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

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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.
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
χ² = χ²/(n-2) = 10.521129
NA49 minbias Pb+Pb 158 AGeV

Method A
- backward = (-0.4, 0.2)
- forward = (0.8, 2.0)
Entries = 41585

\[
\begin{align*}
\sigma &= 1.003637 \pm 0.000370 \text{ or } 0.001627 \\
b &= 0.167921 \pm 0.005516 \text{ or } 0.020661 \\
\chi^2/\nu &= 3.054066 \\
<N_i> &= 1.253247 \pm 0.000173 \\
<P_{T_i}> &= 0.392112 \pm 0.000166
\end{align*}
\]
NA49 minbias Pb+Pb 158 AGeV

std+-160GeV-minbias-00M
Method B
backward = (-0.4, 0.2)
forward = (0.8, 2.0)
Entries = 41585
a = 0.997979 ± 0.000290 or ± 0.001449
b = 0.157811 ± 0.004199 or ± 0.018438
\( \chi^2 = \chi^2/(n-2) = 4.371323 \)
\( \langle N_\gamma \rangle = 1.253247 ± 0.000173 \)
\( \langle p_t \rangle = 0.392112 ± 0.000166 \)
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 = 69.770765 ± 0.068943
b = 0.010212 ± 0.000463
χ² = χ²/(n-2) = 33.009820
NA49 minbias Pb+Pb 158 AGeV

\[ \langle P_{T_b} N_i \rangle \]

28.09.03  old variables
std+-160GeV-minbias-00M
backward = (-0.4, 0.2)
forward = (0.8, 2.0)
Entries = 129183

\[ a = 0.373177 \pm 0.000444 \]
\[ b = -0.000000 \pm 0.000003 \]
\[ \chi^2 = \chi^2/(n-2) = 1.096482 \]
NA49 minbias Pb+Pb 158 AGeV

\[ \langle P_{t_b}\rangle_{P_{t_f}} \]

\begin{align*}
0.6 &\quad 0.5 \\
0.4 &\quad 0.3 \\
0.2 &\quad 0.1 \\
0.0 &\quad 0.1 \\
\end{align*}

\begin{align*}
\text{a} &= 0.372056 \pm 0.002422 \\
b &= 0.002720 \pm 0.006781 \\
\chi^2 &= \chi^2 / (n-2) = 1.159298
\end{align*}

28.09.03 old variables
std+-160GeV-minbias-00M
backward = (-0.4, 0.2)
forward = (0.8, 2.0)
Entries = 129183

\begin{align*}
\chi^2 &\quad P_{t_f}
\end{align*}
$\Delta \rho$ dependence

$\rho$ correlation coefficient

**Examples:** CDF corr
dependence in PSM

LNN correlations / N449

PSM $\theta_b: 0 \rightarrow 3 \mathrm{fm}$

EXAMPLES:

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- 1st class
- 2nd class
- 3rd class
- 4th class
- 5th class
- 6th class
NA49 Pb+Pb 158 AGeV PiPt correlation coefficient

For full EVeto windows
EVeto windows → 0
Event mixing
FLUCTUATIONS [1]

MULTIPCICITY:

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

TRANSVERSE MOMENTUM:

MEAN \( p_T \)

for a given event  \( \langle p_T \rangle = \frac{1}{n} \sum_{i=1}^{n} p_T^i \)

AVERAGED over all events  \( \langle \langle p_T \rangle \rangle = \frac{1}{N_{\text{events}}} \sum_{j=1}^{N_{\text{events}}} \langle p_T \rangle_j \)

\[ \omega_{\langle p_T \rangle} = \frac{\langle \langle p_T^2 \rangle \rangle - \langle \langle p_T \rangle \rangle^2}{\langle \langle p_T \rangle \rangle} \]

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

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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-by-event studies of various correlations between the following observables: mean multiplicity \( n \) and mean transverse momentum \( p_T \) 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 \( p_T \) 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 \( \langle n \rangle - n, \langle p_T \rangle - p_T \) and \( \langle p_T \rangle - n \) are presented, indicating on some experimental peculiarities including:

---- \( \langle n \rangle - n \) correlations (min bias): deviation from the excellent linear dependence for large multiplicity values higher then \( n_F = 250 \) in the forward window.

---- \( \langle p_T \rangle - n \) correlations (min bias): non linear behaviour below \( n_F = 70 \) and above \( n_F = 250 \) while quite linear in-between.

---- \( \langle p_T \rangle - p_T \) correlations (min bias): complicated general non-linear behaviour of correlation function was observed.

---- \( \langle p_T \rangle - p_T \) correlations (min bias): some narrow structure(s) were observed at \( p_T F \) 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 \( \langle n \rangle - n, \langle p_T \rangle - p_T \) and \( \langle p_T \rangle - n \) are presented (6 centrality classes):

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

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

5) \( \langle n \rangle \) and \( \langle p_T \rangle \) fluctuations were also studied for these two rapidity windows as a function of a collision centrality indicating to:

---- general rise of the fluctuation coefficients towards the peripheral region

---- dependence of the \( \langle p_T \rangle \) fluctuation coefficients on the rapidity window used and the absence of such dependence for \( \langle n \rangle \) fluctuations.

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