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Chromoelectric correlators for quarkonia and heavy quarks: a comparison at weak and strong coupling

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Suppression of open heavy flavors and quarkonia in heavy-ion collisions is among the most informative probes of the quark-gluon plasma. Interpreting the full wealth of data obtained from the collision events requires a precise understanding of the evolution of heavy quarks and quarkonia as they propagate through the nearly thermal and strongly coupled plasma. In particular, a complete theoretical calculation of the dissociation and recombination rates of quarkonia has thus far been lacking.

It has recently been shown in [1] that such a calculation requires the evaluation of a particular gauge-invariant correlator of chromoelectric fields dressed with Wilson lines, which is very similar to, but different from the correlator used to define the well-known heavy quark diffusion coefficient [2]. Surprisingly, the difference between these two correlators turns out to be subtle: they only differ by a temperature-independent constant at next-to-leading order (NLO) in perturbation theory, as was shown in [3] by comparing to [4]. In this talk, we will explain the similarities and differences between the correlator for heavy quark diffusion and that for quarkonia dissociation/recombination. We will illuminate the differences from both the qualitative physical grounds and the formal expressions. We will explain why the finite-temperature parts agree at NLO. Going beyond the perturbative theory, we will show how an AdS/CFT calculation can unambiguously establish the different nature of these two correlators within N=4 SYM. Finally, we will discuss how our calculation in the strong coupling limit provides important guidance to understand quarkonium evolution at low temperature.

[1] X. Yao and T. Mehen, "Quarkonium Semiclassical Transport in Quark-Gluon Plasma: Factorization and Quantum Correction,"JHEP 02 (2021) 062
[2] J. Casalderrey-Solana and D. Teaney, "Heavy quark diffusion in strongly coupled N=4 Yang-Mills"
[3] T. Binder, K. Mukaida, B. Scheihing-Hitschfeld, X. Yao, "Non-Abelian Electric Field Correlator at NLO for Dark Matter Relic Abundance and Quakonium Transport,"arXiv:2107.03945 [hep-ph]
[4] Y. Burnier, M. Laine, J. Langelage, L. Mether, "Colour-electric spectral function at next-to-leading order"

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