Charm quark diffusion constant and relaxation time in the deconfined phase in quenched lattice QCD

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A. Ikeda, M. Asakawa, M. Kitazawa(Osaka Univ.)

motivation

• Elliptic flow of heavy quark is observed at the RHIC and LHC

→heavy quarks flow with medium

Charm transport property is important.

• Our purpose is to assume the spectral function structure from relaxation time approximation and to extract transport coefficients from lattice simulation.

Formalism

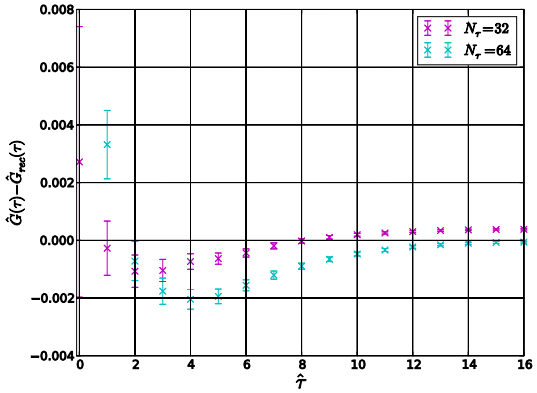
Kubo formula for diffusion constant

$$D = \frac{1}{\chi_{00}} \lim_{\omega \to 0} \sum_{i=1}^{3} \frac{\rho_{ii}(\omega, T)}{\omega}$$

•At under critical temperature low energy structure of spectral function is zero .
→Subtract reconstructed correlator from correlator.

$$\Delta G(\tau, T, T') = G(\tau, T) - G_{rec}(\tau, T, T')$$

T=2.33Tc, T'=0.78Tc



Lσ=1.25fm and 2.50fm

2nd order hidrodynamics

↓

Relaxation time approximation

$$\langle O(t) \rangle = \langle O(0) \rangle e^{-\Gamma t}$$

↓

Low energy structure of spectral function

$$\rho(\omega) \sim A \frac{\omega \Gamma}{\omega^2 + \Gamma^2}$$

Assumption of spectral function

$$\Delta\rho = A \frac{\omega\Gamma}{\omega^2 + \Gamma^2} - Z\delta(\omega - m_{J/\psi})$$

J/ψ is melted above Tc

Result

The smaller lattice :
error is larger than the mean value.

The larger lattice:

$3 \leq \hat{\tau} \leq 16$ is most statistically significant

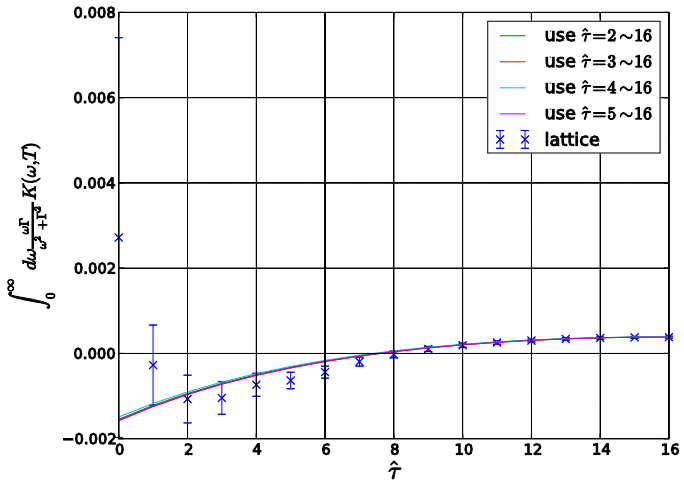
$2\pi DT = (3.4 \pm 0.5) \times 10^{-3}$

$\tau = 0.12 \pm 0.02$ fm

Lσ =2.50fm	A		Gamma		Z	
use tau	mean[MeV ^{2}]	error/mean	mean[GeV]	error/mean	mean[GeV ^{3}]	error/mean
2–16	1957	0.259	2.260	0.270	0.247	0.138
3–16	1536	0.154	0.224	0.208	0.224	0.073
4–16	938	0.182	0.563	0.629	0.188	0.077
5–16	194	11.410	0.002	3.676	0.177	0.008

To use our assumption we might have to use more large space size lattice

Lσ=1.25fm



Lσ=2.5fm