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Self-consistent quasiparticle model for ultrarelativistic e - e+ thermodynamic plasma using different dispersion relation for e(e+) and photon

Content :

Relativistic plasma with two charge species and radiation at thermodynamical equilibrium is a general system of interest in astrophysics and high energy physics. At relativistic limit, plasma frequency depends on number density and temperature.Number density is a thermodynamic quantity of the medium which in turn depends on plasma frequency and hence one need to solve the problem self-consistently. We develop a self-consistent quasiparticle model for such a system to take account of the collective behavior of plasma and study statistical mechanics and thermodynamic properties. It is applied to the ultrarelativistic e, e+ and γ plasma .We assume that the collective excitation of plasma leads to a system of non interacting quasifermions and quasibosons, obeying fermiand bose statistics respectively.

Quark Gluon Plasma(QGP) is another ultrarelativistic system which is made up of quarks and gluons, governed by strong interaction called quantum chromodynamics(QCD).It is similar to the e, e+ and γ system with electrons (positrons)replaced by quarks (antiquarks) and photons by gluons.What is presented here for e, e+ and γ plasma is similar in spirit to that QGP work where they used different density dependent dispersion relation for gluons (bosons) and quarks (fermions)

ωp2 =ag 2 g2 ng/T+ aq 2 g 2 nq/T for gluons

mf2 =bq 2 g 2 nq/T for quarks

where we fix the constant of proportionality by demanding that as T →∞, ωp and mf goes to corresponding perturbative results.Thus using different dispersion for electrons (positron) and photons we study the statistical mechanics and thermodynamics of the system.The departure of various thermodynamical quantities calculated using our model from that of an ideal system is too small and the Planck's distribution in plasma is plotted along with the

Planck's distribution in the absence of plasma and compared with previous results.

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