Charmonium at finite temperature in quenched lattice QCD

Takashi Umeda[a], Kouji Nomura[b] and Hideo Matsufuru[c]

[a] *Center for Computational Physics, University of Tsukuba, Tsukuba 305-8577, Japan*
[b] *Department of Physics, Hiroshima University, Higashi-hiroshima 739-8526, Japan*
[c] *Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto 606-8502, Japan*

We study charmonium correlators in pseudoscalar and vector channels at finite temperature using lattice QCD simulation in the quenched approximation. Anisotropic lattices are used in order to have sufficient numbers of degrees of freedom in the Euclidean temporal direction. In Refs [1, 2], from observation of q-$\bar{q}$ correlations in the Coulomb gauge, it was pointed out that the hadronic correlators still have nontrivial structure and may contain a bound state-like structure even above T_c. On the other hand, a significant change of behavior was also reported in the case of the charmonium correlators [2].

In this work, we analyze the spectral functions of charmonium correlators [3, 4, 5]. We focus on the low energy structure of the spectral function, corresponding to the ground state in the hadron phase, by applying the smearing technique which enhances the contribution to the correlator from this region. We employ two analysis procedures: the maximum entropy method (MEM) for the extraction of the spectral function without assuming a specific form, to estimate the shape of the spectral function, and the standard χ^2 fit analysis using typical forms in accordance with the result of MEM, for a more quantitative evaluation. To verify the applicability of the procedures, we first analyze the smeared correlators as well as the point correlators at zero temperature. We find that by shortening the t-interval used for the analysis (a situation inevitable at $T > 0$) the reliability of MEM for point correlators is lost, while it subsists for smeared correlators. Then the smeared correlators at $T \simeq 0.9T_c$ and $1.1T_c$ are analyzed. At $T \simeq 0.9T_c$, the spectral function exhibits a strong peak, well approximated by a delta function corresponding to the ground state with almost the same mass as at $T = 0$. At $T \simeq 1.1T_c$, we find that the strong peak structure still persists at almost the same place as below T_c, but with a finite width of a few hundred MeV. This result indicates that the correlators possess a nontrivial structure even in the deconfined phase.

The simulation has been done on NEC SX-5 at Research Center for Nuclear Physics, Osaka University and Hitachi SR8000 at KEK (High Energy Accelerator Research Organization).

References

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