Equilibrium radiation in plasma and plasma effects in cosmic microwave background

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In a recent paper [1], Munirov and Fisch proposed application of the well-known approach for the calculation of the fluctuation field radiation spectrum in a transparent plasma to the problem of cosmic microwave background. They used the result for spectral energy distribution of the equilibrium radiation, assuming that the spectrum of free photons is changed to the non-damping spectrum of transverse waves in non-relativistic plasma. The similar approach has been considered earlier by several authors for non-relativistic plasmas (see, e.g., [2] and references therein). The results of Munirov and Fisch are in fact in perfect agreement with the most of the previously existing expressions. However, we argue that this approach based on such simple approximation is not enough justified and the more elaborated consideration, taking into account not only temporal but also spatial dispersion of dielectric permittivity is necessary for a consistent description of radiation in plasmas. Moreover, interaction between free photons and charged particles in the framework of quantum electrodynamics leads to the result different in comparison with the standard consideration even for the transparent plasma medium [2]. The obtained new results for non-transparent plasma can be applied to astrophysical problems, e.g., the CMB history, and also in Earth conditions, changing the asymptotical regimes for the spectral energy distribution of the equilibrium radiation.

[1] Munirov V R and Fish N J 2019 *Phys. Rev. E* **100** 023202
[2] Trigger S A and Maslov S A 2021 *Phys. Scripta* **96** 015605