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Strong Interactions, (De)coherence and Quarkonia

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Quarkonia are the central objects to explore the non-perturbative nature of
non-abelian gauge theories. We describe the confinement-deconfinement
phases for heavy quarkonia in a hot QCD medium and thereby the statistical nature of the inter-quark forces. In the sense of one-loop quantum effects, we propose that the "quantum" nature of quark matters follows directly from the thermodynamic consideration of Richardson potential. Thereby we gain an understanding of the formation of hot and dense states of quark gluon plasma matter in heavy ion collisions and the early universe. In the case of the non-abelian theory, the consideration of the Sudhakov form factor turns out to be an efficient tool for soft gluons. In the limit of the Block-Nordsieck resummation, the strong coupling obtained from the Sudhakov form factor yields the statistical nature of hadronic bound states, e.g. kaons and Ds particles. We provide a unified description encompassing all the regimes of QCD at finite temperature, i.e. the Coulombic, the linear rising and the Regge rotating regimes, for both massless and massive quarkonia. Our results can be used to investigate the statistical nature of soft gluons at LHC.

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