Charmonium spectra at finite temperature from a Bayesian analysis of QCD sum rules

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Charmonium spectral functions at finite temperature are studied, making use of a recently developed method of analyzing QCD sum rules. Employing the Maximum Entropy Method enables us to directly obtain the spectral function from the sum rules, without having to introduce any specific assumption about its functional form. QCD sum rules incorporate finite temperature effects in form of changing values of the various gluonic condensates that appear in the operator product expansion. These changes depend on the energy density and pressure at finite temperature, which we extract from lattice QCD. As a result, J/ψ, η_c, χ_0 and χ_1 dissolve into the continuum already at temperatures around or slightly above the critical temperature T_c.

1 Introduction

The method of QCD sum rules [1] provides a powerful tool for investigating the properties of hadrons at finite temperature directly from QCD [2]. Using this approach the charmonium system was studied recently [3], and evidence for a considerable change just above T_c in the spectral functions of various channels was found. To specify the nature of this change is the major goal of the present study. For this task we employ the Maximum Entropy Method (MEM), which is applicable to QCD sum rules [4] and has the advantage that one does not have to introduce any strong assumption about the functional form of the spectral function, such as the "pole + continuum" ansatz, which is often used in QCD sum rule studies. This approach is especially suitable for the investigation of spectral functions at finite temperature, whose behavior can change drastically above the deconfinement temperature T_c. In these proceedings, we can only show the most important results of our investigation, while more details can be found in [5].

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2 Results

Obtained spectral functions of the vector and pseudoscalar channels at several temperatures are shown in Fig. 1. The lowest peaks corresponding to the J/ψ and η_c are observed to disappear ("melt") just above the critical temperature T_c. The peaks appearing in the scalar and axial-vector channels, which represent the χ_0 and χ_1 resonances, exhibit a similar behavior. This melting effect is caused by a sudden change of the gluonic condensates around T_c. As was shown in [3], this change can be related to the behavior of the energy density and pressure of gluonic matter in this temperature region. A more thorough discussion on all important details of this study will be given in [6].

Furthermore, we note that the same calculation can be done also for bottomonium channels. Such an investigation is presently in progress.

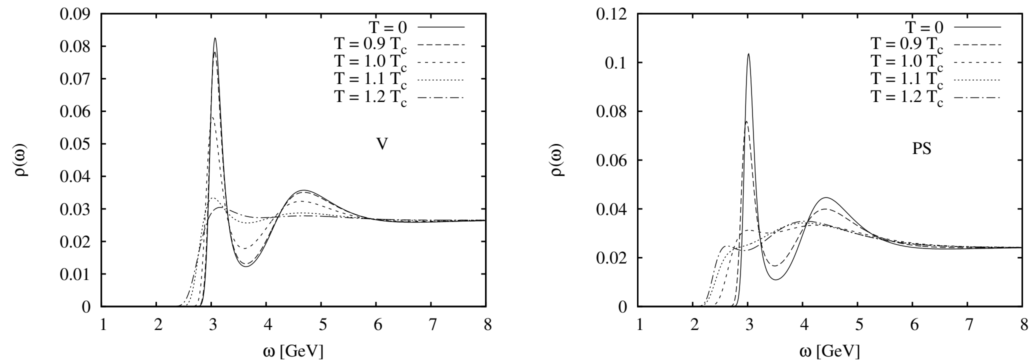

Figure 1: Spectral functions in the vector (left) and pseudosclalar channel (right). For obtaining these curves the default model was chosen to be a constant with a value adjusted to the perturbatively calculated spectral function at large energy.

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