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In-medium quarkonium properties from a lattice QCD based effective field theory

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In order to understand the experimental data on quarkonium production in heavy ion collisions at RHIC and LHC it is necessary (though not sufficient) to pinpoint the properties of heavy quarkonium in the deconfined QGP medium, including their dissolution. Studying quarkonium spectral properties at non-zero temperature, directly in lattice QCD, have proven to be difficult and detailed quantitative information on quarkonium in-medium properties is still lacking.

Lattice QCD based effective theories, such as lattice NRQCD, have seen impressive success in the determination of quarkonium properties in vacuum (e.g. their masses and decay widths), with the underlying framework being applicable in principle also at finite temperature. In combination with realistic lattice QCD simulations of the QGP medium with light pion masses by the HotQCD collaboration [1] gaining reliable first-principles insight into in-medium behavior is now is in reach.

Here we present our recent results on the temperature dependence of bottomonium and charmonium correlators, as well as their spectral functions in lattice NRQCD for temperatures 140 MeV < T< 400 MeV [2,3]. The spectra are reconstructed based on a novel Bayesian prescription [4], whose systematic uncertainties are thoroughly tested. We present indications for sequential melting of different quarkonium species with respect to their vacuum binding energies and discuss implications for phenomenology.

[1] A. Bazavov et. al., Phys. Rev. D85 (2012) 054503; Phys. Rev. D90 (2014) 094503

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[3] S. Kim, P. Petreczky, A. Rothkopf, work in progress

[4] Y. Burnier, A.R., Phys. Rev. Letters, 111 (2013) 182003

Primary author: ROTHKOPF, Alexander (Heidelberg University)

Co-authors: PETRECZKY, Peter (BNL); KIM, Seyong (Unknown)

Presenter: ROTHKOPF, Alexander (Heidelberg University)

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