Behavior of the spectral energy density of equilibrium radiation (SEDER) in the presence of a plasma medium is considered. This problem goes back to the classical works of L. Brillouin, M. Levin and S. Rytov (see, e.g., [1]), where it was shown that in plasma the Planck expression for the SEDER is modified and depends not only on temperature, but also on plasma density. In the framework of such a traditional approach [2–6], any deviations from the Planck distribution are generally described in the framework of the model of a transparent medium, when the dielectric permittivity of the plasma medium is a real function and its spatial dispersion is completely neglected. However, the applicability this approach remains unknown and need to be studied.

In recent works [7–9], it was found that the correct consideration of the influence of plasma on SEDER requires a sequential quantum consideration based on calculating the energy of a system consisting of plasma (with Coulomb interaction between particles) and photons interacting with interaction between them. In this case, the SEDER is expressed integrally through the transverse dielectric permittivity of a plasma (TDP), which depends not only on frequency, but also on wave vector (frequency and spatial dispersion). As an important stage of the work, the study of TDP also arises [10]. Till now the TDP has been studied only in models with a weak Coulomb interaction.

The indicated characteristics of plasma systems and their radiation are essential for the interpretation of experimental data, including astrophysical observations.

In the present work, based on the papers [8–10], as well as on the recently found [11] full expression for the SEDER, the frequency-asymptotic properties of the SEDER are studied.

The developed theory in principle allows to describe consistently the properties of a medium in a wide range of state parameters and at arbitrary frequencies. The results obtained in this case will be of great importance for the description of equilibrium radiation in various plasma systems, including CMB (relic) radiation in existing models of the Universe evolution and the internal structure of planets.

9. V.B. Bobrov and S.A. Trigger, Theoretical and Mathematical Physics, 187, 539 (2016)