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Thermodynamics during the Deconfining Phase Transition

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Abstract : A thermodynamical model of coexisting hadronic and quark–gluon plasma (QGP) phases is used to study the thermally driven deconfining phase transition occurring between the two phases. A color singlet partition function is calculated for the QGP phase with two massless quarks, as in our previous work, but now the finite extensions of the hadrons are taken into account in the equation of state of the hadronic phase. In the present work, the finite-size effects on the system are examined by probing the behavior of some thermodynamic quantities, called response functions, as order parameter, energy density and their derivatives, on a range of temperature around the transition at different volumes. It turns out that the finiteness of the system size has as effects the rounding of the transition and the smearing of all the singularities occurring in the thermodynamic limit, and the additional finite-size effect introduced by the requirement of exact color-singletness involves a shift of the transition point. This shift as well as the smearing of the transition region and the maxima of both susceptibility and specific heat show a scaling behavior with the volume characterized by scaling exponents. Another striking result is the large similarity noted between the behavior of these response functions and that of the cumulants of the probability density. This similarity is worked to try to extract information concerning the occurring phase transition.

Keywords : equation of state, thermodynamics, deconfining phase transition, quark–gluon plasma (QGP)
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