Multiplicity fluctuations in Pb+Pb collisions at energy 158 A GeV

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Data set:

**Pb+Pb 160 AGeV minbias 00M**

Event Cuts:

- VertexX (-0.18, -0.02);
- VertexY (-0.08, 0.18);
- VertexZ (-579.6, -578.2);
- $X_{bpd} - X_{fit}$ (0.0, 0.18);
- $Y_{bpd} - Y_{fit}$ (-0.07, 0.05);
- $Z_{bpd} - Z_{fit}$ (-0.8, 0.5);

Track Cuts:

- Only negative particles;
- $Bx(-4.0, 4.0)$;
- $By(-2.0, 2.0)$;
- $NMaxPoint(3, 25, 240)$;
- $NPointToNMaxPoint(3, 0.5)$;
- $0.005 < p_T < 1.5$;
- $4.0 < y < 5.5$. 
MULTIPLICITY DISTRIBUTION DEPENDS ON THE INTERVAL IN $E_{\text{VETO}}$ (POSITION – $E_v$ AND WIDTH - $\Delta E_v$) SELECTED FOR THE ANALYSIS
THE POSITIONS OF $E_{\text{VETO}}$ INTERVAL SELECTED FOR THE ANALYSIS
MULTIPLICITY DISTRIBUTIONS FOR $\Delta E_V = 100$ GEV FOR VARIOUS POSITIONS OF $E_{\text{VETO}}$ INTERVAL
NORMALIZED VARIANCE OF MULTIPLICITY DISTRIBUTIONS FOR NEGATIVELY CHARGED PARTICLES AS A FUNCTION OF WIDTH OF $\Delta E_{\text{Veto}}$ INTERVAL FOR VARIOUS POSITIONS OF $E_{\text{Veto}}$ INTERVAL
MULTIPLICITY FLUCTUATIONS
IN WOUNDED NUCLEON MODEL:

\[ N = \sum_{i=1}^{k} n_i \]

\[ \langle N \rangle = \langle k \rangle \langle n \rangle \]

\[ Var(N) = \langle k \rangle Var(n) + \langle n \rangle^2 Var(k) \]

\[ \frac{Var(N)}{\langle N \rangle} = \frac{Var(n)}{\langle n \rangle} + \langle n \rangle \frac{Var(k)}{\langle k \rangle} \]
Effect of the finite width of $E_V$ interval

\[ k = \left( A - \frac{E_V}{E_{LAB}} \right) \]  \hspace{1cm} (1)

\[ \text{Var}(k) = \text{Var}\left( \frac{E_V}{E_{LAB}} \right) \]  \hspace{1cm} (2)

\[ \langle k \rangle = A - \frac{\langle E_V \rangle}{E_{LAB}} \]  \hspace{1cm} (3)

\[ \frac{\text{Var}(k)}{\langle k \rangle} = \frac{1}{E_{LAB}} \frac{\text{Var}(E_V)}{\langle E_V \rangle} \]  \hspace{1cm} (4)

\[ \frac{\text{Var}(N)}{\langle N \rangle} = \frac{\text{Var}(n)}{\langle n \rangle} + \langle n \rangle \frac{1}{E_{LAB}} \frac{\text{Var}(E_V)}{\langle E_V \rangle} \]  \hspace{1cm} (5)
Effect of Veto resolution

\[ \sigma(E_V) = 2\sqrt{E_V} \quad [\text{GeV}] \quad (1) \]

\[ Var(E_V)_{RES} = 4 < E_V > \quad (2) \]

\[
\frac{Var(N)}{<N>} = \frac{Var(n)}{<n>} + <n> \frac{1}{E_{LAB}} \left( Var(E_V) + Var(E_V)_{RES} \right) \frac{1}{E_{LAB} A - <E_V>}
\]

\[ \frac{Var(n)}{<n>} = C_1 \]

\[ <n> \frac{1}{E_{LAB}} \left( Var(E_V) + Var(E_V)_{RES} \right) \frac{1}{E_{LAB} A - <E_V>} = \delta \]

\[ \frac{Var(N)}{<N>} = C_1 + \delta \]
THE CORRECTIONS FOR INTERVAL WIDTH AND E_{VETO} RESOLUTION AS A FUNCTION OF INTERVAL WIDTH FOR VARIOUS POSITIONS OF INTERVAL
NORMALIZED VARIANCE OF MULTIPLICITY DISTRIBUTIONS FOR NEGATIVELY CHARGED PARTICLES AS A FUNCTION OF WIDTH OF $E_{\text{VETO}}$ INTERVAL FOR VARIOUS POSITIONS OF $E_{\text{VETO}}$ INTERVAL FITTED BY THE MODEL
THE $C_1$ PARAMETER (THE NORMALIZED VARIANCE OF MULTIPLICITY DISTRIBUTIONS FOR NEGATIVELY CHARGED PARTICLES AFTER SUBTRACTION OF CORRECTIONS FOR INTERVAL WIDTH AND $E_{VETO}$ RESOLUTION) AS A FUNCTION OF INTERVAL WIDTH FOR VARIOUS POSITIONS OF INTERVAL WIDTH
THE $C_1$ PARAMETER (THE NORMALIZED VARIANCE OF MULTIPlicity DISTRIBUTIONS FOR NEGATIVELY CHARGED PARTICLES AFTER SUBTRACTION OF CORRECTIONS FOR INTERVAL WIDTH AND $E_{Veto}$ RESOLUTION) AS A FUNCTION OF INTERVAL WIDTH FOR VARIOUS POSITIONS OF INTERVAL
THE $C_1$ PARAMETER (THE NORMALIZED VARIANCE OF MULTIPLICITY DISTRIBUTIONS FOR NEGATIVELY CHARGED PARTICLES AFTER SUBTRACTION OF CORRECTIONS FOR INTERVAL WIDTH AND $E_{VETO}$ RESOLUTION) AS A FUNCTION OF MEAN NEGATIVE MULTIPLICITY
THE $C_1$ PARAMETER (THE NORMALIZED VARIANCE OF MULTIPLICITY DISTRIBUTIONS FOR NEGATIVELY CHARGED PARTICLES AFTER SUBTRACTION OF CORRECTIONS FOR INTERVAL WIDTH AND $E_{VETO}$ RESOLUTION) AS A FUNCTION OF MEAN NEGATIVE MULTIPLICITY IN COMPARISON WITH HIJING 1.37 SIMULATION
THE $C_1$ PARAMETER (THE NORMALIZED VARIANCE OF MULTIPICLITY DISTRIBUTIONS FOR NEGATIVELY CHARGED PARTICLES AFTER SUBTRACTION OF CORRECTIONS FOR INTERVAL WIDTH AND $E_{\text{VETO}}$ RESOLUTION) AS A FUNCTION OF MEAN NEGATIVE MULTIPLICITY. FULL CIRCLES SHOWS NORMALIZED VARIANCE WITHOUT CORRECTIONS.
RESULT LOOKS INTERESTING
BUT FURTHER STUDIES ARE NEEDED

- Quantify effect of non-vertex events:

  First test for most peripheral collisions:
  \[
  \Delta Z = 1.4 \text{ cm} \\
  \langle N \rangle = 5.75 \quad \text{Var}(N) = 11.47 \quad \frac{\text{Var}(N)}{\langle N \rangle} = 1.99
  \]
  \[
  \Delta Z = 0.7 \text{ cm} \\
  \langle N \rangle = 6.2 \quad \text{Var}(N) = 12.2 \quad \frac{\text{Var}(N)}{\langle N \rangle} = 1.97
  \]

- Study sensitivity on Veto resolution