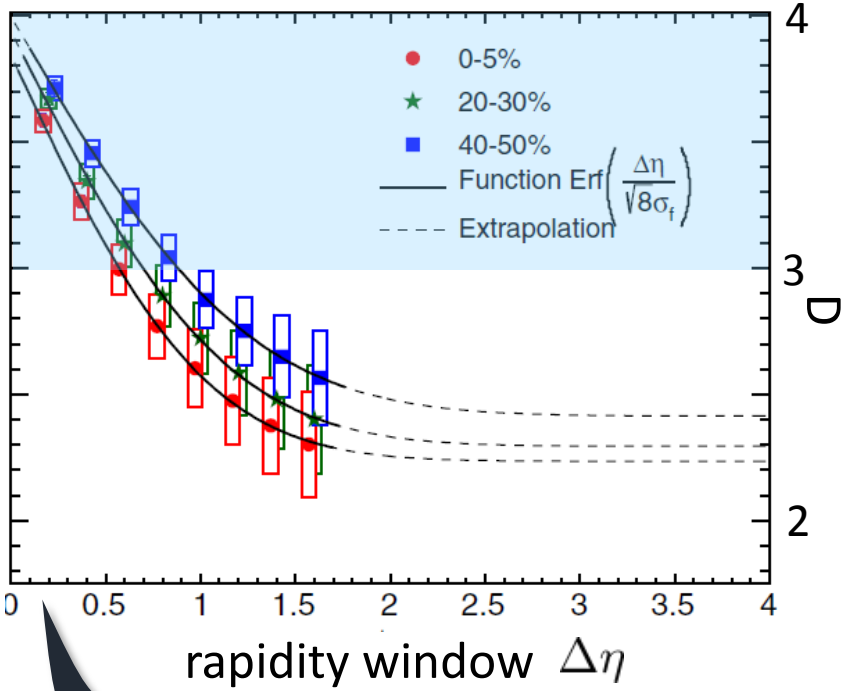
Effect of the global charge conservation on the time evolution of higher order cumulants in ultrarelativistic heavy ion collisions

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

2013.12.3. New Frontier in QCD2013

Δη dependence of charge fluctuation @ALICE

ALICE, PRL110,152301,2013



D measure (2nd order cumulant)

$$D = 4\langle (Q_{\rm ch}^{\rm (net)})^2 \rangle / \langle Q_{\rm ch}^{\rm (tot)} \rangle$$

$Q_{\rm ch}$: electric charge

If the medium is in equilibrium,

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

$\Delta\eta$ dependence of cumulants

$\Delta\eta$: small ➡ hadronic ⬌ $\Delta\eta$: big ➡ QGP

Non-equilibrium!?

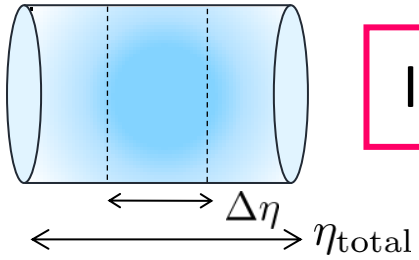
➡ Cumulants generated in QGP medium survive until the final state!?

Asakawa,Heinz,Muller,2000;Jeon,Koch,2000

Global charge conservation

However, the global charge conservation can also suppress cumulants!!

Finite !!



If $\Delta\eta = \eta_{\rm total}$, $\langle (Q^{(\rm net)})^n \rangle_{\rm c} = 0$

Global charge conservation

The effect of the global charge conservation (naïve estimate)

$$\langle (\delta N^{(\rm net)})^2 \rangle_{\rm obs} = \langle (\delta N^{(\rm net)})^2 \rangle_{\rm equil} \times \left(1 - \frac{\Delta\eta}{\eta_{\rm total}}\right)$$

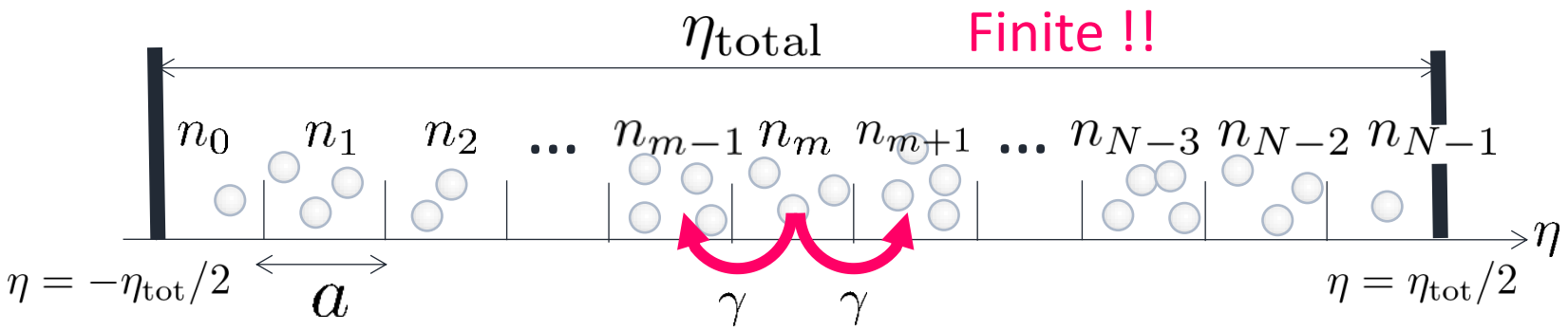
Bleicher, Jeon, Koch, PRC62, 061902, 2000

Fluctuation in QGP? or The global charge conservation?

We evaluate **the effect of global charge conservation on time evolution of cumulants** $\langle (Q^{(\rm net)})^n \rangle_{\rm c}$ in finite volume systems!

Diffusion model for hadrons(1-dim. motion of Brown particles)

Kitazawa, Asakawa, Ono, 2013



Probability $\mathrm{P}(\boldsymbol{n}, \tau)$ that each cell contains n_m particles

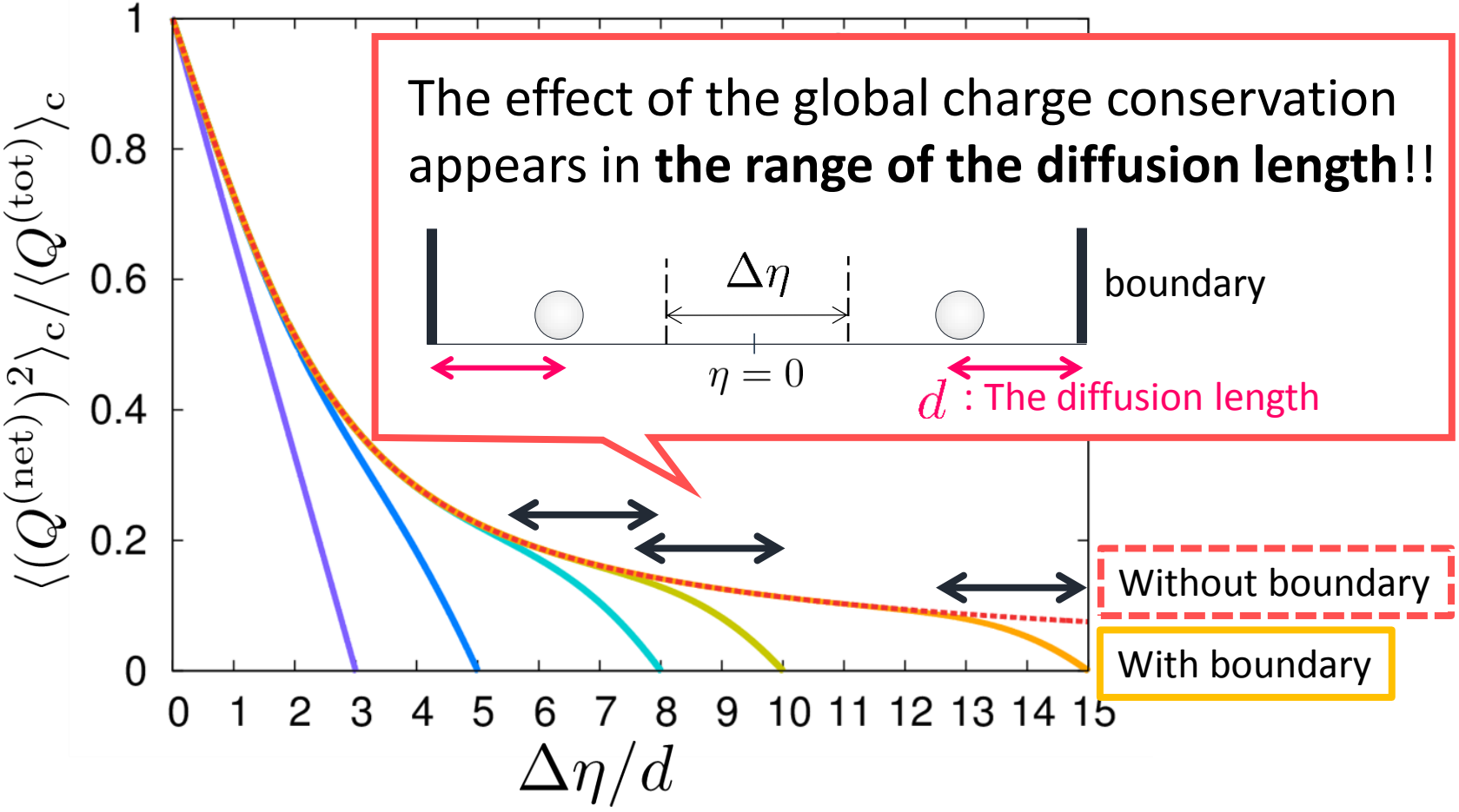
Diffusion master equation + Boundary condition (Finite volume effect)

Initial condition for hadronization

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

Δη dependence of cumulants of conserved charge

$\Delta\eta$ dependence of cumulants tells us many things !!



Further details will be provided in my poster !