Effect of the global charge conservation on the time evolution of higher order cumulants in ultrarelativistic heavy ion collisions

Miki Sakaida, Masayuki Asakawa, Masakiyo Kitazawa (Osaka University)

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Δη dependence of charge fluctuation @ALICE

If the medium is in equilibrium,

\[ D = 4\left\langle \left( \frac{Q^{(\text{net})}}{\sqrt{8\sigma_i}} \right)^2 \right\rangle / \left\langle Q^{(\text{tot})} \right\rangle \]

\( Q_{\text{ch}} \): electric charge

If the medium is in equilibrium,

\( D \sim 3 - 4 \) In hadronic phase
\( D \sim 1 - 1.5 \) In QGP phase

Cumulants generated in QGP medium survive until the final state!?

Asakawa, Heinz, Muller, 2000; Jeon, Koch, 2000
However, the global charge conservation can also suppress cumulants!!

\[ \text{If } \Delta \eta = \eta_{\text{total}}, \langle (Q^{\text{net}})^n \rangle_c = 0 \]

The effect of the global charge conservation (naïve estimate)

\[ \langle (\delta N^{\text{net}})^2 \rangle_{\text{obs}} = \langle (\delta N^{\text{net}})^2 \rangle_{\text{equil}} \times (1 - \frac{\Delta \eta}{\eta_{\text{total}}}) \]

Bleicher, Jeon, Koch, PRC62, 061902, 2000

Fluctuation in QGP? or The global charge conservation?

We evaluate the effect of global charge conservation on time evolution of cumulants \( \langle (Q^{\text{net}})^n \rangle_c \) in finite volume systems!
Diffusion model for hadrons (1-dim. motion of Brown particles)

Initial condition for hadronization

Time evolution of cumulants of conserved charges observed in $\Delta \eta$

Probability $P(n, \tau)$ that each cell contains $n_m$ particles

Diffusion master equation + Boundary condition (Finite volume effect)

Kitazawa, Asakawa, Ono, 2013
The effect of the global charge conservation appears in the range of the diffusion length!!

Further details will be provided in my poster!