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Unscreened potential and quarkonium width in QGP

Screening of the heavy quark anti-quark potential was suggested as the cause of quarkonium melting in quark gluon plasma (QGP). Perturbative QCD calculations within potential non-relativistic QCD (pNRQCD) on the other hand do not lead to a screened potential in general and the thermal correction to the potential also has an imaginary part. We determine the complex potential in QGP using lattice calculations on lattices with large temporal extent $N_\tau = 16 - 36$. The complex potential is extracted from the Wilson line correlators and physically motivated forms of the corresponding spectral functions [1,2]. We find that the real part of the complex potential is not screened in QGP independently of the detailed form of the spectral functions. We also estimate the imaginary part of the potential using prior information from various theoretical calculations [2].

Lattice calculations also find that the wave function of bottomonium states does not change much across the QCD transition [3]. This is consistent with the observation of the unscreened potential. Therefore, we use the vacuum wave function of different quarkonium states and the imaginary part of the potential obtained by us on the lattice to estimate the size of in-medium widths of J/ψ , $\psi(2S)$, $\chi_c(1P)$, $\Upsilon(1S)$, $\Upsilon(1S)$, $\Upsilon(1S)$ and $\chi_b(1P)$ and $\chi_b(2P)$ states in QGP [2] and compare to lattice NRQCD results [3].

[1] Alexei Bazavov, Daniel Hoyer, Rasmus N. Larsen, Swagato Mukherjee, Peter Petreczky, Alexander Rothkopf, Johannes Heinrich Weber, Phys. Rev. D 109 (2024) 074504

[2] Rasmus N. Larsen, Swagato Mukherjee, Peter Petreczky, Johannes Heinrich Weber, work in progress

[3] Rasmus N. Larsen, Stefan Meinel, Swagato Mukherjee, Peter Petreczky, Phys. Rev. D 102 (2020) 114508

Category

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