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The q-statistics and QCD thermodynamics at LHC

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Tsallis non-extensive thermodynamics has been successfully used in describing the transverse momentum distributions from RHIC to LHC energies. In this work, we present a simplified and thermodynamically consistent Tsallis distribution by using Taylor series expansion in (q-1). It helps us to study the degree of deviation of Tsallis distribution from a thermalized Boltzmann distribution, for proton-proton collisions at LHC energies. We provide analytical results for the Tsallis distribution in the presence of collective flow up to the first order in (q-1) and observe that the pion p_T spectrum for Pb+Pb collisions at center of mass energy of 2.76 TeV at LHC, could be well described by Tsallis q-statistics with inclusion of a constant radial flow. We study the degree of deviation of the thermodynamic observables like, the number density, pressure and energy density, from a Boltzmann type of distribution, in the ambient of Tsallis q-statistics, for different physically acceptable values of the q-parameter. Further, we extend the q-statistics for the Hagedorn resonance gas to examine the basic thermodynamical quantities for systems having different 'q' parameters. The speed of sound and thus the equation of state in a Hagedorn resonance gas is also studied in the framework of non-extensive statistics.

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