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Quarkonium dynamics in the quantum Brownian regime with non-abelian quantum master equations

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Being able to deal with the most acurate methods to describe the $Q\bar{Q}$ evolution in a Quark Gluon Plasma is a prerequisite to match the precise quarkonium measurements of all URHIC experiments. Following our recent work [1], we present exact numerical solutions in a one-dimensional setting of quantum master equations previously derived in [2].

We focus on the dynamics of a single $Q\bar{Q}$ pair in a Quark-Gluon Plasma in thermal equilibrium, in the so-called quantum Brownian regime where the temperature of the plasma is large in comparison with the spacing between the energy levels of the $Q\bar{Q}$ system. The one-dimensional potential used in the calculations [2] has been adjusted so as to produce numbers that are relevant for the phenomenology of the charmonium.

The equations are solved using different initial states and medium configurations. Various temperature regimes are studied and the effects of screening and collisions thoroughly analyzed. Distinctive features of the $Q\bar{Q}$ evolution with the quantum master equations are presented. Some phenomenological consequences are addressed by considering evolutions of a single $b\bar{b}$ in both Bjorken scenario and EPOS4 temperature profiles.

Semiclassical approximation has been recently used [1,4] to describe charmonium production in URHIC, where many $c\bar{c}$ are implied. Obtaining an estimate of the systematic error attached to this approximation is of crucial importance to assess the agreement with experimental data. In the second part of the talk, we investigate the accuracy of the SC approximation by benchmarking the corresponding evolutions on the exact solutions derived with the QME for the case of a single $c\bar{c}$ pair.

refs:

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2. J.-P. Blaizot and M.A. Escobedo, JHEP06(2018)034
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4. D.Y. Arrebato Villar et al., Phys.Rev.C 107 (2023) 5, 054913

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