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In-medium bottomonium properties from lattice NRQCD calculations with extended meson operators

Quarkonium production can be used to probe the matter formed in ultrarelativistic heavy-ion collisions. However, for theoretical understanding of the experimental results on quarkonium production in heavy-ion collisions it is necessary to know if and which quarkonium states exist above the crossover temperature, T_c and what are the in-medium masses and widths of different quarkonium states. In this talk we will focus on the lattice QCD study of in-medium bottomonium properties [1].

In-medium bottomonium properties are encoded in the spectral functions, which are related to the Euclidean time correlators calculable on the lattice. We will present lattice QCD studies of 1S, 2S, 3S, 1P, 2P and 3P bottomonium correlators for $T \simeq 133 - 250$ MeV [1], where the 3P state is explored for the first time. These calculations are performed with non-relativistic QCD (NRQCD) approach for the bottom quark and on (2+1)-flavor gauge backgrounds using highly improved staggered quark (HISQ) action near physical point. In our study we use correlators of extended bottomonium operators [2, 3] to gain optimized overlaps with specific states and to be more sensitive to thermal effects. Compared to the previous studies that are based on a single lattice spacing per temperature value and temporal extent $N_\tau = 12$, we use two lattice spacings and lattices with the temporal extent $N_\tau = 16 - 30$.

We find that all bottomonia states below the open beauty threshold exist above T_c, including 3P state. We will show the temperature dependence of the thermal widths and in-medium masses extracted from the bottomonium correlators with physically-motivated ansatzes for the spectral function. We find that, within estimated errors, the bottomonium masses do not change compared to their vacuum values for all temperatures under our consideration, while non-zero widths for different bottomonium states can be observed. These observations suggest excited bottomonium states still exist above T_c and screening is not the likely source of bottomonium dissociation.

References:
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Category

Theory

Collaboration (if applicable)

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