The thermodynamics of the quark-gluon plasma: Self-consistent resummations vs. lattice data

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Abstract

We have shown recently that self-consistent resummations of the perturbation theory account accurately for the lattice data on the thermodynamical functions of the quark-gluon plasma, down to temperatures of about twice the critical temperature: $T \sim 2T_c$ [1]. Our approach is based on the skeleton representations of the *entropy* and the *quark density*, and allows for a gauge-invariant and manifestly ultraviolet finite resummation of the hard thermal/dense loops (HTL/HDL). In contrast to the direct HTL/HDL-resummation of the one-loop free energy [2], both the leading-order and the next-to-leading order effects of interactions are correctly incorporated in an effectively one-loop expression, and arise from kinematical regimes where the HTL/HDL are justifiable approximations. Calculations for a plasma with finite quark density (i.e., with a non-zero chemical potential μ) are no more difficult than at $\mu = 0$. Thus, our method allows for a systematic exploration of the thermodynamics in the $T - \mu$ plane, for sufficiently large T and/or μ.

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