Search for critical point in NA61/SHINE

(posters presentation)

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Proton and negatively charge hadron intermittency in Ar+Sc and Pb+Pb collisions

At the second order phase transition the system is a simple fractal and the factorial moment exhibits a power law dependence on $M$:

$$F_r(M) \equiv \left\langle \frac{1}{M} \sum_{i=1}^{M} n_i(n_i - 1)\cdots(n_i - r + 1) \right\rangle$$

$$F_2(M) \sim (M)^{\phi_2}$$

- Statistically independent points, cumulative variables
- No indication of critical point in these analyses (power-law scaling $F_r(M) \sim M^{\phi_r}$)
- More details → talk by N. Davis
Multiplicity and net-charge fluctuations in p+p, Be+Be and Ar+Sc collisions

\[ \kappa_1 = \langle N \rangle \]
\[ \kappa_2 = \langle (\delta N)^2 \rangle = \sigma^2 \]
\[ \kappa_3 = \langle (\delta N)^3 \rangle = S\sigma^3 \]
\[ \kappa_4 = \langle (\delta N)^4 \rangle - 3 \langle (\delta N)^2 \rangle^2 = \kappa \sigma^4 \]

where: \( N \) – multiplicity, \( \delta N = N - \langle N \rangle \)
\( \sigma \) – standard deviation
\( S \) – skewness
\( K \) – kurtosis

- No structure indicating critical point
- Negatively charged \( \kappa_2/\kappa_1 \): increasing difference between small systems (p+p and Be+Be) and a heavier system (Ar+Sc) with collision energy
- Net-charge \( \kappa_3/\kappa_1 \): increasing difference between Be+Be and other systems (p+p and Ar+Sc) with collision energy
- \( \kappa_4/\kappa_2 \): consistent values for all measured systems at given collision energy
Symmetric Lévy HBT correlations

The Lévy stability parameter $\alpha$ describes shape of the source.

3D Ising model with random external field predicts $\alpha = 0.50 \pm 0.05$ at critical point.
Conclusions

- proton and negative hadron intermittency analyses (scaled factorial moments of multiplicity distribution dependence on number of momentum bins) in Ar+Sc and Pb+Pb collisions do not show power-law scaling

- Multiplicity and net-charge fluctuations in p+p, Be+Be and Ar+Sc collisions do not show significant deviation from 1

- Lévy HBT correlations analysis $\alpha$ parameter value is close to 2 (Gaussian source)

- So far no convincing indication of the critical point

Thank You!