BOUNDARY WAVES IN QUARK-GLUON PLASMA

Baiseitov K.M.,* Moldabekov Zh.A., Ramazanov T.S.

KazNU, Almaty, Kazakhstan

**b.kasymkhan@gmail.com*

Quark-gluon plasma (QGP) is considered a state of matter in the early Universe, in the first $10^{-5}s$ after the Big Bang until the hadronization of QGP occurs. This fact prompted people for theoretical work on the local accumulation of interacting quarks and gluons in thermal and chemical equilibrium [1]. The first significant breakthrough in experimental research was the detection of quark-gluon plasma in laboratory conditions at CERN in 2000 [2, 3]. Due to the confirmation of the state of aggregation, the study of collective effects in the system is of interest. For this purpose, the dielectric functions of collisions in ultrarelativistic plasma were analyzed on the basis of the Bhatnagar - Gross - Krook (BGK) collision integral [4] for the kinetic QGP equation [5, 6].

$$\epsilon_l(\omega,k) = 1+\frac{m_D^2}{k^2}\left(1-\frac{\omega+i\nu}{2k}\ln\frac{\omega+i\nu+k}{\omega+i\nu-k}\right)\left(1-\frac{i\nu}{2k}\ln\frac{\omega+i\nu+k}{\omega+i\nu-k}\right)^{-1},$$

$$\epsilon_t(\omega,k) = 1-\frac{m_D^2}{2\omega(\omega+i\nu)}\left\{1+\left[\frac{(\omega+i\nu)^2}{k^2}-1\right]\left(1-\frac{\omega+i\nu}{2k}\ln\frac{\omega+i\nu+k}{\omega+i\nu-k}\right)\right\}.$$

Most of the works are devoted to waves propagating inside matter with infinite boundaries, and various models were used to describe them [7, 8]. However, the plasma must inevitably have a boundary when we consider the case of QGP creation in the experiment of heavy ion collisions. Therefore, when there is a boundary of the plasma region, there must be boundary waves. These waves at the boundary affect the transport properties of the medium, and hence the quarks moving close to the surface of the medium. For this purpose, this work presents results for surface waves [9].

$$\sqrt{\frac{k_z^2}{\omega^2}-1}+\frac{2\omega}{\pi}\int_0^\infty\frac{dk_x}{k^2}\left(\frac{k_z^2}{\omega^2\epsilon_l}-\frac{k_x^2}{k^2-\omega^2\epsilon_{tr}}\right)=0.$$

The results are obtained numerically in the long-wavelength limit. First, collisions lead to lower values of the frequency of surface waves and their stronger attenuation. Second, the results show that imperfection leads to the appearance of a new branch of surface waves in comparison with the collisionless case.

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