(2) (all)	193	21	315	234	2.2 ± 1.0
Pb+Pb(2) (-)	90	11	281	205	2.4 ± 0.8
Pb+Pb(2) (+)	103	13	344	254	-3.7 ± 1.1
Pb+Pb(1) (all)	230	19	317	236	1.4 ± 0.8
Pb+Pb(1) (-)	108	11	281	203	0.9 ± 0.6
Pb+Pb(1) (+)	122	12	349	257	-2.9 ± 0.8

Table 3: Measured inclusive and event-by-event parameters for accepted particles. $\langle N \rangle$, $\sigma(N)$, $\overline{p_T}$ and $\sigma(p_T)$ values are not corrected for acceptance. Φ_{p_T} values are corrected for limited two track resolution. The systematic error of Φ_{p_T} is smaller than 1.6 MeV/c.

Figure 7

Table 3

5. Results

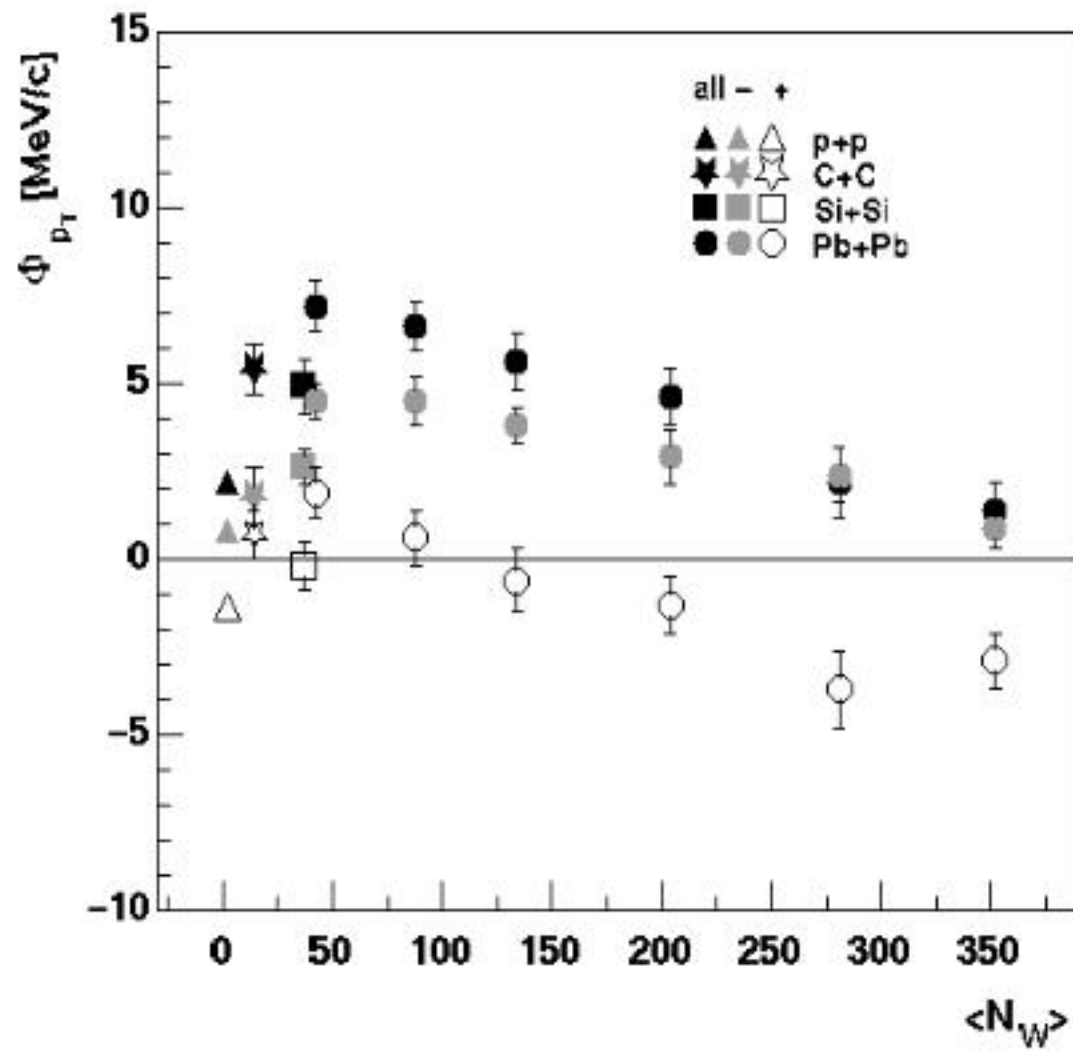


Figure 8

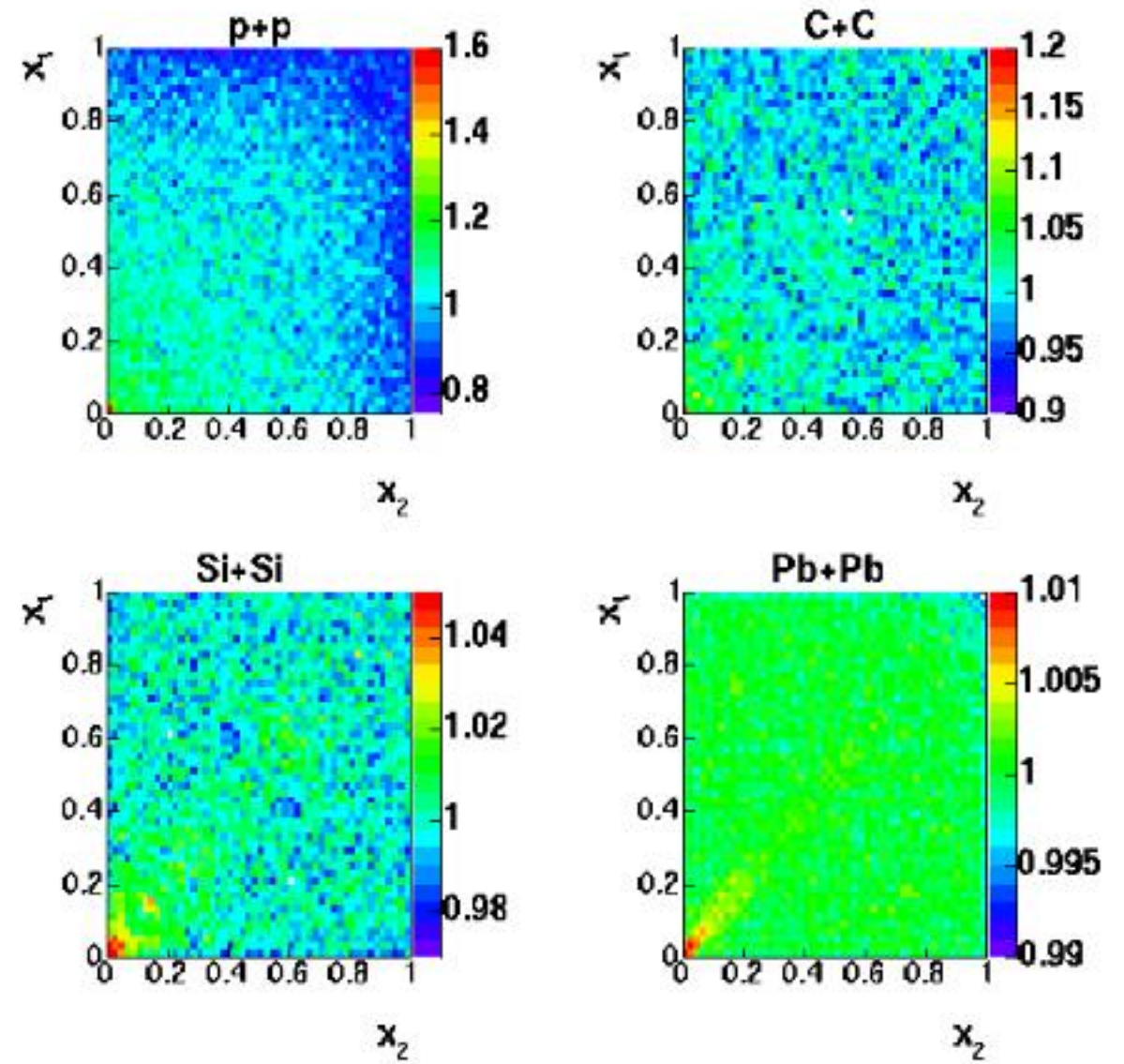
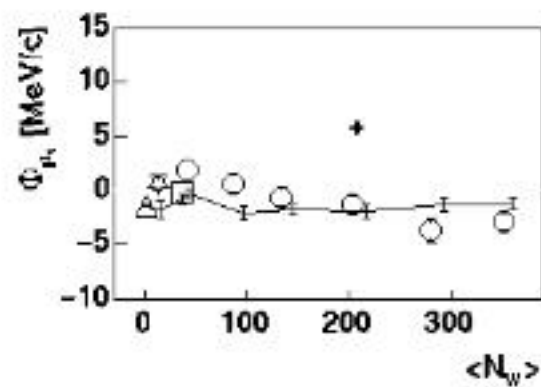
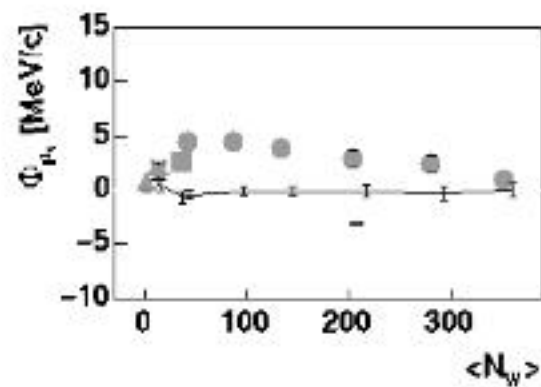
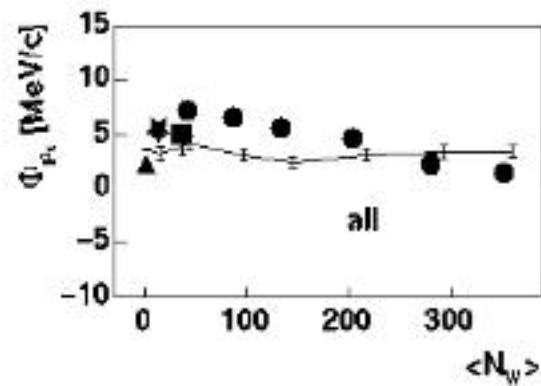


Figure 9

6. Discussion



- HIJING model with NA49 acceptance and kinematical cuts
- No significant centrality dependence

Figure 10

6. Discussion

- Low Φ_{pT} values for p+p (data and HIJING)
- Structure for two-particle correlation plot (p+p) \rightarrow what is the origin ?

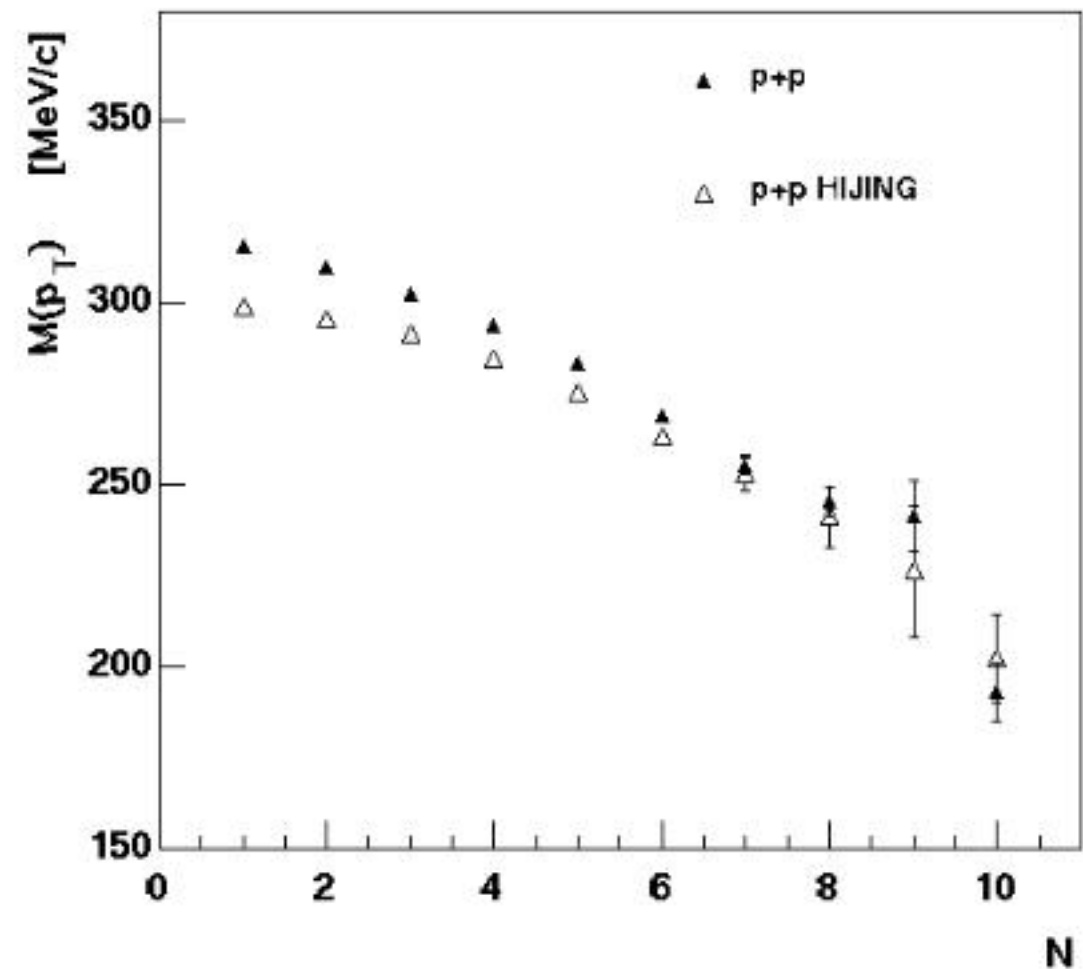
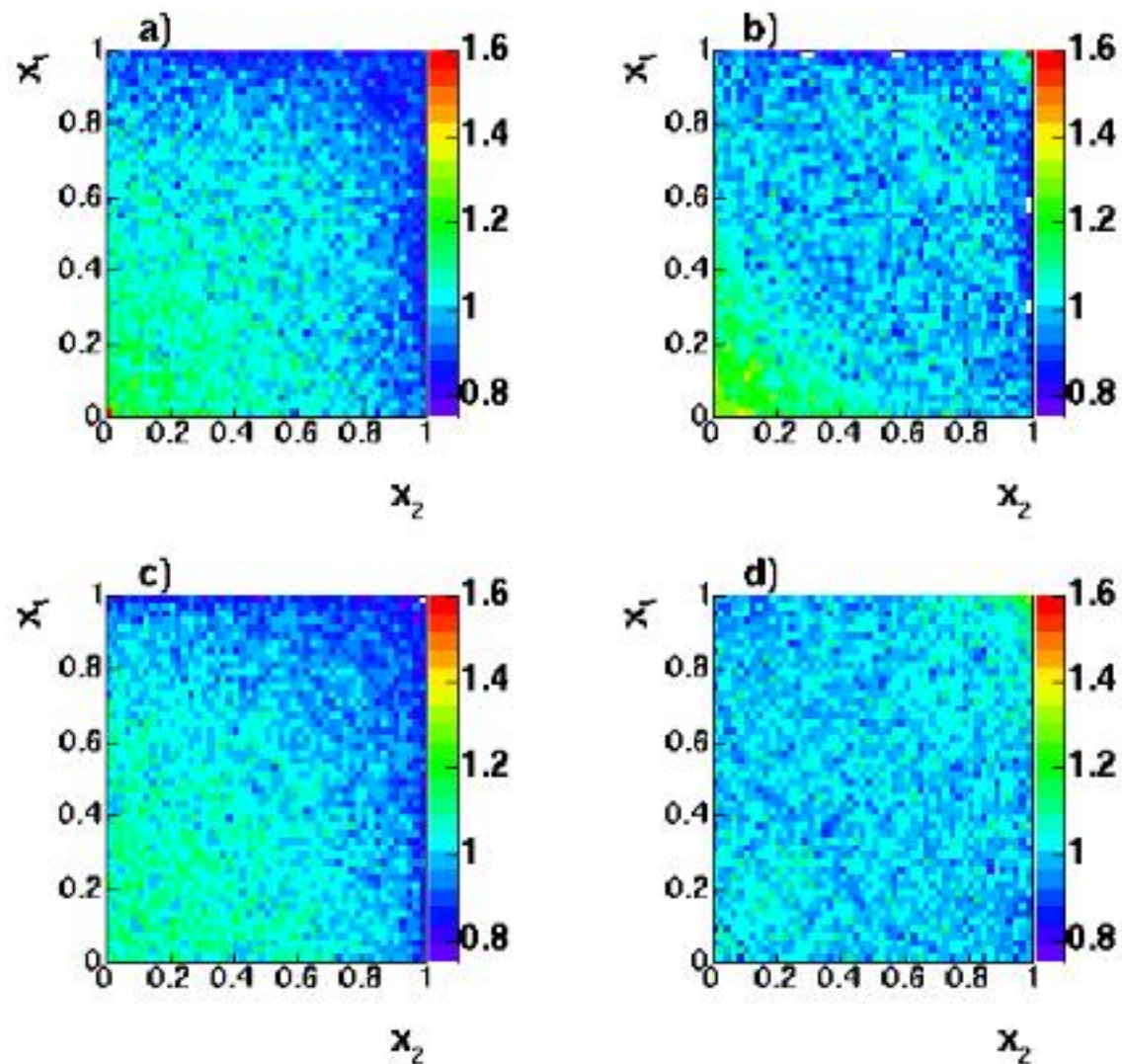


Figure 11

6. Discussion



- a) p+p data
- b) HIJING model
- c) random generator with $M(p_T)$ versus N dependence
- d) fluctuation of the inverse slope parameter (10.5%)

Figure 12

6. Discussion

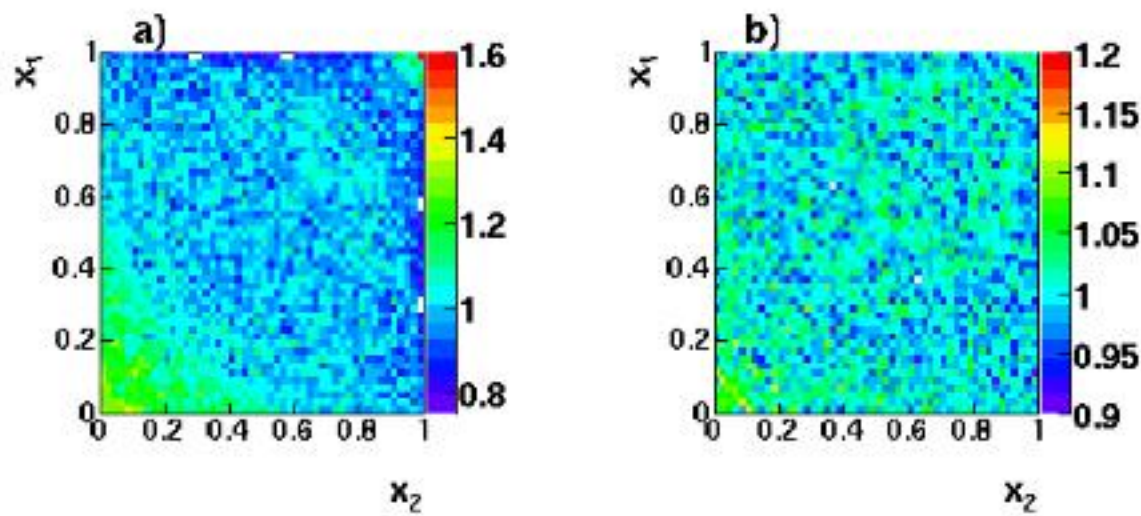


Figure 13

- HIJING model for p+p and C+C interactions
- Dilution effect from the higher number of particle pairs

6. Discussion

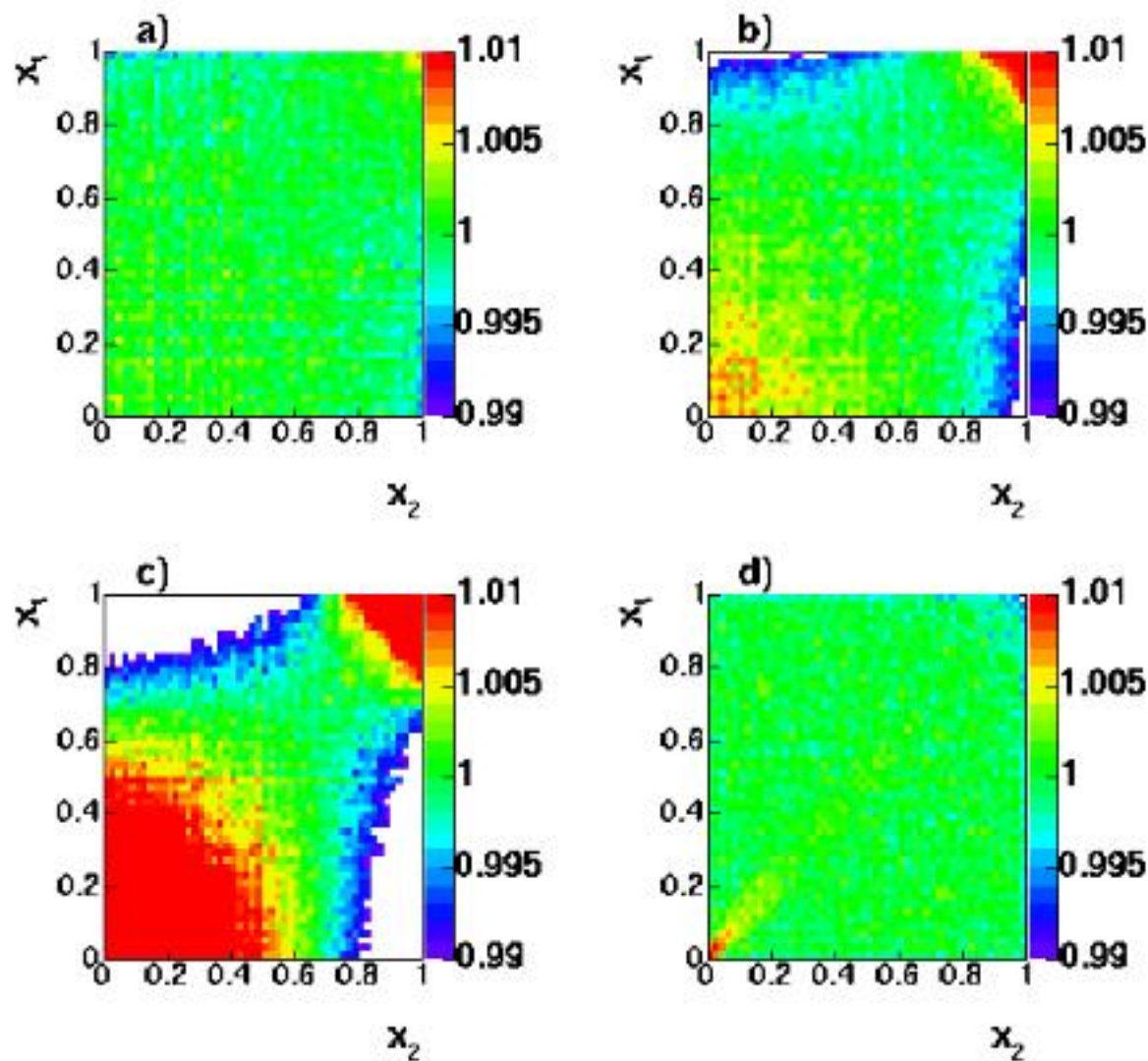


Figure 14

- Model with inverse slope parameter fluctuations for central Pb+Pb
- a) $\sigma(T)/T = 2.6\%$
- b) $\sigma(T)/T = 5.3\%$
- c) $\sigma(T)/T = 10.5\%$
- d) Pb+Pb data

6. Discussion

- $\sigma(T)/T < 1\%$

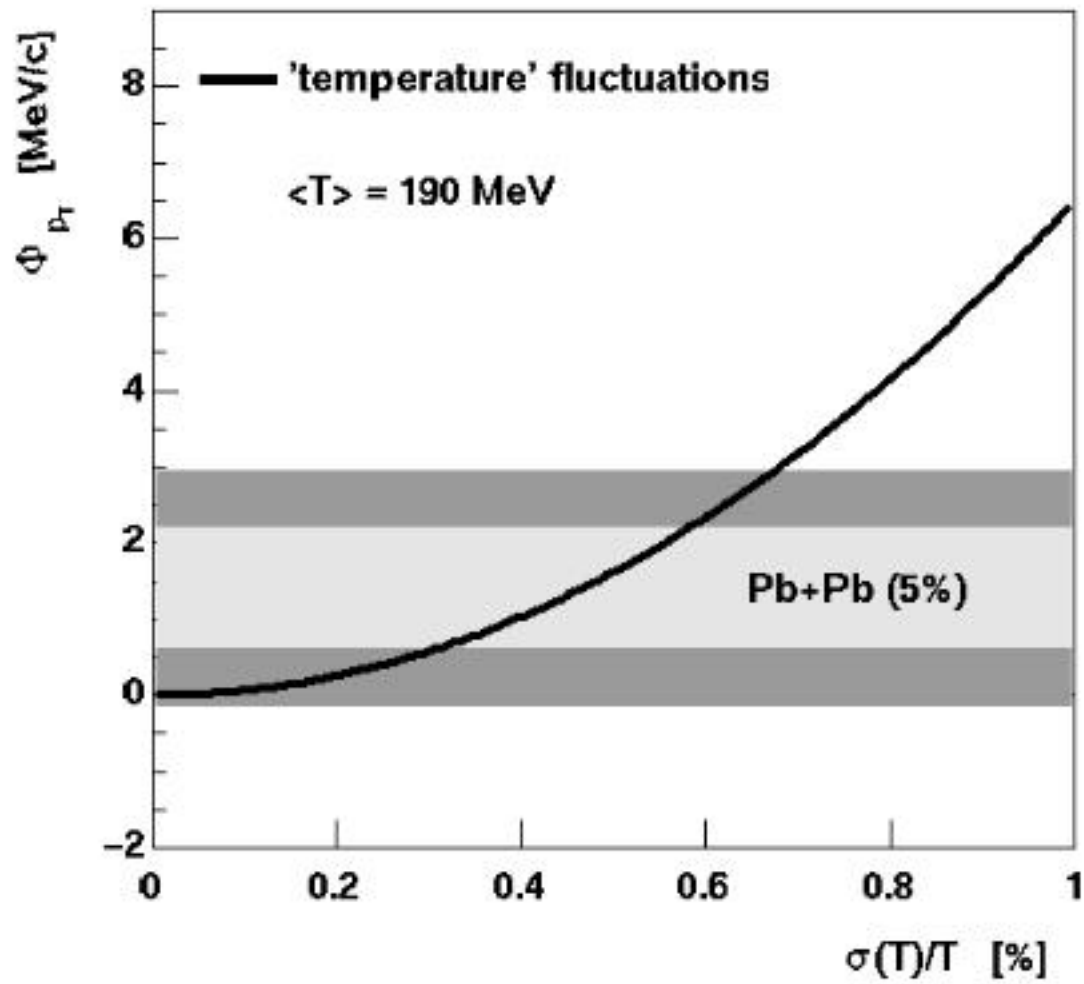


Figure 15

6. Discussion

- STAR
 - Central Au+Au at $\sqrt{s} = 130 \text{ GeV}$
 - $M(p_T)$ distribution 20% wider than corresponding Gamma distribution
 - Saddle shaped structure for two-particle correlation plot
 - ϕ_{pT} about 25 MeV/c for midrapidity
- PHENIX
 - Central Au+Au at $\sqrt{s} = 130 \text{ GeV}$
 - No effect for $M(p_T)$ and ϕ_{pT}
 - The reason: limited azimuthal angle, limited pseudorapidity, lower p_T cut = 0.2 GeV/c

6. Discussion

- NA22
 - Elementary interactions at 250 AGeV
 - ϕ_{pT} dependence on the rapidity region
 - Confirmation of our low fluctuations for forward hemisphere
 - ϕ_{pT} for midrapidity above 25 MeV/c
- CERES
 - Pb+Au at 158 AGeV
 - ϕ_{pT} at midrapidity = 7.8 ± 0.9 MeV/c

7. Summary

- Event-by-event fluctuations for p+p, C+C, Si+Si and Pb+Pb at 158 AGeV
- FORWARD rapidity region only
- $M(p_T)$, ϕ_{pT} and two-particle correlation plots
- Dynamical fluctuations small, system size dependence
- Two-particle correlation plot for p+p data shows a structure connected with $M(p_T)$ versus N correlation
- A small effect of the Bose-Einstein correlations for central Pb+Pb collisions
- HIJING model reproduces two-particle correlation plots but no ϕ_{pT} versus centrality dependence