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Quarkonium spectral functions and heavy quark diffusion of charm and bottom quarks from lattice QCD at finite temperature

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Quarkonium spectral functions have all information about in-medium properties of heavy quarkonia such as dissociation temperatures, which are important to understand suppression of quarkonium yields in relativistic heavy ion collision experiments at RHIC and LHC, where many interesting results on J/Ψ and Υ suppression have been reported already. Since quarkonium suppression can occur through complicated processes not only related to the medium effect but also any other ones such as cold nuclear matter effects, good theoretical understanding of quarkonium behavior in the hot medium is required. Low frequency behavior of the quarkonium spectral functions for the vector channel also tells us transport properties of heavy quarks in quark-gluon plasma, which is important input for hydrodynamic models trying to explain collective phenomena in heavy-ion experiments. Therefore it is important to investigate the quarkonium spectral functions, especially using first-principle lattice QCD calculations.

In this talk we report our recent study on quarkonium spectral functions in lattice QCD at finite temperature. To get correlation functions with high data quality, which is important to extract reliable spectral functions, we performed simulations on very large and fine lattices with a couple of lattice cutoffs towards the continuum limit. Our previous studies on some of these lattices have been reported in [1,2]. At temperatures in a range between $0.75T_c$ and $2.3T_c$ we reconstruct quarkonium spectral functions from temporal Euclidean meson correlators with both charm and bottom quark masses, where to estimate systematic uncertainties we adopt the conventional maximum entropy method as well as two different stochastic methods: one is the stochastic analytical inference based on the Bayes' theorem and the other is the stochastic optimization method, which does not rely on any prior information (see our preliminary works in [3,4]). We discuss dissociation of quarkonium states from temperature and quark mass dependence of the spectral functions. We also estimate the heavy quark diffusion coefficient using low-frequency behavior of the spectral functions for the vector channel.

[1] H. Ohno, PoS LATTICE **2013**, 172 (2014).

[2] H. Ohno, H.-T. Ding and O. Kaczmarek, PoS LATTICE **2014**, 219 (2014).

[3] H.-T. Shu, H.-T. Ding, O. Kaczmarek, S. Mukherjee and H. Ohno, PoS LATTICE **2015**, 180 (2016).

[4] H. Ohno, PoS LATTICE **2015**, 175 (2016).

Preferred Track

Quarkonia

Collaboration

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