NA49 meeting, CERN, 06 Oct.2003
G.Feofilov

"Fluctuations and Long-Range (LR) correlation analysis of NA49 experimental data on PbPb collisions at 158 A*GeV"

A.Asryan,D.Derkach,G.Feofilov,R.Kolevatov,P.Naumenko,P.Valinevich,V.Vechernin

1) Introduction

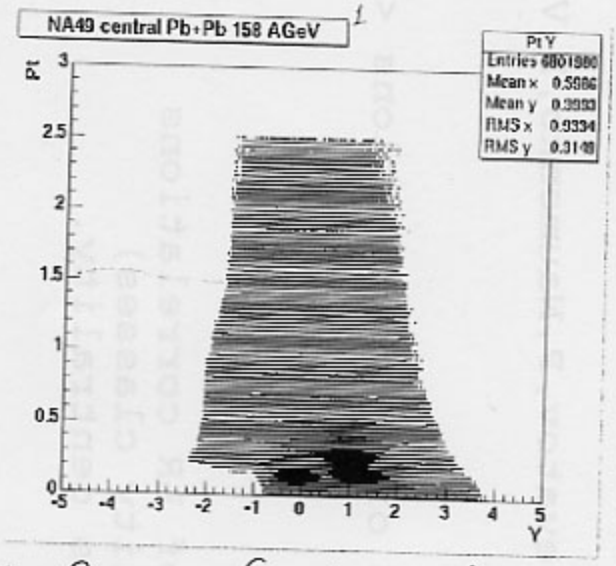
2) Results on minimum bias analysis of LR correlations <n>-n,<pt>-pt and <pt>-n)

3) Results on event mixing

4) Results on centrality analysis of LR correlations <n>-n,<pt>-pt and <pt>-n (6 centrality classes) and on "n" and "pt" fluctuations vs centrality.

Track-Cuts

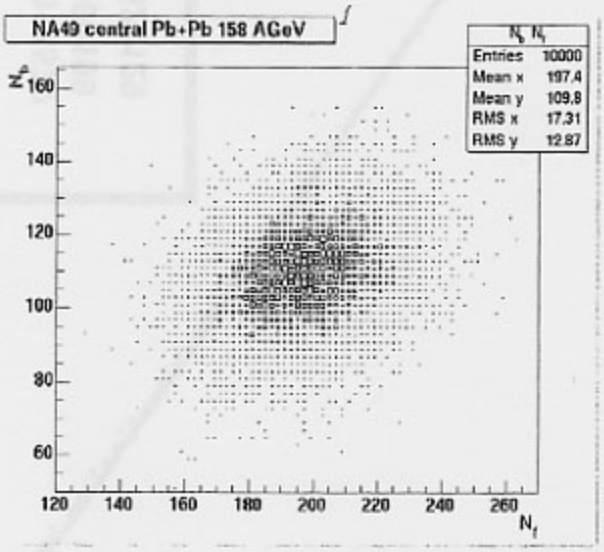
Iflag	0
Zfitst	< 200
NMP	> 30
NFP/NMP	0.5 - 1.1
b_x	-2 – 2
b_y	-1 – 1
Pt	0.005 – 2.5



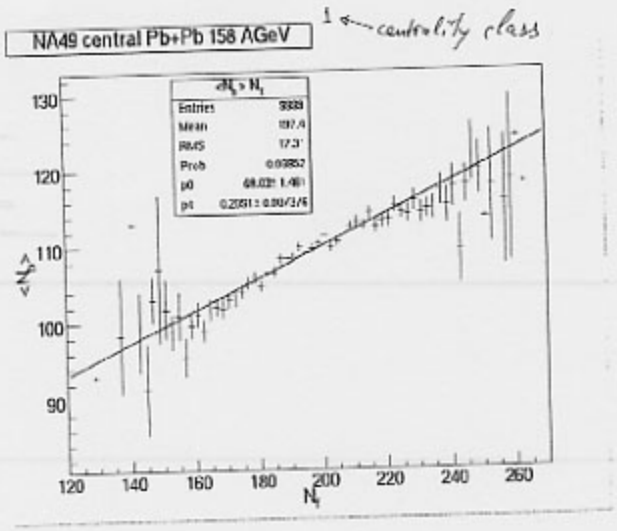
Event-cuts

2 windows: { "B" (-0.4, 0.2) "F" (0.8, 2.0)

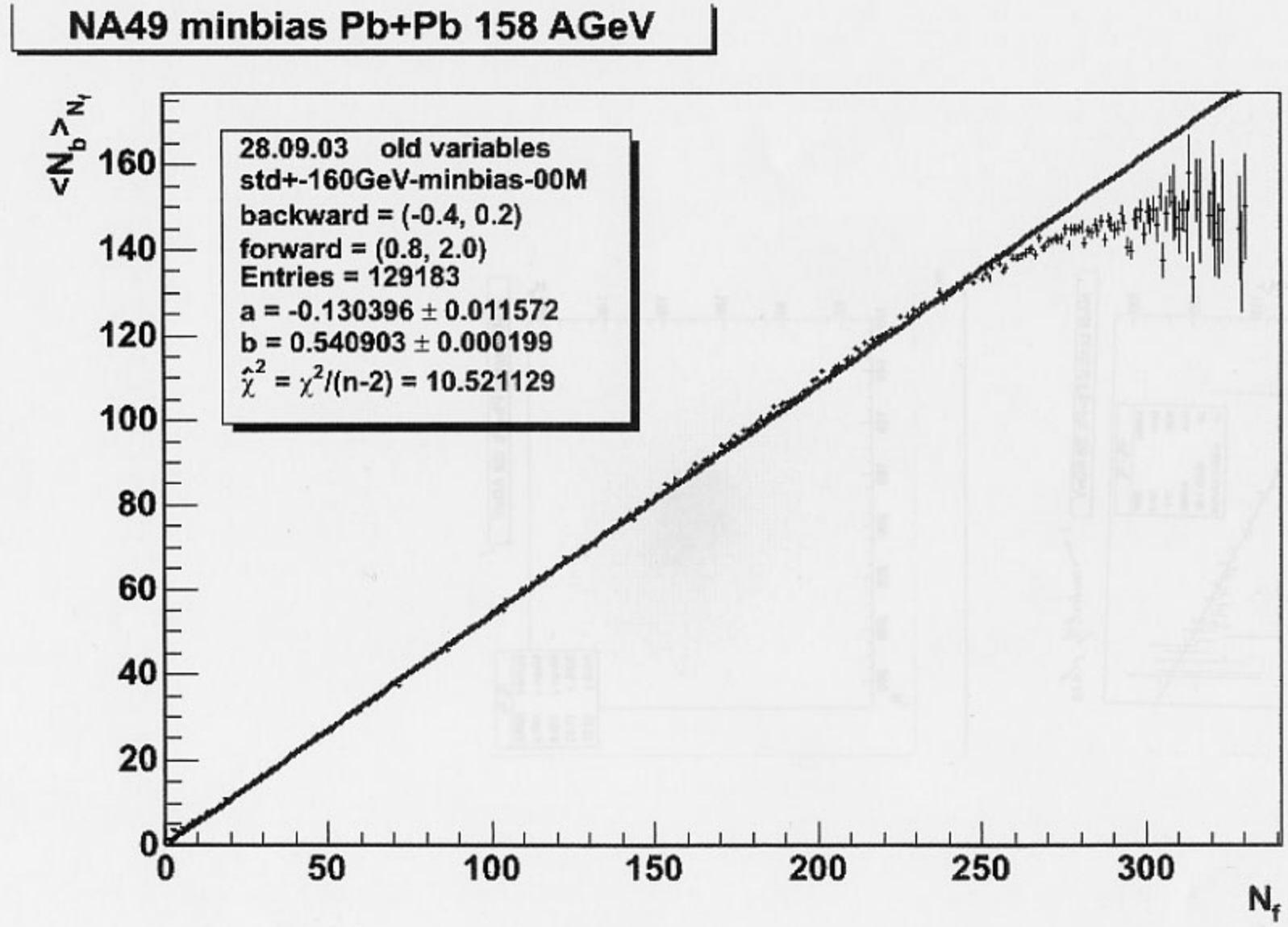
	1-st class	2-nd class	3-rd class	4-th class	5-th class	6-th class
Iflag	0	0	0	0	0	0
VertexX	-0.2 – 0.1	-0.2 – 0.1	-0.2 – 0.1	-0.2 – 0.1	-0.2 – 0.1	-0.2 – 0.1
VettexY	-0.1 – 0.2	-0.1 – 0.2	-0.1 – 0.2	-0.1 – 0.2	-0.1 – 0.2	-0.1 – 0.2
VertexZ	-579.2 – -578.65	-579.2 – -578.65	-579.2 – -578.65	-579.2 – -578.65	-579.2 – -578.65	-579.2 – -578.65
Multiplicity	800 – 1500	700 – 1300	400 – 1200	200 – 900	100 – 700	10 – 500
Eveto	0 – 9250	9250 – 14670	14670 – 21190	21190 – 26080	26080 – 29340	29340 – 36000

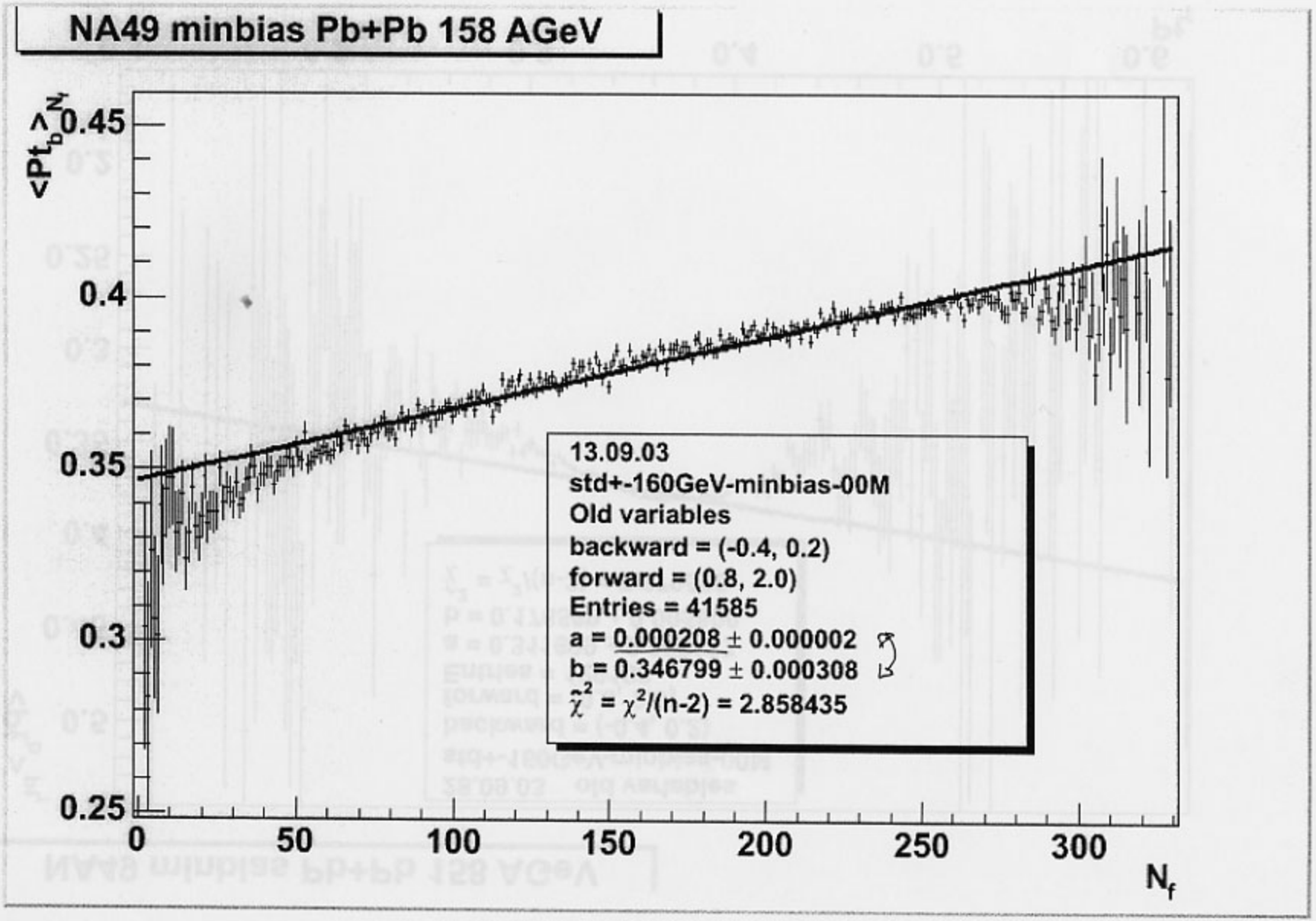

NA49 central Pb+Pb 158 AGeV
Entries 10000
Mean x 197.4
Mean y 109.8
RMS x 17.31
RMS y 12.87
N_p
N_t

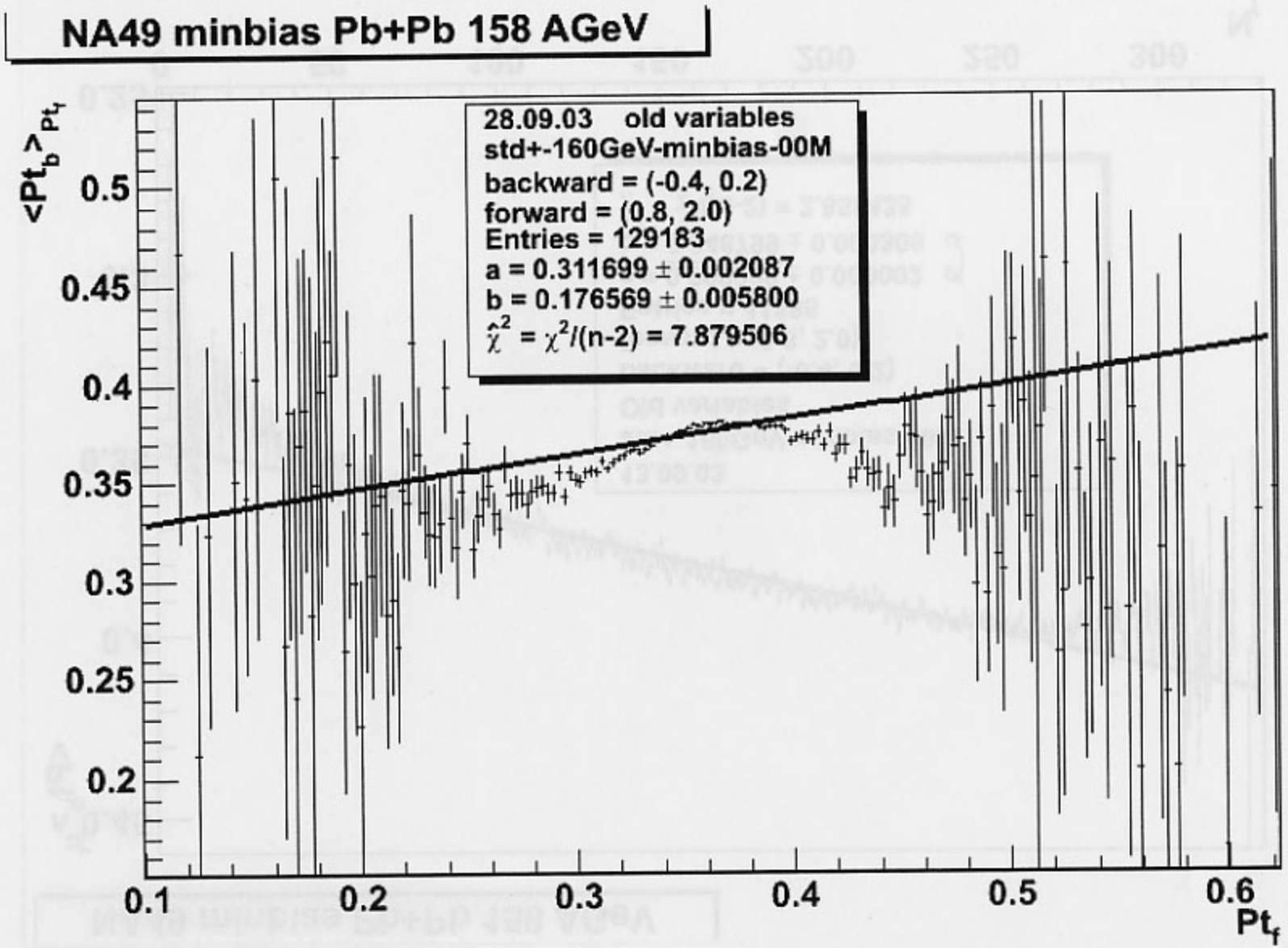
pic


NA49 central Pb+Pb 158 AGeV
1 ← centrality class
Entries
Mean
RMS
Prob
p0
p1
$\langle N_p \rangle$
N_t

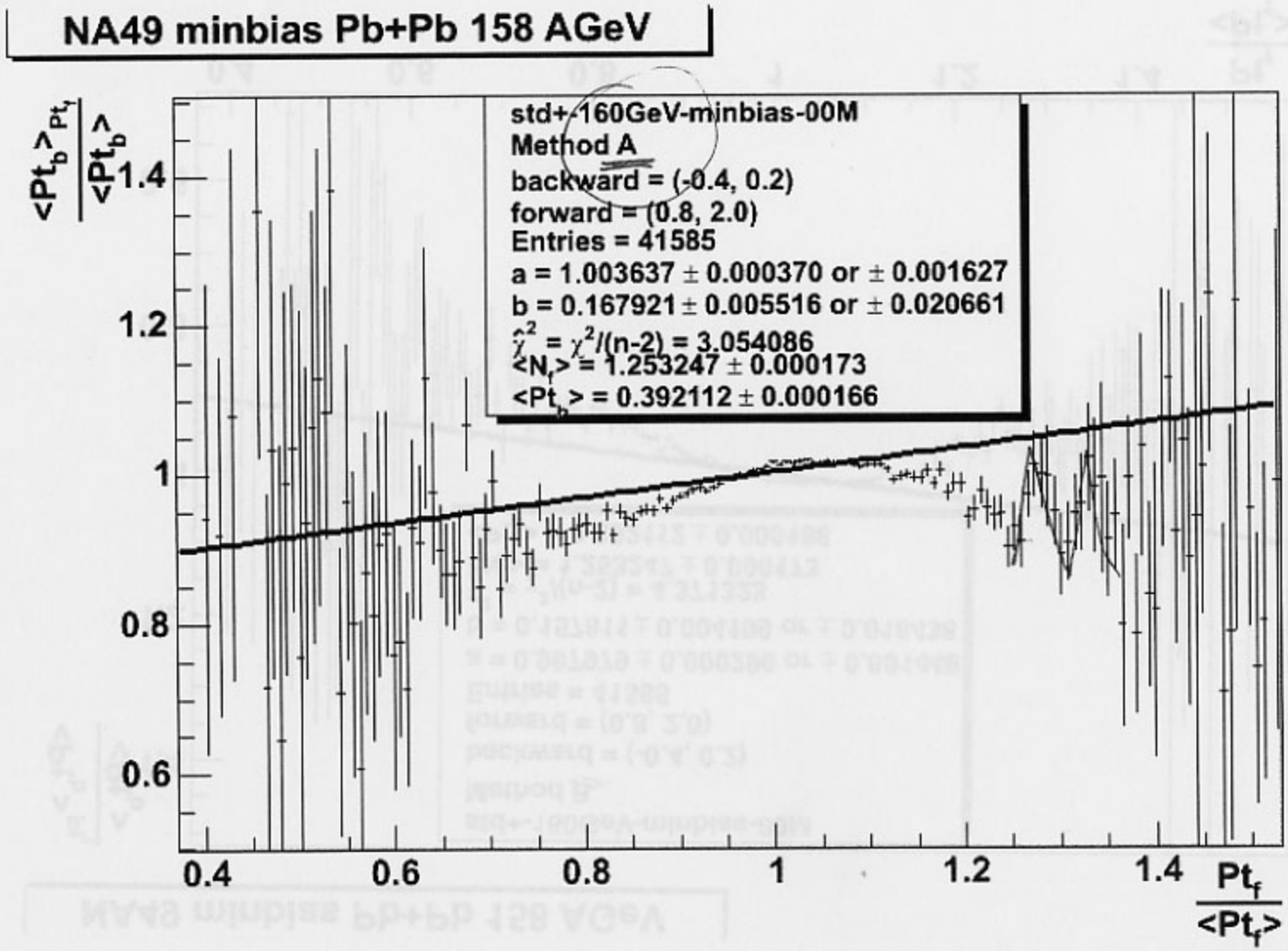
pic


NA49 minbias Pb+Pb 158 AGeV
28.09.03 old variables
std+-160GeV-minbias-00M
backward = (-0.4, 0.2)
forward = (0.8, 2.0)
Entries = 129183
a = -0.130396 ± 0.011572
b = 0.540903 ± 0.000199
$\hat{\chi}^2 = \chi^2/(n-2) = 10.521129$
$<N_b>_{N_f}$
N_f
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250
300


NA49 minbias Pb+Pb 158 AGeV
<Pt_b>^N_f
0.45
0.4
0.35
0.3
0.25
0
50
100
150
200
250
300
N_f
13.09.03
std+-160GeV-minbias-00M
Old variables
backward = (-0.4, 0.2)
forward = (0.8, 2.0)
Entries = 41585
a = 0.000208 ± 0.000002
b = 0.346799 ± 0.000308
χ̃² = χ²/(n-2) = 2.858435


NA49 minbias Pb+Pb 158 AGeV
28.09.03 old variables
std+-160GeV-minbias-00M
backward = (-0.4, 0.2)
forward = (0.8, 2.0)
Entries = 129183
a = 0.311699 ± 0.002087
b = 0.176569 ± 0.005800
$\hat{\chi}^2 = \chi^2/(n-2) = 7.879506$
$<Pt_b>_{Pt_f}$
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.1
0.2
0.3
0.4
0.5
0.6
Pt_f

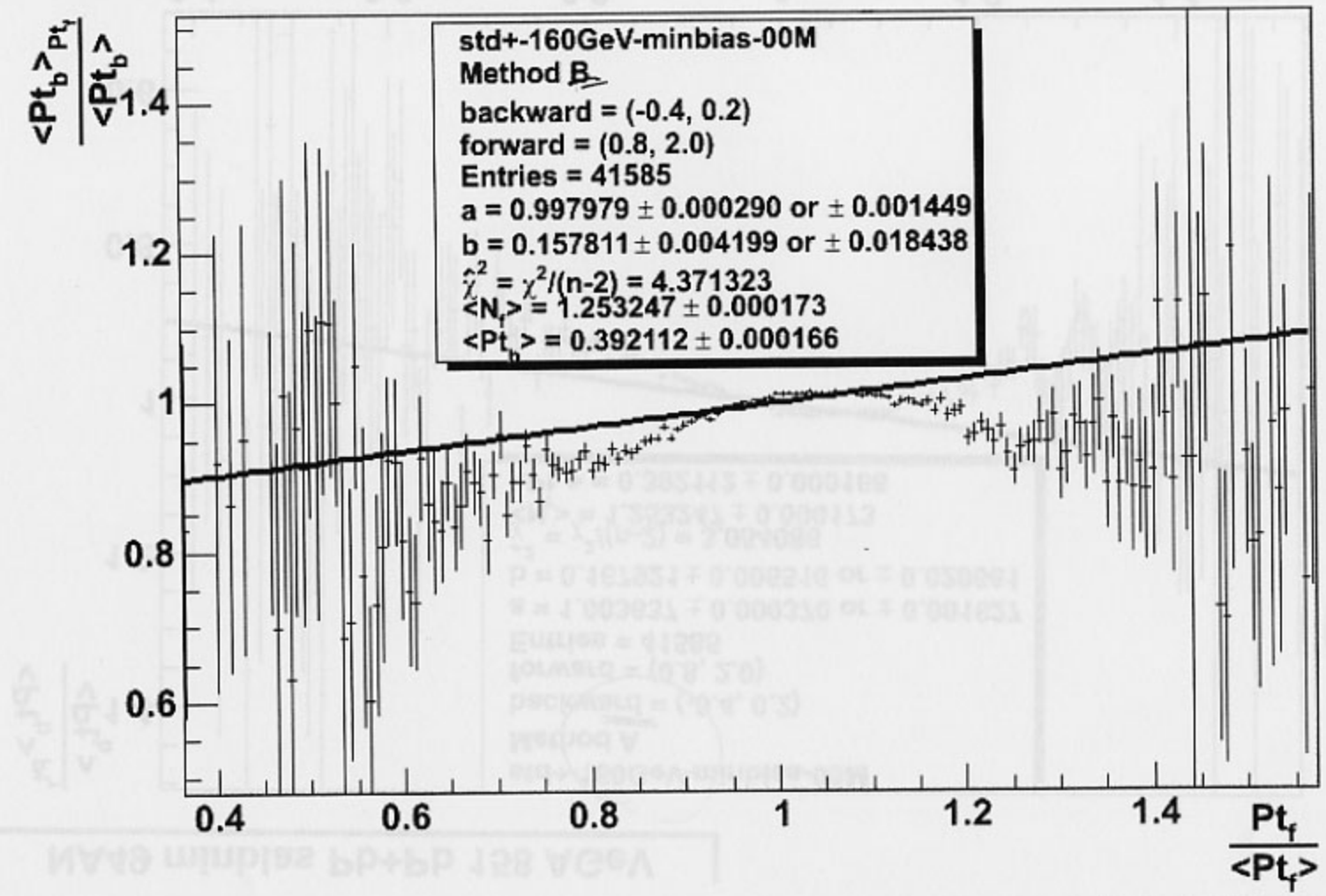
NEW VAR.
min. bias
ucrano cent.



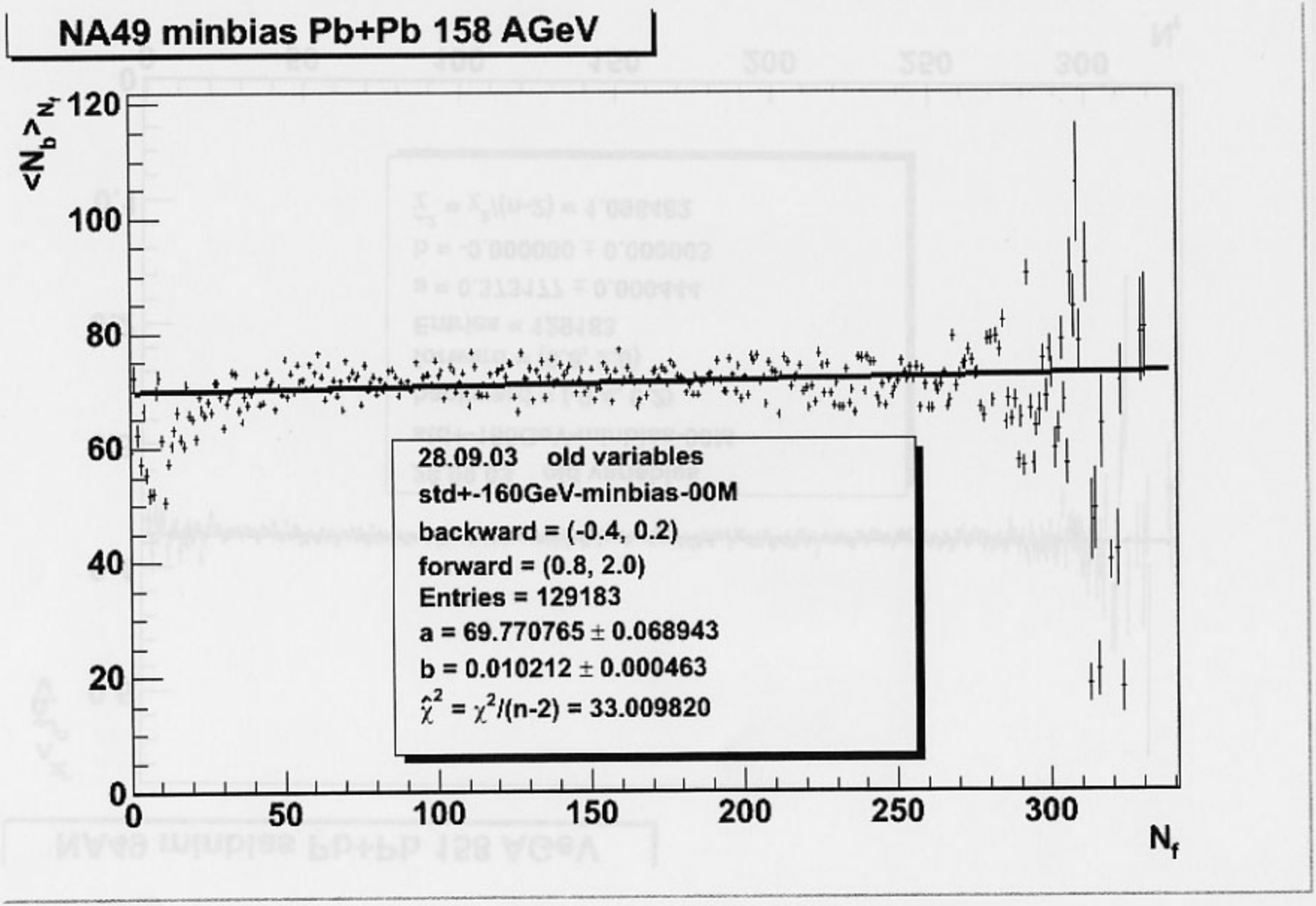
A

$\frac{2\langle p_T \rangle^B}{N_{coll}}$

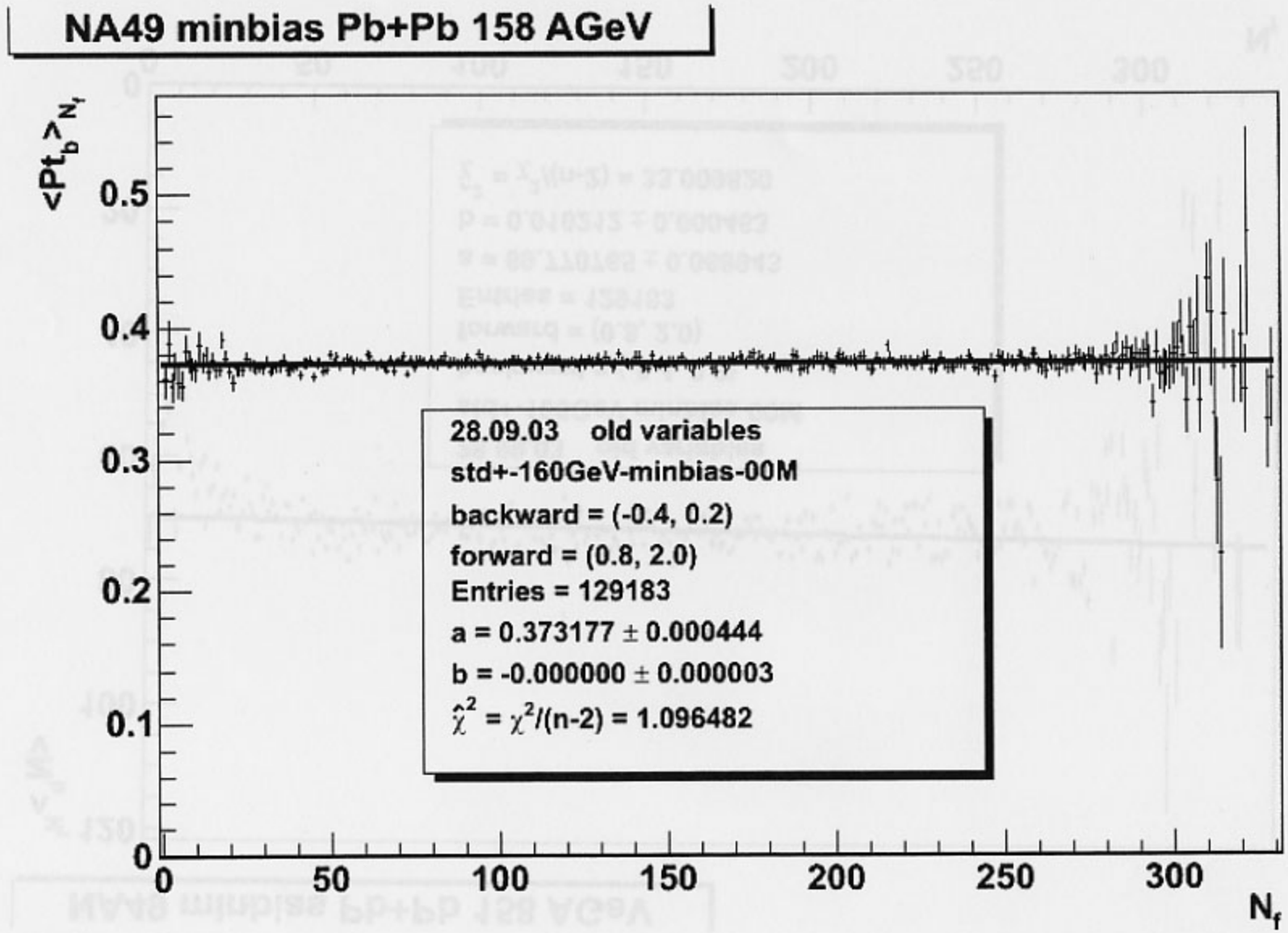
NA49 minbias Pb+Pb 158 AGeV



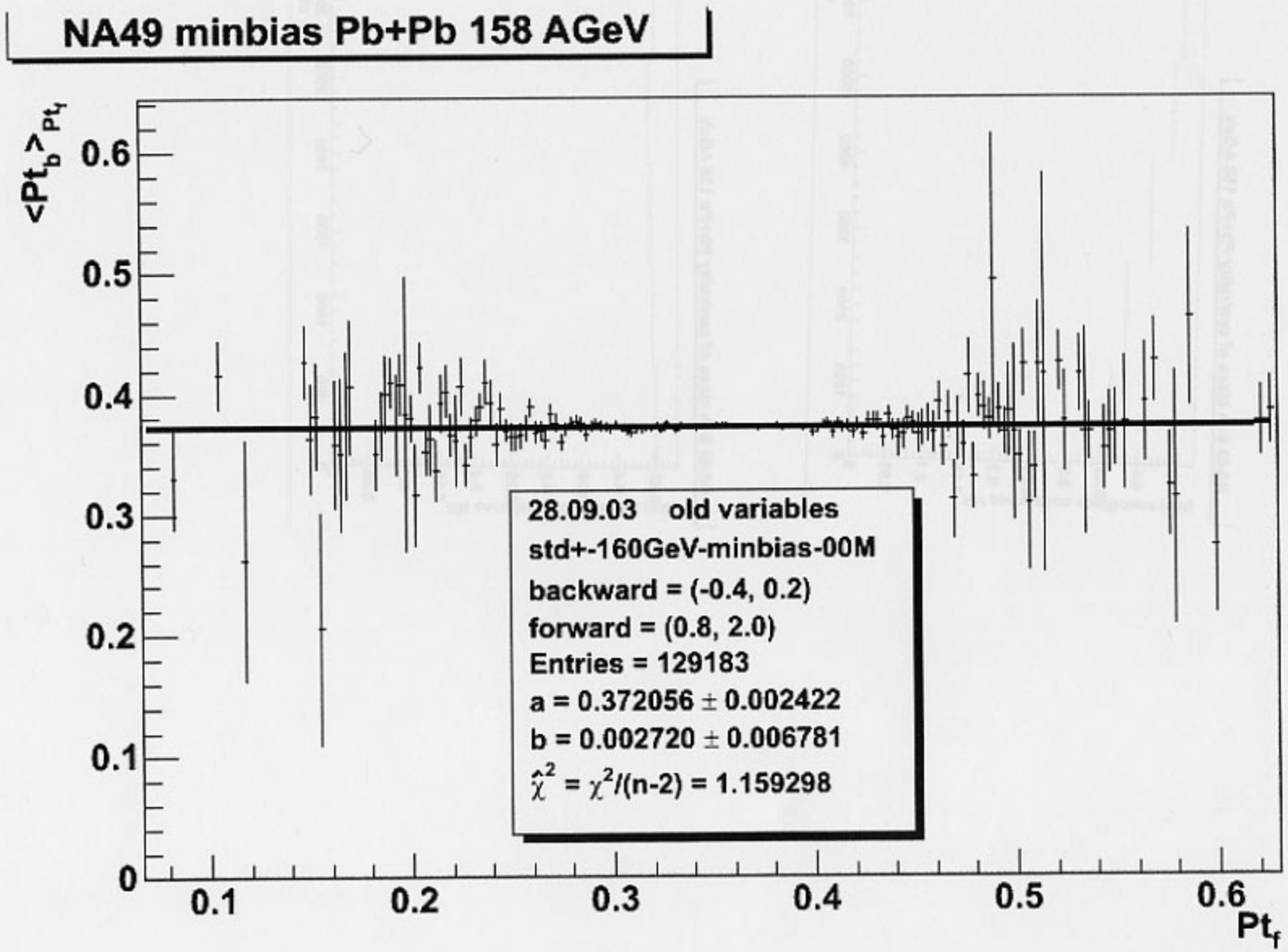
EVENT MIXING



EVENT MIXING

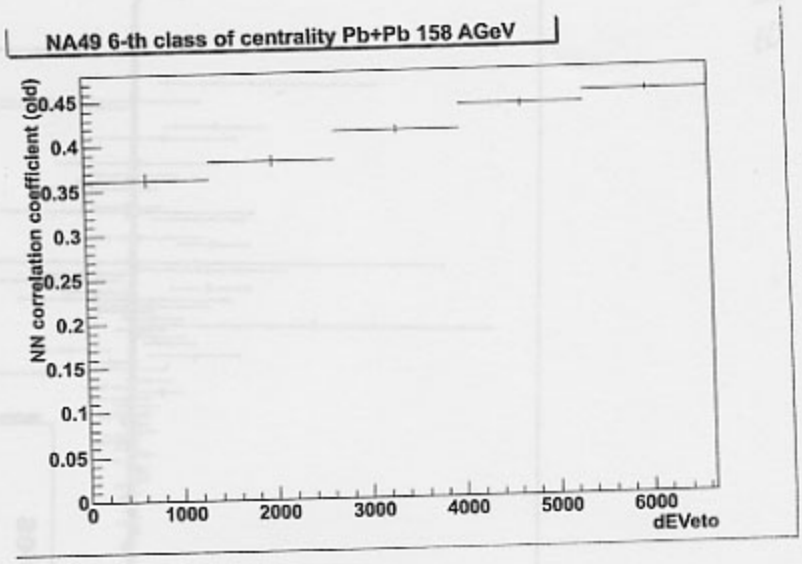


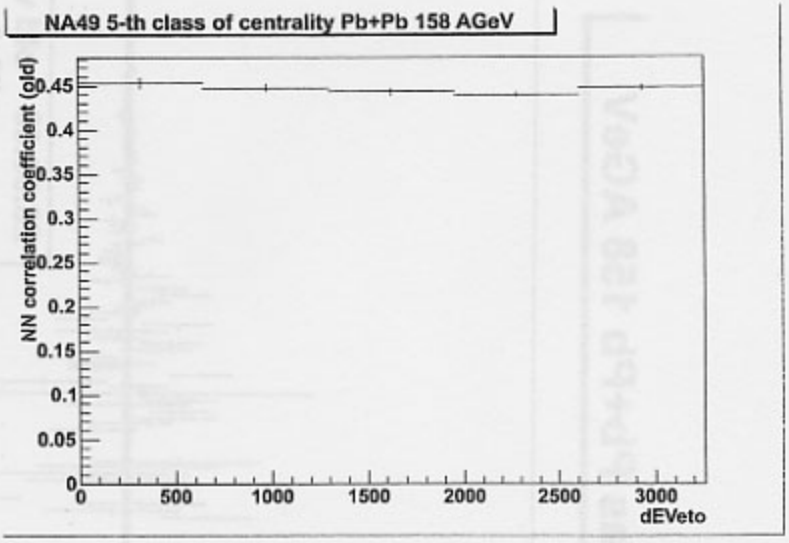
EVENT MIXING



$\Delta\phi$ dependence / NA49

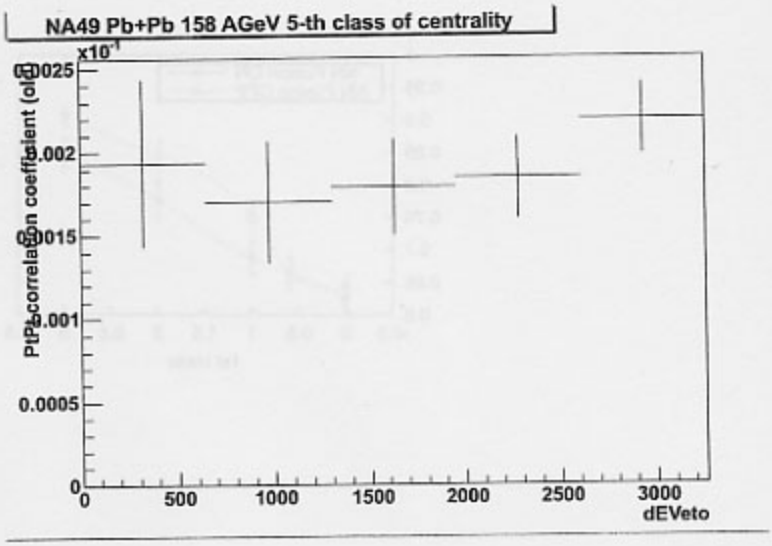
EXAMPLES: $\langle n \rangle h$ corr.

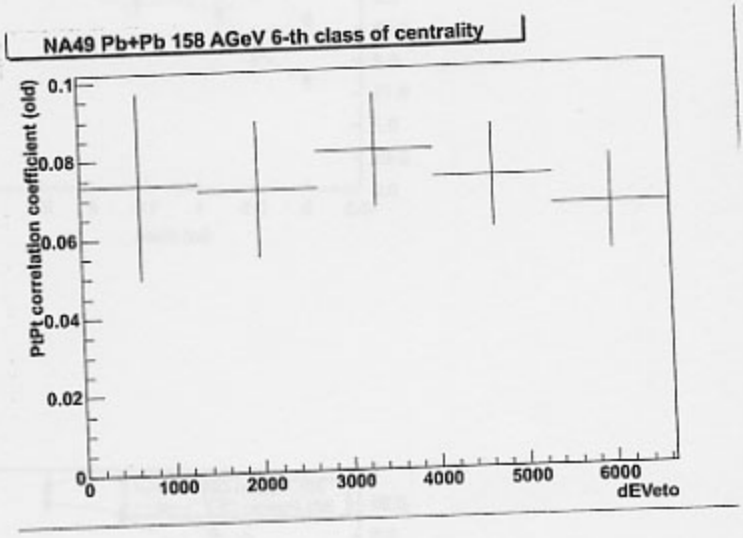




Δb dependence / NA49

EXAMPLES: <pt>pt corr.



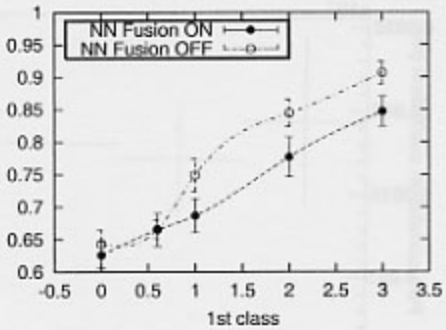


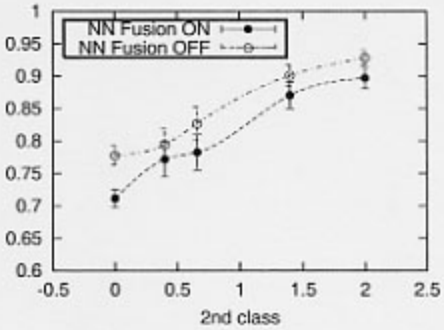
Δb dependence in PSM

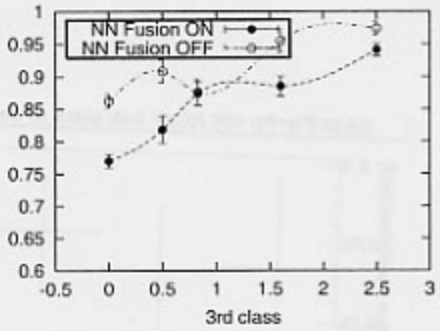
$\langle NN$ correlations / NA49

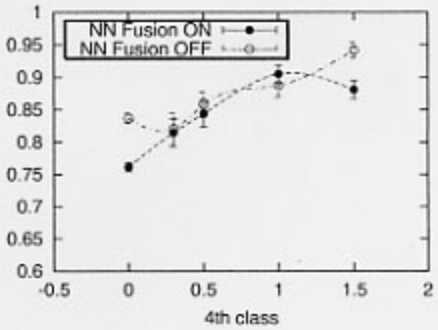
PSM Δb: $0 \div 3$ fm

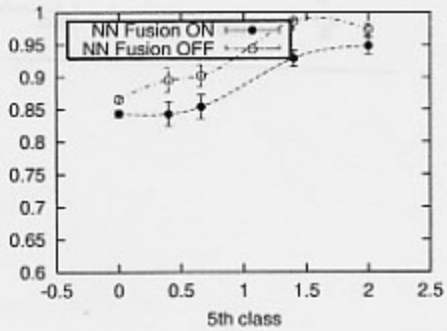
EXAMPLES:

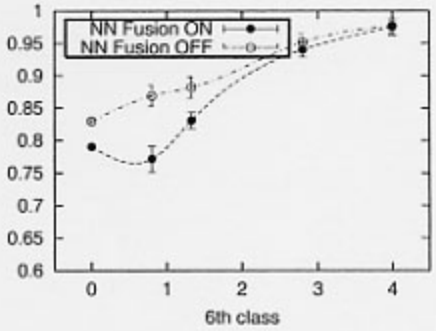


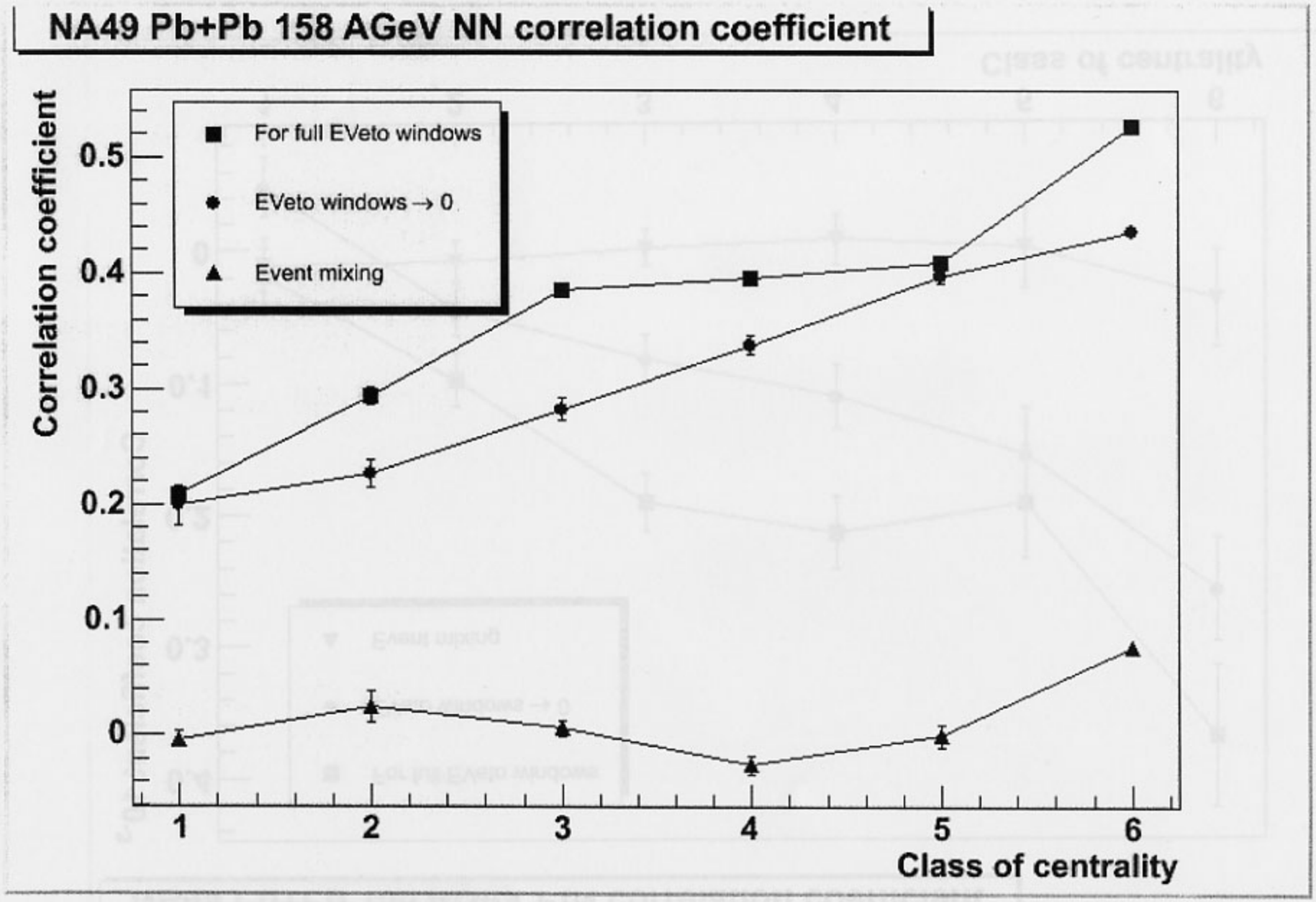


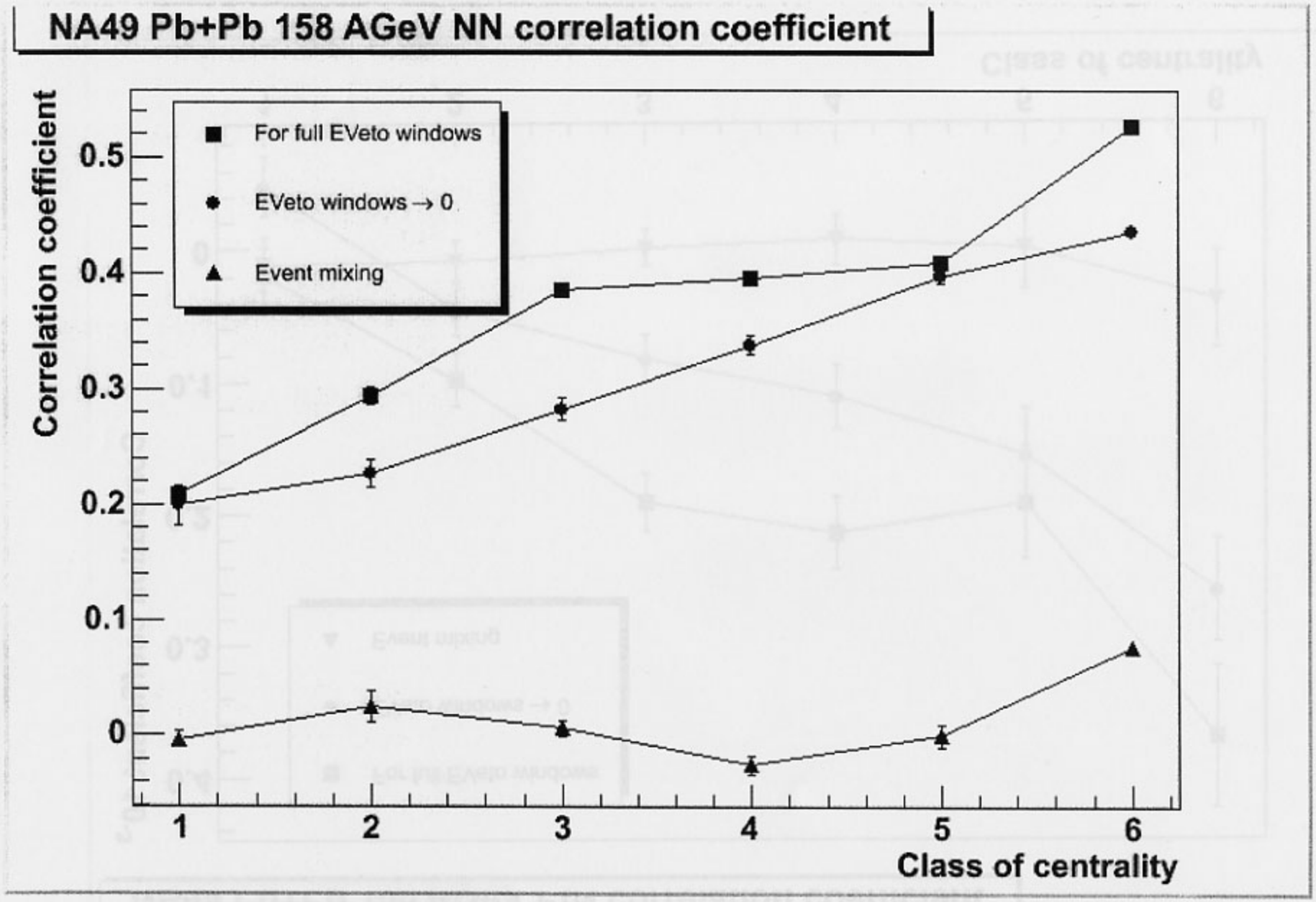


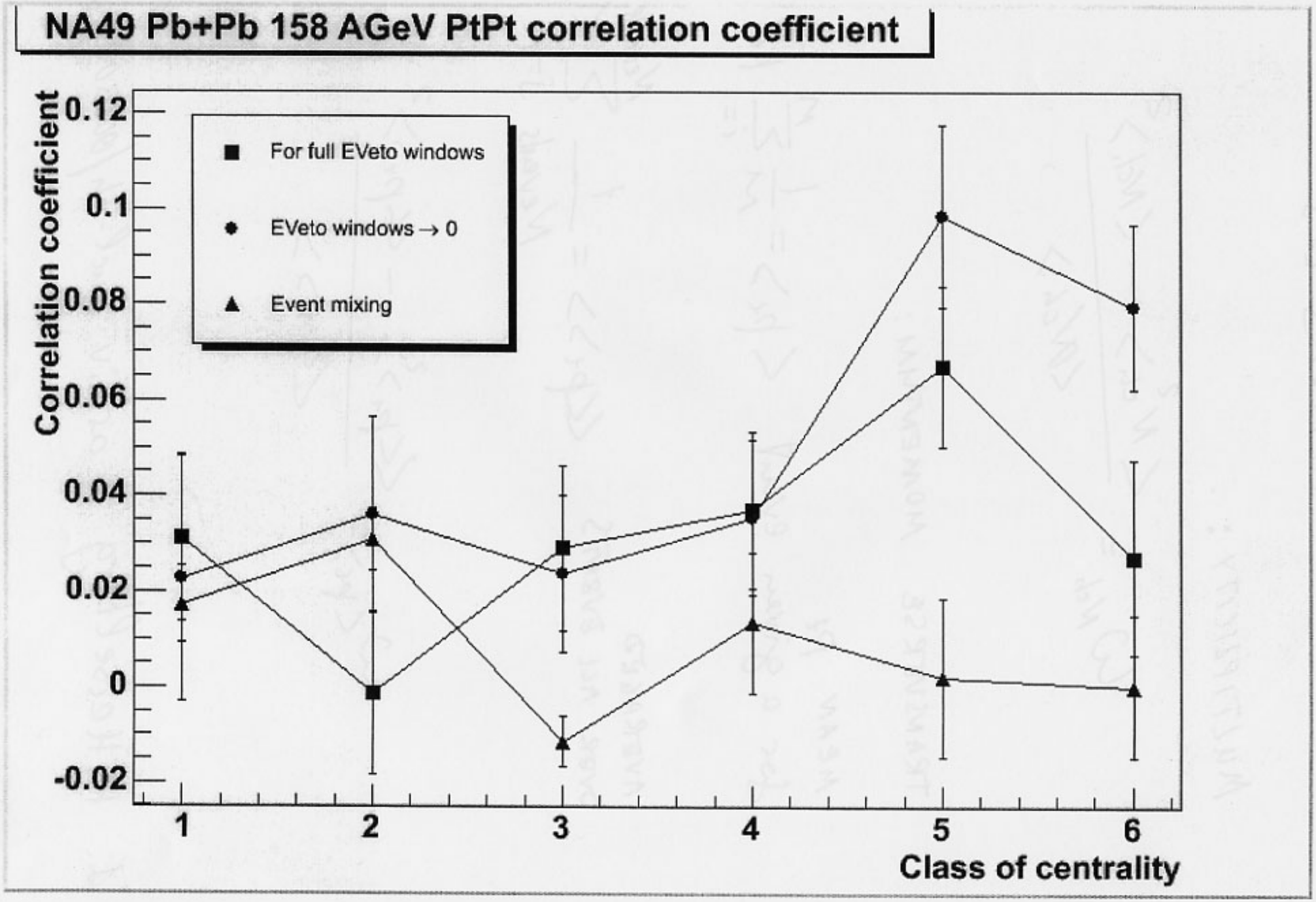







NA49 Pb+Pb 158 AGeV NN correlation coefficient
For full EVeto windows
EVeto windows → 0
Event mixing
Correlation coefficient
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
Class of centrality


NA49 Pb+Pb 158 AGeV NN correlation coefficient
For full EVeto windows
EVeto windows → 0
Event mixing
Correlation coefficient
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
Class of centrality


NA49 Pb+Pb 158 AGeV PtPt correlation coefficient
Correlation coefficient
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
For full EVeto windows
EVeto windows → 0
Event mixing
1
2
3
4
5
6
Class of centrality

FLUCTUATIONS [1]

MULTIPLICITY:

$$\omega_{N_{ch}} = \frac{\langle N_{ch}^2 \rangle - \langle N_{ch} \rangle^2}{\langle N_{ch} \rangle}$$

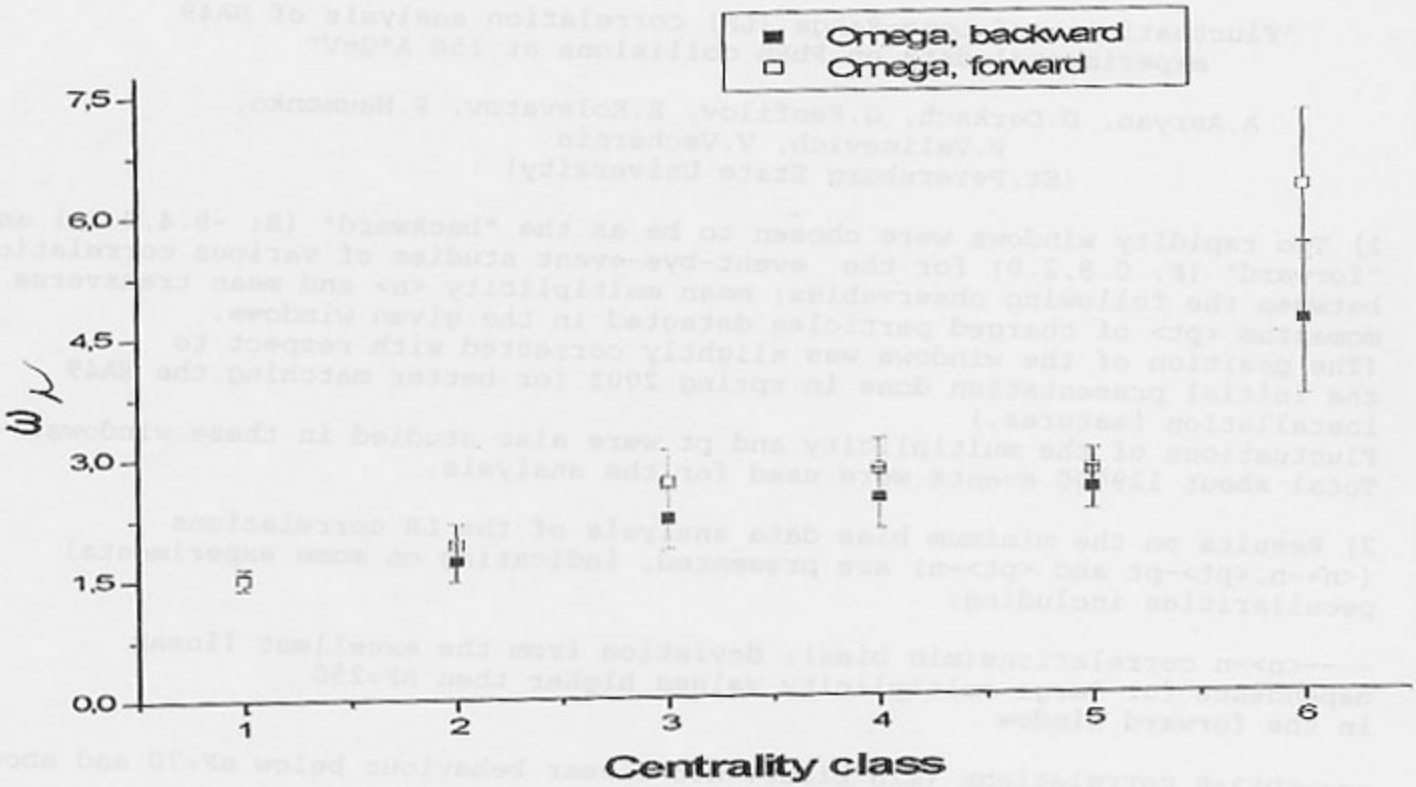
TRANSVERSE MOMENTUM:

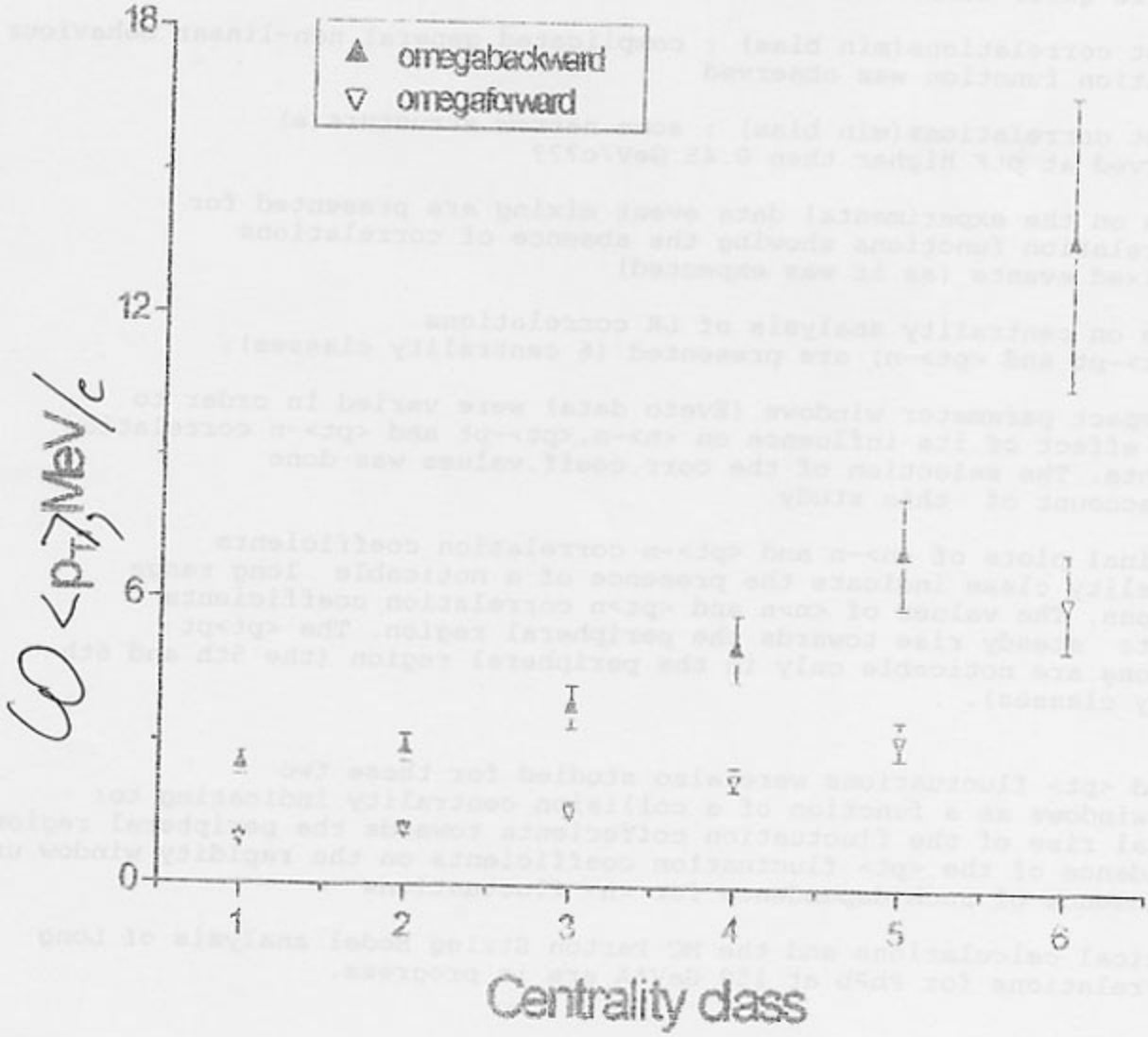
MEAN p_t
for a given event $\langle p_t \rangle = \frac{1}{M} \sum_{i=1}^{M} p_t^i$

AVERAGED
OVER ALL EVENTS $\langle\langle p_t \rangle\rangle = \frac{1}{N_{events}} \sum_{j=1}^{N_{events}} \langle p_t \rangle_j$

$$\omega_{\langle p_t \rangle} = \frac{\langle\langle p_t \rangle^2\rangle - \langle\langle p_t \rangle\rangle^2}{\langle\langle p_t \rangle\rangle}$$

1. H. Heiselberg, arXiv: nucl-th/0003046 v5


Omega, backward
Omega, forward
7,5
6,0
4,5
3,0
1,5
0,0
ω
1
2
3
4
5
6
Centrality class


omegabackward
omegaforward
18
12
6
0
<pT>, MeV/c
1
2
3
4
5
6
Centrality class

SUMMARY

"Fluctuations and Long-Range (LR) correlation analysis of NA49 experimental data on PbPb collisions at 158 A*GeV"

A.Asryan, D.Derkach, G.Feofilov, R.Kolevatov, P.Naumenko, P.Valinevich, V.Vechernin
(St.Petersburg State University)

1) Two rapidity windows were chosen to be as the "backward" (B: -0.4,0.2) and "forward" (F: 0.8,2.0) for the event-bye-event studies of various correlations between the following observables: mean multiplicity <n> and mean transverse momentum <pt> of charged particles detected in the given windows.
(The position of the windows was slightly corrected with respect to the initial presentation done in spring 2003 for better matching the NA49 installation features.)
Fluctuations of the multiplicity and pt were also studied in these windows.
Total about 129000 events were used for the analysis.

2) Results on the minimum bias data analysis of the LR correlations (<n>-n,<pt>-pt and <pt>-n) are presented, indicating on some experimental peculiarities including:

----<n>-n correlations(min bias): deviation from the excellent linear dependence for large multiplicity values higher then nF=250 in the forward window

----<pt>-n correlations (min bias): non linear behaviour below nF=70 and above nF=250 while quite linear in-between

----<pt>-pt correlations(min bias) : complicated general non-linear behaviour of correlation function was observed

----<pt>-pt correlations(min bias) : some narrow structure(s) were observed at ptF higher then 0.45 GeV/c???

3) Results on the experimental data event mixing are presented for these correlation functions showing the absence of correlations for the mixed events (as it was expected)

4) Results on centrality analysis of LR correlations (<n>-n,<pt>-pt and <pt>-n) are presented (6 centrality classes):

--- the impact parameter windows (Eveto data) were varied in order to study the effect of its influence on <n>-n,<pt>-pt and <pt>-n correlation coefficients. The selection of the corr.coeff.values was done with the account of this study

--- the final plots of <n>-n and <pt>-n correlation coefficients vs. centrality class indicate the presence of a noticable long range correlations. The values of <n>n and <pt>n correlation coefficients demonstrate steady rise towards the peripheral region. The <pt>pt correaltions are noticable only in the peripheral region (the 5th and 6th centrality classes).

5) <n> and <pt> fluctuations were also studied for these two rapidity windows as a function of a collision centrality indicating to:
--- general rise of the fluctuation coffecients towards the peripheral region
--- dependence of the <pt> fluctuation coefficients on the rapidity window used and the absence of such dependence for <n> fluctuations

6) Analytical calculations and the MC Parton String Model analysis of Long Range correlations for PbPb at 158 GeV*A are in progress.